THE UMATILLA RIVER ANADROMOUS FISH HABITAT PROJECT

2013 and 2014 BIANNUAL REPORT

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Cover Image: Photograph image of the Meacham Creek Floodplain Restoration and In-stream Enhancement Project RM 6-8.5, Photopoint 9D, June 16, 2014, image by CTUIR

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ACRONYMS

AEM	action effectiveness monitoring
ARBO	Aquatic Restoration Biological Opinion
ATI	assemblage tolerance index
BA	biological assessment
B&G	Bauer & Gustafson
BIA	Bureau of Indian Affairs
BMHRC	Blue Mountain Habitat Restoration Council
BO	biological opinion
BPA	Bonneville Power Administration
cfs	cubic feet per second
CHaMP	Columbia Habitat Monitoring Program
cm	centimeter
COTR	Contracting Officer Technical Representative
CREP	Conservation Reserve Enhancement Program
CTUIR	Confederated Tribes of the Umatilla Indian Reservation
CY	Cubic Yards
dbh	diameter at breast height
DNR	Department of Natural Resources
DPS	distinct population segment
EC	environmental compliance
ELJ	engineered log jam
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act
ft	foot/feet
FY	fiscal year
gpm	gallons per minute
HIP	Habitat Improvement Program
in	inch/inches
JPA	Joint Permit Application
km	kilometer/kilometers
LWD	large woody debris
m	meters
mi	mile/miles
MOA	Memorandum of Agreement
mph	miles per hour
NMFS	National Marine Fisheries Service
NPPC	Northwest Power Planning Council
NWPCC	Northwest Power and Conservation Council
NRCS	Natural Resource Conservation Service
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
ODSL	Oregon Department of State Lands
OWEB	Oregon Watershed Enhancement Board
OWRD	Oregon Water Resources Department
PCSRF	Pacific Coastal Salmon Recovery Fund

PHaMS	Physical Habitat Monitoring Strategy
RM	river mile
SOW	Statement of Work
SZA	stream zone alteration
TFT	The Freshwater Trust
TMDL	total maximum daily load
THPO	Tribal Historic Preservation Office
UAFHP	Umatilla Anadromous Fisheries Habitat Project
UBNPME	Umatilla Basin Natural Production Monitoring and Evaluation Project
UBWC	Umatilla Basin Watershed Council
UCSWCD	Umatilla County Soil and Water Conservation District
UNF	Umatilla National Forest
UPR	Union Pacific Railroad
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WHIP	Wildlife Habitat Incentive Program

Table of Contents

List of Tables

List of Figures

EXECUTIVE SUMMARY

The Umatilla Anadromous Fish Habitat Project (UAFHP) is an ongoing effort to protect, enhance, and restore functional floodplain, channel, and watershed processes to provide sustainable and healthy habitat for aquatic species in the Umatilla River Subbasin, including Threatened Mid-Columbia summer steelhead and Columbia River bull trout. Flow quantity, water temperature, passage, and lack of in-stream channel complexity have been identified as the key limiting factors in the subbasin. During the 2013 and 2014 fiscal years (FY) reporting period (January 1, 2013 to December 31, 2014) primary project activities focused on improving passage, in-stream and riparian habitat complexity and restoring natural channel morphology and floodplain function. Project activities focused more work in Meacham Creek building upon the work completed in 2011 with a primary focus on floodplain connectivity, secondary channel habitat restoration, and riparian planting; continuing irrigation dam improvements in Birch Creek; beginning a geomorphic watershed assessment in Birch Creek to understand the stream processes to directly benefit Threatened Mid-Columbia summer steelhead. The UAFHP completed the Meacham Creek Phase II Restoration Project from (RM 6.0 to 8.5) in 2013 and continued riparian plantings in both 2013 and 2014. The project was a collaborative project between the CTUIR UAFHP and U.S. Forest Service (USFS) staff. The Birch Creek Geomorphic Watershed Assessment was started in 2014 and will be completed in early 2016 which will provide a roadmap for restoration. Other work was completed in Wildhorse Creek, Birch Creek, West Birch Creek, McKay Creek, Iskúulktpe Creek and the Umatilla River including monitoring and maintenance of 10 conservation easements on 15 individual landowners properties, control of noxious weeds on 355 acres (61 riparian, 294 upland) within project areas and easements through hand and mechanical removal, biological control and chemical application, and technical input on plans and proposals by entities within the Umatilla River Basin that may adversely impact floodplain or riverine processes and biota productivity, public project planning relevant to floodplain, river and wetland restoration or impacts, development and review of grant funding proposals, and proposed landowner projects. Given the ongoing project activities in Meacham Creek and the accumulative value of project activities within the lower river focus area (lower 15 miles) CTUIR focused monitoring efforts to evaluate the effects on biotic and abiotic ecological processes as a result of habitat restoration efforts. Habitat and aquatic assessment inventories were conducted at project sites prior to and following implementation. Action effectiveness and project implementation/compliance monitoring will continue prior to and following each project to oversee progression and inspire timely managerial actions. The CTUIR Research, Monitoring and Evaluation Program began implementation of the Action Effectiveness Monitoring (AEM) in collaboration with the Bonneville Power Administration AEM Program in 2014 and the UAFHP coordinates on AEM for both Meacham Creek and the mainstem Umatilla River. Project work is supported both locally and regionally by multiple planning documents: Umatilla/Willow Subbasin Plan (NPCC 2005), Five-Year Action Plan for the Development and Maintenance of Habitat Improvement Projects in the Umatilla Subbasin: 2006-2010 (CTUIR and ODFW 2006), Umatilla River Basin TMDL and Water Quality Management Plan (2001), CTUIR TMDL (2005), Umatilla River Vision (Jones et al. 2008; Existing Project Document ID: P130339), Conservation and Recovery Plan for Oregon Steelhead Populations in the Middle Columbia River Steelhead Distinct Population Segment (NMFS 2009), Bull Trout Draft Recovery Plan within the Umatilla-Walla Walla Recovery Unit (USFWS 2002), Meacham Creek Watershed Analysis and Action Plan (Andrus and Middel 2003) and Umatilla and Meacham Watershed Assessment (UNF 2001).

INTRODUCTION

The Confederated Tribes of the Umatilla Indian Reservation (CTUIR) retain aboriginal and treaty rights related to fishing, hunting, pasturing of livestock, and gathering of traditional plants within the Umatilla River Subbasin. The CTUIR Department of Natural Resources (DNR) has developed and accepted a First Foods organization and approach to ecosystem management based on the cultural traditions and practices of the Longhouse. The organization follows the serving order of food and conceptually "Extends the Table" to manage for sustainability within the Umatilla River Subbasin. The First Foods are considered to be the minimum ecological products necessary to sustain CTUIR culture. The order is watershed-based beginning with water at the first and lowest point and progresses up to salmon, deer, cous, and huckleberry. This creates clear links to treaty rights and resources and sets direction and goals that relate to the community culture. In addition the DNR developed the Umatilla River Vision that provides a description of the processes and conditions needed to protect and provide for First Foods. The River Vision describes physical and biological processes in support of 5 touchstones; hydrology, geomorphology, connectivity, riparian vegetation, and aquatic biota. The work accomplished through this project is directly related to the First Foods of water and salmon and the 5 touchstones, which incorporates goals of restoring high water quality and healthy and sustainable salmonid fish populations.

CTUIR's right to fish in its historical fishing places was acknowledged in the Treaty of 1855 that stated: "the exclusive right of taking fish in the streams running through and bordering said reservation is hereby secured to said Indians, and at all other usual and accustomed stations…" (Treaty of 1855, Articles of Agreement, Article 1, page 3). Decreased salmonid abundance has significantly impacted the livelihood of the Tribal community and altered their way of life.

Overfishing, sweeping changes to rivers and streams, and policies that changed the landscape have endangered salmon and created a "salmon crisis" (Montgomery 2003). It is the challenging duty of the CTUIR Umatilla Anadromous Fisheries Habitat Project (UAFHP) to restore and sustain healthy conditions of local watersheds to both assist in salmon recovery and ensure they provide adequate quantities of sustainable natural resources to satisfy the CTUIR's needs and preserve opportunities for traditional ways of life.

The Bonneville Power Administration (BPA) funds the CTUIR and other Pacific Northwest Tribes to restore salmonid habitat as part of its mitigation activities due to the harmful effects and loss of habitat caused by the massive Columbia River hydroelectric dams. The Umatilla Anadromous Fish Habitat Project (UAFHP; #1987-100-01) initiated by CTUIR in 1987 is an integral component of the Umatilla River Subbasin Salmon and Steelhead Production Plan (NPPC 1990) and project work is supported both locally and regionally by multiple planning documents: Umatilla/Willow Subbasin Plan (NPCC 2005), Five-Year Action Plan for the Development and Maintenance of Habitat Improvement Projects in the Umatilla Subbasin: 2006-2010 (CTUIR and ODFW 2006), Umatilla River Basin TMDL and Water Quality Management Plan (2001), CTUIR TMDL (2005), Umatilla River Vision (Jones et al. 2008; Existing Project Document ID: P130339), Conservation and Recovery Plan for Oregon Steelhead Populations in the Middle Columbia River Steelhead Distinct Population Segment (NMFS 2009), Bull Trout Draft Recovery Plan within the Umatilla-Walla Walla Recovery Unit (USFWS 2002), Meacham Creek Watershed Analysis and Action Plan (Andrus and Middel 2003) and Umatilla and Meacham Watershed Assessment (UNF 2001).

The Final Umatilla Willow Subbasin Plan (Umatilla/Willow Subbasin Planning Team 2005; http://www.nwcouncil.org/fw/subbasinplanning/umatilla/plan/ ; Management Plan) provided a systematic vision of a healthy ecosystem with abundant, productive, viable, and diverse populations of aquatic and terrestrial species with goals, objectives, and management strategies necessary to reach the subbasin vision. The vision entails several broad goals for habitat: 1) Protect existing high quality fish and wildlife habitat and strongholds, 2) restore and enhance degraded and diminished fish and wildlife habitats to support population restoration goals and to mitigate impacts from the construction and operation of the Columbia basin hydropower system and other anthropogenic impacts, and 3) restore the health and function of ecosystems in the Umatilla subbasin to ensure continued viability of their natural resources (Management Plan, page 5-3). Specific aquatic qualitative objectives and strategies were developed in to support the subbasin vision and goals. Quantitative management objectives relative to the UAFHP work activities include 1) maintain and enhance natural production, productivity, abundance, life history characteristics and genetic diversity of fish and mussels throughout the Umatilla Subbasin using habitat protection and improvement and 2) maintain and enhance passage of adult and juvenile steelhead and Chinook throughout the Umatilla Subbasin with passage protection and restoration (Management Plan, page 5-5). The Umatilla Subbasin Plan 2005 determined that the limiting factors could be addressed through habitat restoration and implementation ("Phase III") of the Umatilla Basin Project (pages 5-10). An identification and analysis of limiting factors/conditions and priority areas for action are fully described within the Subbasin Plan (Section 3.5) including passage barriers/entrainment, in-channel characteristics, habitat diversity (LWD), floodplain confinement, high water temperatures, high turbidity, inadequate flows, and poor riparian/floodplain vegetation. Priority management strategies are being conducted by the UAFHP in accordance with the Final Umatilla Willow Subbasin Plan (Umatilla/Willow Subbasin Planning Team 2005; pages 5-8 & 5-9) to address limiting factors within the subbasin:

- Increase water conservation and irrigation efficiency
- Large Wood/Boulder Structure Placement
- Fence/Plant Riparian Zones
- Modify Channel Floodplain Function
- Construct Pool/Riffle – In-stream Modification
- Modify Detrimental Land use Activities
- Restore Upstream/Headwater Attributes to Improve Downstream Conditions
- Increase Passage Efficiency

The UAFHP is an ongoing effort to protect, enhance, and restore functional floodplain, channel, and watershed processes to provide sustainable and healthy habitat for aquatic species in the Umatilla River Subbasin. Habitat restoration efforts fit within a holistic watershed approach supporting capacity building and long-term progress towards 1) achievement of the CTUIR DNR ecological river vision and first foods mission statements, 2) Endangered Species Act delisting of Columbia River bull trout and middle Columbia River steelhead, and 3) addresses water quality limiting factors per the Clean Water Act 303d list.

During the 28-year project history, the CTUIR has helped administer and implement a number of fisheries habitat enhancement projects in the Umatilla River Subbasin. In FY 2013 and 2014, the CTUIR maintained 23 partnership habitat enhancement projects along Meacham Creek, Iskúulktpe Creek, Birch Creek, Wildhorse Creek, West Birch Creek and the mainstem Umatilla River, among other sites. The CTUIR has developed effective interagency partnerships and is effectively working at the policy and project levels with various federal, state, and county agencies and private landowners.

The UAFHP is an integral component of the *Umatilla River Subbasin Salmon and Steelhead Production Plan* (NPPC 1990) and is well integrated into the framework of the *Umatilla Subbasin Plan* (Umatilla/Willow Subbasin Planning Team 2005) established by the NWPCC to better coordinate habitat restoration work in the Umatilla River Basin. The CTUIR, ODFW, Natural Resource Conservation Service (NRCS), Umatilla Basin Watershed Council (UBWC), and other participating agencies and organizations have made significant progress towards restoring and protecting vital salmonid habitat in the basin.

Noteworthy accomplishments for the CTUIR UAFHP during FY2013 and 2014:

- Completion of the Birch Creek Garton Dam Point of Diversion Project by converting a ditch to a pump.
- Completion of the Meacham Creek Restoration project between RM 6 to 8.5 under Phase II in collaboration with Umatilla National Forest completing levee removal, large wood habitat structures, floodplain connectivity, riparian planting, and weed treatments.
- Meacham Creek Hyporheic Flow Study work continued with completion anticipated in 2015. Ongoing reporting and presentations have occurred throughout the project to better understand the hyporheic flow regarding the Meacham Creek Restoration Project.
- Began working on the Birch Creek Geomorphic Watershed Assessment with multiple partners (ODFW, Umatilla Basin Watershed Council UBWC, Umatilla County SWCD, and the USFS to answer questions from the ISRP and other funding agencies for long term fish benefits in the Birch Creek Watershed.
- Maintaining 10 conservation easements on 15 individual landowner properties, and partnering with the NRCS Wildlife Habitat Incentives Program (WHIP) and Conservation Reserve Enhancement Program (CREP). Enhance native vegetation growth using hand and mechanical, biological and chemical controls to treat 355 Acres (61 Riparian, 294 Upland) in project areas.
- Planted approximately 11,886 1 gallon to 5 gallon native shrubs and trees, over 2,000 willow cuttings, and seeded 200 lbs of native grass seed at the Meacham Creek Floodplain Restoration and In-Stream Enhancement Project (RM 6-8.5).
- Conducting project maintenance activities at all sites.

Subbasin planning teams utilized information from a variety of resource assessment sources to classify existing habitat status, determine limiting factors, and identify priority areas for restoration activities. A combination of both passive and active restoration strategies were then developed to address habitat deficiencies. Collection of aquatic habitat, geomorphology, water quality, and fish abundance data is ongoing and utilized for optimizing adaptive restoration plans at project areas.

Project results are reported in various BPA formats including Pisces status reports, project completion reports, and annual reports. The CTUIR maintains a complete database on project planning, proposals, permitting, implementation, and results through the completion of required project deliverables. For a complete list of reports submitted by the CTUIR's UAFHP since 1989, please consult the following website at URL: http://www.efw.bpa.gov/integratedfwp/reportcenter.aspx and search **publications,** typing 1987-100-01 in the project number box provided.

F&W Program Management Question: What are the tributary habitat limiting factors (ecological impairments) or threats preventing the achievement of desired tributary habitat performance objectives?

Habitat protection and restoration needs in the Subbasin have been recognized in numerous reviews, planning processes, and reports (CTUIR 1993; CTUIR 2000; Umatilla/Willow Subbasin Planning Team 2004; 2005). The National Marine Fisheries Service (NMFS) has recently restarted the recovery planning effort for Chinook salmon and steelhead and tributary habitat restoration. The National Research Council (1996) notes the importance of protecting and rehabilitating freshwater habitat as part of salmon recovery and specifically notes the importance of riparian areas. This body recommended that habitat reclamation or enhancement should emphasize rehabilitation of ecological processes and function (NRC 1996). The United States Fish and Wildlife Service (USFWS) draft bull trout recovery plan (USFWS 2002) also recognized the importance of habitat protection and restoration and specifically noted the need to improve water quality, reduce or eliminate fish passage barriers, and restore impaired in-stream and riparian habitat. Pre-project implementation aquatic habitat inventory surveys conducted by CTUIR revealed that habitat quality ranked poor in 85% of areas surveyed and fair in 15% in the Umatilla River.

The Oregon Department of Environmental Quality (ODEQ) listed the Umatilla River Subbasin on the State's list of water quality limited water bodies' 303(d) list (Please see the ODEQ website at URL http://www.deq.state.or.us/wq/assessment/rpt0406/results.asp for details). A Total Maximum Daily Load (TMDL) was also written for waters within reservation boundaries (CTUIR 2005) that, in combination with CTUIR's habitat enhancement work, should lead to water quality improvements over the long term (Please see http://yosemite.epa.gov/R10/WATER.NSF/TMDLs/Approved+TMDLs#OR, select "Oregon", and navigate to "Umatilla Tribal TMDL" for a copy of this report.).

Throughout much of the Subbasin, maximum water temperatures exceed lethal limits for bull trout and approach lethal limits for Chinook salmon and rainbow/steelhead trout. The high stream temperatures potentially limit carrying capacity, adversely affect fish fitness, and should be considered as a primary factor limiting salmonid production in the Subbasin. In addition, passage barriers and entrainment, in-channel characteristics, habitat diversity (LWD), floodplain confinement, high turbidity, flow quantity, and poor riparian/floodplain vegetation were identified as other key limiting factors/ecological impairments.

The UAFHP ecological objectives are derived from planning documents and processes relative to limiting factors/ecological impairments (
Table 1).

F&W Program Management Question: What are the relationships between habitat actions and fish survival or productivity increases, and what actions are most effective?

Proposed restoration actions have focused on protection, enhancement, and restoration of functional floodplain, channel and watershed processes at multiple scales using passive and active restoration techniques. Over the past decade, the CTUIR Department of Natural Resources Fisheries Habitat Program and UAFHP have transitioned from restoration toward a fixed endpoint to address symptoms of a river to a holistic restoration of floodplain/channel processes for long-term sustainable habitat and direct benefit to ecological concerns limiting water quality and fish.

The CTUIR has participated in the BPA's Action Effectiveness Monitoring (AEM) Program since 2013. Representable subsamples of the CTUIR Fisheries Habitat Program habitat restoration projects are selected to be monitored if they meet criteria established in the AEM Program and meet CTUIR selection criteria and are feasible. Monitoring will occur under the AEM Program by the CTUIR's Bio-monitoring of Fish Habitat Enhancement (Project# 2009-014-00[CTUIR Bio-monitoring Project]) and their protocols for CTUIR restoration actions in the Umatilla Subbasin (Stillwater Sciences 2012, Jones et al. 2015 and Contor 2015). The goal of the Bio-monitoring Project is to evaluate physical and ecological response of CTUIR fish habitat restoration projects throughout five subbasins: the Grande Ronde, North Fork John

Day, Tucannon, Umatilla, and Walla Walla rivers. CTUIR sponsored restoration projects in the Umatilla Subbasin and its tributaries will be assessed using a before-after/control- impact design. Data will primarily be collected through expansion of existing juvenile and adult sampling of spring Chinook salmon and summer steelhead trout. The CTUIR Bio-monitoring Project will report findings to BPA regarding fish/habitat relationships. The primary focus of AEM has been habitat restoration implemented actions in Meacham Creek, primary headwater tributary of the Umatilla River Subbasin.

Monitoring habitat in parallel with fish surveys provides valuable information regarding fish/habitat relationships (Bouwes et al. 2011, Stillwater Sciences 2012, and Jones et al. 2015). Our strategy uses regionally standardized protocols to examine pre and post habitat restoration actions in contrast to unmodified control sites. Habitat restoration actions and associated monitoring focuses on addressing limiting factors with the greatest potential for improvement and includes key stream characteristics, floodplain processes and associated hydrologic, geomorphologic, riparian, vegetative, and aquatic biota touchstones of the Umatilla River Vision (Jones et al. 2008).

Active and passive restoration of Meacham Creek has altered the creek from a single-threaded, incised and bedrock-dominated channel to a perched, alluvial channel that seasonally exchanges overbank flows with the surrounding floodplain. The simplified channel resulted in poor channel morphology and sediment sorting processes and poor fish habitat complexity (Tetra Tech 2012 and Tetra Tech 2014B; **See section SELECTED FISH HABITAT ENHANCEMENT AND RESTORATION ACTIVITY**. Physical and ecological monitoring indicates holistic large scale floodplain/channel restoration work in Meacham Creek shows a measurable improvement in physical and ecological conditions, and restoration actions have a direct impact benefitting ecological concerns such as floodplain condition, bed and channel form, in-stream structural complexity, increased sediment quantity and temperature. Early modeled results including measured changes and professional judgement indicate a 27% increase in function above the 2008 Accords baseline measure.

Initial physical and ecological assessment and monitoring results in the Meacham Creek Watershed indicate:

- ***Geomorphology*** – Increased channel migration and function, quantity and quality of habitat diversity, and improved sediment sorting and routing.
- ***Connectivity*** – Increased channel access to the floodplain, off-channel and side-channel habitat, and hydrologic connectivity.
- ***Vegetation*** – Improved geomorphic and hydrologic function has led to improved processes conducive of growing native vegetation.
- ***Hydrology*** – Altering channel planform affects hydrology. Early results indicate increased ground water table and storage and diverse distribution of flowpath lengths and hyporheic/surface water thermal diversity.
- ***Biota*** – Significant increase in spawning and rearing salmon and steelhead habitat availability based on modeled depths and velocity suitability criteria, and the AEM indicates increased fish diversity and use.

Floodplain restoration is essential in recovering lost or degraded habitat from historic floodplain development, and a priority for sustaining or recovery of salmon and steelhead in the Pacific Northwest. Floodplain restoration is essential for storing water and moderating water temperatures to address climate change impacts. We assert that scale-explicit and measurement-focused restoration planning has a greater likelihood of meeting the stated objectives and have a greater potential to result in improved water quality and encourage recovery of many native aquatic species.

Table 1. The Umatilla Anadromous Fish Habitat Project objectives relative to the Umatilla River Vision touchstones (Jones et al 2008), BPA 2008 Fish Accords primary limiting factors (Fish Accords 2008) and NOAA's ecological concerns (NMFS 2009).

Umatilla Habitat Program Objectives	Umatilla River Vision 2008 Touchstones Addressed	BPA 2008 Fish Accords Primary Limiting Factor's Addressed	NOAA Ecological Concerns	NOAA Ecological Concerns Subcategories
Protect and conserve natural ecological processes that support the viability of fish populations and their primary life history strategies	Biota Connectivity Geomorphology Hydrology Riparian Vegetation	In-channel Characteristics Floodplain/Riparian Sediment	Multiple(Habitat Quantity, Injury and Mortality, Peripheral and Transitional Habitats, Channel Structure and Form, Sediment Conditions, Water Quality, Water Quantity, Population Level Effects)	Multiple
Restore passage and connectivity to habitats blocked or impaired by artificial barriers and maintain properly function passage and connectivity	Geomorphology Connectivity	Passage/Entrainment	Habitat Quantity	Anthropogenic Barriers
Maintain and restore floodplain connectivity and function	Aquatic Biota, Connectivity, Riparian Vegetation, Geomorphology, Hydrology	Water Quality-Temperature Riparian/Floodplain	Food, Peripheral and Transitional habitats, Riparian Condition, Channel Structure and Form, Water Quantity	Altered Primary Productivity, Altered Prey Species Composition and Diversity, Riparian Condition, LWD Recruitment, Floodplain Condition, Bed and Channel Form, Instream Complexity, Decreased Water Quantity, Altered Flow Timing
Restore degraded and maintain properly function channel structure and complexity	Connectivity, Riparian Vegetation, Geomorphology	In-channel Characteristics	Riparian Condition, Peripheral and Transitional Habitats, Channel Structure and Form	Riparian Condition, LWD Recruitment, Side Channel Conditions, Floodplain Condition, Bed and Channel Form, Instream Structural Complexity
Restore riparian condition and LWD recruitment and maintain properly functioning conditions	Aquatic Biota, Riparian Vegetation, Hydrology	In-channel Characteristics Riparain/Floodplain	Food, Riparian Condition	Riparian Condition, LWD Recruitment, Altered Primary Productivity, Food-Competition, Altered Prey Species Composition and Diversity
Restore natural hydrograph to provide sufficient flow during critical periods	Connectivity, Aquatic Biota, Hydrology,	Floodplain/Riparian Water Quality-Temperature	Habitat Quantity, Water Quality, Water Quantity	HQ-Competition, Oxygen, Increased Water , Alter Flow Timing
Improve degraded water quality and maintain unimpaired water quality	Hydrology, Aquatic Biota	Floodplain/Riparian Water Quality-Temperature	Riparian Condition, Sediment Conditions, Water Quality	Riparian Condition, Decreased Sediment Quantity, Temperature, Oxygen Turbidity, Toxic Contaminants

PROJECT AREA

Umatilla River Subbasin

The Umatilla River Subbasin is located in the northwest portion of the Blue Mountain Ecological Province in northeast Oregon. The Umatilla River Subbasin comprises 1,465,600 acres of the 6,400,000 acres of ceded CTUIR land (CTUIR 1995) as identified by the Treaty of 1855. Figure 1 illustrates the vicinity of the Umatilla River Subbasin within the Blue Mountain Province (Project map: *http://www.cbfish.org/Project.mvc/Map/1987-100-01).* The Umatilla River drains an area of approximately 2,540 square miles (mi.^{2}) (6,579 square kilometers [km^2]) and flows approximately 89 mi. (143 km) from its mouth to where it divides into the north and south forks of the Umatilla River. Each fork adds another approximately 10 mi. (16 km) of length. Major tributaries in addition to the north and south forks include Meacham Creek, Birch Creek, McKay Creek, Butter Creek, and Wildhorse Creek. The Umatilla River originates at elevations up to 4,228 feet (ft.; 1,289 m) and flows to an elevation of about 269 ft. (82 m) at its confluence with the Columbia River (USFWS 2002).

The Umatilla River Subbasin historically supported viable and harvestable populations of spring/summer and fall Chinook salmon (*Oncorhynchus tshawytscha*), Coho salmon (*O. kisutch*), sockeye salmon (*O. nerka*), summer steelhead (*O. mykiss*), Pacific lamprey (*Entosphenus tridentatus*), bull trout (*Salvelinus confluentus*), steelhead-rainbow trout (*O. mykiss sp*.), and mountain whitefish (*Prosopium williamsoni*). Human-caused alterations have negatively impacted the watershed and caused significant reductions of endemic salmonid populations. Beginning in the late 1800s, fish populations started to decline due to habitat degradation; sockeye and Coho were extirpated in the early 1900s. Irrigation and agricultural development throughout the basin in the early 1900s is believed to be the primary cause of the decline of steelhead and the extinction of salmon. Since the completion of the Treaty of 1855, aquatic and riparian habitats have been degraded through irrigation diversions, water extractions, channelization, livestock grazing, logging, agriculture and urban development (Umatilla/Willow Subbasin Planning Team 2004). Subsequently, the abundance of Chinook, steelhead, bull trout, and other fish species has also been dramatically reduced. With declining fish populations, Tribal governments, federal, state and international agencies were obligated to eliminate or significantly reduce subsistence and sport fisheries by the mid-1970s. The Federal government listed Columbia River spring Chinook salmon, summer steelhead, and bull trout as threatened species under the ESA in 1973, 1992, 1997, and 1998, respectively.

The following species listed under the ESA currently occur in the Umatilla River Basin: Columbia River bull trout Critical Habitat (designated), Columbia River bull trout (threatened), and Mid-Columbia River steelhead (threatened). In the mid-1980s, a successful, hatchery-based salmonid reintroduction effort for the Umatilla River was instituted using neighboring strains of various salmonid species. Although hatchery programs currently support subsistence and restricted sport fishing opportunities for steelhead and Chinook salmon, there remains significant need to re-build viable, harvestable, and sustainable fish stocks throughout the basin.

Our primary area of focus for restoration and monitoring work in FY 2013 and FY 2014 was Meacham Creek, Birch Creek and mainstem Umatilla River (Figure 2; contract maps: *http://www.cbfish.org/Contract.mvc/Map/60836 and http://www.cbfish.org/Contract.mvc/Map/64560*).

METHODS: Protocols, Study Designs, and Study Area

Protocol Title: Meacham Creek Geomorphic-Hyporheic Flow Study v1.0
Protocol Link: http://www.monitoringmethods.org/Protocol/Details/677
Protocol Summary:
CTUIR proposes to strategically implement enhancement work on Meacham Creek river miles 5 to 7.3 to enhance floodplain and stream morphology, while providing enhanced habitat for fish. Enhancement techniques include, but are not limited to, woody debris placement in channel and in floodplain, levee setback or removal, channel reconstruction for increased in-stream habitat complexity and stabilization, and native plant and grass restoration. Project actions are expected to improve physical functions by 1) diversifying channel morphology and 2) increasing connectivity between surface and subsurface features. With time, we expect watershed treatments will lead to increased abundance and diversity of riparian vegetation, and increased fish habitat diversity. This includes project goals of: 1. Quantify water residence time distribution both prior to and after restoration actions to assess changes in recharge and discharge between Meacham Creek and its alluvial aquifer (hyporheic exchange). 2. Establish a monitoring network of stream thermographs to measure changes in surface and subsurface water temperature due to restoration actions. 3. Pilot a new method of stream restoration monitoring that will have broad utility to other restoration efforts in the region. 4. Produce and submit manuscripts for peer reviewed publication describing the results of the study.

Protocol Title: Umatilla Subbasin Fish Habitat Restoration Monitoring Plan v1.0
Protocol Link: http://www.monitoringmethods.org/Protocol/Details/681
Protocol Summary:
The Umatilla Subbasin is a 2,517 square mile subbasin in Northeast Oregon. Currently it supports a depressed native bull trout, summer steelhead, and spring Chinook Salmon population. Much of the subbasin was channelized, cleared, converted to agricultural land and partially leveed beginning in the early 1900's, thus neglecting many of the key biological and physical characteristics essential to sustain native fish populations. The CTUIR-Umatilla Fisheries Habitat Program continues to invest substantial resources in restoring the fisheries habitat within the Umatilla Subbasin and its tributaries. In order to ensure that investments result in actual improvements to biological productivity, an extensive long-term monitoring plan has been setup. This monitoring plan aims to evaluate the effects on biotic and abiotic ecological processes as a result of habitat restoration efforts. With time, we expect watershed treatments to improve stream functions by 1) diversifying channel morphology 2) increasing floodplain connectivity 3) decreasing annual maximum stream temperatures 4) increasing summer base flow 5) increasing abundance of and diversity of riparian vegetation and 6) increasing macroinvertebrate abundance and diversity. Within the subbasin we have setup baseline monitoring to help understand relationships between our instream restoration efforts and aforementioned ecological processes. In order to accomplish this we continue to conduct a combination of monitoring activities and methods included within this protocol. The CTUIRs recent monitoring activities have focused around the Meacham Creek watershed due to the focus of restoration activities in this area. Meacham Creek is a watershed that has been prioritized for restoration because it presents the most opportunities for whole watershed restoration. Although the majority of monitoring is focused on Meacham Creek, monitoring does occur in multiple watersheds within the Umatilla Subbasin.

