McKenzie River Sub-basin Strategic Action Plan for Aquatic and Riparian Conservation and Restoration, 2016-2026

MCKENZIE WATERSHED COUNCIL
AND PARTNERS

June 2016

Photos by Freshwaters Illustrated

ACKNOWLEDGEMENTS

The McKenzie Watershed Council thanks the many individuals and organizations who helped prepare this action plan. Partner organizations that contributed include U.S. Forest Service, Eugene Water & Electric Board, Oregon Department of Fish and Wildlife, Bureau of Land Management, U.S. Army Corps of Engineers, McKenzie River Trust, Upper Willamette Soil & Water Conservation District, Lane Council of Governments and Weyerhaeuser Company.

Plan Development Team

Johan Hogervorst, Willamette National Forest, U.S. Forest Service
Kate Meyer, McKenzie River Ranger District, U.S. Forest Service
Karl Morgenstern, Eugene Water & Electric Board
Larry Six, McKenzie Watershed Council
Nancy Toth, Eugene Water & Electric Board
Jared Weybright, McKenzie Watershed Council

Technical Advisory Group

Brett Blundon, Bureau of Land Management – Eugene District
Dave Downing, Upper Willamette Soil & Water Conservation District
Bonnie Hammons, McKenzie River Ranger District, U.S. Forest Service
Chad Helms, U.S. Army Corps of Engineers
Jodi Lemmer, McKenzie River Trust
Joe Moll, McKenzie River Trust
Maryanne Reiter, Weyerhaeuser Company
Kelly Reis, Springfield Office, Oregon Department of Fish and Wildlife
David Richey, Lane Council of Governments
Kirk Shimeall, Cascade Pacific Resource Conservation and Development
Andy Talabere, Eugene Water & Electric Board
Greg Taylor, U.S. Army Corps of Engineers
Jeff Ziller, Springfield Office, Oregon Department of Fish and Wildlife

Table of Contents

List of Figures

List of Tables

List of Acronyms

BLM	Bureau of Land Management
BPA	Bonneville Power Administration
CPRCD	Cascade Pacific Resource Conservation and Development
CREP	Conservation Reserve Enhancement Program
DEQ	Oregon Department of Environmental Quality
DSL	Oregon Department of State Lands
DWSP	Drinking Water Source Protection
EPA	Environmental Protection Agency (federal)
ESA	Endangered Species Act (federal)
EWEB	Eugene Water & Electric Board
FPA	Oregon Forest Practices Act
GIS	Geographic Information System
HUC	Hydrologic Unit Code
LCC	Lane Community College
LCOG	Lane Council of Governments

LIDAR	Remote sensing technology using light and radar
LRAPA	Lane Regional Air Protection Agency
LWM	Large woody material
MMT	Meyer Memorial Trust
MRT	McKenzie River Trust
MWSG	McKenzie Watershed Stewardship Group
MWC	McKenzie Watershed Council
MWERS	McKenzie Watershed Emergency Response System
MWMC	Metropolitan Wastewater Management Commission
MWP	Mohawk Watershed Partnership
NCAP	Northwest Center for Alternatives to Pesticides
NWFP	Northwest Forest Plan
NMFS	National Marine Fisheries Service
NRCS	Natural Resources Conservation Service
NF	National Forest
ODF	Oregon Department of Forestry
ODFW	Oregon Department of Fish and Wildlife
ODOT	Oregon Department of Transportation
OHV	Off-highway vehicle
OSU	Oregon State University
OWEB	Oregon Watershed Enhancement Board
SLICES	Spatial framework for Willamette River and floodplain monitoring
SMART	Goals and objectives which are **S**pecific, **M**easurable, **A**chievable, **R**esults-oriented and **T**ime-based
SMU	Species Management Unit
SPARC	Stewardship Program in Aquatic Restoration and Conservation
SPS	Springfield Public Schools
SUB	Springfield Utility Board
TFT	The Freshwater Trust
UO	University of Oregon
UOELP	University of Oregon Environmental Leadership Program
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UWSWCD	Upper Willamette Soil & Water Conservation District
VIP	Voluntary Incentives Program
WELL	Water and Energy Learning Lab (Springfield Public Schools)
WFFC	Willamette Farm and Food Coalition
WNF	Willamette National Forest

EXECUTIVE SUMMARY

The McKenzie River Sub-basin is known for outstanding water quality and steady flows due to its unique hydrogeology. It is one of the last remaining strongholds for threatened Willamette River spring Chinook salmon and bull trout. McKenzie rainbow trout are a prized target for recreational fisheries and the businesses that depend on them. Many strong partnerships exist among local organizations, and the Sub-basin is a hub for innovative programs. Despite these excellent features, the Sub-basin is showing signs of degradation in water quality and habitat quality, loss of riparian forest, and disconnection from its floodplain. These downward trends are largely a result of a variety of anthropogenic impacts including dam and hydroelectric project construction, rural and urban development pressures, and land-use practices. Conservation and restoration in the McKenzie River Sub-basin is essential to providing the foundation from which ecological uplift in the entire Willamette River Basin can occur.

The guiding vision for the Action Plan is that the McKenzie River Sub-basin supports exceptional water quality and fish and wildlife habitats in balance with human quality of life. The McKenzie River Sub-basin Strategic Action Plan was developed in cooperation with, and with contributions from, numerous partners including residents and landowners, U.S. Forest Service, Eugene Water & Electric Board, Oregon Department of Fish and Wildlife, Bureau of Land Management, U.S. Army Corps of Engineers, McKenzie River Trust, Upper Willamette Soil & Water Conservation District, Lane Council of Governments, Weyerhaeuser Company, McKenzie Watershed Stewardship Group and the McKenzie Collaborative. As such, the plan represents a unified vision for achieving the major outcomes. (See Section 4 for a description of partners and partnerships.)

The primary purpose of the McKenzie River Sub-basin Strategic Action Plan is the identification and prioritization of specific goals, objectives and actions to achieve desired outcomes. There are three desired outcomes:

Outcome 1: Improved habitat for key aquatic species throughout the McKenzie River Sub-basin. Key species include spring Chinook salmon, bull trout, Oregon chub, Pacific lamprey, Pacific brook lamprey, rainbow trout, cutthroat trout, red-legged frog and western pond turtle.

Outcome 2: Maintenance and improvement of high quality drinking water for the City of Eugene, City of Springfield and watershed residents.

Outcome 3: Enhanced public awareness, understanding and support for watershed conservation and restoration.

Recovery of spring Chinook salmon and bull trout are long-term goals that may take many decades to achieve. In the meantime, the action plan is geared toward making measurable progress in conserving and restoring critical habitat for these and other key species throughout the Sub-basin. The partner organizations will continue their coordinated efforts over the long term to protect drinking water quality and conserve and restore habitat.

Actions to conserve and restore habitat for key species (Outcome 1) were developed using a process that included watershed assessment, action development and action prioritization. The actions address key limiting factors for each species as described in recovery or conservation plans. Four goals developed for Outcome 1 include:

1. Increase in-stream and floodplain habitat complexity, floodplain connectivity and productivity;
2. Improve fish passage;
3. Enhance riparian function; and
4. Maintain water quality for key species.

In total, the plan identifies 110 specific and measurable actions that achieve the habitat goals in six of the seven watersheds in the Sub-basin. Included are actions to conserve and restore riparian habitat as part of EWEB's proposed Voluntary Incentives Program, which is scheduled to be implemented in late 2016. Also of note are proposed actions to restore fish habitat in the South Fork McKenzie Watershed, which are a priority for the U.S. Forest Service and its partners. These actions include augmentation of large woody material, removal of revetments to increase connections with the floodplain and side channels, augmentation of sediment and flow, addition of hatchery chinook carcasses to improve productivity, and actions to improve or decommission roads to protect water quality. (See table below.)

Goals	Objectives	Actions
Increase in-stream habitat complexity, floodplain connectivity, and productivity	Increase marine-derived nutrients	Hatchery Chinook salmon carcass placement • South Fork, Horse Creek, Deer Creek
	Augment in-stream large woody material (LWM)	Implement LWM projects on the following • Private lands (Gate Creek, lower McKenzie River floodplain, upper Mohawk River, Mill Creek (Mohawk River) • Willamette National Forest (South Fork, below Cougar Dam, South Fork, above Cougar Dam, Horse Creek, Anderson Creek, Olallie Creek, Sweetwater Creek)
	Augment in-stream flow downstream of dams	Work with the USACE to periodically release channel forming flows below Cougar Dam
	Augment in-stream sediment (gravel) regime	Implement gravel augmentation in the South Fork Watershed below Cougar Dam
	Levee and revetment removal	Implement levee and revetment removal projects in the South Fork Watershed below Cougar Dam
Enhance riparian function	Implement VIP Program within McKenzie River Sub-basin boundary area	Conduct riparian health assessments and restoration/conservation planning on cooperating private lands
		Implement conservation, restoration, and naturescaping activities on cooperating private lands
	Enhance riparian habitat at priority sites outside of VIP boundary	Implement riparian enhancement at priority locations outside of current VIP boundary • Mohawk River • South Fork McKenzie River below Cougar Dam
Improve fish passage at priority passage barriers	Remove passage barriers at priority road crossings	Implement passage projects on the following • Blowout Creek (Horse Creek watershed) • Pothole Creek (Horse Creek watershed)
		Update and prioritize fish passage barrier databases
	Improve upstream and downstream fish passage at USACE dams	Work with USACE on downstream passage at Cougar Dam
Maintain or improve water quality for key species	Reduce road-related fine sediment delivery to streams within South Fork, Horse Creek and Headwaters Watersheds	Hydrologically stabilize and store roads
		Conduct storm damage risk reduction
		Decommission roads
		Upgrade stream crossings

Actions to maintain and improve drinking water quality (Outcome 2) were developed based on 14 years of research and analysis of threats by EWEB and its partners and include the major components of EWEB's drinking water source protection program. The plan identifies 35 actions (see table below) to achieve the following major goals:

1. Reduce the amount of chemicals used and/or stored in the watershed, and increase hazardous material spill preparedness;
2. Reduce bacteria and nutrient pollution loads into the McKenzie River and its tributaries to reverse increasing trends of *E. coli* and nitrates; and
3. Establish a watershed health monitoring framework that effectively assesses and tracks changes in: water quality and quantity; land cover and landforms; key aquatic species health; and instream habitat in order to assess climate change impacts and effectiveness of actions taken as part of this action plan.

Goals	Objectives	Actions
Reduce chemical use and storage and increase hazardous spill preparedness	Reduce pesticide/nutrient use and storage	• Healthy Farms Clean Water Program • Agricultural chemical collection events • Naturescaping workshops
	Reduce toxic chemical usage and pharmaceutical storage	• Ecobiz Certification Program
	Maintain hazardous spill response (MWERS) readiness	• Annual drills • Develop response system
Reduce bacteria and nutrient pollution	Septic System Assistance Program	• Septic system assistance program
	Storm water treatment systems with City of Springfield	• 48th Street wetland design • 69th and 72nd street treatment designs implementation
	Healthy Farms Clean Water Program	• Develop off-site watering and fencing projects • Manure compost facilities projects
Establish watershed health monitoring framework	Expand SLICES framework to McKenzie Sub-basin	• Map at 1km and 100m intervals • Populate with data at 100m scale • Repeat on 10-year cycle
	Sub-basin water quality monitoring	• Baseline monitoring at 16 sites on quarterly basis • Fall and spring storm event monitoring • Seasonal algal bloom monitoring at reservoirs • Maintain 4 continuous monitoring stations • Conduct bacteria source tracking analysis • Summarize trends on VIP dashboard
	Sub-basin water quality monitoring to assess snow pack, flow levels, precipitation, water use	• Assess patterns and trends in water recharge using existing data sources • Establish continuous flow and temperature monitoring stations on select spring creeks
	Conduct land cover and landform monitoring (LiDAR)	• Conduct 2016 flight • Repeat flights on 5-year interval

Actions to enhance community understanding and support for watershed stewardship (Outcome 3) were developed largely based on the watershed council's successful outreach program involving numerous partners, and on outreach needs for the Voluntary Incentives Program. The plan includes 30 actions (see table below) to meet the following goals:

1. Conduct outreach to increase the participation of McKenzie River landowners in voluntary protection and restoration actions;
2. Increase outreach programs which enhance middle and high school students' knowledge and understanding of watershed conservation and restoration;
3. Maintain opportunities for volunteers and community members to participate in restoration and stewardship projects;
4. Increase collaboration with other watershed councils, agencies and organizations within Lane County who are providing youth programs focusing on watershed health, water quality and fish and wildlife habitat; and
5. Promote and enhance public knowledge of the historic and cultural significance, biological needs, and new research concerning spring Chinook salmon in the McKenzie River Sub-basin, and promote the recovery of Upper Willamette Spring Chinook salmon.

Goals	Objectives	Actions
Conduct outreach to increase private landowner participation in voluntary restoration and conservation	VIP outreach within current boundary	• Development of website and dashboard and other materials development • Focus on landowners previously identified in UO Survey • Focus on 900 landowners with prior participation in partner programs
	Conduct outreach to landowners outside current VIP boundary	• Focus on landowners within high priority areas of Mohawk River and McKenzie River watersheds outside of current VIP boundary
Increase outreach programs to youth	Salmon Watch Program	• Salmon Stewards Committee coordination • Volunteer recruitment and training • Field trips to McKenzie and Siuslaw
	High School Program Middle School Program UO Environmental Leadership Program (ELP) Partnership	• WELL Project with Springfield School District • SPARC Program with McKenzie School District • Marcola School District • Eugene School District 4J • UO ELP
Increase public participation in watershed stewardship	Develop volunteer opportunities for public	• McKenzie River Clean-up • MRT Volunteer Partnerships at BWCA and other conservation properties • South Fork McKenzie River volunteer events
Collaboration with area watershed education providers	Meet with local organizations and partnerships	• Collaboration with area watershed councils and other organizations • Participate in USFS Children's Forest Initiative planning
Upper Willamette River spring Chinook recovery	Promote a greater understanding of McKenzie spring Chinook	• Public forum • Distribute materials on a sub-basin scale

A key feature of the action plan is evaluating success through monitoring frameworks and programs. Based on results of monitoring, the Council and its partners will periodically assess effectiveness of the actions in meeting the goals and objectives prescribed in the plan and make adjustments as necessary to habitat restoration treatments, drinking water quality actions, and outreach activities. As actions are completed, new priority actions may be developed and implemented to achieve goals and objectives. Goals and objectives may be modified as time goes on. In this way, the plan is a living document that will be updated regularly.

1 INTRODUCTION

The McKenzie River supports exceptional water quality and high quality habitat for native fish and wildlife. In many ways the McKenzie River Sub-basin is the backbone of the Willamette River Basin **(Figure 1).** The river accounts for a disproportionate amount of flow in the lower Willamette main stem during the dry season due to the large spring-fed system in the upper watershed; is one of the last remaining strongholds for Endangered Species Act (ESA) threatened spring Chinook salmon and bull trout; has some of the best water quality in Oregon which provides dilution for downstream impacts; and is a hub for innovation and collaboration that can be used as a model to transfer to other watersheds.

Roaring Spring, McKenzie River headwaters (photo: D. Donahue, EWEB)

Over the last century, human activities have resulted in loss of riparian forests, loss of floodplain connectivity and diversity, and altered instream habitats for native fish and wildlife species. These impacts are reflective of construction of flood control dams and hydroelectric projects; urban and rural development*;* and past land use practices including agriculture and forestry (see Section 6 for more detail on impacts). Over the last 15 years, collaborative monitoring efforts show further signs of degradation in water quality and downward trends in wild spring Chinook salmon returns. This Action Plan proposes voluntary restoration and conservation measures to address impacts within the McKenzie River Sub-basin, which can provide the foundation from which ecological uplift in the Willamette River Basin can occur.

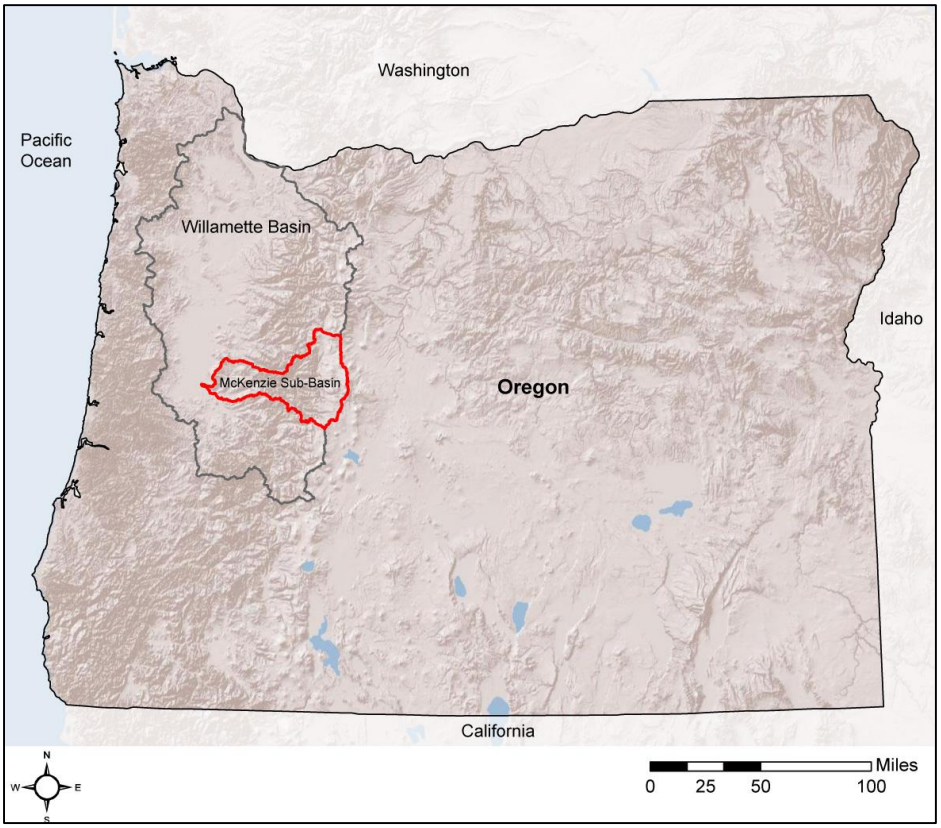


Figure 1. State of Oregon, Willamette River Basin and McKenzie River Sub-basin.

1.1 About the McKenzie Watershed Council

The McKenzie Watershed Council (MWC) is a group of volunteer partners representing the diverse stakeholders and interests in the watershed. Currently, there are 28 partners representing residents, commercial and recreational interests, schools, utilities, conservation organizations, and local, state and federal government entities. Commercial interests include agriculture, forestry and the sand-and-gravel industry. The MWC employs a small staff based in Springfield which is responsible for implementing projects and facilitating partnerships. The MWC is one of five watershed councils officially authorized by action of the Lane County Board of Commissioners **(Figure 2).** Our mission is to foster better stewardship of McKenzie River watershed resources, deal with issues in advance of resource degradation, and ensure sustainable watershed health, function and use. The MWC is not a regulatory body. We work with public and private landowners on a voluntary basis to conserve and restore riparian and aquatic habitat, cooperate with partners to monitor and maintain water quality, implement watershed education programs, focus outreach to residents and provide a monthly forum for addressing important issues. The MWC is funded by a combination of local partner contributions; state, federal and private foundation grants; and private donations.

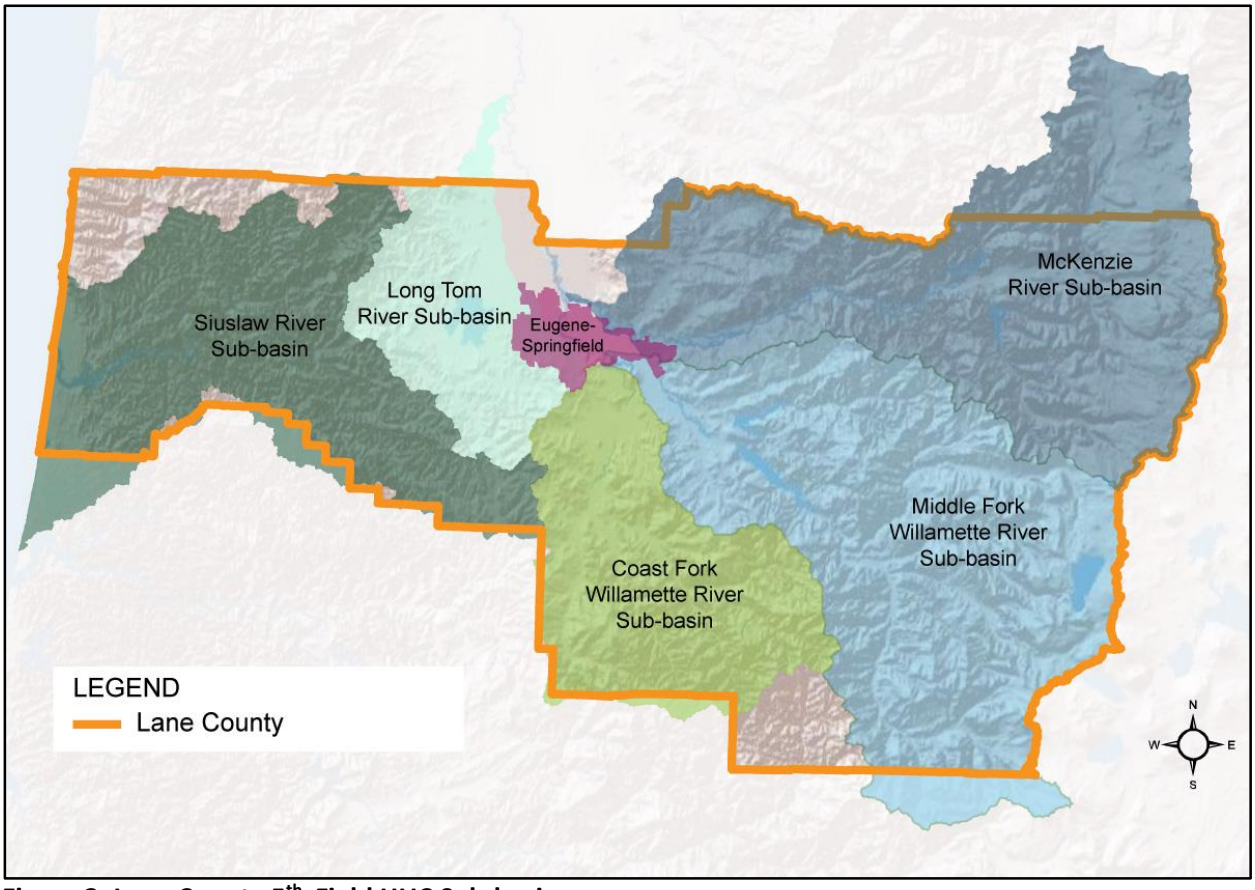


Figure 2. Lane County 5th- Field HUC Sub-basins.

1.2 Purpose and Need for Action Plan

The McKenzie River Sub-basin Strategic Action Plan for Aquatic and Riparian Conservation and Restoration (Action Plan) was developed to identify and prioritize the goals, objectives and actions relating to water quality and fish and wildlife habitat which the MWC and its partners seek to achieve over the next five to ten years. Actions capture both existing and conceptual programs and projects. All

identified actions are voluntary, subject to local, state and federal laws, plans and regulations, and intended to be done collaboratively with a variety of partners. To the extent possible, the Action Plan identifies these partnerships. The Action Plan also identifies methods for monitoring and accounting for investments.

The need for the Action Plan arose from the realization that existing planning and guidance documents do not account for the current level of collaboration, investment, innovation and engagement with landowners taking place within the McKenzie River Sub-basin. *The McKenzie River Watershed Conservation Strategy* (MWC, 2002) has served as the primary guiding document for the MWC for fourteen years. The Strategy established major goals (see inset), prescribed general strategies to achieve those goals and prioritized geographical areas that should be the focus of restoration. This plan served its purpose in providing a roadmap for the MWC and its partners to understand limiting factors to watershed health and areas ripe for collaboration and investment. *The McKenzie River Sub-basin Assessment* (MWC, 2000) formed the basis for the goals and strategies in the Strategy. The Assessment concluded that, despite significant losses of important fish and wildlife habitat, the McKenzie River Sub-basin has some of the best remaining habitat in the Willamette River Basin. However, the current condition of the Sub-basin, combined with existing management and regulations, does not ensure conservation or restoration of high quality habitat in the long term. Although the overarching goals of the Strategy and findings of the Assessment are still largely relevant, they do not account for a number of new partnerships and collaborations in the McKenzie Sub-basin, such as the McKenzie Collaborative, the McKenzie Watershed Stewardship Group, the Voluntary Incentives Program, the McKenzie Watershed Council/Forest Service partnership, and the Lower McKenzie Fish Habitat Enhancement Program (see partnerships described in section 4). All of these efforts will benefit from a specific comprehensive action plan to guide them. The Action Plan will provide a common vision and path forward that establishes priorities for specific actions, leverages and coordinates resources, and increases efficiencies in implementing projects and activities over the next five to ten years. For these reasons, the Council and its partners recognized the need for developing a new Action Plan and have invested time and resources in working together to complete this comprehensive plan that will guide outreach, protection, and restoration actions across the Sub-basin and establish monitoring approaches that assess the effectiveness of these actions over time.

Goals of the 2002 Conservation Strategy

- Protect and restore key fish and wildlife habitats.
- Protect and restore water quality and quantity.
- Facilitate partnerships to advance stewardship.
- Promote community understanding through outreach and education.
- Account for investments in the watershed.

1.3 Action Plan Overview

The Action Plan includes specific voluntary actions to work with willing private and public landowners throughout the McKenzie River Sub-basin in the restoration of key fish and wildlife habitat, the protection of water quality, and implementation of outreach activities linked to habitat and resource stewardship. Restoration actions focus on aquatic, riparian, and floodplain habitat for what we define as "key species": spring Chinook salmon, bull trout, Oregon chub, Pacific lamprey, Pacific brook lamprey, rainbow trout, cutthroat trout, red-legged frog and western pond turtle. Water quality protection actions focus on monitoring and a series of drinking water source protection (DWSP) programs designed to address identified threats to maintenance of the McKenzie River's exceptional water quality. Outreach activities seek to increase awareness of and support for watershed conservation and restoration through multiple programs involving youth, private landowners and the general public.

The Action Plan utilizes a geographic term, Hydrological Unit Code (HUC), established by the U.S. Geological Survey for classifying and identifying hydrologic features such as rivers and drainage basins. The Action Plan defines geographic terms as follows:

- Basin: Willamette River Basin, classified as a 3rd field HUC **(Figure 1).**
- Sub-basin: major tributaries of the Willamette River, such as the McKenzie River, classified as a 4th field HUC **(Figure 1).**
- Watershed: major tributaries or sections of the McKenzie River, classified as 5th- field HUCs (**Figure 3)**.

The McKenzie River Sub-basin includes a total of seven watersheds; McKenzie River, Mohawk River, Quartz Creek-McKenzie River, Blue River, South Fork McKenzie River, Horse Creek and Headwaters McKenzie River **(Figure 3).** It should be noted that within the Action Plan the term McKenzie River Watershed refers to the 5th field HUC, i.e. the section of river (and all tributaries) from the confluence of the McKenzie River and Willamette River upstream to the confluence of the McKenzie River and Ennis Creek at river mile 51. The Action Plan covers the entire McKenzie River Sub-basin with planning organized on the 5th -field HUC scale.

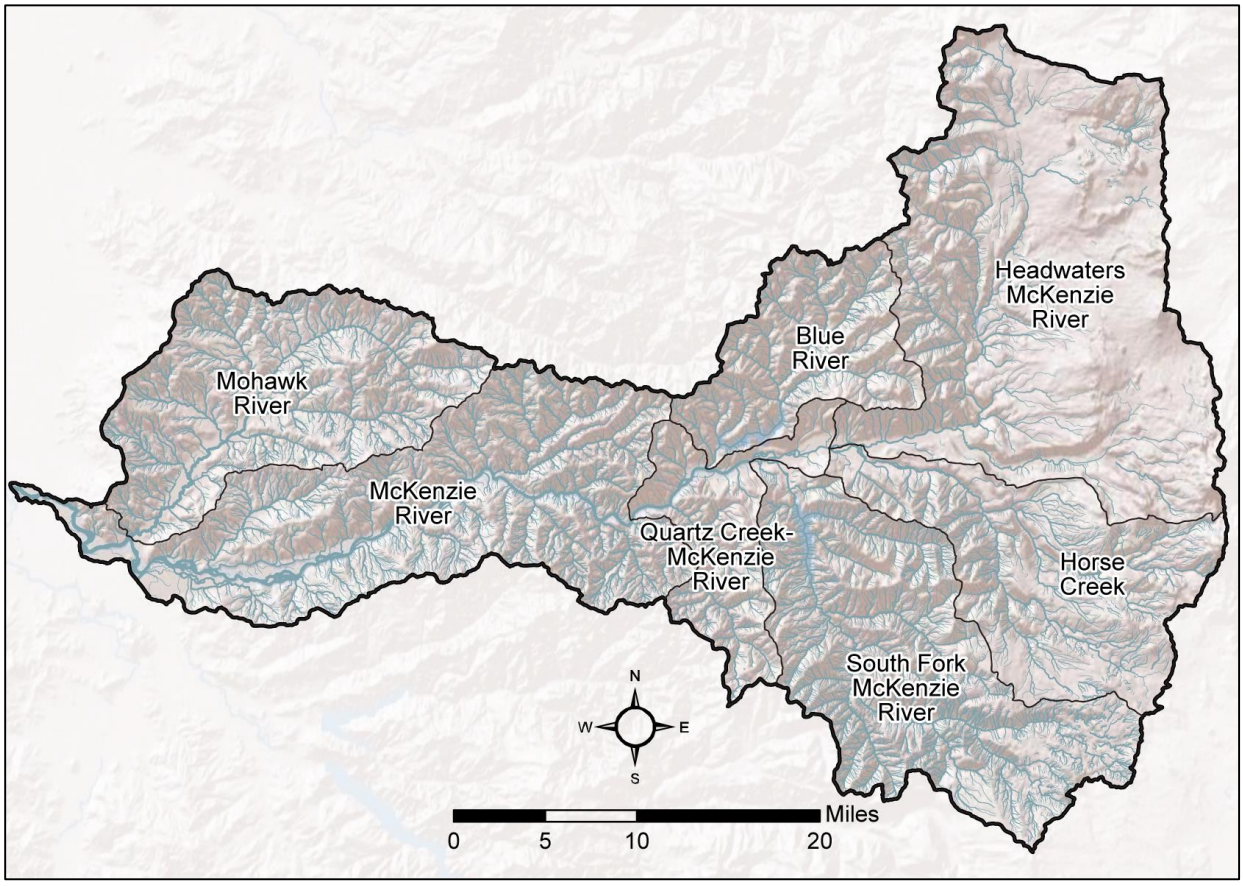


Figure 3. The seven 5th-field watersheds within the McKenzie River Sub-basin.

The following is a summary of the contents of the Strategic Action Plan.

- Section 2 describes the major outcomes expected from implementation of the plan. These outcomes include conservation and restoration of habitat for key species, monitoring and

protection of drinking water quality, outreach and education to promote stewardship of watershed resources, and monitoring and research necessary to improve the plan and its effectiveness.

- Section 3 includes the scope, vision, and guiding principles of the plan, and describes the focus area, which is the entire McKenzie River Sub-basin.
- Section 4 lists ongoing partnerships in the Sub-basin and the roles of key partners.
- Section 5 is a brief profile of the geography, water resources, biotic systems, local communities, and local economy of the McKenzie River Sub-basin.
- Section 6 describes the conservation needs of the area and documents threats to key species' habitats.
- Section 7 lists the primary factors limiting the recovery of the key species that include spring Chinook salmon, bull trout, Oregon chub, Pacific lamprey, Pacific brook lamprey, rainbow trout, cutthroat trout, red-legged frog and western pond turtle.
- Section 8, the core of the plan, describes the goals, objectives, and actions. The goals and objectives are S.M.A.R.T. - **S**pecific, **M**easurable, **A**chievable, **R**esults-oriented, and **T**ime-based. Actions are specific with regard to sites and activities, and form the basis of project grant applications. Together, the goals, objectives, and actions are formulated to achieve the major outcomes described in Section 2. Actions which address habitat for key species are developed for six of the seven watersheds (USGS 5th-Field HUCs; Figure 3) in the Sub-basin (USGS 4th-Field HUC). Actions for drinking water quality and outreach apply throughout the Sub-basin.
- Section 9 describes baseline and effectiveness monitoring needed to evaluate success of the plan.
- Sections 10 and 11 address adaptive management and sustainability of the ecological outcomes over time, including long-term funding required.
- Section 12 lists literature cited within the body of the plan.
- Appendix A documents the process used to develop and prioritize restoration actions for the South Fork McKenzie River, Horse Creek and Headwaters McKenzie River Watersheds.
- Appendix B documents the process used in the McKenzie, Mohawk and Quartz Creek-McKenzie River Watersheds to develop and prioritize restoration actions.
- Appendix C includes details of Eugene Water & Electric Board's (EWEB) Drinking Water Source Protection (DWSP) Program.

1.4 Plan Development Process

> *Outcome 1:* *Improved habitat for key aquatic species*
>
> *Outcome 2:* *Maintenance and improvement of high quality drinking water*
>
> *Outcome 3:* *Enhanced public awareness, understanding, and support for watershed conservation and restoration*

Plan development began in January 2015 as a collaborative effort among a group of partners. A drafting team worked with a technical advisory group including the Eugene Water & Electric Board (EWEB), Lane Council of Governments (LCOG), Oregon Department of Fish and Wildlife (ODFW), US Forest Service (USFS), McKenzie Watershed Council (MWC), U.S. Army Corps of Engineers (USACE), Bureau of Land Management (BLM), McKenzie River Trust (MRT), Upper Willamette Soil and Water Conservation District (UWSWCD), Cascade Pacific Resource Conservation and Development (CPRCD), and Weyerhaeuser Company. The plan development team also consulted with the two local cooperative partnerships, the McKenzie Watershed Stewardship Group (MWSG) and the McKenzie Collaborative (see section 4 for a description of partnerships), in the development of priority actions. This collaborative effort lead to agreement on a unified vision, guiding principles, and primary outcomes for the McKenzie River Sub-basin (see inset; also described in Sections 2 and 3.)

MWC staff reported monthly to the Council on the status of plan development and to receive direction. At its February 2016 meeting, the Council adopted the plan for public review. Public comment was solicited from residents of watershed communities, the Cities of Eugene and Springfield and stakeholder organizations during the public comment period. Notices of availability of the draft plan were published in local newspapers and posted on the MWC and partner websites. Copies of the plan were distributed to those requesting it. The Council revised the plan in response to public, partner and staff recommendations and adopted the final plan at its May 2016 meeting.

1.5 Process for Updating the Plan

The Action Plan is designed to be realistic, adaptable, and open to opportunities that are not foreseen. It will be updated periodically to account for new information from monitoring programs and research. Council staff and partners will report to the Council each biennium, starting in 2018, at its October planning session on the progress of completing actions and achieving outcomes and will make appropriate recommendations for revising the plan. The Council will adopt any necessary revisions.

2 OUTCOMES

There are three primary desired outcomes of the Action Plan which address both ecological and social issues.

- Outcome 1: Improved habitat for key aquatic species – spring Chinook salmon, bull trout, Oregon chub, Pacific lamprey, Pacific brook lamprey, rainbow trout, cutthroat trout, red-legged frog and western pond turtle – throughout the McKenzie River Sub-basin.
- Outcome 2: Maintenance and improvement of high quality drinking water for the City of Eugene, City of Springfield, and watershed residents.
- Outcome 3: Enhanced public awareness, understanding, and support for watershed conservation and restoration.

2.1 Processes for Developing Goals, Objectives and Actions

Key Species of the Action Plan

- Spring Chinook salmon
- Bull trout
- Oregon chub
- Pacific lamprey
- Rainbow trout
- Cutthroat trout
- Pacific brook lamprey
- Red-legged frog
- Western pond turtle

Outcome 1: Outcome 1 focuses on identifying actions to improve habitat for *key* aquatic species (fish) or aquatic-dependent species (frogs, turtles) within the McKenzie River Sub-basin. "Key" species were defined as species which meet at least one of the following criteria: species has a final or draft federal recovery or conservation plans (USFWS and/or NMFS); species is cited as a key species within Conservation Opportunity Areas by the Oregon Conservation Strategy (ODFW, 2006); or species is generally recognized to have significant biological, cultural or economic significance within the McKenzie River Sub-basin. For two of the identified key species, spring Chinook salmon and bull trout, conserving and restoring habitat within the McKenzie is of regional importance because the Sub-basin is a stronghold for both species and critical for long-term recovery within the Willamette River Basin. The nine species recognized (see inset) by the Action Plan are discussed further in Section 7.

Goals, objectives, and actions to improve habitat for key aquatic species in watersheds dominated by federal ownership were developed utilizing a three-step process largely informed by *Stream and Watershed Restoration: A Guide to Restoring Riverine Processes and Habitats: Watershed Assessment, Action Development, and Action Prioritization* (Roni and Beechie, 2013). The purpose of watershed assessment is to identify causes of impairment to physical and biological processes and show how that has affected key aquatic species and their habitats. The team conducted rapid watershed assessments for three (the South Fork McKenzie River, Horse Creek and Headwaters McKenzie River) of the seven watersheds in the Sub-basin **(Figure 3**). In these watersheds, natural watershed processes were first described, followed by identification of current and historic land use and development. Using the information gathered, a table of watershed processes, the causes of impairment, and restoration actions needed to address impaired processes was created. This list of restoration actions was then translated into more site-specific goals, objectives and actions (Section 8). Actions were then prioritized using a set of criteria and scoring system developed by the team and the advisory group. The process utilized within the South Fork McKenzie River, Horse Creek and Headwaters McKenzie River watersheds is detailed in **Appendix A.**

In watersheds either dominated by private lands (McKenzie River) or with mixed ownership (Mohawk River) the prioritization process relied upon previously completed assessments, conservation strategies, action plans (**Table 1**), professional knowledge and current partnerships/opportunities with private

landowners. To the extent possible given data gaps, existing documents were used to identify impacted watershed processes, causes of impairment, and restoration actions needed to address impaired processes. Similar to the process described above, this list of potential restoration actions was then used to help identify and prioritize more site-specific goals, objectives and actions (Section 8). Because of the predominance of private land within these three watersheds, this process was heavily influenced by opportunity and existing partnerships. An outline of the process utilized within the McKenzie River and Mohawk River watersheds is further detailed in **Appendix B.** In the Quartz Creek-McKenzie River, watershed prioritization was based primarily on professional knowledge from partnering organizations such as the MRT and USFS. Limited opportunities with large-scale private landowners within the watershed made a more comprehensive and rigorous assessment and prioritization process challenging.

Table 1. Watershed Assessments, Conservation/Restoration Strategies, Action Plans and other planning documentation consulted for the development of the Action Plan.

Plan, Source and Year	Focus area within McKenzie River Sub-basin
Mohawk River Watershed Assessment (Weyerhaeuser 1994)	NF Mohawk, SF Mohawk, Upper Mohawk, and Mill Creek sub-watersheds
Lower McKenzie South Side Watershed Analysis (Weyerhaeuser 1994)	McKenzie River Watershed
BLM Mohawk/McGowan Watershed Analysis (BLM 1995)	Main stem Mohawk River, tributaries
Lower McKenzie North Side Watershed Analysis (Weyerhaeuser 1995)	McKenzie River Watershed
Upper McKenzie Watershed Analysis (USFS 1995)	Headwaters McKenzie River Watershed
Technical Report for Water Quality and Fish and Wildlife Habitat (LCOG 1996)	Entire McKenzie River Sub-basin
Action Plan for Water Quality and Fish and Wildlife Habitat (LCOG 1996)	Entire McKenzie River Sub-basin
Vida McKenzie Watershed Analysis (BLM 1996)	McKenzie River Watershed
Horse Creek Analysis (USFS 1997)	Horse Creek Watershed
Bear/Marten Watershed, McKenzie Resource Area (BLM 1998)	McKenzie River Watershed
Quartz Creek (USFS 1998)	Quartz Creek Watershed
NRCS Mohawk Watershed Profile (1999)	Mohawk River Watershed - lower elevations
MWP Supplemental Assessment of the Mohawk Watershed (MWP 2000)	Mohawk River Watershed
McKenzie River Sub-basin Assessment (MWC 2000)	McKenzie River Watershed
Biological Evaluation of the Willamette River and McKenzie River Confluence Area (MWC 2000)	McKenzie River-Willamette River Confluence area
McKenzie River Conservation Strategy (MWC 2002)	McKenzie River and Mohawk River Watersheds
NRCS McKenzie Profile (NRCS 2005)	Entire McKenzie River Sub-basin
The Oregon Conservation Strategy (ODFW 2006)	State-wide
South Fork McKenzie River Watershed Analysis – *Update* (USFS 2010)	South Fork McKenzie River Watershed
Cougar Creek Watershed Restoration Action Plan (USFS 2012)	Cougar Creek sub-watershed (South Fork Watershed)
Western Oregon Aquatic Restoration Strategy (BLM 2015)	Western Oregon BLM lands including the Mohawk and McKenzie Watersheds

No assessment or prioritization process was completed for the Blue River Watershed during this process. No priority actions are foreseen over the next ten years in this watershed. This is primarily due

to the fact that Blue River Dam does not provide anadromous fish passage and is not a priority for fish passage of any kind within the *Willamette Dams Biological Opinion* (NMFS, 2008).

Outcome 2: Outcome 2 of the Action Plan focuses on maintenance and improvement of high quality drinking water within the McKenzie River Sub-basin. Similar to its role in recovering and maintaining spring Chinook salmon and bull trout populations within the Willamette River basin, the McKenzie River is critical to maintaining both local and regional high-quality drinking water. The McKenzie River is the sole source of drinking water for over 200,000 residents in Eugene, and groundwater near the river is one of two sources utilized by the Springfield Utility Board (SUB) to supply water to over 56,000 residents in Springfield. Because of its unique geology and resulting high water quality and consistent quantity, the McKenzie River Sub-basin plays a significant role in diluting downstream impacts and maintaining water quality within the main stem Willamette River (see Section 5.2 Water Resources).

Goals, objectives, and actions to maintain high-quality drinking water identified within the Action Plan were developed based on 14 years of research and analysis of threats to water quality in the Sub-basin by EWEB, the United States Geologic Survey (USGS), University of Oregon (UO), Oregon State University (OSU), Oregon Department of Environmental Quality (DEQ), USFS, City of Springfield, SUB and the MWC as part of EWEB's DWSP Program. Programs developed and maintained by the City of Springfield and SUB complement and enhance EWEB's DWSP. The following is an overview of the process used to assess various threats to water quality in the McKenzie Sub-basin and develop mitigation strategies and incentives to improve and maintain excellent drinking water quality for future generations.

Eugene's drinking water is sourced directly from the McKenzie River at EWEB's Hayden Bridge Filtration Plant at river mile 15 and is susceptible to impacts from upstream land use. In 2000, EWEB completed a risk assessment of the threats to Eugene's drinking water and developed a source water protection plan, incorporating feedback and ideas from major stakeholders in the McKenzie Watershed (see http://www.eweb.org/public/documents/water/WaterProtectionPlan.pdf). The major threats identified upstream of EWEB's drinking water intake included:

- urban runoff from the City of Springfield's storm water system;
- hazardous material spills from transport along State Highway 126;
- impacts from increased development (conversion of farm and forest land to urbanized development);
- commercial and industrial facilities;
- roadside vegetation management; and
- agriculture.

In 2001, EWEB hired a DWSP Coordinator to create and implement the source water protection plan. The Coordinator developed an implementation plan that provided EWEB's management team and Board of Commissioners with a 5-year vision for how the program could be rolled out, strategies for leveraging partner and stakeholder resources and expertise, and a budget to ramp-up EWEB funding over this period of time (see http://eweb.org/public/documents/water/SourceProtectionProgramProposal.pdf). The implementation plan articulated EWEB's DWSP vision as creating the ability "t*o measure the balance between watershed health and human use over time and to implement actions that maintain a healthy balance for production of exceptional water quality."* EWEB strives to achieve this vision through mitigation of activities that have known or potential harmful impacts on source water quality and by promoting public awareness and stewardship of a healthy watershed in partnership with others.

Central to achieving this vision is EWEB's comprehensive water quality monitoring program. EWEB has developed this program to assess the health of the McKenzie River and identify potential threats to drinking water. This program consists of baseline monitoring, storm event monitoring, passive sampling, split sampling with high school students, harmful algal bloom monitoring and other special projects. The program monitors a number of different parameters including the presence of metals (arsenic, cadmium, copper, zinc), nutrients (nitrogen, phosphorous), dissolved oxygen, turbidity, bacteria and temperature. All water quality data is stored in a database and made available online at: http://reach.northjacksonco.com/EWEB/ . Several projects have been done in partnership with the U.S. Geological Survey (USGS). In 2012, EWEB and the USGS published a study based on 10 years of storm event monitoring using automated samplers that found over 40 different pesticides detected in the McKenzie River Sub-basin. The study indicated that the largest number of pesticide detections was associated with storm water runoff from Springfield, and the greatest potential threat to drinking water quality is associated with urbanization, increased development, and agricultural pesticide applications (http://pubs.usgs.gov/sir/2012/5091/). EWEB uses monitoring data to conduct trending analysis where possible, as well as prioritize areas of the watershed on which to focus resources and programs. In 2016, EWEB is expected to complete the next water quality baseline report that will highlight trends over the period that data has been collected (1993-present). The previous report was completed in 2011 and indicated increasing trends in *E. coli* bacteria and nitrates in the lower McKenzie River (below Hendricks Bridge) (http://www.eweb.org/public/documents/water/baselineReportJan2011.pdf).

Because EWEB does not have jurisdictional control over activities that occur in the Sub-basin, it is essential to work with landowners and other stakeholders on a voluntary and collaborative basis to protect water quality. EWEB has worked with multiple partners within the Sub-basin to develop a number of diverse and innovative water quality protection programs, which include:

- McKenzie Watershed Emergency Response System
- Healthy Farms Clean Water Program
- Septic System Assistance Program
- Naturescaping Workshops
- Voluntary Incentives Program
- Ecosystem Valuation and the Economic Benefits of Source Protection

EWEB DWSP programs are described in detail in **Appendix C**.

City of Springfield drinking water is supplied largely by a system of wells that tap into groundwater beneath the city and surrounding areas. Several of these well fields are located near the McKenzie River. SUB also pumps surface water from the Middle Fork Willamette River, and has a water right to tap the McKenzie River when existing sources are insufficient to meet needs. The *Springfield Drinking Water Protection Plan* (LCOG and SUB, 1999) contains goals and measures to protect sources of drinking water for citizens of Springfield. Management authorities for the plan include SUB, the City of Springfield and the Rainbow Water District. The plan was certified by the DEQ in 1999. Since then, the City of Springfield, SUB and other partners have been actively implementing the management strategies in the plan. The *Springfield Drinking Water Protection Plan Recertification Request* (SUB, 2013) submitted to DEQ updates measures taken by the management authorities to implement the plan. The plan's primary protection measures are preventative: a public education program and adoption of a Drinking Water Protection Zoning Overlay District.

Strategies for protection of drink water quality identified within the plan include:

1. implement a public education program;
2. adopt a drinking water protection overlay zone;
3. develop and implement groundwater and surface water monitoring programs;
4. enhance the existing hazardous waste collection program;
5. develop and implement a septic system upgrade and maintenance program;
6. use and enhance existing spill response plan;
7. form public-private partnerships;
8. implement a water conservation program; and
9. use property purchase/donation to provide protection areas.

The City of Springfield's *Stormwater Management Plan* (City of Springfield, 2010) guides the City's efforts to improve water quality in local waterways. City storm water flows into numerous swales, waterways, and through outfalls that discharge to both the McKenzie and Willamette Rivers. In much of the Springfield's northern section, storm water discharges to the McKenzie, particularly in the Thurston neighborhood and areas north of Highway 126/105. Approximately 25% of the Cedar Creek watershed is within Springfield city limits, and several urban drainage ways flow into Cedar Creek. The *Stormwater Management Plan* includes goals, policies and implementation actions, consistent with local goals and state and federal requirements. Goals include:

1. protect citizens and property from flooding;
2. ensure compliance with state and federal requirements to reduce risk of third-party lawsuits or enforcement actions;
3. improve surface and subsurface waters for aquatic life and other beneficial uses;
4. preserve and maintain surface waters, wetlands and riparian areas as functional and attractive for people, fish and wildlife;
5. citizens, businesses and industries understand the need to protect water quality;
6. provide regulatory certainty for the development community while ensuring that growth is not constrained by lack of planning or facilities; and
7. urban drainage ways become community amenities.