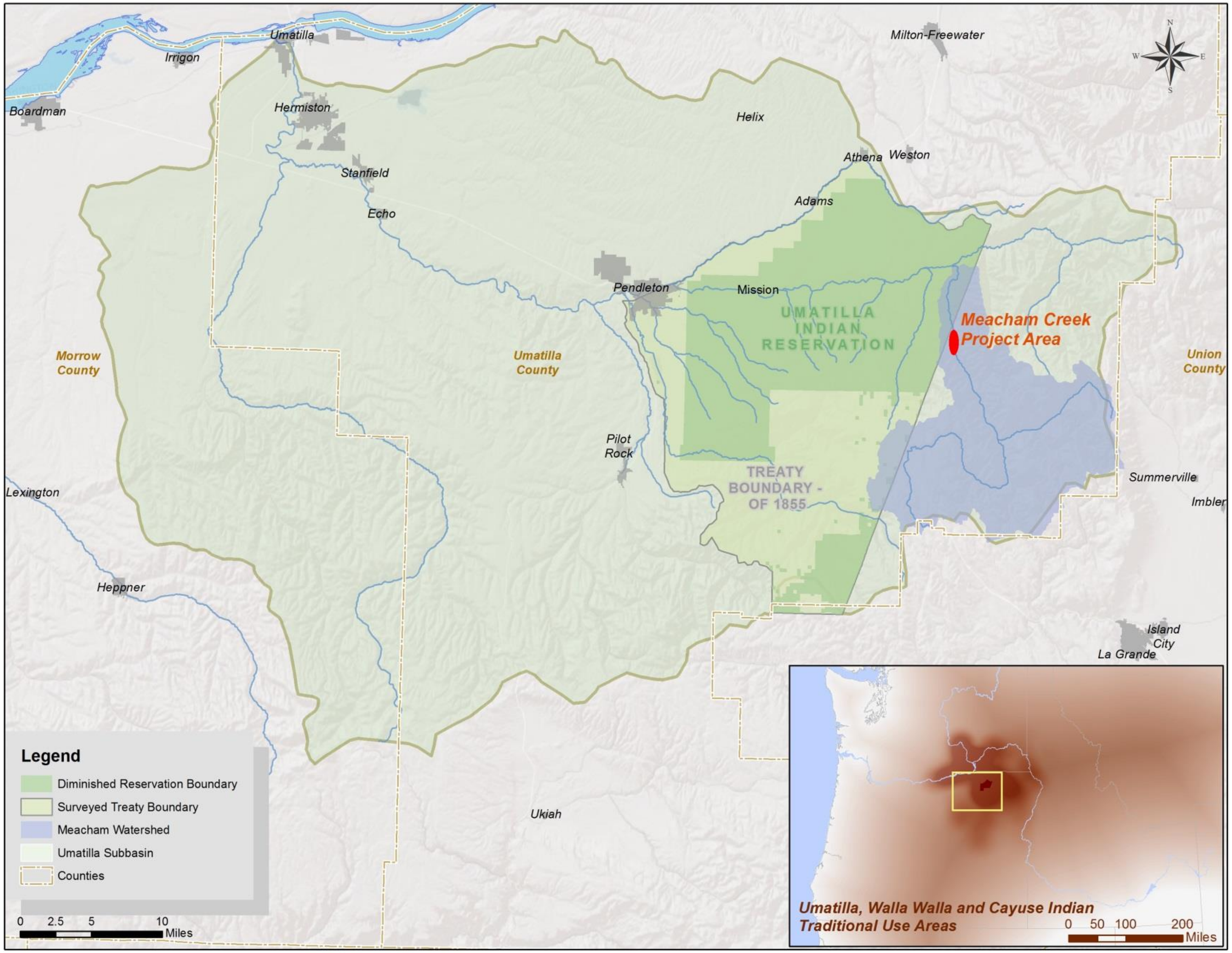


Figure 1. Umatilla River Subbasin

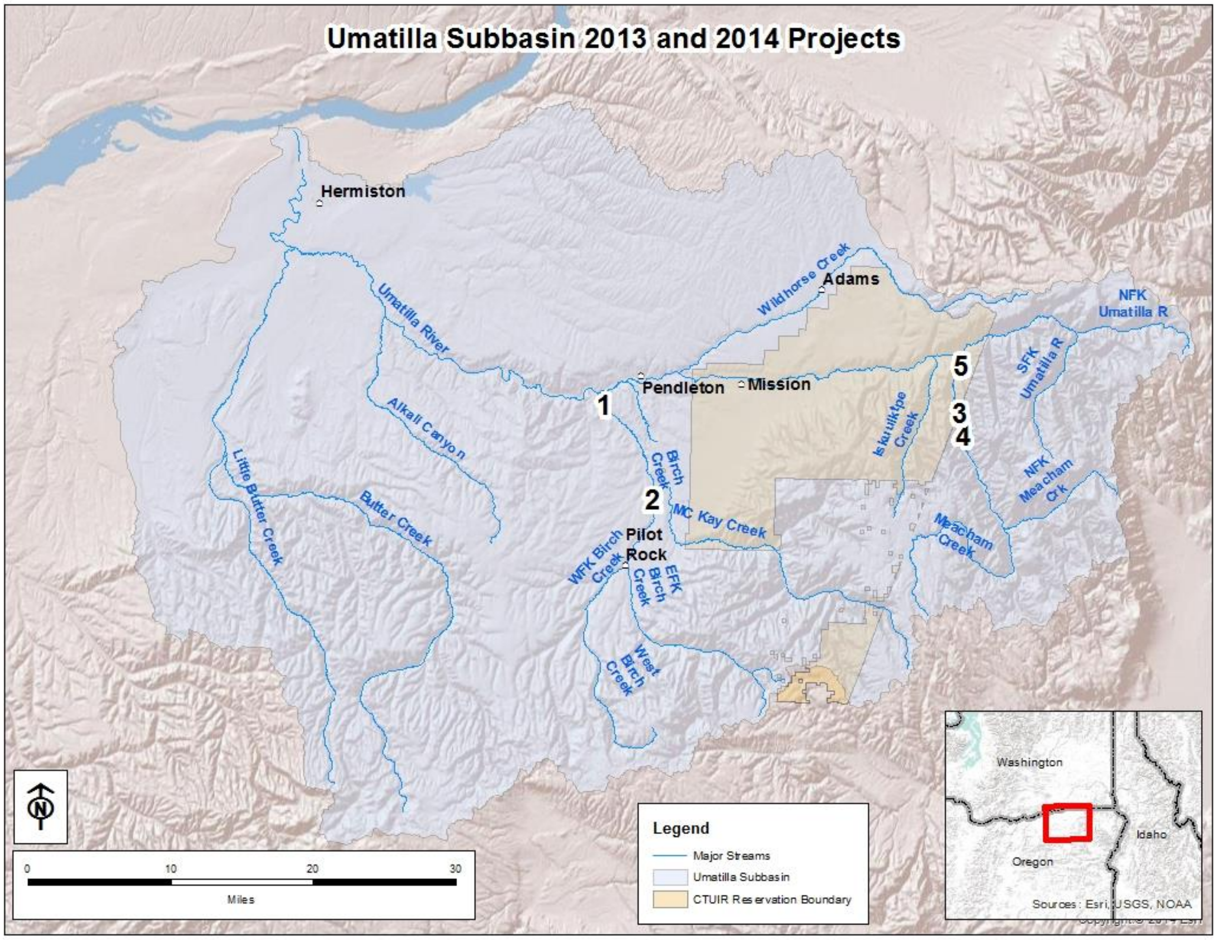


Figure 2. Umatilla River Basin FY2013 and FY 2014 UAFHP Project Sites

1: Birch Creek Watershed; 2014 Began development of a multi-partner geomorphic watershed assessment and action plan.

4: Meacham Creek, RM 6.0-8.5; 2013 Construction of the Meacham Creek Restoration and In-stream Enhancement Phase II Project.

2: Birch Creek, RM 10.0; 2014 Converted point of diversion from ditch to a pump for future diversion dam removal.

5: Meacham Creek Project Implementation/Compliance and Action Effectiveness Monitoring; 2013-2014 Synthesis of monitoring methodologies to evaluate the effects on biotic and abiotic ecological processes as a result of habitat restoration efforts.

3: Meacham Creek, RM 6-7; 2013-2014 Additional plantings and seeding as part of the 2011&2013 Floodplain Restoration and In-stream Enhancement Phase I and Phase II Projects.

RESULTS

This section highlights and describes completed UAFHP Pisces work elements in an outline similar to the BPA contracted work period for fiscal years 2013 and 2014. Each work element with associated identifier code and milestone are listed, followed by a comprehensive summary of completed work under each work element. In addition to a description of completed work elements specific to restoration activities, we highlight monitoring results specific to tributary habitat RM&E and tributary habitat restoration and protection.

Work Element: Produce Pisces Status Report

CTUIR reported to BPA periodically during the 2013 and 2014 contract periods on the status of each contract work element, milestones and deliverables using the computer program Pisces:

- February-March 2013 (2/1/2013-3/31/2013)
- April-June 2013 (4/1/2013 - 6/30/2013)
- July-September 2013 (7/1/2013 - 9/30/2013)
- October-December 2013 (10/1/2013 - 12/31/2013)
- Final January 2014 (1/1/2014 - 1/31/2014)
- February-March 2014 (2/1/2014-3/31/2014)
- April-June 2014 (4/1/2014 - 6/30/2014)
- July-September 2014 (7/1/2014 - 9/30/2014)
- October-December 2014 (10/1/2014 - 12/31/2014)
- Final January 2015 (1/1/2015 - 1/31/2015)

The BPA Contracting Officer Technical Representative (COTR) reviewed the Pisces status reports, recommended changes as necessary and accepted them electronically upon approval. Additionally, upon completion of each deliverable milestone, we provided metrics and final project location (latitude and longitude) when required. These Pisces status reports provide a tool for the BPA COTR and administrative staff to track project progress in meeting contract requirements.

Work Element: Manage and Administer Projects

This work element includes a suite of management actions required to administer the project, including preparation of annual operations and maintenance budgets, managing and preparing statements of work and budgets, and property inventory to the assigned BPA COTR for the following contract period. The project leader reports quarterly or as necessary on milestones and metrics to BPA using the BPA Pisces Program, supervises, trains, and directs staff activities, conducts vehicle and equipment maintenance and management, performs payroll, purchasing, subcontracting for services, and administers habitat enhancement activities.

Work Element: Produce Environmental Compliance Documentation

CTUIR successfully submitted all applicable and required documents to the appropriate federal, tribal, state, county entities for select implementation projects in a timely manner required under work elements related to producing environmental compliance documentation in FY2013 and FY2014. Secondary environmental compliance accomplishments during the reporting period included coordination with various compliance personnel to prepare supplemental documentation and reporting for ongoing and planned management actions. Environmental compliance methods include development of appropriate documentation under various federal, Tribal, state and county laws and regulations governing federally funded project work. Methods involve coordination with various federal and state entities agencies and development and submittal of permit applications, cultural clearances, biological assessments, National Environmental Policy Act checklists, etc., as necessary. Part of the environmental compliance work element includes planning and developing site-specific proposals tailored to accomplish fisheries goals and meet compliance standards. The details concerning the implementation of treatments and preparations for putting efforts on the ground, including preparations for subcontracting, and specifics in regarding the safeguarding of ESA-Listed species during the implementation process are outlined in the proposals.

The following milestones were completed under contract in FY2013 and FY2014:

1) Reported lamprey observations observation and catch data to USFWS for 2013 and 2014.
2) Obtain BPA's Environmental Compliance (EC) lead sign-off that EC requirements were completed.
3) HIP 3 Risk Determination: Contacted BPA EC lead for risk determinations.
4) Used best management practices to stabilize soils and prevent spread of noxious weeds.
5) Determined if contract work could adversely affect Pacific lamprey.
6) Inspected field project field gear and equipment used in or near water for aquatic invasive species.
7) Participated in cultural/historical resource consultation.
8) Participated in ESA consultation.
9) Completed and documented public involvement activities and provided to the EC lead.
10) Obtained/renewed applicable local, state, federal and Tribal environmental permits.
11) Provided the BPA environmental compliance lead with proposed herbicide use form for each contract year.
12) Provided the BPA environmental compliance lead with the actual herbicide use form for each contract year.

Cultural Resource Protection and Preservation

CTUIR submitted a letter and attachments with necessary project descriptions and geo-referenced maps for assisting BPA with section 106 National Historic Protection Act consultations and environmental compliance. The following projects were submitted for compliance:

- Meacham Creek Floodplain Restoration and In-stream Enhancement Phase II Project RMs 6.0 to 8.5; 2013-2014 implementation.
- Birch Creek Garton Irrigation Efficiency and Pump Station Project RM 10.0; 2014 implementation.

The CTUIR DNR Cultural Resource staff completed the cultural resource project area surveys and reports and submitted to BPA for cultural resource compliance with the State Historic Preservation Office (SHPO) and Tribal Historic Preservation Office (THPO) for all projects.

UAFHP Environmental Compliance Documentation

Most ESA consultation with NMFS for the FY 2013 and FY 2014 project activities were covered under the Terms and Conditions of the HIP II Programmatic Biological Opinion 2013 (HIP II BO) and the revised HIP III Programmatic Biological Opinion 2014 (HIP III BO). Project work elements covered under the HIP II BO and HIP III BO included:

- Maintain/Remove Vegetation

- Plant vegetation
- Operate and maintain habitat/passage/structure: seven passage rectification projects and maintaining 27 existing conservation agreements
- Field data collection and
- Remove/install diversion

Meacham Creek Floodplain Restoration and In-stream Enhancement Phase II Project RMs 6.0-8.5 Environmental Compliance Documentation

All the necessary permitting documents were developed and completed in 2013 prior to implementation to satisfy the federal and state permits required to construct the design. This included provided support documentation to the USFS to enable them to demonstrate compliance with the NMFS programmatic coverage under the revised Aquatic Restoration Biological Opinion (ARBO II) (NMFS 2013; USFWS 2013). All comments received during the permitting process were incorporated into the implementation plan, which incorporated the final design.

Habitat for endangered and threatened species listed under the ESA was identified in the Meacham project focus area: bull trout (and designated critical habitat; project area is within the Umatilla-Walla Walla recovery area) and steelhead (middle Columbia River Distinct Population Segment).

The following permits and approvals were required for the project:

- NMFS. Endangered Species Act Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Conservation Recommendations for the Meacham Creek Floodplain Restoration Project. Issued December 3, 2010 and Reinitiated on April 25, 2013.
- USFWS. Biological Opinion for the Meacham Creek Restoration Project. Issued December 14, 2010 and Extension Letter on March 19, 2013.
- U.S. Army Corps of Engineers Regional General Permit No. 4 (RGP-4; Aquatic Habitat Restoration, Establishment, and Enhancement Activities). Issued February 3, 2011 and Extension April 9, 2012.
- USFS Categorical Exclusion Decision Memo. Issued April 8, 2011.
- Oregon Department of State Lands Removal/Fill Permit No. 42104-61 (GP). Issued December 31, 2013.

Work Element: Produce Annual Progress Report

The CTUIR UAFHP BPA FY 2012 Annual Progress Report was completed and uploaded to BPA through Pisces on November 6, 2014 covering the contract period January 2012 through December 2012 (Lambert 2014). The CTUIR UAFHP BPA FY 2013-2014 Annual Progress Report was drafted in 2014, and will be submitted as part of the FY 2015 contract deliverables.

Work Element: Produce Other Report

A project completion report was completed in 2014 to document the second phase of the Meacham Creek Floodplain Restoration and In-stream Enhancement Project – Phase II between RM 6.0 and 8.5 (CTUIR 2014). The Completion Report presents a summary of all the design, implementation, construction, and monitoring efforts that went into the successful accomplishment of the project.

Work Element: Produce Other Report

A project completion report was completed in 2014 to document the second phase of the Meacham Creek Floodplain Restoration and In-stream Enhancement Project – Phase II between RM 6.0 and 8.5 (CTUIR 2014). The Completion Report presents a summary of all the design, implementation, construction, and monitoring efforts that went into the successful accomplishment of the project.

Work Element: Watershed Coordination

CTUIR UAFHP staff participated and coordinated with multiple agencies and stakeholders in the Umatilla River Subbasin through the Umatilla Subbasin Restoration Team (Restoration Team) including ODFW, USFS, NRCS, conservation districts, USFWS, Umatilla Basin Watershed Council and local stakeholders to enhance natural resources, identify problems and solutions, coordinate efforts to prevent duplication, enhance communication and cooperation and identify funding and cost share opportunities within the Umatilla River Subbasin. Staff further coordinated with other agencies in planning and implementing partner habitat restoration and enhancement projects, ESA planning processes, and project prioritization and selection processes. The Restoration Team coordinated several passage projects in Birch Creek, and upcoming project activities in McKay Creek and the lower Umatilla River. CTUIR staff prepared agreements, if necessary, to assign duties and responsibilities to the appropriate entities. We also developed documents, press releases, web sites, and other communications to impart information to participating stakeholders and the public. Furthermore, CTUIR UAFHP staff updated the Restoration Team, UBWC, CTUIR Committees and Commissions, and permitting agencies on project activities by presentation and in writing on project activities.

Work Element: Identify and Select Projects

<u>CTUIR Strategic Framework for Restoration Activities:</u>
Our CTUIR Fisheries Habitat Program's hierarchical approach to stream restoration planning and project development is supported by the Umatilla River Vision (Jones et al. 2008), and local and regional plans and assessments in 1) protecting high functioning habitat, 2) removal of fish migration barriers, 3) restoration of watershed processes, and 4) enhancement of in-stream habitat. Roni et al. (2002) supports this broadly applicable approach to sequencing stream and watershed restoration projects. Beechie et al. (2008) expanded on Roni et al.'s (2002) approach, incorporating it into a "General Protocol for Identifying and Prioritizing Restoration Actions", which includes:

Step 1: Define the restoration goal
Step 2: Choose prioritization approach
Step 3: Assess problems and identify restoration actions
Step 4: Prioritize restoration actions

The CTUIR Fisheries Habitat Program and UAFHP supported goal is to protect, enhance and restore floodplain, channel and watershed processes for the purpose of protecting and restoring fisheries and aquatic species important to the Umatilla Tribes. The UAFHP has the ability to freely develop projects within the geographic boundary of the subbasin to meet this goal and must prioritize and select restoration action types and locations based on scientifically defensible strategies and the best available scientific information. Within the organization of the UAFHP Project, the selection process for actions must consider several important criteria that include key species habitat needs, ecological conditions and processes within a watershed context, impediments to proper functioning conditions, project constraints such as landowner willingness, coordination with other agency and stakeholders goals within the subbasin and region, and action agency goals and objectives. In addition, there are practical considerations of property access and economic feasibility. To consider these criteria the project must complete a review and prioritization of actions internally and then in coordination with other subbasin implementers.

The process for action selection begins with the Umatilla River Vision, developed under guidance of the Umatilla Tribe's First Foods Concept. This River Vision defines a functional river as a dynamic environment that incorporates and expresses ecological processes that continue the natural production of First Foods used by the Tribal community. The River Vision is a literature rich document that provides direction for restoration by focusing on the five touchstones of hydrology, geomorphology, connectivity, riparian vegetation, and aquatic biota. Operating under this guidance, CTUIR fish habitat projects are planned, designed, implemented, and monitored across the usual and accustomed harvesting areas to achieve fish habitat restoration goals.

Our planning process then integrates these criteria with Primary Limiting Factors from the 2008 Fish Accords MOA (FCRPS, 2008), Steelhead Recovery Planning documents, the NWPCC Subbasin Plans, TMDL reports, and local assessments and strategies. Designated high priority areas, with a preference for ecologically connected or contiguous project locations are the focus of the Fisheries Habitat Program, which addresses channel and floodplain function and aquatic habitat deficiencies through a systematic, holistic watershed planning approach termed the Riverine Ecosystem Planning Approach (Figure 3). This includes the prioritization of focal areas and management practices based on key species utilization of existing and historic available habitat, and limiting factors with a mechanism for riverine planning that utilizes scientifically defensible techniques. Five basic stages have been identified to develop lists of prioritized restoration actions including scoping, assessment, monitoring, implementation, and reporting. Scoping allows for the interface of community needs and issues with resource priorities. The issues and concerns developed from scoping can direct the needs defined for assessment. Using existing and collected data, assessments are developed with the intent to prioritize work locations identify limiting factors, and define project objectives. Monitoring data in its various forms is collected utilizing scientific knowledge and accepted methodology to determine historic and baseline conditions, determine the effectiveness of treatments, and determine the actions ability to address objectives and limiting factors. During the implementation stage, restoration actions are designed to address limiting factors through means that restore natural channel and floodplain processes. The final stage of reporting provides an opportunity to summarize monitoring and project actions and evaluate results. Based on the findings of reporting efforts all phases of future actions are modified and improved through lessons learned and new information provided by cooperators or outlined in professional literature.

Interdisciplinary teams are an integral part of project development when planning projects both internally with CTUIR and with other agencies when projects span multiple ownership boundaries. Restoration work today requires a knowledge base in many scientific disciplines and engineering. The CTUIR personnel listed have a scientific knowledge base including geomorphic processes, hydrology, fish biology, ecology, and have an experience base from implementing small to large scale projects in fluvial systems. The CTUIR managed native plant nursery staff participate in project planning with trained botanists that participate in project planning activities.

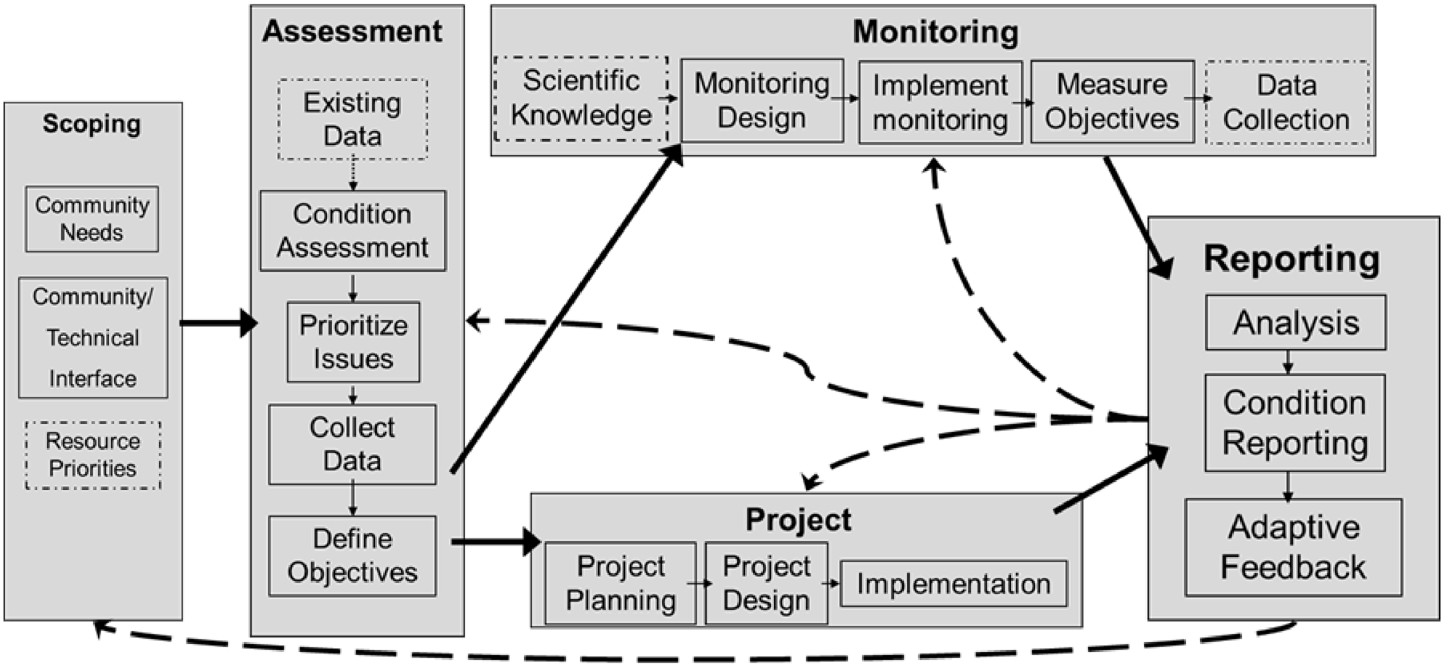


Figure 3. Riverine Ecosystem Planning Approach.

CTUIR UAFHP staff annually coordinated and planned projects with State, Federal, and local partners, and private landowners to develop habitat restoration and enhancement projects consistent with local planning documents. CTUIR project development is guided and prioritized by project activities that are supported by the CTUIR Department of Natural Resources ecological and First Foods mission statements to enhance or protect ecological and physical processes thus sustaining biota production (Jones et al. 2008). The CTUIR is guided in its habitat restoration activities by multiple planning documents:

1) Final Umatilla Willow Subbasin Plan *(*Umatilla/Willow Subbasin Planning Team 2005),
2) Middle Columbia River Steelhead Recovery Plan (NMFS 2009),
3) Bull Trout (Salvelinus confluentus) Draft Recovery Plan (USFWS 2002), and
4) Five-Year Action Plan for the Development and Maintenance of Habitat Improvement Projects in the Umatilla Subbasin: 2006-2010 for BPA-Funded Fish Habitat Improvement Programs sponsored by: Oregon Department of Fish and Wildlife (ODFW) and Confederated Tribes of the Umatilla Indian Reservation (CTUIR and ODFW 2006).
5) Meacham Creek Watershed Analysis and Action Plan (Andrus & Middel, 2003)

Projects were identified, prioritized and developed with project partners (ODFW, UBWC, and UCSWCD) as part of the Restoration Team who implement restoration projects within the Umatilla River Basin as part of the Restoration Team. Projects that were ranked by priority, CTUIR identified funding sources and projects were prepared for planning, engineering design, permitting and implementation and included in the FY 2014 and FY2015 BPA statement of work and budget.

In 2013, the Northwest Power and Conservation Council (NWPCC) conducted a science review of habitat projects in the areas of the Columbia River Basin accessible to anadromous fish referred to as the *Geographic Review*. The Geographic Review is a review cycle of all fish and wildlife projects funded under Bonneville Power Administration. As part of the review, projects were identified, technically reviewed, and prioritized for funding from 2013 to 2018.

Work Element: Provide Technical Review

CTUIR UAFHP staff reviewed and provided technical input as applicable on plans and proposals by entities within the Umatilla River Subbasin that may adversely impact floodplain or riverine processes and biota productivity, public project planning relevant to floodplain, river and wetland restoration or impacts, development and review of grant funding proposals, and proposed landowner projects. Project staff provided input to multiple CTUIR departments on annual activities relevant to work within the floodplain, rivers, and wetlands, US Army Corps of Engineers/Oregon Division of State Lands removal-fill permit applications, and CTUIR Stream Zone Alteration (SZA) Permit applications on work proposed within the floodplain on Reservation land.

CTUIR Fisheries Habitat Program Supervisor and the UAFHP staff reviewed and provided technical input to protect, enhance or mitigate damages that occurred to the floodplain/riverine processes:

<u>2013</u>

- City of Pendleton Riparian Corridor Wetland Ordinance
- City of Pendleton Riparian Corridor Comprehensive Planning
- Board of Trustees-City of Pilot Rock Fisheries Habitat, Water Quality and Flooding Briefing
- West Spring Hollow Creek-Miller Property CTUIR Land Acquisition
- CTUIR DECD Timber Harvest Mitigation
- Union Pacific Railroad Meacham Creek Bridge Abutment Emergency Repair
- Strahm Property Wood Thinning Project
- Upper Umatilla River Road 32 Repair

2014

- Crawford Hollow Tribal Farm Grain Storage Resource Assessment
- Iskúulktpe Creek Road Flood Erosion Project
- Union Pacific Railroad Transformer and Pole Project Transformer Spill Response RM 0.0 to 10.0
- Union Pacific Railroad Railway milepost 236 Emergency Embankment Scour Project – Mainstem Umatilla River
- Union Pacific Railroad-CTUIR Railway Track Expansion Consultation – Milam to Gibbon (Mainstem Umatilla River below Iskúulktpe Creek to Bonifer Pond on Meacham Creek

Work Element: Outreach and Education

CTUIR UAFHP staff educated the public regionally and locally on the CTUIR River Vision (programmatic scientific literature rich guiding document that describes touchstones that make up a fully functioning floodplain); ongoing process based protection and restoration principles; and associated project activities completed throughout the year. Staff activities included giving project tours and presentations (field, written, and verbal) and participating in local and regional workshops, symposia and/or conferences (training, project presentation, and professional memberships forums), newspaper articles and public education (local school districts or college programs).

CTUIR UAFHP staff completed CTUIR semi-annual reports summarizing project objectives and outputs, expected outcomes, and resulting impacts of project restoration activities (Figure 4 - Figure 7). These reports are used by the CTUIR Department of Natural Resources (DNR) to inform CTUIR staff and government officials, other agencies and entities, and the public of project activities.

Community Education

CTUIR UAFHP staff has participated in educational activities in the Umatilla River Basin specific to floodplain and riverine restoration. CTUIR UAFHP staff participate in several annual educational opportunities including the 5th Grade Watershed Field Days organized by the Umatilla County SWCD, CTUIR organized Seeds of the Future Building Workshop with University of Idaho (U of I) and the CTUIR DNR Community Workshop. The 5th Grade Watershed Field Days are multiple workshops throughout Umatilla County where 5th grade classes from all local school districts participate in a one-day outside workshops in April. Students rotate hourly through stations that cover hands-on educational material on plants, soils, macro-invertebrates, water quality, orienteering, and streambank stabilization. Our staff teaches the streambank stabilization class where we educate students on natural streambank processes and benefits of stable riparian vegetation. We show comparisons between an unstable and stable bank and discuss reasons for the differences. Lastly, kids participate with CTUIR staff in planting 300 native plant 12 cubic inch plugs within the riparian. About 250 students and 25 adult teachers and assistants participate in the educational workshop.

Each October, the natural resource students from U of I and CTUIR DNR staff participate in a two day Seeds for the Future Building Workshop in Pendleton, Oregon. This is an annual service learning partnership to foster a significant means of integrating student learning from the Tribes perspective and sharing about our community across state, cultural, and landscape boundaries. U of I students assisted in CTUIR UAFHP staff in planting native vegetation at the Meacham Creek Floodplain Restoration and In-stream Enhancement Project for an entire day each October, 2013-2014. About 40 college students and several professors participate in the workshop.

The CTUIR DNR Community Workshop is organized to invite the CTUIR local community and high school students to a one-day workshop whereas DNR staff present program and project posters, and educate the community on ongoing activities that affect them.

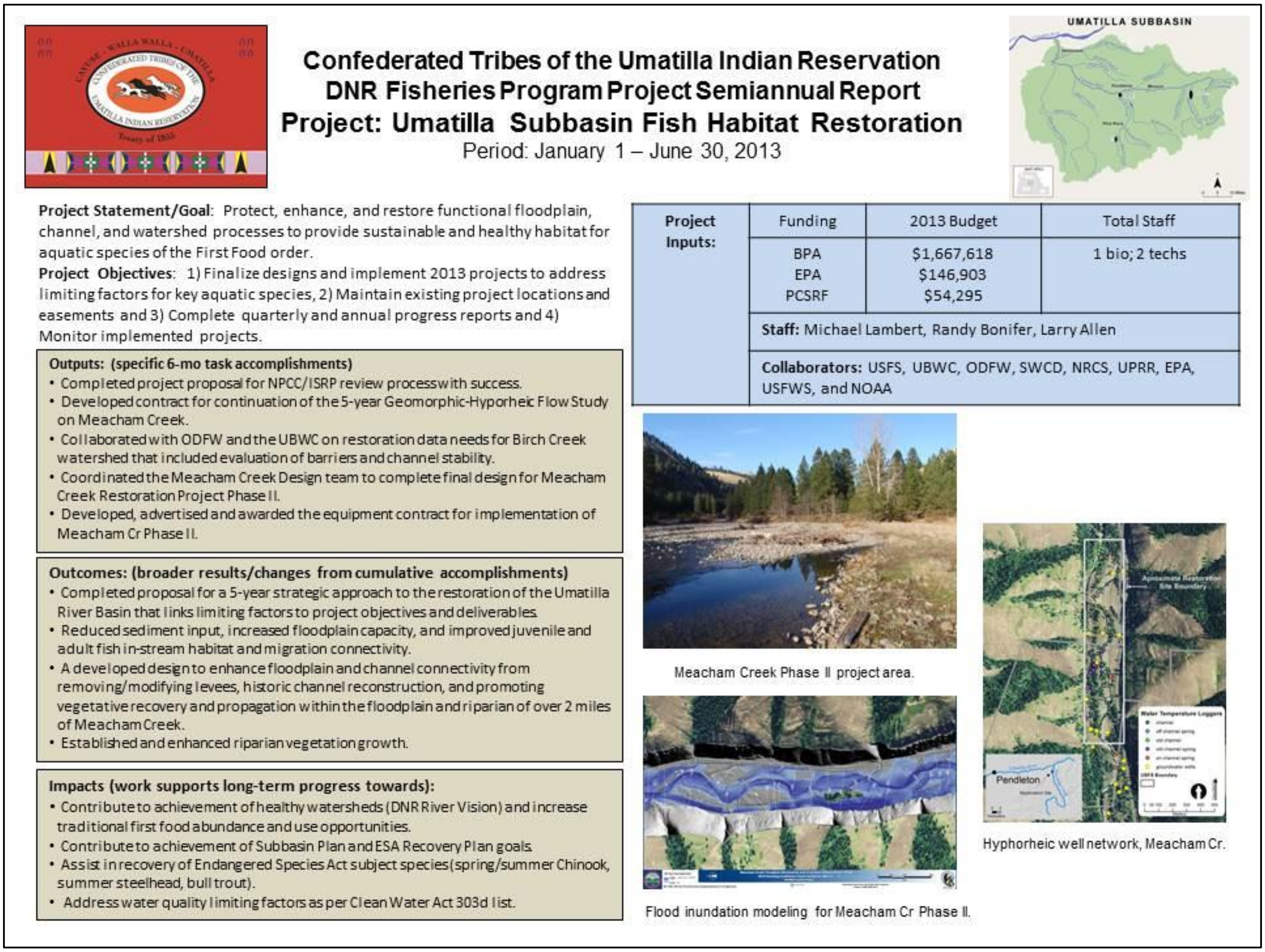
Meacham Creek Floodplain Restoration and In-stream Enhancement Phase I and Phase II Projects – RM 6-7.1(Phase I: 2011 Implementation) and RM 6-8.5 (Phase II; 2013 Implementation)

The Meacham Creek Floodplain Restoration and In-stream Enhancement Project RM 6-7.1 was a historic partnership between CTUIR and USFS that restored processes in Meacham Creek that create and maintain habitat complexity (CTUIR 2012). In 2013, an additional project was completed on Meacham Creek expanding reach based holistic restoration from river miles 6 to 8.5 (CTUIR 2014). The restoration effort in relationship to past efforts in Meacham Creek highlights efforts by CTUIR and project partners to restore floodplain processes. A partnership and project of this significance and magnitude was one that demanded the spotlight. A high level of coordination between the USFS and CTUIR went into ensuring a consistent, common, and clear message was portrayed to our local communities. This project received attention throughout the region and country for its success. In 2013-2014, project and educational tours were provided to government and agency officials and employees, education groups, policy and management staff, funding partners. A professional handout outlining a common message of the project including background, partners, strategies, goals, objectives and monitoring was developed for message consistency amongst agencies.