Outcome 3: Outreach and education are central to the voluntary approach to watershed stewardship in the McKenzie River Sub-basin. Goals, objectives, and actions within the Action Plan to enhance public awareness, understanding, and support for watershed conservation and restoration in the Sub-basin were developed based on a combination of the efforts of multiple local partners. The MWC has worked with a variety of partners to integrate outreach and education within active watershed enhancement and monitoring projects for over ten years. The McKenzie Watershed Outreach and Education program accomplishes this through a variety of projects involving middle and high school students from six school districts within Lane County, the University of Oregon, Lane Community College, public agencies, private landowners, and the general public. The MWC and partners seek to engage landowners and the public through public meetings, volunteer events, project tours, website, an annual newsletter, and tabling events.

EWEB has conducted extensive outreach over the last five years through its DWSP, including landowner surveys and use of a landowner advisory committee by the UO, feedback and interaction with 15 VIP pilot project landowners, public meetings, MWC meetings, farmer advisory groups, EWEB rate payer surveys, and engagement with over 700 landowners as part of various watershed programs. SUB has been a major contributor to education programs in the McKenzie watershed. In 1998, a grant from SUB

launched Springfield School District's award-winning Water and Energy Learning Lab (WELL) Project, which provides students and teachers with resources, instructional support, and training in topics related to water and energy science. The Salmon Stewards of Lane County are a collaborative group made up of representatives from ODFW, EWEB, BLM, and local school districts dedicated to providing outdoor education through the local Salmon Watch Program and associated public outreach events.

3 VISION, GUIDING PRINCIPLES AND SCOPE

3.1 Vision

The guiding vision for the Action Plan is that the McKenzie River Sub-basin supports exceptional water quality and fish and wildlife habitats in balance with human quality of life.

In the short term, by 2026, we envision the following:

- a Sub-basin where exceptional water quality is maintained through a wide range of voluntary programs;
- the rate of voluntary habitat conservation and restoration is accelerated through a diverse and cooperative programmatic approach;
- aquatic habitat for spring Chinook salmon, bull trout and Pacific lamprey within high priority locations has been measurably improved;
- the monitoring framework to track and report water quality and habitat trends and progress is established;
- high functioning partnerships remain in place and continue to innovate and address on-the-ground issues; and
- outreach programs continue to involve youth and residents in active watershed stewardship and engage private landowners in voluntary conservation and restoration.

3.2 Guiding Principles

1. The Action Plan will be a collaborative and comprehensive effort to adopt and implement actions on a sub-basin scale.
2. Programs outlined within the Action Plan will strive to provide incentives for private landowners to participate in voluntary conservation and restoration activities.
3. Actions will reflect the need to conserve existing high quality habitat while restoring degraded habitat to the extent possible.
4. Actions will be based on process-based (physical and biological) restoration principles.
5. Protection of existing high quality water is less expensive than treatment of degraded water.
6. Protection of healthy riparian and floodplain forests is less expensive than restoration of degraded riparian areas and allows restoration efforts to potentially exceed the rate of degradation from anthropogenic activities over time.
7. Outreach to communities to increase awareness of watershed values is a cornerstone of effective watershed conservation and restoration.
8. Ecological uplift and protection of drinking water quality provide significant social and economic benefits to local communities.

3.3 Area Covered by the Action Plan

The plan covers the entire McKenzie River Sub-basin (USGS 4th-Field HUC), from the headwaters to the confluence with the Willamette River. Strategic actions to conserve and improve habitat for key aquatic species are organized by USGS 5th-Field watersheds. Priority conservation and enhancement actions are described for six of the seven watersheds. Monitoring, assessment, and outreach activities will occur throughout the Sub-basin. Drinking water protection efforts occur primarily upstream of the EWEB intake at Hayden Bridge at river mile 15, which encompasses most of the focus area.

The McKenzie River Sub-basin totals 857,364 acres. Private lands constitute 31% of the total area but 91% of the Sub-basin's floodplain (MWC, 2000). Private land and population dominate in the lower

portions of the Sub-basin, while public ownership dominates in the upper Sub-basin, largely comprised of the McKenzie River Ranger District of the Willamette National Forest (**Figure** 4). The Forest Service manages 62% of the Sub-basin and the BLM manages 6%. State lands and USACE lands each amount to less than 1%.

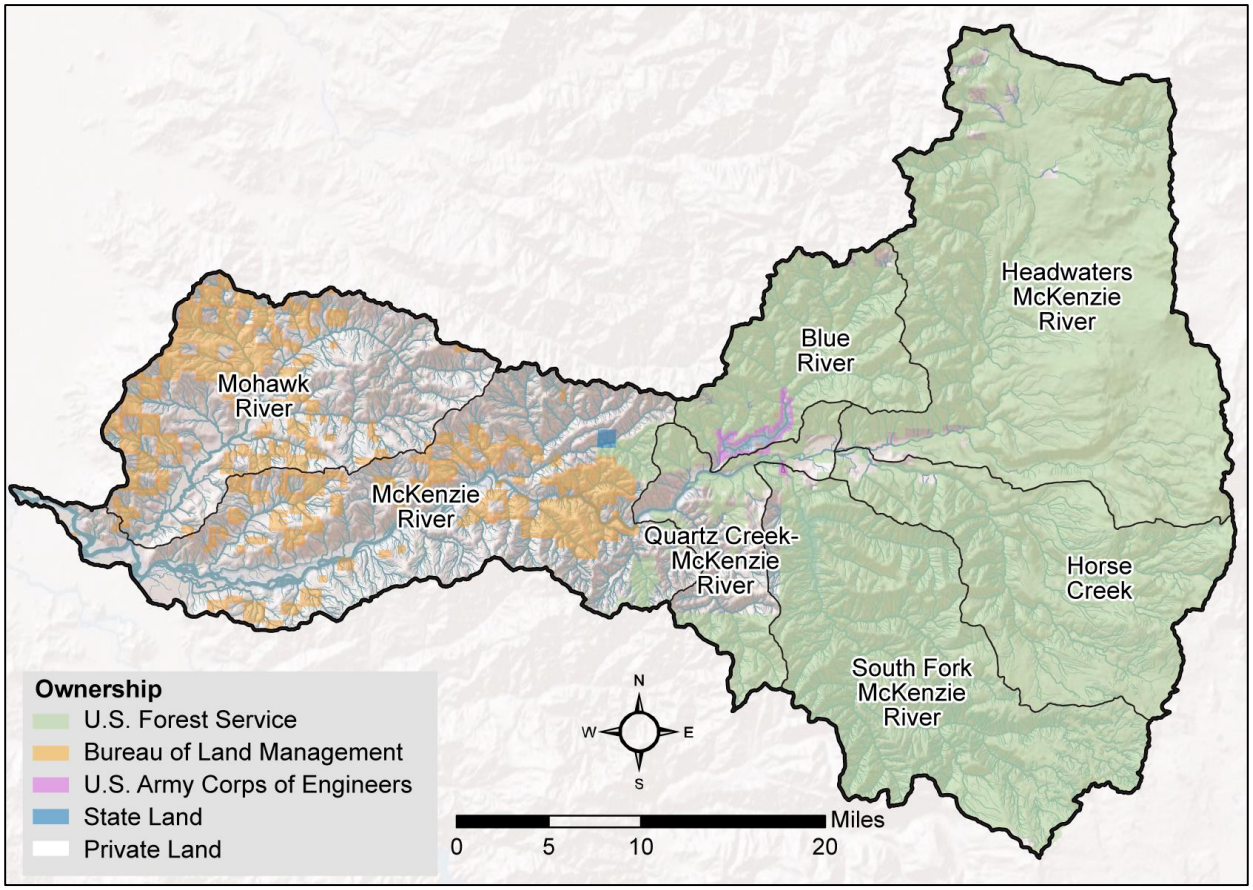


Figure 4. Land ownership in the McKenzie River Sub-basin.

The Oregon Department of State Lands (DSL) is responsible for managing submerged and submersible lands of the state's extensive navigable waterway system. Within the McKenzie River Sub-basin, river miles 0-37.5 have been determined to meet the federal test of navigability for purposes of State ownership of the underlying submerged and submersible land. DSL owns and is responsible for managing these and other lands adjacent to the river and within the McKenzie River floodplain. The Action Plan will seek to include DSL-owned riparian property when working in cooperation with adjacent landowners as appropriate.

The plan addresses both public and private sectors. All proposed actions are voluntary and are subject to approval by landowners and governed by applicable plans, laws and regulations. On federal lands all actions are subject to the National Environmental Policy Act (NEPA), the ESA, the Northwest Forest Plan and applicable agency plans. The U.S. Forest Service's Watershed Condition Framework (USFS, 2011), BLM's Environmental Assessment and Record of Decision for Aquatic and Riparian Restoration Activities (BLM, 2010) and Western Oregon Aquatic Restoration Strategy (BLM, 2015) will help guide actions on public lands. EWEB's multiple programs to protect drinking water quality involve extensive work with private landowners. The MWC, MRT and UWSWCD work with private landowners in their efforts to

conserve and restore habitat and protect water quality. The Weyerhaeuser Company owns and manages a large share of private timberland in the lower and middle portions of the Sub-basin, often intermingled with BLM land, and opportunities exist to cooperate with these two landowners to improve aquatic and riparian habitat on their lands. The MWC's McKenzie Watershed Outreach and Education Program involves multiple partners, and will work with students from throughout Lane County to provide field-based learning directly tied to restoration and conservation work taking place on private and public land. Outreach efforts involve all of the communities in the Sub-basin. Together, the partners will use their complementary strengths to address outcomes in a comprehensive and collaborative fashion.

4 GOVERNANCE/PARTNERSHIPS

There are a number of high-performing partnerships in the McKenzie River Sub-basin addressing the outcomes of the Action Plan. These include:

- ***McKenzie Collaborative:*** This group was formed in 2012 to develop new programs that protect water quality and protect and restore habitat. The Voluntary Incentives Program (VIP) and the McKenzie Watershed Stewardship Group are products of the Collaborative. Member organizations are CPRCD, Earth Economics, Ecotrust, EWEB, LCOG, MRT, MWC, MWMC, OSU, The Freshwater Trust (TFT), UO, USFS, and UWSWCD. The group is led by EWEB and meets monthly on the second Friday.
- ***McKenzie Watershed Stewardship Group:*** This new group signed an operating agreement in 2014 and serves to advise the McKenzie River Ranger District on restoration projects funded by stewardship contracting revenues and other sources of restoration dollars. Members are USFS, EWEB, MRT, MWC, BLM, UWSWCD, Oregon Wild, a private forester, Oregon Department of Forestry (ODF), and CPRCD. The group is convened by EWEB and meets monthly on the second Monday. Interested landowners or members of the public may attend these meetings.
- ***Shade Credit Partnership:*** The Metropolitan Wastewater Management Commission (MWMC) for the Cities of Eugene and Springfield and Lane County is funding an initial shade credit project involving TFT and MWC targeting Cedar Creek in the McKenzie Sub-basin. EWEB and MWMC are in the process of entering into an agreement to align additional investments with VIP landowner opportunities.
- ***Lower McKenzie Fish Habitat Enhancement:*** This is a partnership involving EWEB, ODFW, MRT, and MWC to conserve and restore floodplain and riparian habitat in the lower watershed. This partnership started in 2005 and is expected to continue for 20 years. Annual funding is provided by EWEB and is used to match grants for acquisitions, easements and restoration projects.
- ***Berggren Watershed Conservation Area:*** MRT, EWEB, MWC and a private farm enterprise collaborate to restore floodplain forest and operate a sustainable farm on 92 acres in the lower Sub-basin.
- ***McKenzie Watershed Emergency Response System:*** EWEB, USACE, Region 2 HazMat, McKenzie Fire, Eugene Springfield Fire, Springfield Public Works, Lane County Sheriff and Public Works, Oregon Department of Transportation (ODOT), Oregon Department of Environmental Quality (DEQ), USFS, Weyerhaeuser, and Springfield Utility Board (SUB) collaborate to maintain a GIS system, spill response trailers, and conduct annual drills to test pre-determined response strategies.
- ***Healthy Farms Clean Water Program:*** EWEB, Oregon State University (OSU), OSU Extension, UWSWCD, CPRCD, Willamette Farm and Food Coalition (WFFC), Lane Community College (LCC), Northwest Center for Alternatives to Pesticides (NCAP), Oregon Tilth, Oregon Hazelnut Commission, hazelnut growers, blueberry growers, and other farmers collaborate to reduce chemical use on farms, establish local food markets, obtain organic certification, assist with nutrient management, and remove old agricultural chemicals from farms.
- ***South Fork McKenzie River Floodplain Enhancement:*** The USFS and MWC are facilitating a partnership to restore about 400 acres of historically high value fish and wildlife habitat along 4.5 miles of the South Fork McKenzie River below Cougar Dam. The design for this project, funded by OWEB and USFS, is currently being done by a USFS enterprise team that specializes in

large-scale restoration and USFS staff. Additional interested partners include ODFW, U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), EWEB, Trout Unlimited, University of Oregon (UO), OSU, and USACE.

- ***Water Quality Monitoring:*** Water quality monitoring is occurring throughout the Sub-basin by EWEB, SUB, USFS, BLM, MWC, Springfield Public Schools (SPS), and McKenzie and Marcola Schools. This includes baseline monitoring, storm event monitoring, harmful algal bloom monitoring and other special projects.
- ***Lane County Pollution Prevention Coalition (lanep2c.org):*** This partnership consists of EWEB, SUB, DEQ, Lane County Waste Management, City of Springfield, City of Eugene, MWMC, and Lane Regional Air Protection Agency (LRAPA) to implement education and business programs that reduce use of toxics. This has led to the EcoBiz certification program for auto repair which recognizes businesses who take steps to minimize air, water, and solid waste pollution.
- ***Field-based Education:*** The fundamental focus of the MWC Outreach and Education Program is the direct involvement of students in hands-on, inquiry- and field-based education centered in watershed assessment, monitoring and enhancement projects. The MWC partners with private landowners and the following agencies, utilities and organizations: USFS, BLM, ODFW, EWEB, SUB, and MRT. Partnering school districts include SPS, McKenzie, Marcola, Eugene-4J, Bethel, and South Lane School Districts, as well as LCC and UO.
- ***Mohawk Watershed Partnership:*** The Mohawk River is the major tributary in the lower McKenzie. The Partnership was created in 1999, and its members are landowners and citizens in the Mohawk Watershed interested in habitat restoration and community outreach.
- ***Cedar Creek Partnership:*** This partnership was created in 2010 to maintain flows, water quality and habitat in Cedar Creek, a lower river tributary. Members include MWC, SUB, City of Springfield, Lane County, SPS, Willamalane Parks, Cedar Creek Irrigation Association, EWEB, Oregon Water Resources Department, and private landowners.
- ***HJ Andrews Experimental Forest:*** The Experimental Forest, created in 1948, is a 16,000-acre ecological research site located in the Blue River Watershed of the McKenzie Sub-basin. Research is administered cooperatively by the USFS's Pacific Northwest Research Station, Willamette National Forest, and OSU.
- ***McKenzie Interpretive Center:*** A partnership has formed to plan, finance and build a McKenzie Interpretive Center that is expected to rival the High Desert Museum near Bend, OR. The Center will showcase the fish, the fishermen, and the origin of the McKenzie drift boat and the unique hydrogeology of the watershed.
- ***Salmon Stewards of Lane County:*** This partnership was formed to guide the planning and implementation of Salmon Watch. Member organizations include BLM, Bethel School District, Eugene School District 4J, EWEB and MWC.

Roles of the principal partner organizations involved in action plan implementation are as follows:

BLM: planning and implementation of riparian and aquatic habitat improvement and fish passage projects; roads management; participant in McKenzie Watershed Stewardship Group; outreach and education; major landowner; technical support; and funding.

City of Springfield: implementation of storm water management plan; drinking water protection code; septic tank outreach and education program, EcoBiz, Auto Shops Program, Clean Water Garden

Program, program for chemical storage and use, annual Lane County hazardous waste roundup, garden center and nursery outreach, drug take back box at Justice Center and annual roundup, MWERS drills and training, and local match funding.

EWEB: implementation of DWSP; implementation of Lower McKenzie River Fish Habitat Enhancement Program; outreach and education; convener of the McKenzie Collaborative and McKenzie Watershed Stewardship Group; implementation of VIP Program; funding; technical support; and monitoring. EWEB will provide significant matching funds, dedicate staff time, provide monitoring and survey equipment, maintain databases and websites, fund and manage contracts of partners associated with LiDAR/GIS/data management/website maintenance (LCOG), water quality monitoring/data analysis (USGS), ecosystem service accounting/valuing return on watershed investments (Earth Economics and Ecotrust), fiscal management of watershed investments (CPRCD), and watershed research (UO and OSU), and provide funding for conservation easements and land acquisition (MRT).

Lane County: planning and collaboration of riparian and other stewardship projects on County lands within the Sub-basin; outreach and education.

MRT: conservation acquisitions and easements; landowner; planning and implementation of riparian and aquatic habitat enhancement projects on MRT land in cooperation with MWC and other partners; participant in McKenzie Collaborative, McKenzie Watershed Stewardship Group, and Lower McKenzie Fish Habitat Enhancement Program; outreach and education; grant applications and grant management; technical support; and monitoring.

MWC: planning and implementation of riparian and aquatic habitat enhancement projects and outreach activities; coordination of Lower McKenzie River Fish Habitat Enhancement Program; grant applications and grant management; fiscal management; participant in McKenzie Collaborative and McKenzie Watershed Stewardship Group, MWC/USFS partnership; MWMC Shade Credit Program; and participant in VIP program.

ODFW: participant in Lower McKenzie River Fish Habitat Enhancement Program; outreach and education; monitoring; and technical support.

School Districts: Springfield, McKenzie and Marcola School Districts partner with MWC and others to implement field-based education programs.

SUB: implementation of drinking water protection program; outreach program; local match funding; and funding of watershed education programs in Springfield.

U.S. Army Corps of Engineers: planning to increase peak flows in the South Fork McKenzie River and resolve fish passage problems at Cougar Dam.

USFS: planning and implementation of riparian and aquatic habitat improvement and fish passage projects; roads management; participant in McKenzie Collaborative, McKenzie Watershed Stewardship Group and MWC/USFS partnership; major landowner; technical support; outreach and education; monitoring; and funding.

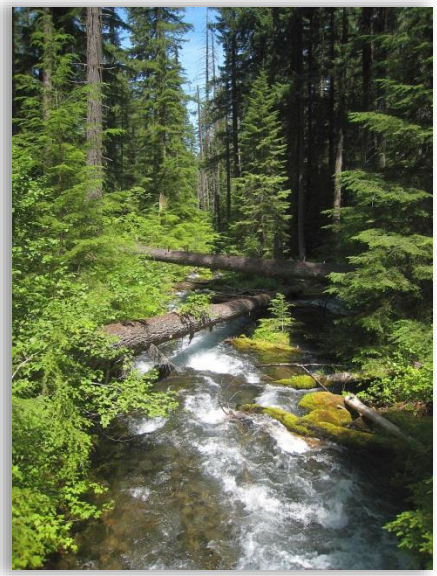
UWSWCD: planning and implementation of riparian habitat improvement projects, cattle exclusion systems and manure management devices, especially on agricultural land; participant in McKenzie Collaborative, McKenzie Watershed Stewardship Group and VIP Program.

Weyerhaeuser Company: major landowner; roads management; culvert replacements; cooperator in implementing fish habitat improvement projects; technical support; and funding.

5 CONTEXT: PROFILE OF THE AREA

5.1 Physical Geography

The McKenzie River Sub-basin extends from the central Cascade Mountain Range to the Willamette Valley, joining the Willamette River just north of the City of Eugene, Oregon. The Sub-basin covers 1,300 square miles, with elevation ranging from 10,358 feet at the summit of South Sister to 375 feet at the confluence with the Willamette River. The McKenzie River originates from Clear Lake, flowing south for 15 miles to Belknap Springs and then west 75 miles, where it enters the Willamette River as a major tributary, approximately doubling the discharge of the Willamette River (Minear, 1994).



Roaring River, headwater stream in the McKenzie River Sub-basin. (Photo: USFS)

The McKenzie River Sub-basin is largely contained within two geologic provinces, the High Cascades and Western Cascades (**Figure 5**). The High Cascade province is found in the high elevation headwaters of the Sub-basin and is characterized by volcanic rocks with extensive lava flows and glacial deposits. Large areas of the High Cascades lack developed stream networks. Within these areas rain runoff and snow melt infiltrates through the relatively young permeable volcanic material feeding large underground aquifers. This notable feature has profound impacts on the water quality and quantity of the McKenzie River.

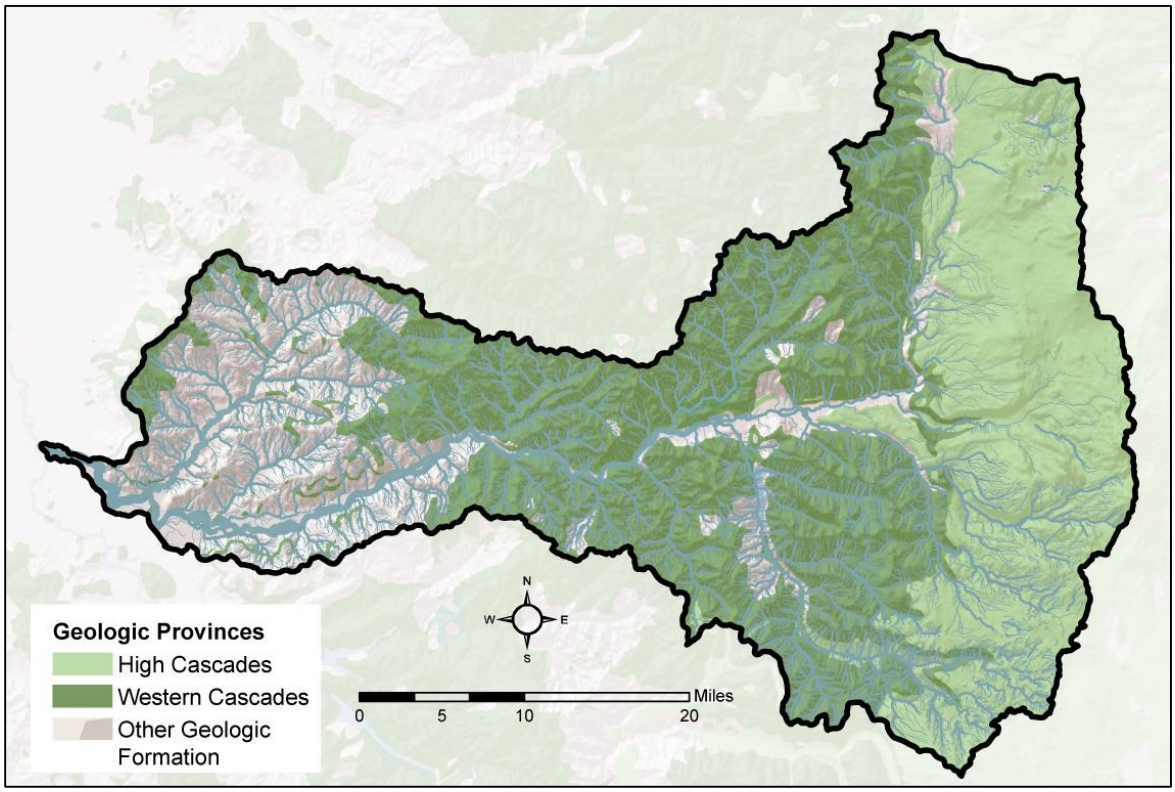


Figure 5. Dominant geology of the McKenzie River Sub-basin.

From the High Cascades the river then follows a fault-defined valley south to Belknap Springs, where it turns west through the older, less permeable volcanic material of the West Cascades province. The landscape is significantly more dissected within the Western Cascades, and stream flows are more heavily influenced by rain runoff rather than springs. Glacial influences diminish within this region with the most recent glacial advances marked by the Lost Creek moraine downriver from Belknap Springs. Earlier glacial advances extended farther downriver to Blue River, below which bedrock outcrops are more prevalent in the channel. Channel slope reflects the transition from volcanic to glaciated landforms as it decreases from 1.2% upriver of Belknap Springs to less than 0.4% in the area of Blue River. The river bottoms within the lower McKenzie are more characteristics of the Willamette Valley province. Landform is characterized by a broad floodplain with alluvial deposits and underlying basalt sedimentary rock (Sherrod and Smith, 2000).

The physical characteristics of the river channel change considerably moving downstream. The river channel within the upper Sub-basin is largely confined to a single channel, with limited floodplain and constrained by hillslopes. Downstream of Leaburg Dam the valley begins to widen but is still constrained by hillslopes on its southern bank. To the east of Springfield the valley opens up, and the river begins to meander widely. Floodplains and terraces are generally lower in elevation and regularly flooded. Aerial photos from 1910 reveal a complex river system, with side channels, alcoves, islands, and ponds which provided diverse habitat. Today the channel is constricted in many places by development and a series of revetments. The lower river still retains some of these diverse habitat features, and active efforts are underway to conserve the best habitat. The McKenzie River currently enters the Willamette River about three miles upstream from where it did in 1965. The old McKenzie River channel along this three-mile section contains diverse floodplain habitat, is only fully watered during high flows (MWC, 2000), and is nearly all contained on landed owned by the MRT.

5.2 Water Resources

The geology of the High Cascades fundamentally influences the water resources of the McKenzie River. The porous and fractured rock of the High Cascades allows snow melt and rain runoff to filter down underneath the ground and avoid picking up sediment. Underground flows and aquifers hold runoff for long periods of time and tend to release water at a relatively constant rate. The McKenzie River's headwater springs provide a source of clear, cold water at a consistent rate throughout the year. This has significant water quality and quantity implications for both the McKenzie and Willamette Rivers. A total of 42% of the McKenzie River Sub-basin lies within the High Cascade geologic province (**Figure 5**), the most of any Willamette River tributary (Sherrod and Smith, 2000; Jefferson and Grant, 2010). This contributes to both the river's exceptional water quality and its significant influence on downstream water quality and quantity. One study looking at spring discharge influence on summer flows within the McKenzie River calculated that over 80% of the river flow measured at the Vida gauging station came from the Sub-basin's spring-fed streams (Jefferson and Grant, 2006). The McKenzie River Sub-basin covers less than 12% of the total area of the Willamette River Basin but accounts for nearly 25% of the Willamette River's flow during low flow periods (PNWERC, 2002). Historically, the McKenzie River accounted for over 40% of the Willamette River's flow in Portland Harbor prior to construction of dams (Tague and Grant, 2004).

The spring-fed nature of the McKenzie River is the basis of the river's exceptional water quality. The McKenzie River is the sole source of drinking water for nearly 200,000 people in the Eugene metropolitan area, including the community of Veneta to the west of Eugene. Wells fed by the river are one of two sources providing drinking water to over 56,000 City of Springfield residents. Municipal water withdrawal points are located in the lower watershed meaning that upstream land uses directly

influence drinking water quality. Residents outside of the Springfield-Eugene metropolitan area rely upon the McKenzie River as a drinking water source either through wells or a number of smaller scale water providers.

In addition to being both a municipal and non-municipal drinking water source, the McKenzie River is the source for numerous out-of-stream and in-stream water rights. Out-of-stream water rights supply various industrial and agricultural interests, primarily within the lower portion of the Sub-basin. In-stream water rights include fish protection and recreation. Portions of the McKenzie River are one of the few areas within the Willamette Basin where surface water rights have not been fully allocated (PNERC, 2002).

There are total of six dams within the Sub-basin (**Figure 6**), which provide hydroelectric power, flood control, irrigation and recreation. In the lower river, EWEB operates the Leaburg-Walterville Hydroelectric Project, consisting of two power canals with associated power stations and Leaburg Dam. Water is diverted from the McKenzie River into the two canals, used to make power, and then returned to the main stem river. The Walterville Canal was constructed in 1911, and the Leaburg Canal and Leaburg Dam were constructed in 1930. The partial dewatering of the McKenzie River associated with Leaburg and Walterville Canals impacts 5.9 miles and 7.3 miles, respectively. In the early 1960s, EWEB constructed the Carmen-Smith Project near the headwaters of the McKenzie. McKenzie River water is withdrawn below Koosah Falls and diverted to the Smith River via an 11,381-foot diversion tunnel dissecting the ridge between the two drainages. The Smith River then feeds Smith Reservoir which acts as the storage center for the Carmen Power Plant. Water is released from the Carmen Power Plant downstream to Trail Bridge Reservoir which acts as a re-regulating reservoir. Two projects constructed by the USACE, Cougar Dam on the South Fork (1964) and Blue River Dam (1968), function primarily as storage projects and serve to modify the flood flows of the McKenzie and Willamette Rivers. Cougar Dam is equipped with hydroelectric capacity, while Blue River Dam is not. Cougar Dam has been retrofitted with a temperature control tower and upstream passage facility for returning adult salmon and other native fish. The USACE is planning to build a permanent downstream passage facility at Cougar. (See Section 6 for information on impacts of dams.)

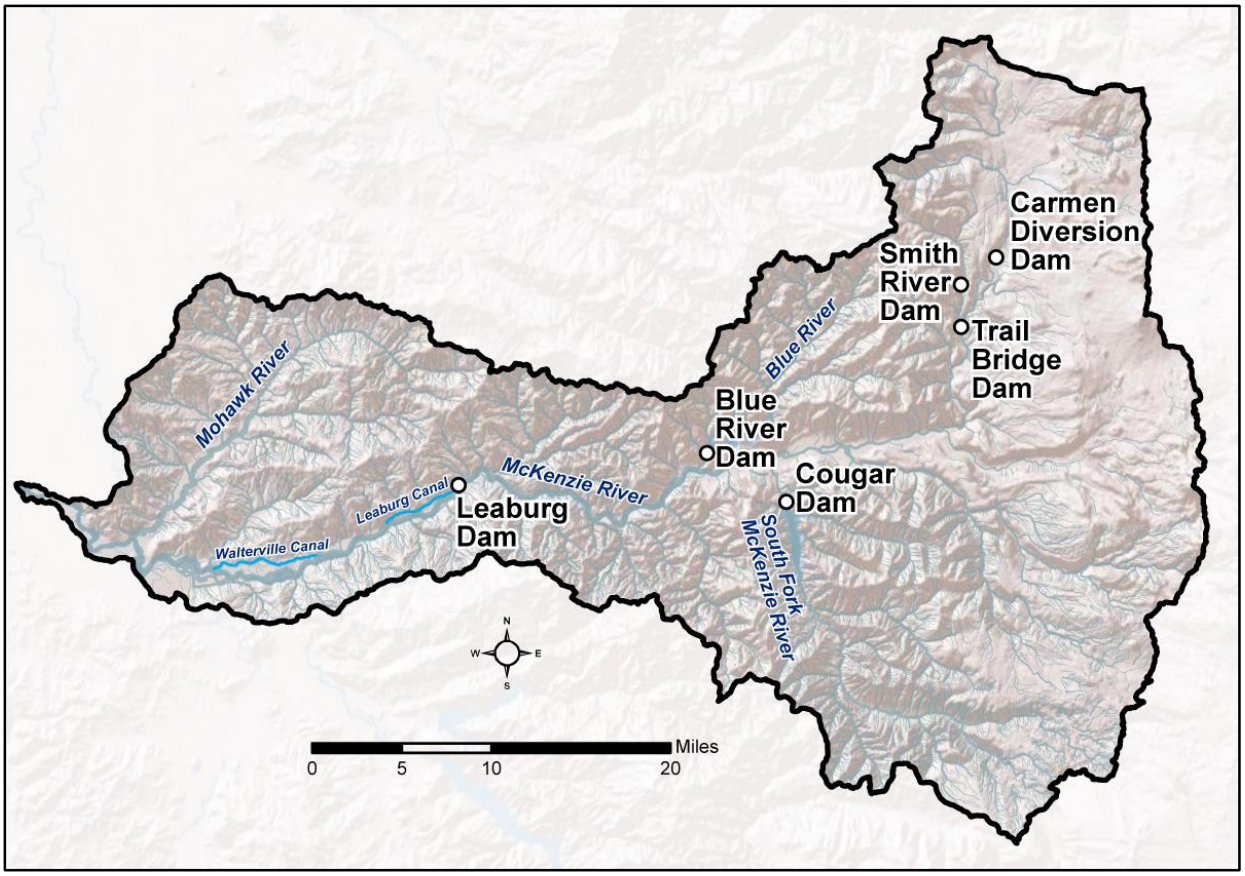


Figure 6. Location of six dams in the McKenzie River Sub-basin.

The federal Clean Water Act (CWA) requires states to compile a list of state waters that do not meet applicable water quality standards. Section 303(d) of the CWA identifies water quality standards to protect drinking water, aquatic habitat, recreation and other uses. In Oregon, the Department of Environmental Quality (DEQ) is responsible for identifying water bodies that do not meet CWA 303(d) standards. The Willamette Basin TMDL (Total Maximum Daily Load) Water Quality Management Plan (DEQ, 2006) is a pollution analysis to determine why certain waterbodies in the basin do not meet water quality standards and a strategy to return those waterbodies to a healthy status. The Oregon 303(d) lists state water bodies that do not meet CWA 303(d) standards and where a TMDL is required to be developed. Within the McKenzie River Sub-basin over 170 miles of stream are identified on the state 303(d) list for temperature or dissolved oxygen (DEQ, 2006).

The river has been further impacted by the placement of large rock in levees and riprap to redirect the flow of the river and protect stream banks, homes, farm lands, roads and mining operations. The majority of the levees and riprapped banks found on the McKenzie River are concentrated downstream of Hendricks Bridge (MWC, 2000). Within the lower 5 miles of the river from its confluence upstream to the Interstate 5 Highway Bridge, approximately 18% of the McKenzie River banks, roughly 1.5 miles, are constrained by riprap (MWC, 2000).

5.3 Biotic Systems

Biotic components of the McKenzie River Sub-basin can be generally characterized in terms of its vegetative communities, fisheries and terrestrial wildlife. Native fish and wildlife species found within

the Sub-basin are well adapted to the various ecosystems. As anthropogenic forces have altered these ecosystems, biotic communities have also changed.

The McKenzie River Sub-basin is contained within two Environmental Protection Agency Level III Ecoregions (ftp://ftp.epa.gov/wed/ecoregions/or/or_eco_pg.pdf). The Willamette Valley Ecoregion covers the broad floodplain of the lower reaches of the McKenzie River and the lower reaches of larger tributaries such as the Mohawk River and Camp Creek. Historically this area was characterized by open prairie and oak savannahs, wetlands and wide bottomland riparian forest concentrated along the main stem McKenzie River. The West Cascade Ecoregion covers the remainder of the Sub-basin and is generally characterized by older, lower elevation mountains with numerous steep stream valleys. Natural vegetation in this area is characteristic of the western hemlock zone, the most extensive vegetation zone in western Washington and Oregon. Western hemlock, western red cedar and Douglas fir dominate the over story up to about 3,500 feet. Pacific silver fir and noble fir are the transition tree species with mountain hemlock, subalpine fir and lodgepole pine dominating above 4,500 feet.

South Fork McKenzie River bull trout (Photo: K. Meyer)

The McKenzie River is home to 23 native fish species and supports an economically important fishery composed of native rainbow trout, cutthroat trout, spring Chinook salmon, non-native brook trout and hatchery-origin steelhead. Historically, the McKenzie River has been an important spawning area for ESA-threatened spring Chinook salmon and is considered the most important remaining area for natural production in the Willamette Basin. Prior to construction of dams, the McKenzie River produced an estimated 40% of the spring Chinook run above Willamette Falls. Anadromous fish now can access 57 miles of habitat on the McKenzie; an additional 70 miles of previously available habitat has been blocked by dams. The McKenzie River population of spring Chinook has a low risk of extinction and is considered a genetic legacy population for the Upper Willamette Evolutionarily Significant Unit, but current run sizes are a fraction of historical levels. McKenzie spring Chinook historical abundance is estimated at 110,000 (ODFW and NMFS, 2011). Recent counts observed at the Leaburg Dam fish ladder document returns below 2,000 wild-origin spring Chinook salmon to the McKenzie River (ODFW, personal communication, 2015) (**Figure 7)**.

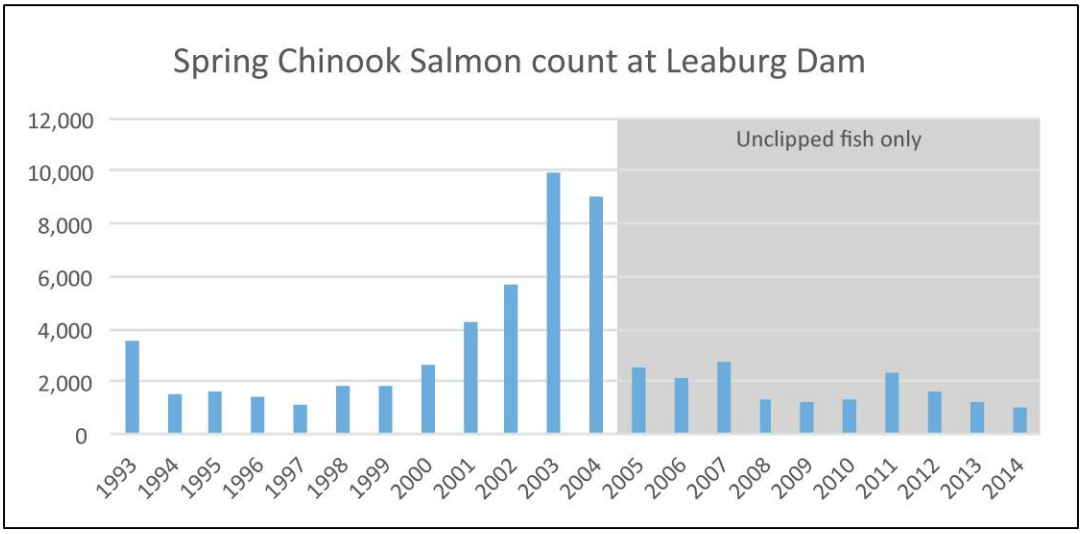


Figure 7. Adult spring Chinook counts at Leaburg Dam. (Note: Counts prior to 2005 do not differentiate between hatchery (clipped) and wild (unclipped) fish. The data from 2005-2014 are wild fish only.) Source: ODFW

The McKenzie River is also a stronghold for ESA-threatened bull trout in the Willamette River Basin. Bull trout historically occurred in eleven Oregon sub-basins within the Columbia Basin, plus the Klamath Basin. They once occurred in much of the Willamette Basin, but now reside only in the McKenzie River and more recently the Clackamas and Middle Fork Willamette Rivers following reintroduction efforts with fish of McKenzie River origin. Bull trout are highly dependent upon cold water and are primarily found in the main stem McKenzie River upstream of Leaburg Dam, Horse Creek and in the South Fork McKenzie River above and below Cougar Dam. A small population of bull trout also exists in the main stem McKenzie River upstream of Trail Bridge Dam.

The Oregon chub is found only in the Willamette Valley and depends upon floodplain habitats such as sloughs, beaver ponds and marshes. There are multiple known populations of Oregon chub in the McKenzie and Mohawk Watersheds. The small minnow was listed as endangered by the US Fish and Wildlife Service in 1993, and the Oregon Chub Recovery Plan was adopted in 1998 (USFWS, 1998). Since that time, basin-wide efforts, including those in the McKenzie Sub-basin, have contributed to Oregon chub becoming in 2015 the first fish ever to be removed from the list of endangered and threatened species.

Hatchery rainbow trout, summer steelhead and spring Chinook are released in the McKenzie River. The ODFW-operated Leaburg Hatchery produces rainbow trout which are used to stock the main stem McKenzie River between Hendricks Bridge and Blue River. ODFW's McKenzie Hatchery produces spring Chinook salmon which are released directly into the McKenzie River at the hatchery downstream of Leaburg Dam.

The McKenzie River Sub-basin provides habitat for a number of big game species including black-tailed deer, Roosevelt elk, black bear and mountain lion. Grasslands occurring as natural openings and meadows within the forested zones of the Western Cascades Ecoregion are important habitat for big game species and upland bird species such as blue and ruffed grouse, mountain quail, hawks and owls. Oak savannas within the lower Sub-basin and Mohawk watershed provide a measure of habitat diversity. Agricultural lands, particularly in the lower Sub-basin and Mohawk watershed, are important habitat for wildlife and waterfowl. Floodplain habitats, particularly within the lower Sub-basin provide

connectivity between riverine and upland habitats and are important areas for wildlife and amphibians such as western pond turtle and red-legged frog (LCOG, 1996).

5.4 Human Population, Local Communities and Land Use

Native Americans have lived along the McKenzie River for about 8,000 years (Williams, 2015 in Oregon Encyclopedia). The Kalapuya and Molalla tribes lived in the area seasonally until the 1850's when native people were moved to federal reservations. Subsequently, European settlers began populating the area.

Current communities in the Sub-basin include parts of Eugene, Springfield, Thurston, Marcola, Cedar Flat, Walterville, Leaburg, Vida, Nimrod, Blue River, Rainbow, and McKenzie Bridge (**Figure 8**). With the exception of Eugene and Springfield, all communities are unincorporated areas within Lane County. Lane County has a present population of over 350,000, (US Census Bureau, 2010). A County-wide population of just over 435,600 is anticipated to be seen by 2035, an increase of over 89,700 (Portland State University, 2009).

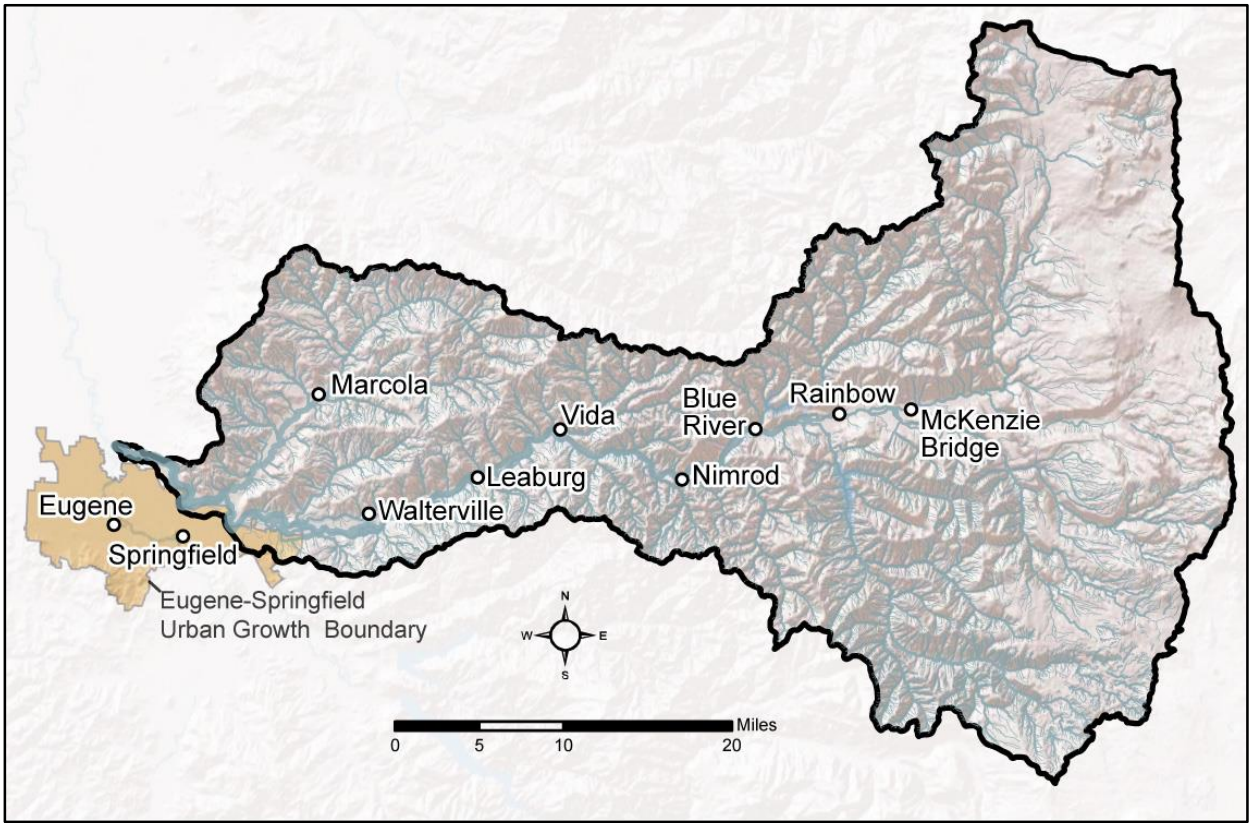


Figure 8. **Communities of the McKenzie River Sub-basin.**

Land use within the McKenzie River Sub-basin is dominated by forestry. Federal forest lands, managed by the BLM and USFS, account for over 500,000 acres or 64% of the land cover within the Sub-basin (NRCS, 2005). Federal forest lands managed by the USFS are primarily located in the Blue River, South Fork McKenzie River, Horse Creek and Headwaters McKenzie River Watersheds. Federal forest lands managed by the BLM are predominately located in the Mohawk River Watershed, with small holdings near Vida in the McKenzie River Watershed. Private forestry lands total over 200,000 acres, approximately 25% of the Sub-basin, and are primarily concentrated in the McKenzie River, Mohawk River, and Quartz Creek-McKenzie River Watersheds (NRCS, 2005).

Agricultural lands are found primarily in the floodplain of the lower Sub-basin and Mohawk River Watershed. Seventy-five percent of the farms are less than 50 acres in size (NRCS, 2005). Private pasture and hay fields account for over 33,000 acres or 4% of the Sub-basin (NRCS, 2005). There are roughly 1,000 acres of hazelnut orchards found along the McKenzie River (EWEB, 2000). Other crops such as blueberries, Christmas trees and row crops are also grown commercially but account for less than 1% of the land cover (NRCS, 2005).

Rural development is largely concentrated within the lower Sub-basin, the Mohawk River Watershed and smaller portions along the McKenzie River and major tributaries in the Quartz Creek-McKenzie River, Horse Creek and Headwater Watersheds. Urban development is concentrated within the Urban Growth Boundaries of the Eugene and Springfield and occupies approximately 17,000 acres, less than 1% of the Sub-basin (NRCS, 2005). Development in the Sub-basin could increase by 730 to 980 new homes over the next 30 years (LCOG, 2010). Nearly 60% of this development will occur in the lower McKenzie. The majority of future development will occur on tax lots within 300 feet of the river or other water bodies. More than 200 structures currently exist within the floodway, and over 1,100 structures are within the 100-year floodplain, with many requiring revetments for protection.

Sand and gravel mining is an important local industry. Due to the abundance of natural sand and gravel deposits, mining is a major land use activity in the confluence area of the McKenzie and Willamette Rivers, with major operations on both the north and south banks of the McKenzie River.

Public road systems within the Sub-basin include Interstate 5 in the lower Sub-basin, Oregon State Highways 126 and 242, Lane County roads and City of Springfield roadways. An extensive public road system within the Willamette National Forest provides access for management, recreation and resource extraction. The BLM also manages an extensive road system, primarily within the Mohawk River Watershed. Many of the forest roads are managed in cooperation with private timber companies. Private road systems on private timber lands provide access for forestry operations throughout the Sub-basin. Public access is typically seasonal or controlled on these private road systems. Numerous public agencies, private individuals and companies, and non-governmental organizations have invested heavily in addressing fish passage barriers at road crossings in the Sub-basin. In the upper Sub-basin, all known fish passage barriers for Chinook salmon at road crossings have been addressed.

Recreation is an important economic industry in the McKenzie River Sub-basin, particularly hiking, cycling, rafting, kayaking and fishing. The McKenzie River National Recreation Trail follows the river for over 20 miles in the upper Sub-basin and is recognized as a nationally-renowned mountain bike, trail running and hiking destination. The Mt. Washington and Three Sisters wilderness areas cover roughly 225,000 acres and provide multiple hiking opportunities. The main stem McKenzie River is heavily boated, both recreationally and commercially, from Olallie Boat Ramp (River Mile 81) to the confluence. A 12.7-mile section of the McKenzie River from Clear Lake to Scott Creek is designated as a National Wild and Scenic River. Oregon Scenic Waterway designation includes the McKenzie River from Clear Lake to Paradise Campground and two sections of the South Fork McKenzie River above and below Cougar Dam. There are two National Scenic By-ways within the Sub-basin, Aufderheide Drive (USFS Road 19) and the Old McKenzie Pass Highway 242. Multiple county, state and federal parks and campgrounds are present, and in general, heavily used.

6 CONSERVATION NEED

Conservation needs and key threats for the Action Plan's key species and maintenance of high quality drinking water were identified through a combination of previously published documents (**Table 1**), rapid watershed assessments (**Appendix A**) conducted as part of the planning process for this document, and professional opinion. This process identified multiple causes of impaired physical and biological processes which pose a threat to habitat and/or drinking water. Identified causes include: dam construction; rural and urban land development; roads; land use; fire suppression; invasive species; recreational impacts; and climate change. **Table 2** lists threats to conservation of McKenzie River resources and their impacts, and links the threats to proposed actions.

Table 2. McKenzie River conservation threats and impacts, and proposed actions to address threats.

Threats	Impacts	Actions
Sub-basin dams	• Altered downstream flow regime • Altered downstream sediment and large wood transport • Impaired fish passage • Altered temperature regime • Altered floodplain connectivity and productivity • Altered aquatic habitat complexity	Work with USACE to periodically release channel forming flows below Cougar Dam.
		Implement gravel augmentation in the South Fork basin below Cougar Dam.
		Work with USACE on downstream passage at Cougar Dam.
		Implement in-stream large wood placement projects below Cougar Dam.
		Implement levee and revetment removal projects in the South Fork basin below Cougar Dam.
		Hatchery Chinook salmon carcass placement.
Rural and urban development	• Altered riparian function • Decreased aquatic habitat complexity • Decreased floodplain connectivity and productivity • Impacted water quality • Fish passage barriers at road crossings	Implement riparian and floodplain protection and restoration activities under the VIP.
		Implement riparian enhancement at priority locations outside of current VIP boundary.
		Implement passage projects on priority road crossings.
		Identify and prioritize remaining fish passage barriers.
		Work with federal agencies and others to reduce water quality impacts from roads.
		City of Springfield and EWEB storm water treatment programs.
		Septic system assistance program with rural residents.
		Naturescaping workshops with rural residents.
		Hazardous waste spill response team.
		Hazardous chemical and material round-ups with rural and urban residents, urban businesses.
Land use	• Altered riparian function • Altered upland function • Decreased aquatic habitat complexity • Decreased floodplain connectivity and productivity • Impacted water quality	Implement LWM projects at priority sites.
		Hatchery Chinook salmon carcass placement.
		Implement Healthy Farms/Clean Water Programs.
		Nutrient reduction projects (manure composting).
		Hazardous chemical & material round-ups with local farms.
		Maintain partnerships.

Fire suppression	• Altered riparian function • Altered upland function • Impacted water quality	No specific actions proposed in the Action Plan at this time.
Invasive species	• Altered riparian function • Impacted water quality	Implement protection and restoration activities on cooperating private lands under the VIP.
		Implement riparian enhancement at priority locations outside of current VIP boundary.
Recreation	• Decreased aquatic habitat complexity	No specific actions proposed in this Plan.
Climate change	• More frequent winter flooding • Longer summer dry spells	Certain actions can mitigate for climate change, such as maintaining or restoring river/floodplain connections and conserving or enhancing riparian habitat.

6.1 Dam Construction and Operation

Dams provide benefits such as flood control, power generation, irrigation and recreation, and they have increased summer flows. They also fundamentally alter instream and floodplain habitat and are a key threat to spring Chinook salmon, bull trout, and other native fish species. Dams limit or block upstream and downstream passage, alter the natural thermograph below the facilities, limit the frequency and amplitude of peak flows that help to restore aquatic ecosystems, and block recruitment of large wood, nutrients, and sediment to downstream areas, thus limiting aquatic habitat quality and complexity. The six dams in the Sub-basin have varying impacts on habitat and key species. Non-federal dams are licensed and regulated by the Federal Energy Regulatory Commission (FERC). Federal dams operated by the USACE are subject to the Clean Water Act (CWA) and Endangered Species Act (ESA).

Cougar Dam on the South Fork McKenzie River (Photo: USACE)

Fish Passage: Dam construction in the McKenzie River Sub-basin has blocked access to 70 miles of habitat for native anadromous and migratory fish and has had varying impacts on downstream passage. Leaburg Dam is the only dam in the McKenzie River Sub-basin equipped with a fish ladder. The Leaburg Dam fish ladder was upgraded in 2007 as a condition of EWEB's relicensing agreement with FERC. Downstream migrating juvenile salmon are prevented from entering the power canal by a fish screen and are returned to the river via a pipe. The lower-most dam in the Carmen-Smith Hydroelectric Project, Trail Bridge Dam, lacks a fish passage facility and blocks access upstream to Tamolich Falls, a natural barrier. Smith River Dam and Carmen Dam are both considered to be located upstream of spring Chinook habitat and are not equipped with passage facilities. An application from EWEB for the renewal of the license to operate the Carmen-Smith Project is currently pending with FERC. A likely condition of relicensing will be the requirement to provide for both upstream and downstream passage for spring Chinook salmon and bull trout at Trail Bridge Dam.

Blue River Dam lacks a fish passage facility and blocks access to the watershed for anadromous fish above river mile 1. Current USACE priorities within the Willamette River Basin do not address fish passage at Blue River Dam. The USACE completed construction of a fish trap-and-haul facility on Cougar Dam in 2010 and is currently working on a permanent downstream fish passage solution. Both efforts

address key limiting factors identified in the Willamette Project Biological Opinion (NMFS 2008), which details effects of dams on the continued existence of Willamette spring Chinook salmon and steelhead listed under the ESA.

Temperature: The installation of dams within the Sub-basin has altered river temperature with a negative impact to native fish. Water temperatures can have a significant influence on the timing of fish migration, fry emergence, growth rates, nutrient cycling and the biological process of aquatic plants and insects. The construction of Cougar Dam significantly altered downstream temperature conditions on the South Fork McKenzie River. Summer temperatures were cooler and fall temperatures warmer, which affected fish migration along with other negative impacts. In 2006, the USACE constructed a temperature control tower at Cougar Dam, which has returned the seasonal distribution of stream temperatures to a more natural pattern (Risely, et al., 2010). Plans to install a similar temperature control on the Blue River Dam were abandoned in the mid-2000s, and the dam continues to disrupt the natural seasonal distribution of temperatures with cooler stream temperatures during the summer and warmer fall stream temperatures. Despite the lack of a temperature control tower at Blue River Dam, its thermal impact on the McKenzie River is limited because of the relatively small size of the tributary compared to the main stem McKenzie River (Risely, et al., 2010).

The two EWEB-operated hydroelectric projects have varying thermal impacts on the McKenzie River. Because of its relative size and operation (hydropower generation only as opposed to flood control) the Carmen-Smith Project has not significantly affected the natural seasonal pattern of stream temperatures (Stillwater Sciences, 2006). The Leaburg-Walterville Project's primary thermal impacts are tied to the partial dewatering of the main stem channel associated with the Leaburg and Walterville Canals. Flow withdrawals from the McKenzie River into the canals are regulated by a 1996 agreement between ODFW and EWEB. Diversion flows from April through October are reduced in order to limit temperature increases in the main stem McKenzie River and eliminate flows from the canal that could attract migrating salmon. Gauges currently exist above canals (Vida), in dewatered portion of canals (Leaburg and Walterville), and below canals (Hayden Bridge). All gauges measure continuous flow and two monitor temperature (Vida & Hayden Bridge).

Flows: The installation of the two large flood control dams and two hydroelectric projects in the McKenzie River Sub-basin has dramatically altered the flow regime and disturbed multiple watershed processes critical for the creation and maintenance of aquatic and floodplain habitat. Peak flow events are vital for maintaining a river's ability to meander and create new side channels, alcoves and other diverse habitats critical for native fish at all life stages. Peak flows are also critical for the downstream transport of large woody materials and sediment (see below). A study conducted by Minear (1994) on the main stem McKenzie River from Leaburg Dam to Trail Bridge Dam compared channel structure and position in 1945-49 to conditions in 1986. The study found that mean peak flows decreased 44%, and occurrence of peak flows with a 2-year recurrence interval declined approximately 29% after dams were constructed upriver.

Cougar and Blue River Dams were built for flood control and have significantly altered the frequency and amplitude of peak flows in the Sub-basin. Both dams have reduced the magnitude of flood events, increased summer and early fall low flows and changed the annual distribution of streamflow (Risley et al., 2010). The Carmen-Smith Project was constructed solely for hydroelectric power generation and exhibits only a moderate modulation of the annual hydrograph when compared to pre-dam conditions (Risley et al., 2010). The two power canals associated with the Leaburg-Walterville Project have significantly impacted minimum stream flows within the dewatered sections of the lower McKenzie

River. The canals reduce stream flows throughout the year in the respective dewatered sections by 1,000 to 2,000 ft^3/s (Risley et al., 2010).

Large Wood and Sediment Transport: All six dams in the Sub-basin act to disrupt and block downstream passage of woody material and have caused reduction in the downstream sediment supply. In total, the Carmen-Smith complex of dams, Cougar and Blue River Dams intercept wood and sediment from 35% of the Sub-basin's headwaters (WRI, 2004). Large wood contributes to the creation and maintenance of critical habitats such as pools, off-channel habitat and alluvial bed features. Elimination of sediment inputs from the sediment-rich Blue River and South Fork McKenzie River watersheds are assumed to have led to substantial reductions in coarse bed material entering the middle and lower McKenzie River (Risley et al., 2010). The decrease in recruitment of large wood, gravels and other sediment has negatively impacted habitat for native fish. A comparison of main stem McKenzie River conditions between 1945-49 and 1986 found less large woody material and a decrease in frequency of large pools by 19% on the main stem McKenzie River between Leaburg Dam and Trail Bridge Dam (Minear, 1994). The same study also showed adjustments to reduced sediment supply and flow alteration by dams in this system included a 57% decrease in exposed gravel bars, 40% decrease in side channel length, and a general coarsening of substrate (as compared to historical estimates).

6.2 Rural and Urban Development

Human activities associated with development can modify processes that link aquatic and terrestrial habitats. Activities which alter hydrology, vegetation and physical habitat pose a threat to aquatic habitat and drinking water quality. In the McKenzie River Sub-basin, rural development is largely regulated by Lane County. Urban development is contained within the Eugene-Springfield Urban Growth Boundary and regulated by the respective city governments.

Storm water: Storm water from both urban and rural development can alter volume and timing of discharge as well as impair water quality and physical habitat. Storm water has an increased potential to carry residues from gas, oil, and grease products, as well as heavy metals, pesticides and other toxic chemicals. Volume and water quality changes can negatively impact biotic communities including macroinvertebrate and fish populations. The City of Springfield has 30 miles of open channel waterway which convey storm water to both the Willamette and McKenzie Rivers. Assessments of open channel waterways by the City of Springfield has found that a significant number are degraded, with high concentrations of invasive vegetation and elevated water temperature (City of Springfield, 2013). Rural and urban development not only removes natural vegetation which acts to slow down and filter run-off, but also replaces it with impervious surfaces which increases pollutant loads and volume of storm water runoff. EWEB water quality monitoring has shown storm water outfalls introduce contaminants to local waterways and decrease water quality (EWEB, 2011).

Groundwater: City of Springfield residents and rural landowners throughout the McKenzie River Sub-basin rely upon groundwater as their primary drinking water source. Identified threats to the City of Springfield's groundwater drinking water system include: flooding, contamination from chemical spills or leaking underground storage tanks, railroad or highways spills, spills to surface water, and storm water contamination (City of Springfield and SUB, 2002). Chemical contamination from urban and rural-sources may leach into groundwater and the degree to which this happens and the potential consequences for aquatic ecosystems are largely unknown (IMST, 2010).

Septic: All rural residential properties within the Sub-basin rely upon septic systems for treatment of wastewater. A combination of factors such as environmental conditions (poor drainage, high water

tables, flood prone), age of the system, and history of maintenance can lead to a situation where septic systems discharge partially treated or untreated wastewater into ground or surface water. EWEB water quality monitoring immediately upstream and downstream of serval high density clusters of septic systems and from shallow groundwater in these areas indicate increasing trends in *E. coli*, total coliforms and nitrates downstream of these septic cluster areas along the McKenzie River (EWEB, 2011).

Vegetation removal: Development within the Sub-basin is typically associated with small to significant levels of removal of riparian vegetation. Riparian vegetation influences multiple aspects of aquatic and floodplain habitat including stream bank formation and stabilization, contributions of large wood and small detritus to streams, moderating stream temperatures, maintenance of channel complexity features and filtration of sediments and nutrients from surface run-off. Numerous studies have shown a strong association between aquatic ecosystem condition and riparian vegetation condition (Independent Multidisciplinary Science Team (IMST), 2010). Based on preliminary LiDAR analysis of riparian forest canopy cover within the VIP pilot project area, approximately 21% of riparian forests appear intact and healthy on private lands (i.e., have >66% canopy cover by tax lot), while nearly 50% are potentially degraded from development and past forestry and agricultural activities (i.e., have <33% canopy cover by tax lot) (Karl Morgenstern, EWEB, personal communication). Riparian human disturbance and low riparian canopy density are cited as leading stressors of stream habitat condition within the McKenzie River Sub-basin in the Willamette Basin Rivers and Streams Assessment (DEQ, 2009).

Road construction: There are over 1,900 miles of roads in the McKenzie River Sub-basin. When roads are not maintained or upgraded, or when stream crossing infrastructure is undersized for a given stream, road failures can cause chronic or catastrophic failures that input unnatural amounts of fine sediment into streams. While downstream movement of coarse and fine sediment is natural, road failures can produce excess amounts of fine sediment that can smother spawning redds, detrimentally affect macro-invertebrate populations, and decrease water quality. Undersized culverts also restrict aquatic organism passage, reducing the habitat available to these species, and can also restrict movement of wood and sediment that are vital to replenishing habitat in main stem channels. Road impacts can affect fish populations as well as aesthetic qualities of an iconic river like the McKenzie. Trucks carrying hazardous materials on Highway 126 next to the river pose a threat from spills. Current data gaps include identification of remaining fish passage barriers associated with road crossings and opportunities for road stabilization, decommissioning and storage projects with public and private landowners.

Bank stabilization: Bank stabilization structures (rip rap, levees and revetments) have been constructed on many miles of the McKenzie River, major tributaries, and smaller streams throughout the Sub-basin in order to protect rural and urban development, agricultural and industrial lands, and roads. Bank stabilization structures are primarily found in the lower Sub-basin from river mile 0 – 25, and include the reaches downstream of the I-5 bridge, along the south bank of the river in close proximity to the City of Springfield, and just downstream of Hendricks Bridge Wayside County Park (MWC, 2000). While bank stabilization serves to protect directly adjacent land and structures from floodwater and erosion, they have significant implications for geomorphology and physical habitat quality. Studies have shown revetments can increase channel capacity, velocity and the potential for downstream erosion (IMST, 2010). Numerous studies have shown that bank stabilization projects cause down cutting of channels and limit lateral channel migration and floodplain connectivity, significantly reducing stream and floodplain habitat complexity (IMST, 2010). Levees and revetments cut off side channels and other

floodplain habitats that provide critical habitat for salmon and other key Action Plan species. Given the level of complexity associated with land use surrounding existing bank stabilization, removal of existing bank stabilization structures is likely currently limited in scale within the lower Sub-basin. Actions should focus on conservation of floodplain habitat and prevention of the need for additional bank stabilization projects.

6.3 Land Use

Land use practices throughout the Sub-basin present threats to water quality and fish and wildlife habitat. Impacts vary among agricultural, forest, industrial and residential/urban (see above). The Willamette Basin Rivers and Streams Assessment (DEQ, 2009) (Assessment) examined the status of watershed conditions within the Willamette River Basin at three spatial extents: basin, sub-basin, and land use category (urban, agriculture and forest). The Assessment classified a total of 46% of the river and stream miles in the Willamette River Basin within the *most disturbed* category as measured by stream insect community and other macroinvertebrates. A total of 62% of the *most disturbed* stream miles were found on agricultural lands, which include about 30% of the total stream miles within the basin. A total of 21% of the *most disturbed* stream miles were found within urban lands, which include 10% of the basin's total stream miles. The remaining 18% of the *most disturbed* stream miles were found on forest lands, which include 60% of the basin's stream miles (DEQ, 2009).

Agriculture: Between 4% (NRCS, 2005) and 5.7% (DEQ, 2009) of the Sub-basin is in agricultural use. The Oregon Department of Agriculture (ODA) is responsible for developing plans to prevent and control water pollution from agricultural activities and soil erosion on rural lands. The Southern Willamette Valley Agricultural Water Quality Management Area Plan (ODA, 2012) (Area Plan) provides voluntary guidance for addressing agricultural water quality issues on private lands in the Southern Willamette Valley, including the McKenzie River Sub-basin. Resource concerns pertaining to agricultural practices identified within the Area Plan include impacts to and loss of riparian vegetation, soil erosion and streambank integrity, nutrient and bacteria runoff into surface water or leaching into groundwater, accidental releases of pesticides into soils or waterways and application of excess nutrients. The Area Plan contains best management practices for limiting impacts to riparian areas and aquatic habitats, managing nutrient loads and controlling erosion and sedimentation impacts.

The McKenzie River Watershed Baseline Monitoring Report 2000 to 2009 (EWEB, 2011) cites agricultural operations, along with septic systems and development, as a potential source of increased levels of nitrates, total phosphorus, *E. coli* and total coliform. The report is careful to note that the type of water quality analysis completed as part of the monitoring is not able to differentiate between potential sources of pollution.

Forestry: Forestry accounts for nearly 89% of the land use cover in the McKenzie River Sub-basin (NRCS, 2005; DEQ, 2009). Over 64% of the Sub-basin is publicly owned forest, managed by the USFS and BLM, and nearly 25% is privately-owned timber lands (NRCS, 2005; DEQ, 2009). Harvest volume and practices vary by ownership (public vs. private) and respective regulatory bodies. Federal forestland in the Sub-basin is managed in accordance with the Northwest Forest Plan (NWFP), which was adopted in 1994 and prescribes standards for timber harvest, road building and maintenance, forest regeneration and other activities. Prior to the adoption of the NWFP, harvest volumes on the Willamette National Forest were significantly higher, averaging over 500 million board feet per year from 1946 through 1989 (Rakestraw, 1991). Timber harvests levels on federal lands since the early 1990s have been significantly reduced to a fraction of that figure due to concerns related to endangered species and change in government management goals for federal forests. Changes in forest management for BLM lands in Western Oregon

are currently under consideration through the Proposed Resource Management Plan. The Oregon Department of Forestry (ODF) regulates timber harvest and management on private forest lands and state lands under the Oregon Forest Practices Act (FPA). The FPA was adopted by the State of Oregon in 1971 and establishes standards for commercial harvesting, management and reestablishment of timberlands on private and state lands. The FPA is overseen by the State Board of Forestry, which is responsible for approving rules and amendments. The FPA and the NWFP vary in multiple ways including different requirements for buffers near streams which vary according to a variety of factors, such as stream class order and presence of fish (see https://www.oregon.gov/ODF/Working/Pages/FPA.aspx , and http://www.fs.usda.gov/detail/r6/landmanagement/planning/?cid=fsbdev2_026990).

While current forest practices rules are designed to minimize environmental impacts, there is still the potential for forest practices to impact water quality and aquatic habitat. For example, removal of streamside trees can increase water temperature and alter the amount of organic material delivered to the stream channel. Forest roads, especially if poorly maintained, can cause an increase of fine sediment delivery to waterways. Forest road stream-crossings, not updated to current standards which require fish passage, can disrupt fish migration and distribution patterns. Upland harvest can affect the volume and timing of surface run-off; though for peak flows, these impacts are usually limited to small watersheds in the rain-on-snow zone (Grant et al., 2008). For summer flows, timber harvest usually results in an initial increase in streamflow, though they decline shortly afterwards (e.g., Keppler and Ziemer, 1990; Surfleet and Skaugset, 2013). Other potential contaminants from forestry practices include nutrients, herbicides, volatile organic compounds (VOCs), and oil and grease (EWEB, 2000).

Several long-term studies were initiated in Oregon since 2000 to examine the effects of contemporary private and state forest practices on aquatic ecosystems and water quantity and quality. These studies are at the reach or local scale as well as the downstream or watershed scale. In 2002, the Oregon Department of Forestry "RipStream" study was initiated to determine the effects of forest harvest on stream temperature and large wood recruitment. Soon after this time, three paired watershed studies were initiated to examine the effects of contemporary forest practices on water quantity and quality (e.g., sediment, temperature, nutrients, etc.) and aquatic biota (e.g., periphyton, macroinvertebrates, amphibians, and fish) across intensively managed forest landscapes. The watershed studies evaluate both local responses (harvest unit or road crossing) as well as whether effects are transported downstream in order to explore any offsite impacts.

The "RipStream" study indicated that contemporary forest practices resulted in an average increase in stream temperature of 0.7 °C (Groom et al., 2011b), though actual stream temperatures were well below the numeric criteria and did not persist downstream (Davis et al., 2015). However, as a result of the small temperature increase which was found, ODF ruled in November of 2015 to increase streamside buffers on small to medium streams which support salmon, steelhead or bull trout in western Oregon (ODF, 2015). The formalization of new rules will likely take place in 2017 and will allow for public review and input (ODF website, January 2016). The paired watershed studies found that contemporary forest management effects are dramatically different than historic practices and are often within natural background variability. The initial results from studies examining fish dynamics have indicated that there is no apparent downstream fish response to upstream harvest of non-fish streams. Timber harvests along fish-bearing streams have generally shown a positive response in growth and/or density. Likewise, preliminary data shows that amphibians and macroinvertebrates had little immediate response to harvest even in streams where no overstory was retained. (Reiter, 2015 and Watersheds Research Cooperative website http://watershedsresearch.org/).

Two watershed analyses completed by Weyerhaeuser Co., in cooperation with state agencies (ODF, ODFW) and other organizations (Pacific Rivers Council, McKenzie Landowners Association) examined conditions on Weyerhaeuser-owned land in the McKenzie River Sub-basin and impacts from forest management activities. While deep-seated, shallow landslides and debris torrents are a natural occurrence within the study area, forest management activities have increased mass wasting rates for shallow rapid landslides and debris torrents, primarily road-related failures and, to a lesser extent, in-unit failures (Weyerhaeuser, 1995). In logged areas within the study boundary, recent forest practices have not led to substantial fine sediment transport from upland sources to streams (Weyerhaeuser, 1995). Watershed conditions produced negligible to moderate increase in peak flows over that expected from a fully-mature forest cover condition (Weyerhaeuser, 1994). During active haul scenarios delivery of fine sediments increases, and the change in annual sediment yield would likely exceed water quality standards (Weyerhaeuser, 1995). Stream shading was found to be high throughout the study area (Weyerhaeuser, 1995). Land use practices have influenced riparian species composition and reduced the amounts of large wood found within streams (Weyerhaeuser, 1995).

Mining: Mining within the Sub-basin is largely comprised of sand and gravel mining operations located in the McKenzie River-Willamette River confluence area. Nearly all of the operations are protected by a series of levees and revetments. Mining river sediments can alter aquatic and floodplain habitats by affecting habitat quantity, channel geometry, channel gradient, channel stability and channel incision rates (IMST, 2010). The Oregon Department of Geology and Minerals (DOGAMI) is the lead regulator for geologic resources (oil; gas; geothermal energy; metallic and industrial minerals; and sand, gravel, and crushed stone), with attention paid to environmental, reclamation, conservation, and related economic, engineering, and technical issues (DOGAMI website, January 2016). Local mining interests, the MWC, public agencies and other partners have a strong history of working together through the McKenzie Confluence Steering Committee. Maintaining this partnership is a conservation opportunity moving forward.

6.4 Fire Suppression

Wildfires are an important episodic source of wood, input of bedload materials such as gravel, cobble and boulders, and delivery of nutrients to streams. Aquatic biota have evolved with that disturbance mechanism. Fire suppression has been occurring extensively throughout the Sub-basin for over a century and has dramatically changed the frequency of wildfire occurrence. This has further affected aquatic communities.

6.5 Invasive Species

Historic and modern day land-use practices such as agricultural development, urban growth, road construction, bank stabilization and timber harvest have reduced the amount and altered the types of riparian plant communities present today along the lower main stem McKenzie River. In many areas invasive vegetation now dominates the altered landscape and prevents establishment of native vegetation. Additionally, scouring associated with historic seasonal flooding events has essentially been eliminated by the presence of large flood control and hydroelectric dams in the upper McKenzie and its tributaries. Without seasonal scour events, sediments tend to build up in slower moving areas of the river and along gravel bars. Fewer inundation periods also contributes to the creation of favorable habitat conditions for certain invasive plant species. The presence of invasive vegetation alters riparian function by decreasing available shade, large woody material and small organic matter inputs into streams, bank stability, and nutrient and pollutant filtration and degrades habitat for wildlife. Actions to manage invasive vegetation also pose risks to water quality and the aquatic habitat. Chemical herbicides

used in the management of invasive vegetation pose both known and unknown risks to terrestrial and aquatic habitat and water quality.

6.6 Recreational Impacts

Because the main stem McKenzie River is heavily boated, large wood has been removed and cut out of the channel to maintain safe boating passage for many years. This practice continues today and has a significant impact on channel geomorphology and fish habitat. The lack of large wood caused by dams, development, timber harvest, and recreational impacts, is decreasing suitable habitat for native aquatic and riparian species. This trend is expected to continue on the main stem McKenzie River, making restoration of tributaries, side channels and other off-channel habitats of utmost importance.

6.7 Climate Change

Climate change research at OSU focused on the Upper Willamette Basin predicts that loss of snowpack with a 2^{o} C increase in temperature will potentially lead to 56% more runoff during winter, instead of being slowly released during snowmelt. This indicates a trend toward more frequent winter flooding and longer summer dry seasons (Sproles et. al., 2013). The projected altered hydrology could increase losses of side channels and other off channel habitats which provide critical habitat for multiple key species. Dry seasons can increase the occurrence of wildfire, reduce in-stream flows, and increase stream temperatures and erosion. Climate change may also degrade and alter riparian habitats, potentially further impacting aquatic conditions through decreased shading, filtration and input of large wood and detritus. These conditions and other uncertain impacts of climate change may adversely affect salmonids, other native species and water quality.

7 Key Species

The Action Plan identifies key species in the McKenzie River Sub-basin as spring Chinook salmon, bull trout, Oregon chub, Pacific lamprey, Pacific brook lamprey, rainbow trout, cutthroat trout, red-legged frog and western pond turtle. Distribution of the major key species is shown in **Figures 9 and 10**.

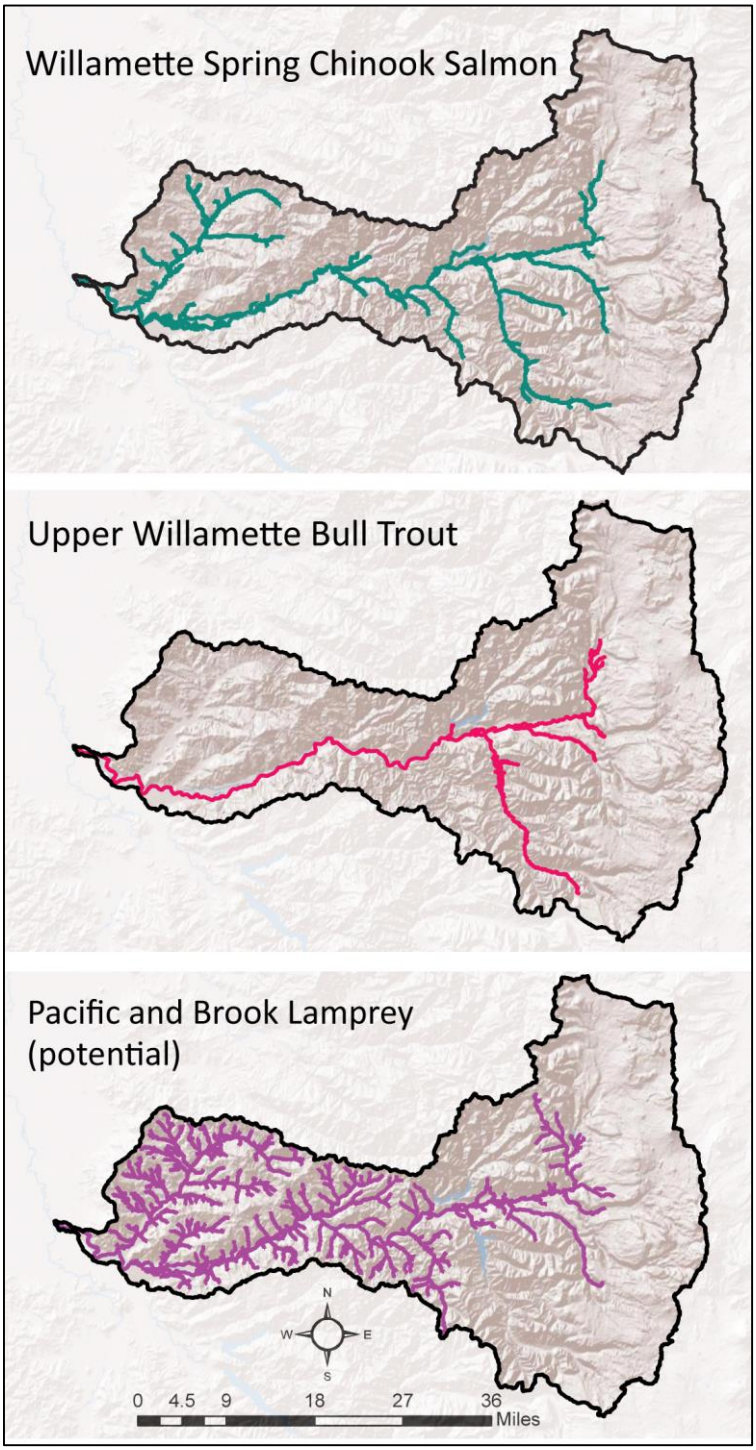


Figure 9. Distribution of Action Plan key species within the McKenzie River Sub-basin. (Source: ODFW)

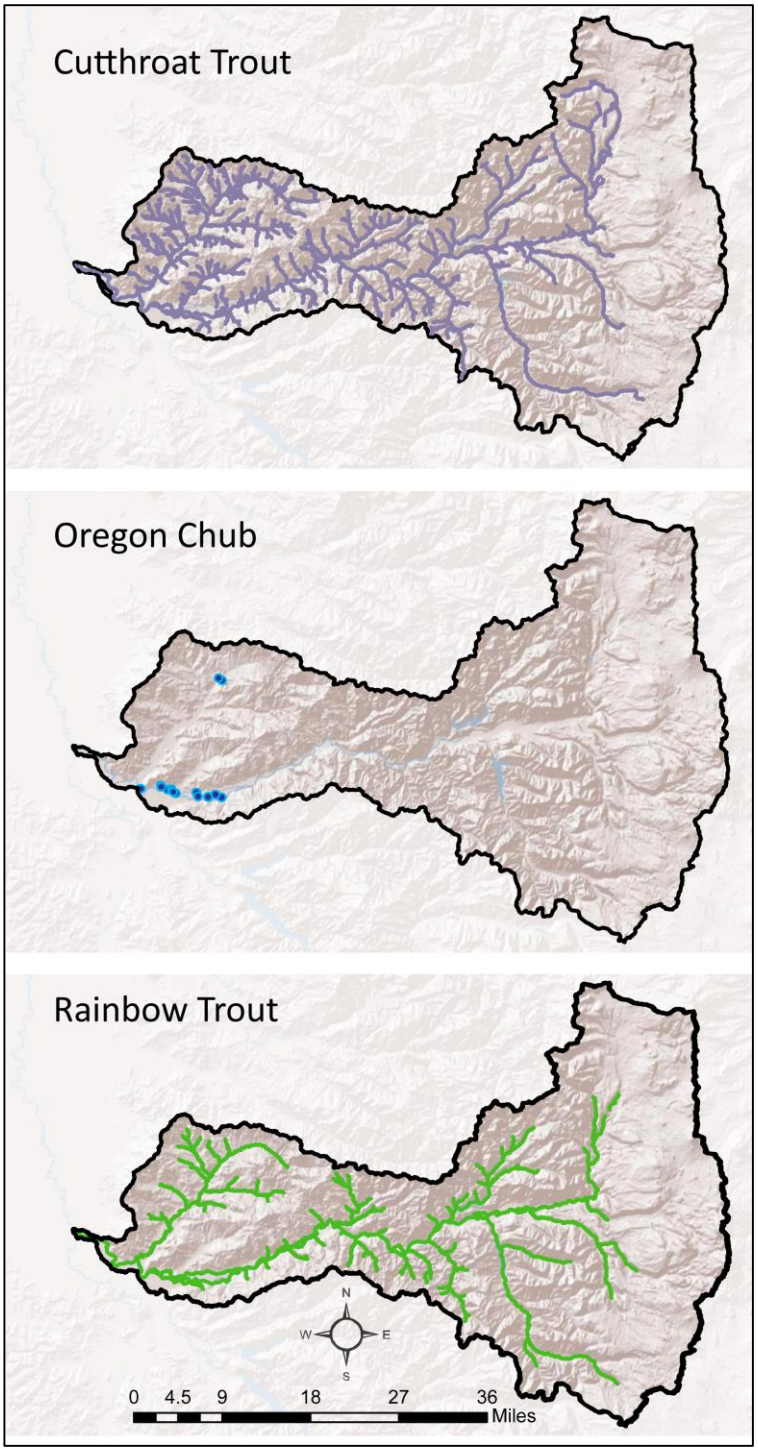


Figure 10. **Distribution of Action Plan key species within the McKenzie River Sub-basin. (Source: ODFW)**

Spring Chinook salmon and bull trout are listed as threatened under the Endangered Species Act. Until recently, Oregon chub were listed as threatened but were delisted by the U.S. Fish and Wildlife Service in 2015. These three species each have draft or final federal recovery plans. The USFWS Lamprey Conservation Initiative Plan covers Pacific lamprey in seven Oregon river systems, including the

Willamette River Basin. Western pond turtles are considered to be a priority at-risk species in the Oregon Conservation Strategy. Coastal cutthroat trout are classified as a species of concern by the federal government and a sensitive species by the State of Oregon in the West Cascades and Willamette Valley ecoregions. Rainbow trout, also known as "McKenzie redsides," are a prized recreational target species and an iconic symbol of the McKenzie River. All wild rainbow trout must be released.

Recovery and conservation plans identify the major limiting factors and threats unique to each species and guide development of the goals, objectives, and actions set forth in this Action Plan.

7.1 Spring Chinook Salmon

Upper Willamette River spring Chinook salmon have been shown to be genetically differentiated from nearby populations, and are considered one of the most genetically distinct groups of Chinook salmon in the Columbia River Basin (Waples et al., 2004; Beachum et al., 2006). Currently, significant natural production occurs in only the Clackamas and McKenzie populations (NMFS, 2007), although there are fair numbers of returning fish to the North and South Santiam systems. Limiting factors for spring Chinook salmon are described in the Upper Willamette River Conservation and Recovery Plan for Chinook Salmon and Steelhead (ODFW and NMFS, 2011). Limiting factors and associated threats cited in the plan which are specific to the McKenzie River Sub-basin include:

1. **Habitat Access**
    - Impaired downstream juvenile passage at McKenzie River dams
    - Impaired adult access to habitat above McKenzie River dams
2. **Physical Habitat Quality**
    - Impaired gravel recruitment below McKenzie River dams

      "*Reduced peak flows in the McKenzie Basin due to flood control operations cause a reduction of channel complexity and diversity of rearing habitat for juvenile Chinook. The dams also capture large wood that historically created complex habitat conditions. Trail Bridge Dam and, to a greater extent, Cougar Dam and Blue River Dam, intercept large wood and sediment from 35% of the McKenzie's headwaters (WRI, 2004). Together, reductions in the peak flows and reduced delivery of large wood in the channel have also resulted in fewer side channels and other backwater features, and reduce recruitment of gravel and other substrates. The main stem McKenzie below Deerhorn Park (RM 32) has lost most of its islands and side channels (WRI, 2004).*"
    - Impaired habitat complexity/diversity, off-channel habitats due to land management

      "Altered habitat diversity (loss of channel confinement, riparian function, wood in the channel, and other attributes) has affected all of the Chinook life stages in the geographic areas, with larger impacts in the Blue River watershed, lower McKenzie River, lower sub-basin tributaries, and Mohawk watershed (WRI, 2004). Impacts have particularly degraded rearing potential for Chinook juveniles during the winter parr life stage."
3. **Hydrology/Water Quantity**
    - Altered hydrology; reduced peak flow

      "Peak flows have been greatly diminished by Cougar and Blue River dams. Average annual peak flows after the dams were completed in 1968 are only 60% of the average annual peak flows that occurred before dam construction (MWC, 2000).

Reduced peak flows cause a reduction of channel complexity and diversity of rearing habitat for juvenile Chinook."

4. **Water Quality**
    - Elevated water temperatures due to flow alterations at dams
      "Elevated water temperatures below McKenzie hydropower/flood control dams result in premature hatching and emergence of Chinook. A temperature control tower has been operational at Cougar Dam since 2005. Evaluation of that facility relative to emergence timing and other effects is ongoing as described and proposed in the WP BiOp (NMFS, 2008; RPA 5.4)."
    - Elevated water temperature from land uses
      "Elevated water temperatures from past and/or present land management practices decrease survival and/or growth for McKenzie Chinook summer parr."
    - Toxins from agricultural sources
    - Toxins from urban and industrial sources
5. **Hatchery management**
    - Introgression with hatchery spring Chinook

This Action Plan will address limiting factors listed in the Recovery Plan, except for hatchery impacts. More specifically, the plan focuses on impaired gravel recruitment below dams, altered hydrology and reduced peak flows caused by dams. The plan also addresses impaired habitat complexity/diversity and off-channel habitats, elevated water temperature from land uses, toxins from agricultural sources, and toxins from urban, industrial and other sources. EWEB, USACE and ODFW are concurrently addressing limiting factors by improving upstream and downstream passage at dams, developing ways to better control water temperatures below dams, and addressing impacts from hatchery management.

7.2 Bull Trout

Of all the native salmonids in the Pacific Northwest, bull trout generally have the most specific habitat requirements, which are often referred to as the "four C's": Cold, Clean, Complex, and Connected habitat. Bull trout require cold water temperatures (often less than 12 degrees Celsius), complex stream habitat including deep pools, overhanging banks and large woody material, and connectivity between spawning and rearing areas and downstream foraging, migration, and overwintering habitat. Key threats that address limiting factors to bull trout are listed in the Revised Draft Recovery Plan for the Coterminous United States Population of Bull Trout (USFWS, 2014). For the Upper Willamette area of the Coastal Recovery Unit (including the McKenzie), these include:

1. **Connectivity impairment** (Trail Bridge and Cougar Dams)
2. **Nonnative fishes** (brook trout and warmwater game fish in reservoirs)
3. **Angling impacts** (incidental catch from other fisheries)
4. **Lack of anadromous forage fish** (primarily juvenile salmon)

The Action Plan will address the lack of forage fish by implementing actions intended to increase spring Chinook salmon (an important source of prey) and other fish distribution and productivity.

Partners in the Sub-basin (EWEB, USACE, ODFW) are concurrently addressing the other threats by improving upstream and downstream passage at dams and addressing angling impacts.

7.3 Oregon Chub

The Oregon Chub Recovery Plan includes the following limiting factors and threats:

1. **Habitat alteration** (lack of channel connectivity to floodplain; elimination of slack-water habitats)
2. **Predation and competition with nonnative species**
3. **Water quality** (introduction of chemicals)

While chub have been de-listed, recovery actions are still needed. The Action Plan will address habitat alteration through fee title acquisitions and conservation easements of high potential Oregon chub habitat by the McKenzie River Trust. Once acquired, restoration projects will help restore floodplain connectivity and off-channel habitat. The Plan also contains voluntary actions to reduce introduction of chemicals through the various EWEB Source Water Protection Programs.

7.4 Pacific Lamprey

Threats to Pacific lamprey are documented in *Pacific Lamprey Assessment and Template for Conservation Measures* (Luzier et al., 2011). The threats applicable to the McKenzie Sub-basin include:

1. **Artificial barriers to migration**
2. **Poor water quality**
3. **Predation by native and nonnative species**
4. **Stream and floodplain degradation**
5. **Decline in prey**
6. **Dewatering and flow management**

Pacific Lamprey (Photo: Freshwaters Illustrated/USFW)

The Action Plan will address stream and floodplain degradation by implementing actions that restore river and floodplain function. Poor water quality will be addressed through voluntary programs to reduce introduction of chemicals, bacteria and nutrients. Partners in the Sub-basin (EWEB, USACE, and ODFW) are concurrently addressing other threats by improving upstream and downstream passage at dams and improving flow management to minimize potential for dewatering.

7.5 Pacific brook lamprey

It was recently confirmed by researchers that western brook lamprey thought to inhabit the McKenzie Sub-basin are in fact Pacific brook lamprey *(Lampetra pacifica)* (Stewart B. Reid, Ph.D*,* personal communication*)*. Because Pacific brook lamprey have been misidentified and little is known about them, this species was included as a key species in the Action Plan. Potential threats to brook lamprey include poor water quality, harvest, predation by nonnative species, stream and floodplain degradation, dredging and dewatering.

The Action Plan will address stream and floodplain degradation by implementing actions that restore river and floodplain function. Poor water quality will be addressed through voluntary programs to reduce introduction of chemicals, bacteria and nutrients. Other partners in the Sub-basin (EWEB, USACE, and ODFW) are concurrently addressing other threats by improving flow management to minimize potential for dewatering. Predation by nonnative species continues to be a challenging task.

7.6 Rainbow Trout

Rainbow trout are cold water fish that have long been symbolic of clear, healthy mountain streams and lakes in North America. It is considered by many to be the most important game fish west of the Rocky Mountains. In many ways "McKenzie Redsides" are the iconic fish species of the McKenzie River and have important local cultural and economic significance. In the McKenzie River, resident rainbow occur in the main stem from Tamolitch Falls to the confluence with the Willamette River and the lower portions of medium and large streams. Reduction of habitat diversity, including pool frequency and depth, and lack of floodplain connection and nutrient loading have significantly reduced the distribution and abundance of rainbow trout. In addition, construction of dams, road crossings, and other structures impede the ability of rainbow trout to migrate upstream and downstream, which is critical to successful completion of their life cycles.

The Action Plan will address reduction in habitat by implementing actions that restore river and floodplain function, loss of riparian vegetation, and point and nonpoint source pollution from municipal development and agriculture. Other partners in the Sub-basin are concurrently addressing other threats by improving upstream and downstream passage at dams and road crossings

7.7 Coastal Cutthroat Trout

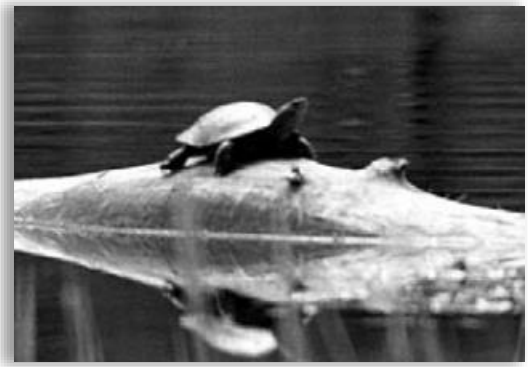
The Willamette River Coastal Cutthroat Trout Species Management Unit (SMU) includes all populations of cutthroat trout inhabiting tributary streams to the Willamette River above Willamette Falls, as well as portions of the main stem Willamette. Willamette River coastal cutthroat are currently classified as "not at risk" by ODFW (ODFW, 2005).

Native coastal cutthroat trout are the most widely distributed fish in the McKenzie River Sub-basin, ranging from headwater streams to the main stem McKenzie River. Previous timber management in riparian areas has affected aquatic habitat quality by altering the quantity, size and recruitment source of large woody material, which can affect substrate storage, habitat composition (e.g. pools, riffles, off channel habitat) and water temperature. Because of their fluvial migratory behavior, these fish are more affected by dams and road crossings than rainbow trout. The Action Plan will address impacts to habitat by implementing actions that restore river and floodplain function.

7.8 Western Pond Turtle

Major factors cited as limiting western pond turtle populations include loss of aquatic habitats, elevated nest and hatchling predation, reduced availability of nest habitat, and road mortality (Rosenberg et. al., 2009).

The Action Plan will address loss of habitat by implementing actions that restore river, pond, and floodplain function and availability of nest habitat.



Western Pond Turtle (photo: MRT)

7.9 Northern Red-legged Frog

The Oregon Conservation Strategy (ODFW, 2006) lists northern red-legged frogs as a Strategy species in the Willamette Valley Ecoregion and as a key species in the Willamette River floodplain. The northern red-legged frog is cited as a management indicator species for riparian habitats in the Willamette Valley

in *Strategic Conservation and Management in the Willamette Valley* (USFWS, 2014). Ponds, wetlands and adjacent forested habitats are cited as special habitat needs for the northern red-legged frog (ODFW, 2006; USFWS, 2014). Loss of egg-laying habitat and predation by invasive fish and bullfrogs are limiting factors (ODFW, 2006). Specific conservation actions recommended by the Strategy for the northern red-legged frog include maintaining wetland habitat and adjacent riparian forest.

The Action Plan will address conservation recommendations by implementing actions that conserve and restore riparian areas, wetlands and floodplain habitat and restore floodplain connection.

We considered inclusion of Oregon spotted frog as a key species for the Action Plan. This species has just been listed as threatened under the ESA, and the State lists them as a sensitive species, critical category. Their distribution in the McKenzie Sub-basin is limited to one high elevation area in the Three Sisters Wilderness – the Mink Lake Basin. Due to their relative isolation and land management protection status, this species were not considered a key species in this Plan, and no restoration actions were proposed.

8 GOALS, OBJECTIVES, AND ACTIONS

The primary purpose of the Action Plan is the identification and prioritization of specific goals, objectives and actions to achieve desired outcomes. Development of goals and objectives was guided by the major limiting factors and threats identified for each key species in recovery or conservation plans as well as the restoration actions needed to improve impaired physical and biological processes as identified by watershed assessments (**Table 1**) and analysis by resource professionals working in the Sub-basin. Goals and objectives are described in the SMART format. Objectives are organized by one or more project type(s) (i.e. augment large woody material, remove levees or augment gravel) which may be utilized to achieve the goal (i.e. improved floodplain function). Actions are defined as specific steps or projects needed to achieve the objective. All proposed actions are voluntary and subject to local, state and federal laws, plans and regulations.

8.1 Outcome 1: Improved habitat for key aquatic species – spring Chinook salmon, bull trout, Oregon chub, Pacific lamprey, Pacific brook lamprey, rainbow trout, cutthroat trout, red-legged frog and western pond turtle – throughout the McKenzie River Sub-basin.

Goals, objectives and actions are organized by watershed (USGS 5th-field HUC). Certain actions, specifically the VIP, apply to multiple watersheds. Four categories of SMART goals developed for Outcome 1 include:

1. Increase in-stream and floodplain habitat complexity, floodplain connectivity and productivity;
2. Improve fish passage;
3. Enhance riparian function; and
4. Maintain water quality for key species.

Table 3 lists objectives and actions for each of the four goals for Outcome 1 for the entire Sub-basin.

Table 3. Goals, objectives and actions for Outcome 1.

Goals	Objectives	Actions	Lead(s)
Increase in-stream habitat complexity, floodplain connectivity, and productivity	Increase marine-derived nutrients	Hatchery Chinook salmon carcass placement • South Fork, Horse Creek, Deer Creek	ODFW
	Augment in-stream large woody material (LWM)	Implement LWM projects on the following • Private lands (Gate Creek, lower McKenzie River floodplain, upper Mohawk River, Mill Creek (Mohawk River) • Willamette National Forest (South Fork, below Cougar Dam, South Fork, above Cougar Dam, Horse Creek, Anderson Creek, Olallie Creek, Sweetwater Creek)	MWC BLM WeyCo USFS
	Augment in-stream flow downstream of dams	Work with the USACE to periodically release channel forming flows below Cougar Dam	USACE
	Augment in-stream sediment (gravel) regime	Implement gravel augmentation in the South Fork Watershed below Cougar Dam	USFS
	Levee and revetment removal	Implement levee and revetment removal projects in the South Fork Watershed below Cougar Dam	USFS
Enhance riparian function	Implement VIP Program within McKenzie River Sub-basin boundary area	Conduct riparian health assessments and restoration/conservation planning on cooperating private lands	EWEB MWC SWCD
		Implement conservation, restoration, and naturescaping activities on cooperating private lands	EWEB MWC SWCD
	Enhance riparian habitat at priority sites outside of VIP boundary	Implement riparian enhancement at priority locations outside of current VIP boundary • Mohawk River • South Fork McKenzie River below Cougar Dam	MWC USFS
Improve fish passage at priority passage barriers	Remove passage barriers at priority road crossings	Implement passage projects on the following • Blowout Creek (Horse Creek watershed) • Pothole Creek (Horse Creek watershed)	USFS
		Update and prioritize fish passage barrier databases	MWC
	Improve upstream and downstream fish passage at USACE dams	Work with USACE on downstream passage at Cougar Dam	USACE
Maintain or improve water quality for key species	Reduce road-related fine sediment delivery to streams within South Fork, Horse Creek and Headwaters Watersheds	Hydrologically stabilize and store roads	USFS
		Conduct storm damage risk reduction	USFS
		Decommission roads	USFS
		Upgrade stream crossings	USFS

8.1.1 McKenzie River Watershed

The McKenzie River Watershed stretches from the confluence with the Willamette River near the town of Coburg upstream approximately 51 miles to the mouth of Ennis Creek near Nimrod. The watershed covers approximately 118,000 acres, accounting for 14 percent of the total Sub-basin. The watershed covers two eco-regions, Willamette Valley and West Cascades. Significant tributaries include Cedar Creek (river mile (rm) 17), Camp Creek (rm 21), Gate Creek (rm 41), Marten Creek (rm 44), Bear Creek (rm 47), Deer Creek (rm 49) and Ennis Creek (rm 51) (**Figure 11**). Note that the enumeration of river mileage on the McKenzie River starts at the historic confluence of the McKenzie and Willamette Rivers, which is located several miles downstream from the current confluence location.