Professional Workshops and Working Groups

Project staff also developed and fostered relationships with participating experts in related fields by attending training, professional workshops and working groups, and gained professional advancement and improved project success through informative, instructional interactions. CTUIR UAFHP and DNR

Fisheries Habitat Program staff attended multiple professional conferences and workshops, and participated in oral and poster presentations of project activities including:



Confederated Tribes of the Umatilla Indian Reservation
DNR Fisheries Program Project Semiannual Report
Project: Umatilla Subbasin Fish Habitat Restoration
Period: January 1 – June 30, 2013

Project Statement/Goal: Protect, enhance, and restore functional floodplain, channel, and watershed processes to provide sustainable and healthy habitat for aquatic species of the First Food order.
Project Objectives: 1) Finalize designs and implement 2013 projects to address limiting factors for key aquatic species, 2) Maintain existing project locations and easements and 3) Complete quarterly and annual progress reports and 4) Monitor implemented projects.

Project Inputs:	Funding	2013 Budget	Total Staff
	BPA EPA PCSRF	$1,667,618 $146,903 $54,295	1 bio; 2 techs
	Staff: Michael Lambert, Randy Bonifer, Larry Allen		
	Collaborators: USFS, UBWC, ODFW, SWCD, NRCS, UPRR, EPA, USFWS, and NOAA		

Outputs: (specific 6-mo task accomplishments)
- Completed project proposal for NPCC/ISRP review process with success.
- Developed contract for continuation of the 5-year Geomorphic-Hyporheic Flow Study on Meacham Creek.
- Collaborated with ODFW and the UBWC on restoration data needs for Birch Creek watershed that included evaluation of barriers and channel stability.
- Coordinated the Meacham Creek Design team to complete final design for Meacham Creek Restoration Project Phase II.
- Developed, advertised and awarded the equipment contract for implementation of Meacham Cr Phase II.

Outcomes: (broader results/changes from cumulative accomplishments)
- Completed proposal for a 5-year strategic approach to the restoration of the Umatilla River Basin that links limiting factors to project objectives and deliverables.
- Reduced sediment input, increased floodplain capacity, and improved juvenile and adult fish in-stream habitat and migration connectivity.
- A developed design to enhance floodplain and channel connectivity from removing/modifying levees, historic channel reconstruction, and promoting vegetative recovery and propagation within the floodplain and riparian of over 2 miles of Meacham Creek.
- Established and enhanced riparian vegetation growth.

Impacts (work supports long-term progress towards):
- Contribute to achievement of healthy watersheds (DNR River Vision) and increase traditional first food abundance and use opportunities.
- Contribute to achievement of Subbasin Plan and ESA Recovery Plan goals.
- Assist in recovery of Endangered Species Act subject species (spring/summer Chinook, summer steelhead, bull trout).
- Address water quality limiting factors as per Clean Water Act 303d list.

Meacham Creek Phase II project area.

Hyphorheic well network, Meacham Cr.

Flood inundation modeling for Meacham Cr Phase II.

Figure 4. CTUIR semi-annual report for the Umatilla Subbasin Fish Habitat Restoration Project, January – June, 2013.

Confederated Tribes of the Umatilla Indian Reservation
DNR Fisheries Program Project Semiannual Report
Project: Umatilla Subbasin Fish Habitat Restoration

Period: July 1 – December 31, 2013

Project Statement/Goal: Protect, enhance, and restore functional floodplain, channel, and watershed processes to provide sustainable and healthy habitat for aquatic species of the First Food order.

Project Objectives: 1) Finalized designs and constructed 2013 projects to address limiting factors for key aquatic species, 2) Maintain existing project locations and easements and 3) Complete quarterly and annual progress reports and 4) Monitor implemented projects.

Project Inputs:	Funding	2013 Budget	Total Staff
	BPA EPA PCSRF OWEB	$1,667,618 $146,903 $54,295 $50,000	2 bio; 2 techs
	Staff: Michael Lambert, Olin Anderson, Randy Bonifer, Larry Allen		
	Collaborators: USFS, UBWC, ODFW, SWCD, NRCS, EPA, USFWS, NOAA, and Union Pacific Railroad		

Outputs: (specific 6-mo task accomplishments)

- Completed OWEB proposal with UBWC for funding assessment activities on Birch Cr.
- Completed EPA Competitive 319 Grant Proposal for Meacham Planting.
- Continued implementation of the of the 5-year Geomorphic-Hyporheic Flow Study on Meacham Creek. Field data collection for project was completed in 2013.
- Collaborated with ODFW and the UBWC on restoration data needs for Birch Creek watershed that included evaluation of barriers and channel stability.
- Implemented and completed construction of the Meacham Creek Phase II Project RM 6-8.5. Restored 80 acres of floodplain and channel habitat, removed or modified 14 levees and dikes at a total length 1.02 miles, placed 83 log jams and woody debris structures, and reinitiated a 2,200 foot long side channel.

Outcomes: (broader results/changes from cumulative accomplishments)

- Reduced sediment input, increased floodplain capacity, and improved juvenile and adult fish in-stream habitat and migration connectivity.
- Enhanced transient storage and bi-directional exchange of river water across floodplain surfaces and within the shallow groundwater promoting natural riverine process, increased in-stream geomorphic complexity and fish habitat with large wood and boulder input, off-channel rearing habitat from side-channel development, promoting vegetative recovery and propagation within the floodplain and riparian of over 2.5 miles of Meacham Creek.
- Established and enhanced riparian vegetation growth on Meacham Creek Phase I and II project areas RM 6-8.5.

Impacts (work supports long-term progress towards):

- Contribute to achievement of healthy watersheds (DNR River Vision) and increase traditional first food abundance and use opportunities.
- Contribute to achievement of Subbasin Plan and ESA Recovery Plan goals.
- Assist in recovery of Endangered Species Act subject species (spring/summer Chinook, summer steelhead, bull trout).
- Address water quality limiting factors as per Clean Water Act 303d list.

Before-after photos of a levee removed on the Meacham Creek Phase II RM 6-8.5 Project

Photos of large woody debris constructed on the Meacham Creek Phase II RM 6-8.5 Project

Figure 5. CTUIR semi-annual report for the Umatilla Subbasin Fish Habitat Restoration Project, July – December, 2013.

Confederated Tribes of the Umatilla Indian Reservation
DNR Fisheries Program Project Semiannual Report
Project: Umatilla Subbasin Fish Habitat Restoration

Period: January 1 – June 30, 2014

Project Statement/Goal: Protect, enhance, and restore functional floodplain, channel, and watershed processes to provide sustainable and healthy habitat for aquatic species of the First Food order.
Project Objectives: 1) Finalized designs and constructed 2014 projects to address limiting factors for key aquatic species, 2) Maintain existing project locations and easements and 3) Complete quarterly and annual progress reports and 4) Monitor implemented projects.

Project Inputs:	Funding	2013 Budget	Total Staff
	BPA EPA PCSRF	$1,039,594 $90,344 $40,000	2 bio; 2 techs
	Staff: Mark Lacy (New Hire: Project Leader Bio III), Olin Anderson, Randy Bonifer, Larry Allen		
	Collaborators: USFS, UBWC, ODFW, SWCD, NRCS, UPRR, EPA, USFWS, and NOAA		

Outputs: (specific 6-mo task accomplishments)
- Completed OWEB proposal with UBWC for funding assessment and action plan on Birch Creek.
- Completed EPA 319 Tribal competitive proposal and funding approval for Meacham Creek floodplain vegetation restoration.
- Bank stabilization and vegetation plantings on Meacham Creek Phase II Restoration Project. Working on project completion report.
- Maintained and enhanced riparian conservation easement properties including ungulate protection, tarp maintenance, vegetation monitoring and noxious weed control.
- Implemented Garton Property Irrigation Efficiency Project on Birch Creek converting ditch to pump station and pipe for the purpose of long-term dam removal.
- Completed and approved PCSRF grant proposal for continuation of the Geomorphic-Hyporheic Flow Study on Meacham Creek.


Birch Creek Vegetation Enclosures


Meacham Phase II Bank Erosion Restoration

Outcomes: (broader results/changes from cumulative accomplishments)
- Coordinated strategic approach to a geomorphic assessment and action plan for future restoration of Birch Creek.
- Reduced sediment input, increased floodplain capacity, and improved juvenile and adult fish in-stream habitat and migration connectivity.
- Enhancement of floodplain and channel connectivity, channel function, fish habitat availability and use, and promoting vegetative recovery over 3.5 miles of Meacham Creek.
- Established and enhanced riparian vegetation growth.

Impacts (work supports long-term progress towards):
- Contribute to achievement of healthy watersheds (DNR River Vision) and increase traditional first food abundance and use opportunities.
- Contribute to achievement of Subbasin Plan and ESA Recovery Plan goals.
- Assist in recovery of Endangered Species Act subject species (spring/summer Chinook, summer steelhead, bull trout).
- Address water quality limiting factors as per Clean Water Act 303d list.


Meacham Phase II Floodplain Plantings

Figure 6. CTUIR semi-annual report for the Umatilla Subbasin Fish Habitat Restoration Project, January – June, 2014.

Confederated Tribes of the Umatilla Indian Reservation
DNR Fisheries Program Project Semiannual Report
Project: Umatilla Subbasin Fish Habitat Restoration

Period: July 1 – December 31, 2014

Project Statement/Goal: Protect, enhance, and restore functional floodplain, channel, and watershed processes to provide sustainable and healthy habitat for aquatic species of the First Food order.
Project Objectives: 1) Finalized designs and constructed 2014 projects to address limiting factors for key aquatic species, 2) Maintain existing project locations and easements and 3) Complete quarterly and annual progress reports and 4) Monitor implemented projects.

Project Inputs:	Funding	2013 Budget	Total Staff
	BPA EPA PCSRF	$1,039,594 $90,344 $40,000	2 bio; 2 techs
	Staff: Mark Lacy (New Hire: Project Leader Bio III), Olin Anderson, Randy Bonifer, Larry Allen		
	Collaborators: USFS, UBWC, ODFW, SWCD, NRCS, UPRR, EPA, USFWS, and NOAA		

Outputs: (specific 6-mo task accomplishments)
- Completed summer watering and fall planting - site prep and planting at Meacham Creek.
- Awarded the Birch Creek Geomorphic Watershed Assessment and began project that is expected to be completed in 2016.
- Completed fall weed spraying on 7 acres at Meacham Creek
- The Meacham Creek Phase I and II Completion Report was completed.
- A Post-Implementation Meacham Creek Phase I Report was submitted to fulfill OWEB grant requirements.
- An application was successfully submitted to USEPA for Section 319 competitive grant funds. If awarded, this grant would reopen other portions of the Meacham Creek floodplain with levee removals.
- Continued Hyporheic Flow Study on Meacham Creek.
- Completed more plantings on the B&G cooperative project with NRCS.


Meacham Planting using Soil Amendments


Meacham Site Prep – Rip and Auger

Outcomes: (broader results/changes from cumulative accomplishments)
- Coordinated strategic approach for assessing and building an action plan for future restoration of Birch Creek with multiple partners and supported the OWEB funding received by UBWC for public outreach.
- Reduced sediment input, increased floodplain capacity, and improved juvenile and adult fish in-stream habitat and migration connectivity.
- Enhancement of floodplain and channel connectivity, channel function, fish habitat availability and use, and promoting vegetative recovery over 3.5 miles of Meacham Creek.

Impacts (work supports long-term progress towards):
- Contribute to achievement of healthy watersheds (DNR River Vision) and increase traditional first food abundance and use opportunities.
- Contribute to achievement of Subbasin Plan and ESA Recovery Plan goals.
- Assist in recovery of Endangered Species Act subject species (spring/summer Chinook, summer steelhead, bull trout).
- Address water quality limiting factors as per Clean Water Act 303d list.


Meacham Shade and Game Protection

Figure 7. CTUIR semi-annual report for the Umatilla Subbasin Fish Habitat Restoration Project, July – December, 2014.

Work Element: Maintain/Remove Vegetation

Project activities conducted in FY2013 and FY2014 included the monitoring and maintenance of 10 conservation easements on 15 individual landowner properties. Watering, weeding and maintenance methods for each conservation easement and project area is important for enhanced native vegetation and project site but maintenance varies by site conditions. Strategies to address weeds are included in agreements that are either completed by the landowner, CTUIR, subcontractor, and/or through the County Weed Control Board. CTUIR staff provides assistance to landowners by coordinating and managing herbicide application vendors, providing funding, and developing treatment strategies. Manual, biological and chemical treatment options are utilized by CTUIR and may be employed when consistent with existing standards. Weed control is essential in establishing native grass and plant species. CTUIR subcontracts a professional, licensed applicator to spray/control noxious weeds on sites where chemical application is necessary. The contractor identifies problem weeds, determines the appropriate herbicide and selects the most effective application methods and rates in accordance with the National Oceanic and Atmospheric Administration's (NOAA) Biological Opinion under BPA's Habitat

Improvement Program. The contractor utilizes handgun spraying, backpack spraying and wiper applications to treat perennial, annual and biennial weed species. All herbicide applications are consistent with Oregon Revised Statue (ORS).570.505 and Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) Regulations. CTUIR complies with BPA standards and supplies a report to BPA detailing the types and quantities of herbicides applied to specified locations. Biological controls are used in advantageous areas.

In FY 2013-2014, CTUIR removed noxious and/or undesirable weeds through mechanical, biological, or chemical means. CTUIR is obligated to control noxious weeds on 121 riparian non-wetland habitat and 465 upland non-wetland habitat acres in Wildhorse Creek, Umatilla River, McKay Creek, Spring Hollow Creek, Birch Creek and Meacham Creek. CTUIR complied with BPA standards and supplied a report to BPA detailing the types and quantities of herbicides applied to specified locations. In 2013 and 2014, CTUIR chemically treated 36.5 riparian non-wetland habitat and 9 upland non-wetland habitat acres (Table 2).

In addition to the CTUIR UAFHP, the CTUIR DNR Range Department used goat grazing for biological control treatment of yellow starthistle along the canyon walls and floodplain of Meacham Creek from river mile 1.0 to 6.0.

Work Element: Plant Vegetation

A. Supplement Riparian Areas of Existing and New Projects with Additional Vegetation.
B. Meacham Creek Floodplain Restoration and In-stream Enhancement, RM's 6-8.5 Phase II Planting Plan.

Project activities conducted in FY2013-2014 included the monitoring and maintenance of managed properties under conservation easements and specific project areas. CTUIR personnel routinely maintain and replant vegetation, water and weed plantings, and maintain structural integrity of riparian enclosure and livestock fencing at project sites. In FY2013, UAFHP staff manually maintained noxious weeds around plants on tarps within CREP project areas. In addition to tarp maintenance, UAFHP staff annually plant vegetation and distribute native grass seed in areas we have implemented existing or new habitat enhancement projects or have identified a need in maintained riparian conservation easement areas. In both fall 2013 and spring 2014, CTUIR focused most planting efforts within the newly implemented Meacham Creek Floodplain Restoration and In-stream Enhancement Phase II Project RMs 6-8.5 area as outlined in the implementation plan (Tetra Tech 2013) and Taylor Dam Removal and Habitat Restoration Project. Staff also planted vegetation on CREP tarps within the B&G property maintained under CTUIR conservation agreements. As part of project planting, CTUIR staff planted 7,185 and 5,992 various plant sizes and species in multiple locations in 2013 and 2014, respectively (Table 3 and Table 4).

Planting tasks include site planning and development of planting strategies, collection and preparation of materials (pruning and conditioning of live willow material), pre-order coordination with the CTUIR Tribal Native Plant Nursery, and installation. Planting techniques are customized for conditions within each project area. Planting location, species, age, form (cuttings, saplings, bare-roots, potted, plugs), and soil/substrate conditions were considered and addressed during the implementation planning phase. The CTUIR UAFHP staff work closely with the Tribal Native Plant Nursery to collect local seed and plant stock to provide native plants for particular project areas by elevation and planting zones.

Work Element: Operate and Maintain Habitat/Passage/Structure

Deliverables: 1) Maintain proper operation of in-stream habitat structures and
2) Maintenance of land or structures associated with conservation easements.

Maintain In-stream Habitat Structures

CTUIR monitors 6 passage rectification projects to assure that treatments are effectively working and to insure that intrusive objects are not interfering with the designed function of the passage structures (Table 5). Routine quarterly scheduled site visits of individual projects are conducted either independently by the CTUIR or jointly with project partners such as ODFW. Site visits also follow significant flow events or responses to landowner requests at project sites.

Project maintenance includes, but is not limited to, meeting specified conditional language in state and Federal permits, maintaining debris that is routinely captured or caught on in-stream structures, responses to landowner requests and concerns, and completion of post-treatment surveys to monitor and quantify changes to physical and ecological responses. If necessary a work plan is developed and contractor hired for completion for project activities greater than routine maintenance. The 2013 and 2014 project activities involved routine maintenance. At the request of a private landowner, at the Hoeft Dam fish ladder, the UAFHP removed gravel from the diversion gate for irrigation purposes. No structure modifications were required in 2013 and 2014.

Maintain Conservation Agreement Project Areas

The UAFHP have and will continue to maintain project areas under secured conservation agreements with landowners on private properties for protection and enhancement of floodplain and riparian habitat and investments from past passage and in-stream structure projects. CTUIR currently maintains 10 conservation easements on 15 individual landowner properties. Current easements provide secured access and protection of resources for functional floodplain, channel watershed processes to provide sustainable and healthy habitat for aquatic specifies. CTUIR routinely conducts custodial maintenance on individual projects to ensure that project structures and fencing are functioning and habitat recovery is progressing towards meeting projects goals and objectives. Activities include, but are not limited to, installing and repairing riparian cattle exclusion fences, maintaining or installing water gaps, riparian and floodplain plantings and maintenance, noxious weed control, maintenance of fish habitat improvement structures, and landowner coordination and education.

Table 2. BPA form annually submitted by CTUIR listing actual herbicide application, both the active ingredient and adjuvant, by location within the Umatilla River Basin, 2013 and 2014.

LOCATION					RIPARIAN			UPLAND		
Township Range & Section (can be found in Pisces)	OR Latitude and Longitude	6th HYDROLOIC UNIT CODE	ACTIVE INGREDIENT (see Note #1 below)	ADJUVANT USED (see Note#2 below)	Estimate of Acres to be Treated	Estimate of Total Volume of Herbicide Only- Do not inlcude adjuvant or water. Report amount in GALLONS. (see note #5 below)	Application Method- choose all methods that were used, e.g. spot treatment with hand wand, broadcast spray, etc. (see note #6 below)	Estimate of Acres to be Treated	Estimate of Total Volume of Herbicide Only- Do not inlcude adjuvant or water. Report amount in GALLONS. (see note #5 below)	Application Method- choose all methods that were used, e.g. spot treatment with hand wand, broadcast spray, etc. (see note #6 below)
EXAMPLE: ***T2N, R5E, Sec. 10***	***30° 35' 40"*** ***121° 45' 34"***	***170601020510***	***Clopyralid***	***Syl-Tac***	***4***	***5 gallons***	***Mechanized and Wicking***	***2***	***8 gallons***	***Mechanized***
Umatilla R., B&G	45° 40' 4.47" 118° 59' 47.69"	170701030703	Clopyralid	Super Spread MSO	19	1.44 gal	hand wand / spot spraying	4.8	0.38 gal	hand wand / spot spraying
Umatilla R., B&G	45° 40' 4.47" 118° 59' 47.69"	170701030703	Dicamba	Super Spread MSO	19	1.44 gal	hand wand / spot spraying	4.8	0.38 gal	hand wand / spot spraying
Umatilla R., Becker (Wolfe)	45° 39' 13.05" 118° 57' 28.66"	170701030703	Clopyralid	Super Spread MSO	10	2.96 gal	hand wand / spot spraying	2.7	0.21 gal	hand wand / spot spraying
Umatilla R., Becker (Wolfe)	45° 39' 13.05" 118° 57' 28.66"	170701030703	Dicamba	Super Spread MSO	10	2.96 gal	hand wand / spot spraying	2.7	0.21 gal	hand wand / spot spraying
Wildhorse Cr., Adams	45° 45' 12.79" 118° 34' 33.13"	170701030404	Clopyralid	Super Spread MSO	1.7	0.14 gal	hand wand / spot spraying	1.5	0.12 gal	hand wand / spot spraying
Wildhorse Cr., Adams	45° 45' 12.79" 118° 34' 33.13"	170701030404	Dicamba	Super Spread MSO	1.7	0.14 gal	hand wand / spot spraying	1.5	0.12 gal	hand wand / spot spraying
Meacham Creek, CTUIR	45° 38' 31.2" 118° 21' 28.8"	170701030206	Glyphosate	Super Spread MSO	3.1	0.385 gal	hand wand / spot spraying			
Meacham Creek, CTUIR	45° 38' 31.2" 118° 21' 28.8"	170701030206	Clopyralid	Super Spread MSO	3.1	0.385 gal	hand wand / spot spraying			
Meacham Creek, CTUIR	45° 37' 56.3" 118° 21' 29.5"	170701030206	Glyphosate	Super Spread MSO	3.1	0.385 gal	hand wand / spot spraying			
Meacham Creek, CTUIR	45° 37' 56.3" 118° 21' 29.5"	170701030206	Clopyralid	Super Spread MSO	3.1	0.385 gal	hand wand / spot spraying			
Umatilla R., Hartman	45° 43' 18.53" 118° 18' 11.95"	170701030206	Glyphosate	Super Spread MSO	0.7	0.17 gal	hand wand / spot spraying			
Umatilla R., Hartman	45° 43' 18.53" 118° 18' 11.95"	170701030206	Clopyralid	Super Spread MSO	0.7	0.17 gal	hand wand / spot spraying			
Umatilla R., Richards	45° 44' 27.72" 118° 13' 07.79"	170701030106	Glyphosate	Super Spread MSO	2	0.5 gal	hand wand / spot spraying			
Umatilla R., Richards	45° 44' 27.72" 118° 13' 07.79"	170701030106	Clopyralid	Super Spread MSO	2	0.5 gal	hand wand / spot spraying			

Table 3. Planting materials and grass seed by species, quantity, and size, planted and established at Umatilla River Basin existing and new project sites, 2013.

Water body	River mile	Date planted	Project site location	Species (Common Name)	Quantity Trees/Shrubs	Quantity Seed (lbs)
Birch Creek	0.2	1/3-4/2013	Taylor Dam Removal and Habitat Restoration Project	Willow species	300 cuttings	
Meacham Creek	6.0-8.5	4/1/13	Meacham Creek Floodplain Restoration and In-stream Enhancement Phase II Project[a]	Cottonwood	40 stakes	
Meacham Creek	6.0-8.5	4/1/13	Meacham Creek Phase II Project	Willow species	200 cuttings	
McKay Creek	1.0	4/15/13	UBWC McKay Creek Landowner Planting Project	Cottonwood	800 stakes	
Meacham Creek	5.8	4/30/13	Meacham Levee Removal Project - Side Channel Near Orchard	Cottonwood/willow	34 3 gal	
Meacham Creek	6.0-8.5	July-Aug, 2013	Meacham Creek Phase II Project - New Construction of Structures	Willow species	1507 cuttings	
Meacham Creek	6.0-8.5	July-Aug, 2013	Meacham Creek Phase II Project - New Construction of Structures	Cottonwood/willow	94 3 gal pots	
Meacham Creek	6.0-8.5	September, 2013	Meacham Creek Phase II Project - Floodplain STA 43+00	Ponderosa pine	93 1&5 gal pots	
Meacham Creek	6.0-8.5	September, 2013	Meacham Creek Phase II Project - Floodplain STA 43+00	Black hawthorn	101 1&2 gal pots	
Meacham Creek	6.0-8.5	September, 2013	Meacham Creek Phase II Project - Floodplain STA 43+00	Woods rose	105 1&2 gal pots	
Meacham Creek	6.0-8.5	Sept-Oct, 2013	Meacham Creek Phase II Project - New Construction	Mountain alder	253 2&5 gal pots	
Meacham Creek	6.0-8.5	Sept-Oct, 2013	Meacham Creek Phase II Project - New Construction	Red alder	150 3 gal pots	
Meacham Creek	6.0-8.5	Sept-Oct, 2013	Meacham Creek Phase II Project - New Construction	Serviceberry	64 1&5 gal pots	
Meacham Creek	6.0-8.5	Sept-Oct, 2013	Meacham Creek Phase II Project - New Construction	Water birch	203 1,2&5 gal pots	
Meacham Creek	6.0-8.5	Sept-Oct, 2013	Meacham Creek Phase II Project - New Construction	Red Osier dogwood	304 1,2&5 gal pots	
Meacham Creek	6.0-8.5	Sept-Oct, 2013	Meacham Creek Phase II Project - New Construction	Black hawthorn	80 1&2 gal pots	
Meacham Creek	6.0-8.5	Sept-Oct, 2013	Meacham Creek Phase II Project - New Construction	Black hawthorn	156 10 cu in plugs	
Meacham Creek	6.0-8.5	Sept-Oct, 2013	Meacham Creek Phase II Project - New Construction	Cascara	199 2 gal pots	
Meacham Creek	6.0-8.5	Sept-Oct, 2013	Meacham Creek Phase II Project - New Construction	Mock orange	223 2&5 gal pots	
Meacham Creek	6.0-8.5	Sept-Oct, 2013	Meacham Creek Phase II Project - New Construction	Mock orange	41 10 cu in plugs	
Meacham Creek	6.0-8.5	Sept-Oct, 2013	Meacham Creek Phase II Project - New Construction	Ninebark	125 10 cu in plugs	
Meacham Creek	6.0-8.5	Sept-Oct, 2013	Meacham Creek Phase II Project - New Construction	Ponderosa pine	88 1 gal pots	
Meacham Creek	6.0-8.5	Sept-Oct, 2013	Meacham Creek Phase II Project - New Construction	Black cottonwood	70 1 gal pots	
Meacham Creek	6.0-8.5	Sept-Oct, 2013	Meacham Creek Phase II Project - New Construction	Cottonwood/willow	356 3 gal pots	
Meacham Creek	6.0-8.5	Sept-Oct, 2013	Meacham Creek Phase II Project - New Construction	Bitter cherry	30 10 cu in plugs	
Meacham Creek	6.0-8.5	Sept-Oct, 2013	Meacham Creek Phase II Project - New Construction	Bitter cherry	5 5 gal pots	
Meacham Creek	6.0-8.5	Sept-Oct, 2013	Meacham Creek Phase II Project - New Construction	Choke cherry	25 10 cu in plugs	
Meacham Creek	6.0-8.5	Sept-Oct, 2013	Meacham Creek Phase II Project - New Construction	Choke cherry	50 5 gal pots	
Meacham Creek	6.0-8.5	Sept-Oct, 2013	Meacham Creek Phase II Project - New Construction	Golden currant	245 1,2&5 gal pots	
Meacham Creek	6.0-8.5	Sept-Oct, 2013	Meacham Creek Phase II Project - New Construction	Wax currant	145 1&2 gal pots	
Meacham Creek	6.0-8.5	Sept-Oct, 2013	Meacham Creek Phase II Project - New Construction	Nootka rose	204 1/2&1 gal pots	
Meacham Creek	6.0-8.5	Sept-Oct, 2013	Meacham Creek Phase II Project - New Construction	Woods rose	38 10 cu in plugs	
Meacham Creek	6.0-8.5	Sept-Oct, 2013	Meacham Creek Phase II Project - New Construction	Woods rose	355 1&2 gal pots	
Meacham Creek	6.0-8.5	Sept-Oct, 2013	Meacham Creek Phase II Project - New Construction	Douglas spirea	475 1,2&5 gal pots	
Meacham Creek	6.0-8.5	Sept-Oct, 2013	Meacham Creek Phase II Project - New Construction	Snowberry	27 1 gal pots	
Meacham Creek	6.0-8.5	Sept-Oct, 2013	Meacham Creek Phase II Project - New Construction	Mountain goldenbanner	16 10 cu in plugs	
Meacham Creek	6.0-8.5	Oct-Nov, 2013	Meacham Creek Phase II Project - New Construction	Bluebunch wheatgrass, blue wildrye, Idaho fescue, California brome, basin wildrye, slender (annual) hairgrass, and western yarrow		550

[a] Meacham Creek Floodplain Restoration and In-stream Enhancement Phase II Project (RMs 6 to 8.5) = Meacham Creek Phase II Project

Table 4. Planting materials and grass seed by species, quantity, and size, planted and established at Umatilla River Basin existing and new project sites, 2014.

Water body	River mile	Date planted	Project site location	Species (Common Name)	Quantity Trees/Shrubs	Quantity Seed (lbs)
Meacham Creek	7.3-7.7	May, 2014	Meacham Creek Floodplain Restoration and In-stream Enhancement Phase II Project[a]	Black cottonwood	30 10 cu in plugs	
Meacham Creek	7.3-7.7	May, 2014	Meacham Creek Phase II-EPA Reach Project	Big leaf sedge	30 10 cu in plugs	
Meacham Creek	7.3-7.7	May, 2014	Meacham Creek Phase II-EPA Reach Project	Beaked sedge	30 DP-4	
Meacham Creek	7.3-7.7	May, 2014	Meacham Creek Phase II-EPA Reach Project	Small fruit bulrush	15 DP-4	
Meacham Creek	7.3-7.7	May, 2014	Meacham Creek Phase II-EPA Reach Project	Baltic rush	30 DP-4	
Meacham Creek	7.3-7.7	May, 2014	Meacham Creek Phase II-EPA Reach Project	Big leaf sedge	15 DP-4	
Meacham Creek	7.3-7.7	May, 2014	Meacham Creek Phase II-EPA Reach Project	Beaked sedge	5 1 gal pots	
Meacham Creek	7.3-7.7	May, 2014	Meacham Creek Phase II-EPA Reach Project	Willow species	15 2 gal pots	
Meacham Creek	7.3-7.7	May, 2014	Meacham Creek Phase II-EPA Reach Project	Willow species	2000 cuttings	
Meacham Creek	6.0-8.5	Sept-Nov, 2014	Meacham Creek Phase II Project - New Construction	Mountain alder	124 1,3&5 gal pots	
Meacham Creek	6.0-8.5	Sept-Nov, 2014	Meacham Creek Phase II Project - New Construction	Serviceberry	12 1 gal pots	
Meacham Creek	6.0-8.5	Sept-Nov, 2014	Meacham Creek Phase II Project - New Construction	Water birch	69 1,2&5 gal pots	
Meacham Creek	6.0-8.5	Sept-Nov, 2014	Meacham Creek Phase II Project - New Construction	Red Osier dogwood	105 1&2 gal pots	
Meacham Creek	6.0-8.5	Sept-Nov, 2014	Meacham Creek Phase II Project - New Construction	Black hawthorn	65 1&3 gal pots	
Meacham Creek	6.0-8.5	Sept-Nov, 2014	Meacham Creek Phase II Project - New Construction	Black hawthorn	9 TP4	
Meacham Creek	6.0-8.5	Sept-Nov, 2014	Meacham Creek Phase II Project - New Construction	Cascara	145 1 gal pots	
Meacham Creek	6.0-8.5	Sept-Nov, 2014	Meacham Creek Phase II Project - New Construction	Oceanspray	146 1,2&5 gal pots	
Meacham Creek	6.0-8.5	Sept-Nov, 2014	Meacham Creek Phase II Project - New Construction	Mock orange	10 1 gal pots	
Meacham Creek	6.0-8.5	Sept-Nov, 2014	Meacham Creek Phase II Project - New Construction	Mallow ninebark	57 1 gal pots	
Meacham Creek	6.0-8.5	Sept-Nov, 2014	Meacham Creek Phase II Project - New Construction	Mallow ninebark	18 TP4	
Meacham Creek	6.0-8.5	Sept-Nov, 2014	Meacham Creek Phase II Project - New Construction	Ponderosa pine	1424 1&5 gal pots	
Meacham Creek	6.0-8.5	Sept-Nov, 2014	Meacham Creek Phase II Project - New Construction	Aspen	24 2 gal pots	
Meacham Creek	6.0-8.5	Sept-Nov, 2014	Meacham Creek Phase II Project - New Construction	Cottonwood/willow	110 5 gal pots	
Meacham Creek	6.0-8.5	Sept-Nov, 2014	Meacham Creek Phase II Project - New Construction	Black cottonwood	199 2&5 gal pots	
Meacham Creek	6.0-8.5	Sept-Nov, 2014	Meacham Creek Phase II Project - New Construction	Golden currant	189 3 gal pots	
Meacham Creek	6.0-8.5	Sept-Nov, 2014	Meacham Creek Phase II Project - New Construction	Nootka rose	25 1 gal pots	
Meacham Creek	6.0-8.5	Sept-Nov, 2014	Meacham Creek Phase II Project - New Construction	Woods rose	233 1&2 gal pots	
Meacham Creek	6.0-8.5	Sept-Nov, 2014	Meacham Creek Phase II Project - New Construction	Woods rose	94 3&5 gal pots	
Meacham Creek	6.0-8.5	Sept-Nov, 2014	Meacham Creek Phase II Project - New Construction	Willow	36 TP4	
Meacham Creek	6.0-8.5	Sept-Nov, 2014	Meacham Creek Phase II Project - New Construction	Blue elderberry	108 1&5 gal pots	
Meacham Creek	6.0-8.5	Sept-Nov, 2014	Meacham Creek Phase II Project - New Construction	Blue elderberry	18 TP4	
Meacham Creek	6.0-8.5	Sept-Nov, 2014	Meacham Creek Phase II Project - New Construction	Western spirea	132 1&2 gal pots	
Meacham Creek	6.0-8.5	Sept-Nov, 2014	Meacham Creek Phase II Project - New Construction	Snowberry	4 5 gal pots	
Meacham Creek	6.0-8.5	Sept-Nov, 2014	Meacham Creek Phase II Project - New Construction	Snowberry	113 TP4	
Meacham Creek	6.0-8.5	Oct-Nov, 2014	Meacham Creek Phase II Project - New Construction	Bluebunch wheatgrass, blue wildrye, Idaho fescue, California brome, basin wildrye, slender (annual) hairgrass, and western yarrow		400
Umatilla River	41.0-44.0	Nov, 2014	B & G easement CREP maintenance	Big Sagebrush	10 3 gal pots	
Umatilla River	41.0-44.0	Nov, 2014	B & G easement CREP maintenance	Black hawthorn	10 TP4	
Umatilla River	41.0-44.0	Nov, 2014	B & G easement CREP maintenance	Cascara	20 1 gal pots	
Umatilla River	41.0-44.0	Nov, 2014	B & G easement CREP maintenance	Oceanspray	15 1 gal pots	
Umatilla River	41.0-44.0	Nov, 2014	B & G easement CREP maintenance	Ponderosa pine	170 1 gal pots	
Umatilla River	41.0-44.0	Nov, 2014	B & G easement CREP maintenance	Black cottonwood	40 5 gal pots	
Umatilla River	41.0-44.0	Nov, 2014	B & G easement CREP maintenance	Golden currant	20 3 gal pots	
Umatilla River	41.0-44.0	Nov, 2014	B & G easement CREP maintenance	Woods rose	30 3 gal pots	
Umatilla River	41.0-44.0	Nov, 2014	B & G easement CREP maintenance	Blue elderberry	20 1 gal pots	
Umatilla River	41.0-44.0	Nov, 2014	B & G easement CREP maintenance	Snowberry	18 TP4	

[a] Meacham Creek Floodplain Restoration and In-stream Enhancement Phase II Project (RMs 6 to 8.5) = Meacham Creek Phase II Project

Table 5. Habitat passage structures monitored and maintained by CTUIR to meet design specifications.