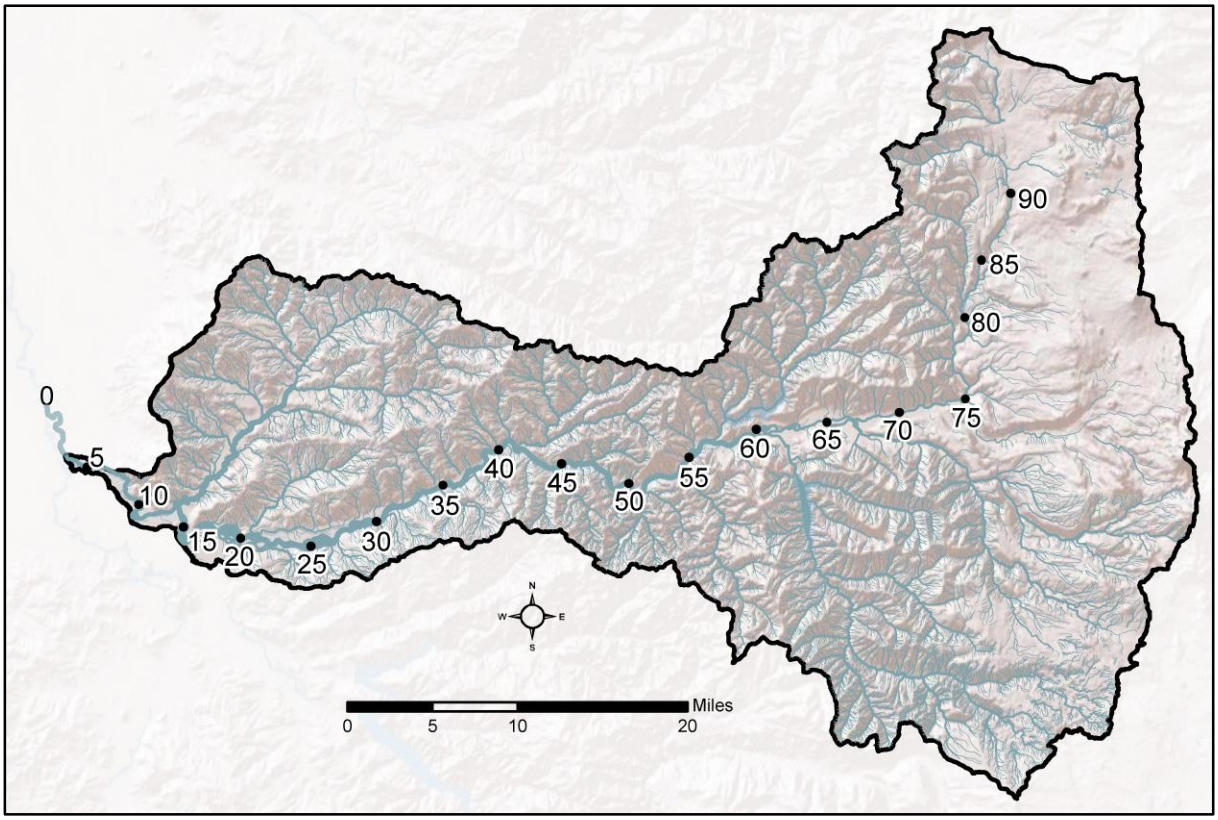


Figure 11. River mileage (miles above the mouth) on the McKenzie River.

Spring Chinook salmon are found throughout the main stem McKenzie and lower portions of the major tributaries such as Gate Creek and Deer Creek. The lower McKenzie River provides the migration corridor for spawning salmon heading upriver, along with spawning and critical rearing habitat. Bull trout utilized the main stem river for foraging and migration historically and are still occasionally documented within the lower river. Oregon chub populations are known to occur at several locations in the watershed, and recent monitoring has documented movement of individual fish between chub populations (Bangs et al., 2013). Little is known about distribution or population of Pacific lamprey within the McKenzie River watershed. Sampling conducted in 2012 and 2013 as part of a Willamette River basin-wide study documented the presence of Pacific lamprey larva at one out of three sites examined in the watershed (Shultz et al., 2014). Cutthroat trout are widely distributed throughout the watershed and include both resident and fluvial life histories. Resident rainbow trout are found throughout the main stem river and lower portions of the major tributaries, and are the iconic game fish of the McKenzie. See **Figures 9 and 10** for species distribution information.

Land use within the McKenzie River Watershed is a mixture of urban, rural residential, agricultural, forestry and industrial. Compared to other USGS 5th-field HUC watersheds within the McKenzie Sub-basin, the McKenzie Watershed contains the greatest amount of non-forest lands, along with the only major urban centers (Eugene and Springfield) and the majority of the small unincorporated communities (Cedar Flats, Walterville, Leaburg, and Vida). Private residential and agricultural lands are concentrated within the McKenzie River floodplain. Uplands are primarily a mixture of private industrial forest and public lands managed by BLM and USFS. The EWEB-owned and operated Leaburg-Walterville Hydroelectric Project is located in this watershed.

A number of previous assessments and conservation/restoration plans have examined the McKenzie River watershed in an effort to define watershed condition, identify impairments and provide frameworks and priorities to guide restoration and conservation actions (**Table 1**). Priority actions and focus areas identified within these assessments have been used by a variety of individual organizations and collaborative partnerships to guide conservation and restoration work within the watershed over the last 10-15 years. The Eugene BLM District has implemented numerous projects and policies designed to address priority watershed impairments, including fish passage barriers and undersized culverts impacting bedload transport. Weyerhaeuser and other private timberland owners have upgraded numerous culverts and stream crossings to enhance fish passage and bedload transport, and implemented various road improvement projects in an effort to decrease fine sediment transport to streams. The National Resource Conservation Service (NRCS) and the MWC have worked with numerous private landowners to implement riparian and livestock fencing and watering projects. The McKenzie River Trust was formed in 1989 and began working with landowners on the conservation of high priority floodplain habitat within the watershed. Starting in 2005 several partners including EWEB, MRT, MWC and the ODFW began a partnership (Lower McKenzie Fish Enhancement) focused on the lower McKenzie River from its confluence with the Willamette River upstream to Gate Creek at river mile 41. This partnership has focused on identifying and implementing priority conservation and restoration opportunities within the lower McKenzie Watershed. The following SMART Goals, Objectives and Actions were developed primarily based upon the previously completed work and professional judgement of this partnership.

SMART Goal 1: Increase in-stream and floodplain habitat complexity, floodplain connectivity and productivity on 6 miles of stream and 50 acres of floodplain by 2026.

Multiple anthropogenic factors have disturbed multiple natural processes, negatively impacting in-stream and floodplain habitat within the McKenzie River Watershed. While impacted, the lower McKenzie River retains multiple areas with relatively undeveloped floodplain which allow for both preserving and enhancing natural function and habitat for native species. Local partners have previously identified six “high priority” areas within the lower McKenzie River watershed (**Figure 12**) which retain complex and diverse habitat features and are largely unconstrained by surrounding development. Restoration and conservation efforts within the lower river over the last 10 years have largely focused on these “high priority” areas. Since 2000 over 1,500 acres within the lower McKenzie River floodplain have been placed in conservation. Enhancement of in-stream habitat and floodplain function has occurred at three of these conservation sites, including nearly 3 miles of in-stream enhancement, 0.5 mile of channel reconstruction, over a mile of floodplain levees or berms removed, multiple alcove construction or reconnection projects and enhancement of four road/stream crossings. Opportunities exist to build upon this work on both private and public land within the watershed.

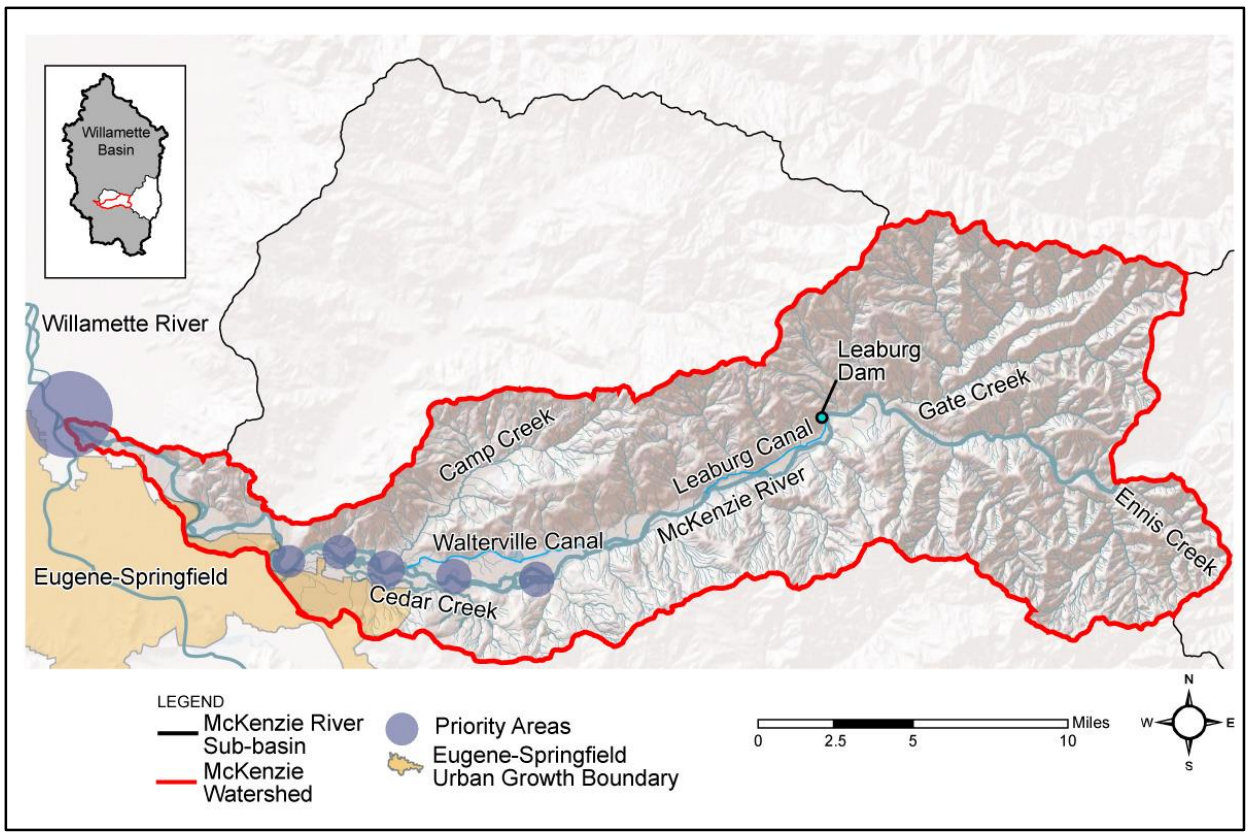


Figure 12. Priority restoration and conservation actions in McKenzie River Watershed (5th -field HUC).

Objective A: Augment large woody material (LWM), finer organic material, and/or gravel, in at least 6 miles of streams and 50 acres of floodplains by 2026. (Various partners)

Action 1: Pursue conservation easements and/or acquisition with willing private landowners in the following previously identified priority areas. (MRT)

Action 2: Pursue the development of cooperative partnerships with private landowners and public agencies within lower river tributaries, listed in order of priority (MWC):

a. Gate Creek
b. Deer Creek (lower)
c. Ennis Creek
d. Marten Creek

Action 3: Implement LWM augmentation in the following reaches (BLM, MWC, ODFW, and Weyerhaeuser):

a. Lower McKenzie River – High Priority Areas – 3 miles
b. Gate Creek – 3 miles

Action 4: Monitor project effectiveness. (BLM, MWC, ODFW, and Weyerhaeuser)

Objective B: Pursue removal or repositioning of levees or other bank stabilization structures.

Action 1: Identify high priority areas for levee and floodplain reconnection work. (MWC)

Action 2: Pursue conservation and/or MOU with willing private landowners. (MRT, MWC)

SMART Goal 2: Improve fish passage.

Multiple local partners including the BLM, Lane County, Weyerhaeuser and other private landowners have completed numerous culvert replacement projects within the McKenzie River Watershed over the last 15-20 years. It is believed that all significant passage barriers impacting spring Chinook salmon within the watershed have been addressed. Identifying and prioritizing remaining passage barriers within the watershed for other key fish species is a known data gap. The MWC, in partnership with the Willamette NF, Eugene District BLM, and the Middle Fork Willamette Watershed Council completed a fish passage assessment and database project in 2005.

Objective A: Update culvert database for the McKenzie River watershed by 2020.

Action 1: Compile existing BLM, Weyerhaeuser, ODFW and MWC culvert databases for the McKenzie River Watershed. (MWC)

Action 2: Identify data gaps and need for additional field surveys. (MWC)

Action 3: Prioritize remaining fish passage barriers for restoration. (BLM, MWC, and ODFW)

SMART Goal 3: Conserve and/or enhance over 300 acres of riparian forests on private land by 2026.

Bottomland riparian forests in the lower McKenzie River have been altered by a variety of land uses and other factors. Though diminished and fragmented, floodplain forests within the lower McKenzie River still provide excellent habitat for native fish and wildlife and serve to protect water quality. Protecting and, where appropriate, enhancing and expanding these floodplain forest habitats has been a primary focus of local partners such as EWEB, MRT, MWC and the UWSWCD for over 10 years. Over 1,500 acres of lower McKenzie River floodplain habitat have been placed in conservation, and over 700 acres of private riparian and floodplain habitat have been enhanced since the early 2000's. Starting in 2017, McKenzie River partners are poised to implement a programmatic approach to riparian restoration on private lands in the McKenzie Sub-basin. The Voluntary Incentives Program (VIP) will work with willing private landowners to conserve and enhance riparian habitat through voluntary partnerships and long-term (20-year) agreements. Initial efforts will focus on the delineated VIP Boundary (**Figure 13**). Participation targets cited in the objectives listed below were established based on a 2012 survey conducted by EWEB and the University of Oregon (EWEB 2012) which showed that greater than 40% of McKenzie River landowners surveyed were either extremely likely, very likely or somewhat likely to participate in voluntary programs which conserved water quality or floodplain forests. Slightly less, 30%, indicated a willingness to participate in voluntary restoration programs.

EWEB and partners will continue watershed monitoring programs that measure numerous water quality parameters over time associated with baseline conditions, storm event runoff, harmful algal blooms, and other conditions to assess trends (see http://reach.northjacksonco.com/EWEB/). Success of voluntary programs to conserve and restore floodplain and riparian forests may show up in long term trends as maintaining the current level of exceptional water quality. However, complexities of watersheds, land use changes, annual and seasonal variability, climate change, and other factors make it very difficult to link riparian conservation with specific water quality improvements.

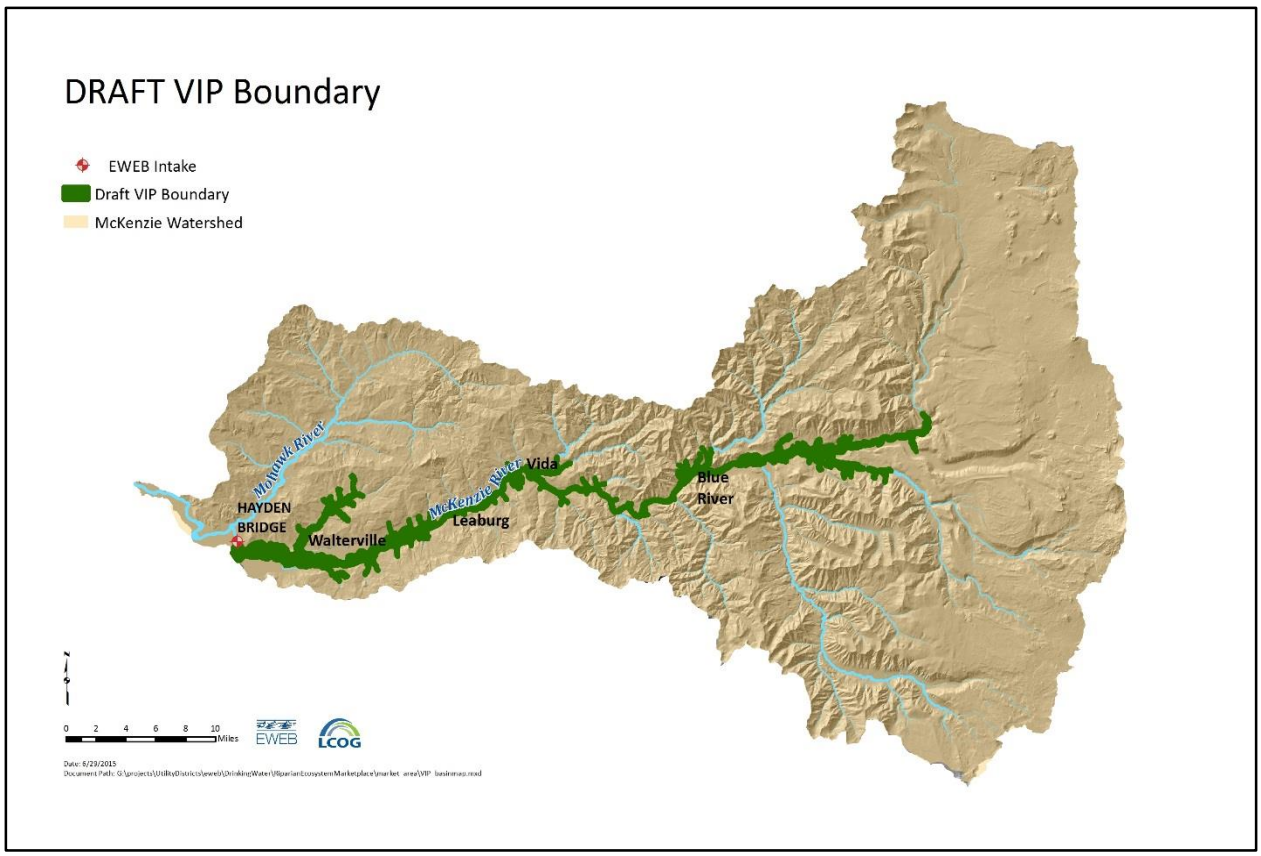


Figure 13. Draft McKenzie River Voluntary Incentives Program boundary.

Objective A: **Implement VIP in partnership with 300 landowners on 400 acres of private land within current boundary by 2026.**

Action 1: Conduct 300 riparian health assessments in the McKenzie River Watershed. (MWC and UWSWCD)

Action 2: Complete VIP agreements and associated management plans with 100 landowners with medium to large size tax lots. (EWEB)

Action 3: Enroll 200 landowners with small residential tax lots for naturescaping program. (EWEB)

Action 4: Implementation restoration actions (invasive vegetation management and/or native vegetation establishment) on 400 acres. (MWC and UWSWCD)

Action 5: Implement maintenance program(s) on 400 acres. (MWC and UWSWCD)

Action 6: Leverage opportunities with 10 VIP landowners to promote and implement conservation easements or land acquisitions covering 200 acres. (MRT)

Action 7: Establish site level monitoring programs. (EWEB)

SMART Goal 4: Maintain or improve water quality for key species.

No specific restoration or conservation actions addressing water quality for key fish species such as decommissioning roads, upgrading stream crossings (non-fish passage barriers) and road stabilization within the McKenzie River watershed are identified at this time. Floodplain and riparian conservation and enhance actions outlined in Goals 1 and 3 are expected to benefit water quality in terms of temperature and fine sediment. Voluntary programs listed under Outcome 2 targeting maintenance of drinking water quality are also expected to improve water quality for key species.

8.1.2 Mohawk River Watershed

The Mohawk River watershed is located within the northwestern portion of the McKenzie River Sub-basin, draining an area of approximately 115,000 acres within the western Cascade foothills. Land ownership within the watershed is a mixture of private forestry (52%), federal lands managed by the Bureau of Land Management (26%), private agricultural or residential (20%), small acreage farms or residential and other land uses such as light industrial and recreation (2%) (BLM, 1995) **(Figure 4).** As elsewhere in the Willamette Valley, early Euro-American settlement was marked by conversion of bottomland floodplain to agricultural use and a robust history of logging within the Cascade foothills. These historic practices, combined with modern-day land uses such as residential development, extensive road systems on both private and public lands, fire suppression and timber management, have substantially altered aquatic and terrestrial habitats over the past 150 years.

A number of previous assessments and conservation/restoration plans have examined the Mohawk River watershed in an effort to define watershed condition, identify impairments and provide frameworks and priorities to guide future restoration and conservation actions (**Table 1**). Individually, these plans have identified a number of restoration and conservation priorities and opportunities within the watershed. Recurring priorities include the restoration and conservation of floodplain and riparian forests along the lower main stem Mohawk River and select tributaries (McGowan, Cartwright, Mill); and the removal of fish barriers and restoration of habitat connections throughout the watershed. Specific recommendations and priorities cited in the listed plans are cited in **Appendix B**.

A number of agencies, organizations and collaborative partnerships have been working to address Mohawk watershed impairments for the last 10-15 years. The Eugene BLM District has implemented numerous projects and policies designed to address priority watershed impairments, including fish passage barriers and undersized culverts, adding large wood material to streams and addressing off-highway vehicle (OHV) impacts. Weyerhaeuser and other private timberland owners have upgraded numerous culverts and stream crossings to enhance fish passage and bedload transport. The Mohawk Watershed Partnership, NRCS, and MWC have worked with numerous private landowners to implement riparian, livestock fencing and off-channel watering projects.

Historically, the Mohawk River was one of the lowest elevation streams in the Willamette River Basin to support a population of spring Chinook salmon. Distribution is thought to have included the main stem river and larger tributaries **(Figure 9).** The small run is thought to have been extirpated by about 1910 (Parkhurst et al., 1950; Willis et al., 1960), though reports of spawning salmon from numerous landowners have been recurring. ODFW maintained a policy of out-planting pre-spawned adult Chinook into the Mohawk system for a number of years through the early 2000's. High stream temperatures and low flows common within the Mohawk River during the summer and fall months when spring Chinook are migrating and spawning are significant factors likely limiting recovery of the Mohawk River Chinook salmon population. Working to develop broad and large-scale projects within the lower Mohawk River floodplain while enhancing potential spawning habitat in upriver tributaries are objectives that would potentially benefit spring Chinook salmon.

Oregon chub are documented to occur at two sites in the Mohawk River basin (Bangs et al., 2013). Both populations were introduced to private ponds by ODFW in the early 2000's. Cutthroat trout are the most widespread salmonid species in the watershed (**Figure 10**). Populations include both resident and fluvial life histories. Field studies conducted by ODFW in the mid-1990's showing large winter-spring out-migrations of juvenile cutthroat suggest that the Mohawk watershed may provide primary spawning

habitat for Willamette River and McKenzie River fluvial cutthroat trout. Little is known about the distribution or population of Pacific lamprey within the Mohawk River watershed. Reports from landowners regarding sightings of "eels" are a periodic occurrence. Surveys completed by MWC staff in the mid-2000's documented likely Pacific lamprey redds in the main stem Mohawk River upstream of Shotgun Creek. Sampling conducted in 2012 and 2013 as part of a Willamette River basin-wide study documented the presence of Pacific lamprey larva at all three sites examined in the Mohawk watershed (Shultz et al., 2014*)*. See **Figures 9 and 10** for complete species distribution information.

The following SMART Goals, Objectives and Actions were developed based on review of previously completed assessments, strategies and analyses, as well as professional judgment and input from local partners in order to address limiting factors and impaired watershed processes for identified focal species. Proposed actions largely focus on riparian enhancement in the lower Mohawk River floodplain and in-stream enhancement in the upper reaches of the Mohawk River and Mill Creek **(Figure 14).**

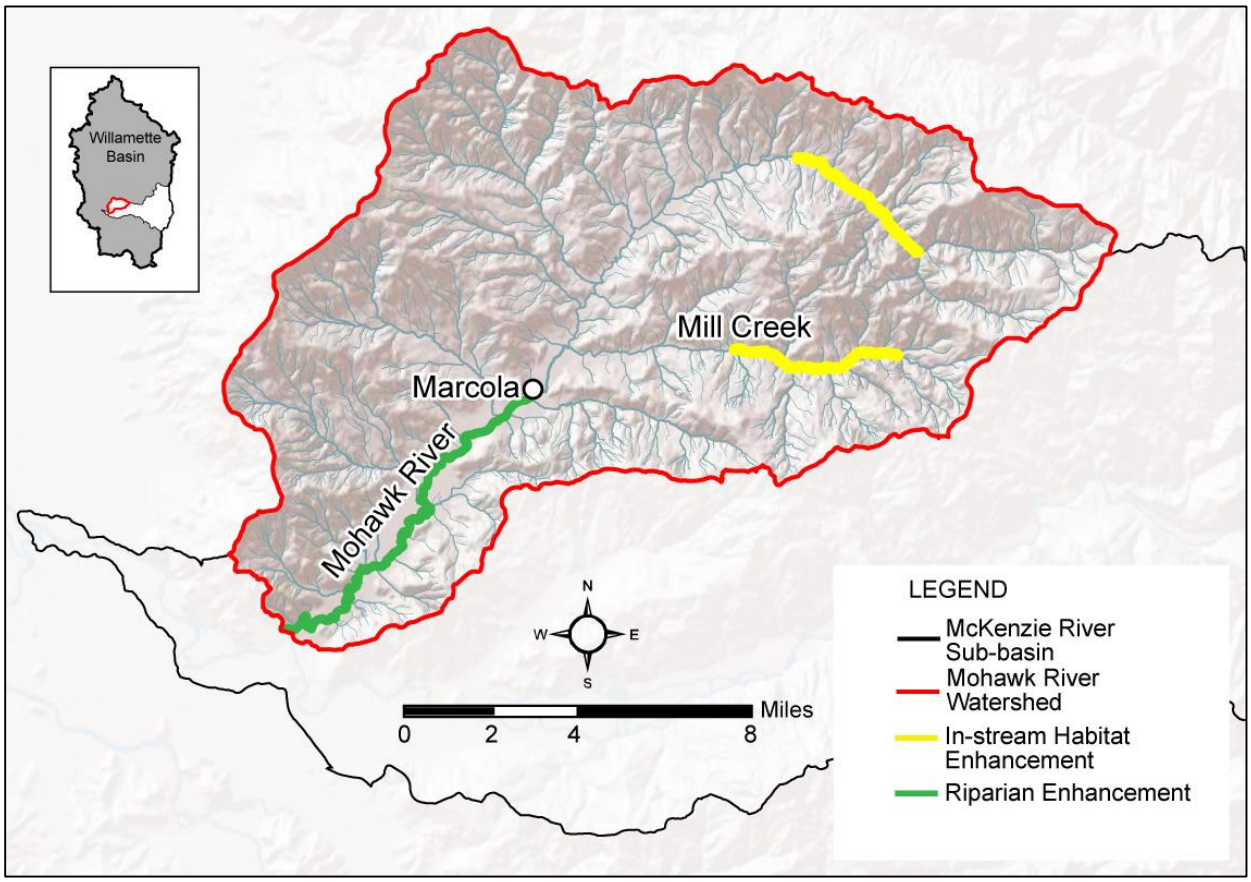


Figure 14. Priority actions in the Mohawk River Watershed (5th field HUC).

SMART Goal 1: In-stream and Floodplain Function – Enhance in-stream habitat complexity in the Mohawk River watershed by 2026.

Conversion of much of the floodplain in the lower Mohawk River to agricultural, residential and other human development has altered river characteristics by increasing the amount of channel down-cutting, increasing the amount of armored banks and decreasing channel complexity. In the upper reaches of the Mohawk River and multiple tributaries, development of residential property, road systems and historical forestry practices have degraded in-stream habitat and reduced floodplain connectivity. While a varied amount of human development infrastructure does limit the scope of potential in-stream and floodplain enhancement projects in this watershed, opportunities exist in portions of the lower and upper watershed and select tributaries to enhance in-stream and floodplain habitat. Assuming a large-scale approach and a broad spectrum of support from landowners and the public, additional in-stream opportunities may exist within the lower Mohawk River floodplain.

Objective A: Augment large woody material (LWM), finer organic material and/or large sediment in priority areas by 2026.

Action 1: Pursue conservation easements and/or acquisitions with willing private landowners in the Mohawk River watershed (MRT)

Action 2: Pursue the development of cooperative partnerships with private landowners and public agencies within priority tributaries, listed in order of priority (MWC):

a. Lower Mohawk River
b. Upper Mohawk River
c. Mill Creek

Action 3: Implement LWM, boulder structures and/or finer organic material augmentation with willing landowners (MWC, BLM, private landowners).

SMART Goal 2: Improve Fish Passage: Improve upstream and downstream passage at priority road crossings for key species by 2026.

Access to spawning, refuge and rearing habitat for cutthroat trout and other aquatic organisms has been negatively impacted by the construction of extensive road systems on both public and private land throughout the Mohawk River basin. Undersized and poorly functioning road culverts associated with roads have created multiple passage barriers. The BLM, Weyerhaeuser and other private timber companies have been assessing and upgrading culverts in the Mohawk since the mid 1990's. The MWC, in partnership with the Willamette NF, Eugene District BLM, and the Middle Fork Willamette Watershed Council completed a fish passage assessment and database project in 2005. The project sought to identify and prioritize fish passage barriers in the McKenzie and Middle Fork Willamette watersheds.

Objective A: Update culvert database for the Mohawk River by 2020.

Action 1: Compile existing BLM, Weyerhaeuser, ODFW and MWC culvert databases. (MWC)

Action 2: Identify data gaps and need for additional field surveys. (MWC)

Action 3: Prioritize remaining fish passage barriers for restoration. (MWC, BLM, ODFW)

Objective B: Remove upstream and downstream passage barriers at priority road crossings by 2026.

Action 1: Develop MOU among appropriate parties. (Various partners)

Action 2: Complete design and permitting. (Various partners)

Action 3: Remove passage barriers at priority road crossings by either removing culverts through road storage/decommissioning or upgrading culverts to restore fish passage. (Various partners)

SMART Goal 3: Enhance Riparian Function on 50 acres along 12 miles of the Mohawk River by 2026.

Historic land use conversion combined with roads, residences and other human developments concentrated next to streams have greatly diminished and altered bottomland riparian forests in the lower Mohawk River. Remaining riparian habitats have been simplified and are largely dominated by invasive vegetation. Over the last 10-15 years multiple riparian enhancement projects have been implemented along the lower Mohawk River by the NRCS, MWP, MWC and others. These projects have lacked a programmatic approach focused on connectivity and long-term plant establishment. While this watershed will not be part of the initial Voluntary Incentives Program in 2017, opportunities exist to work toward expansion of the program at a later date. Another opportunity would be to increase landowner participation in programs such as the NRCS-administered Conservation Reserve and Enhancement Program (CREP). It may also be possible to develop a program which delivers DEQ-approved shade credits for municipal waste water organizations to help them meet respective TMDL requirements for reducing thermal impacts of waste water to the Willamette River. These programs may serve to provide willing private landowners opportunities to conserve and enhance riparian habitat on a watershed scale.

Objective A: Implement riparian enhancement projects at 10 privately owned sites within the lower 12 miles of the Mohawk River by 2026.

Action 1: Pursue development of MOUs or easements with willing private landowners. (Various partners)

Action 2: Control 50 acres of invasive vegetation at 6-10 private parcels. (MWC)

Action 3: Establish native plants at a density of approximately 2,000 stems per acre on 50 acres. (MWC)

Action 4: Conduct five years of plant establishment at all sites. (MWC)

Action 5: Monitor project effectiveness. (MWC)

SMART Goal 4: Maintain or improve water quality for key species.

No specific restoration or conservation actions addressing water quality for key fish species such as decommissioning roads, upgrading stream crossings (non-fish passage barriers) and road stabilization within the Mohawk River watershed are identified at this time. Floodplain and riparian conservation and enhance actions outlined in Goals 1 and 3 are expected to benefit water quality in terms of temperature and fine sediment.

8.1.3 Quartz Creek-McKenzie River Watershed

The Quartz Creek-McKenzie Watershed includes the Quartz Creek sub-watershed and the main stem McKenzie River from Ennis Creek (rm 51) upstream to approximately rm 65 downstream of the mouth of Horse Creek. Quartz Creek (rm 54) and Elk Creek (rm 56.5) are the significant tributaries within the watershed **(Figure 11).** The watershed covers over 70,000 acres and ownership is predominately private with public ownership primarily managed by the USFS (LCOG, 1995). The unincorporated communities of Blue River and Rainbow are found in the watershed **(Figure 8).** Most of the private land within the Quartz Creek sub-watershed (Quartz Creek drainage only, not including any of the area along the main stem McKenzie River) is used for timber production (LCOG, 1995). The main stem McKenzie River provides critical habitat for spring Chinook salmon. Quartz Creek provides spawning and rearing habitat for rainbow and cutthroat trout. The lower portion of Quartz Creek may provide limited spawning habitat for spring chinook and foraging habitat for bull trout (USFS, 1998). The watershed lies within the Western Cascades Ecoregion.

In 2015 and 2016, the MRT purchased two parcels of land, termed Finn Rock Reach, totaling about 280 acres from Rosboro Lumber Company. The Finn Rock Reach property is located near the town of Blue River, and extends from Elk Creek downstream to Finn Rock, near the confluence of Quartz Creek and the McKenzie River. The property includes approximately 2 miles of riverfront along the McKenzie River, numerous side channels, ponds, wetlands, and old floodplain forest. MRT will work with local partners to manage the land, including possible restoration of areas impacted by gravel extraction and timber harvest.

Proposed actions in the Quartz Creek-McKenzie River Watershed are focused on private lands along the main stem McKenzie River in partnerships with the VIP and MRT **(Figure 15)**. Additional actions are proposed on public lands managed by the WNF within the Quartz Creek sub-watershed. Current partnerships with private landowners within the Quartz Creek sub-watershed are limited.

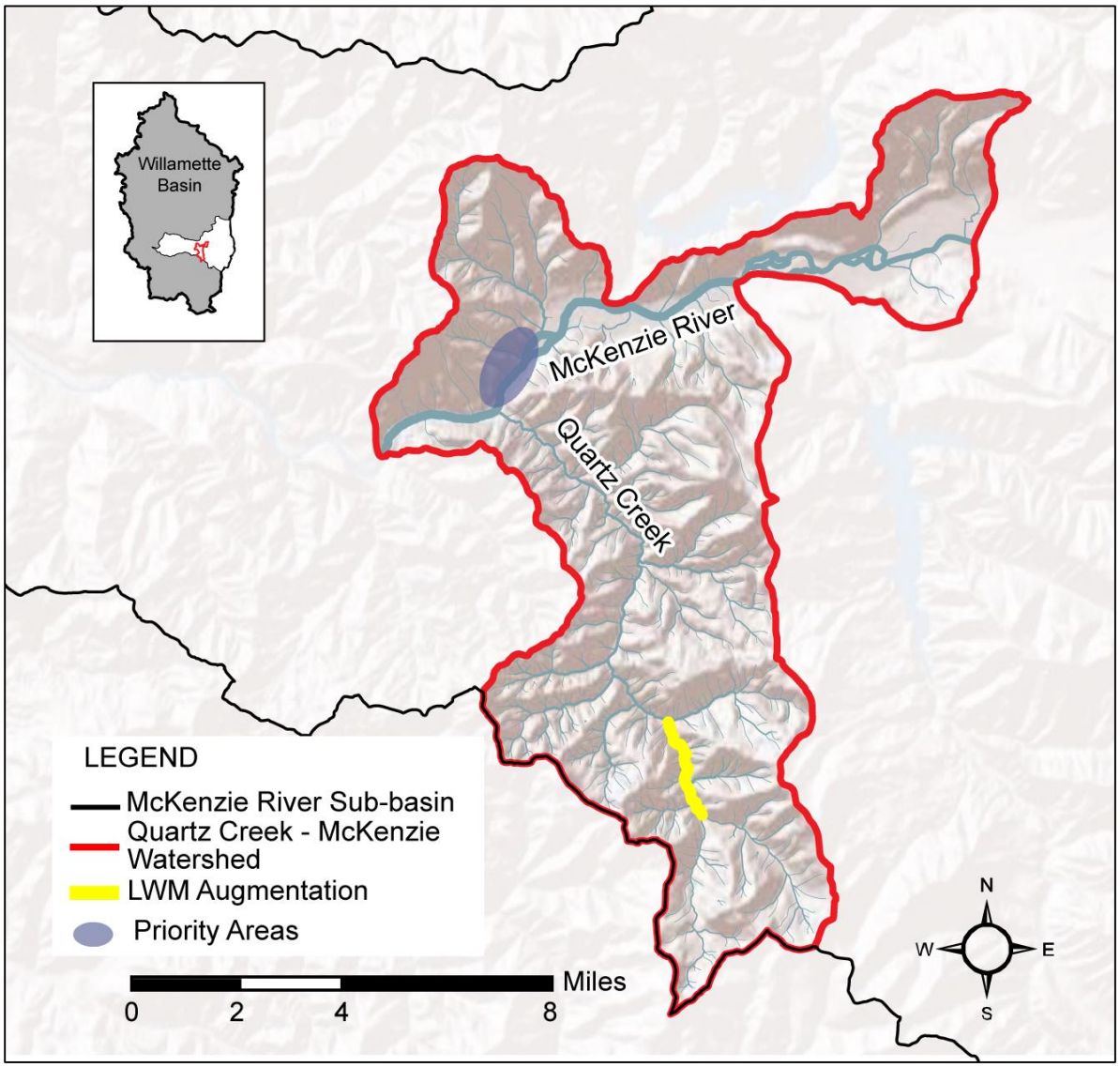


Figure 15. Priority restoration and conversation actions in the Quartz Creek-McKenzie River Watershed (5th Field HUC).

SMART Goal 1: Enhance in-stream habitat complexity and floodplain connectivity on 2 miles of stream and 25 acres of floodplain in the Quartz Creek-McKenzie River Watershed by 2026.

The McKenzie River main stem within the Quartz Creek-McKenzie River Watershed is a mixture of federal lands managed by the WNF, private residential properties and conservation lands owned by the MRT. Floodplain connectivity and instream habitat have been impacted by a combination of past land use practices such as logging within riparian areas and in-stream log salvage, modern-day development and the installation of upriver dams. The WNF, MWC and others have completed several in-stream habitat enhancement projects within McKenzie River side channels within the watershed. The MRT's acquisition of the Finn Rock Reach property represents a significant opportunity for in-stream habitat enhancement and floodplain connectivity benefiting key species. Opportunities for in-stream habitat enhancement within the main stem McKenzie River and its floodplain are limited due to conflicts with recreation and private residences.

The majority of the Quartz Creek sub-watershed is privately owned and is primarily managed for commercial timber production. WNF lands are found in the upper reaches and headwaters of the system. Quartz Creek has been impacted by surrounding land use, an extensive road system and a history of landslides. Several small-scale in-stream enhancement projects were completed in the 1990's in cooperation among the private landowners, USFS and ODFW.

Objective A: Augment LWM on 3 miles of stream and 75 acres of floodplain by 2026.

Action 1: Develop collaborative partnerships among MRT, USFS, MWC, willing private landowners and others.

Action 2: Enhance in-stream habitat and floodplain connectivity on 1 mile of McKenzie River side channel and 50 acres of floodplain habitat on conservation and/or private lands by 2026. (MRT, USFS, MWC, EWEB)

Action 3: Augment LWM on 2 miles of Quartz Creek and 25 acres of associated floodplain by 2026, beginning on USFS land. (USFS, MWC)

SMART Goal 2: Improve fish passage.

No fish passage actions are identified for prioritization at this time. Multiple local partners including the USFS and private landowners have completed numerous culvert replacement projects within the Quartz Creek - McKenzie River Watershed over the last 10-15 years. The MWC, in partnership with the Willamette NF, Eugene District BLM, and the Middle Fork Willamette Watershed Council completed a fish passage assessment and database project in 2005.

Objective A: Update culvert database for the Quartz Creek-McKenzie River watershed by 2020.

Action 1: Compile existing USFS, ODFW, MWC and private landowner culvert databases for the Quartz Creek-McKenzie River Watershed. (MWC)

Action 2: Identify data gaps and need for additional field surveys. (MWC)

Action 3: Prioritize remaining fish passage barriers for restoration. (MWC, ODFW)

SMART Goal 3: Conserve and enhance over 50 acres of riparian forests on private land by 2026.

Private residential development within the Quartz Creek – McKenzie River watershed is primarily concentrated along the main stem McKenzie River. Efforts to conserve and enhance riparian habitat within the watershed will focus on private residences and conservation lands owned by the MRT within the VIP boundary (**Figure 13**).

Objective A: Implement VIP in partnership with 150 landowners on 50 acres of private land within current boundary by 2026.

Action 1: Conduct 150 riparian health assessments and in this watershed. (MWC and UWSWCD)

Action 2: Complete VIP agreements and associated management plans with 50 landowners with medium to large size tax lots. (EWEB)

Action 3: Enroll 100 landowners with small residential tax lots for VIP naturescaping program. (EWEB)

Action 4: Implement restoration actions (invasive vegetation management and/or native vegetation establishment) on 50 acres. (MWC and UWSWCD)

Action 5: Implement maintenance program(s) on 50 acres. (MWC and UWSWCD)

Action 6: Leverage opportunities with 3 VIP landowners to promote and implement conservation easements or land acquisitions cover 50 acres. (EWEB, MRT)

Action 7: Establish site level monitoring programs. (EWEB)

SMART Goal 4: Maintain or improve water quality for key species.

No specific restoration or conservation actions addressing water quality for key fish species such as decommissioning roads, upgrading stream crossings (non-fish passage barriers) and road stabilization within the Quartz Creek-McKenzie River watershed are identified for prioritization at this time. Floodplain and riparian conservation and enhancement actions outlined in Goal 1 and 3 are expected to benefit water quality in terms of temperature and fine sediment. Voluntary programs listed under Outcome 2 targeting maintenance of drinking water quality are also expected to improve water quality for key species.

8.1.4 Blue River Watershed

No actions are foreseen during the period 2016-2026 in this watershed. This is primarily due to the fact that Blue River Dam does not provide anadromous fish passage and is not a priority for fish passage of any kind within the Willamette Dams Biological Opinion.

8.1.5 South Fork McKenzie River Watershed

The South Fork McKenzie River Watershed is over 137,000 acres and is comprised of predominately public lands with 94% managed by the Willamette National Forest and just over 2% managed by the USACE (LCOG, 1995). The watershed includes Cougar Dam and Cougar Reservoir. The South Fork McKenzie River provides habitat for bull trout and spring Chinook salmon both upstream and downstream of Cougar Dam.

The South Fork McKenzie River Watershed has been a priority area for restoration for many years. Due to spring Chinook salmon and bull trout distribution throughout much of the watershed **(Figure 9**), habitat improvement projects (primarily LWM augmentation) have already been implemented on over 9 miles of channel. In 2011, the South Fork McKenzie River Watershed was selected as the priority watershed for the McKenzie River Ranger District, under the Watershed Condition Framework (USFS, 2011) - a national effort to improve the Forest Service's approach to watershed restoration by targeting work in watersheds that have been identified as priorities. Based on the high potential for restoration benefits to various natural resources, the Cougar Creek Sub-watershed was subsequently chosen as the first priority for an action plan. In 2012, the Cougar Creek Watershed Restoration Action Plan was

signed and essential projects were identified to move the watershed condition rating from *Functioning at Risk* towards *Functioning Properly*. The essential projects that have not yet been completed have been incorporated into the following restoration actions. Actions discussed in this section are all on public lands of the WNF. Priority restoration actions are depicted in **Figure 16** and described in SMART Goals 1-4.

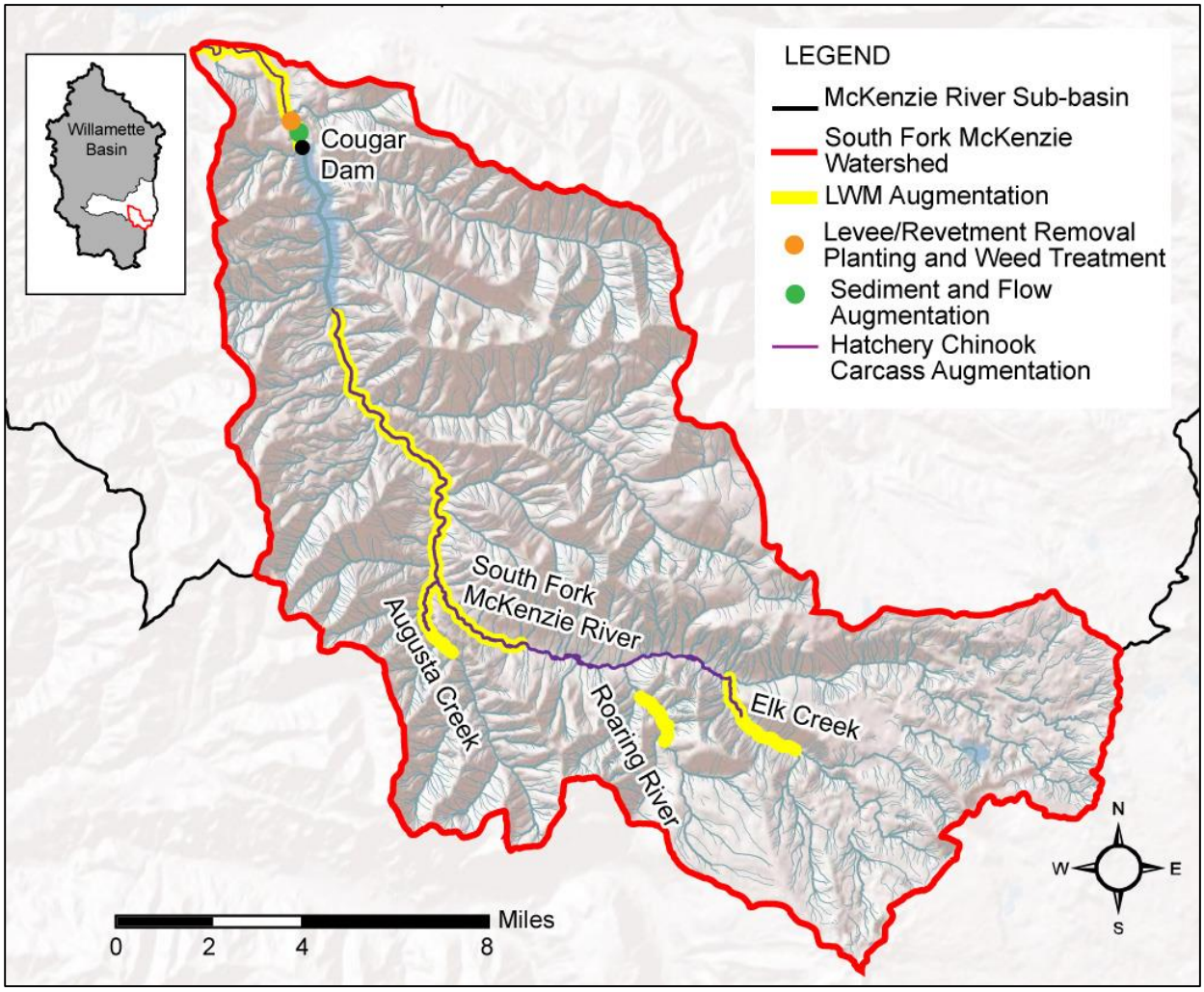


Figure 16. Priority restoration actions in the South Fork McKenzie River Watershed.

<u>SMART Goal 1: In-stream and Floodplain Function - Enhance in-stream habitat complexity, floodplain connectivity, and productivity on at least 10 miles of stream and 400 acres of floodplain by 2026.</u>

Due to the presence of Cougar Dam, historic logging practices, road, levee and revetment construction, and fire suppression, in-stream and floodplain conditions are degraded in portions of the watershed. The most degraded conditions are found on a broad alluvial fan near the confluence of the South Fork with the McKenzie River, where Cougar Dam has altered the hydrologic regime and cut off the sediment[1] (gravel recruitment), wood, and nutrient supply. Levee and revetment construction has further straightened the channel and limited floodplain connectivity. This area was once a biological hotspot, but is no longer functioning as such.

[1] Sediment is a general term that includes fines, gravel, cobble and boulders.

Objective A: Increase marine derived nutrients from spring Chinook salmon on at least 10 miles of stream annually, beginning in 2016.

Action 1: Implement hatchery Chinook carcass augmentation in the following reaches, listed in order of priority: (ODFW)

a) South Fork McKenzie River - 4.5 miles below Cougar Dam
b) South Fork McKenzie River - 16.75 miles above Cougar Reservoir
c) Elk Creek - lower 1.0 miles
d) Augusta Creek - lower 1.5 miles

Objective B: Augment LWM and finer organic material to properly functioning levels in at least 10 miles of stream and 400 acres of floodplain by 2026.

Action 1: Implement LWM and finer organic material augmentation in the following reaches, listed in order of priority: (USFS)

a. South Fork McKenzie River - 4.5 miles below Cougar Dam
b. South Fork McKenzie River - 8.5 miles above Reservoir
c. Elk Creek - lower 2.5 miles
d. Augusta Creek - lower 2.25 miles
e. Roaring River - 1.5 miles (RM 1.0-2.5)

Action 2: Monitor project effectiveness. (Various partners)

Objective C: Restore a more natural flow regime by 2026.

Action 1: Work with the USACE to periodically release channel forming flows (approx. 6,000-8,000cfs) below Cougar Dam (see The Nature Conservancy Environmental Flow Recommendations Report for details) by 2020 following LWM and sediment augmentation and levee removal projects. (USACE)

Action 2: Conduct additional assessment of impacts to the flow regime by the road network to determine need for treatment by 2017. (USFS)

Action 3: Monitor project effectiveness. (USFS)

Objective D: Restore a more natural sediment regime by 2026.

Action 1: Implement sediment augmentation (approx. 200,000cy initially and approx. 3,000-8,000cy annually) in the South Fork McKenzie River below Cougar Dam (4.5 miles) following LWM augmentation and levee removal projects, beginning in 2018. (USFS)

Action 2: Upgrade at least 2 stream crossings for effective transport of sediment and wood by 2026. (USFS)

Action 3: Conduct additional assessment of impacts to the flow regime by the road network to determine need for treatment by 2017. (USFS)

Action 4: Monitor project effectiveness. (USFS)

Objective E: Reconnect at least 5 miles of side channels and 400 acres of floodplain through levee and revetment removal by 2026.

Action 1: Remove approximately 40 acres of levees and revetments in the South Fork McKenzie River below Cougar Dam by 2020. (USFS)

Action 2: Monitor project effectiveness. (USFS)

SMART Goal 2: Passage – Improve upstream and downstream passage for key species at a minimum of 2 road crossings and 1 dam by 2026.

Downstream passage improvements are needed to successfully pass fish through Cougar Dam. USACE is planning to build a permanent downstream passage facility. Several road crossings have recently been upgraded to improve passage for key species, including Cougar Creek in 2012 that was the last remaining culvert restricting passage of ESA-listed fish. There are approximately 16 remaining culverts that are barriers to rainbow and cutthroat trout migration in the watershed. We are proposing to upgrade at least two of the highest priority culverts (yet to be determined).

Objective A: Advocate for improved fish passage at Cougar Dam.

Action 1: Develop a collaboration involving MWC, USACE, ODFW, USFS and other partners to resolve downstream fish passage. (MWC)

Action 2: Meet with the partners on an ongoing basis. (MWC)

Objective B: Remove upstream and downstream passage barriers at a minimum of 2 road crossings for rainbow and cutthroat trout and at 1 dam for key species by 2026. (USFS)

Action 1: Improve upstream and downstream passage effectiveness at Cougar Dam by 2026. (USACE)

Action 2: Remove high priority passage barriers at a minimum of 2 road crossings by either removing culverts through road storage/decommissioning or upgrading culverts to restore fish passage. (USFS)

Action 3: Conduct additional assessment of passage issues to determine need for treatment. (USFS)

Action 4: Monitor effectiveness. (USFS)

SMART Goal 3: Riparian Function – Enhance native riparian vegetation communities on at least 50 acres by 2026. Invasive plants are common to some riparian areas along the South Fork McKenzie River below Cougar Dam, particularly on disturbed surfaces such as levees and revetments. Weed treatment is needed before and after removal of levees and revetments, and planting of native species on disturbed surfaces will be a critical step in ensuring restoration success. Seasonal and youth conservation corps crews have been used periodically over the past several years to help manage invasive vegetation in several priority areas, such as dispersed camp sites and decommissioned skid roads in the South Fork McKenzie River floodplain.

Objective A: Enhance native riparian vegetation communities by controlling or removing invasive species and/or planting native species on at least 30 acres by 2026.

Action 1: Control 30 acres of invasive species along the South Fork floodplain. (USFS)

Action 2: Plant 30 acres of native vegetation following levee removal. (USFS)

Action 3: Conduct additional assessment of invasive species abundance/distribution to determine need for treatment. (USFS)

Action 4: Monitor project effectiveness. (USFS)

SMART Goal 4: Water Quality – Maintain or improve water quality by reducing road-related fine sediment delivery to streams on at least 35 miles of road by 2026. Roads throughout the watershed can deliver chronic fine sediment to streams and some are at risk of episodic failure that can deliver large amounts. The USFS has recently conducted a Sustainable Roads Analysis to recommend that roads of high aquatic risk be hydrologically stabilized and stored or decommissioned. The actions proposed below reflect what can realistically be accomplished by 2026. Most of the actions listed below will be implemented by the USFS.

Objective A: Reduce road-related fine sediment delivery to streams on at least 30 miles of road by 2026.

Action 1: Hydrologically stabilize and store at least 10 miles of road by 2026. (USFS)
Action 2: Conduct storm damage risk reduction (new surfacing; improve drainage; replace culverts) on at least 20 miles of road by 2026. (USFS)
Action 3: Decommission at least 5 miles of road by 2026. (USFS)
Action 4: Upgrade at least 2 stream crossings to reduce the risk of failure and fine sediment delivery. (USFS)
Action 5: Conduct additional assessment of sediment delivery issues to determine need for treatment. (USFS)
Action 6: Monitor effectiveness. (USFS)

8.1.6 Horse Creek Watershed

The Horse Creek Watershed is over 100,000 acres in size. Nearly all of the watershed is publically owned and managed by the Willamette National Forest (LCOG, 1995). Private ownership includes both residential and timber lands in the lower portion of the watershed. Horse Creek is a very important tributary for spring Chinook salmon spawning and bull trout foraging. Land use practices, including historic logging practices, stream cleanout of wood and roads construction, have impacted instream habitat complexity (primarily lack of LWM). There are also barriers to native fish passage and LWM and sediment delivery on several tributaries. Because the headwaters are in designated Wilderness, Horse Creek is in relatively good condition, though the 1997 Horse Creek Watershed Analysis documented a decline in pools, reduced abundance and size of LWM, and coarse substrate. These trends can primarily be attributed to the historic removal of large wood, logging, and stream channelization (USFS, 1997).

Proposed priorities in the Horse Creek Watershed include actions associated with the VIP **(Figure 13)** and a combination of fish passage and in-stream and floodplain habitat enhancement projects on public lands of the WNF **(Figure 17)**.

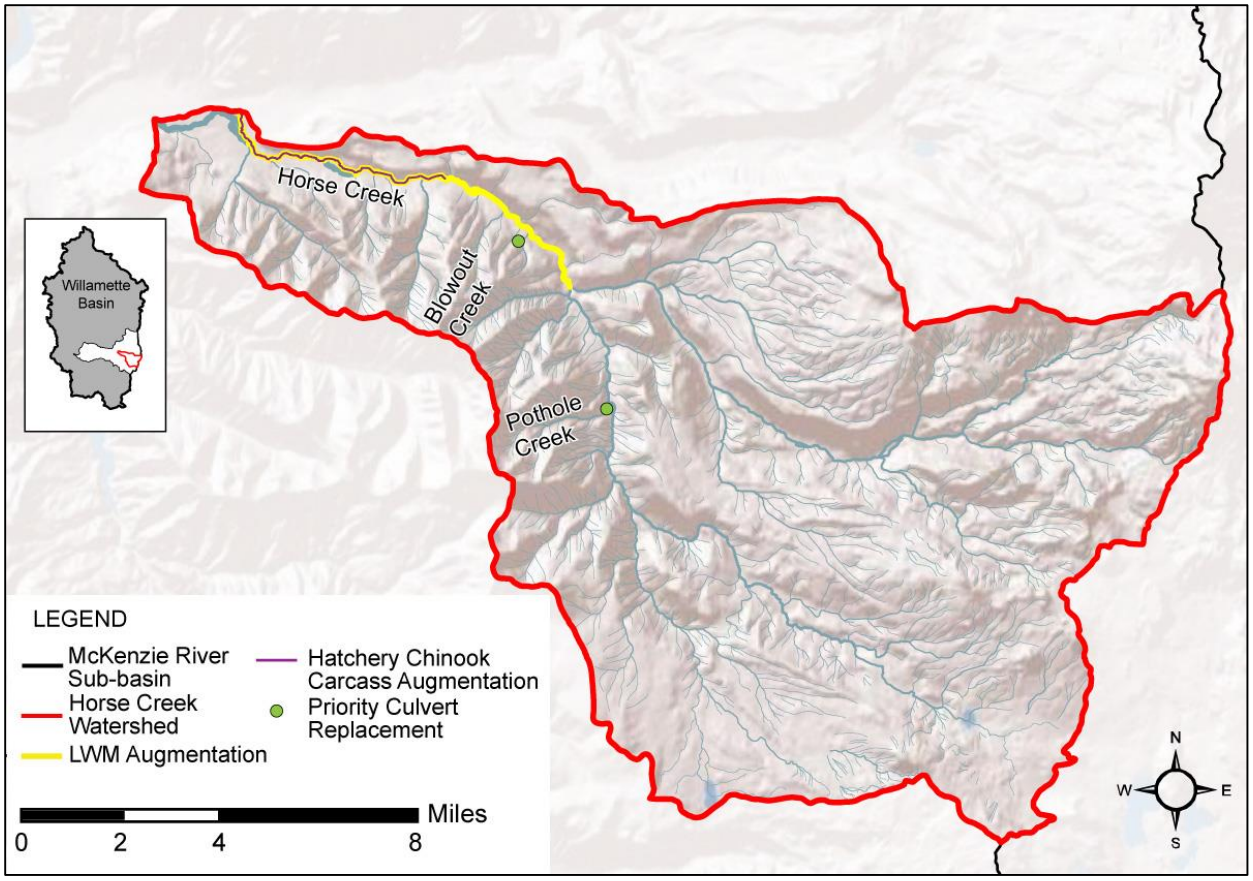


Figure 17. Priority restoration actions in the Horse Creek Watershed (5th -Field HUC).

SMART Goal 1: In-stream and Floodplain Function - Enhance in-stream habitat complexity, floodplain connectivity, and productivity on at least 9 miles of stream and 100 acres of floodplain by 2026. Horse Creek is a very important tributary for spring Chinook salmon spawning and bull trout foraging (**Figure 9**). Due to historic logging practices, stream cleanout of wood, and building of roads, Horse Creek is lacking LWM and has excessive fine sediment delivery from roads. There are also passage barriers to cutthroat trout on several tributaries. Because the headwaters are in designated Wilderness, Horse Creek is in relatively good condition. The stream just needs a one-time augmentation of large diameter wood for it to be self- sustaining into the future.

Objective A: Increase marine-derived nutrients from spring Chinook salmon on at least 5 miles of stream annually, beginning in 2016.

Action 1: Implement hatchery Chinook carcass augmentation in the lower 5 miles of Horse Creek. If there are excess carcasses, augment up to river mile 10.5. (ODFW)

Objective B: Augment LWM and finer organic material to properly functioning levels in at least 9 miles of stream and 100 acres of floodplain by 2026.

Action 1: Implement LWM and finer organic material augmentation in the following reaches, listed in order of priority: (USFS)

a. Horse Creek – lower 9.3 miles
b. Horse Creek – RM 9.3-13.9 (4.6 miles)

Action 2: Monitor project effectiveness. (USFS)

SMART Goal 2: Passage – Improve upstream and downstream passage for key species at a minimum of 2 road crossings by 2026.

In 2014, a partnership was initiated between the USFS, EWEB, and Geos Institute to pursue replacement of culverts for the benefit of both fish passage and municipal water quality benefit. Horse Creek was selected for this project given the presence of a number of undersized road crossings that, if upgraded, would provide the desired benefits to native fish and water quality. These culverts frequently get overtopped during storms with detrimental effects to resources. In preparation for this work, LiDAR was flown to be able to track the geomorphic changes that would occur above and below these crossings after upgrades were completed. Upgrades to these culverts would also complement large woody material placement in the main stem of Horse Creek (Objective B above).

Objective A: Improve upstream and downstream passage at a minimum of 2 locations for cutthroat trout by 2026.

Action 1: Improve upstream and downstream passage at the following locations, listed in order of priority: 1) Blowout Creek, 2) Pothole Creek. Secondary priorities include: 3) Taylor Creek, 4) Pasture Creek, and 5) Castle Creek. (USFS)

Action 2: Monitor project effectiveness. (USFS)

SMART Goal 3: Conserve and enhance over 25 acres of riparian forests on private land by 2026.

Private residential development within the Horse Creek watershed is concentrated along the lower 2 miles of the Horse Creek floodplain and along the West Fork of Horse Creek. Efforts to conserve and enhance riparian habitat within the watershed will focus on private residences within the VIP boundary in these areas (**Figure 13)**.

Objective A: **Implement VIP in partnership with 25 landowners on 25 acres of private land within current boundary by 2026.**

Action 1: Conduct 20 riparian health assessments in the Horse Creek watershed. (MWC, UWSWCD)

Action 2: Complete VIP agreements and associated management plans with 10 landowners with medium to large size tax lots. (EWEB)

Action 3: Enroll 10 landowners with small residential tax lots in VIP naturescaping program. (EWEB)

Action 4: Implementation restoration actions (invasive vegetation management and/or native vegetation establishment) on 25 acres. (MWC, UWSWCD)

Action 5: Implement maintenance program(s) on 25 acres. (MWC, UWSWCD)

Action 6: Establish site level monitoring programs. (EWEB)

SMART Goal 3: Water Quality – Maintain or improve water quality by reducing road-related fine sediment delivery to streams on at least 7 miles of road by 2026. Roads throughout the watershed can deliver chronic fine sediment to streams and some are at risk of episodic failure that can deliver large amounts. The USFS has recently conducted a Sustainable Roads Analysis to recommend roads of high aquatic risk be hydrologically stabilized and stored or decommissioned. The actions proposed below reflect what can realistically be accomplished by 2026. Most of the actions listed below will be implemented by the USFS.

Objective A: Reduce road-related fine sediment delivery to streams on at least 7 miles of road by 2026.

Action 1: Hydrologically stabilize and store at least 2 miles of road by 2026. (USFS)
Action 2: Decommission at least 5 miles of road by 2026. (USFS)
Action 3: Upgrade at least 2 stream crossings to reduce the risk of failure and fine sediment delivery by 2026. (USFS)
Action 4: Conduct additional assessment of sediment delivery issues to determine need for treatment. (USFS)
Action 5: Monitor project effectiveness. (USFS)

8.1.7 Headwaters McKenzie River Watershed

The Headwaters McKenzie River Watershed is over 200,000 acres and extends upstream from the mouth of Horse Creek to the headwaters of the McKenzie River (LCOG, 1995). Major tributaries include Lost Creek (rm 74), Scott Creek (75.5), Boulder Creek (rm 76), Frissell Creek (rm 78), Deer Creek (rm 79) and the Smith River (rm 82) **(Figure 11)**. Ownership is nearly all public land managed by the Willamette National Forest. Private residential land is found along the main stem McKenzie River in and around the community of McKenzie Bridge. The Mt. Washington and Three Sisters Wilderness Areas dominate the headwaters of the watershed. EWEB's Carmen-Smith Hydroelectric Project is located within the watershed. The watershed contains important habitat for spring Chinook salmon and bull trout. Several creeks, Anderson Creek, Olallie Creek, and Sweet Water Creek provide spawning habitat for bull trout. Separate bull trout populations exist above and below Trail Bridge Dam. Chinook salmon rely upon the main stem river for spawning and early rearing (LCOG, 1995).

Proposed priorities in the Headwaters McKenzie River Watershed include actions associated with the VIP **(Figure 13)** and a variety of in-stream and floodplain habitat enhancement projects on public lands of the WNF **(Figure 18)**.

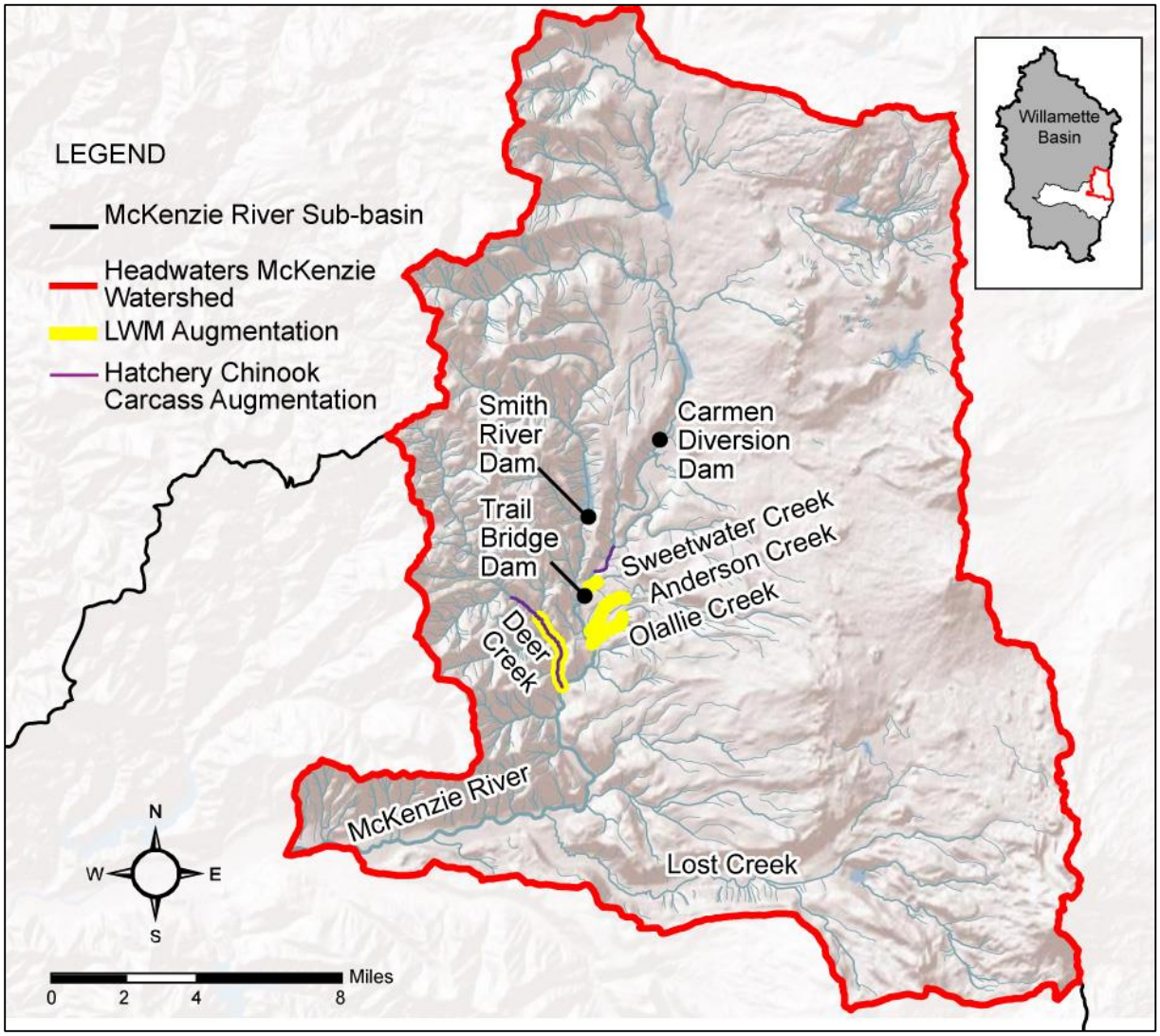


Figure 18. Priority actions in the Headwaters McKenzie River Watershed (5th Field HUC).

SMART Goal 1: In-stream and Floodplain Function - Enhance in-stream habitat complexity, floodplain connectivity and productivity on at least 5 miles of stream and 60 acres of floodplain by 2026.

Due to the presence of three dams, historic logging practices, revetment and road construction, fire suppression, private development and recreation, in-stream and floodplain conditions are degraded in portions of the watershed. The most degraded conditions are found in the main stem McKenzie River, where the dams have altered the hydrologic regime and cut off the sediment (gravel recruitment), wood, and nutrient supply. Revetment construction near campgrounds and private land has further straightened the channel and limited floodplain connectivity. Four of the five bull trout spawning streams in the entire McKenzie River Sub-basin are found in the Headwaters McKenzie River Watershed – Anderson, Olallie, and Sweetwater Creeks and the McKenzie River above Trail Bridge Reservoir. Due to historic logging practices, they are lacking LWM, an important habitat element for bull trout. Another important stream, Deer Creek, was once suitable habitat for spring Chinook salmon spawning. Due to historic logging practices and stream cleanout of wood, Deer Creek is severely lacking in LWM and consequently is not retaining gravel needed for spawning.

Objective A: Increase marine-derived nutrients from spring Chinook salmon on at least 4 miles of stream annually, beginning in 2016.

Action 1: Implement hatchery Chinook carcass augmentation in the following reaches, listed in order of priority: (ODFW)

a) Deer Creek – lower 2 miles
b) McKenzie River – 1 mile above Trail Bridge Dam
c) McKenzie River - 16.2 miles through Florence Creek-McKenzie River and Boulder Creek-McKenzie River Sub-watersheds
d) Lost Creek - lower 2.0 miles

Action 2: Monitor project effectiveness. (Various partners)

Objective B: Augment LWM and finer organic material to properly functioning levels in at least 5 miles of stream and 60 acres of floodplain by 2026.

Action 1: Implement LWM and finer organic material augmentation in the following reaches, listed in order of priority: (USFS)

a) Deer Creek – lower 1.6 miles
b) Anderson Creek – lower 2 miles
c) Olallie Creek – lower 1.25 miles
d) Sweetwater Creek – lower 0.5 miles
e) McKenzie River - 16.2 miles through Florence Creek-McKenzie River and Boulder Creek-McKenzie River Sub-watersheds
f) Lost Creek - lower 2.0 miles
g) Smith River – lower 0.5 miles

Action 2: Monitor project effectiveness. (USFS)

Objective C: Restore a more natural sediment regime (gravel recruitment) by 2026.

Action 1: Implement sediment (gravel) augmentation (amount and distribution to be determined) in the McKenzie River below Trail Bridge Dam, Carmen Dam, and Smith Dam annually, beginning in 2020. (USFS)

Action 2: Upgrade at least 2 stream crossings for effective transport of sediment and wood by 2026. (USFS)

Action 3: Conduct additional assessment of impacts to the flow regime by the road network to determine need for treatment by 2017. (USFS)

Action 4: Monitor project effectiveness. (USFS)

SMART Goal 2: Passage – Improve upstream and downstream passage for key species at a minimum of 2 road crossings and 1 dam by 2026. EWEB is currently undergoing FERC relicensing for operation of their 3 dams in the watershed. Passage improvements are included in their relicensing proposal. Several road crossings have been upgraded to improve passage for key species, including Anderson Creek, Olallie Creek, and Sweetwater Creek on bull trout spawning streams. There are approximately 15 remaining culverts that are barriers to rainbow and cutthroat trout migration in the watershed. We are proposing to upgrade at least two of the highest priority culverts (yet to be determined).

Objective A: Remove upstream and downstream passage barriers for rainbow and cutthroat trout at a minimum of 2 road crossings and 1 dam by 2026.

Action 1: Improve upstream and downstream passage effectiveness at Trail Bridge Dam by 2026. (EWEB)

Action 2: Remove passage barriers at a minimum of 2 road crossings by either removing culverts through road storage/decommissioning or upgrading culverts to restore fish passage. (USFS)
Action 3: Conduct additional assessment of passage issues to determine need for treatment. (USFS)
Action 4: Monitor project effectiveness. (Various partners)

SMART Goal 3: Conserve and enhance over 50 acres of riparian forests on private land by 2026.
Private residential development within the Headwaters McKenzie River watershed is primarily concentrated along the main stem McKenzie River. Efforts to conserve and enhance riparian habitat within the watershed will focus on private residences within the VIP boundary (**Figure 13**).

Objective A: **Implement VIP in partnership with 75 landowners on 25 acres of private land within current boundary by 2026.**
Action 1: Conduct 75 riparian health assessments in the Headwaters McKenzie River Watershed. (MWC and UWSWCD)
Action 2: Complete VIP agreements with 25 landowners with medium to large size tax lots. (EWEB)
Action 3: Enroll 50 landowners with small residential tax lots in VIP naturescaping program. (EWEB)
Action 4: Implement restoration actions (invasive vegetation management and/or native vegetation establishment) on 25 acres. (MWC and UWSWCD)
Action 5: Implement maintenance program(s) on 25 acres. (MWC and UWSWCD)
Action 6: Establish site level monitoring programs. (EWEB)

SMART Goal 4: Water Quality – Maintain or improve water quality by reducing road-related fine sediment delivery to streams on at least 20 miles of road by 2026. Roads throughout the watershed can deliver chronic fine sediment to streams. The USFS has recently conducted a Sustainable Roads Analysis to recommend that roads of high aquatic risk be hydrologically stabilized and stored or decommissioned. The actions proposed below reflect what can realistically be accomplished by 2026. Most of the actions listed below will be implemented by the USFS.

Objective A: Reduce road-related fine sediment delivery to streams on 20 miles of road by 2026.
Action 1: Hydrologically stabilize and store at least 10 miles of road by 2026. (USFS)
Action 2: Decommission at least 10 miles of road by 2026. (USFS)
Action 3: Conduct additional assessment of sediment delivery issues to determine need for treatment. (USFS)
Action 4: Monitor project effectiveness. (USFS)

8.2 Outcome 2: Maintenance and improvement of high quality drinking water for City of Eugene, City of Springfield and watershed residents.

Goals, objectives and actions are organized on a sub-basin scale (USGS 4th-field HUC). Three SMART goals developed for Outcome 2 include:

1. Reduce the amount of chemicals used and/or stored in the watershed, and increase hazardous material spill preparedness;
2. Reduce bacteria and nutrient pollution loads into the McKenzie River and its tributaries to reverse increasing trends of *E. coli* and nitrates by 2026; and
3. Establish a watershed health monitoring framework that effectively assesses and tracks changes in: water quality and quantity; land cover and landforms; key aquatic species health; and instream habitat, in order to assess climate change impacts and effectiveness of actions taken as part of the Action Plan by 2026.

Table 4 outlines the goals, objectives and actions of Outcome 2.

Table 4. Outcome 2 goals, objectives and actions.

Goals	Objectives	Actions	Lead(s)
Reduce chemical use and storage and increase hazardous spill preparedness	Reduce pesticide/nutrient use and storage	• Healthy Farms Clean Water Program • Agricultural chemical collection events • Naturescaping workshops	EWEB
	Reduce toxic chemical usage and pharmaceutical storage	• Ecobiz Certification Program	Various
	Maintain hazardous spill response (MWERS) readiness	• Annual drills • Develop response system	EWEB
Reduce bacteria and nutrient pollution	Septic System Assistance Program	• Septic system assistance program	EWEB
	Storm water treatment systems with City of Springfield	• 48th Street wetland design • 69th and 72nd street treatment designs implementation	EWEB
	Healthy Farms Clean Water Program	• Develop off-site watering and fencing projects • Manure compost facilities projects	EWEB
Establish watershed health monitoring framework	Expand SLICES framework to McKenzie Sub-basin	• Map at 1km and 100m intervals • Populate with data at 100m scale • Repeat on 10-year cycle	UO, OSU, EWEB
	Sub-basin water quality monitoring	• Baseline monitoring at 16 sites on quarterly basis • Fall and spring storm event monitoring • Seasonal algal bloom monitoring at reservoirs • Maintain 4 continuous monitoring stations • Conduct bacteria source tracking analysis • Summarize trends on VIP dashboard	EWEB
	Sub-basin water quality monitoring to assess snow pack, flow levels, precipitation, water use	• Assess patterns and trends in water recharge using existing data sources • Establish continuous flow and temperature monitoring stations on select spring creeks	EWEB, USGS
	Conduct land cover and landform monitoring (LiDAR)	• Conduct 2016 flight • Repeat flights on 5-year interval	EWEB, LCOG

SMART Goal 1: Reduce the amount of chemicals used and/or stored in the watershed, and increase hazardous material spill preparedness.

EWEB has created a number of programs to help address the threat chemicals pose to drinking water quality in the McKenzie River Sub-basin. The MWERS was created in order to address the threat from hazardous material spills in the Sub-basin. Additional programs by EWEB, SUB and the City of Springfield target working with farmers, residential landowners and business owners to remove chemical, pesticide and nutrient storage loads in the floodway. The following actions would be additional to the ongoing programs by these partners.

Objective A: Work with 50 farmers and 200 homeowners to reduce pesticide/nutrient use and/or storage of chemicals by 40 tons by 2022.

Action 1: Work with 15 farmers through the Healthy Farms Clean Water Program to reduce pesticide and nutrient use by 5 tons. (EWEB, partners)

Action 2: Hold 2 agricultural chemical collection events and annual household hazardous waste collection events in the McKenzie Sub-basin that removes 35 tons of chemicals from the watershed. (EWEB, partners)

Action 3: Conduct annual Naturescaping Workshops for McKenzie residents (estimate 20 residents per workshop). (EWEB, MWC, UWSWCD)

Objective B: Work with 10 McKenzie/Springfield businesses to reduce use of toxic chemicals by 2022.

Action 1: Conduct Ecobiz Certification audits at 10 auto shops in the McKenzie Sub-basin to eliminate use of toxic chemicals. (Various partners)

Objective C: Conduct annual drills and/or exercises with first responders using response trailers and web-based GIS MWERS to maintain spill response readiness.

Action 1: Conduct annual interagency spill response drills and/or exercises that test deployment of response equipment on waterbodies in the McKenzie Sub-basin. (EWEB, various partners)

Action 2: Develop and test web-based MWERS response system that builds off the existing PC desktop GIS-based system by 2017. (EWEB, various partners)

SMART Goal 2: Reduce bacteria and nutrient pollution loads into the McKenzie River and its tributaries to reverse increasing trends of *E. coli* and nitrates by 2026.

In order to address potential trends in increased bacteria and nutrient inputs into the McKenzie River, EWEB has created several programs which target sources of these inputs. The McKenzie Septic System Financial Assistance Program consists of two components: 1) 50% cost-share program for septic system inspections and pump-outs and 2) zero-interest loans for major septic system repairs or replacements. EWEB is also working with local partners and farmers to address inputs from agricultural lands through its Healthy Farms Clean Water Program. A wetland enhancement project is being designed in order to address inputs from City of Springfield storm drains. The City of Springfield and SUB also partner on a septic tank education and outreach program.

Objective A: Work with 500 homeowners in the McKenzie Sub-basin to reduce impacts from septic systems to river water quality by 2022.

Action 1: Inspect and pump-out (as needed) 500 septic systems in the McKenzie Sub-basin. (EWEB)

Action 2: Repair or replace 50% of failing septic systems identified in the inspections. (EWEB)

Objective B: Design and develop wetland or other treatment systems for urban storm water runoff from East Springfield at 48th, 69th and 72nd Street storm water channel outfalls that have high bacteria and nutrient loads by 2022.

Action 1: Implement wetland design for treatment of storm water runoff in 48th Street channel prior to discharge into Keizer Slough. (It should be noted that the City of Springfield does not own the 48th St. channel, so work will be contingent on the willingness of landowners to participate.) (City of Springfield)

Action 2: Work with City of Springfield to design green infrastructure to treat storm water runoff from 69th and 72nd channels. (City of Springfield)

Action 3: Implement storm water treatment design at 69th Street or 72nd Street storm water channel by 2022. (City of Springfield)

Objective C: Work with 10 farms to reduce bacteria and nutrient runoff from livestock or other farm operations by 2022.

Action 1: Implement 10 off-stream water systems using solar pumps and fencing to keep livestock out of 4 miles of river/creek frontage in the McKenzie Sub-basin. (EWEB, various partners)

Action 2: Implement other nutrient reduction projects (manure composting/storage) on 1,000 acres of farmland through the Healthy Farms Clean Water Program. (EWEB, various partners)

SMART Goal 3: Establish a watershed health monitoring framework that effectively assesses and tracks changes in water quality and quantity; land cover and landforms; key aquatic species health; and instream habitat in order to assess climate change impacts and effectiveness of actions taken as part of the Action Plan by 2026.

EWEB's comprehensive water quality monitoring program is designed to assess the health of the McKenzie River and identify the potential threats to drinking water. This program consists of baseline monitoring, storm event monitoring, passive sampling, split sampling with high school students, harmful algal bloom monitoring and other special projects. Integrating the EWEB water quality monitoring program with sub-basin scale monitoring to track effects of conservation work will create efficiency and offer a more complete picture of water quality status in the sub-basin.

Objective A: Work with the UO,OSU, LCOG and EWEB to expand the Willamette Basin SLICES spatial framework into the McKenzie Sub-basin by 2026 (see Section 10).

Action 1: Map SLICES at 1km and 100m intervals. (UO, OSU, EWEB)

Action 2: Populate SLICES with data at 100m scale. (UO, OSU, EWEB)

Objective B: Conduct water quality monitoring throughout the McKenzie Sub-basin to assess pollution inputs from urban areas, rural communities, and development, agriculture, and forestry and assess impacts from dams and reservoir operations by 2026.

Action 1: Collect water samples from 16 monitoring sites located throughout the watershed on a quarterly basis to assess nutrient, metals, bacteria, and other physical parameters for trend analysis. (EWEB)

Action 2: Conduct fall and spring storm event runoff monitoring in lower McKenzie River, Cedar Creek, Camp Creek, urban storm water outfalls, and other areas as necessary to assess pesticides and other organic and emerging contaminants for acute and chronic toxicity to humans and aquatic organisms. (EWEB)

Action 3: Conduct Harmful Algal Bloom (HAB) monthly monitoring for toxic species from spring to fall in Cougar Reservoir, South Fork McKenzie below Cougar Dam, Blue River Reservoir, Blue River below Blue River Dam, Walterville Pond and EWEB's Hayden Bridge intake. (EWEB)

Action 4: As part of HAB monitoring effort, assess types and frequency of blooms over time to understand toxin producing potential of certain species that may change over time due to climate variability and/or reservoir operations and nutrient balance. (EWEB)

Action 5: Install and maintain four continuous monitoring stations on the McKenzie River and tributaries that measure turbidity, pH, conductivity, temperature, DOM (dissolved organic materials), dissolved oxygen at USGS gauges and/or other locations and add temperature tidbits to key areas. (EWEB)

Action 6: Conduct passive monitoring study to assess low level dissolved organic contaminants in the McKenzie and compare with upper Willamette River results. (EWEB)

Action 7: Conduct bacteria source tracking analysis in McKenzie, tributaries and storm water systems to determine human versus animal sources for focusing outreach and mitigation efforts. (EWEB)

Action 8: A summary of the key water quality trends will be displayed as part of the McKenzie watershed health dashboard. (EWEB)

Objective C: Conduct water quantity monitoring throughout the McKenzie Sub-basin to assess snow pack, spring and river flows, precipitation, reservoir operations, water use, and floods (magnitude, frequency, and extent) by 2026.

Action 1: Assess patterns and trends in water recharge, flows, and use through the collection and analysis of data from: NRCS SNOTEL sites (snow pack); various weather stations (precipitation); USGS gaging stations (flow); ACOE reservoir levels, water use patterns (hydroelectric, drinking water, agricultural, and commercial/industrial); and flood extent, frequency, and magnitude tracking. (Various partners)

Action 2: Establish continuous flow and temperature monitoring stations on key spring-fed creeks (Olallie, Anderson, Separation, and Horse). (Various partners)

Action 3: A summary of the key water quantity patterns and trends will be displayed as part of the McKenzie watershed health dashboard. (Various partners)

Objective D: Conduct land cover monitoring and assessment throughout the McKenzie Sub-basin to assess changes over time in floodplain land use, riparian forest health, vegetation patterns, urban growth boundaries, structural footprints, septic systems, revetments and roads (including culverts) by 2026.

Action 1: Leverage data from repeat flights of LiDAR, aerial photography and infrared flights every 4-5 years to map floodplain land use types, floodplain/riparian forest canopy coverage and height, dwelling and structural footprints, roads, and changes in channel morphology. (EWEB, LCOG, various partners)

Action 2: Continue collection and enhancement of tax lot and urban growth boundary data, general location of septic systems (EWEB Septic Assistance Program data), numbers of building and septic permits issued in the watershed, and revetments (EWEB collected via boat and GPS). (EWEB, LCOG, various partners)

Action 3: A summary of the key land cover patterns and trends will be displayed as part of the McKenzie watershed health dashboard. (EWEB, LCOG, various partners)

Objective E: Conduct landform mapping over time to assess changes in channel morphology, floodplain extent, and floodway extent by 2026.

Action 1: Leverage data from repeat flights of LiDAR, aerial photography and infrared flights every 4-5 years to map landforms. (EWEB, LCOG, various partners)

Action 2: A summary of the key landform patterns and trends will be displayed as part of the McKenzie watershed health dashboard. (EWEB, LCOG, various partners)

Objective F: Collect fish abundance and diversity data over time to assess changes in key aquatic populations that can inform watershed health trends and the effectiveness of watershed investments by 2026.

Action 1: Conduct fish abundance and diversity surveys as part of McKenzie SLICES protocol. (OSU, UO, EWEB, ODFW)

Action 2: A summary of the key fish abundance and diversity patterns and trends will be displayed as part of the McKenzie watershed health dashboard. (OSU, UO, EWEB)

Objective G: Collect instream habitat data over time to assess changes that can inform watershed health trends and the effectiveness of watershed investments by 2026.

Action 1: Leverage data from repeat flights of LiDAR, aerial photography and infrared flights every 4-5 years to map islands and side channels. (EWEB, LCOG, various partners)

Action 2: A summary of the key instream habitat patterns and trends will be displayed as part of the McKenzie watershed health dashboard. (Various partners)

8.3 Outcome 3: Enhanced public awareness, understanding, and support for watershed conservation and restoration.

Goals, objectives and actions are organized on a sub-basin scale (USGS 4th-field HUC). Five SMART goals developed for Outcome 3 include:

1. Conduct outreach to increase the participation of McKenzie River landowners in voluntary conservation and restoration actions;
2. Maintain and promote existing outreach programs which enhance middle and high school youth knowledge and understanding of watershed conservation and restoration;
3. Maintain opportunities for volunteers and community members to participate in the development and implementation of restoration and stewardship projects;
4. Increase collaboration with other watershed councils, agencies and organizations within Lane County who are providing youth programs focusing on watershed health, water quality and fish and wildlife habitat; and
5. Promote and enhance public knowledge of the historic and cultural significance, biological needs, and new research concerning spring Chinook salmon in the McKenzie River Sub-basin, and promote the recovery of Chinook.

Table 5 summarizes the goals, objectives and action of Outcome 3.

Table 5. Outcome 3 goals, objectives and actions.

Goals	Objectives	Actions	Lead(s)
Conduct outreach to increase private landowner participation in voluntary restoration and conservation	VIP outreach within current boundary	• Development of website and dashboard and other materials development • Focus on landowners previously identified in UO Survey • Focus on 900 landowners with prior participation in partner programs	EWEB
	Conduct outreach to landowners outside current VIP boundary	• Focus on landowners within high priority areas of Mohawk River and McKenzie River watersheds outside of current VIP boundary	MWC
Increase outreach programs to youth	Salmon Watch Program	• Salmon Stewards Committee coordination • Volunteer recruitment and training • Field trips to McKenzie and Siuslaw	MWC
	High School Program, Middle School Program, UO Environmental Leadership Program (ELP) Partnership	• WELL Project (Springfield School District) • SPARC Program (McKenzie School District) • Marcola School District • Eugene School District 4J • UO ELP	MWC
Increase public participation in watershed stewardship	Develop volunteer opportunities for public	• McKenzie River Clean-up • MRT Volunteer Partnerships at BWCA and other conservation properties • South Fork McKenzie River volunteer events	MWC Guides Flyfishers MRT USFS
Collaboration with area watershed education providers	Meet with local organizations and partnerships	• Collaboration with area watershed councils and other organizations • Participate in USFS Children's Forest Initiative planning	MWC USFS
Upper Willamette River spring Chinook recovery	Promote a greater understanding of McKenzie spring Chinook	• Public forum • Distribute materials on a sub-basin scale	MWC

SMART Goal 1: Conduct outreach to increase the participation of McKenzie River landowners in voluntary conservation and restoration actions, enrolling over 900 private landowners over a ten-year period from 2016 to 2026.

The McKenzie River Sub-basin is a large and complex watershed which provides habitat for native fish and wildlife; a high-value drinking water source; and numerous economic and recreational opportunities. Landownership varies greatly from private residential, to working agricultural and forestry lands, to public land managed by the U.S. Forest Service and BLM. Successful sub-basin-scale stewardship efforts must include the voluntary collaboration of a range of landowners and land managers.

Objective A: Conduct outreach to landowners of 2,235 tax lots within the VIP boundary (**Figure 13**) to participate in the VIP, with 910 tax lots enrolled in VIP by 2026.

Action 1: Develop VIP website, watershed health dashboard, and outreach materials for landowners to learn, request riparian assessments, and engage in VIP by 2016. (EWEB)

Action 2: Contact 67 landowners within VIP boundary that expressed interest in VIP as part of UO landowner survey by 2016. (EWEB, various partners)
Action 3: Conduct focused outreach and follow-up activities with the over 900 landowners that EWEB has already worked with in past watershed incentive programs (600 septic assistance, 300 Clearwater Coalition members, 68 farmers, and 25 naturescaping workshop participants). (EWEB, MWC, UWSWCD)
Action 4: Use GIS/LiDAR analysis results to focus outreach to landowners with large tax lots that contain healthy riparian forests as a high priority for protection. (EWEB, LCOG)

Objective B: Conduct outreach to landowners outside of the VIP Boundary through ongoing collaboration with community organizations in the Mohawk River watershed.
Action 1: Meet with Mohawk River community groups including the Mohawk Grange and Mohawk Valley Lions Club and large-scale landowners. (MWC)
Action 2: Restructure the Mohawk Watershed Partnership based on local input. (MWC)

SMART Goal 2: Maintain and promote existing outreach programs which enhance middle and high school youth knowledge and understanding of watershed conservation and restoration.
In partnership with numerous school districts, government agencies and private landowners, the McKenzie Watershed Council has developed multiple programs engaging middle school, high school and post-secondary school students in watershed conservation and restoration efforts. Collectively, the programs serve over 1,600 students on an annual basis through a multi-modal approach that best fits the needs of participating schools, students and community partners. Slightly increasing the reach of this program will help ensure that participating students will continue to engage in hands-on learning experiences developed around watershed restoration and monitoring. Students will gain a better understanding of river ecology, riparian restoration and conservation.

Objective A: Annually provide, on average, 35 Salmon Watch field trips per year for middle and high school students throughout Lane County.
Action 1: Hold up to 12 meetings annually of Lane County Salmon Stewards (steering committee for Salmon Watch). (MWC)
Action 2: Recruit and train volunteers for field trips on an annual basis. (MWC, various partners)
Action 3: Coordinate and schedule field trips with partnering teachers. (MWC)
Action 4: Coordinate and oversee fall field trips to upper McKenzie River and Whittaker Creek. (MWC)

Objective B: Annually provide field-based programs with four local high schools involving at least six groups of 14-20 students focused on habitat and/or restoration project monitoring.
Action 1: Continue SPARC program in partnership with McKenzie HS and USFS. (MWC)
Action 2: Continue implementation of Mohawk program in partnership with Mohawk HS. (MWC)
Action 3: Maintain partnership with Springfield Public Schools' (SPS) WELL Program and continue current programs with Thurston and Springfield High Schools. (MWC)
Action 4: By 2017, work with WELL Program to expand high school program to at least one SPS alternative high school. (MWC, SPS)
Action 5: Coordinate with various community partners and landowners to ensure access to potential project sites. (MWC)

Objective C: Annually provide field-based programs with SPS middle schools and promote program with additional school districts.

Action 1: Maintain partnership with SPS's WELL Program and continue current programs with Hamlin, Thurston, Briggs and Agnes Stewart Middle School. (MWC)

Action 2: Maintain partnership with Eugene School District 4J Coburg Community Charter School. (MWC)

Action 3: Promote the middle school program with additional school districts (Eugene School District 4J), private schools and home school organizations. (MWC)

Action 4: Coordinate with various community partners and landowners to ensure access to potential project sites. (MWC)

Objective D: Coordinate with the University of Oregon Environmental Leadership Program (UO ELP) to provide one field-based service learning project for undergraduate students annually.

Action 1: Design and plan project with UO ELP instructor and partnering landowner/agency. (MWC)

Action 2: Present project to UO ELP team during winter term and work with instructor to identify and/or develop field protocols. (MWC)

Action 3: Coordinate eight day-long field sessions during spring term. (MWC)

SMART Goal 3: **Maintain opportunities for volunteers and community members to participate in restoration and stewardship projects.**

Participation in voluntary stewardship of McKenzie River resources enhances awareness and understanding of challenges and issues. One effective method of increasing public awareness is through direct participation in restoration and stewardship projects. Due to limited organization capacity, the MWC currently oversees a single volunteer event geared toward direct stewardship, the Annual McKenzie River Clean-up. The opportunity exists to collaborate with current partners and expand opportunities for direct participation in stewardship events.

Objective A: Develop and maintain opportunities for the public to participate in watershed stewardship events involving 300 people on an annual basis

Action 1: On an annual basis organize the McKenzie River clean-up. (MWC, McKenzie River Guides)

Action 2: In partnership with the MRT coordinate two volunteer events at the MRT-owned BWCA property on an annual basis through 2017. (MRT, MWC)

Action 3: Develop 1-2 public events per year for the South Fork River Floodplain Enhancement Project by 2020. (MWC)

Action 4: On an annual basis organize a Salmon Celebration in partnership with the Lane County Salmon Stewards. (MWC)

SMART Goal 4: Increase collaboration with other watershed councils, agencies and organizations who are providing youth programs focusing on watershed health, water quality and fish and wildlife habitat.

Lane County is home to five watershed councils[2], numerous non-governmental organizations and multiple local and federal agencies who provide some level of youth-based outreach programs focused on watershed stewardship. These various programs justifiably tend to focus on local issues and projects while addressing the unique needs and desires of partnering schools. While recognizing that this range

[2] Siuslaw WC, Long Tom WC, Coast Fork Willamette WC, Middle Fork Willamette WC and MWC.

of program variability is highly desirable, opportunities exist to collaborate, learn from one another, share resources and increase funding options. Potential options for collaboration range from creation of an umbrella organization structure to an increased number of direct partnerships between organizations. This effort is not necessarily limited to Lane County.

Objective A: Over the course of 2016 and 2017 meet with other organizations and agencies within Lane County to explore opportunities for partnerships on youth outreach programs and increase resource sharing and organization collaboration.

Action 1: Arrange individual meetings with Lane County watershed councils to explore opportunities to integrate youth outreach programs and increase collaboration. (MWC)

Action 2: Attend regular meetings to explore the development of the USFS McKenzie River Ranger District-led Children's Forest initiative. (USFS)

SMART Goal 5: Promote and enhance public knowledge of the historical and cultural significance, biological needs, and new research concerning spring Chinook salmon in the McKenzie River Sub-basin, and promote the recovery of Chinook.

Objective A: Promote community understanding of the life history, threats and actions needed to restore McKenzie River spring Chinook salmon through education and outreach.