Year	Stream	Stream Location	Project Description
2007	Meacham Creek	RM 1.7	Passage rectified by removing large cabled boulders (improved adult passage)
2007	Meacham Creek	RM 20.2	Partial dam removed (juvenile and adult passage)
2007	Camp Creek	RM 0.3	Partial dam removal (juvenile and adult passage)
2007	Greasewood Creek	RM 0.4	Partial dam removal (juvenile and adult passage)
2007	West Birch Creek	RM 3.2	Roughened channel to restore proper gradient and reduce step height at road bridge crossing for adult passage
2008	West Birch Creek	RM 2.7	Hoeft Dam fish passage rectification (juvenile and adult passage)

Work Element: Enhance Floodplain/Remove, Modify, Breach Dike-Enhance Floodplain Connectivity and Function via Levee Setback on Meacham Creek, RM's 6-8.5 Phase II

This project work element was completed in FY 2013 in association with the following two work elements: increase in-stream habitat complexity and stabilization and realign, connect, and or create channel. Project activities are fully described in report section ***Selected Fish Habitat Enhancement and Restoration Activities: Fiscal Years 2013-2014: Meacham Creek Floodplain Restoration and In-stream Enhancement Phase II Project, RM 6 to 8.5*****.**

Work Element: Increase In-stream Habitat Complexity and Stabilization Meacham Creek Floodplain Restoration and In-Stream Enhancement, RM's 6-8.5 Phase II

This project work element was completed in FY 2013 and fully described in report section ***Selected Fish Habitat Enhancement and Restoration Activities: Fiscal Years 2013-2014: Meacham Creek Floodplain Restoration and In-stream Enhancement Phase II Project, RM 6 to 8.5*****.**

Work Element: Realign, Connect, and/or Create Channel – Create and Enhance Side- and Off-channel Habitat in Meacham Creek, RM's 6-8.5 Phase II

This project work element was completed in FY 2013 and fully described in report section ***Selected Fish Habitat Enhancement and Restoration Activities: Fiscal Years 2013-2014: Meacham Creek Floodplain Restoration and In-stream Enhancement Phase II Project, RM 6 to 8.5*****.**

Work Element: Remove/Install Diversion – Garton Irrigation Efficiency: Garton Barrier and Channel Modification

<u>Project Area</u>
Birch Creek, a major tributary to the Umatilla River in Northeast Oregon is a 291 square mile drainage extending from the Blue Mountains down through the Umatilla Plain and into the Umatilla River downstream of Pendleton, Oregon (Figure 2). The topography of the Birch Creek Watershed is typical of the Blue Mountain foothills, with broad flat ridges bisected by moderately steep, constraining canyons with a variety of aspects across a broad valley floor. The valley floor is comprised of low and high

terraces with much incidence of actively eroding banks with an overall lack of in-stream cover. Thin riparian transects contain sparse tree growth. Water temperatures and habitat conditions throughout Birch Creek are classified as marginal for salmonids. Several passage issues, including the Garton (formerly named Broun) Diversion Dam, in the lower subbasin are in the process of being evaluated by the UAFHP and ODFW and are quite problematic for migrating salmonids seeking more desirable conditions in the upstream areas of the watershed. The upper reaches consist of moderately-steep, closely orientated hill slopes that cradle the channel and support substantial tree growth, and cooler waters.

The Umatilla/Willow Subbasin Plan (2005) and Five Year Action Plan for the Development and Maintenance of Habitat Improvement Projects in the Umatilla Subbasin: 2006-2010 (CTUIR/ODFW, 2006) recognize impediments to anadromous fish passage in the Birch Creek Watershed as high priority sites for rectification. Passage is identified as a primary limiting factor, NOAA ecological concern, to ESA Threatened Mid-Columbia Summer Steelhead in the Birch Creek subbasin. The majority of impediments are irrigation dams of which many are abandoned or not being used for irrigation water withdrawal. Jump heights are excessive and out of compliance with established state and federal standards. The effects of the structures hinder adults ascending upstream to spawning grounds and interfere with the timing of juvenile migration patterns. Juveniles can be carried downstream over the structures during high flow events, or during winter fluvial movements, but then are unable to effectively ascend to more favorable summer rearing conditions upstream. Remediation of fish passage problems would allow both resident and anadromous fish to freely pass upstream with decreased injury and increased survival of steelhead, redband trout and other native fishes. Retaining in-stream flows during the irrigation season will also contribute to improvements in fish passage in the lower reach of Birch Creek. Restoration of summer steelhead in Birch Creek is an important component of the effort to restore salmon and steelhead in the Umatilla subbasin as Birch Creek supports approximately 30% of the wild steelhead production in the subbasin. The United States Environmental Protection Agency (EPA) lists Birch Creek as Section 303d water quality limited for flow, temperature, and nutrients. Of those parameters, flow and temperature are the most limiting factors for salmonid reproduction. Additional habitat limiting factors include lack of functioning floodplain, disconnected channel and floodplain, limited in-channel habitat complexity, lack of adequate riparian characteristics or function, and unstable flow hydrograph patterns.

<u>Introduction</u>

Restoration actions, identified as part of the overall Birch Creek Garton (formerly named Broun) Barrier and Channel Modification Project (Figure 8), were selected to meet project objectives to restore habitat fragmentation/connectivity and juvenile and adult fish passage; install landowner irrigation efficiency systems in conjunction with purchase of landowner senior water rights to improve unstable flow hydrograph patterns, temperature and hydrologic connectivity in-channel and with vegetation restored channel and bank function, channel flood capacity, fish habitat complexity, sediment recruitment, and riparian enhancement. A phased approach was identified to complete the project: Phase l- Goal of dam removal is prioritized, Phase ll- Landowner negotiations, Phase lll- Remove landowner's need of ditch, Phase lV - Design dam removal and floodplain and riverine restoration, and Phase V – Construction.

A long project history exists primarily due to the landowner sensitivity of water rights and land use. In 2005, CTUIR began landowner negotiations that would lead to removal of a diversion dam that served an unscreened írrigation ditch. The diversion historically had five water right holders, each of whom must approve removal of the dam and deactivation of the diversion. The dam is listed as high priority for removal in CTUIR annual work plan. In 2007 an alternative irrigation water delivery point was designed that involved a pit well. Agreements were signed but former landowner, Joyce Broun, elected to back out

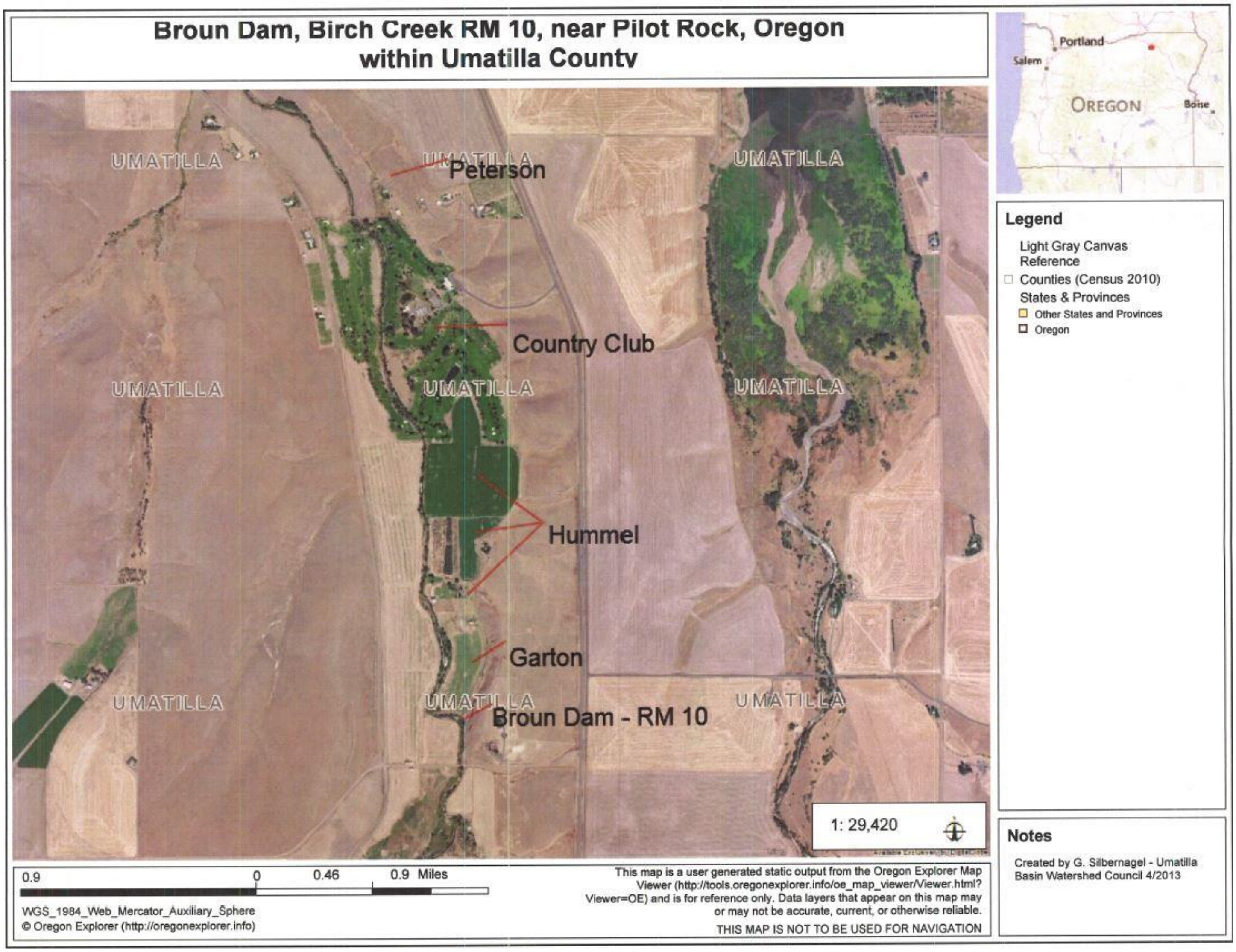


Figure 8. Birch Creek Garton Barrier and Channel Modification Project area near RM 10.0.

of the project due to potential injury. No guarantee by CTUIR could be made that the pit well/ground water would provide water mid-summer when flows were limited in the creek. In 2008, CTUIR worked with the Pendleton Country Club to transfer their water right from Bround Dam to a successful pit well system. The water right transfer was processed through the OWRD leaving four remaining landowners associated with the diversion ditch. In 2010 the Broun Property was purchased by Gabe Garton. A restoration team was formed in 2010, and the UBWC and ODFW joined in landowner negotiations. At that time the UBWC became the project lead for negotiating project activities with landowners. The Freshwater Trust (TFT) was brought in to look at the potential of purchasing senior water rights from the Hummel family. In regards to the Peterson property, no delivery system exists by ditch to maintain the existing water right. Paper work has been submitted to the OWRD by the landowner to change Point of Diversion for water right from current location to existing downstream for use of an in-stream surface pump. In 2012, the UBWC continued to work with landowners and has became a liaison with Restoration Team including CTUIR. Negotiations continued between TFT and Hummel family to purchase water rights. Several offers by TFT were declined by Hummel's due to priority water right concerns. ODFW installed a portable fish screen in the ditch as a temporary solution to limit fish loss and impacts to downstream migrant salmonids and resident fish until the overall project can be completed.

<u>Restoration Action</u>

The Garton Irrigatin Efficiency Project, another component of the overall Birch Creek Garton Barrier and Channel Modification Project, was implemented in fall 2014 to convert from flood irrigation and use of the diversion dam and ditch delivery system to a new pump and piped irrigation system for the landowner (Figure 8 and Figure 9). The new 7.5 horsepower pump station with screened intake pipe is located along Birch Creek at the existing point of delivery and did not necessitate a water rights point of delivery transfer (Figure 9). The pump was installed with a NOAA and ODFW approved fish screen by ODFW as cost share to the project (Figure 10).



Garton Dam (formerly Broun Dam)

Figure 9. Garton Irrigation Efficiency Project photos, Birch Creek RM 10.0.

OREGON DEPARTMENT OF FISH AND WILDLIFE
OREGON WATER RESOURCES DEPARTMENT

FISH SCREEN INSPECTION FORM

Applicant
Name: _Gabe Garton_
Address: 43839 Hoeft Road, Pendleton, Oregon _Phone 541-969-0951

Application Number: _N/A_____ Water Right Certificate Number: 56170
Water Right Amount (cfs) 0.15 Water Right Transfer Number: _N/A_

Diversion
Stream: ____Birch Creek_______ Tributary to: ___Umatilla River___________
Address (if different than applicants):____ ___________
Diversion Type (gravity or pump): ___Pump___________ Location: T1N, R32E, Sec. 22
GPS Coordinates: Lat: 45.54967, Long:-118.79443

Pump Information
Brand: Cornell Horsepower: 7.5 hp Intake Size: ____6 inch_____

Screen Information
Type/Brand: ______Backwash Active___ Installed by: Kerns Irrigation, Lowden, WA___
Date Installed: ___07_/_21__/__2014____ Date of Inspection: __07/24/2014
Manufacturer: _____Clemons_________ Model #: _____CW400__________
Inspected by: ____Alec Moore_______ Agency: ___ODFW__________

Comments:
× Screen meets current state criteria for fish protection.
☐ Screen does not meet current state criteria for fish protection.
☐ Another screen inspection should be done before water use begins.
☐ Fish passage meets current criteria
☐ Fish passage does not meet current criteria
☐ Fish passage not required
☐ Bypass structure meets current state criteria
☐ Bypass does not meet current state criteria
☐ Bypass Structure not required

Figure 10. Completed ODFW fish screen inspection form for the Garton pump and screened intake.

Converting from flood irrigation to a pump and piped irrigation system eliminated the need for this landowner to use the diversion and ditch system and completes another step towards dam removal in out-years. With completion of this project the ditch headgate was closed reducing impacts to juvenile and adult anadromous and resident fish entering the ditch and being bypassed back to the river. A written agreement with the landowner is in place allowing the dam to be removed when all landowners with water rights associated with this diversion dam and ditch have been converted to alternative water use sources and they have changed their point of diversion with the OWRD. Negotiations are ongoing with last landowners to convert their point of diversion to other systems. No other landowners are currently using the ditch for water.

This project was completed with several partners and f unding sources including the Oregon Watershed Enhancement Board through a small grant ($10,000), ODFW In-kind/cash match, BPA and the landowner. The overall project cost was about $35,000.

SELECTED FISH HABITAT ENHANCEMENT AND RESTORATION ACTIVITY

Meacham Creek Floodplain Restoration and In-stream Enhancement Phase II Project, RM 6 to 8.5

Introduction

Following the successful implementation of the Meacham Creek Floodplain Restoration and In-stream Enhancement Project between river miles 6.0 and 7.1 in 2011 (CTUIR 2012 and CTUIR 2012a), the CTUIR and USFS initiated a second project phase. This section of the report documents the project actions completed as part of the Meacham Creek Floodplain Restoration and In-stream Enhancement Phase II Project from river miles 6.0 to 8.5 (Meacham Phase II Project; CTUIR 2014); which builds on previous work within the phase I reach with restoration actions extending upstream an additional 1.5 miles. The project area expands over both CTUIR and USFS lands. Design for the Meacham Phase II Project began in 2012 and construction was completed in 2013 and 2014.

Action Area

The Meacham Creek watershed is a 114,000 acre, 37-mile long tributary, that flows off the west slope of the Blue Mountains into the Umatilla River, entering at river mile 78.8 (Figure 11). It contributes about half of the flow to the Umatilla River during high flow events and a significant amount to the base flow. Meacham Creek originates near the town site of Kamela, Oregon at approximately 4500 feet elevation. Data from CTUIR shows that Meacham Creek runs 2-3 ºC degrees warmer (16 ºC [60.8 ºF] vs. 13.5 ºC [56.3 ºF]) during the summer than the Umatilla River at the confluence. The USGS maintains a gauging station on Meacham Creek at RM 1.4 at Gibbon, OR (USGS 14020300) in cooperation with the CTUIR. The drainage area covered is 176 mi^2 with a maximum peak flow recorded as 8,800 cubic feet per second (cfs), while minimums of 7 cfs constitute summer base flows. Three channel reaches of Meacham Creek flow intermittently and subsurface during the summer months, but provide short reprieve to high temperatures during low summer flows.

The Meacham Creek watershed is also of significance to CTUIR Tribal members because of its traditional hunting, fishing and gathering opportunities. Meacham Creek provides habitat and refuge for spring Chinook salmon, summer steelhead, and bull trout but at reduced levels due to degraded habitat and water quality. The anadromous salmonid component is of significance to the Umatilla Subbasin. In the lower 15 miles of Meacham Creek, more than twice as many salmonids are estimated to thrive than found in the lower 81.8 miles of the Umatilla River. Historically, Meacham Creek was a major spring Chinook, steelhead, and coho salmon producing tributary to the Umatilla River, along with healthy populations of bull trout and resident redband trout.

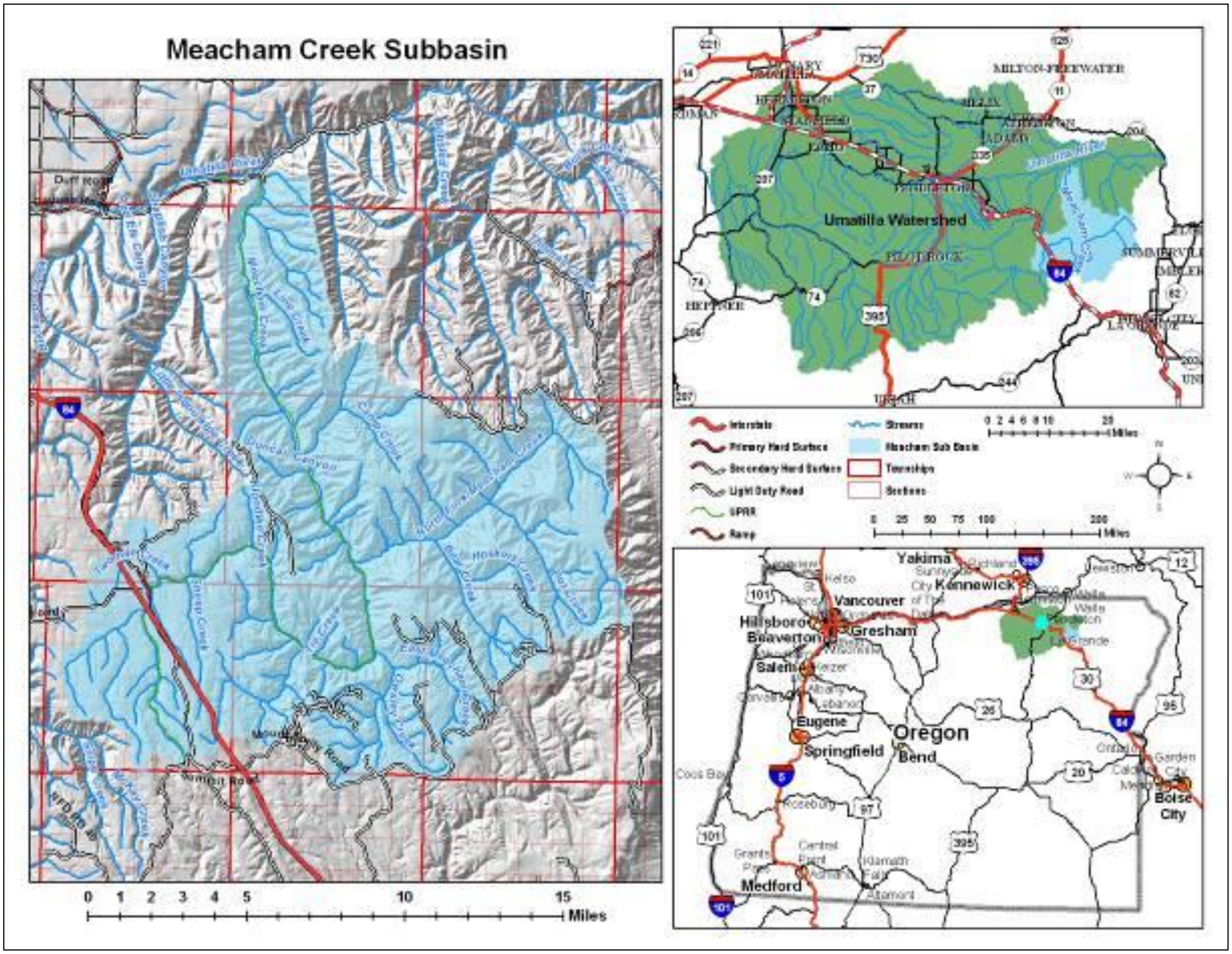


Figure 11. Meacham Creek Subbasin, tributary to the Umatilla Subbasin.

The primary negative impact to Meacham Creek is an adjacent railway built in the early 1900's that has included the construction of extensive levees, channel relocation, channelization, and vegetation alteration. The Meacham Creek Watershed Assessment and Action Plan (Andrus and Middel 2003) concluded the following: 1) Railroad tracks border the stream for the majority of its 37-mile length; 2) A ledge was blasted out of the adjacent hill slope in the upper canyon to make room for the railway; 3) Following construction, Meacham Creek repeatedly collided into the railroad prism in the lower valley and threatened to undo what had been built; 4) Angled dikes and parallel levees were constructed to force the stream away from the tracks and, following floods, bulldozers were used to create a straight channel that was free of logs; and 5) Early trains were fueled by wood and may partly explain the shortage of large woody material in the valley.

A significant secondary impact to Meacham Creek is high intensity grazing by domestic livestock in the riparian area. More than a century of concentrated cattle and sheep grazing has limited tree regeneration in many areas, degraded shrub and herbaceous conditions, and has led to unstable streambank conditions. Current natural regeneration of riparian plant species is most successful in areas where livestock are excluded. Additional impacts have included timber harvest (high-grading from the riparian area), road construction, and some urban development. These activities have contributed to high water temperatures, unstable channel bed and banks, simplified and degraded aquatic habitat conditions, poor riparian vegetation conditions, and possibly reductions in late season flow. The extent of impacts dictates that watershed scale processes must be considered in restoration planning and a holistic watershed approach is necessary for success.

Documented watershed-scale impacts and the importance of salmon and steelhead on the lower 15-miles of Meacham Creek, the portion of the mainstem Meacham Creek from the confluence of the North Fork Meacham Creek downstream to the confluence with the Umatilla River has been identified as the highest priority for active watershed restoration and termed the "Focus Area", supports a holistic watershed approach for successful restoration planning (Figure 12). The holistic watershed approach supports long-term progress towards:

1. Achievement of the CTUIR River Vision and First Foods Policy,
2. ESA delisting of steelhead and bull trout, and
3. Addresses water quality limiting factors per the Clean Water Act 303d list.

The Meacham Phase II Project (RM 6-8.5) was supported by the Meacham Creek Assessment and Action Plan (Andrus, 2003). The development of action alternatives draws from knowledge gained from other restoration and assessment efforts. The proposed project actions build on restoration activities since 2006 (Figure 13). As a multi-year and multi-funded effort, the implementation actions overlap locations within the 15-mile Focal Area and may include the same action being implemented over several years. For example, there have been and will continue to be multiple efforts of riparian planting in the Meacham Creek floodplain during the spring and fall that will overlap with whole tree additions, levee removal/setback and natural channel construction. These efforts are integrated and designed to provide support to each other.

Limiting Factors

Historically Meacham Creek was a major spring Chinook, steelhead and Coho Salmon producing tributary to the Umatilla River, along with healthy populations of bull trout and resident redband trout. Currently, Meacham Creek provides habitat and refuge for spring Chinook salmon, summer steelhead and bull trout, but well below historic levels due to degraded habitat and water quality conditions.

Meacham Creek is water quality limited primarily by high water temperature. Physical aquatic habitat is also in poor condition and been shown to be a limiting factor to the health of important aquatic species. The primary cause of habitat degradation in Meacham Creek is hydro-modification from simplification of the channel by channelization and streambank modification for the purpose of protecting the infrastructure of the UPR Railway.

The Middle Columbia River Steelhead Recovery Plan supports this project by identifying the actions of reconnecting Meacham Creek to the floodplain, removing dikes and levees, as well as reconnecting side channels and off-channel habitat as the first priority under Strategy 3. Restoring natural channel form, placing stable wood and other large organic debris in the streambed, stabilizing and protecting

Figure 12. Meacham Creek Restoration Project Focus Area, River Miles 0.0-15.0.

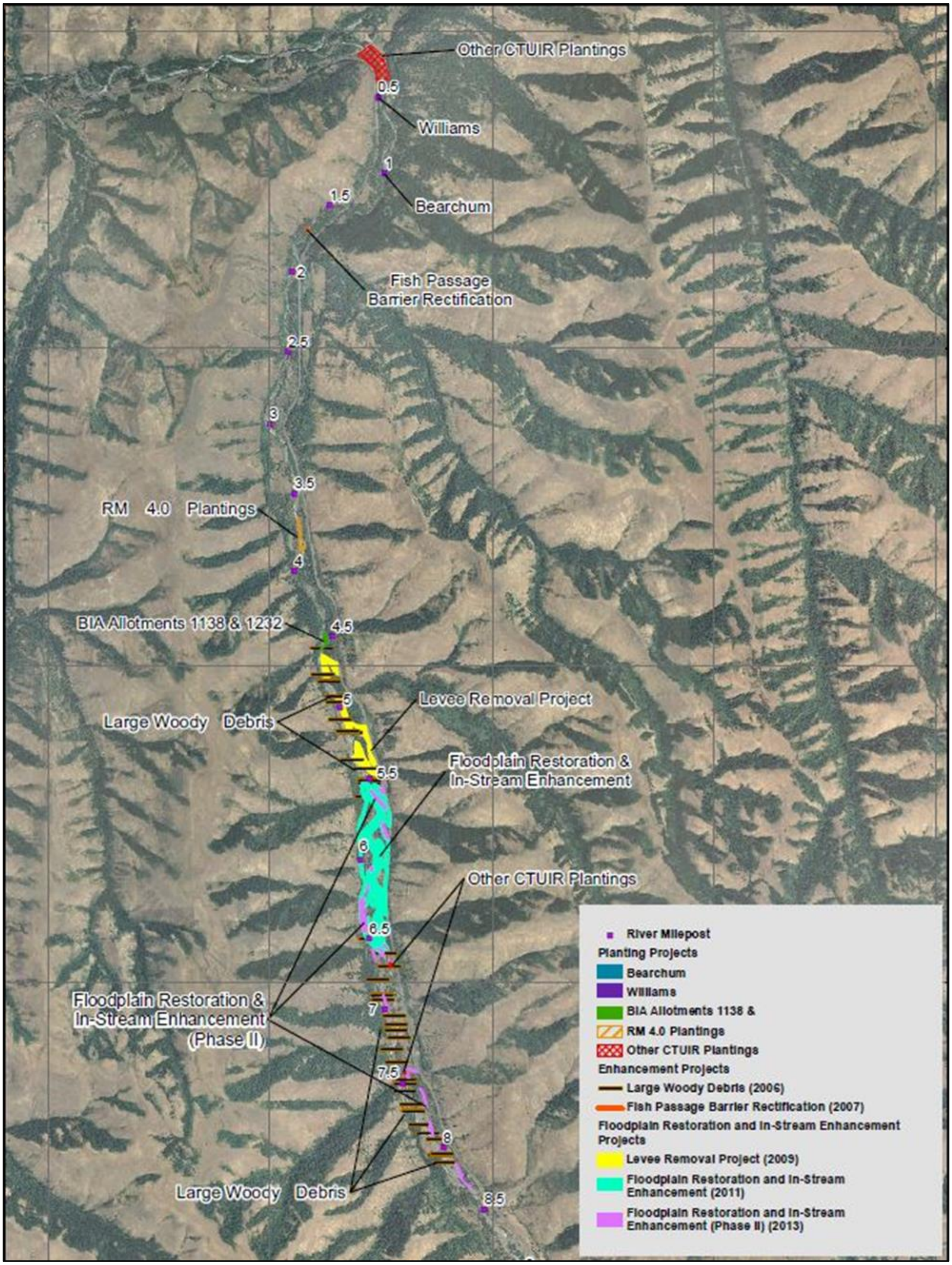


Figure 13. Project areas in lower Meacham Creek, 2006-2014.

streambanks, and constructing rock and log weirs to create pool habitat or elevating incised channels have also been identified as first priorities in the Middle Columbia River Steelhead Recovery Plan under Strategy 4. Degraded floodplain and channel structure, altered sediment routing, altered hydrology, and water quality (temperature) have been identified in the Middle Columbia River Steelhead Recovery Plan as major factors limiting steelhead populations in Meacham Creek (NMFS 2009).

Exploring solutions with UPR for improving migratory habitat in the Meacham Creek watershed is identified as the highest priority in the Bull Trout Draft Recovery Plan within the Umatilla/Walla Walla Recovery Unit (RU). Furthermore, restoring floodplain function and channel complexity is the second highest priority identified in the Bull Trout Draft Recovery Plan within the Umatilla/Walla Walla RU. Altering dikes in the mainstem of Meacham Creek has been identified in the Bull Trout Draft Recovery Plan as an action that would improve channel complexity and improve fish habitat and potential use by bull trout. The construction and maintenance of the UPR, which parallels mainstem Meacham Creek, along with dikes or levees in place to protect the railroad from flooding, is identified in the Bull Trout Draft Recovery Plan as significantly altering stream and channel complexity, riparian shade, and likely affecting stream temperatures (USFWS 2002).

Full project details of planning, design, consultation and permitting, construction, monitoring and assessment can be found in the Meacham Creek River Mile 6.0 to 8.5 Floodplain Restoration and In-stream Enhancement Project Completion Report (CTUIR 2014).