Action 1: Hold public educational fora to provide informational presentations and discussion on a variety of topics. (MWC)

Action 2: Distribute information presented to a wider audience. (MWC)

Objective B: Promote partnerships to support local stewardship actions specific to McKenzie River spring Chinook salmon. (MWC)

9 EVALUATING SUCCESS

While on-the-ground restoration projects are the actions that we assume will contribute to a healthier river, scientifically sound assessment and monitoring of the aquatic and floodplain ecosystem and individual projects are important for creating a guiding vision, improving restoration efforts, and documenting the status and trends of river health and human communities. Monitoring ensures program reliability and accountability for all program stakeholders, funders and the public. Additionally, monitoring allows for the collection of important data and analysis needed to assess the success of program objectives over time. Based on monitoring results, the MWC and partners will be able to revise and improve actions (see Section 10 Adaptive Management). Lastly, monitoring is designed to develop and maintain relationships between the landowners and the monitoring partners. Consistency and transparency in the monitoring process will allow McKenzie partners to maintain open communication and clear expectations for program participation.

The structure of project monitoring is planned as a two-tier approach: 1) watershed monitoring to assess if various investments are meeting key objectives; and 2) site-level monitoring to ensure restoration and conservation actions are meeting key objectives.

9.1 Watershed Monitoring

Three main approaches to monitoring watershed condition over time will be utilized:

1. Conducting repeat LiDAR flights every 4-5 years to measure change in canopy cover, structural footprints and other infrastructure (i.e., roads, levees, docks, bridges, impoundments/dams, etc.), and creek/river channel morphology;
2. Continuing water quality monitoring across the watershed to assess changes in baseline conditions, harmful algal bloom production, and daily water quality trends; and,
3. Extending the Willamette SLICES approach up into the McKenzie Sub-basin.

LiDAR Monitoring: Repeat LiDAR (remote sensing technology that measures distance by illuminating a target with a laser and analyzing the reflected light) and aerial photography will be used to monitor for changes in canopy cover, structural footprints, roads and other infrastructure, and channel morphology over time. Due to the high cost of the technology and the need to share this cost with other parties interested in collecting this type of data it is anticipated that LiDAR flights will be flown in the McKenzie Watershed every 4 to 5 years. An initial assessment of the region has been conducted and LCOG has analyzed the data provided from the 2009 LiDAR flight. EWEB and its partners are planning for a 2016 LiDAR flight that will provide additional baseline conditions prior to implementation of the Action Plan.

As part of the 2014-15 VIP Pilot Program, LCOG assessed the effectiveness of using LiDAR with aerial photography to monitor for changes in canopy cover, structural footprints, roads and other infrastructure, and channel morphology. Literature review and meetings with the USGS confirmed that LiDAR can be an effective tool for mapping these changes via use of algorithms that highlight differences between two LiDAR flights. Mapping structural footprints and changes over two different flights is more challenging and will need additional analysis to determine if feasible. LCOG also spent time developing LiDAR specifications so that repeat flights are of similar accuracy, processing, and deliverables that will allow easier comparison and analysis over time. These specifications will be used in the 2016 LiDAR contract.

Watershed Water Quality Monitoring: EWEB currently conducts various water quality monitoring efforts in the McKenzie Watershed in partnership with the USGS, MWC, USFS, and SUB that will

continue and provide a basis for assessing watershed health over time. These efforts include baseline monitoring to assess long-term trends associated with metals, bacteria, nutrients, organic carbon, and other general water quality parameters (EWEB, 2011). Baseline monitoring collects water samples from 16 locations throughout the watershed four times per year that are sent to a certified analytical laboratory for metals, bacteria, nutrients, and general water quality parameter analysis (see http://eweb.org/sourceprotection/baseline). EWEB also conducts monthly monitoring in Blue River and Cougar reservoirs and downstream of these reservoirs to assess harmful algal blooms between April to October. EWEB also funds a USGS steam flow gauge at Hayden Bridge that allows continuous water quality data to be correlated with stream flow. These continuous water quality records that are tied to stream flow at the middle and lower parts of the watershed will be valuable over time to assess effects of climate change and watershed health. In addition, EWEB funded the placement of a water quality sonde at the USGS Vida stream flow gauge that collects continuous temperature, turbidity, conductivity, pH, dissolved oxygen, and fluorescent dissolved organic matter data. EWEB's Hayden Bridge drinking water filtration plant is also equipped to collect continuous data for the same parameters measured at the Vida gauge.

EWEB is in the process of completing the next water quality baseline report that will highlight trends over the period that data has been collected (i.e., 1993-present). The previous report was completed in 2011 and indicated increasing trends in *E. coli* bacteria and nitrates in the lower McKenzie River (EWEB, 2011). Future reports will be used to document McKenzie River water quality trends and conditions over time. All water quality data that EWEB collects goes through a rigorous quality assurance/quality control process before being loaded into an SQL database that feeds a publicly available website (see http://reach.northjacksonco.com/EWEB). This provides additional transparency as all parties have access to the raw data used for long-term monitoring and analysis.

Watershed Monitoring Using SLICES: EWEB and McKenzie Collaborative partners are moving forward to extend a regional SLICES framework developed by Hulse et al. (2002) up into the McKenzie Watershed. Upon its creation in 2007, The Willamette Special Investment Partnership identified four metrics of a healthy Willamette River:

- floodplain forest extent,
- main stem channel complexity,
- native fish abundance, and
- water quality.

In understanding the Willamette River and its ecotone, the Willamette River restoration partners found that the floodplain provides the most constant and quantifiable spatial framework for comparing physical, biological, and human characteristics of the river corridor. The river's channel position, adjacent forests, and land use may all change, but the floodplain (the area historically inundated by floods) is relatively constant. The SLICES framework, oriented on the floodplain axis, provides a consistent basis for comparing changes in geomorphic structure, aquatic ecosystems and human settlement. The partners have employed this framework for floodplain assessment by first mapping one-km "slices" of the floodplain at right angles to the floodplain's center axis (Hulse et al., 2002; Hulse and Gregory, 2004) and then adding further detail on biological presence of target species at finer scales. This finer scale is nested slices of 100 m lengths, and constrained to a narrower pragmatic floodplain. This pragmatic floodplain is limited by significant infrastructural investments, primarily roads. For more information on the SLICES framework, visit: http://ise.uoregon.edu/slices/main.html .

Within the McKenzie River Sub-basin, expansion of the SLICES spatial framework will be used to incorporate baseline monitoring of status and trends for two key metrics---floodplain forest extent and

native fish---so that the central question of whether restoration goals are being met can be answered over time. This monitoring approach will be driven by a scientifically defensible understanding of the river system and the programmatic goals derived from an understanding of what to restore. Of the four broad types of monitoring (status and trends, implementation/compliance, effectiveness, and validation monitoring), and the three relevant scales at which such monitoring can be carried out in a large river floodplain (river, reach, project), the most cost-effective and broadly useful combination for the McKenzie floodplain is status and trends monitoring of the river system extent. The McKenzie SLICES approach also provides planning level data that will help prioritize investments and map the uplift these investments have, which will assist with funders looking for mitigation opportunities.

9.2 Site Level Monitoring

Site level monitoring associated with the VIP, in-stream enhancement and other identified restoration actions is critical in order to assess effectiveness of these actions toward meeting the Action Plan's objectives, goals and outcomes. Site level monitoring associated with the VIP will rely upon the following activities:

1. Landowner self-reporting through submittal of annual photos from pre-determined photo points;
2. VIP partner (MWC or UWSWCD) site visits to collect riparian health metrics and assess effectiveness of actions (frequency determined by site actions and included in landowner agreement); and,
3. GIS assessment using aerial photos and LiDAR collected every 4-5 years.

Landowners: The VIP includes a self-reporting monitoring process that will involve taking systematic photos of designated areas on a landowner's property. Monitoring partners will assist the landowner in finding the best location for setting up monitoring points. Monitoring will occur systematically every year at a set time, date and location on the property. The photos will be delivered via email to the monitoring partners. Specifics for each site are included in the landowner VIP agreement to make sure landowners know upfront what this activity involves. The goal of the self-reported monitoring is to reduce overhead costs, retain the commitment to the program once enrolled, provide a monitoring process that landowners can participate in, and collect images that illustrate to landowners and partners change over time on their property as a result of these actions.

VIP Partner Site Visit: A trained specialist from one of the VIP partner organizations (MWC or UWSWCD) will visit the VIP landowner's property on regular basis based on the interval specified in the agreement. This interval is determined based on actions being conducted per the landowner management plan (e.g., riparian restoration will need more frequent visits than protection). The technician will use the most recent aerial imagery and LiDAR data from LCOG in conjunction with the eligibility criteria and the contract terms to assess the property and document any changes.

Monitoring partners will also evaluate properties to see if invasive species have grown significantly, to gauge the overall health of the riparian forest, and measure the quality of the habitat on the property. Monitoring partners will discuss the state of the property with the landowner and determine if any major changes to the riparian habitat have occurred. The landowner advisory committee expressed interest in learning about the riparian habitats they have on their properties and how they can be improved with basic maintenance.

GIS Assessment: Aerial photography and LiDAR will be flown every 4-5 years. This data can be used to assess aspects of individual projects such as canopy cover and channel morphology. The data and images can then be provided to landowners and the general public as appropriate.
Site level monitoring associated with two SMART Goals, *Increase in-stream and floodplain habitat complexity, floodplain connectivity, and productivity* and *Improve fish passage,* will rely on monitoring plans developed for individual projects and may include the following parameters: fish presence/absence, substrate size (pebble counts at cross sections in project area), in-stream habitat complexity (LWM, pool counts), and floodplain inundation and total side channel length. In order to maintain consistency, methods for evaluating progress toward achieving SMART goals are organized by goal type (**Table 6**). While some variation between methods for individual SMART goals listed in Section 8 is expected, Action Plan monitoring will adhere to the following methods.

Table 6. Baseline and effectiveness monitoring with the SLICES framework related to four SMART goals for the McKenzie River Sub-basin.

SMART Goal Type	Baseline Monitoring	Effectiveness Monitoring
Increase in-stream and floodplain habitat complexity, floodplain connectivity, and productivity	Existing fish use and presence/absence database (spawning surveys)	Fish presence/absence, substrate size (pebble counts at cross sections in project area), in-stream habitat complexity (LWM, pool counts), floodplain inundation and total side channel length
	Initial SLICES survey	SLICES surveys completed on a 10-year interval
Improve fish passage	Existing fish use and presence/absence database	Fish presence/absence
	Initial SLICES survey	SLICES surveys completed on a 10-year interval
Enhance riparian function	Remote sensing methods (LiDAR, aerial photography)	Canopy cover, channel complexity
	VIP Site Surveys	Canopy cover, Invasive species cover, Species diversity
	Initial SLICES survey	SLICES surveys completed on a 10-year interval
Maintain water quality	EWEB water quality database	EWEB WQ monitoring program
	Initial SLICES survey	SLICES surveys completed on a 10-year interval

10 ADAPTIVE MANAGEMENT

Through the monitoring program described in the previous section, the Council and its partners will periodically assess effectiveness of the actions in meeting the goals and objectives prescribed in the plan and make adjustments as necessary to habitat restoration treatments, drinking water quality actions, and outreach activities. As actions are completed, new priority actions may be developed and implemented to achieve goals and objectives. Goals and objectives may be modified as time goes on. In this way, the plan is a living document that will be updated regularly.

The partnership will assess progress in achieving goals and objectives in years 2, 4 and 6 following plan implementation. The partnership may modify treatments or actions to better achieve goals and objectives or pursue additional funding to implement actions. At the end of year 6, the partnership will review outcomes, goals, objectives, priorities and actions and the overall effectiveness and relevance of the plan. Habitat assessments for each 5th field watershed will be updated. At this juncture, the partnership may revise any elements of the plan as necessary for the next 6-year period and/or pursue a different funding strategy.

11 SUSTAINABILITY

Recovery of spring Chinook salmon and bull trout are long-term goals that may take many decades to achieve. In the meantime, the action plan is geared toward making measurable progress in conserving and restoring critical habitat for these and other key species throughout the Sub-basin. The partner organizations will continue their coordinated efforts over the long term to protect drinking water quality and conserve and restore habitat. Collaborative efforts such as the VIP Program and McKenzie Watershed Stewardship Group will provide long-term sources of matching funds for federal, state, and private grants. Sources of funding include Oregon Watershed Enhancement Board (OWEB) regular grants; BLM and Forest Service budgets; ODFW Restoration and Enhancement grants; EWEB ratepayer funds; local area business donations; BPA Wildlife Mitigation Program funds for acquisition and restoration; ODOT mitigation funds; Oregon Clean Water Fund; NRCS Conservation Innovation Grants; shade credit investments from the Metropolitan Wastewater Management Commission; and local match from City of Springfield, City of Eugene, EWEB, Springfield Utility Board, Weyerhaeuser Company, International Paper Company, and BLM.

12 LITERATURE CITED

Bangs, B. L., P. D. Scheerer, and S. Clements. 2013. 2013 Oregon Chub Investigations. Oregon Department of Fish and Wildlife. Fish Research Project EF-13, Annual Progress Report, Corvallis.

Bureau of Land Management. 1995. Mohawk/McGowan Watershed Analysis.

Bureau of Land Management. 2010. Environmental Assessment and Record of Decision for Aquatic and Riparian Restoration Activities.

Bureau of Land Management. 2015. Western Oregon Aquatic Conservation Strategy.

City of Springfield. 2010. City of Springfield Stormwater Management Plan.

City of Springfield and Springfield Utility Board (SUB). 2002. Springfield Drinking Water Protection Plan Addendum.

Eugene Water & Electric Board. Website. Leaburg Dam information. www.eweb.org/resources/leaburg

Eugene Water & Electric Board. 2000. Drinking Water Protection Plan Source Protection Monitoring.

Eugene Water & Electric Board. 2011. McKenzie River Watershed Baseline Monitoring Report, 2000 to 2009.

Davis, L.J., M. Reiter, and J.D. Groom. 2015. Modelling temperature change downstream of forest harvest using Newton's law of cooling. Hydrological Processes. DOI: 10.1002/hyp.10641

Goodman, R.D. Nelle, K. Ostrand and B. Streif. 2011. Pacific Lamprey (*Entosphenus tridentatus*) Assessment and Template for Conservation Measures. US Fish and Wildlife Service, Portland, Oregon. 282 pp.

Grant, G. E, S.L. Lewis, F.J. Swanson, J.H. Cissel, and J.J. McDonnell. 2008. Effects of forest practices on peak flows and consequent channel response: a state-of-science report for western Oregon and Washington. Gen. Tech. Rep. PNW-GTR-760. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 76 p.

Gregory, S., D. Hulse, M. Bertrand, and D. Oetter. 2012. The role of remotely sensed data in future scenario analyses at a regional scale. Ch. 12 in Carbonneau, P.E. and Piegay, H. (eds) Fluvial Remote Sensing for Science and River Management. Wiley Blackwell Sussex, U.K.

Groom J.D., L. Dent, L. Madsen and J. Fleuret. 2011b. Response of western Oregon (U.S.A.) stream temperatures to contemporary forest management. *Forest Ecology and Management*. **262**:1618-1629. DOI:10.1016/j.foreco.2011.07.012.

Hulse, D., and S. Gregory. 2004. Integrating resilience into floodplain restoration. Journal of Urban Ecology 7:295–314.

Hulse, D., S. Gregory and J. Baker. 2002. The Willamette River Planning Atlas: Trajectories of environmental and ecological change. Oregon State University Press. 2nd edition.

Independent Multidisciplinary Science Team (IMST). 2010. Urban and Rural-residential Land Uses: Their Role in Watershed Health and the Rehabilitation of Oregon's Wild Salmonids

Jefferson, A., G.E. Grant, and S. Lewis. 2010. A River Runs Underneath It: Geological Control of Spring and Channel Systems and Management Implications, Cascade Range, Oregon

Jefferson, A., G.E. Grant, and T. Rose. 2006. Influence of volcanic history on groundwater patterns on the west slope of the Oregon High Cascades: Water Research v 42.

Keppeler, E. T., and R. R. Ziemer. 1990. Logging effects on streamflow - water yield and summer low flows at Caspar Creek in northwestern California. Water Resour. Res. 26(7):1669-1679.

Lane Council of Governments and Springfield Utility Board. 1999. Springfield Drinking Water Protection Plan.

Lane Council of Governments. 1995. Technical Report for Water Quality and Fish and Wildlife Habitat.

Lane Council of Governments. 2010. Future residential development study for the McKenzie watershed.

Luzier, C.W., H.A. Schaller, J.K. Brostrom, C. Cook-Tabor, D.H. Goodman, R.D. Nelle, K. Ostrand and B. Streif. Pacific lamprey (Entosphenus tridentatus) assessment and template for conservation measures. U.S. Fish and Wildlife Service, Portland, Oregon. 282pp.

McKenzie Watershed Council. 2000. McKenzie River Sub-basin Assessment.

McKenzie Watershed Council. 2002. The McKenzie River Watershed Conservation Strategy.

Minear, Paula J. 1994. Historical change in channel form and riparian vegetation of the McKenzie River, Oregon. Corvallis, OR: Oregon State University. 102 p. M.S. thesis.

Mohawk Watershed Partnership. 2000. A Supplemental Assessment of the Mohawk Watershed.

National Marine Fisheries Service. 2007. 5-Year Review: summary and evaluation of upper Willamette River steelhead and upper Willamette River spring Chinook.

National Marine Fisheries Service. 2008. Biological opinion on the continued operation of 13 dams and maintenance of 43 miles of revetments in the Willamette Basin, Oregon.

NRCS (National Resource Conservation Service). 2005. McKenzie Hydrologic Unit Profile.

Oregon Department of Agriculture (ODA). 2012. The Southern Willamette Valley Agricultural Water Quality Management Area Plan.

Oregon Department of Environmental Quality (DEQ). 2006. The Willamette Basin TMDL Water Quality Management Plan.

Oregon Department of Environmental Quality (DEQ). 2009. Willamette Basin Rivers and Streams Assessment.

Oregon Department of Fish and Wildlife. 2005. Oregon Native Fish Status Report. http://www.dfw.state.or.us/fish/ONFSR/

Oregon Department of Fish and Wildlife. 2006. The Oregon Conservation Strategy.

Oregon Department of Fish and Wildlife and National Marine Fisheries Service Northwest Region. 2011. Upper Willamette River Conservation and Recovery Plan for Chinook Salmon and Steelhead. http://www.nmfs.noaa.gov/pr/pdfs/recovery/chinook_steelhead_upperwillametteriver.pdf

Oregon Department of Forestry (ODF), website, Riparian Rule 2015 11/09. http://www.oregon.gov/ODF/Documents/WorkingForests/RiparianRule20151109.pdf

Parkhurst, Z.E., F.G. Bryant and R.S. Nielsen. 1950. Survey of the Columbia River and its tributaries. Part III. Fish and Wildlife Service. Spec. Sci. Rpt. Fish and Walla and its tributaries --Part III. Fish Walla Dist., 20 pp. + 74 tables, Wildl. Serv., Spec. Sci. Rep. Fish. 36.

PNERC (Pacific Northwest Ecosystems Research Consortium). 2002. Willamette River basin planning atlas: http://www.fsl.orst.edu/pnwerc/wrb/Atlas_web_compressed/PDFtoc.html

Portland State University, Population Research Center College of Urban and Public Affairs. 2009. Population Forecasts for Lane County, its Cities and Unincorporated Area 2008-2035.

Rakestraw, Lawrence and Mary. 1991. History of the Willamette National Forest.

Reiter, M. 2015. Aquatic Ecosystem Response to Managing Riparian Areas in the Working Forests of the Pacific Northwest. Society of Am. Foresters, Western Forester 60(5) 6-9.

Risley, J., J.R Wallick, I. Waite and A. Stonewall. 2010, Development of an environmental flow framework for the McKenzie River basin, Oregon: U.S. Geological Survey Scientific Investigations Report 2010-2016, 94 p.

Risley, J., L. Back, and J.R Wallick. Summary Report: Environmental Flows Workshop for the McKenzie River, Oregon. November 2010. pg. 34.

River Design Group. 2012. Willamette River floodplain inundation mapping: Eugene to Oregon City. RDG Inc. 311 SW Jefferson Ave. Corvallis, OR. 97333.

Roni, P., and T. J. Beechie. Editors. 2013. Stream and watershed restoration: a guide to restoring riverine processes and habitats. John Wiley & Sons, Ltd. Hoboken, New Jersey.

Rosenburg, D., J. Gervais, D. Vasely, S. Barnes, L. Holts, R. Horn, R. Swift. L. Todd and C. Yee. 2009. Conservation Assessment of the Western Pond Turtle in Oregon (*Actinemys marmorata*). Version 1.0. http://www.fs.fed.us/r6/sfpnw/issssp/documents/planning-docs/ca-hr-actinemys-marmorata-2009-11.pdf

Schulz, L., M.P. Mayfield, G.T. Sheoships, L.A. Wyss, B.J. Clemens, B. Chasco and C.B. Schreck. 2014. The distribution and relative abundance of spawning and larval Pacific lamprey in the Willamette River Basin.

Sherrod, D.R. and J.G. Smith. 2000. Geologic map of upper Eocene to Holocene volcanic and related rocks of the Cascade Range, Oregon: USGS Geologic Investigations Series Map 1_2529.

Springfield Utility Board. 2013. Springfield Drinking Water Protection Plan Recertification Request.

Sproles, E. A., A.W. Nolin, K. Rittger, and T.H. Painter. 2013. Climate change impacts on maritime mountain snowpack in the Oregon Cascades, Hydrol. Earth Syst. Sci., 17, 2581-2597, doi: 10.5194/hess-17-2581-2013, 2013.Jul 8, 2013.

Stillwater Sciences. 2006. Hydrologic regimes at the Carmen-Smith Hydroelectric Project, upper McKenzie River basin, Oregon.

Surfleet, C.G., and A. E. Skaugset. 2013. The effect of timber harvest on summer low flows, Hinkle Creek, Oregon." *Western Journal of Applied Forestry* 28.1:13-21.

Tague, C. and G.E. Grant. 2004. A geological framework for interpreting the low-flow regimes of Cascade streams, Willamette River Basin, Oregon. Water Resources Research 40: doi: 10.1029/2003WR002629. issn: 0043-1397.

T.D. Beacham, K.L. Jonsen, J. Supernault, M. Wetklo, L. Deng, and N. Varnavskaya. Pacific Rim population structure of Chinook salmon as determined from microsatellite analysis. Trans. Am. Fish. Soc. (2006) http://dx.doi.org/10.1577/T06-071.1.

U.S. Fish and Wildlife Service. 1998. Recovery Plan for the Oregon Chub.

U.S. Fish and Wildlife Service. 2014. Revised draft recovery plan for the coterminous United States population of bull trout (*Salvelinus confluentus*). Portland, Oregon. xiii + 151 pp.. http://www.fws.gov/pacific/bulltrout/pdf/Revised%20Draft%20Bull%20Trout%20Recovery%20Plan.pdf

U.S. Fish and Wildlife Service. 2014. Strategic Conservation Management in Oregon's Willamette Valley. Surrogate Species: Pilot 1.0. Review Copy, Region 1, Portland Oregon.

U.S. Forest Service. 1997. Horse Creek Analysis.

U.S. Forest Service. 2011. Watershed Condition Framework. http://www.fs.fed.us/biology/watershed/condition_framework.html

U.S. Census Bureau website. 2015. http://quickfacts.census.gov/qfd/states/41/41039.html

Waples, R. S., D. J. Teel, J. M. Myers, and A. R. Marshall. 2004. Life-history divergence in Chinook salmon: historic contingency and parallel evolution. Evolution, 58(2):386-403.

Weyerhaeuser Company. 1994. Lower McKenzie River, South Side Watershed Analysis, Springfield, OR.

Weyerhaeuser Company. 1994. Upper Mohawk River Watershed Analysis. Springfield, OR.

Weyerhaeuser Company. 1995, Lower McKenzie River, North Side Watershed Analysis, Springfield, OR.

Willamette National Forest. 1998. Quartz Creek and Minor Tributaries Watershed Analysis.

Willis, R.A., M.D. Collins and R.E. Sams. 1960. Environmental survey report pertaining to salmon and steelhead in certain rivers of eastern Oregon and the Willamette River and its tributaries. Part II. Fish Comm. Oreg. 554pp.

Williams, Gerald W. 2015. McKenzie River. In: Oregon Encyclopedia.

APPENDIX A: Process for Restoration Action Plan Development

South Fork, Horse Creek and Headwaters McKenzie Watersheds

We generally followed a three-step process to develop a restoration action plan for the McKenzie River Sub-basin. This process was largely informed by *Stream and Watershed Restoration: A Guide to Restoring Riverine Processes and Habitats* (Roni and Beechie 2013). The three steps include:

1. Watershed Assessment
2. Project Development
3. Project Prioritization

This process was most closely followed for McKenzie River USGS 5th Field HUCs predominately owned by the United States Forest Service: South Fork McKenzie River Watershed, Horse Creek Watershed and Headwaters McKenzie River Watershed. For the McKenzie River Watershed and Mohawk River Watershed we followed a modified version of the process outlined above which relied more heavily upon review of previously completed assessments, relevant restoration and conservation strategies, professional judgment and partner review (**Appendix B**).

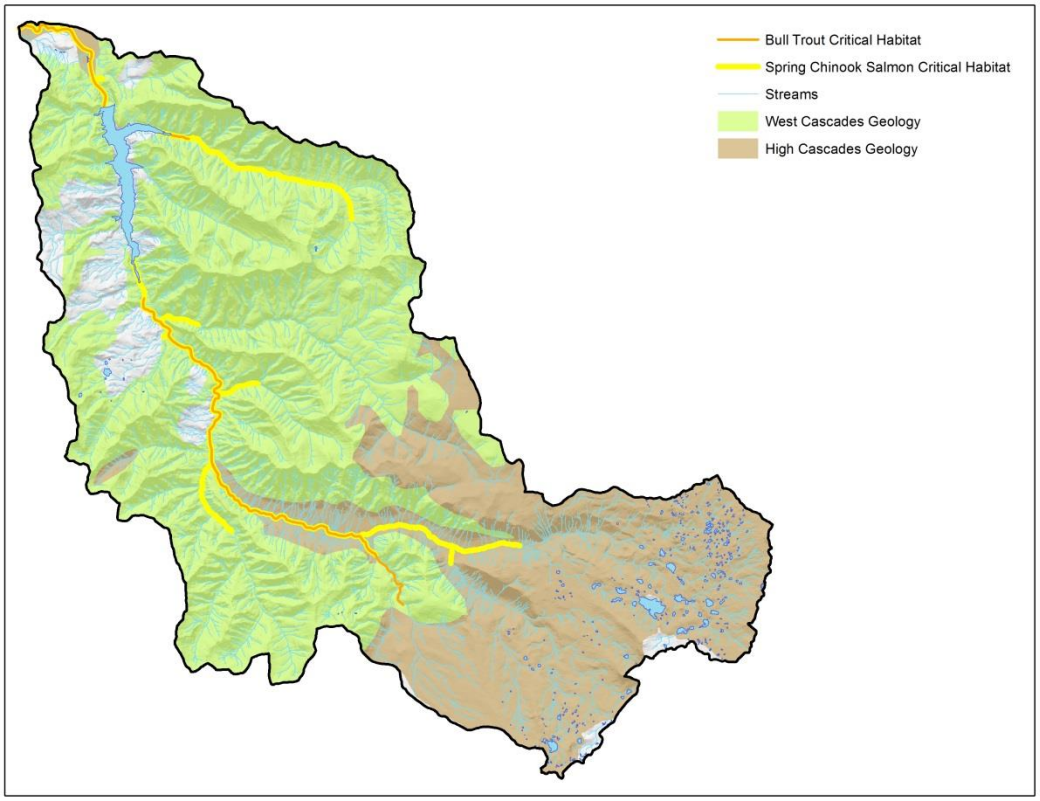
South Fork McKenzie River Watershed – example of the process

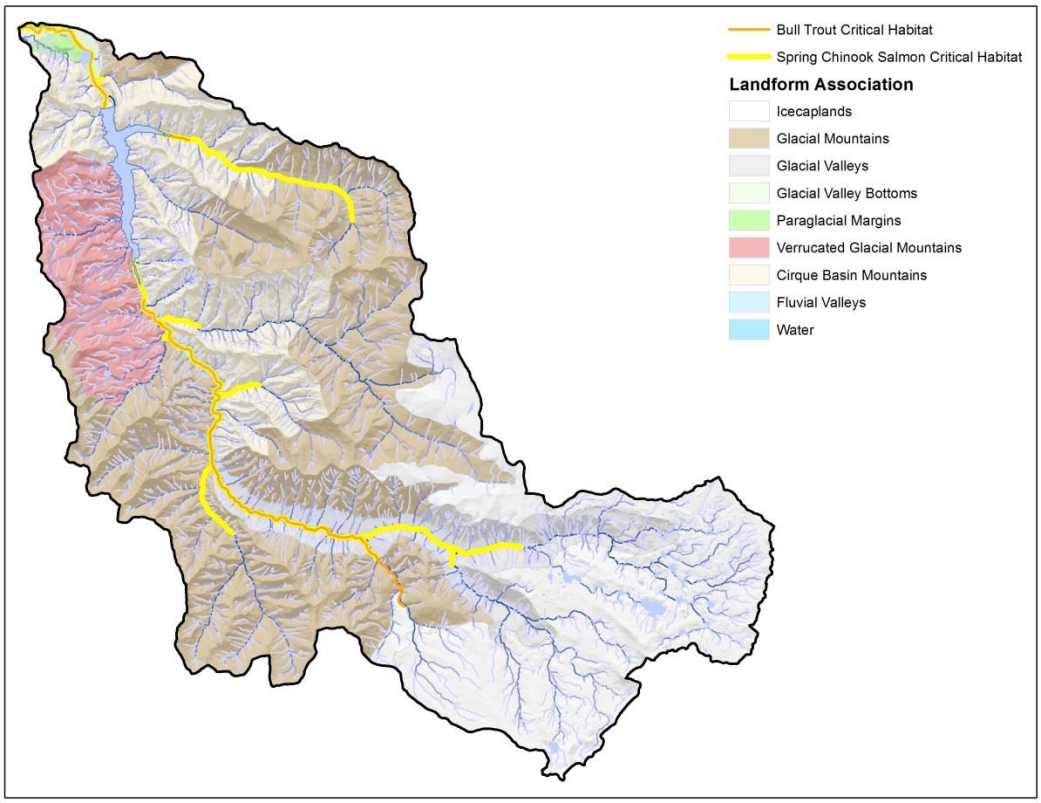
2. Watershed Assessment

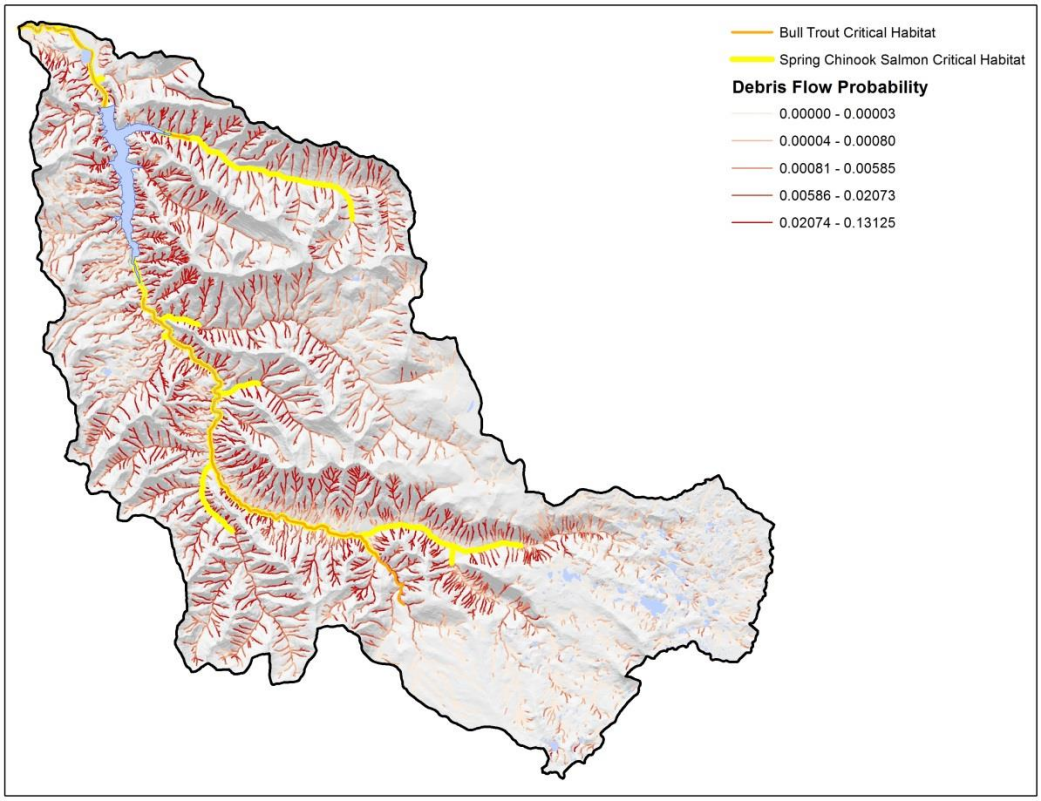
Watershed Template and Processes

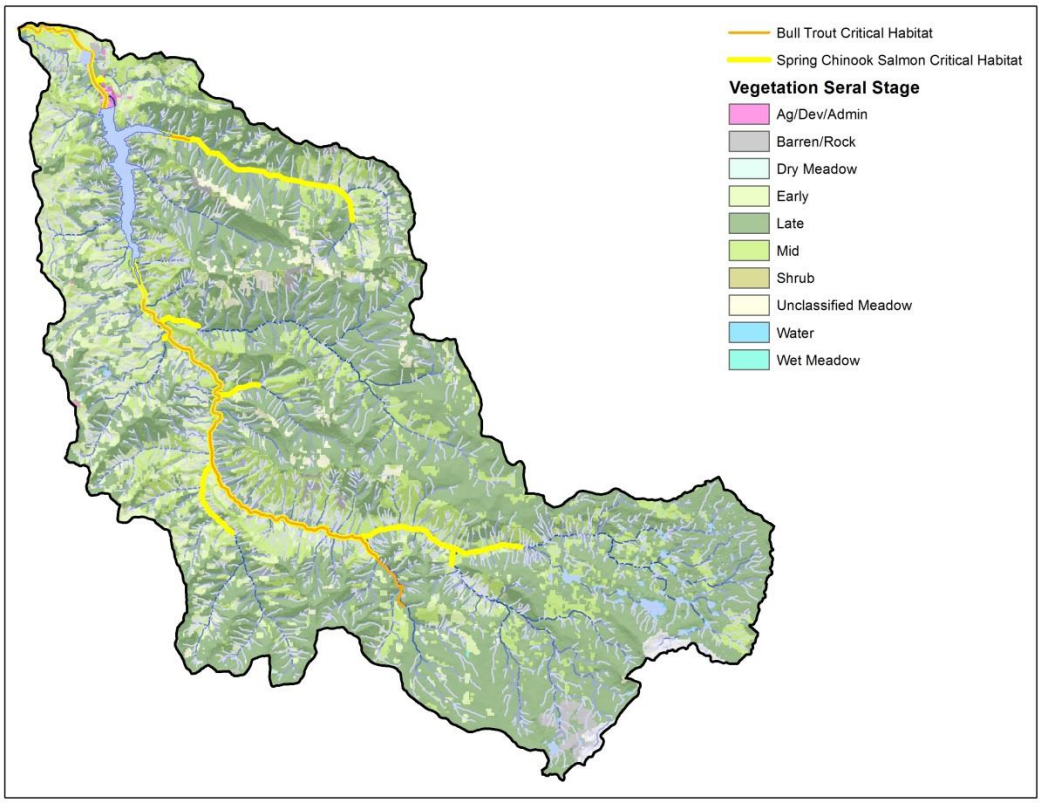
- Create maps showing:
  - Geologic Setting (hydrologic and erosional processes)
  - Landform or Land Type Association (erosional processes)
  - Landslide or Debris Flow Potential (erosional and wood recruitment processes)
  - Vegetation Seral Stage (wood recruitment processes)
  - Riparian Vegetation Class (organic matter processes)
  - Fire Regime Departure (erosional, wood, and nutrient processes)
  - USFS Watershed Condition (combination of processes, can be separated)
- Utilize existing USFS Watershed Assessments (1994, updated 2010)
- USGS Flow and Water Quality Data (Stream Gage #14159500 and #14159200)

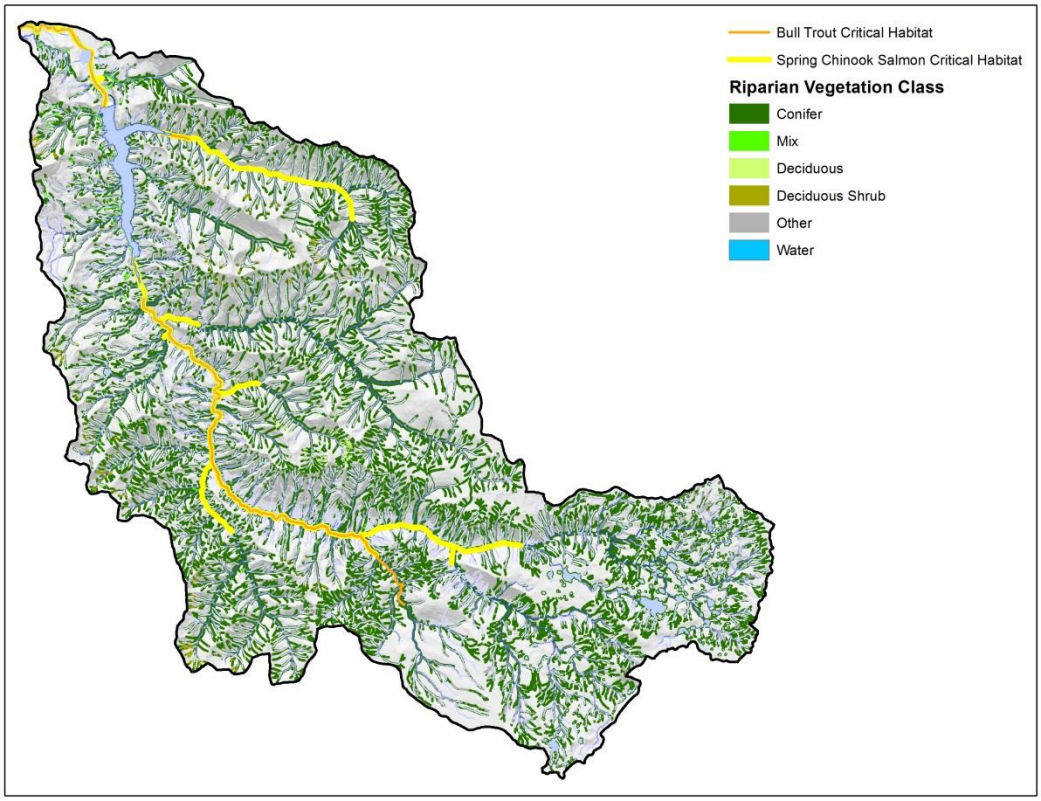
Various Maps:

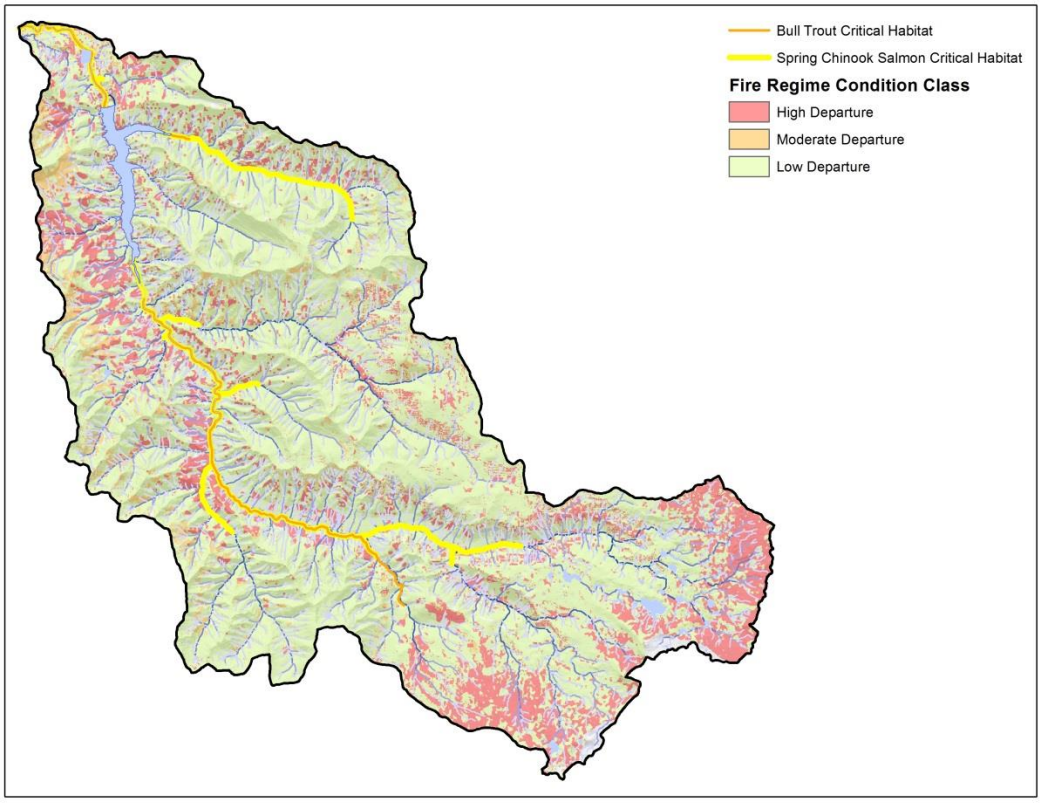

Bull Trout Critical Habitat
Spring Chinook Salmon Critical Habitat
Streams
West Cascades Geology
High Cascades Geology

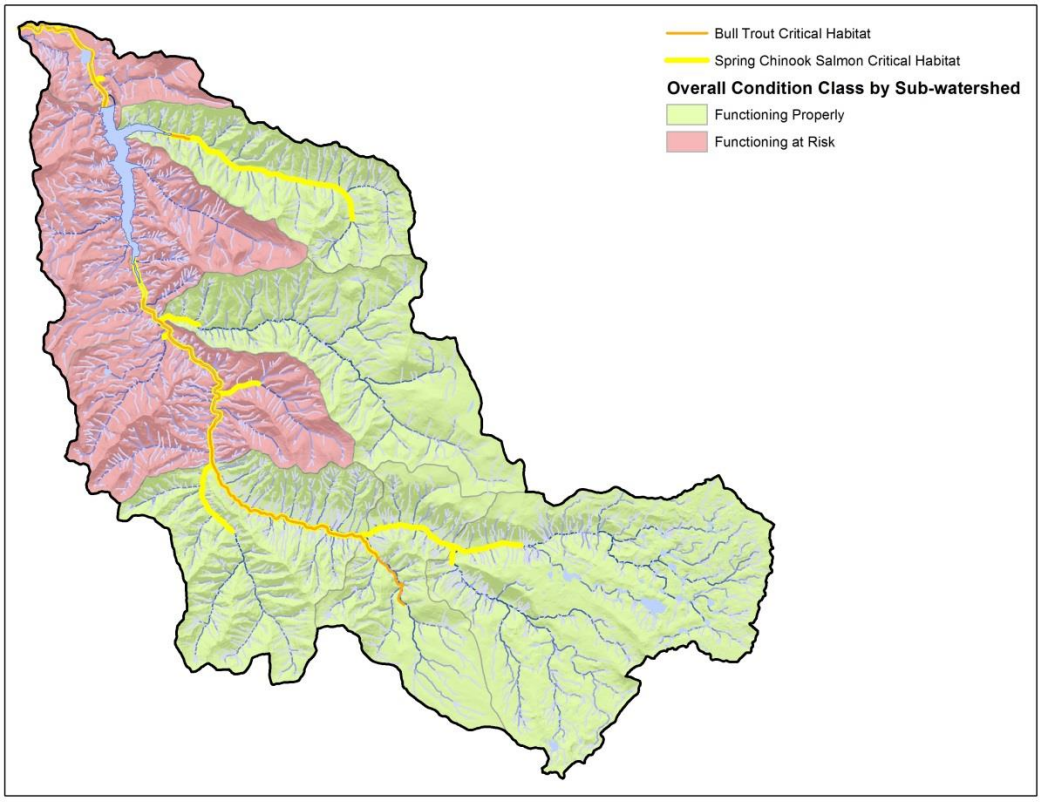

Bull Trout Critical Habitat
Spring Chinook Salmon Critical Habitat
Landform Association
Icecaplands
Glacial Mountains
Glacial Valleys
Glacial Valley Bottoms
Paraglacial Margins
Verrucated Glacial Mountains
Cirque Basin Mountains
Fluvial Valleys
Water


Bull Trout Critical Habitat
Spring Chinook Salmon Critical Habitat
Debris Flow Probability
0.00000 - 0.00003
0.00004 - 0.00080
0.00081 - 0.00585
0.00586 - 0.02073
0.02074 - 0.13125


Bull Trout Critical Habitat
Spring Chinook Salmon Critical Habitat
Vegetation Seral Stage
Ag/Dev/Admin
Barren/Rock
Dry Meadow
Early
Late
Mid
Shrub
Unclassified Meadow
Water
Wet Meadow


Bull Trout Critical Habitat
Spring Chinook Salmon Critical Habitat
Riparian Vegetation Class
Conifer
Mix
Deciduous
Deciduous Shrub
Other
Water

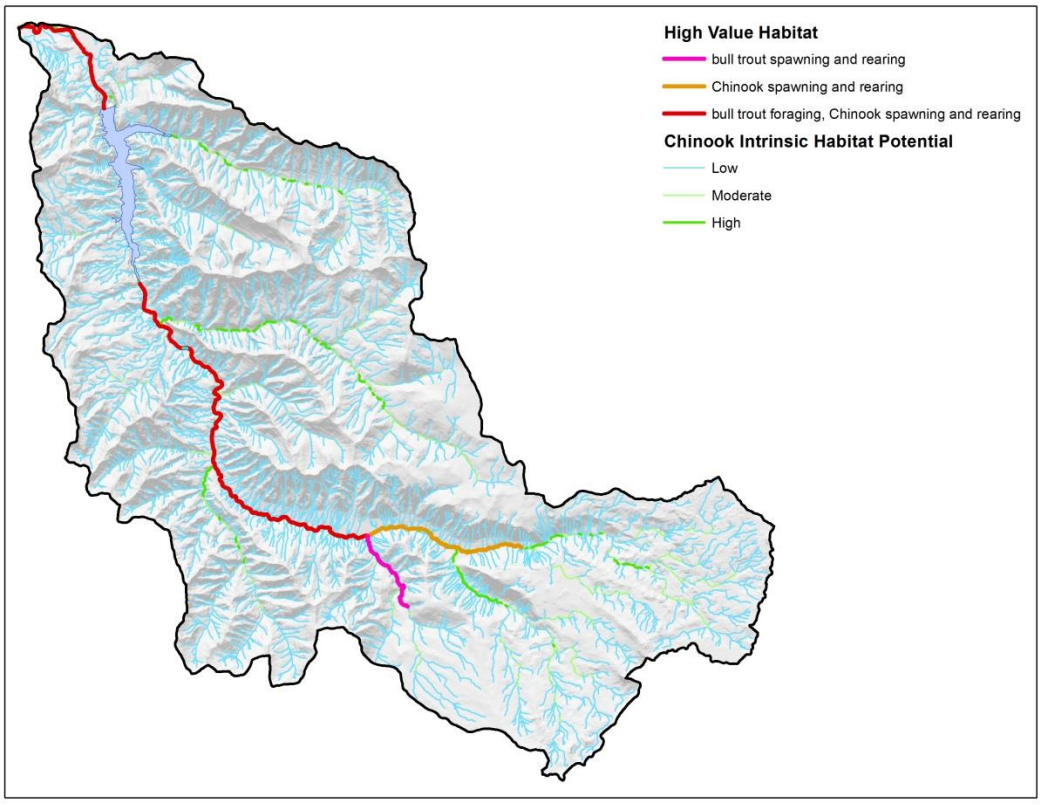

Bull Trout Critical Habitat
Spring Chinook Salmon Critical Habitat
Fire Regime Condition Class
High Departure
Moderate Departure
Low Departure