Goal and Objectives

The overall purpose of the Phase II Project was to improve floodplain connectivity and in-stream and riparian habitat for listed and non-listed species by restoring channel morphology, hydrologic processes, and riparian and in-stream processes. The goal of the Phase II Project was to address the Primary Limiting Factors identified for Meacham Creek in the 2008 Fish Accords (Three Treaty Tribes-Action Agencies 2008), consistent with the Middle Columbia River Steelhead Distinct Population Segment ESA Recovery Plan (NMFS 2009), Bull Trout Draft Recovery Plan within the Umatilla/Walla Walla Recovery Unit (USFWS 2002), and the Umatilla/Willow Subbasin Plan (NPCC 2005), as well as incorporating the touchstones described in the Umatilla River Vision (Jones et al. 2008). To address the project goal, the following objectives were developed:

- Increase channel pattern complexity and hyporheic fluxes, with channel morphology maintained and reshaped over time by Meacham Creek hydrology.
- Increase habitat heterogeneity, with dynamic channel morphology that is able to create a variety of diverse channel features.
- Increase riparian connectivity and functions with dynamic hydrology and geomorphology that is able to maintain a diverse community of self-sustaining wild populations of native riparian vegetation.
- Increase floodplain connectivity and complexity with floodplain inundation that connects and maintains habitat for native riverine communities.
- Improve sediment sorting and routing with transport and deposition that is able to maintain aquatic communities that support and provide First Foods.
- Increase areas suitable for adult spawning and juvenile rearing with a sediment regime that is able to maintain longitudinal, lateral, and vertical connectivity under a range of flows.
- Increase in-stream thermal diversity with hyporheic fluxes that would improve the water quality of Meacham Creek.

As part of the design criteria, key criteria and goals for fish utilization, physical habitat features, geomorphic features, riparian management, and wildlife were developed and evaluated to meet project objectives.

<u>Restoration Actions</u>

The Meacham Creek Phase II Project expanded upon a past restoration project implemented in 2011 between RM 6 and RM 7.1. The purpose of the Meacham Creek Phase II Project was to improve floodplain connectivity and in-stream and riparian habitat for listed and non-listed fish species in Meacham Creek by restoring channel morphology and hydrologic, riparian, and in-stream processes. The need for the project has resulted from past impacts and current factors limiting aquatic productivity; specifically, levees and spur dikes limit floodplain connectivity and riparian shade, and lack of large wood or other structures limits in-stream habitat complexity and quantity. Based on post-construction assessments and monitoring of the Meacham Creek Floodplain Restoration and In-stream Enhancement Project between RM 6 and 7.1, and the existence of additional levees and spur dikes between RM 6 and 8.5 affecting geomorphic and hydrologic processes, the following needs in the project reach were identified:

- Address placing backfill material in the floodplain between RM 6 to 7.1 to provide more representative floodplain characteristics and to reduce the potential that Meacham Creek will recapture the 2010 channel location.
- Address channel geometry changes that resulted from flooding in 2011 prior to construction in the Phase I reach.
- Evaluate existing islands and bars in the Phase II reach to determine their current state and expected duration and their role in affecting channel grade and alignment, flood elevations, sediment transport and deposition, and habitat complexity.
- Evaluate removal of levees and spur dikes that continue to impact floodplain and riparian connectivity, aquatic habitat, and geomorphic processes in the Phase II reach.
- Evaluate the adequacy of 100-year flood protection to the UPRR access road based on removal of levees and spur dikes in the Phase II reach.
- Identify locations where the addition of LWD will improve habitat complexity in the Phase II reach.
- Address habitat complexity, including off-channel and side channel habitat, floodplain connectivity, and riparian function in the Phase II reach.

As described above, the need for the project has resulted from past impacts and current factors limiting aquatic productivity. To address these, specific project actions were designed into the project area and include (Tetra Tech 2013; (Figure 14):

- Placing backfill material in a portion of the floodplain of the Phase I reach.
- Removing or modifying levees and spur dikes in the Phase II reach to increase floodplain connectivity.
- Placing log jams and LWD structures in the Phase II reach to increase habitat complexity and side channel habitat.
- Lowering the elevation of the floodplain in a portion of the reach between RM 6 to 7.1.
- Excavating a portion of floodplain between RM 7 to 8.5 reach to reinitiate a side channel to increase off-channel and side channel habitat.
- Re-vegetating areas disturbed by Project activities with native plant species.

The proposed actions met the overall project objectives of improving floodplain connectivity and in-stream and riparian habitat for listed and non-listed fish species in Meacham Creek by restoring channel morphology and hydrologic, riparian, and in-stream processes.

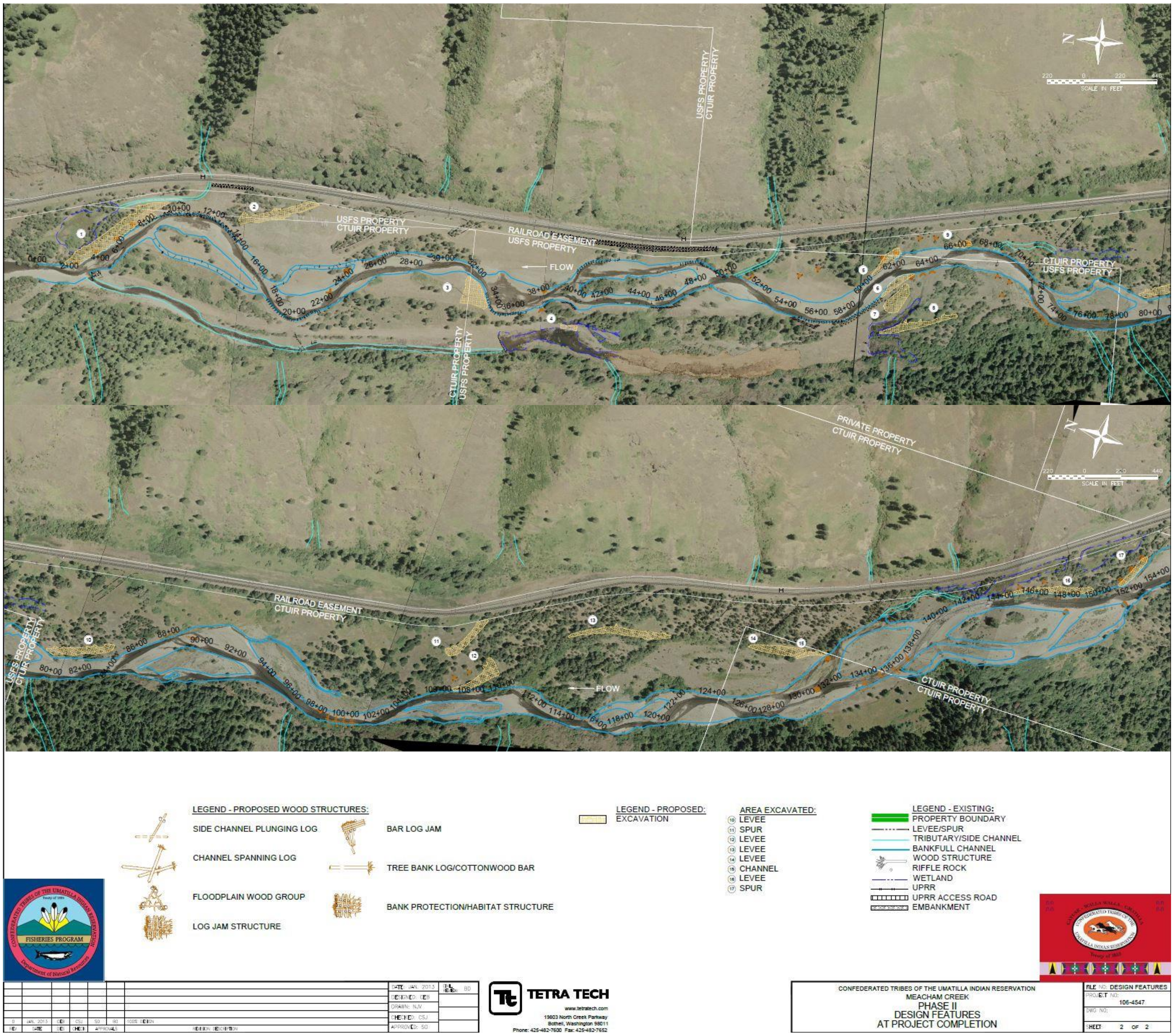


Figure 14. Meacham Creek Phase II Project Design Features, RM's 6-8.5.

The Meacham Creek Phase II Project construction occurred between June and September, 2013. Activities in the floodplain occurred throughout the project timeline, whereas work in the wetted channel occurred between July 1 and August 15 during the ODFW in-water work period. Implementation of the planting plan for the project occurred during spring and fall planting seasons both in 2013 following implementation and 2014. Major restoration and enhancement actions included removal of levees and dikes, secondary channel length increased, addition of large wood to channel and floodplain, recontouring of floodplain surface, areas of native vegetation planted, and relative abundance of floodplain habitats (wetted areas and wetlands) created (Table 6). Provided below is an outline of the Meacham Creek Phase II Project construction sequence:

Floodplain Work: June–September

- Installed erosion and sediment controls and BMPs.
- Cleared and grubbed proposed temporary access roads.
- Stockpiled wood and rock material for future use.
- Removed or modified levees and spur dikes in floodplain where no temporary bridges or stream crossings of the wetted channel were required.
- Graded and shaped floodplain.
- Separated and stockpiled earth, rock, and woody materials for future use.
- Constructed floodplain LWD structures and engineered log jams (ELJs) outside of wetted channel where no temporary bridges or stream crossings of the wetted channel were required.
- Revegetated disturbed areas.

Wetted Channel Work: July 1–August 15

- Installed erosion and sediment controls and BMPs.
- Installed temporary bridges or stream crossings in the wetted channel as directed by the CTUIR or USFS.
- Isolated work areas and conducted fish salvage to remove any stranded fish where necessary.
- Removed or modified levees and spur dikes where temporary bridges or stream crossings in the wetted channel were required.
- Graded and shaped floodplain.
- Constructed wetted channel LWD structures and ELJs where temporary bridges or stream crossings in the wetted channel were required.
- Backfill the floodplain west of STA 42+00 and STA 55+00.
- Removed temporary bridges or stream crossings from the wetted channel, graded and shaped the floodplain area, and graded and subsoiled compacted temporary access roads.

The Meacham Creek Phase II Project was jointly constructed by the Umatilla National Forest and CTUIR staff with implementation engineering oversight by Tetra Tech Inc. Partney Construction was the construction contractor hired to complete the restoration actions. The following major work elements were constructed in 2013 (Table 7 & Figure 15):

- Excavation of 2,920 feet of levees and 2,100 feet of spur dikes (18,653 CY) at 13 locations to increase floodplain connectivity and allow development of wetland and riparian characteristics and off-channel habitat.
- Placement of 18,376 CY of material was placed as backfill in the floodplain between RM 6.5 and 7.1 to provide more representative floodplain characteristics, improve wetland and riparian planting success, and reduce the potential of Meacham Creek recapturing the 2010 channel location.
- Placement of 60 large wood structures and engineered log jams for increased in-stream habitat complexity and quantity, and side-channel habitat.
- Excavation of 160 feet of floodplain near RM 8.0 to reinitiate a 2,200-foot-long side-channel and to increase off-channel and side-channel habitat.
- Revegetation of disturbed areas with native plant species and/or seed mix. A mulch mix with native grass seed was used through hydroseeding.

Table 6. Summary of Restoration and Enhancement Actions for the Meacham Creek Floodplain Restoration and In-stream Enhancement Project (RM 6-7.1) and the Meacham Creek Phase II Project (6-8.5).

Restoration and Enhancement Actions	Phase I (2011)	Phase II (2013)	Total
Removal of Levees and Dikes (feet)	3,400	5,020	**8,420**
Realignment of Stream Channel (feet)	5,922	0	**5,922**
Secondary Channel Length[1/] (feet)	8,230	1,960	**10,190**
Addition of LWD to Channel and Floodplain (number of pieces)	1,493	565	**2,058**
Recontouring of Floodplain Surface (acres)	40	22	**62**
Area of Native Vegetation Planting (acres)	40	22	**62**
Relative Abundance of Floodplain Habitats[2/] Created (acres)	1.9	1.4	**3.3**

Notes:
1/ Secondary channel length includes off-channel and side-channel habitat lengths.
2/ Floodplain habitats include floodplain features (e.g., wetted areas with downed wood and/or aquatic vegetation) and wetlands.

During construction, vegetation was maintained or protected within the project area to the extent practicable. Plants that could remain on site within the construction zone were left in place, and were specifically discussed with the contractor and protected with flagging. Disturbed floodplain and riparian areas that had been re-contoured and ripped totaled about 22 acres. Of these, 12 acres were planted in the fall of 2013, focusing primarily on areas west of the channel, largely while still accessible at lower flows during the planting season. The remaining 10 acres were planted in spring and fall 2014 planting seasons primarily on the east side of the channel. A total of 20,345 riparian/floodplain and wetland native plants of various sizes were planted in the project area (Table 3 & Table 4).

Table 7. Project Earthwork Material Quantities in Cubic Yards (CY).

Source	Phase II Design[1/] (CY)	2013 Phase II As-Built[2/] (CY)
Floodplain Connectivity		
Lower Floodplain	757	508
Aquatic Habitat Excavation		
Side Channel	120	328
Wetland Access Road	211	173
Enhance Wetland	425	425
Levee and Dike Removal		
Levees	7,435	8,320
Spur Dikes	9,991	10,333
Fill Material		
Floodplain Backfill[3/]	16,483	18,376
Access Road Fill	0	135
Embankment Fill	570	446
Total Earthwork		
Excavation	18,939	20,087
Fill	17,053	18,957
Import Material	6,700	6,700
Total Materials Hauled	**26,209**	**27,368**

Notes:
1/ Quantities include those from Phase II Design Revision 1 and Phase II Design Field Changes.
2/ Quantities include those from Phase II Design Field Changes.
3/ Does not incorporate shrink factor associated with compaction. Shrink factor would results in 14,568 cy and 15,451 cy for Phase II Design and 2013 Phase II As-Built, respectively.

Figure 15. Photos of the Meacham Creek Phase II Project, RM's 6-8.5.

<u>Implementation and Effectiveness Monitoring</u>

Implementation monitoring was completed immediately following construction to evaluate whether the Meacham Creek Phase II Project was constructed as designed. Implementation monitoring for the Meacham Creek Phase II Project included a comprehensive as-built survey. In addition, effectiveness monitoring was completed to measure the action effectiveness of the project at achieving overall physical and ecological objectives:

1. Protect and conserve natural ecological processes that support the viability of fish populations and their primary life history strategies,
2. Maintain and restore floodplain connectivity and function,

3. Restore degraded and maintain properly function channel structure and complexity, and
4. Improve degraded water quality and maintain unimpaired water quality.

Complete construction, implementation and effectiveness monitoring results can be found in the Meacham Creek Floodplain Restoration and In-Stream Enhancement (Phase II) As-Built Survey Monitoring Analysis (Tetra Tech 2014a) and Meacham Creek Floodplain Restoration and In-Stream Enhancement (Phase II) Project Completion Report (Tetra Tech 2014b). The project monitoring assessment and associated reports incorporated and analyzed data from the as-built survey monitoring analysis (Tetra Tech 2014a) including high-resolution aerial photography, light detection and ranging (LiDAR) imagery; ongoing types of Pre- and Post-Phase I and Pre- and Post-Phase II effectiveness monitoring including topographic and aquatic habitat characteristics from the 2011-2014 CHaMP surveys, one-dimensional hydraulic modeling results, pebble counts, LWD counts, repeat topographic survey data in 2011, 2012, and 2013, and observations of spring Chinook salmon and summer steelhead redds from 2009 to 2013 were used to evaluate changes in aquatic habitat and fish distribution; macroinvertebrate study; vegetation monitoring; a Biological Monitoring Plan (Stillwater Sciences 2012); and groundwater monitoring. The remainder of this section provides a brief summary of findings from the monitoring immediately following construction.

The Meacham Creek Phase II Project restored floodplain connectivity, increased habitat complexity including off-channel and wetland habitats, and improved channel morphology including sediment sorting processes. The newly constructed restoration actions provide a significant increase in habitat diversity and hiding cover including increased primary and secondary channel length, relative habitat and feature abundance, and large wood that salmonids and resident native fish can take advantage of immediately (Table 8). Removal of levees and spur dikes and increased habitat features in-channel significantly increased connectivity between the channel and floodplain (Table 8 & Figure 16). Habitat complexity was increased significantly with improved access between the primary channel and the floodplain and associated off-channel (secondary channel) habitats (Table 8 & Figure 17; Brown 2002). With an increase in floodplain connectivity and channel complexity there is an increased connection between the surface channel and shallow water table (hyporheic zone), resulting in an increased diversity of water temperature with areas of low temperature for refuge and moderated daily temperature fluctuations. We expect lower stream temperatures as the project restoration site fully recovers from implementation. Surface and hyporheic temperature/flow response continues to be monitored as part of the Meacham Geomorphic/Hyporheic Flow Study (results presented below).

Potential spawning and rearing habitat was identified using spawning and rearing habitat depth and velocity preferences for spring Chinook salmon, summer steelhead, and bull trout; one-dimensional hydraulic modeling; and model integration with spawning and rearing preferences. Spawning and rearing preferences were determined by life history descriptions and habitat utilization information gathered by the CTUIR and Tetra Tech. Utilizing the results from hydraulic modeling, spatial analysis were performed to delineate potential areas that satisfied the criteria at the range of flows when spawning and rearing typically occurs. Based on the modeling results, a significant amount of spawning and rearing habitat was created from implementation between RM 6.0 and 7.0. Table 8 shows the increase in spawning and rearing habitat from 2009 (pre-project) to 2013 (post-project as-built). The potential spawning area increased from 0.5 to 2.9 acres, and potential rearing area increased from 0.1 acre to 3.5 acres. In the project area between RM 7.0 to 8.5, spawning potential increased from 0.8 to 2.9 acres and there was a modeled decline in rearing potential. Overall, the modeled rearing and spawning habitat potential increased significantly within the project area.

Table 8. In-channel characteristics, floodplain connectivity and sediment comparisons RM 6.0 to 7.0 (2009-2013) and RM 7.0 to 8.5 (2012-2013).

Limiting Factor	Metrics	RM 6.0 to 7.0 2009 Pre-Project (Phase I)	 2012 Pre-Project (Phase II)	 2013 As-Built (Phase II)	RM 7.0 to 8.5 2012 Pre-Project (Phase II)	 2013 As-Built (Phase II)
In-Channel Characteristics	Primary Channel Length (ft)	6,010	6,500	6,550	8,870	9,140
	Secondary Channel Length[1/] (ft)	1,890	10,120	11,650	13,050	13,470
	Bankfull Width (ft)	99	96	110	135	121
	Bankfull Depth (ft)	3.0	2.0	1.6	2.1	1.7
	Bankfull Cross-Sectional Area (ft^2)	297	187	177	286	204
	Width/Depth Ratio (Wbkf/Dbkf)	33	49	68	64	71
	Gradient (ft/ft)	0.0086	0.0078	0.0078	0.008	0.0081
	Sinuosity (Lc/Lv)	1.1	1.2	1.2	1.1	1.2
	Average Meander Length (ft)	1,550	1,490	1,400	1,430	1,600
	Braided-Channel Ratio	1.0	1.3	1.7	1.3	1.4
	Channel Complexity Index	0.0005	0.0026	0.0049	0.0041	0.0043
	Pool-to-Pool Spacing (ft)	778[4/]	473	319	388	450
	Percent Pool Area (%)	28[4/]	21	26	21	18
	Relative Habitat Abundance – Percent Riffles| Glides (%)	72 | 0[4/]	63 | 16	51 | 23	45 | 34	65 | 17
	Relative Feature Abundance[2/]	--	39	65	--	34
	LWD Counts[3/]	--	964	1,144	--	185
Floodplain	Percent of Floodplain Disconnected (%)	36.6	12.6	1.1	4.6	2.0
	Floodplain Inundation (acres)	57	79	90	102	107
	Relative Abundance of Floodplain Habitats (acres)	14.3	12.6	12.8	2.3	2.3
	Channel Migration Rate (ft/yr)	2 - 16	2 - 16	2 - 16	2 - 16	2 - 16
Sediment	Sediment Size Distribution, in channel – D50 (mm)	100	43	68[5/]	--[6/]	66
	Sediment Size Distribution, in bars – D50 (mm)[7/]	68	48	52	49	33

Limiting Factor	Metrics	RM 6.0 to 7.0 2009 Pre-Project (Phase I)	 2012 Pre-Project (Phase II)	 2013 As-Built (Phase II)	RM 7.0 to 8.5 2012 Pre-Project (Phase II)	 2013 As-Built (Phase II)
	Sediment Size Distribution, in floodplain	Poorly to well-graded gravel with sand and cobbles with little or no fines.	Poorly to well-graded gravel with sand and cobbles with little or no fines.	Poorly to well-graded gravel with sand and cobbles with little or no fines.	Poorly to well-graded gravel with sand and cobbles with little or no fines.	Poorly to well-graded gravel with sand and cobbles with little or no fines.
	Threshold Grain Size and Transport Rate (mm)	78	51	40	56	42
	Fine Sediment Percentage in Bed Material (%)	4	0 to 12	0 to 34	0	1 to 28
	Scour | Deposition (cy)	--[8/]	21,440 | 7,800	4,910 | 13,010	--[8/]	4,020 | 10,320
	Relative Abundance of Spawning Habitat (acres)	0.5	1.2	2.9	0.8	2.9
	Relative Abundance of Rearing Habitat (acres)[9/]	0.1	4.7	3.5	3.1	1.9

[1/] Includes off-channel habitat length.

[2/] Includes LWD structures with two or more pieces and boulder clusters. The 2013 as-built (Phase II) quantity includes both Phase I and Phase II structures.

[3/] Quantity based on LWD count in design plans and does not include preexisting LWD. The 2013 as-built (Phase II) quantity includes both Phase I and Phase II LWD. Additional wood, not in the original plans, was placed on the banks and within the floodplain during Phase I (about 500 additional pieces) and Phase II (about 200 additional pieces) construction activities, and is not accounted for in the table.

[4/] Habitat units were not identified in the field in 2009. Habitat calls and associated metrics were therefore based on habitat unit delineation using the thalweg profile, aerial photographs, and knowledge of the area. The reach was broken out into fast and slow habitats identified as riffles and pools, and off-channel habitats. This results in an over-estimation of both riffles and pools and underestimates (i.e., artificial absence) of glide habitat.

[5/] Sampled using CHaMP pebble counts protocols which collect 21 particles at each of 10 evenly spaced transects in riffle habitat units.

[6/] Sediment size in bars was collected for RM 7.0 to 8.5 for the 2012 pre-project (Phase II) but sediment size in-channel was not.

[7/] Average D50 from samples at multiple bar locations.

[8/] Scour and deposition data were not calculated for 2009 baseline conditions or the 2012 pre-project (Phase II) because there were no repeat topographic surveys to derive estimates.

[9/] Additional off-channel rearing area was estimated using aerial photographs and habitat characteristics. Primary and secondary channel rearing habitat is 6.3 acres (3.2 acres between RM 6.0 and RM 7.0) for 2012 pre-project and3.9 (2.0 acres between RM 6.0 and RM 7.0) for 2013 post-project. The total presented in the table includes the additional area in the off-channel area.

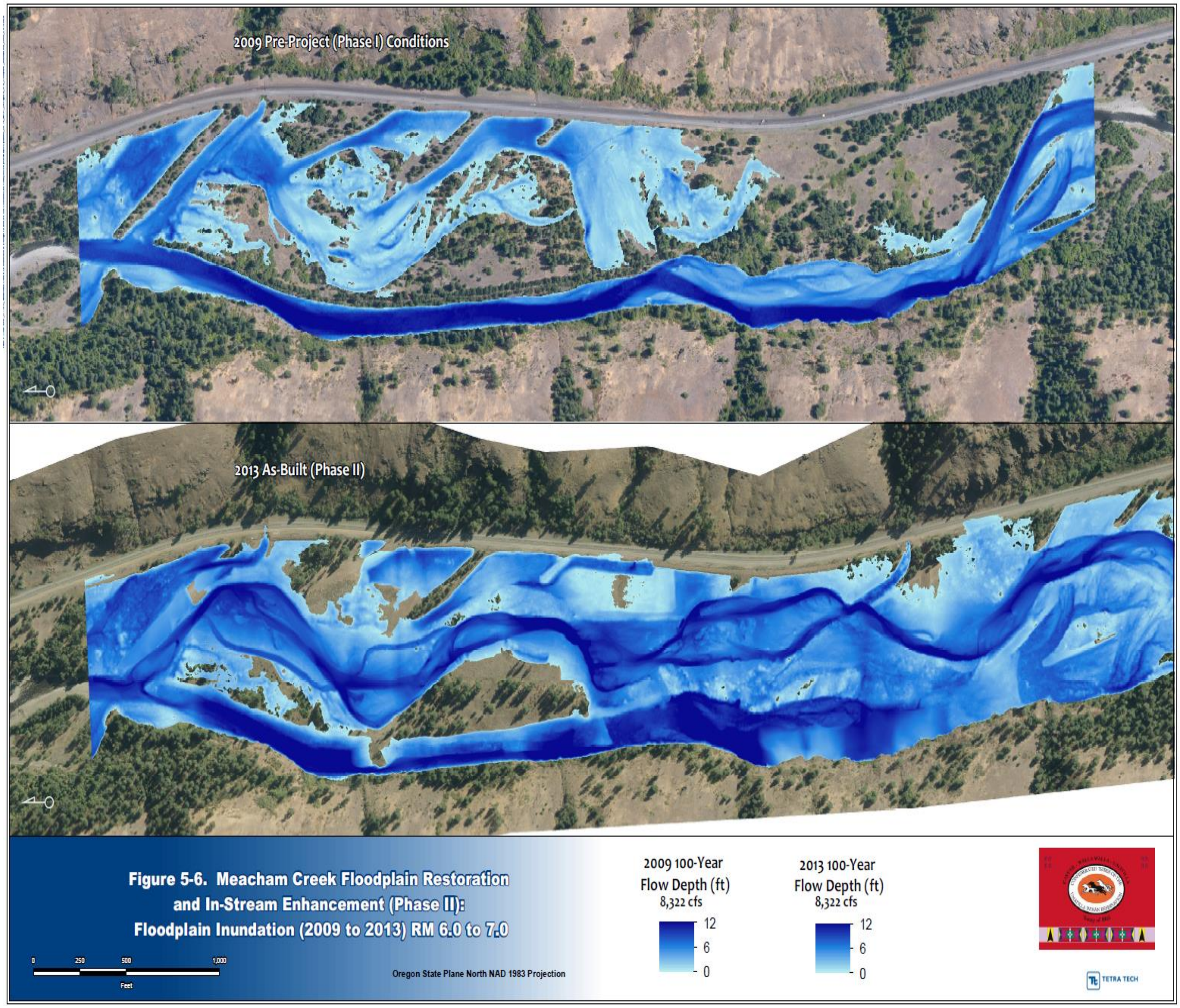


Figure 16. Meacham Creek floodplain inundation (2009 to 2013) RM 6.0 to 7.0.

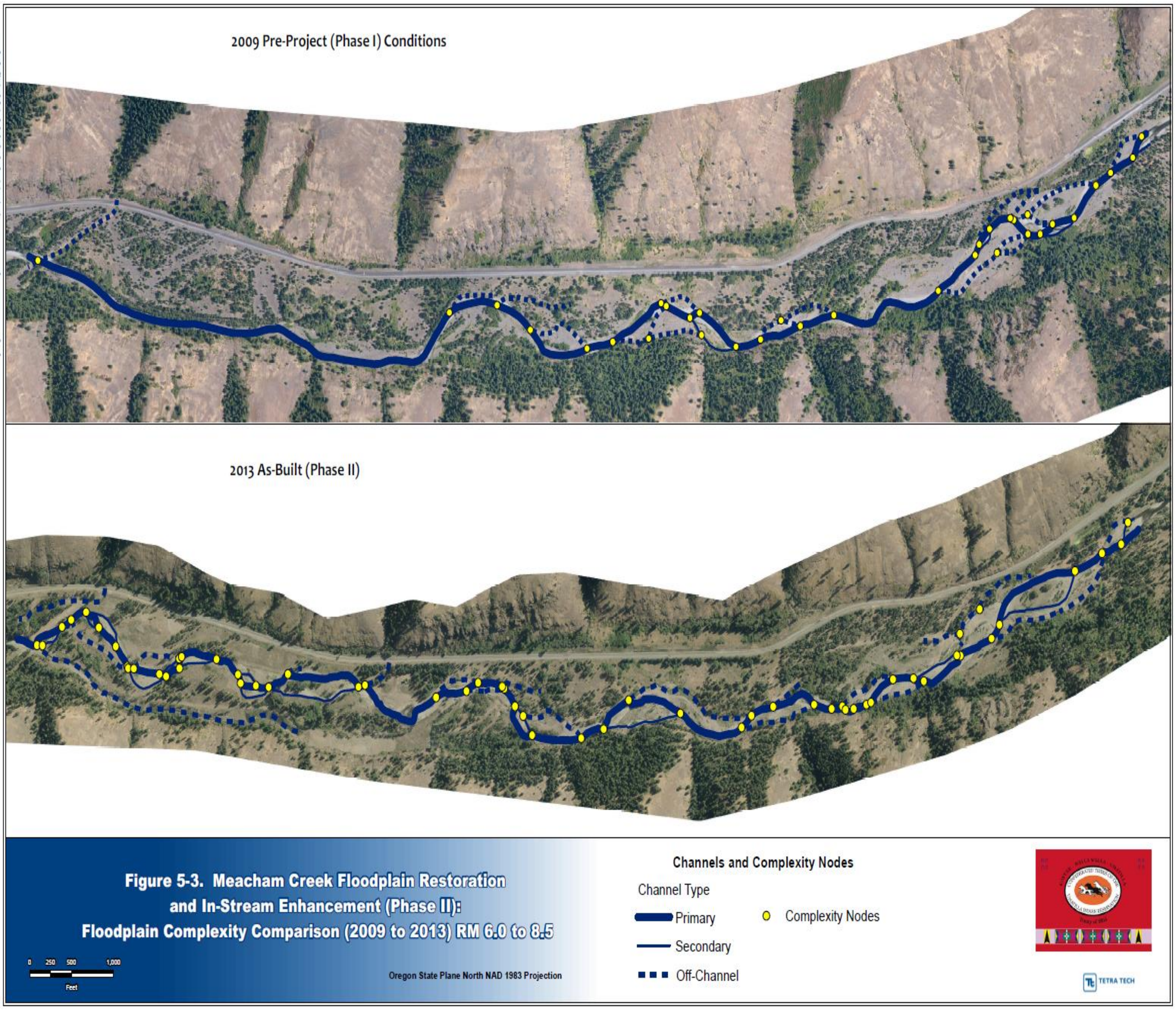


Figure 17. Meacham Creek floodplain complexity comparison (2009 to 2013) RM 6.0 to 8.5.

SYNTHESIS OF FINDINGS: DISCUSSION/CONCLUSIONS

Background/Rationale

The CTUIR Fisheries Habitat Program and UAFHP continues to invest substantial resources in restoring fisheries habitat within the Umatilla Subbasin and its tributaries. With time, we expect watershed treatments to improve stream functions by 1) diversifying channel morphology 2) increasing floodplain connectivity 3) decreasing annual maximum stream temperatures 4) increasing summer base flows 5) increasing abundance of and diversity of riparian vegetation and 6) improved ecological processes including an increase in native biota abundance and diversity.

The UAFHP monitoring can be delineated into three categories: the first aligns with the BPA's Programmatic Action Effectiveness Monitoring (AEM) Program designed and implemented to evaluate restoration action effectiveness with respect to in-stream restoration and physical and ecological/fish responses, second is project feasibility and development monitoring to design, permit and implement technically sound restoration actions, and lastly project implementation/compliance monitoring of management restoration actions to determine if they were implemented properly according to the project design or comply with established standards or with laws, rules or benchmarks.

The CTUIR UAFHP began participating in BPA's AEM Program in 2013. When feasible, restoration projects may be selected to be monitored if they meet criteria established in the AEM Program. Monitoring will occur under the AEM by the CTUIR's Bio-monitoring of Fish Habitat Enhancement (Project# 2009-014-00[CTUIR Bio-monitoring Project]) and their protocols for CTUIR restoration actions in the Umatilla Subbasin (Contor 2015). The goal of the Bio-monitoring Project is to evaluate CTUIR fish habitat restoration projects throughout five subbasins: the Grande Ronde, North Fork John Day, Tucannon, Umatilla, and Walla Walla rivers. CTUIR sponsored restoration projects in the Umatilla Subbasin and its tributaries will be assessed using a before-after/control- impact design. Data will primarily be collected through expansion of existing juvenile and adult sampling of spring Chinook salmon and summer steelhead trout.

Monitoring habitat in parallel with fish surveys provides valuable information regarding fish/habitat relationships (Bouwes et al. 2011, Stillwater Sciences 2012). Our strategy uses regionally standardized protocols to examine pre and post habitat restoration actions in contrast to unmodified control sites. Habitat restoration actions and associated monitoring focuses on addressing limiting factors with the greatest potential for improvement and includes key stream characteristics, floodplain processes and associated hydrologic, geomorphologic, riparian, vegetative, and aquatic biota touchstones of the Umatilla River Vision.