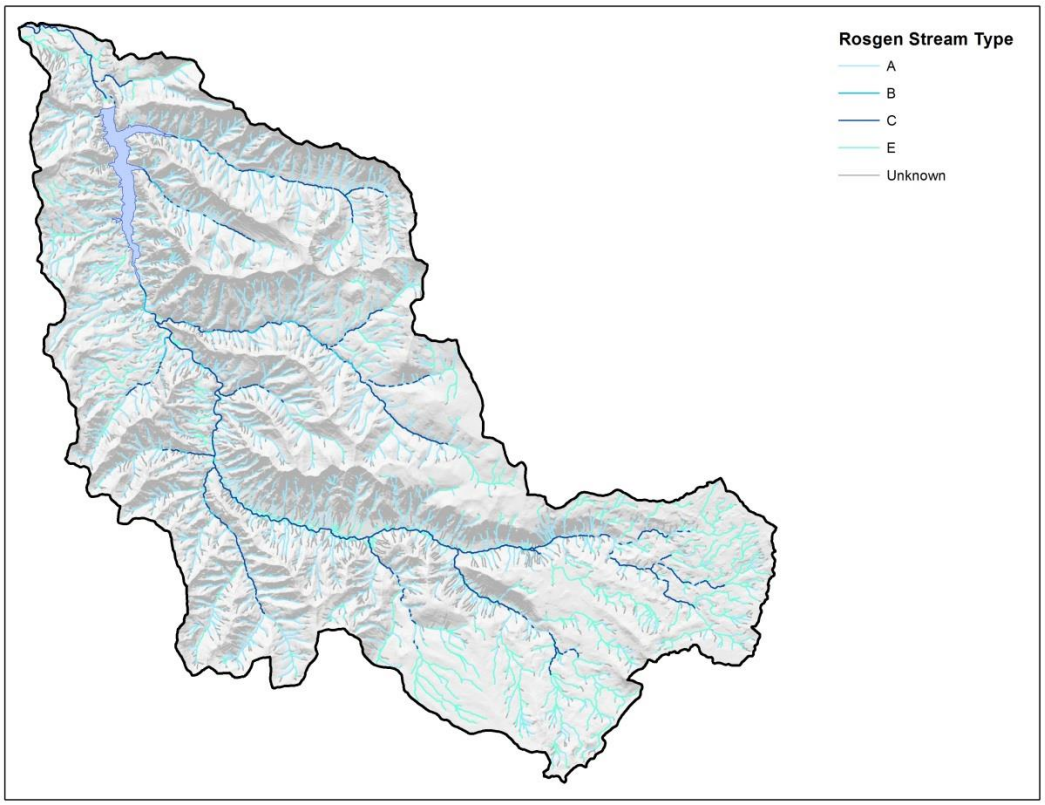

Bull Trout Critical Habitat
Spring Chinook Salmon Critical Habitat
Overall Condition Class by Sub-watershed
Functioning Properly
Functioning at Risk

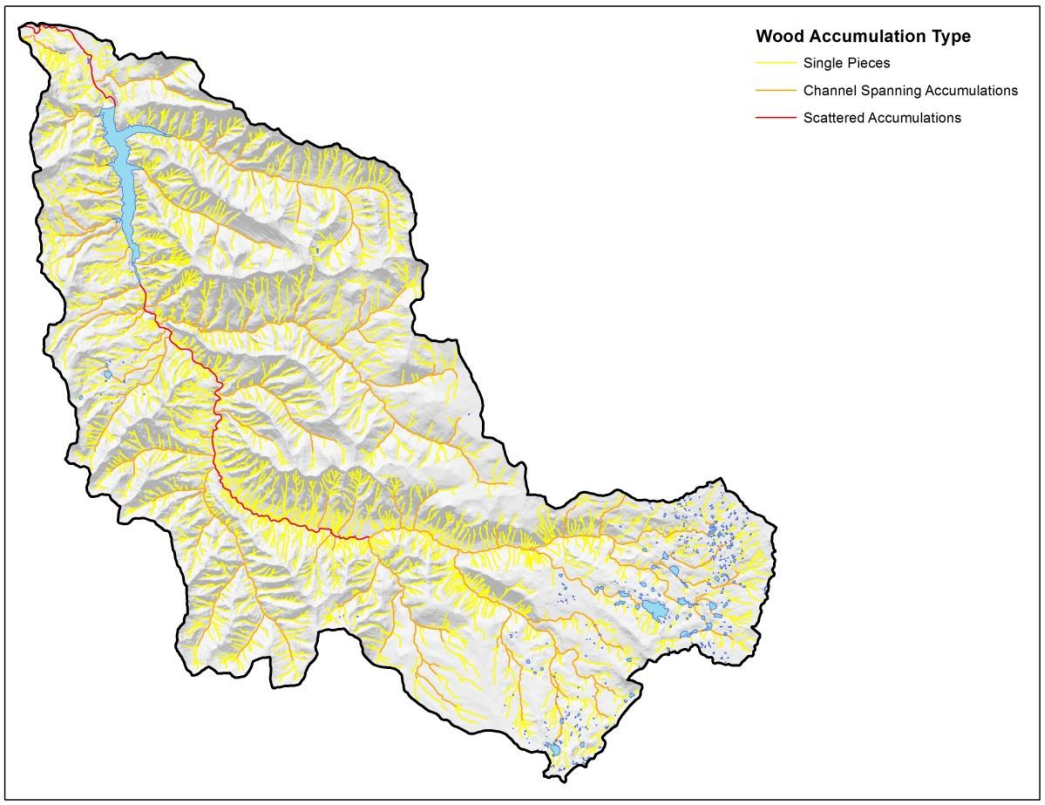
Reach Types and Processes

- Create maps showing:
  - High Value Fish Habitat (biological hotspots)
  - Chinook Intrinsic Habitat Potential (areas where expanded distribution may be possible if conditions are improved)
  - Rosgen Channel Classification (indicator of restoration potential)
  - Wood Accumulation Types (guide appropriate restoration techniques)
- Existing USFS Watershed Assessments (1994, updated 2010)

Various Maps:



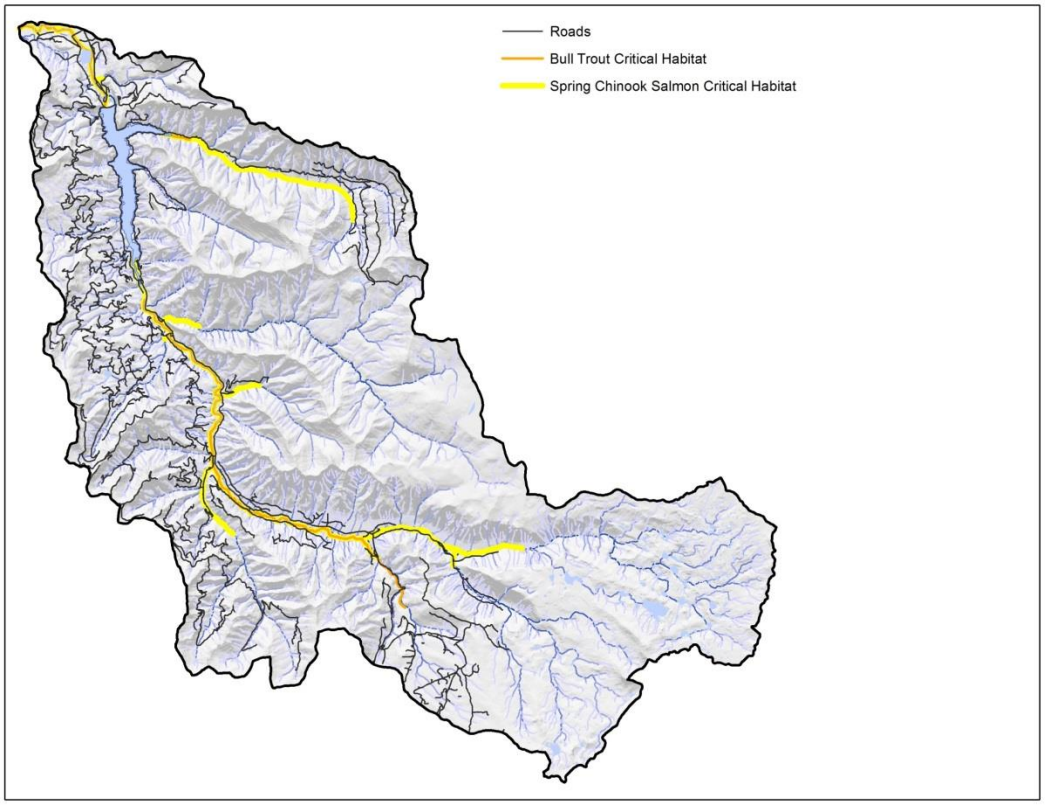

Rosgen Stream Type
A
B
C
E
Unknown

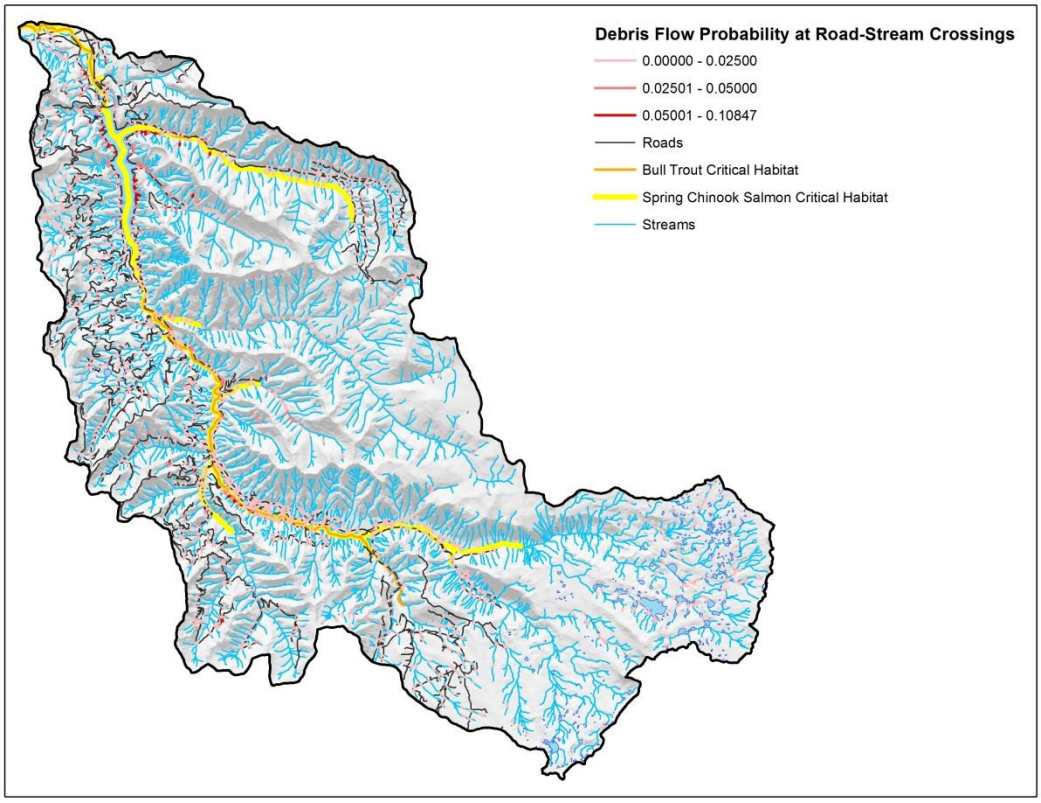

Wood Accumulation Type
Single Pieces
Channel Spanning Accumulations
Scattered Accumulations

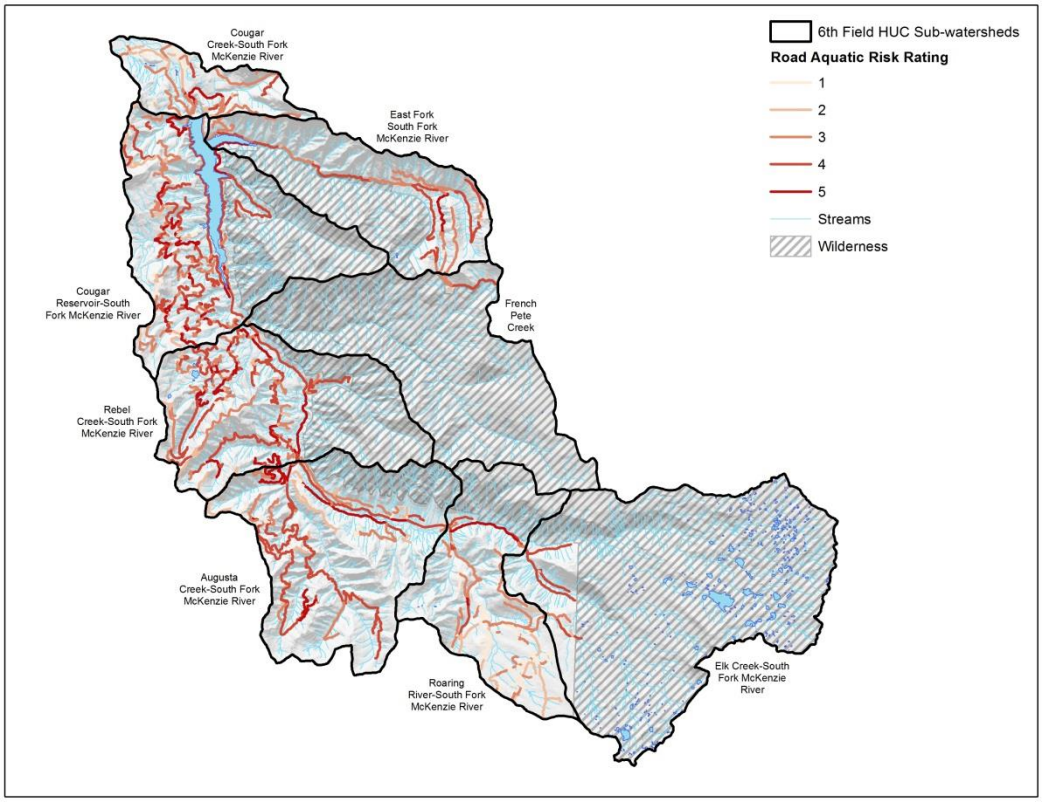
Historic and Current Land Use and Development

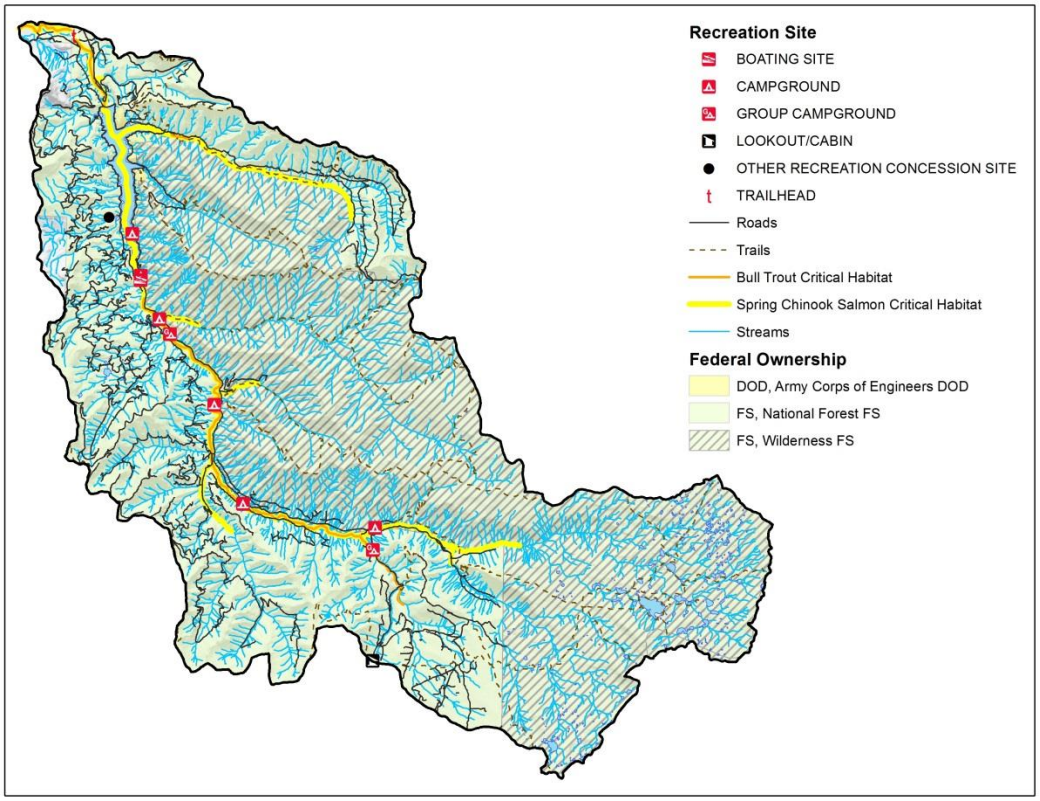
- Create maps showing:
  - Roads and culverts (potential fish barriers, sediment input, and hydrologic impairment)
  - Logging/Agriculture
  - Ownership/Development
  - Levees
  - Recreation
  - Stream Survey Data (wood, pools, side channels, etc.)
- Existing USFS Watershed Assessments (1994, updated 2010)
- USGS Flow and Water Quality Data (Stream Gauge #14159500 and #14159200)

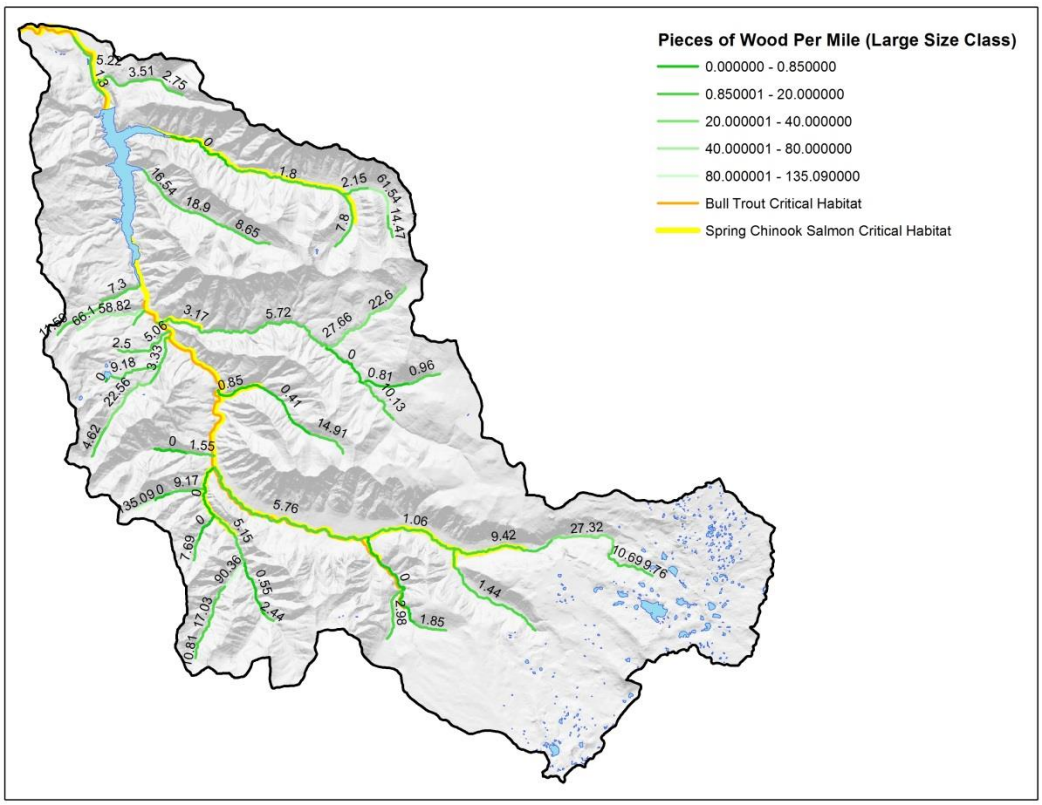
Various Maps:

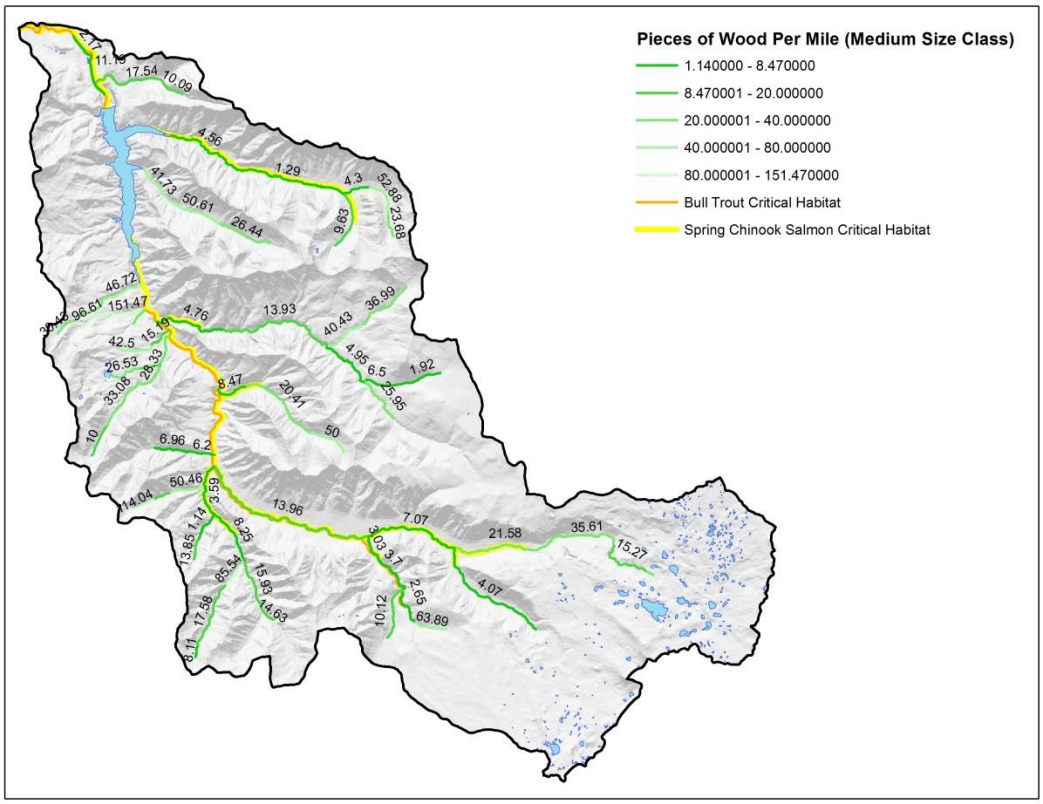


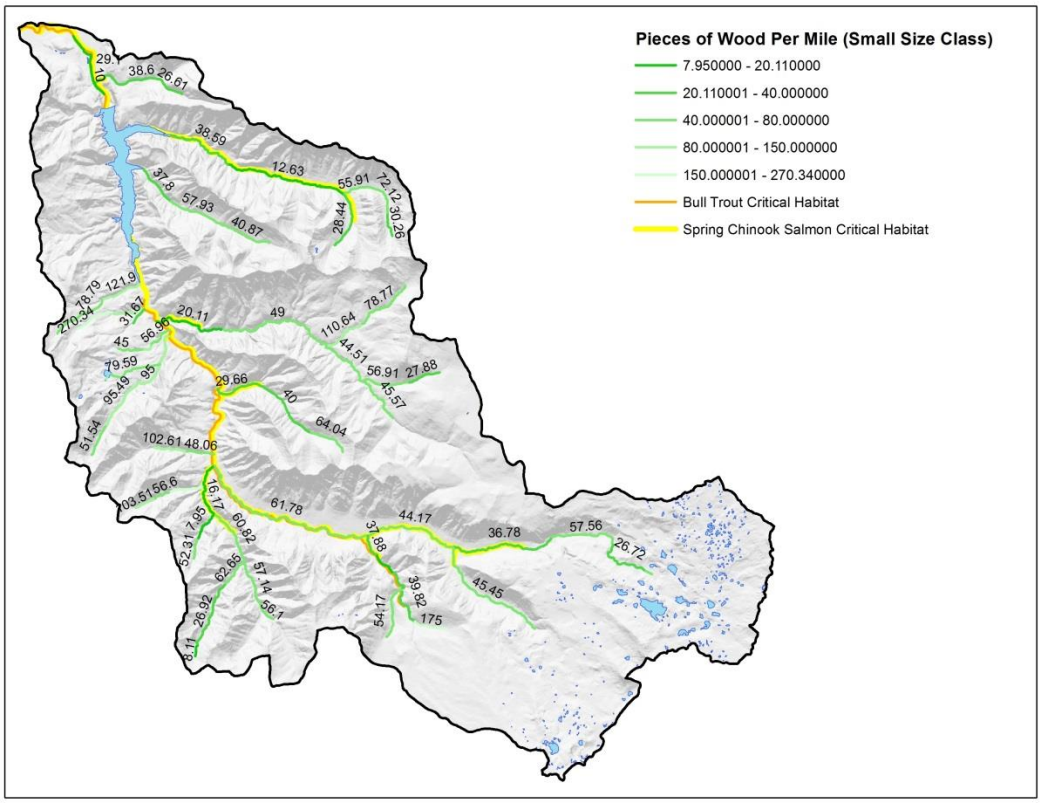

Debris Flow Probability at Road-Stream Crossings
0.00000 - 0.02500
0.02501 - 0.05000
0.05001 - 0.10847
Roads
Bull Trout Critical Habitat
Spring Chinook Salmon Critical Habitat
Streams

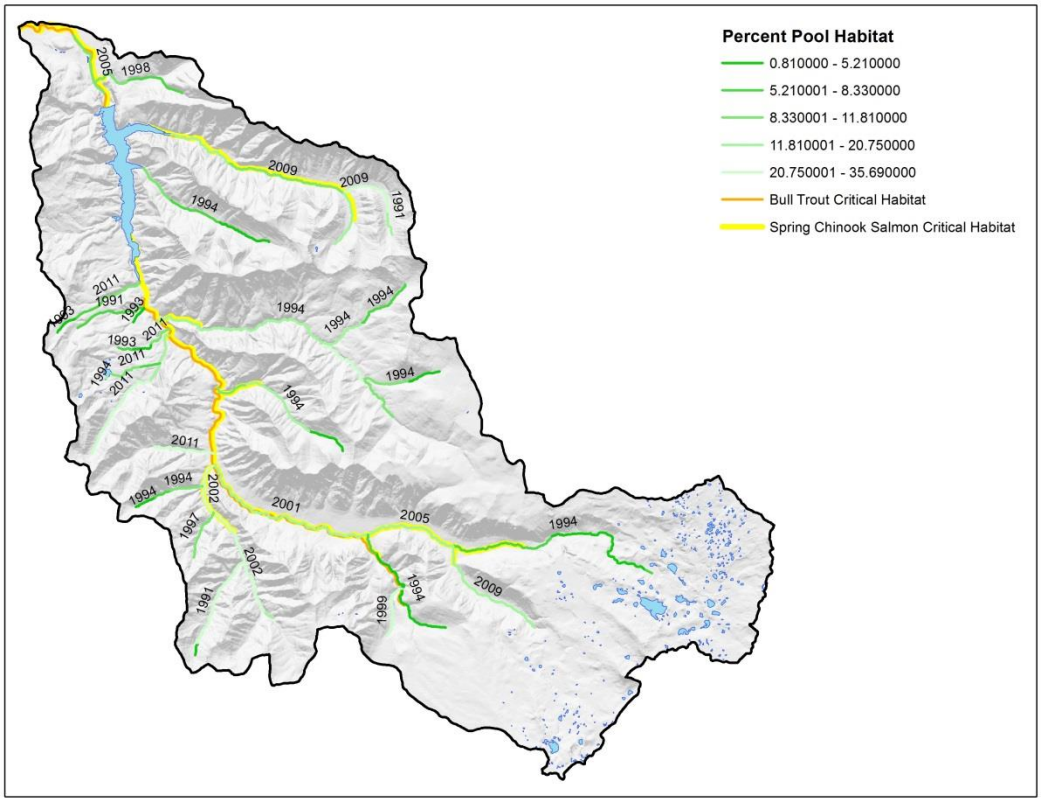

6th Field HUC Sub-watersheds
Road Aquatic Risk Rating
1
2
3
4
5
Streams
Wilderness
Cougar Creek-South Fork McKenzie River
East Fork South Fork McKenzie River
Cougar Reservoir-South Fork McKenzie River
French Pete Creek
Rebel Creek-South Fork McKenzie River
Augusta Creek-South Fork McKenzie River
Roaring River-South Fork McKenzie River
Elk Creek-South Fork McKenzie River

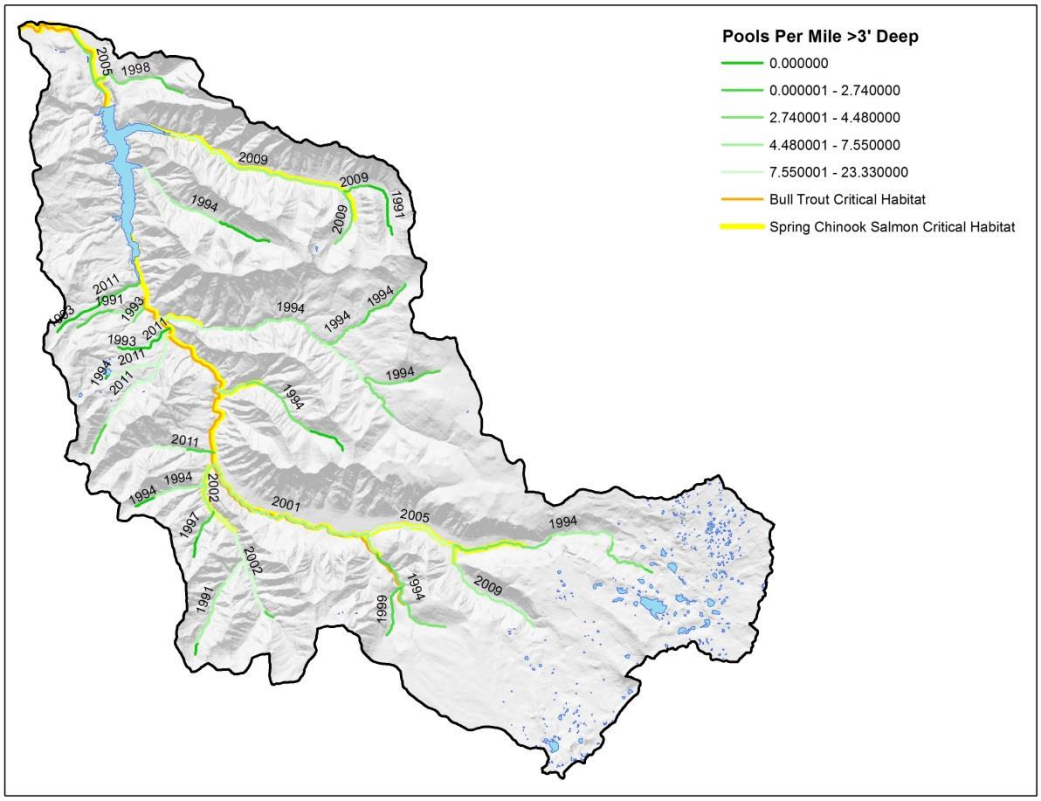

Recreation Site
BOATING SITE
CAMPGROUND
GROUP CAMPGROUND
LOOKOUT/CABIN
OTHER RECREATION CONCESSION SITE
TRAILHEAD
Roads
Trails
Bull Trout Critical Habitat
Spring Chinook Salmon Critical Habitat
Streams
Federal Ownership
DOD, Army Corps of Engineers DOD
FS, National Forest FS
FS, Wilderness FS

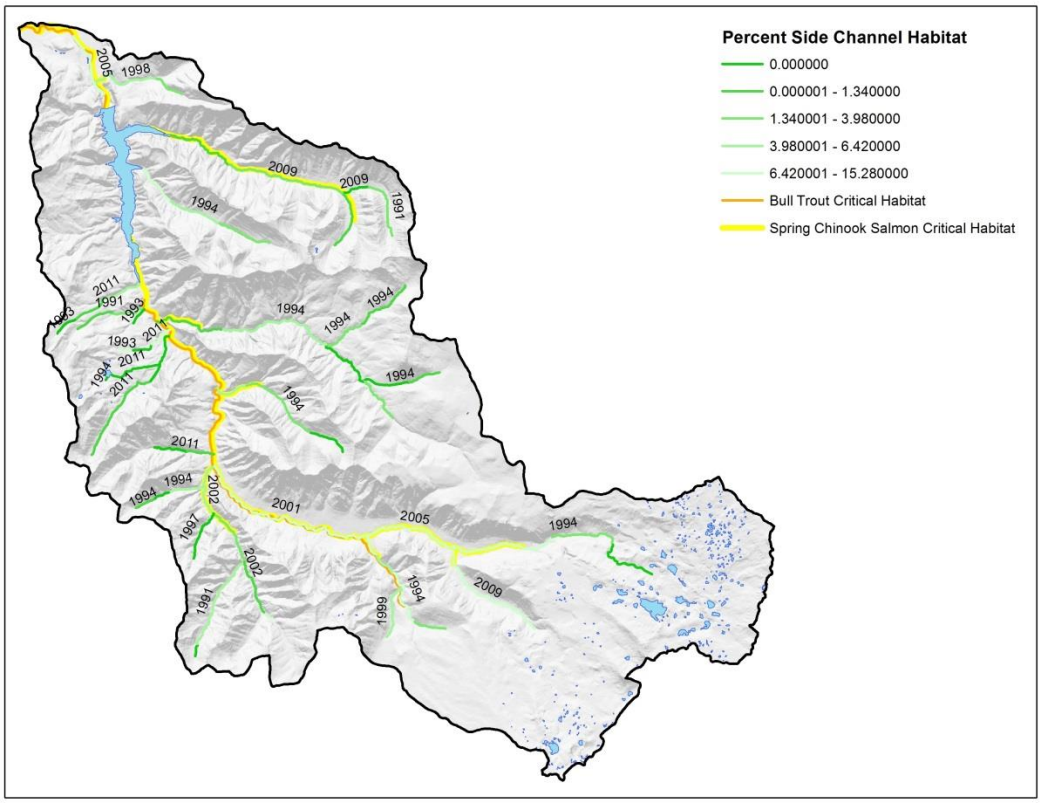

Pieces of Wood Per Mile (Large Size Class)
0.000000 - 0.850000
0.850001 - 20.000000
20.000001 - 40.000000
40.000001 - 80.000000
80.000001 - 135.090000
Bull Trout Critical Habitat
Spring Chinook Salmon Critical Habitat


Pieces of Wood Per Mile (Medium Size Class)
1.140000 - 8.470000
8.470001 - 20.000000
20.000001 - 40.000000
40.000001 - 80.000000
80.000001 - 151.470000
Bull Trout Critical Habitat
Spring Chinook Salmon Critical Habitat


Pieces of Wood Per Mile (Small Size Class)
7.950000 - 20.110000
20.110001 - 40.000000
40.000001 - 80.000000
80.000001 - 150.000000
150.000001 - 270.340000
Bull Trout Critical Habitat
Spring Chinook Salmon Critical Habitat


Percent Pool Habitat
0.810000 - 5.210000
5.210001 - 8.330000
8.330001 - 11.810000
11.810001 - 20.750000
20.750001 - 35.690000
Bull Trout Critical Habitat
Spring Chinook Salmon Critical Habitat


Pools Per Mile >3' Deep
0.000000
0.000001 - 2.740000
2.740001 - 4.480000
4.480001 - 7.550000
7.550001 - 23.330000
Bull Trout Critical Habitat
Spring Chinook Salmon Critical Habitat



Lower South Fork McKenzie Watershed Conditions

Within the South Fork McKenzie River Watershed, the South Fork McKenzie River Watershed Analysis Update (USFS 2010) documents current conditions, updates progress made since the initial South Fork McKenzie Watershed Analysis (USFS 1994) and presents management recommendations and priorities. The baseline conditions specific to the lower South Fork restoration action area (4.5 miles below Cougar Dam) are very well inventoried and documented through USFS Stream Inventory Surveys, pre-project monitoring surveys, and LiDAR data. Those surveys have revealed:

- very low pool frequency (less than 3 pools per mile, an 80% loss of pools since 1937);
- very low LWM frequency (less than 10 pieces of LWM per mile);
- lack of spawning gravels (cobble is the dominant substrate in both pools and riffles);
- channel straightening (sinuosity of 1.0 to 1.3, very low values for a low-gradient channel in a wide alluvial valley);
- loss of floodplain connectivity and off-channel habitat (over 400% reduction in floodplain inundation), and
- channel incision up to 10 feet in places.

These impaired conditions are limiting productivity of spring Chinook salmon, bull trout, and Pacific lamprey as discussed in their respective recovery or conservation plans (see Section b above). Spring Chinook salmon redd abundance in the lower South Fork ranges from 36-158 since 2001. Historic redd abundance is unknown, but based on estimates of 15,000-20,000 adults once occupying the South Fork, redd abundance in the lower reach was likely in the thousands. Bull trout use the lower South Fork for foraging, overwintering, and migratory habitat. Since 2011, 5-16 bull trout have been caught in the trap below Cougar Dam. Historically, the lower South Fork was known as a “bull trout paradise that was intensively fished.” Historic and current Pacific lamprey use in the South Fork is unknown, but ammocete presence was confirmed in the action area in August 2015.

Changes to Watershed-Scale Processes

- ***Run-off and stream flow***
  - Roads that intersect hill slopes often intercept ground water and convert it to surface flow. These roads also extend the stream network during run off events, facilitating the rapid transit of water from the system.
  - Cougar Dam significantly alters natural flow regime downstream.
- ***Erosion and sediment supply***
  - Roads, particularly in West Cascades geology, are increasing fine sediment delivery to streams and may trigger or exacerbate mass wasting.
  - Cougar Dam significantly alters sediment supply downstream.
- ***Nutrient delivery***
  - Large-scale conversion of vegetation to conifer-dominant may be reducing deciduous (higher quality) litter fall and stream productivity.
  - Fire suppression may be limiting nutrient delivery to streams.
  - Significant reduction of marine derived nutrients from Chinook salmon is limiting stream productivity.
  - Cougar Dam significantly alters nutrient delivery downstream.

Changes to Reach-Scale Processes

- ***Riparian processes***
  - Wood supply to streams is reduced by historic riparian clearcutting (currently an abundance of small trees, lack of large trees), fire suppression (reducing sources of wood), roads (intercepting wood), and Cougar Dam (intercepting wood).
- ***Stream flow and flood storage***
  - Impaired due to lack of large wood in streams (altered timing of stream flow, decreased flood storage).
  - Cougar Dam significantly alters stream flow and flood storage downstream.
  - Levees below Cougar Dam impact stream routing and flood storage.
- ***Sediment transport and storage***
  - Impaired due to lack of large wood in streams (reduced sediment deposition/storage).
  - Roads and culverts alter sediment transport and storage in tributary streams.
  - Cougar Dam significantly alters sediment transport downstream.
  - Levees below Cougar Dam impact sediment transport and storage.
- ***Channel, floodplain, and habitat dynamics***
  - Impaired due to lack of large wood in streams (reduced pool and bar formation and reduced channel migration).
  - Cougar Dam significantly alters channel, floodplain, and habitat dynamics downstream due to altered sediment and flow regime.
  - Levees below Cougar Dam limit channel dynamics and floodplain building.
- ***Organic matter transport and storage***
  - Impaired due to lack of large wood in streams (accelerated transport, reduced retention).
  - Cougar Dam significantly alters organic matter supply, transport and storage downstream.
  - Levees below Cougar Dam limit organic matter deposition on floodplain.
- ***Instream biological processes***
  - Large-scale conversion of vegetation to conifer-dominant may be reducing deciduous (higher quality) litter fall and stream productivity.

- Changes in primary production may be affecting secondary production (invertebrates) and higher trophic levels.
- Lack of large wood and subsequent lack of nutrient and organic matter retention may be limiting stream productivity.
- Lack of suitable habitat may be limiting fish reproduction and survival.

Changes in Biota

- ***Spring Chinook Salmon***
  - Cougar Dam/Reservoir and degradation of habitat have impaired distribution, abundance, and survival.
  - Genetic integrity is greatly reduced due to low population size.
- ***Bull Trout***
  - Cougar Dam/Reservoir and degradation of habitat have impaired distribution, abundance, and survival.
  - Genetic integrity is greatly reduced due to low population size.
  - Bull trout production is limited by lack of prey production, specifically Chinook fry and smolts.

Potential Effects of Climate Change

- Climate change predictions indicate an increase in stream temperatures, more frequent flood events, altered timing of run-off, reduced base flows, and shrinking of stream network.
- More frequent storm events could lead to increased mass wasting and sediment delivery to streams. Roads may exacerbate this.
- A shrinking of the stream network during low flows could alter fish distribution.
- Relatively rapid rates of changing conditions could exacerbate stressors (temperature, fine sediment, floods, etc.).
- Reduced genetic integrity may hinder ability for populations to adapt to changing conditions.

Restoration Projects Completed

Summary of recently completed restoration projects by Sub-watershed and effectiveness rating

- Cougar Creek culvert removal and bridge replacement: In 2013 an undersized passage barrier culvert was removed and an existing bridge that did not meet weight load ratings was replaced. Upstream passage to over 2.5 miles of stream was restored to native aquatic organisms, including 0.25 miles for spring Chinook salmon. This project improved multiple watershed processes including: sediment transport and storage; organic matter transport and storage; and instream biological processes. The project appears to have a high level of effectiveness.
- Upper South Fork McKenzie River Enhancement Project: In 2007 and 2008 large woody material was added to 5.5 miles of the South Fork via stream adjacent whole tree yarding and helicopter placement. In addition, 12 dispersed campsites access roads were closed or decommissioned to reduce erosion, reestablish riparian vegetation and improve water quality. Watershed processes that improved include: erosion and sediment supply; riparian process; stream flow and flood storage; sediment transport and storage; channel, floodplain and habitat dynamics; organic matter transport and storage; instream biological processes. The project appears to have a high level of effectiveness.
- Upper South Fork McKenzie River Enhancement Project: In 2007 and 2008 large woody material was added to 2.75 miles of the South Fork and 1 mile of Roaring River via stream adjacent whole tree yarding and helicopter placement. Watershed processes that improved include: riparian process; stream flow and flood storage; sediment transport and storage; channel, floodplain and habitat dynamics; organic matter transport and storage; instream biological processes. The project appears to have a high level of effectiveness.