The UAFHP primarily conducted monitoring in Meacham Creek as a "Case Study" identified under the BPA AEM Program (Table 9). Project monitoring will continue to expand under the Bio-monitoring Project as new restoration projects are identified and designed for construction. UAFHP staff coordinates annually with both BPA and the CTUIR Bio-monitoring Project staff to identify projects to be monitored under the AEM Program. Meacham treatment and control sites, and associated methodology, identified as programmatic monitoring under the CTUIR Bio-monitoring and BPA AEM are summarized as monitoring under the Umatilla Basin Natural Production Monitoring and Evaluation Project 2014 Annual Progress Report (Table 9; Contor 2015). We report on the remainder of monitoring conducted and reported by the UAFHP on Meacham Creek as part of the case study.

Table 9. Monitoring locations in 2013 and 2014 identified as the Meacham Creek case study under the CTUIR Bio-monitoring Project and BPA's AEM Program.

Site	Limiting Factors	Programmatic	Monitoring	Monitoring Type
Meacham Treatment 1	Habitat, Flow, Water Temperature	CTUIR Bio-monitoring and BPA AEM	AEM Floodplain & CHaMP; Electrofishing	Action Effectiveness
Meacham Treatment 2	Habitat, Flow, Water Temperature	CTUIR Bio-monitoring and BPA AEM	AEM Floodplain & CHaMP; Snorkel&Electrofishing	Action Effectiveness
Meacham Control 1	Habitat, Flow, Water Temperature	CTUIR Bio-monitoring and BPA AEM	AEM Floodplain & CHaMP; Electrofishing	Action Effectiveness
Meacham Creek Restoration 5.8 to 7.2	Habitat, Flow, Water Temperature	CTUIR UAFHP	Geomorphic-hyporheic Flow Study on Meacham Creek	Action Effectiveness
Meacham Creek Restoration 2.4 to 8.5	Habitat, Flow, Water Temperature	CTUIR UAFHP	Macroinvertebrate Study for Evaluating Meacham Creek Restoration Effectiveness	Action Effectiveness
Meacham Creek Watershed RM 2.0	Habitat, Flow, Water Temperature	CTUIR UAFHP	Meacham Creek Water Quality ISCO Sampling and Analysis	Project Implementation Compliance
Meacham Creek Restoration 5.0 to 8.5	Habitat, Flow, Water Temperature	CTUIR UAFHP	Photo Point Monitoring	Project Implementation Compliance
Meacham Creek Restoration RM 2.0	Habitat, Flow, Water Temperature	CTUIR UAFHP	Meacham Flow/Hydrology Monitoring (USGS)	Project Feasibility and Development

Action Effectiveness Monitoring

Meacham Creek Geomorphic-Hyporheic Flow Study

Protocol: Meacham Creek Geomorphic-Hyporheic Flow Study (URL Citation: http://www.monitoringmethods.org/Protocol/Details/677).

Introduction

CTUIR recently completed a large scale restoration project on Meacham Creek (2011 Phase I, RM 6-7.1 & 2013 Phase II, RM 6-8.5) that included, but is not limited to, channel realignment (re-meandering), reconstruction, addition of large woody debris and flood plain reconnection (Tetra Tech 2012 and Tetra Tech 2014b). These projects have many goals, one of which is to enhance hyporheic exchange and create thermal refugia for rearing salmonid juveniles during summer low flow periods.

The Meacham Creek Geomorphic-Hyporheic Flow Study combines a variety of field and numerical modeling techniques to create a complete picture of the residence time distribution for hyporheic water at the restoration site for both pre- and post- restoration conditions and will document the effects of channel re-alignment (restoration) on hyporheic exchange (rates, magnitude, and volume), hyporheic flow path lengths, residence time, and ultimately, channel temperature. The groundwater and surface water monitoring study was designed to meet the following three objectives:

1. Quantify the groundwater rate and magnitude of surface water - groundwater exchange and groundwater residence time both prior to and after restoration actions to assess changes in recharge and discharge between Meacham Creek and its alluvial aquifer (hyporheic exchange).
2. Establish a monitoring network of stream temperature loggers and water level loggers to measure changes in the surface and subsurface water elevation and temperature due to restoration actions.
3. Pilot a new method of stream restoration monitoring that will have broad utility to other restoration efforts in the region.

This work is a component of a regional strategy for salmon habitat recovery by the CTUIR. More specifically, the Meacham Creek Restoration Project and this monitoring plan are components of a focused evaluation of limiting factor response (e.g. temperature) to salmon habitat recovery efforts. Since Meacham Creek historically provided a substantial component of salmon production in the Umatilla Subbasin it is an ideal recovery and research target.

The monitoring project was designed to track water temperature in the groundwater and surface water prior and subsequent to the restoration project. Furthermore, developing the theory underlying temperature dynamics in porous alluvial aquifers will in turn allow updating numerical models designed to predict the effects of channel restoration in Meacham Creek specifically, and in regional recovery efforts generally.

This monitoring and associated research will be shared with both the natural resource management and scientific communities via peer-reviewed publications. The work should make a substantial contribution to ongoing research about the interactions of groundwater and surface water and important water quality parameters such as temperature. In addition, refined monitoring methods will be developed for use by the CTUIR and other resource management agencies as they seek to evaluate the effect of their projects on groundwater and surface water temperatures. Finally, this work would serve as a model for partnership between academia and managers in developing research-based monitoring strategies that facilitate learning and thus adaptive identification of effective structural and process-based restoration strategies for reestablishing vertical connectivity (Ward 1989, Stanford and Ward 1993) by restoring hyporheic hydrology in river ecosystems.

Instrument deployment

The specific opportunity addressed by this project was to continue post-project monitoring of the effectiveness of the restoration project on surface and groundwater temperature and hydrology. A main feature of the monitoring work was installation of groundwater wells with recording level and temperature loggers deployed in them and deployment of surface water temperature loggers to document hydrological and water temperature at the restoration site before and after the restoration project (Figure 18).

During the spring and summer of 2011 and 2012, a series of 32 monitoring wells were established prior to and during stream restoration activities. In each well a water temperature and level data logger was deployed (Onset HOBO U20 Water Level Data Logger model U20-001-01 [pressure accurate to 0.05% and temperature to 0.1 °C] or Solinst Model 3001 Levelogger Junior Edge [pressure accurate to 0.1% and temperature to 0.1 °C]). Twenty of the well loggers were deployed six weeks before the restoration project began, and another twelve were deployed just prior to diversion of flow to the new channel, and two were install in July 2012; 22 well loggers remain deployed, while the remainder were either accidentally broken during construction or were removed during construction or prior to the onset of seasonal high flows.

In 2011 about thirty temperature loggers have been deployed in surface water features along the restored stream channel prior to diversion of flow into it (Onset HOBO Pendant Temperature/Light Data Logger model 64K - UA-002-64 (accurate to 0.53 °C), or Maxim Dallas iButton model DS1922L (accurate to 0.5 °C) encased in waterproof resin (sold as iBcod by Alpha Mach, Inc.). In addition to those loggers deployed along the restored channel reach, approximately 20 more temperature loggers were deployed in the main channel above and below the project reach as well as in groundwater upwelling features near the channel and in the floodplain. The groundwater upwelling features include springs, flowing backwater areas, and spring brooks far-removed from the channel. In 2012, 54 surface water temperature loggers were deployed. Since 2013 about 30 temperature loggers have been deployed (Figure 18).

Database
The database was developed using the open source database software PostgreSQL (www.postgresql.org) because of its flexibility, dependability, and capability to handle spatial data objects. The data model was designed around a single table that contains all types of data (e.g. groundwater temperature, groundwater level, surface water temperature, etc.) where each measurement is distinguished both by data type as well as when the instrument that recorded it was deployed (a "deployment"). All other tables are linked through deployments and allow flexible updates and queries of the database.

Surface water temperature data through 2014 were added to a PostgreSQL database. All groundwater temperature and water level data through 2014 were added to a PostgreSQL database. Subsequent to data upload, any irregularities and errors revealed via QA/QC were corrected. An optional for a geospatial field for each measurement point has been added to the database, though not yet fully implemented. The addition of the spatial field allows straightforward extraction of spatially-referenced measurements for use in a GIS. By the end of 2014 there were 2.3 million quality-assured controlled/quality-controlled records in the database. These data are the sum of continuous hourly measurements in 22 wells, and about 30 surface water locations each summer since 2011. An example of a simple query to extract mean daily groundwater temperature measured in each well since the beginning of the project in March 2011 until mid-2014, shown in Figure 19.

Groundwater Temperature Dynamics
Some key features of groundwater temperature dynamics that we exploit for our work are depicted in Figure 20, which shows times series from a well with a relatively long flow path and a one with a shorter flow path. As water traverses the subsurface the temperature is dampened and the phase is lagged relative to surface water. The further parcel of water travels in the subsurface, the more its temperature is dampened and lagged. The important point is that the degree of temperature dampening and lagging are proportional to aquifer properties including hydraulic conductivity, thermal conductivity, and mechanical dispersivity.

Recent research has developed inverses methods utilizing diurnal temperature signals to estimate values for these properties over small segments of a streambed (e.g. ~1m3). Our work specifically extends this recent research to exploit annual temperature signals at the scale of the aquifer (e.g. 1000m3).

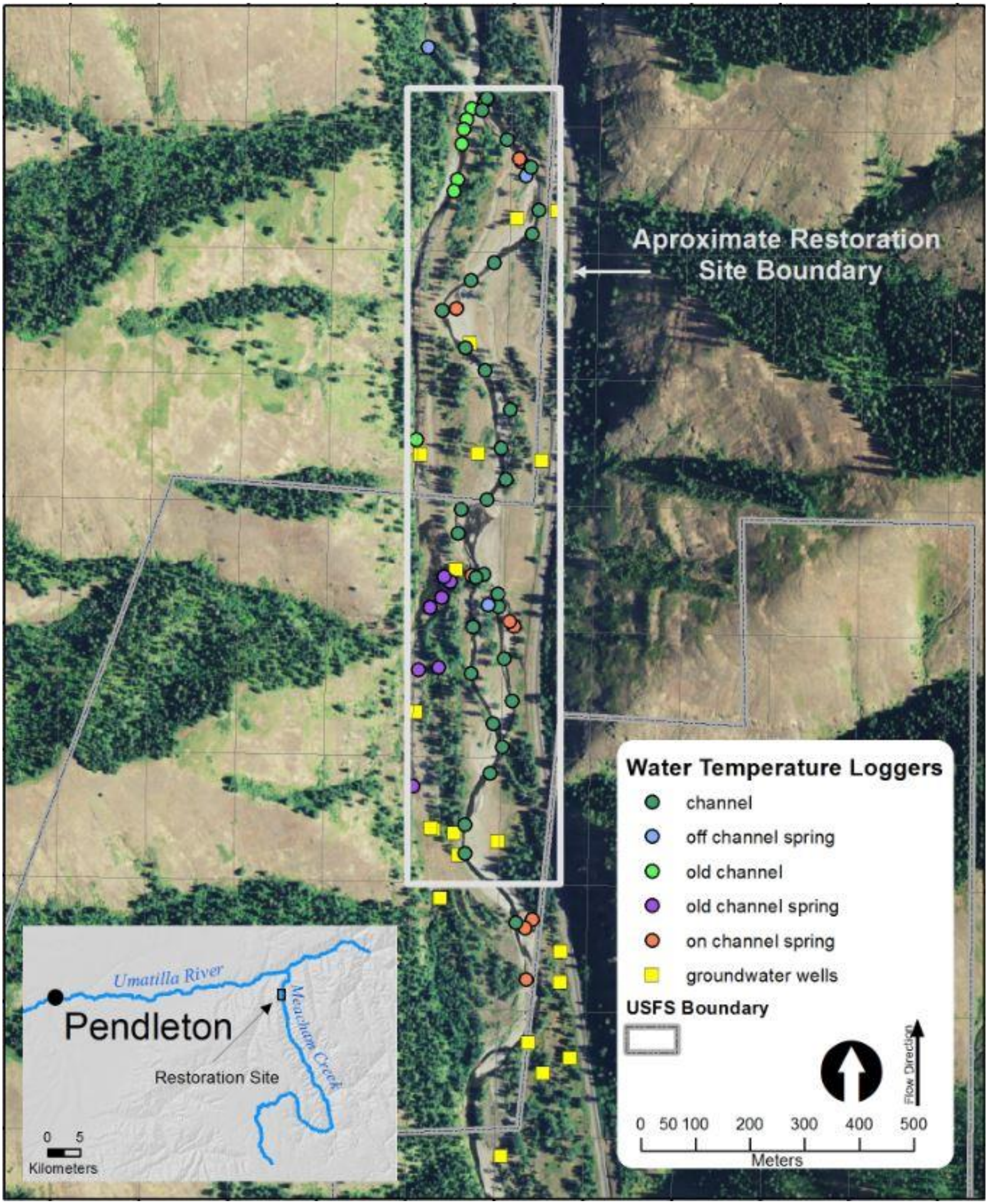


Figure 18. Meacham Creek restoration site map depicting groundwater wells and surface water temperature logger locations and water types.

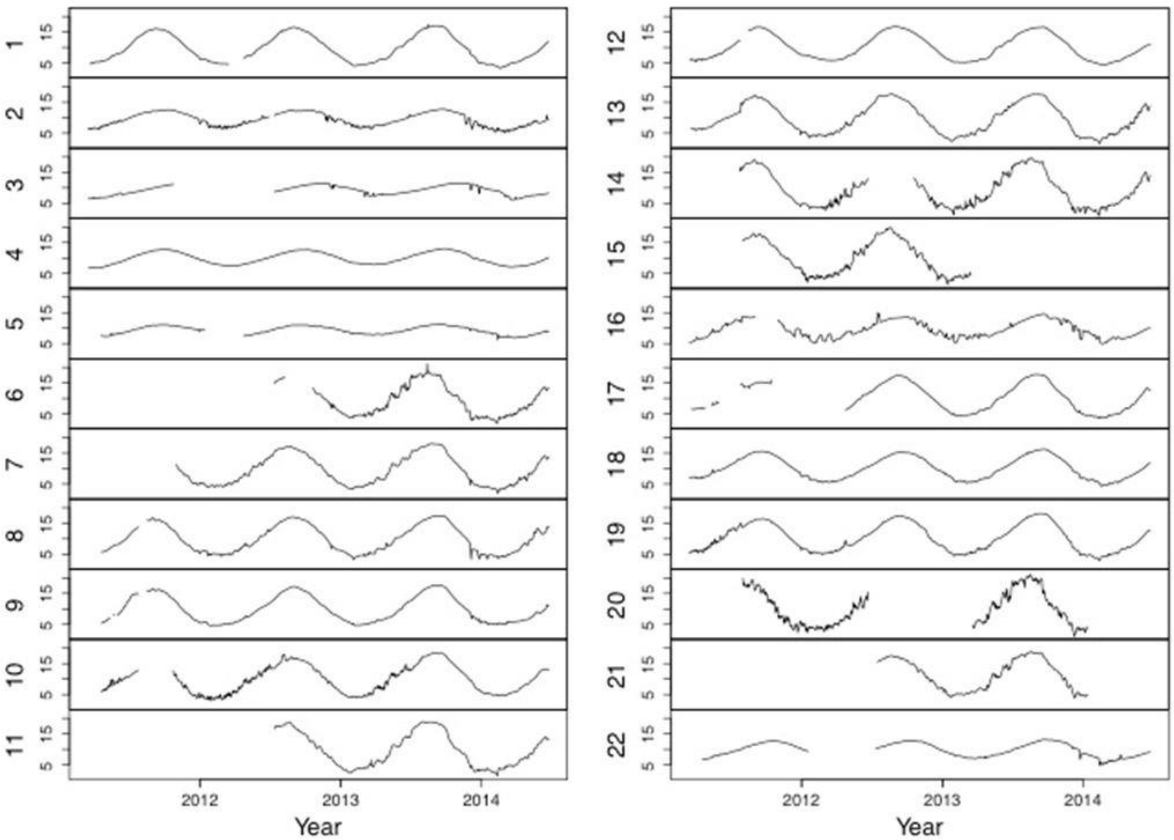


Figure 19. Plots of groundwater temperature in each of the 22 wells installed at the Meacham Creek Restoration Project site. Temperatures are plotted in degrees Celsius.

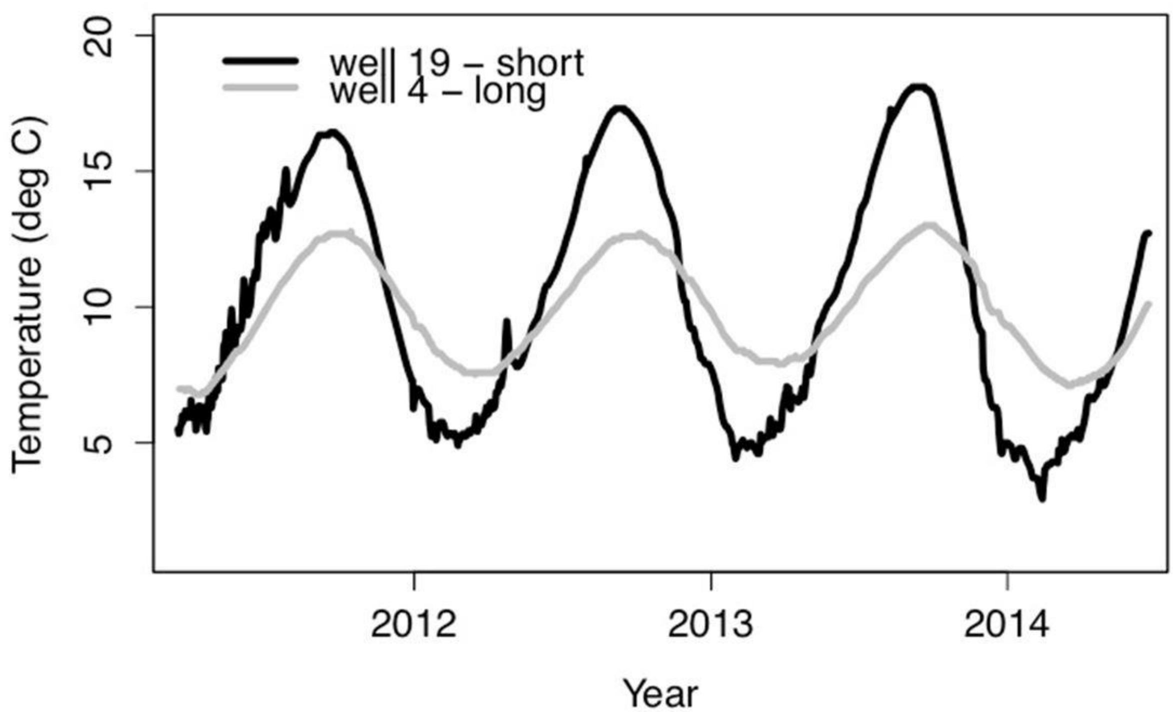


Figure 20. Groundwater temperature profiles in two wells at the Meacham Creek restoration site.

This updated approach allows estimation of aquifer properties, which are important inputs into groundwater flow and temperature models. Importantly, this approach relies on temperature signals alone to generate the estimates. Since temperature is easy and inexpensive to measure this approach may be useful for routine pre-project design alternative evaluation, post-project monitoring, and environmental modeling.

Groundwater Modeling Methods and Preliminary Model Analysis

In late 2010 and early 2011, groundwater hydrology of the baseline and restored channel alluvial aquifers was modeled using the USGS groundwater modeling software MODFLOW (Harbaugh, 2005), where the main input into the aquifer was the water surface elevation of the creek plan form. Surface water elevation was derived from first-return LiDAR for the baseline condition, and under the restored condition it was based on "filling" the design channel pools and the riffle ground elevations. In either case, aquifer thickness was assumed to be 5 m in the valley center, tapering to .5 m at the valley wall using the LiDAR terrain model as the surface. Once the potentiometric flow surface was developed, subsurface flow path lines through the potentiometric flow field were generated by releasing "particles" along the creek using the USGS solute modeling software MODPATH (Pollock, 1994)

The groundwater modeling results predicted that there would be a substantial shift in groundwater surface elevation, as well as in the pattern and magnitude of exchange between groundwater and surface water in the project reach. Based on these initial hydrologic simulations of the site (Figure 21), it is predicted that the residence time distribution of hyporheic water will shift to include a higher number of intermediate duration hyporheic flow paths, but that the magnitude of gross hyporheic exchange may either increase or decrease, depending on the change in hydraulic conductivity (Figure 22).

Preliminary Results

Here we present some preliminary results from our work. Figure 21 and Figure 22 show a comparison of the distribution of modeled subsurface flow paths prior to and after the restoration project was implemented. Comparison of the plots of subsurface flow paths along with frequency distributions of modeled flow path lengths predicts that the pattern of subsurface flow should shift after restoration.

The pre-restoration channel was deeply incised into the aquifer and much of the creek flowed over bedrock (e.g. the aquifer boundary) or a very shallow veneer of sediment. After the restoration, the aquifer depth increased by a bit more than a meter because the restored channel was moved up onto the floodplain where the creek could recharge the aquifer. The abrupt increase in water level occurred soon after the restoration channel was re-watered in late July 2011.

Observations over 25 groundwater upwelling features along the restored channel demonstrated that there has been a shift in groundwater hydrology at the restoration site (Figure 23). These features include a range of types from strongly flowing springs to seeps along the downstream margin of point bars marked by filamentous algae growing in these nutrient-enriched outflows. In addition, observations of groundwater flow into the exposed portions of the baseline channel and in other areas throughout the floodplain suggest substantial changes in groundwater hydrology (Figure 24). It is expected that there has been concomitant changes in the thermal processes of the aquifer as well. Cursory exploration of level logger confirms these observations.

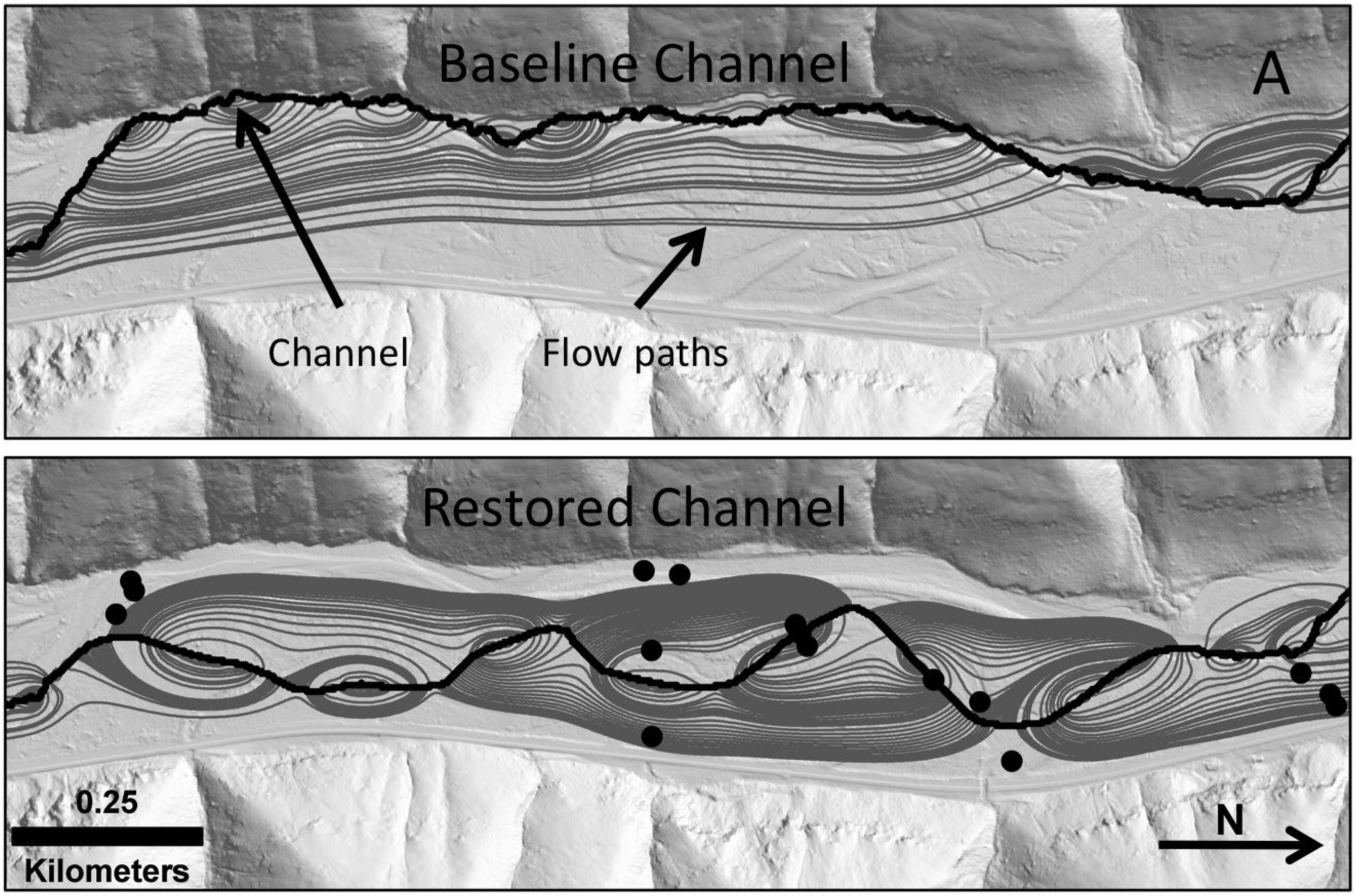


Figure 21. Results from MODFLOW simulation showing expected influence of restoration on hyporheic flow paths (grey lines) on the Meacham Cr. restoration site. Dots show locations of installed monitoring wells in the project site area.

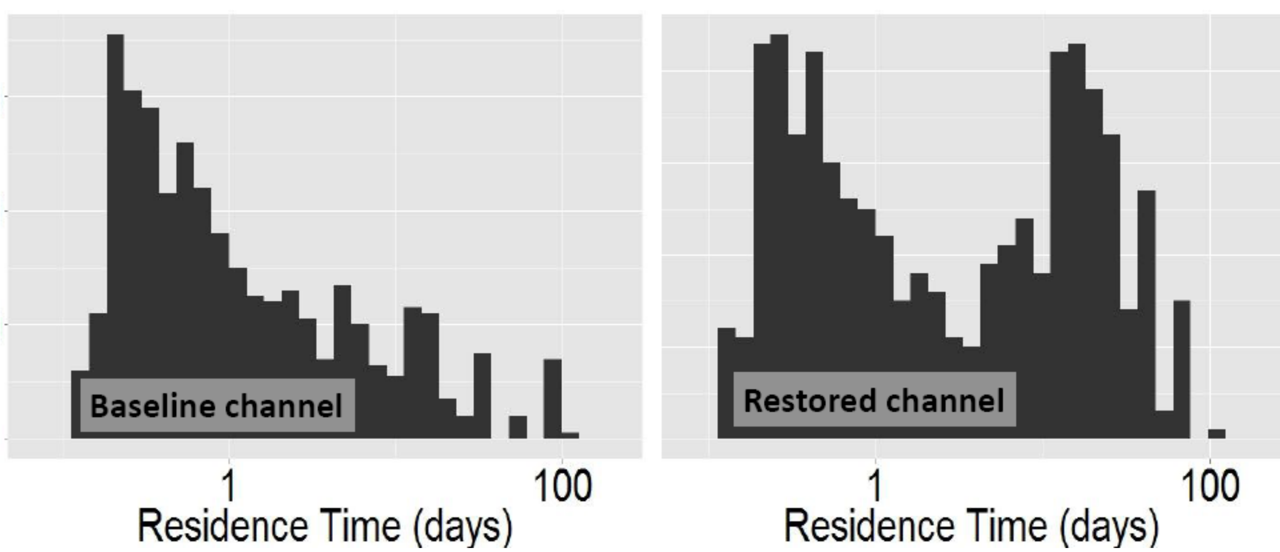


Figure 22. Simulated hyporheic flow-path residence time distributions based on MODFLOW groundwater models depicted in Figure .

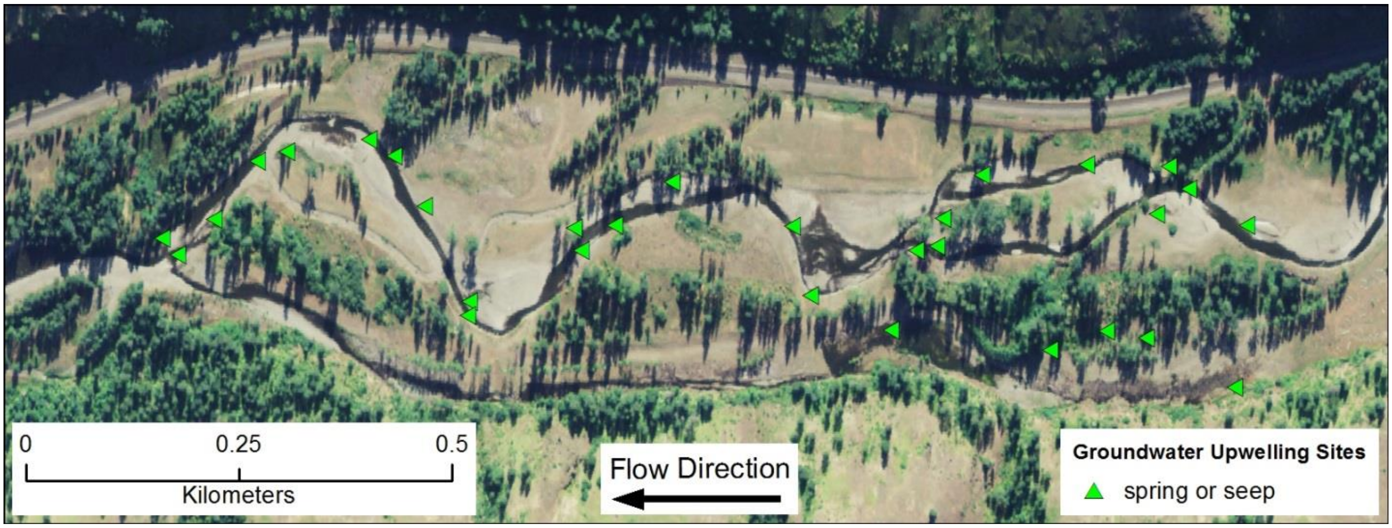


Figure 23. The location of easily observed groundwater upwelling features along the restored reach of Meacham Creek observed in summer 2012.

Figure 24. An actively flowing groundwater spring and seep (note filimentaous algae growing in nutrient-rich outflow) along the restored reach of Meacham Creek in summer 2012.

Our hypothesis can be summed up this way: the change in groundwater-surface water exchange as shown by the change in subsurface flow path distribution, and an increase in the cross-sectional area of the aquifer, both due to restoration, should lead to a change in the energy balance in the restored reach of Meacham Creek. Below we present some preliminary results that address this hypothesis.

Possible changes in mean upwelling temperature related to changes in flow path distribution are related to a potential increase in mean residence time. Longer mean residence time would equate with more buffering and lagging. Our preliminary results show that there is only a modest increase in buffering and lagging; basically mean upwelling temperature is essentially the same based on modeled flow path length distributions (Figure 25).

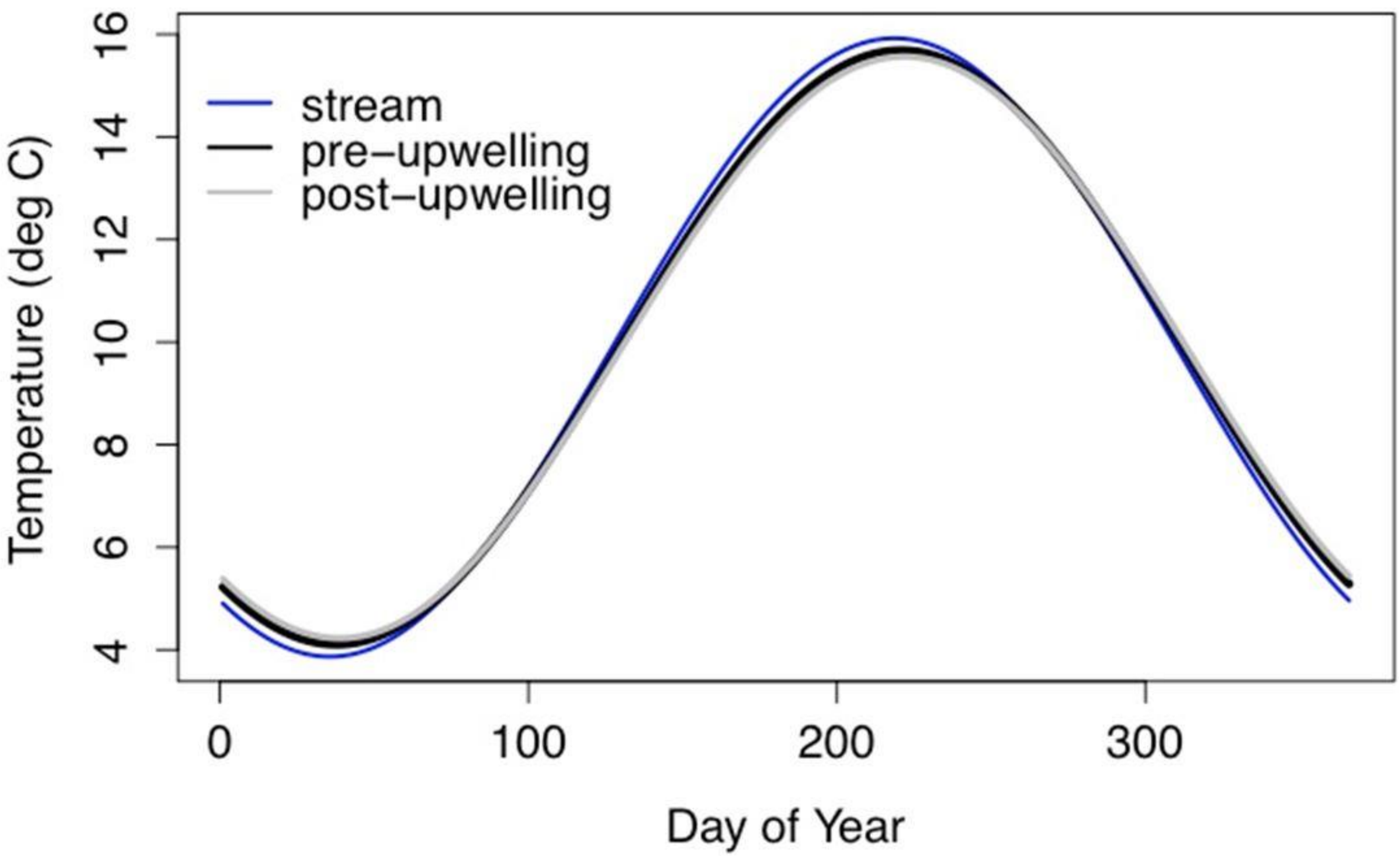


Figure 25. Modeled Meacham Creek surface water temperature (based on mean, amplitude, and phase fitted to 2012 annual stream temperature data) plotted in blue, along with predicted mean upwelling temperature under pre-restoration conditions in black, and mean upwelling temperature under post-restoration conditions in gray.

However, the total energy exchanged between the surface water and groundwater may have increased by as much as 2.4 times during midsummer (Figure 26). This is due to the increase in cross sectional area of the aquifer due the increase in aquifer depth post-restoration. Since discharge in the reach is similar pre-and-post-restoration, but the aquifer volume has increased, the by conservation of mass (e.g. continuity of flow: Q = AV, where Q is discharge, V is volume, and A is area), a greater volume of water must exchange between the stream and the aquifer (e.g. gross hyporheic exchange). The implication is that while the mean temperature of the upwelling water is the same, gross hyporheic exchange must increase if we assume all water in the reach exchanges with the aquifer, and hence could indicate net cooling of the surface water flow downstream of the restoration reach because a greater volume of relatively cool hyporheic water is upwelling.

We should emphasize that this is a preliminary prediction of the effect of the restoration project and hinges on the assumption that all water in the river exchanges with the complete volume of the aquifer in the reach. The approach as it stands is best conceived of as an index of energy exchange due to the change in the hyporheic exchange volume (e.g. the volume of the aquifer that actively exchanges with the river), here conceived of as the entire aquifer volume. If we make estimates of hyporheic exchange volume based on cross sectional areas that are 20%, 50%, and 80% of the aquifer cross sectional area for the sake of comparison, we can get a sense of the volume of hyporheic exchange and the energy exchange due to the increase in aquifer depth due to restoration. For this example estimated hyporheic exchange ranges from 7.1 to 10.5 m^3/s (Table 10).

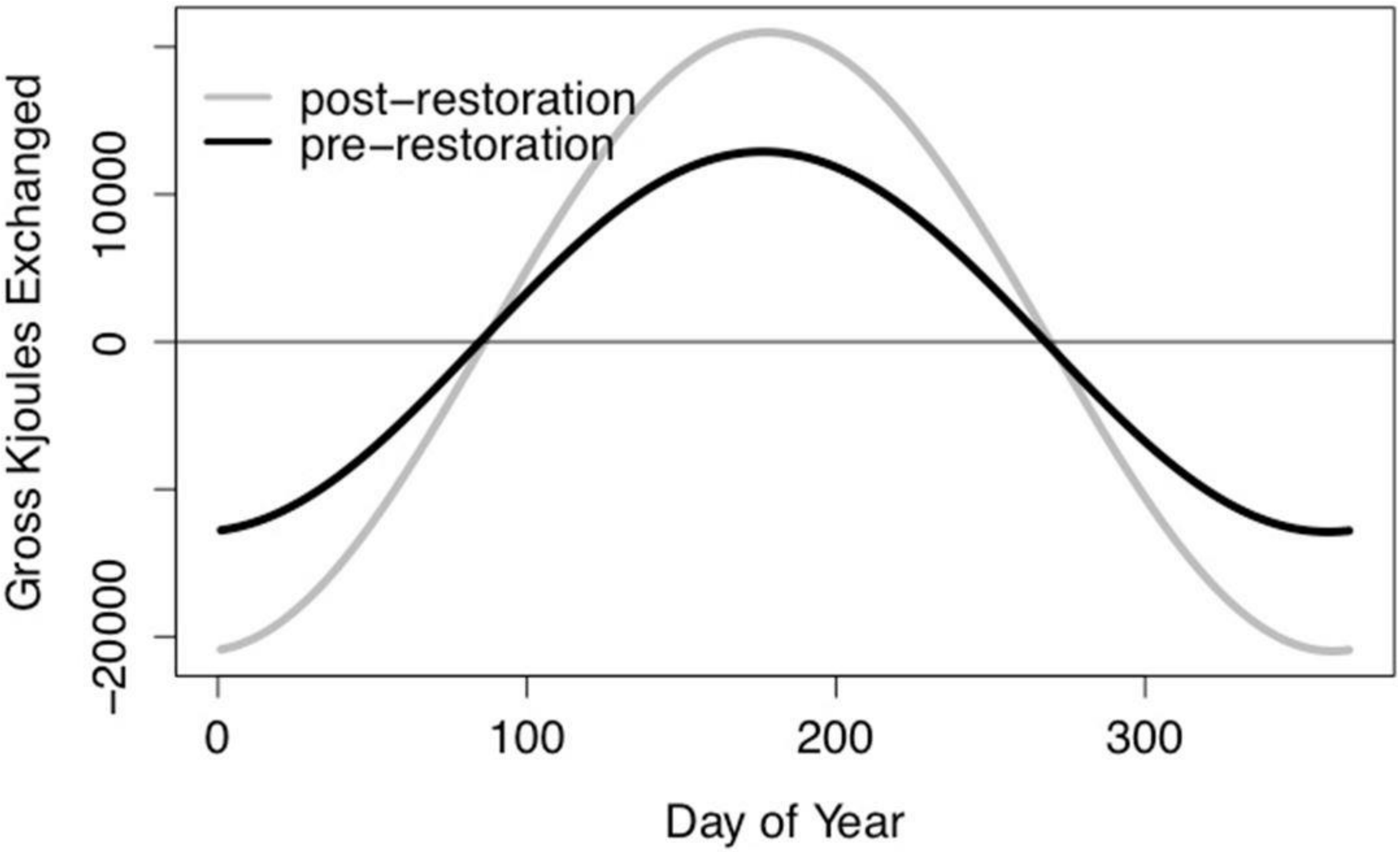


Figure 26. Gross Kilojoules exchanged for each day of the year under pre-restoration (black) and post-restoration (gray) conditions in Meacham Creek.

Table 10. Modeled gross hyporheic exchange and maximum gross energy exchanged in Meacham Creek under different hyporheic exchange cross sectional areas (as a percent of aquifer cross sectional area).

Hyporheic Exchange Area (m^2)	Gross Hyporheic Exchange (m^3/s)	Max Gross Energy Exchanged (KJ)
100%: 600	10.5	20984.2
80%: 552	9.6	19305.5
50%: 480	8.4	16787.4
20%: 408	7.1	14269.3

The above example highlights the next steps in the research, namely what is the cross sectional area of the hyporheic exchange in the restoration reach, is there a measureable increase in the volume of gross hyporheic exchange, and can we detect a temperature change in surface water of the restoration site due to increased hyporheic exchange?

Lessons Learned

Inclusion of realistic estimates of mechanical dispersion in numerical models (e.g. USGS MODFLOW and MT3DMS) is paramount to generating realistic predictions of water temperature dynamics in porous alluvial aquifers.

Measurements of annual groundwater signals appear to offer a relatively simple and inexpensive method for making estimates of key aquifer properties including hydraulic conductivity and mechanical dispersion, which are in turn useful for both hydraulic and temperature modeling restoration effects.

Our preliminary results suggest that mean upwelling water temperature is essentially unchanged post-restoration, but that gross hyporheic exchange has increased due to an increase in cross-sectional area of the aquifer. Therefore, raising the water table may be a possible approach to increasing hyporheic exchange in future restoration projects.

Aquifer tests performed in porous alluvial aquifers need to utilize piezometers (e.g. well casing open only at the bottom end) rather than perforated well casings. In low conductivity aquifers this is a feasible approach because the mound of water that rises in the well dissipates relatively slowly and can be easily measured, which in turn can be used to make reasonable estimates of hydraulic conductivity. In contrast, in Meacham Creek the hydraulic conductivity is extremely high. Hence, the water level mounding as the slug is dropped is near instantaneous and measurements do not reliably record its dissipation. However, our approach to using annual temperature signals to make inverse estimates of aquifer properties allows estimation of hydraulic conductivity, among several other important aquifer properties.

<u>Macroinvertebrate Study</u>

Abstract

Macroinvertebrate assemblage structure is being used as a tool for the bio-assessment of the effectiveness of the 2011-2013 constructed Meacham Creek Floodplain Restoration and In-stream Enhancement Project (RM 6-7.1; Phase I) restoration and future Meacham Creek Bonifer Reach Project (RM 1.9-5.7) [Figure 13]. Macroinvertebrates have been sampled annually at six sites in Meacham Creek since 2005. In addition, in 2007 sites were sampled on the North Fork Umatilla River that serves as a relatively pristine reference site. Five macroinvertebrate metrics are being used to describe the condition of the stream reaches being sampled. The Meacham Creek sites and sampling follow a BACI (Before-After-Control-Impact) design with sites found both within (Impact) and outside (Control) of the restoration project area and sampling occurring both before and after restoration at all sites. All pre-restoration project sampling has been analyzed and a couple years of post-restoration analysis from the Meacham Phase I Project. The prediction for differences in macroinvertebrate metrics between impact and control sites before restoration is that the sites will not differ in either mean metric values or in trajectories of change through time. As predicted no significant differences were found between control and impact sites during the before restoration period in mean metric values. In addition, none of the metrics showed any significant linear changes through time for the before restoration period at either the impact or control sites. These results indicate that the BACI design is a robust design for examining the effectiveness of the Meacham Creek Phase I restoration. Macroinvertebrate samples were collected in both 2013 and 2014 and have been processed. Plans are being drawn up to continue sampling at the same six sites on Meacham Creek in the future allowing for post-restoration comparisons to be made. Information provided in this report is from an ongoing study with the Oregon State University Extension Office and was provided in a draft technical memorandum prepared for CTUIR (Wooster and DeBano 2015).

Intent of Research
The intent of the macroinvertebrate research is to assess the effectiveness of the Meacham Creek Phase I and Meacham Creek Bonifer Reach (RM 1.9-5.7) projects restoration efforts administered by the CTUIR.

Macroinvertebrate assemblage structure can be used as an indicator of stream reach quality and is a useful tool for assessing the effectiveness of restoration projects (Miller et al. 210). In 2005 an agreement was reached between CTUIR and Oregon State University (OSU) to begin an assessment of the condition of Meacham Creek in the Phase I project area. Two types of sites and two periods of sampling were outlined at this time. The site types include three sites within the Phase I project area (i.e., "impact" sites) and three sites outside of the project area that are subject to standard management practices in the Meacham Creek drainage (i.e., "control" sites). The two time periods of sampling were before Phase I restoration commenced (from 2005 to 2010) and after restoration (from 2011 to completion). On further consideration with CTUIR a third type of site ("reference" sites; sites that are in relatively pristine conditions) was added to the sampling program in 2007. These sites are located in the Umatilla Subbasin on the North Fork Umatilla River.

This sampling program follows a Before-After-Control-Impact (BACI) design which provides a powerful means of inference in regards to the impact of land management and other human activities on ecosystems (Downes et al. 2002). The addition of the reference sites on the North Fork Umatilla provides an important comparison of the condition of Meacham Creek (both pre- and post-restoration) relative to the condition of a nearly pristine stream in the Umatilla Subbasin. In addition, sampling in the North Fork Umatilla allows an examination of the temporal variability of macroinvertebrate assemblages in the absence of extensive human impacts as well as allowing for a tracking of any directional change through time resulting from climatic cycles (e.g., ENSO) and climate change.

Macroinvertebrate Site Locations
A total of seven sites were sampled, six on Meacham Creek that spanned the restoration project and one site on the North Fork of the Umatilla River that serves as a reference site. Sampled sites on Meacham Creek included two sites below the restoration project (MCRM6-1 and MCRM6-2) and one site above the restoration project (MCRM6-7). These sites serve as restoration controls (i.e., they are non-restored reaches of Meacham Creek). Three sites were also sampled within the restored reach of Meacham Creek (MCRM6-3, MCRM6-4, MCRM6-5). These three sites had been inundated with surface water in 2011. Site names and coordinate locations are shown in Table 11 and Figure 27 illustrates site locations.

Methods
Macroinvertebrates were sampled in the field following modified EPA EMAP protocols for targeted riffle sampling (Peck et al. 2006). Study reaches were defined as 100m long stretches of stream with the downstream end at the GPS location. Eight sampling locations were randomly located in riffle habitat at each study reach. Macroinvertebrates were collected at each of these locations by placing a D-frame net (500 μm mesh) firmly against the substrate and scrubbing by hand all cobble and larger sized rocks in an $0.09m^2$ area just upstream of the net. After these rocks had been scrubbed and set aside the same area was agitated by foot for 30 seconds. Each of the 8 samples was composited in the field into a single large sample for each study site and preserved in 90% ethanol. In the laboratory samples were spread over a 30x20 cm Caton sorting tray and subsamples representing 3% of the area of the tray were randomly taken. Invertebrates were picked from subsamples until at least 500 organisms had been counted from the subsamples. These invertebrates were identified to genus (for most insects) and order or family (for most non-insect invertebrates) using published keys (Merritt et al. 2008; Thorp and Covich 2010, Wiggins 2000).

Metrics: Five macroinvertebrate metrics are being used to characterize the condition of Meacham Creek at each of the study site locations. These metrics are all expected to change in response to the Phase I restoration. One metric in particular, Inferred Temperature, is relevant to one of the major goals of the Phase I restoration which is reduction in stream temperature. The metrics and their calculations are:

1) Assemblage Tolerance Index (ATI). This metric was developed by the US Environmental Protection Agency using macroinvertebrate and human disturbance data from the US EPA EMAP survey of over 1100 sites in the western US (Whittier and Van Sickle 2010). To develop this metric tolerance values were assigned to individual macroinvertebrate taxa by relating their abundance to a synthetic human disturbance index. The human disturbance index was based upon nine variables from three general classes related to the lotic environment – water quality, physical habitat at the sample reach, and human activity in the sampled watershed above the sample reach (Whittier and Van Sickle 2010). The ATI is an average tolerance value for the macroinvertebrate assemblage at a study site weighted by the relative abundance of each taxon:

$ATI = \Sigma(TV_i \times RA_i)$, where TV_i is the tolerance value of taxon "i" and RA_i is its relative abundance within the assemblage.

Table 11. Study site names, GPS locations and 2011 sampling dates for Meacham Creek (MC) and North Fork (NF) sites.

Study Site Name	Study Site Name for 2007-2010 sampling periods	Location	Sampling Date
MCRM6-1	MC1	-118° 21' 44.65" 45° 39' 20.22"	9/27/11
MCRM6-2	MC2	-118° 21' 25.11" 45° 38' 21.77"	9/28/11
MCRM6-3	MC3	-118° 21' 23.66" 45° 38' 15.36"	9/27/11
MCRM6-4	MC4	-118° 21' 22.01" 45° 37' 43.30"	9/27/11
MCRM6-5	MC5	-118° 21' 23.71" 45° 37' 35.38"	9/28/11
MCRM6-7	MC7	-118º 21' 16.28" 45º 37' 1.10"	9/29/11
NF-1	NF1	-118º 10' 42.50" 45º 43' 35.70"	9/26/11

Tolerance values for taxa are scaled from 0 to 10 with sensitive taxa having low tolerance values and tolerant taxa having high tolerance values. With improvement of conditions within a restored reach the ATI score is expected to decrease (as the relative abundance of sensitive taxa increases).

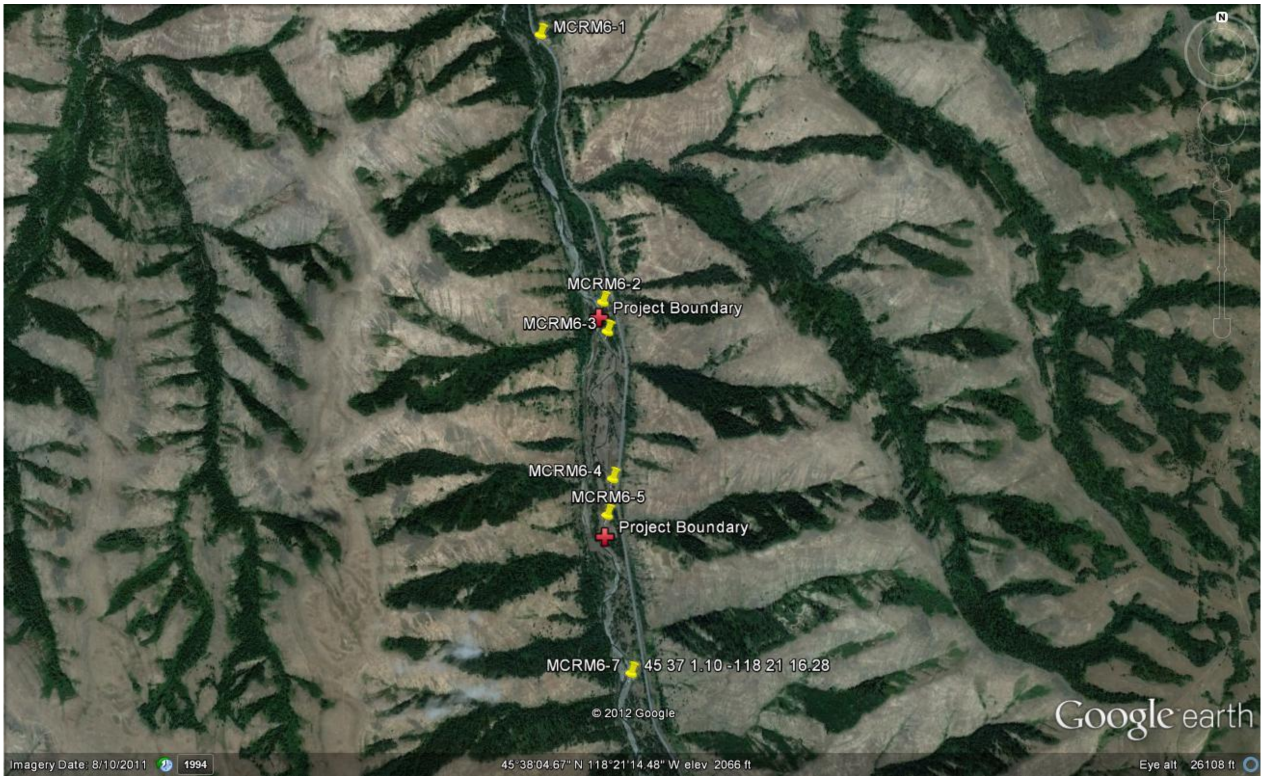


Figure 27. Digital image of the six macroinvertebrate sites on Meacham Creek sampled in 2011. The yellow tabs indicate the sampling sites and the red crosses indicate the project boundaries. Image from Google Earth©.

2) Inferred Temperature. This metric was developed by the Oregon Department of Environmental Quality using macroinvertebrate and temperature data from 328 sites throughout Oregon (Huff et al. 2006). This metric was developed and is calculated in a similar fashion as the ATI. From the 328 sites, invertebrate taxa were assigned an optimal temperature based upon their abundance and the average of the daily maximum water temperature for the warmest 7-day period. The inferred temperature metric is calculated as:

Inferred Temperature = $\Sigma(TempOpt_i \times RA_i)$, where $TempOpt_i$ is the temperature optima for taxon "i" and RA_i is its relative abundance.

Summing these values across all taxa within an assemblage provides an "inferred temperature," which is the water temperature estimated based upon a site's assemblage composition. Huff et al. (2006) found a good fit between inferred temperatures and actual water temperatures (measured using dataloggers) for the Oregon data set. However, they found that in relatively warm systems, macroinvertebrate assemblages tended to underestimate actual maximum water temperatures and in cold systems macroinvertebrates tended to overestimate maximum water temperatures. In his bio-assessment of a restoration project in the Grande Ronde watershed that involved channel reconstruction, Whitney (2007) found this metric to be responsive to the restoration efforts. Given that temperature reduction is one of the major goals of the Phase I Meacham Creek restoration, this metric is particularly relevant to our bio-assessment.

3) Assemblage Diversity. Assemblage diversity is a function of both taxa richness and the relative abundance of each taxon. Shannon diversity (H') is the specific diversity metric calculated for the Meacham Creek macroinvertebrate data:

$H' = -\Sigma p_i \log_e p_i$, where p_i is the relative abundance of species "i".

Diversity is predicted to increase with increasing habitat quality (Karr and Chu 1999).

4) Taxa Richness. This is a simple count of the number of taxa found in the macroinvertebrate assemblage at each reach. Taxa richness is predicted to increase with increasing environmental quality (Karr and Chu 1999; Whitney 2007).

5) Mayfly-Stonefly-Caddisfly (Ephemeroptera-Plecoptera-Trichoptera, EPT) Taxa Richness. This metric is a count of the number of taxa found within these three orders of aquatic insects. Taxa within these three groups are generally sensitive to a variety of human impacts, and thus their taxa richness is predicted to increase with increasing stream habitat quality (Karr and Chu 1999).

Analytical Approach: The macroinvertebrate sampling design follows a Before-After-Control-Impact (BACI) design. Sites were located on Meacham Creek outside of the restoration project area (Controls) as well as within the project area (Impact sites) and both sampling before restoration and after restoration has occurred. While the North Fork Umatilla does not formally fit into the BACI design, sampling there provides additional information on trends in macroinvertebrate metrics through time in an area minimally disturbed by human activity.

Graphically, the expected results for the inferred temperature metric (as an example) follow the pattern shown in Figure 28. To test this graphical model, four regressions will be conducted on the data for each macroinvertebrate assemblage metric. The four regressions are: control before restoration, within project before restoration, control after restoration, and within project after restoration. For the time period after restoration, the regression analyses allowed a determination of whether restoration had the predicted effect on macroinvertebrate metrics. Significant regressions with a slope in the appropriate direction (negative for inferred temperature and ATI values and positive for taxa richness, EPT richness, and diversity) would indicate support for our prediction that restoration improves the conditions in Meacham Creek at river mile 6-7. However, it is possible that conditions could improve throughout the Meacham Creek basin over time (e.g., a short-lived cooling trend or increased levels of water) indicating that restoration is not necessarily having an impact. To determine whether conditions, in general, are changing an analysis of the control sites is necessary. Our prediction is that the macroinvertebrate metrics at these sites will not change (or change very little) through time. Therefore, regressions are conducted on these data as well. In addition, a comparison of the slopes of the regression lines for control and project sites allows a determination of whether project sites are changing as predicted and in a fashion different from control sites. In summary, our prediction that conditions have improved because of restoration is supported if the following occurs 1) a significant regression through time is found for the project sites, 2) the slope of that regression is in the predicted direction, and 3) the slope of the regression line for the project sites is significantly different from the slope of the regression line for the control sites.

Sampling was conducted in 2011 (the year that the main thrust of the restoration project took place, during this summer the wetted channel of Meacham Creek was moved into a historic channel with a relatively high level of sinuosity) approximately one month after the Meacham Creek channel was moved.

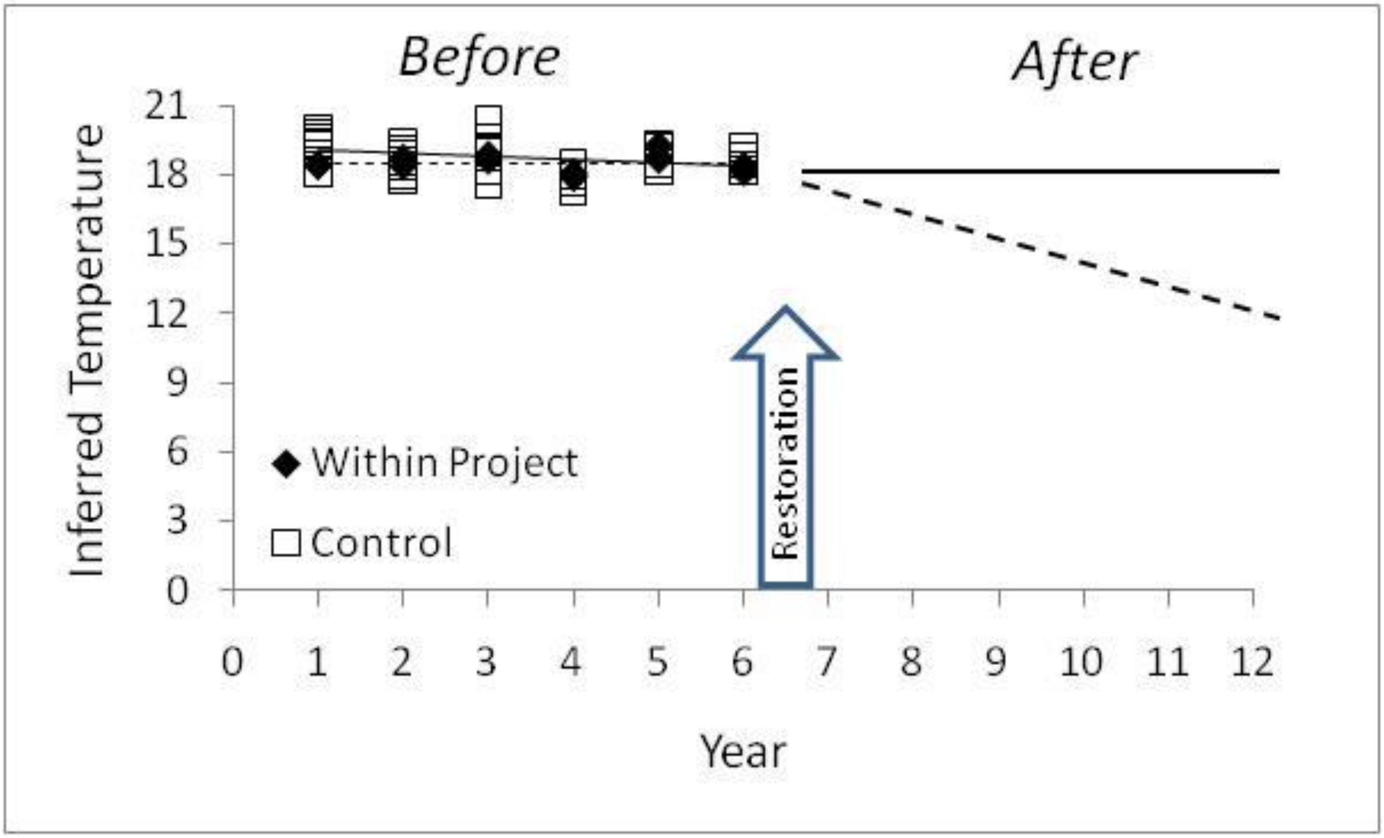


Figure 28. A graphical representation of the expected trajectories of the inferred temperature metric for within project (impact) sites and control sites both before and after restoration actions. Within project inferred temperatures are represented by filled diamonds and a dashed line and inferred temperatures at control sites are represented by open squares and a solid line. The predicted responses are that before restoration no change in inferred temperature will be observed for either the within project or control sites through time. However, after restoration the within project inferred temperatures will show a significant decline through time (as the macroinvertebrate community responds to the changing conditions) while the inferred temperatures at the control sites will continue to show no response through time.

However, these data were not used in the regression analyses. Sampling was conducted during this year to examine how rapidly macroinvertebrates would begin to colonize the new channel and the types of macroinvertebrates that were the rapid colonizers. One month does not represent enough time for anything but a small number of a few rapidly dispersing taxa to enter a new channel.

Regressions were conducted using a simple linear models (e.g., Inferred Temperature ~ Year + ε) and regression slopes were compared among project and control sites using an analysis of covariance. All analyses were conducted in the statistical program R (version 3.1.3; R Core Team 2012).

Results

Figure 29 shows the five macroinvertebrate metrics through the entire sampling period (2005 to 2014) with sites coded as "control" or "project."

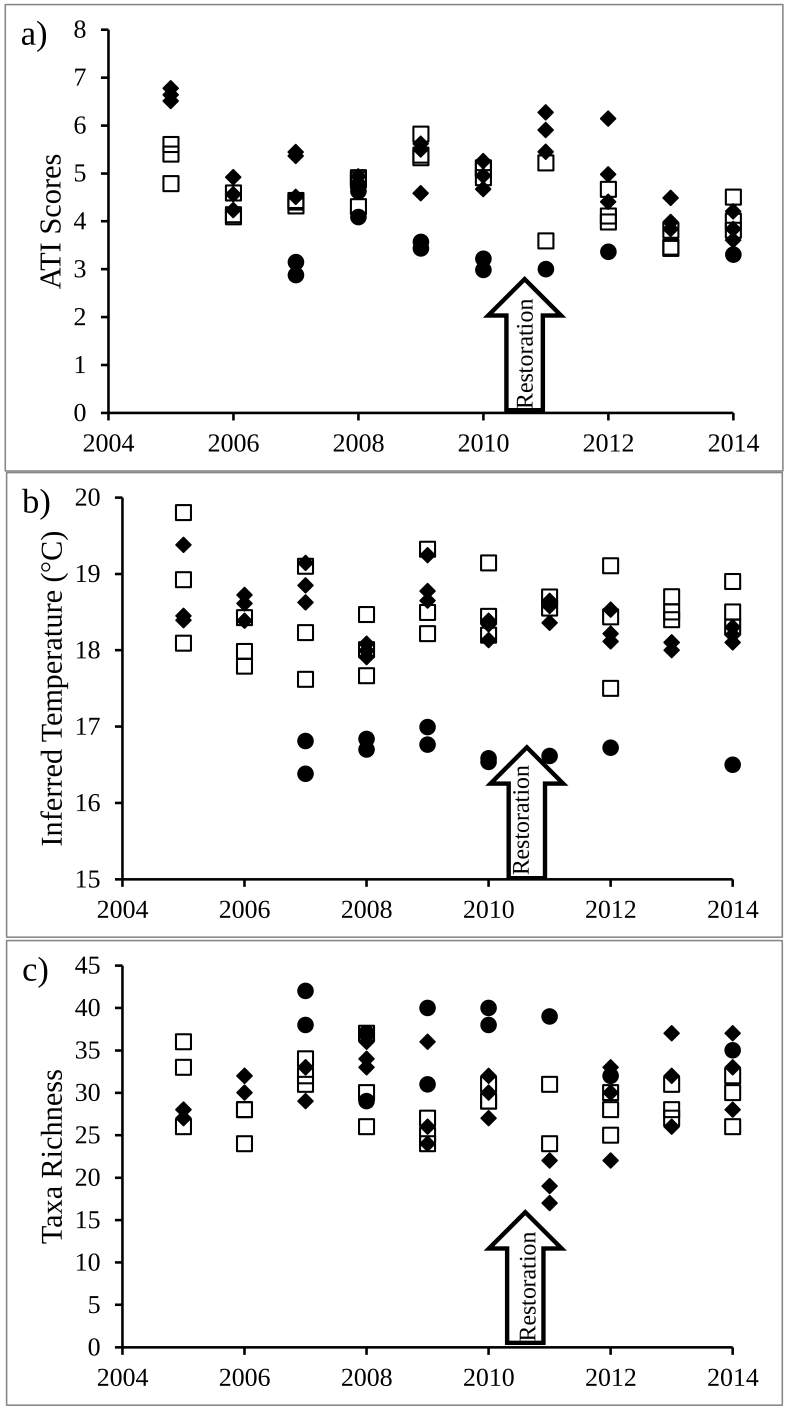


Figure 29. The five metrics illustrated across all years of sampling. The metrics are a) Assemblage Tolerance Index (ATI), b) inferred temperature, c) total taxa richness, d) Ephemeroptera-Plecoptera-Trichoptera (EPT) taxa richness, and e) Shannon diversity. Values for control sites (outside the restored reach) are open boxes; values for within-project (restored reach) sites are filled diamonds. In addition, the metric values for the North Fork Umatilla River are shown as filled circles.