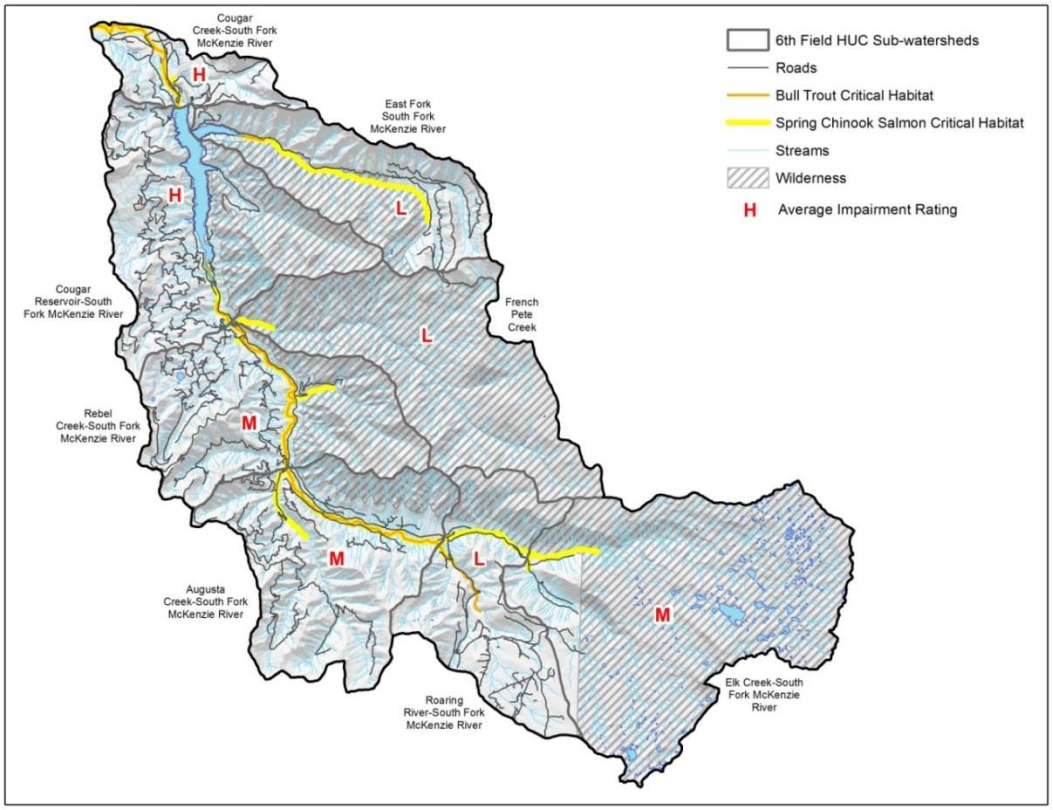
3. Project Development

Watershed Assessment Results Summary

Table 2. Process Impairment Rating by Sub-watershed and Causes of Impairment

Process	Cause(s) of Impairment	Sub-watershed Impairment Rating (High/Moderate/Low)							
		Cougar Creek	East Fork South Fork	Cougar Reservoir	French Pete Creek	Rebel Creek	Augusta Creek	Roaring River	Elk Creek
Run-off and stream flow	Roads, Cougar Dam	H	L	H	L	M	M	L	L
Erosion and sediment supply	Roads, Cougar Dam	H	L	H	L	M	M	L	L
Nutrient delivery	Veg mgmt, fire suppression, decline in Marine Dervied Nutrients, Cougar Dam	H	M	H	L	H	M	M	H
Riparian processes	Veg mgmt, fire suppression, roads	M	L	H	L	M	M	L	M
Stream flow and flood storage	Lack of LWM, Cougar Dam, levees below dam	H	L	H	L	M	M	L	M
Sediment transport and storage	Lack of LWM, roads/culverts, Cougar Dam, levees below dam	H	L	H	L	M	M	L	M
Channel, floodplain, and habitat dynamics	Lack of LWM, Cougar Dam, levees below dam	H	L	H	L	M	M	L	M
Organic matter transport and storage	Lack of LWM, Cougar Dam, levees below dam	H	L	H	L	M	M	L	M
Instream biological processes	All of the above	H	L	H	L	M	M	L	M

Average Impairment Rating by Sub-watershed



Constraints on Restoration Options:

- Removal of Cougar Dam is not currently a feasible option
- Wholesale closure or decommissioning of roads is not a feasible option
- Complete cessation of fire suppression is not a feasible option

Actions Needed to Improve Impaired Processes

Table 3. Restoration Actions and Approximate Level of Effort

Process	Restoration Actions	Sub-watershed Effort Rating (High/Moderate/Low)							
		Cougar Creek	East Fork South	Cougar Reservoir	French Pete	Rebel Creek	Augusta Creek	Roaring River	Elk Creek
Run-off and stream flow	Increase frequency of drainage structures on roads that convert ground water to surface flow and extentd stream network. Upgrade undersized culverts. Store or decommission roads not needed for future management.	M	M	H	--	H	H	M	L
	Work with USACE to restore higher flows below Cougar Dam to maintain important processes and habitat conditions.	L	--	--	--	--	--	--	--
Erosion and sediment supply	Upgrade undersized culverts. Store or decommission roads not needed for future management.	M	M	H	--	H	H	M	L
	Augment sediment supply downstream of Cougar Dam.	H	--	--	--	--	--	--	--
Nutrient delivery	Conduct further studies to determine if there is a lack of deciduous vegetation and how that affects stream productivity.	L	L	L	L	L	L	L	L
	Work with USFS to restore fire to the watershed. Implement prescribed fires, where appropriate, that will deliver large wood, nutrients, and sediment to streams.	M	M	M	M	M	M	M	M
	Because Marine Derived Nutrients were once an enormous source of nutrients, implement projects that improve habitat for anadromous Chinook and Pacific lamprey. Restore passage to all historic and potential habitat. Work with partners to increase Chinook and lamprey abundance. Consider hatchery carcass augmentation to important stream reaches.	H	H	H	H	H	H	H	H
	Augment nutrient supply downstream of Cougar Dam.	L	--	--	--	--	--	--	--

Process	Restoration Actions	Sub-watershed Effort Rating (High/Moderate/Low)							
		Cougar Creek	East Fork South Fork	Cougar Reservoir	French Pete Creek	Rebel Creek	Augusta Creek	Roaring River	Elk Creek
Riparian processes	Protect in-tact riparian areas and sources of LWM. Accelerate development of large diameter wood where appropriate. Maintain adequate stream shade.	M	M	M	L	M	M	M	M
	Work with USFS to restore fire to the watershed. Implement prescribed fires, where appropriate, that will deliver large wood, nutrients, and sediment to streams.	M	M	M	M	M	M	M	M
	Upgrade road-stream crossings for effective transport of wood and sediment downstream. Develop plan for relocation (instead of removal) of riparian trees that fall across roads.	L	L	M	--	H	H	L	L
Stream flow and flood storage	Restore LWM to appropriate levels.	H	M	L	L	M	M	L	M
	Work with USACE to restore higher flows below Cougar Dam to maintain important processes and habitat conditions.	L	--	--	--	--	--	--	--
	Remove levees below Cougar Dam to improve stream routing and flood storage.	H	--	--	--	--	--	--	--
Sediment transport and storage	Restore LWM to appropriate levels.	H	M	L	L	M	M	L	M
	Upgrade road-stream crossings for effective transport of wood and sediment downstream.	L	L	M	--	H	H	L	L
	Augment sediment supply downstream of Cougar Dam.	H	--	--	--	--	--	--	--
	Remove levees below Cougar Dam to improve sediment transport and storage.	H	--	--	--	--	--	--	--
Channel, floodplain, and habitat dynamics	Restore LWM to appropriate levels.	H	M	L	L	M	M	L	M
	Augment sediment and wood downstream of Cougar Dam and restore higher flows to maintain important processes and habitat conditions.	H	--	--	--	--	--	--	--
	Remove levees below Cougar Dam to improve channel, floodplain, and habitat dynamics.	H	--	--	--	--	--	--	--
Organic matter transport and storage	Restore LWM to appropriate levels.	H	M	L	L	M	M	L	M
	Augment organic matter downstream of Cougar Dam.	H	--	--	--	--	--	--	--
	Remove levees below Cougar Dam to improve organic matter deposition and storage.	H	--	--	--	--	--	--	--
Instream biological processes	Instream biologicial processes depend on improvement of all restoration actions listed above. (Rating is an average)	H	M	M	L	M	M	L	M

Table 4. Restoration Strategy by Sub-watershed Based on Impaired Processes

Strategy by Sub-watershed	Cougar Creek	East Fork South Fork	Cougar Reservoir	French Pete Creek	Rebel Creek	Augusta Creek	Roaring River	Elk Creek
Protect and maintain relatively good conditions		X		X			X	
High potential for improvement	X				X	X		X
Low potential for improvement			X					

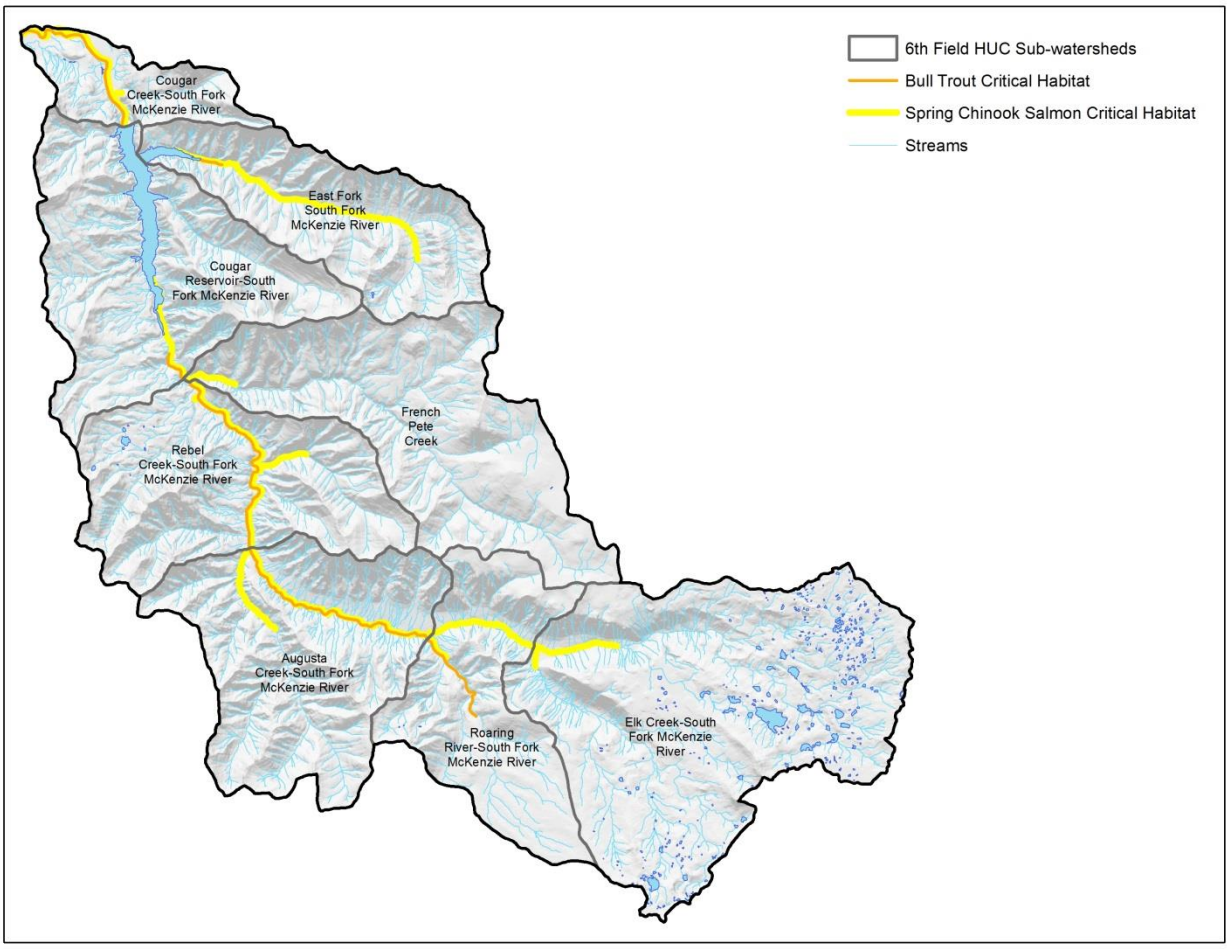


Table 5. Specific Projects Needed to Improve Impaired Processes

Projects	Specific Locations Within Sub-watersheds							
	Cougar Creek	East Fork South Fork	Cougar Reservoir	French Pete Creek	Rebel Creek	Augusta Creek	Roaring River	Elk Creek
Vegetation Management								
Conduct further studies to determine if there is a lack of deciduous vegetation and how that affects stream productivity. If there is a lack, manage riparian vegetation to increase species and structural diversity.	N/A (no lack of riparian deciduous vegetation)	Initial analysis shows lack of riparian deciduous vegetation. Manage riparian vegetation to increase diversity.	N/A (no lack of riparian deciduous vegetation)	Initial analysis shows lack of riparian deciduous vegetation. Management is limited in Wilderness. Limit fire suppression to the extent possible.	Initial analysis shows lack of riparian deciduous vegetation. Manage riparian vegetation to increase diversity.	Initial analysis shows lack of riparian deciduous vegetation. Manage riparian vegetation to increase diversity.	Initial analysis shows lack of riparian deciduous vegetation. Manage riparian vegetation to increase diversity.	Initial analysis shows lack of riparian deciduous vegetation. Management is limited in Wilderness. Limit fire suppression to the extent possible.
Work with USFS to restore fire to the watershed. Implement prescribed fires, where appropriate, that will deliver large wood, nutrients, and sediment to streams.	Cougar Creek drainage	N/A (mostly low fire regime departure; road would intercept wood/sediment)	Penny Creek drainage	French Pete Creek drainage	Balm Creek, Bouy Creek, Hardy Creek, Blue Creek, and Starr Creek drainages	Augusta and Loon Creek drainages	Upper Roaring River drainage	Upper South Fork and Elk Creek drainages
Protect in-tact riparian areas and sources of LWM. Accelerate development of large diameter wood where appropriate. Maintain adequate stream shade.	Need better stand data	Need better stand data	Need better stand data	Need better stand data	Need better stand data	Need better stand data	Need better stand data	Need better stand data

Projects	Specific Locations Within Sub-watersheds							
	Cougar Creek	East Fork South Fork	Cougar Reservoir	French Pete Creek	Rebel Creek	Augusta Creek	Roaring River	Elk Creek
Biological/Instream								
Implement projects that improve habitat for Chinook, bull trout, and Pacific lamprey	South Fork McKenzie River - 4.5 miles below Cougar Dam	EFSF McKenzie River - lower 6 miles	South Fork McKenzie River - 1.25 miles above Reservoir	French Pete Creek - lower 1.25 miles	South Fork McKenzie River - 5.25 miles	South Fork McKenzie River - 5.5 miles; Augusta Creek - lower 2.25 miles	South Fork McKenzie River - 2.75 miles; Roaring River - lower 2.5 miles	South Fork McKenzie River - 2.0 miles; Elk Creek - lower 2.5 miles
Restore passage to all historic and potential habitat for Chinook, bull trout, and Pacific lamprey	Improve upstream and downstream passage effectiveness at Cougar Dam	N/A (no passage barriers)	Improve upstream and downstream passage effectiveness at Cougar Dam and through Reservoir	N/A (no passage barriers)	N/A (no passage barriers)	N/A (no passage barriers)	N/A (no passage barriers)	N/A (no passage barriers)
Augment hatchery Chinook carcasses	South Fork McKenzie River - 4.5 miles below Cougar Dam	EFSF McKenzie River - lower 6 miles	South Fork McKenzie River - 1.25 miles above Reservoir	French Pete Creek - lower 1.25 miles	South Fork McKenzie River - 5.25 miles	South Fork McKenzie River - 5.5 miles; Augusta Creek - lower 2.25 miles	South Fork McKenzie River - 2.75 miles; Roaring River - lower 0.75 miles	South Fork McKenzie River - 2.0 miles; Elk Creek - lower 0.5 miles
Restore LWM to appropriate levels.	South Fork McKenzie River - 4.5 miles below Cougar Dam	EFSF McKenzie River - lower 6 miles	South Fork McKenzie River - 1.25 miles above Reservoir	French Pete Creek - lower 1.25 miles	Rebel Creek - lower 1.25 miles; South Fork McKenzie River - 5.25 miles	Augusta Creek - lower 2.25 miles	Roaring River - RM 1.0-2.5	South Fork McKenzie River - 2.0 miles; Elk Creek - lower 2.5 miles
Restore higher flows below Cougar Dam	South Fork McKenzie River - 4.5 miles below Cougar Dam	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Augment sediment supp	South Fork McKenzie River - 4.5 miles below Cougar Dam	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Augment nutrient supply below Cougar Dam	South Fork McKenzie River - 4.5 miles below Cougar Dam	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Augment organic matter below Cougar Dam	South Fork McKenzie River - 4.5 miles below Cougar Dam	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Remove levees below Cougar Dam	South Fork McKenzie River - 2 miles below Cougar Dam	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Projects	Specific Locations Within Sub-watersheds							
	Cougar Creek	East Fork South Fork	Cougar Reservoir	French Pete Creek	Rebel Creek	Augusta Creek	Roaring River	Elk Creek
Road Related								
Increase frequency of drainage structures on roads that convert ground water to surface flow	See USFS travel management plan and legacy roads analysis	See USFS travel management plan and legacy roads analysis	See USFS travel management plan and legacy roads analysis	See USFS travel management plan and legacy roads analysis	See USFS travel management plan and legacy roads analysis	See USFS travel management plan and legacy roads analysis	See USFS travel management plan and legacy roads analysis	See USFS travel management plan and legacy roads analysis
Upgrade undersized culverts	See USFS travel management plan and legacy roads analysis	See USFS travel management plan and legacy roads analysis	See USFS travel management plan and legacy roads analysis	See USFS travel management plan and legacy roads analysis	See USFS travel management plan and legacy roads analysis	See USFS travel management plan and legacy roads analysis	See USFS travel management plan and legacy roads analysis	See USFS travel management plan and legacy roads analysis
Store or decommission roads not needed for future management	See USFS travel management plan and legacy roads analysis	See USFS travel management plan and legacy roads analysis	See USFS travel management plan and legacy roads analysis	See USFS travel management plan and legacy roads analysis	See USFS travel management plan and legacy roads analysis	See USFS travel management plan and legacy roads analysis	See USFS travel management plan and legacy roads analysis	See USFS travel management plan and legacy roads analysis
Upgrade road-stream crossings for effective transport of wood and sediment downstream.	See USFS travel management plan and legacy roads analysis	See USFS travel management plan and legacy roads analysis	See USFS travel management plan and legacy roads analysis	See USFS travel management plan and legacy roads analysis	See USFS travel management plan and legacy roads analysis	See USFS travel management plan and legacy roads analysis	See USFS travel management plan and legacy roads analysis	See USFS travel management plan and legacy roads analysis
Develop plan for relocation (instead of removal) of riparian trees that fall across roads.	Work with USFS District Ranger	Work with USFS District Ranger	Work with USFS District Ranger	Work with USFS District Ranger	Work with USFS District Ranger	Work with USFS District Ranger	Work with USFS District Ranger	Work with USFS District Ranger

APPENDIX B: Process for Restoration Action Plan Development

McKenzie River and Mohawk River Watersheds

For the McKenzie River Watershed and Mohawk River Watershed we followed a modified version of the process outlined in Appendix A which relied more heavily upon review of previously completed assessments, relevant restoration and conservation strategies, professional judgment and partner review.

1.0 Watershed Assessment

The purpose of watershed assessment is to identify causes of habitat change and how habitat changes have affected target species.

STEP 1. Classify and map landscape and streams to understand the watershed template. Landscape-scale features define the range of potential conditions that may be expressed within stream reaches.

Watershed Template and Processes –relied on previously completed assessment (see Table **B1**).

Reach Types and Processes – reflects local valley type, slope, sediment supply and hydrology

- We relied upon a combination of existing watershed assessments (**Figure B1**) and professional knowledge to identify fish population and distribution information and stream habitat condition in areas where GIS data was unavailable.

Table B1. Existing Watershed Assessments for McKenzie River and Mohawk River Watersheds

Plan, Source and Year	Focus area within McKenzie River Sub-basin
Mohawk River Watershed Assessment (Weyerhaeuser 1994)	NF Mohawk, SF Mohawk, Upper Mohawk, and Mill Creek sub-basins
Lower McKenzie South Side Watershed Analysis (Weyerhaeuser 1994)	McKenzie River Watershed
BLM Mohawk/McGowan Watershed Analysis (BLM 1995)	Main stem Mohawk River, tributaries
Lower McKenzie North Side Watershed Analysis (Weyerhaeuser 1995)	McKenzie River Watershed
Technical Report for Water Quality and Fish and Wildlife Habitat (LCOG 1996)	Entire sub-basin
Action Plan for Water Quality and Fish and Wildlife Habitat (LCOG 1996)	Entire sub-basin
Vida McKenzie Watershed Analysis (BLM 1996)	McKenzie River Watershed
Bear/Marten Watershed, McKenzie Resource Area (BLM 1998)	McKenzie River Watershed
NRCS Mohawk Watershed Profile (1999)	Mohawk River Watershed - lower elevations
MWP Supplemental Assessment of the Mohawk Watershed (MWP 2000)	Mohawk River Watershed
McKenzie River Sub-basin Assessment (MWC 2000)	Lower main stem McKenzie River
Biological Evaluation of the Willamette River and McKenzie River Confluence Area (MWC 2000)	McKenzie River-Willamette River Confluence area
McKenzie River Conservation Strategy (MWC 2002)	McKenzie River and Mohawk River watersheds
NRCS McKenzie Profile (2005)	Entire watershed
The Oregon Conservation Strategy (ODFW 2006)	State-wide
Western Oregon Aquatic Restoration Strategy (BLM 2015)	Western Oregon BLM lands

STEP 2. Create maps showing current and historic land use and development.

- We relied upon a combination of existing watershed assessments (Table **B1**) and professional knowledge

STEP 3. Assess changes to natural processes, habitat, and biota using information gathered from Steps 1 and 2.

Changes to Watershed-Scale Processes

- ***Run-off and stream flow***
  - Multiple dam and hydroelectric projects significantly alter natural flow regime downstream (McKenzie).
  - Roads that intersect hill slopes often intercept ground water and convert it to surface flow. These roads also extend the stream network during run off events, facilitating the rapid transit of water from the system.
- ***Erosion and sediment supply***
  - Multiple dam and hydroelectric projects significantly alter sediment supply downstream (McKenzie).
  - Roads, particularly in West Cascades geology, are increasing fine sediment delivery to streams and may trigger or exacerbate mass wasting.
- ***Nutrient delivery***
  - Multiple dam and hydroelectric projects significantly alter nutrient delivery downstream (McKenzie).
  - Large-scale conversion of riparian vegetation to non-forested landcover (residential, roads, agricultural) and domination of invasive vegetation reduces litter fall, delivery of woody material and stream productivity.
  - Fire suppression may be limiting nutrient delivery to streams.
  - Elimination of marine derived nutrients from Chinook salmon is limiting stream productivity.

Changes to Reach-Scale Processes

- ***Riparian processes***
  - Riparian vegetation altered and removed by past and current land use practices, fire suppression, changes in flow regimes and roads.
- ***Stream flow and flood storage***
  - Multiple dam and hydroelectric projects significantly alter stream flow and flood storage downstream (McKenzie).
  - Impaired due to lack of large wood in streams (altered timing of stream flow, decreased flood storage).
  - Bank hardening (rip rap), channelization and down-cutting have reduced interaction with floodplain decrease flood storage, stream flow and stream routing.
- ***Sediment transport and storage***
  - Multiple dam and hydroelectric projects significantly alter sediment transport downstream (McKenzie).
  - Levees and revetments impact sediment transport and storage.
  - Impaired due to lack of large wood in streams (reduced sediment deposition/storage).
  - Roads and culverts alter sediment transport and storage in tributary streams.

- ***Channel, floodplain, and habitat dynamics***
  - Multiple dam and hydroelectric projects significantly alters channel, floodplain, and habitat dynamics downstream due to altered sediment and flow regime (McKenzie).
  - Levees and revetments limit channel dynamics and floodplain building.
  - Impaired due to lack of large wood in streams (reduced pool and bar formation and reduced channel migration).
  - Bank hardening and development within floodplain alter channel, floodplain, and habitat dynamics due to altered sediment and flow regime.
- ***Organic matter transport and storage***
  - Multiple dam and hydroelectric projects significantly alter organic matter supply, transport and storage downstream (McKenzie).
  - Levees and revetments limit organic matter deposition on floodplain.
  - Impaired due to lack of large wood in streams (accelerated transport, reduced retention).
- ***Instream biological processes***
  - Conversion of riparian vegetation to other land uses and domination of invasive plants is likely reducing deciduous litter fall and stream productivity.
  - Changes in primary production may be affecting secondary production (invertebrates) and higher trophic levels.
  - Lack of large wood and subsequent lack of nutrient and organic matter retention may be limiting stream productivity.
  - Lack of suitable habitat may be limiting fish reproduction and survival.

<u>Changes in Biota</u>

- ***Spring Chinook salmon***
  - Multiple dam and hydroelectric projects and degradation of habitat have impaired distribution, abundance, and survival (McKenzie).
  - Genetic integrity is greatly reduced due to low population size.
  - Extirpated from Mohawk River, though reports of sightings are reoccurring.
- ***Bull Trout***
  - Multiple dam and hydroelectric projects and degradation of habitat have impaired distribution, abundance, and survival (McKenzie).
  - Genetic integrity is greatly reduced due to low population size.
  - Bull trout production is limited by lack of prey production, specifically Chinook fry and smolts.
- ***Oregon Chub***
  - Delisted in 2015.
  - Populations within McKenzie and Mohawk are well documented with stable or increasing population trends.
- ***Pacific Lamprey***
  - Population and distribution within McKenzie Sub-basin not well documented.
  - Reoccurring reports from landowners.
  - Staff sightings of apparent redds at various location in the Mohawk River watershed.
- ***Cutthroat trout and rainbow trout***
  - Assumed to be widespread.
  - Mohawk River is *"primary spawning area for one of the strongest populations of cutthroat trout in the Willamette Basin*" (Oregon Conservation Strategy 2006).
  - ODFW study showed Mohawk to have a strong run of fluvial cutthroat trout.

Potential Effects of Climate Change

- Relied upon two primary documents to examine potential effects of climate change in the McKenzie River Sub-basin: Climate Change Impacts on Mountain Snowpack (Sproles et al., 2013) and Preparing for Climate Change in the Upper Willamette River Basin of western Oregon (Dopplet et al., 2009). Key findings include:
  - Climate change predictions indicate an increase in stream temperatures, more frequent flood events, altered timing of run-off, reduced base flows and shrinking of stream network.
  - More frequent storm events could lead to increased mass wasting and sediment delivery to streams. Roads may further exacerbate this.
  - A shrinking of the stream network during low flows could alter fish distribution.
  - Relatively rapid rates of changing conditions could exacerbate stressors (temperature, fine sediment, floods, etc.).
  - Reduced genetic integrity may hinder ability for populations to adapt to changing conditions.
  - Vegetation shifts from fir dominated landscape to pine, hardwoods, madrone and oak.
  - Characteristics of river systems most at risk to impacts of climate change include several that directly apply to the Sub-basin such as the Mohawk River Watershed;
    - Systems where water rights are already fully or over-allocated
    - Already experiencing high temperature problems (DEQ 303d list)
    - High susceptibility to high intense surges of water in a short period of time ("flashy").

2.0 Project Development

STEP 1. Rank level of impairment.

- Rank levels of impairment for each watershed process to indicate which impairments have the largest habitat effects. Process was completed on a sub-watershed scale for the Mohawk River Watershed (**Table B2**).
- In the McKenzie River Watershed this process primarily relied upon previously completed work by the Lower McKenzie River Fish Habitat Enhancement Team.

Table B2. Mohawk River sub-watershed impairment ranking.

Process	Cause(s) Of Impairment	Sub-basin Impairment rating (High, Medium and Low)								
		Lower Mohawk	Upper Mohawk	Kelly	McGowan	Parsons	Cartwright	Mill	Shotgun/ Cash	Drury /Log
Run-off and stream flow	Roads	M	M	M	M	M	M	M	M	M
Erosion and sediment supply	Roads, land use practices, development within floodplain	H	M	M	M	M	M	M	M	M
Nutrient delivery	Veg mgmt., fire suppression, decline in marine derived nutrients	M	M	M	M	M	M	M	M	M
Riparian processes	land use practices and conversion, veg mgmt., fire suppression, roads	H	M	H	H	H	H	H	L	M

Stream flow and flood storage	Roads, Lack of in-stream LWM, development within floodplain	M	L	M	M	M	M	M	M	M
Sediment transport and storage	Lack of instream wood, loss of interaction with floodplain, interruptions in delivery (roads, culverts)	H	M	H	H	H	H	H	M	M
Channel, floodplain, and habitat dynamics	Lack of in-stream LWM, development within floodplain	H	L	H	H	H	H	H	L	M
Organic matter transport and storage	Development within floodplain, lack of in-stream wood	H	L	H	H	H	H	H	L	M
Instream Biological Process		H	L	H	M	M	M	M	M	M
Average Impairment Rating		**H**	**L-M**	**M-H**	**M-H**	**M-H**	**M-H**	**M-H**	**M**	**M**

STEP 2. Conduct field inventory of impaired reaches and/or rely on professional knowledge within the watershed to verify watershed assessment results and identify specific areas where restoration is needed.

- We relied primarily upon professional knowledge within the watershed to verify watershed assessment results and identification of priority restoration and conservation areas.

STEP 3. Develop a restoration strategy that acknowledges the biological importance of habitat types and which restored habitats will achieve the greatest advancement toward restoration goals.

- In the McKenzie River Watershed priority areas along the main stem river had been previously identified by the Lower McKenzie Fish Enhancement Technical Team. Within the Mohawk River Watershed several sub-watersheds and portions of the main stem river were previously identified as important habitat areas and recommended as high-priority restoration (Table **B3**).
- Within high priority restoration areas, specific actions for each impaired process where examined for feasibility based on geographic, logistic, social, and economic constraints. See Table **B4** for Mohawk River basin example.

Table B3. Summary of previously identified priority actions and emphasis areas within the Mohawk River Watershed.

Document, Assessment or Strategy	Prioritized Action	Emphasis, or Opportunity Area	Secondary Area
Mohawk/McGowan Watershed Analysis (BLM 1995)	Decommission roads that are significantly affecting water flow regiment and that highly impacting erosion.	N/A	N/A
Mohawk/McGowan Watershed Analysis (BLM 1995)	Eliminate fish barriers created by unnatural situations.	N/A	N/A
Mohawk/McGowan Watershed Analysis (BLM 1995)	Install in-stream structures (large wood, boulders) to create aquatic habitat diversity.	N/A	N/A

Mohawk/McGowan Watershed Analysis (BLM 1995)	Establish network of forest patches and riparian corridors to provide connectivity between refugia, mature and old forest habitats throughout the western portion of the watershed	N/A	N/A
Mohawk/McGowan Watershed Analysis (BLM 1995)	Create ponds and off-channel habitat for riparian dependent species.	N/A	N/A
Mohawk/McGowan Watershed Analysis (BLM 1995)	Control exotic species (plants and animals) that are harmful to native biota.	N/A	N/A
Mohawk Supplemental Assessment (2000)	Protect and restore bottomland forest conditions.	Lower Mohawk	Lower Mill Creek
Mohawk Supplemental Assessment (2000)	Improve riparian conditions.	Upper Mohawk, Cartwright, Parsons, McGowan	Watershed-wide
Mohawk Supplemental Assessment (2000)	Fix unnatural barriers to migration.	Upper Mohawk, Cartwright, Parsons, McGowan	Watershed-wide
Mohawk Supplemental Assessment (2000)	Address erosional hazards associated with active and abandoned roads and railroad grades.	Upper Mohawk, Cartwright, Parsons, McGowan	Watershed-wide
Mohawk Supplemental Assessment (2000)	Increase aquatic habitat complexity.	Upper Mohawk, Cartwright, Parsons, McGowan	Watershed-wide
Mohawk Supplemental Assessment (2000)	Restore wetlands and other off-channel habitats.	Lower Mohawk River, Cartwright, Parsons, McGowan	Watershed-wide
McKenzie Sub-basin Assessment (2000)	Riparian enhancement.	Sub-basin wide	
McKenzie Sub-basin Assessment (2000)	Restore wetlands.	Lower Mohawk	N/A
McKenzie River Watershed Conservation Strategy (MRWCS) (MWC 2002)	Restore habitat connections.	Entire basin	
MRWCS (MWC 2002)	Protect and restore floodplain and riparian habitat.	Lower Mohawk and lower valley tributaries	N/A
MRWCS (MWC 2002)	Protect and restore wetland.	Lower Mohawk	N/A
MRWCS (MWC 2002)	Protect and restore pond turtle habitat.	Lower Mohawk	N/A
MRWCS (MWC 2002)	Protect and restore water quality and quantity.	Entire basin	N/A
Oregon Conservation Strategy (OCS) (ODFW 2006)	Maintain or enhance in-channel watershed function, connection to riparian habitat, flow and hydrology.	Lower Mohawk	N/A
OCS (ODFW 2006)	Maintain or restore riparian habitat and ecological function; ensure sufficient habitat complexity for wildlife.	Lower Mohawk	N/A
OCS (ODFW 2006)	Restore river and floodplain interactions.	Lower Mohawk	N/A
Western Oregon Aquatic Restoration Strategy (BLM 2015)	Identify and prioritize sub-basin within the Eugene District with high “intrinsic” fish habitat value. Mohawk system did not rank high enough to warranted prioritization during this process.	N/A – No stream or reach scored high enough to be ranked	N/A

Table B4. Summary of potential restoration actions, feasibility and potential for process and habitat improvement within select focus areas of the Mohawk River Watershed.

Focus Area or Sub-basin	Project Type			
	Reestablishment of native riparian vegetation	**Restore LWM to channel and floodplain**	**Increase floodplain connectivity and bank stability (erosion)**	**Roads: store or decommission roads, upgrade undersized culverts**
Lower Mohawk (mouth to Marcola, includes Black Canyon, Spores and Wade Creek Basins)	Lower section of miles (10-12 miles) of Mohawk River entirely privately owned. Prior assessment identified 50-70 acres of floodplain as priority.	Lower river and unconstrained floodplain is likely lacking LWM. Given surrounding land use and development LWM may be difficult.	Locally high concentrations of bank failure and rates of erosion. Potential to increase floodplain connections and flood storage capacity at several locations.	Data gap – likely multiple small stream crossings on smaller lower river tributaries.
Upper Mohawk (Marcola to headwaters)	Privately owned with mixture of residential and agricultural properties. Multiple small scale projects implemented.	Given surrounding land use and development LWM may be difficult.	Limited floodplain and opportunity with surrounding land use.	Weyerhaeuser has completed multiple culvert and road upgrades in upper watershed. Data gap on remaining fish passage barriers.
Kelly Creek	Lower 2.5 – 3 miles on private land.	Lower portion of creek is down-cutting and likely lacking LWM. Project development may be possible with participation of multiple landowners.	Potential to increase floodplain connections and flood storage capacity at several locations. Surrounding land use may limit opportunity.	At least one known likely fish barrier. Data gap on remaining stream crossings. Data gap on remaining fish passage barriers.
McGowan Creek	Lower 1.5 miles, multiple project implemented.	Given surrounding land use and development LWM may be difficult. BLM has completed multiple projects upstream. Potential for additional projects.	Lower section is unconstrained but opportunity is limited by surround development.	BLM and Weyerhaeuser have completed multiple culvert and road upgrades in upper portion of watershed. At least one known fish-passage barrier at difficult site.
Parsons Creek	Lower 4 -5 miles privately owned, primarily small scale rural residential. Several small scale projects completed.	Given surrounding land use and development LWM may be difficult.	Constrained system with floodplain limited to lower section. Limited opportunity with surrounding land use and development.	One known fish barrier at difficult site. Data gap on remaining fish barriers on private land.

Cartwright Creek	Lower 2.5 miles privately owned. Several small scale projects completed.	Bridge and surrounding development, LMW placement may be difficult.	Limited opportunity with surrounding land use and development.	Data gap on remaining fish barriers on private land.
Mill Creek	Lower 2 miles privately owned, Several small scale projects completed.	Given surrounding land use and development LWM may be difficult. Project development may be possible with participation of multiple landowners.		Weyerhaeuser has completed multiple culvert and road upgrades in watershed. One possible fish barrier on major tributary.
Shotgun/Cash Creeks	Primarily federally owned.	BLM has completed multiple instream projects.	Primarily constrained system with floodplain limited to lower section.	BLM and Weyerhaeuser have completed multiple culvert and road upgrades. BLM has also completed multiple projects targeting OHV use.
Drury/Log Creeks	Lower 1 mile of both Drury and Log Creeks privately owned, primarily small rural residential.	Given surrounding land use and development LWM placement may be difficult.	Constrained system with limited floodplain. Surrounded by development.	Data gap on remaining fish barriers on private land.

3.0 Project Prioritization

STEP 1. Establish a prioritization goal based on goals and objectives of the restoration action plan.

- Example goal: *Prioritize projects within the McKenzie River Sub-basin based on their ability to (1) provide the highest quality of habitat needed to support key species and the recovery of ESA-listed species, (2) maintain high quality drinking water, and (3) offer socio-economic benefits to local communities.*

STEP 2. Select a team that will prioritize projects.

- McKenzie Watershed Council staff and members of the Lower McKenzie River Fish Habitat Enhancement Team reviewed existing priorities based on previous prioritization processes within the McKenzie River Watershed.
- The prioritization process for the Mohawk River Watershed relied heavily upon previously completed assessment and prioritization processes with limited review from community groups, the Bureau of Land Management and Weyerhaeuser Company.

STEP 3. Establish prioritization approach and criteria

- **Table B5** shows the prioritization approach and criteria used for the Action Plan.
- Partners attempted to account for biological, habitat and socioeconomic, and feasibility criteria.
- Weight was given to certain criteria based on professional judgement of significance for the target species.

- The prioritization approach for the Mohawk River Watershed relied upon previously identified projects and emphasis area Table **B3** and upon current partnership opportunities with private landowners. Individual projects within the Mohawk River Watershed were not scored utilizing the process depicted in Table **B6**.

Table B5. Prioritization approach and criteria used for the Action Plan.

METRIC	WEIGHT (Total Possible score = 55)	SCORING
BIOLOGICAL	**15 pts possible**	
Target species	High (5pts)	• Two or more T & E and/or Oregon Conservation Strategy (OCS) species directly impacted (5 pts) • One T & E and/or OCS species directly impacted (3 pts) • Native species benefit, but no direct connection to T & E and/or OCS species (1 pt)
Potential to expand target species distribution or amount of available habitat (lateral or longitudinal expansion)	High (5 pts)	*Based on professional judgement:* • >90% likelihood (5 pts) [*ex: very likely that species will re-colonize restored stream reach or reconnected side channels/ floodplain for spawning or rearing*] • 50-90% likelihood (3 pts) [*ex: somewhat likely that species will re-colonize restored stream reach or reconnected side channels/ floodplain for spawning or rearing*] • <50% likelihood (1 pt) [*ex: low likelihood that target species will re-colonize restored stream reach or reconnected side channels/ floodplain for spawning or rearing*]
Potential to increase target species suitable habitat (as a proxy for productivity)	High (5 pts)	*Based on professional judgement:* • >90% likelihood (5 pts) [*ex: very likely the project will sort and retain spawning sized gravels, and add habitat complexity for rearing*] • 50-90% likelihood (3 pts) [*ex: somewhat likely the project will sort and retain spawning sized gravels, and add habitat complexity for rearing*] • <50% likelihood (1 pt) [*ex: low likelihood that the project will sort and retain spawning sized gravels, and add habitat complexity for rearing*]
HABITAT	**26 points possible**	
Improves water quality and water storage	High (5 pts)	*Based on professional judgement:* • >90% likelihood (5 pts) [*ex: very likely the project will reduce threats to water quality (fine sediment, chemicals, excess nutrients) or increase water storage in floodplains*] • 50-90% likelihood (3 pts) [*ex: somewhat likely the project will reduce threats to water quality (fine sediment, chemicals, excess nutrients) or increase water storage in floodplains*]

		• <50% likelihood (1 pt) [*ex: low likelihood that the project will reduce threats to water quality (fine sediment, chemicals, excess nutrients) or increase water storage in floodplains*]
Connects to existing high quality habitat ("anchor habitat").	High (5 pts)	• Project is directly adjacent to establish and recognized "anchor habitat" on either conservation or public land and/or existing high quality habitat (5 pts) [*ex: MRT-owned Green Island, Big Island, BWCA, McKenzie Oxbow properties in the lower McKenzie River, USFS lands in upper river*] • Project is close to, but not directly adjacent to either "anchor" habitat or high quality habitat (3 pts) • Project is isolated and not directly adjacent to, or in close proximity to, "anchor" habitat or high quality habitat (1 pt)
Potential to ameliorate threat of invasive species that may alter habitat or compete with focus species	Moderate (3 pts)	• Invasive species not present or in very low quantities (3 pts) • Established best management practices in place to mitigate threat of invasive species (1 pt)
Number of key processes restored: • *Run-off and stream flow* • *Erosion and sediment supply* • *Nutrient delivery* • *Riparian processes* • *Stream flow and flood storage* • *Sediment transport and storage* • *Channel, floodplain, and habitat dynamics* • *Organic matter transport and storage* • *Instream biological processes*	High (5 pts)	• 7-9 processes restored (5 pts) • 4-6 processes restored (3 pts) • 1-3 processes restored (1 pt)
Potential to increase resiliency to climate change	Moderate (3 pts)	• Project will likely increase resiliency to fire, flooding, drought, and/or help maintain low stream temperatures (3 pts) • Low likely hood of increased resiliency to climate change (1 pt)
Habitat Scale of Project (Amount of enhanced habitat complexity, expansion of habitat connectivity, acres acquired or enhanced)	High (5 pts)	• > 2 mile or more of habitat either expanded or enhanced, 20 or more acres (5 pts) • 0.5 – 2 mile of habitat either expanded or enhanced, 5 – 20 acres, (3 pts) • < 0.5 mile of habitat either expanded or enhanced, 5 acres or less (1 pt)
SOCIO-ECONOMIC and FEASIBILITY	**14 points possible**	

Existing conservation policies and/or cooperating landowners	Moderate (3 pts)	• Land in conservation or public lands (3 pts) [*ex: BLM/USFS Riparian reserve, conservation easement, VIP]* • Voluntary cooperative agreement or regulatory considerations (1 pt) *ex: OWEB – Cooperative Agreement with watershed council or legal protection like FPA or County Riparian Ordinance*) • No established landowner relationship and no history of collaboration (0 pts)
Potential for education, outreach and/or research	Moderate (3 pts)	• High potential for alignment with existing education programs, public outreach, and/or research needs or interests (3 pts) • Low potential for alignment with existing education programs, public outreach, and/or research needs or interests (1 pt) • No real opportunity for outreach or education (0 pts)
Potential for positive local economic impact	Moderate (3 pts)	• Project has high likelihood of utilizing contractors within the McKenzie sub-basin (3 pts) • Low likelihood of utilizing local contractors (1 pt) (ex: *helicopter projects*)
Cost/benefit ratio	High (5 pts)	• Low cost – high benefit (5 pts) [*ex: Increased flow releases from USCAE dams or certain LWM projects (fall and leave]* • High cost – high benefit (3 pts) [*ex: LWM projects*, *gravel augmentation*] • Low cost – low benefit (1 pt) • High cost – low benefit (0 pts) [*ex: funding considerations such as high permitting or design costs]*

STEP 4. Complete prioritization process

- **Table B6** shows a draft version of score projects in the McKenzie River Watershed**.**
- Projects within the Mohawk River Watershed were prioritized using a modified version which relied more significantly upon previously completed prioritization processes (Table **B1**), professional judgement and perceived feasibility and constraints (Table **B4**). A summary of Mohawk project recommends is listed below.

Table B6. Prioritization scoring example for identified McKenzie River Watershed projects.

Project	Conservation/Restoration Type	Score
Chub Slough Priority Area (Cedar Creek confluence to MRT Big Island Property)	Conservation	46
Hendricks Bridge to Leaburg Dam	Conservation	46
Springfield Oxbow Priority Area (Hayden Bridge to Cedar Creek confluence)	Conservation	44
Confluence Priority Area (Green Island to I-5 Bridge)	Floodplain and Instream Enhancement	40
Springfield Oxbow Priority Area (Hayden Bridge to Cedar Creek confluence)	Floodplain and Instream Enhancement	39
I-5 Bridge to Hayden Bridge	Conservation	35

Dehne (MRT)	Floodplain and Instream Enhancement, Riparian Enhancement	35
Gate Creek	Floodplain and Instream Enhancement	35
Hendricks Bridge to Leaburg Dam	Floodplain and Instream Enhancement	34
I-5 Bridge to Hayden Bridge floodplain	Floodplain and Instream Enhancement	33
Ezell (MRT)	Riparian Enhancement	33
McKenzie Oxbow Priority Area (Camp Creek confluence to Hendricks Bridge, including MRT McKenzie Oxbow property)	Riparian Enhancement	33
Confluence Priority Area (Green Island to I-5 Bridge)	Riparian Enhancement	28
Cedar Creek Riparian Projects	Riparian Enhancement	27
Springfield Oxbow Priority Area (Hayden Bridge to Cedar Creek confluence)	Riparian Enhancement	25
Camp Creek Confluence Priority Area (MRT BWCA property to Camp Creek confluence)	Riparian Enhancement	25
Hendricks Bridge to Leaburg Dam	Riparian Enhancement	25
Vickery Park	Upland Enhancement	23
Camp Creek	Riparian Enhancement	23

Summary Recommendations for Restoration Actions for the Mohawk River Watershed

1. Riparian restoration – High Priority (use established implementation protocols with minimal risk, long term benefit, possible funding nexus with potential shade-credit programs, limited landowner partners currently).
    - Prioritize lower Mohawk River and surrounding floodplain. Opportunity to operate on large scale with multiple large acreage landowners.
    - Take advantage of opportunities with private landowners in Kelly, McGowan, Cartwright and Mill Creeks.
2. Large wood placement and floodplain connectivity projects. – Medium priority – (difficult implementation with some inherent risk, high cost, low funding feasibility due to lack of ESA listed species, potential partnership needs further development, likely short term benefit, long-term benefit unknown due to project stability).
    - Explore opportunities to increase floodplain connectivity and increase flood storage capacity with private landowners within the lower river by either re-contouring banks, adding large woody material and/or boulders.
    - Explore opportunities to restore instream channel complexity (LWM and boulder placement) with Weyerhaeuser and BLM within Mill Creek, Upper Mohawk, Shotgun and Cash Creek.
3. Culverts and roads – Medium priority (data gaps, funding difficultly).
    - Several known fish barriers remaining within basin. Projects have been difficult to fund.
    - BLM and WeyCo have both completed multiple road and culvert upgrade projects.

Data gaps remain on private stream crossings throughout the watershed. Opportunity exists to work with BLM and Weyerhaeuser.

APPENDIX C: Eugene Water & Electric Board Drinking Water Source Protection Subprograms

Water Quality Monitoring

EWEB has developed a comprehensive water quality monitoring program to assess the health of the McKenzie River and identify the potential threats to drinking water. This program consists of baseline monitoring, storm event monitoring, passive sampling, split sampling with high school students, harmful algal bloom monitoring and other special projects. All water quality data is stored in a database and made available online at: http://reach.northjacksonco.com/EWEB/ . Several projects have been done in partnership with the U.S. Geological Survey (USGS). For example, EWEB and the UGSG recently published a study based on 10 years of storm event monitoring using automated samplers that found over 40 different pesticides detected in the McKenzie Watershed. The study indicated that the largest number of pesticide detections was associated with storm water runoff from Springfield and the greatest potential threat to drinking water quality is associated with urbanization, increased development, and agricultural pesticide applications (http://pubs.usgs.gov/sir/2012/5091/). EWEB uses monitoring data to do trending analysis where possible, as well as prioritize areas of the watershed on which to focus resources and programs.

McKenzie Emergency Response System

Highway spill situation (Photo: EWEB)

One of the major threats to the McKenzie River is a hazardous material spill. Highway 126 runs right alongside the main stem McKenzie River for most of its route, and approximately 500 tractor trailer trucks per day travel back and forth across the Oregon Cascades. In order to address this threat, EWEB has implemented the McKenzie Watershed Emergency Response System (MWERS). MWERS is used by incident commanders to quickly gain access to crucial information, equipment and trained personnel allowing for an effective response. Watershed responders use Geographic Information System (GIS) technology to access information on threats, critical resources, spill response strategies, equipment availability and other information needed during a crisis. This information is used to efficiently and effectively stabilize accidental or intentional chemical releases as soon as possible and avoid the initial confusion often associated with spills. EWEB and partners conduct annual drills to raise the level of preparedness among all partner agencies and practice deploying booms in challenging conditions. The City of Springfield and SUB are partners in this effort. For more information about the MWERS, see http://eweb.org/sourceprotection/emergency.

Healthy Farms Clean Water Program

The Healthy Farms Clean Water Program assists McKenzie watershed growers with agricultural chemical disposal, promotes free soil sampling and nutrient management consultations, and assists farmers with accessing local food markets, among other efforts, to reduce chemical use and increase economic viability all while protecting water quality. EWEB recognizes the value of keeping agricultural land as agricultural land, rather than seeing it carved up into parcels and sold off to developers. Development along the river can have negative impacts on water quality, including increased pesticide/fertilizer use, loss of riparian vegetation, increased use of revetment, loss of floodplain function, increased traffic

density, and a higher density of septic systems. Furthermore, keeping farmland intact in the valley ultimately benefits both the local community and the environment, especially in the face of a changing climate. EWEB has also worked closely with hazelnut farmers in the watershed to engage in nutrient management and pesticide reduction activities with help from Oregon State University researchers and funding from the Oregon Hazelnut Commission. See http://www.eweb.org/sourceprotection/farms for more information on Healthy Farms Clean Water.

Septic System Assistance Program

On the residential side, EWEB provided over 430 free septic systems inspections and pump outs to residents in high risk areas of the watershed through a grant in 2008-2009. This project was very well-received and EWEB subsequently created a long-term septic system financial assistance program. This consists of both a cost-share and zero-interest loan program to encourage residents to properly maintain their septic systems and repair or replace failing systems in order to protect both shallow groundwater and surface water. In the last three years, EWEB has engaged over 180 additional homeowners through this program (see http://www.eweb.org/septic/assistance). In addition, EWEB created a septic system maintenance brochure as part of ongoing efforts to educate homeowners about the importance of septic system maintenance to water quality. Brochures are mailed to participants along with a survey about the value of the program (http://eweb.org/public/documents/water/septicSystemMaintenance.pdf).

Naturescaping Program

In the last several years, EWEB has worked with partners to put together and hold naturescaping workshops for McKenzie residents to raise awareness about the impacts of chemical use along the river and to provide alternatives to pesticide use. Workshops have included information on identifying and removing invasive species, selecting appropriate native species for your property, riparian restoration, alternatives to pesticides, and suggestions and technical assistance for designing a functional and attractive residential landscape. The workshops have been well-received by participants and EWEB plans to continue this program. In addition, EWEB is partnering with the McKenzie Watershed Council, Upper Willamette Soil & Water Conservation District and Northwest Center for Alternatives to Pesticides to increase outreach to rural residents.

Voluntary Incentives Program

EWEB is currently developing a new and innovative approach to engaging landowners in watershed protection called the Voluntary Incentives Program (VIP). This program is designed to reward landowners who are good stewards of their riparian property and agree to long-term protection of these areas in return for annual dividend payment or other financial incentives for maintaining the value of this natural treatment infrastructure. What makes this program unique is that it has been designed to protect intact riparian as opposed to just paying to restore degraded riparian land, which is often the case with other programs such as the Natural Resource Conservation Service's farmer programs, and most of work done by Oregon's watershed councils. The VIP places value on healthy riparian forests for their pollution filtration, flood mitigation, erosion control, shade production/water cooling and habitat services. That being said, for properties which do not quality for protection, there is a restoration pathway in which VIP partners will help to seek appropriate funding for landowner projects. EWEB is finishing the pilot phase of this project, with full rollout expected to occur in late 2016. The Oregon Watershed Enhancement Board (OWEB) has been instrumental in helping to fund the pilot project and its transition to a fully operational program. Other Oregon utilities have also expressed interest in this concept.

There will be three main components to this program: protection, restoration and naturescaping. For interested landowners with eligible property, surveyors will assess their property and compare it to pre-established reference sites. For lands that are currently healthy and protective of water quality, EWEB would enter into a long-term agreement with landowners to continue to protect these riparian areas. EWEB would fund payments to landowners as well as routine maintenance assistance through ratepayer funds. For landowners with properties in need of restoration, EWEB will enter into similar agreements. However, funding for restoration work will come from a McKenzie Watershed Fund, which will aggregate money from a variety of sources such as private businesses (via a business sponsorship program), city/county partnerships (i.e. Metropolitan Wastewater Management Commission shade credits), the U.S. Forest Service (stewardship contracting retained receipts), and OWEB. For small-acreage landowners, there is a naturescaping option in which landowners can sign a more informal agreement in which they agree to apply naturescaping principles on their property. An initial consultation by the MWC or SWCD would be conducted to give the landowner overview of what principles could be applied to their landscape. EWEB and local partners offer naturescaping classes for McKenzie residents, which are helpful in learning about naturescaping concepts and designing landscapes.

Ecosystem Valuation and the Economic Benefits of Source Protection
EWEB recognizes that the McKenzie Watershed is an extremely valuable asset. Although the natural services that it provides are not financially accounted for in traditional economic models, new methods are being developed attempt to place value on this 'natural capital.' In 2010, EWEB hired Earth Economics to conduct a watershed valuation, which estimated the annual value of McKenzie Watershed ecosystem services at between $248 million to $2.4 billion. Services include things such as water supply, flood mitigation, soil erosion control and many other ecosystem services.

Protecting this drinking water source ultimately helps EWEB avoid future expenses such as increased treatment costs, new water treatment methods to deal with traditional and emerging contaminants, increased regulatory requirements, new treatment facilities, and dealing with the effects of potential hazardous material spills.

In addition, source water protection is a way of mitigating future risk. Currently, the McKenzie River exhibits excellent water quality. However, monitoring has shown that certain parameters (ex. *E. coli,* nutrients) are increasing over time, and an upward trend in development poses further risks to water quality. Climate change impacts are becoming increasingly apparent and need to be taken into account in future planning. EWEB would prefer to engage landowners and other watershed stakeholders in protecting water quality now, as opposed to waiting until the problem gets worse down the road and requires more money to address.

Finally, one of EWEB's main goals is to protect the McKenzie River as a reliable source of excellent drinking water for present *and future* generations. Drinking water source protection is by definition a long-term, future-oriented process. Increasing development and other threats are not going away, and, if anything, will intensify. Climate change is becoming a reality that is acknowledged by more and more people and businesses. Drought in California, loss of snow pack in Oregon and Washington, and increased forest diseases and wildfires across the west are a few signs of these changing conditions. EWEB and its many partners understand that investments in watershed protection pay dividends in increasing community resiliency in these uncertain times while increasing economic and public health security.