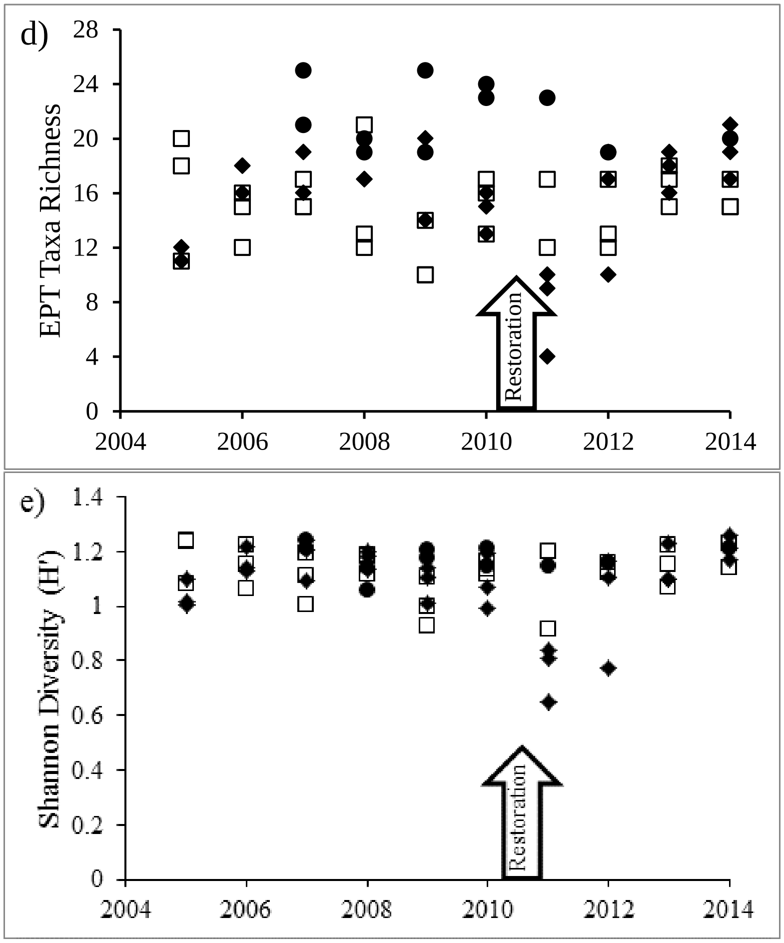


Figure 29. Continued.

No significant regressions were found for any of the five metrics for either control or project sites during the pre-restoration period. This indicates that over the six year period before restoration (2005 to 2010) Meacham Creek along the sampled reach was not increasing or decreasing in condition based upon the macroinvertebrate assemblage. During the post-restoration period (2012-2014) only a single metric showed a significant regression through time.

The assemblage tolerance index (ATI) significantly changed through time at the project sites. In addition, the slope of the regression line was negative suggesting an improvement in conditions at the project site through time. However, the slope of this regression line was not significantly different from the regression slope of the control sites. Therefore, we cannot confidently conclude at this time that the decrease in ATI values at the project sites was the result of the restoration activities.

Discussion

As of 2014 we are unable to detect any changes in the condition of Meacham Creek at the River Mile 6-7 restoration site that are significantly different from the control sites that encompass the restored area. However, declines in the ATI scores (indicating improved conditions) at the project sites after restoration are encouraging and suggestive of improvements in condition in the restored area. It can require years before restoration projects mature and have large impacts on their ecosystems. We propose to continue to sample these sites in, at least, the near future.

Project Feasibility and Development Monitoring

<u>Water Quality and Hydrological Analysis</u>

Water Quality – Meacham Creek

CTUIR cost share operates with the USFS an automated water sampler (ISCO) near the mouth of Meacham Creek (RM 2.0). Water samples are analyzed under subcontract at the USFS Water Quality Laboratory for turbidity, total suspended solids (TSS), total dissolved solids, and specific conductivity. Data is entered into the CTUIR water quality data base. About 800 samples are processed annually for Meacham Creek and 6,500 samples from other subbasin locations within the Umatilla River Subbasin by CTUIR. Analyzed water sample data is reported by the UBWC in a water quality annual report and referenced here (UBWC 2014).

Analyzed data can measure changes in suspended solids and turbidity from watershed activities, and is a good measure of water quality. Samples for turbidity, TSS, and specific conductivity will be collected and transported to the USFS Water Quality Laboratory for analysis. Sampling procedures and water quality analysis will conform to the stipulations included in the latest edition of EPA's Water Quality Criteria (1986) and *A Guide to the Sampling and Analysis of Water and Wastewater* (1987). All approved data is then uploaded to the CTUIR water quality data base semi-annually. Table 12 shows the annual median, average, maximum and 90th percentile of the total suspended solids concentration, conductivity, and turbidity for Meacham Creek. Figure 30 shows the number of three day events over which turbidity exceeded 30 nephelometric turbidity units (NTU's) for the four tributaries for water years 2001 through 2014. Figure 31 shows the number of three day events for the same streams for water years 2001 through 2014, but only for the June – September period. Meacham Creek is a low sediment input stream and not listed for turbidity, but this helps monitor for any significant changes in turbidity levels. Monitoring will continue to be used for evaluating habitat project effectiveness from long-term project ground disturbance. Major restoration actions were implemented in 2009, 2011, and 2013 on Meacham Creek with no observed elevated levels of turbidity.

Hydrological Analysis – Meacham Creek

The hydrological analysis for the Meacham Creek Floodplain Restoration and In-stream Enhancement Phase II Project RM 6-8.5 site were determined by evaluating the USGS average daily stream flow data (Tables 13, 14 & 15). The annual flood-frequency analysis for the gage data was performed using the USGS PeakFQ software package (USGS 2006), which follows the Bulletin 17B methods. Discharge estimates for the Meacham Creek Floodplain Restoration and In-stream Enhancement Phase II RM 6-8.5 Project area were reduced from the recorded flows and calculated statistics at the USGS stream gage by applying the gage transfer equation using the ratio of the applicable drainage areas (OWRD 2006). The results from the hydrological analysis were incorporated into a hydraulic model to evaluate the existing adequacy of the 100-year flood protection to the Union Pacific Railroad (UPRR). In addition, the hydraulic model is used to evaluate the potential risks to the UPRR and restoration action response associated with changes in geomorphic, hydrologic, hydraulic, and habitat characteristics of the stream from removing levees and spur dikes throughout the project area.

Table 12. Annual statistics for total suspended solids, conductivity, and turbidity for Meacham Creek for Water Year 2014.

Sample	Statistics			
	Average	Median	Maximum	90th Percentile
Total Suspended Solids, mg/l	13.6	3.8	988.7	15.8
Conductivity, umhos/cm	61.2	61.0	83.0	76.0
Turbidity, NTU	5.8	2.6	237.0	10.1

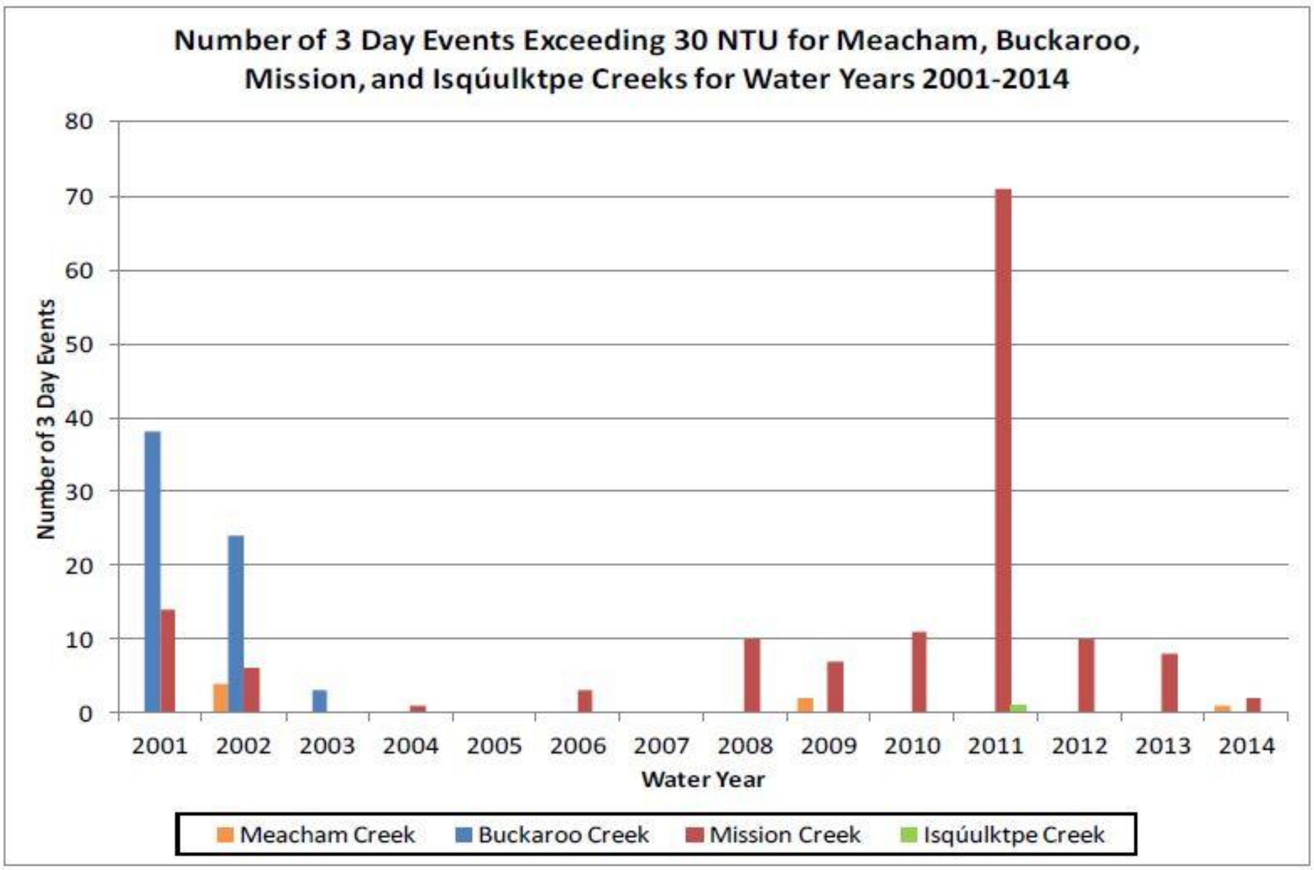


Figure 30. Number of 3-day events exceeding 30 NTU for Meacham, Iskúulktpe, Buckaroo, Mission creeks, water years 2001-2014.

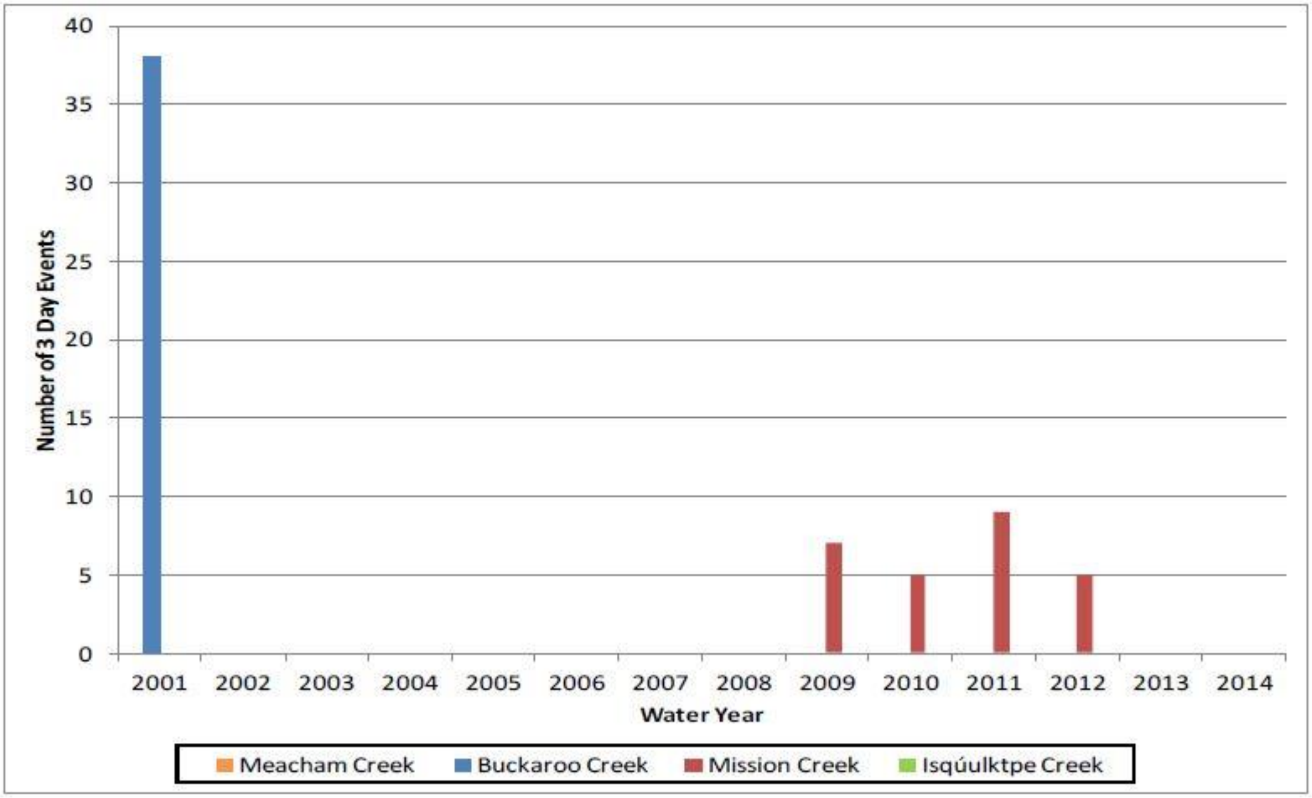


Figure 31. Number of 3-day events exceeding 30 NTU for Meacham, Iskúulktpe, Buckaroo, Mission creeks, for June through September, water years 2001-2014.

Characteristic flows represent the typical range of flows that can be expected in a stream or river during the hydrologic year. Characteristic flows, shown in Table 13, include average annual flow, seven-day average low flow, and one-day average flood flow.

Monthly flows represent the range of flows to be expected during each month of the year. These flows, shown in Table 14, include average monthly mean, minimum, and maximum flows. Flood flows represent the high flows that can be expected at different recurrence intervals. These flows, shown in Table 15, are instantaneous peak flood flows to be used in the Project design.

Table 13. Characteristic Flows for Meacham Creek at the Meacham Creek Floodplain Restoration and In-stream Enhancement Phase II RM 6-8.5 Project.

Average Annual Flow (cubic feet/second	197
Seven-Day Average Low Flow (cubic feet/second	8.8
One-Day Average Flood Flow 2 Year RI (cubic feet/second	2,230
Bankfull Flow 1.5 RI (cubic feet/second	1,761

Table 14. Monthly Flows for Meacham Creek at the Meacham Creek Floodplain Restoration and In-stream Enhancement Phase II RM 6-8.5 Project.

	Monthly Flow (cubic feet/second)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Mean	15	70	191	262	359	508	586	363	126	13	12	12
Minimum	8	11	18	22	27	134	228	58	22	12	7	7
Maximum	29	323	582	724	1,074	1,016	1,185	1,028	483	52	21	17

Table 15. Flood Flows for Meacham Creek at the Meacham Creek Floodplain Restoration and In-stream Enhancement Phase II RM 6-8.5 Project.

	Recurrence Interval Flow (cubic feet/second)					
	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Peak Flood	3,561	4,552	5,941	7,082	8,322	11,665

Project Implementation/Compliance Monitoring

Photo Point Documentation

Protocol: CTUIR-Umatilla Basin Photo Points (URL Citation: https://www.monitoringmethods.org/Method/Details/1313

Photo point monitoring intensity varies depending on the magnitude of size and project type. We conduct selected photographic data points from about 150 photo locations over 24 habitat restoration project areas or conservation easement locations completed or managed by CTUIR. Photo points are taken prior to project initiation in order to capture pre project conditions and project progression. If possible photos will be taken showing high and low flow conditions. During project construction photos are taken in order to capture major changes within the project area. After project completion, photos are repeated opportunistically to capture major changes or during bankfull plus events, low flows and/or every 2-5 years. New projects typically have a higher intensity of photo point monitoring due to the high level of changes that can occur.

Currently, CTUIR is heavily monitoring the Meacham Creek Floodplain Restoration and In-stream Enhancement Phase I (RM 6-7.0) completed in 2011 and Phase II (RM 6.0-8.5) completed in 2013 (**See Section SELECTED FISH HABITAT ENHANCEMENT AND RESTORATION ACTIVITY**). Photo point sites are set up in order to track the progression of landscape features (i.e. vegetation, channel morphology) of past, present and future projects (i.e. Figure 32). Repeatable photo point documentation is used to monitor and quantify the general magnitude of change in habitat characteristics to distinguish trends and determine the relation to habitat enhancement projects as a means of effectiveness monitoring. Besides monitoring the Meacham Creek Project, CTUIR continues to use photo point monitoring to assess changes on past projects on Meacham Creek, Birch Creek, the Umatilla River, Wildhorse Creek and McKay Creek.

The CTUIR (Confederated Tribes of the Umatilla Indian Reservation)-Umatilla Basin Photo Points Method is based off of the 2002 USDA "Photo Point Monitoring Handbook" by Frederick C. Hall (http://www.fs.fed.us/pnw/pubs/gtr526/gtr526A1.pdf). Photo points are uploaded and archived in the CTUIR CDMS data depository for comparable visuals for tracking physical changes over time.

Before **After**

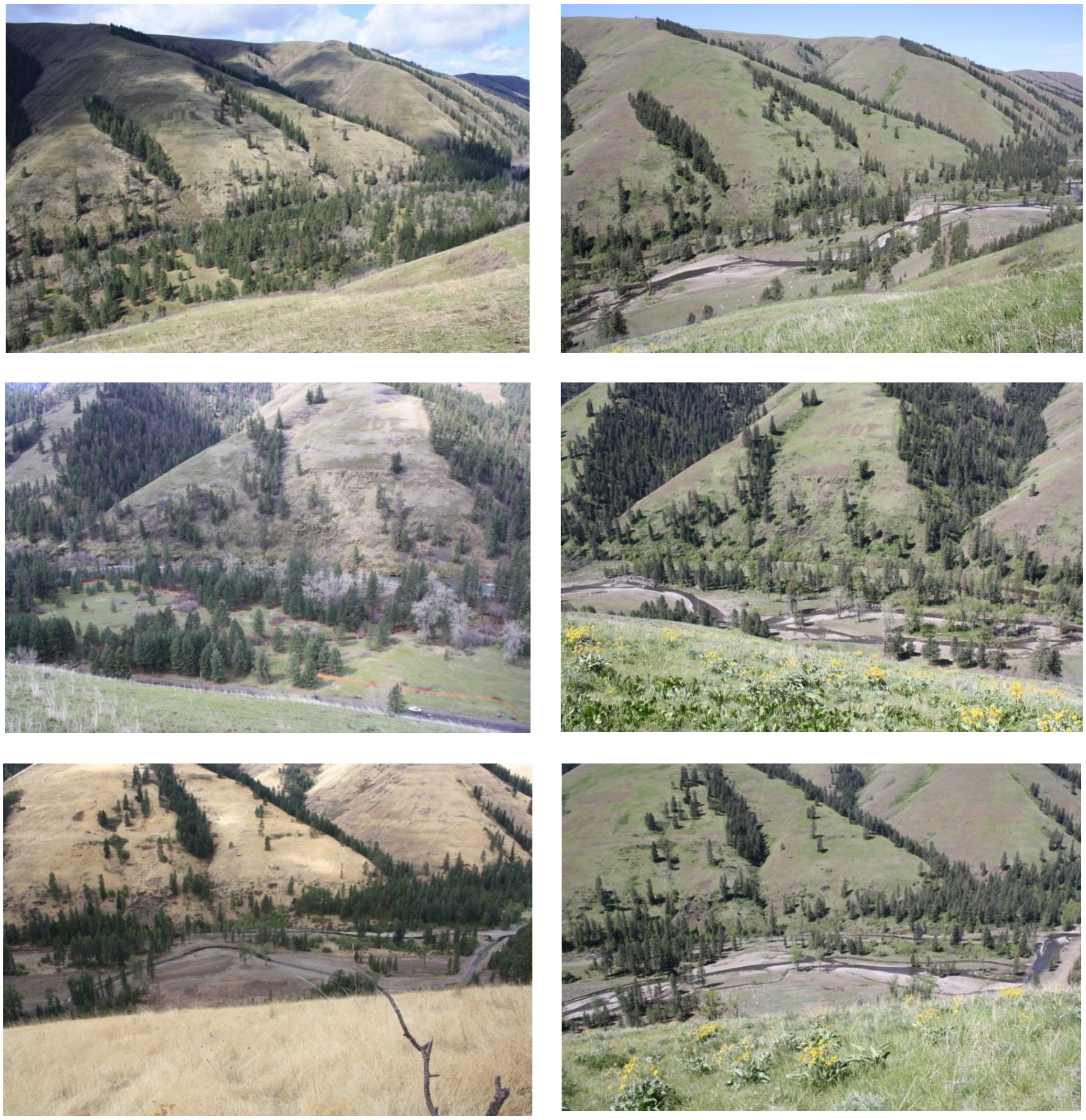


Figure 32. Before and after photos of the Meacham Creek Floodplain Restoration and In-stream Enhancement Phase I (RM 6.0-7.0) and Phase II (RM 6.0-8.5).

SUMMARY AND CONCLUSIONS

In accordance with the 2006 NPCC solicitation outline, the CTUIR UAFHP since 2007 focused its restoration activities primarily on Meacham Creek, Birch Creek, and mainstem Umatilla River. However, project restoration activities occur in other areas of the subbasin where floodplain and riverine processes are treated with outcomes that are beneficial to ecological processes, water quality and fish production. The Meacham Creek Watershed has long been a primary focal point of the CTUIR effort to improve habitat conditions in the Umatilla Basin because of its location, size, historical significance, and recovery potential. Table 16highlights the CTUIR Umatilla Anadromous Fish Habitat Project restoration accomplishments since 2008.

Proposed restoration actions have focused on protection, enhancement, and restoration of functional floodplain, channel and watershed processes at multiple scales using passive and active restoration techniques. Over the past decade, the CTUIR Department of Natural Resources and UAFHP have transitioned from restoration toward a fixed endpoint to address symptoms to a restoration of processes. The CTUIR UAFHP currently operates under the 2008 Columbia Basin Fish Accords Memorandum of Agreement between the Three Treaty Tribes and FCRPS Action Agencies (Fish Accords 2008). Restoration of process is more likely to address causes of river ecosystem degradation, whereas restoration toward a fixed endpoint addresses only symptoms. Specific restoration actions proposed for completion by CTUIR, partnering agencies and in collaboration with independent engineer contractors include levee and dike removal and or modification, floodplain and channel construction, in-stream and floodplain large wood debris additions, in-stream structure placement, wetland enhancement, floodplain and riparian plantings, noxious weed removal, riparian management through fencing, and removal of physical migration barriers. The UAFHP have and will continue to maintain project areas under secured conservation agreements with landowners on private properties for protection and enhancement of floodplain and riparian habitat and investments from past passage and in-stream structure projects. Completed project activities are described below in more detail in the context of the watershed with reference to annual progress reports.

The CTUIR UAFHP continues to focus restoration efforts large reach floodplain/channel restoration and passage projects in the Umatilla Subbasin (Table 16). Since 2008, CTUIR has implemented 3 large reach projects reactivating about 350 floodplain acres with the channel over four miles including restoration actions such as active channel construction, large wood addition, in-steam structures, levee removal, wetland development and enhancement, side-channel reconnection or development, and native vegetation planting (Figure 13). Work has also included fish barrier removal in the Birch Creek watershed. The CTUIR UAFHP worked with ODFW, UCSWCD and private landowners to remove a total of four abandoned irrigation diversion barriers and providing unimpeded access to 7.7 river miles of stream.

A principal strength and focus of the CTUIR UAFHP project is the ability to work cooperatively with the various entities throughout the restoration process. Staff worked closely with stakeholder agencies in the Umatilla Basin Subbasin including ODFW, USFS, Umatilla County Soil and Water Conservation District, USFWS, Umatilla Basin Watershed Council and other local interest groups to enhance or protect natural resources, identify problems and solutions, coordinate efforts to prevent duplication, enhance communication and cooperation and identify funding and cost share opportunities within the Umatilla River Subbasin. This was magnified by the development of the Umatilla Basin Restoration Team. This forum was established to build a coordinated and strategic approach to the restoration of habitat in the Umatilla Basin.

The CTUIR continues to emphasize more attention toward project planning in regard to developing a systematic approach for site selection based on scientific data as well as to increase efforts towards habitat action effectiveness monitoring (both have been considered as shortfalls in the past from review committees). CTUIR emphasizes adaptive management as a means of maximizing success at each project site. With future years of monitoring data, the CTUIR will be able to track changes in the habitat quality and quantity of the restoration areas as compared to unrestored areas. This information will be useful in guiding future restoration actions and decisions in Meacham Creek but also within the Umatilla Subbasin, and will ultimately help to restore salmonid populations for both cultural and ecosystem benefits.

The UAFHP is an ongoing effort to protect, enhance and restore functional floodplain, channel and watershed processes to provide sustainable and healthy habitat for aquatic species in the Umatilla River Subbasin, including Threatened Mid-Columbia steelhead. Project work further supports the CTUIR Department of Natural Resource ecological and First Foods mission statements to sustain production. Applying River Vision floodplain principles has been successfully applied in effort to reestablish the salmonids to self-sustaining levels. We expect an exponential response of salmonid populations once habitat floodplain and channel function is addressed and improved. We believe a positive correlation between habitat improvement, salmonid density, and fitness levels will shift the status of ESA-Listed species towards a safer level of sustainability in the Umatilla River Basin.

Table 16. The CTUIR UAFHP restoration project descriptions by location, treated primary limiting factors (NMFS 2009) by CTUIR River Vision touchstones (Jones et al. 2008) and accomplishments; 2008-2014.

Subbasin, Stream and Years	Project Description	Species	CTUIR River Vision Touchstones/ Habitat Limiting Factors (PLF's shaded in yellow)								Comment/ Accomplishments
			Biota-Connectivity	Geo-morphology	Connectivity		Hydrology			Riparian Veg.	
			Passage Barriers/ Entrainment	In-channel Characteristics	Habitat Diversity (LWD)	Floodplain Confinement	High Temps	High Turbidity	Low Flows	Riparian/Flood-plain	
UMATILLA											
Meacham Creek (2008-2011)	Floodplain improvement with channel redesign, levee setback, large wood placement, riparian protection fencing and plantings	CHS, STS,BT, Lamprey	X	X	X	X	X		X	X	Removed and modified 4 levees and woody debris floodplain input over 1 mile (3,200 linear ft, 24,000 cubic yards); Built 9.8 miles of livestock exclusion fence (~350 acres protected); 15,000 planted hardwood and conifer seedlings (30acres).
Birch Creek (2008-2010)	Fish passage rectification, bank stabilization and large wood habitat complexity, riparian protection fencing and planting	STS	X	X	X		X	X		X	3.25 miles unimpeded habitat, 335 ft of streambank stabilization with added wood complexity, 0.3 miles livestock exclusion fence, 5,000 planted hardwood seedling trees
Birch Creek Broun (Garton) Dam and Fish Screen Passage Project (Initiated 2008-2014)	Rectification activities related to reducing juvenile and adult passage impacts	STS	X	X							Transfer of water right point of diversions for multiple landowners, water efficiency irrigation piping, and installation of ODFW certified pump station and fish screen. Eliminated irrigation ditch, fish screen and fish bypass impacts. Later efforts will involve full irrigation dam removal and channel restoration.
Mainstem Umatilla River (2008-2014)	Treated and maintained 3.5 miles of floodplain and channel; riparian and uplands	CHS, STS, Coho					X	X	X	X	355 maintained acres (61 riparian and 294 upland acres; 60.7 acres of CREP tract's), 13,400 seedling trees, 1,335 lbs of native grass seed and noxious weed control; Installation of an access restriction fence (3 acres riparian protection). An additional 330 potted plants were planted in 2014 for CREP contract maintenance.

Meacham Creek Floodplain Restoration and In-Stream Enhancement Project Phase I (2011-2012)	Floodplain and channel improvement with levee setback, large wood placement, side-channel connectivity, wetland enhancement, and riparian plantings.	STS, CHS, BT, Pacific Lamprey		X	X	X	X	X	X	X	Restored 67 acres of floodplain over 1-mile of stream by removing a 2,800 foot levee and modifying two spur dikes, realigning Meacham Creek into its historic channel and meanders present in the floodplain, 12 large pool structures and another 120 rock and channel features, and installing riparian plantings.
Birch Creek (2012)	Fish passage rectification and habitat restoration project.	STS, Coho	X	X						X	Removed two abandoned irrigation diversions creating unimpeded access to the entire Birch Creek drainage. Included channel reshaping, setback of road adjacent to the channel, reshaping of the channel and banks and rock structure placement over 0.6 miles of stream.
West Birch Creek (2012)	Fish passage rectification and habitat restoration project.	STS	X	X	X			X	X	X	Removed one abandoned irrigation diversion providing unimpeded access to 5.0 river miles of stream, installation of rock and large wood structures, channel re-shaping and plantings over 1-mile of stream.
Meacham Creek Floodplain Restoration and In-Stream Enhancement Project Phase II (2012-2014)	Floodplain and channel improvement with levee setback, large wood placement, side-channel connectivity, wetland enhancement, and riparian plantings.	STS, CHS, BT, Pacific Lamprey		X	X	X	X	X	X	X	Restore 90 acres of floodplain over 2.5 miles of stream by removing and modifying 3,700 ft of levees (5) and dikes (5); installation of 27 LWD structures; restoration and enhancement of off-channel, side-channel and wetland development; and installation of riparian plantings.
Meacham Creek Vegetation Recovery Project RM 7.3 to 7.7 (2014-2015)	Floodplain and riparian re-vegetation in historically heavily disturbed areas from heavy grazing and manipulation of floodplain material for railroad grade protection.	STS, CHS, BT, Pacific Lamprey		X	X		X		X	X	Restored 7 floodplain/riparian acres over 0.4 miles, including 1,500 linear ft of river bank where stability was of immediate concern by installing 4,765 potted native plant stock.
Basin-wide easements O&M (2008-2014)	Ongoing maintenance of 27 riparian conservation agreements on 23 properties including livestock exclusion fencing, tree planting and weed control	CHS, CHF, STS, Coho, BT Lamprey		X			X	X	X	X	552 acres protected and maintained including noxious weed control, 15 miles of riparian fence protection (182 ac.), 7,000 planted hardwood seedling trees.

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APPENDIX A: LIST OF METRICS AND INDICATORS

Category	Subcategory	Subcategory Focus 1	Subcategory Focus 2	Specific Metric Title
Hydrology/Water Quantity	Ground Water Level Change			Groundwater Recharge
Hydrology/Water Quantity	Runoff Timing			Flood Duration
Landscape Form & Geomorphology	Abundance of Habitat Types	Habitat Type: Multiple		Available Habitat Unit Quanitity
Landscape Form & Geomorphology	Cover	Habitat Type: Overhanging Vegetation		Stream Cover
Landscape Form & Geomorphology	Density of Instream Wood			Functional wood
Landscape Form & Geomorphology	Edge/Density/Sinuosity	Habitat Type: Rivers & Streams		Sinuosity
Landscape Form & Geomorphology	Structural Stability			Function of restoration features
Landscape Form & Geomorphology	Width: Flood Prone			Floodplain Connectivity
Macroinvertebrates	Productivity: Macroinvertebrates	Species Life Stage: Adult		Macroinvertabrate Assembalge/Diversity/Abundance
Sediment/Substrate/Soils	Composition: Substrate/Soil-Dominant Size			Stream Substrate
Vegetation/Plants	Growth: Vegetation			Increased Riparian Vegetation
Vegetation/Plants	Survival Rate: Plants			Planting survival
Water Quality	Conductivity			Conductivity
Water Quality	Turbidity			Total Suspended Solids
Water Quality	Water Quality Index			Water Quality
Water Quality	Water Temperature			Stream Temperature

Water Quality	Water Temperature			Diel water temperature reduction
Hydrology/Water Quantity	Ground Water Level Change			Groundwater Recharge
Hydrology/Water Quantity	Runoff Timing			Flood Duration
Landscape Form & Geomorphology	Abundance of Habitat Types	Habitat Type: Multiple		Available Habitat Unit Quanitity
Landscape Form & Geomorphology	Cover	Habitat Type: Overhanging Vegetation		Stream Cover
Landscape Form & Geomorphology	Density of Instream Wood			Functional wood
Landscape Form & Geomorphology	Edge/Density/Sinuosity	Habitat Type: Rivers & Streams		Sinuosity
Landscape Form & Geomorphology	Structural Stability			Function of restoration features
Landscape Form & Geomorphology	Width: Flood Prone			Floodplain Connectivity
Macroinvertebrates	Productivity: Macroinvertebrates	Species Life Stage: Adult		Macroinvertabrate Assembalge/Diversity/Abundance
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Vegetation/Plants	Growth: Vegetation			Increased Riparian Vegetation
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Hydrology/Water Quantity	Flow			Radon 222 Geochemistry
Hydrology/Water Quantity	Ground Water Level Change			Groundwater Surface Elevation
Hydrology/Water Quantity	Hyporheic Flow			Groundwater Budget Model

Water Quality	Water Temperature			Groundwater Temperature
Water Quality	Water Temperature			Surface Water Temperature
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