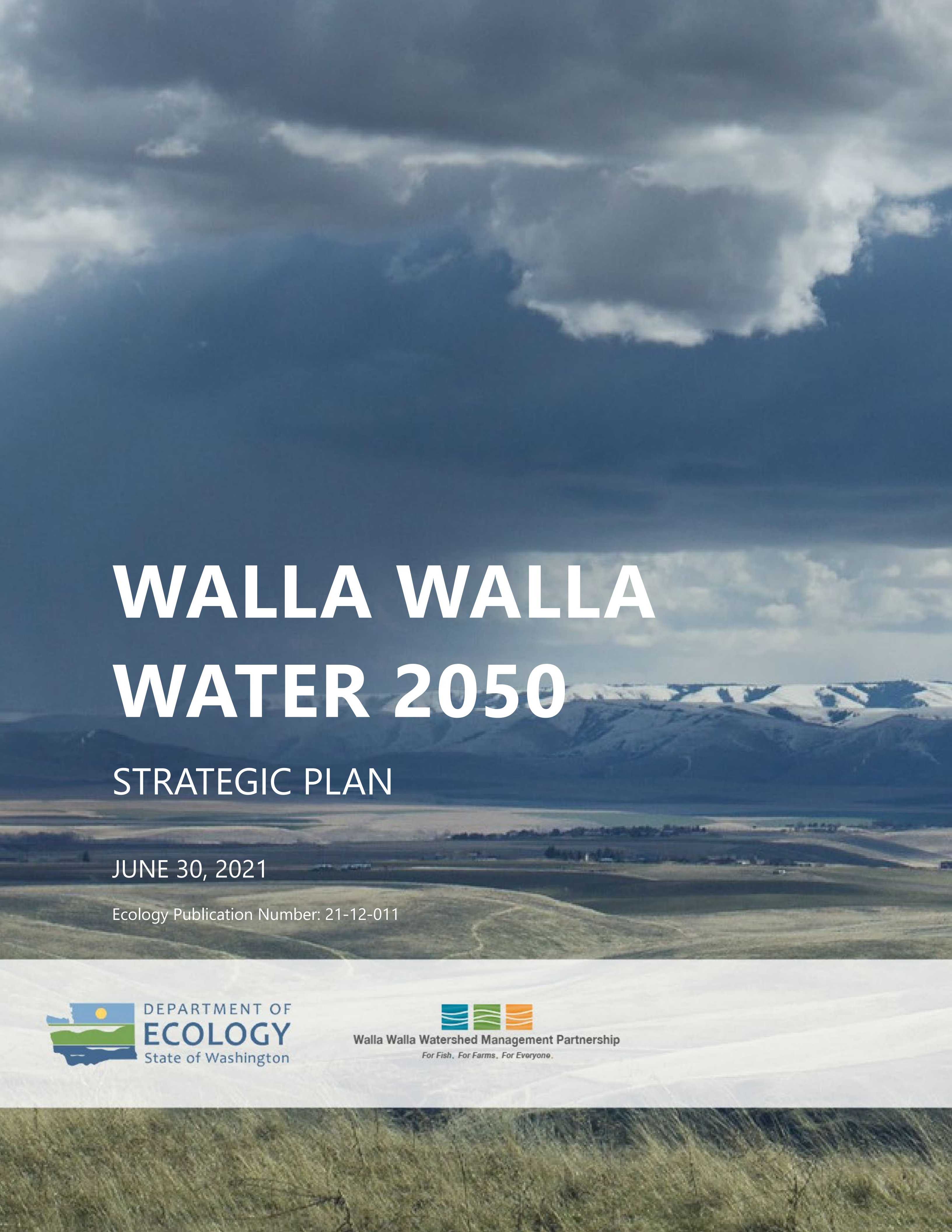


WALLA WALLA WATER 2050

STRATEGIC PLAN

JUNE 30, 2021

Ecology Publication Number: 21-12-011

DEPARTMENT OF ECOLOGY
State of Washington

Walla Walla Watershed Management Partnership
For Fish. For Farms. For Everyone.

Publication Number: 21-12-011
This document is available on the Department of Ecology's website at:
https://apps.ecology.wa.gov/publications/SummaryPages/2112011.html.

ADA accessibility

To request an ADA accommodation, contact Ecology by phone at 509-454-4241 or email at tim.poppleton@ecy.wa.gov, or visit https://ecology.wa.gov/accessibility.

For Relay Service or TTY call 711 or 877-833-6341.

Prepared for the Washington State Department of Ecology by:

Cascadia Consulting Group
AMP Insights
Northwest Land & Water, Inc.
Sound Resolutions

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY

Walla Walla Watershed Management Partnership
For Fish. For Farms. For Everyone.

June 30, 2021

The Honorable Jay Inslee, Governor
Honorable Members of the Washington State Legislature Olympia, Washington

RE: Walla Walla Water 2050 Strategic Plan Report – June 2021

The Department of Ecology's Office of Columbia River and the Walla Walla Water Management Partnership (Partnership) is pleased to present the *June 2021 Walla Walla Water 2050 Strategic Plan Report* to the Legislature, meeting the requirements under RCW 90.92. This document is available on the Department of Ecology's website at https://apps.ecology.wa.gov/publications/SummaryPages/2112011.html.

In 2019, under Senate Bill 5352, the Washington State Legislature extended the Walla Walla Water Management Partnership pilot program through June 30, 2021, to allow the pilot to perform internal and external evaluations, build upon previous pilot program efforts, continue Walla Walla flow enhancement work, and develop a 30-year integrated water resource management strategic plan.

Ecology's Office of Columbia River worked collaboratively with the Partnership, Confederated Tribes of the Umatilla Indian Reservation, Oregon Department of Water Resources, local governments in both Washington and Oregon, environmental non-profits, irrigators, and basin stakeholders representing a diverse representation of water users and the interested public. The result is the Walla Walla Water 2050 Strategic Plan to guide water resource decisions for the next 30 years in the basin.

"Judith and I are extremely proud of our entire team that stayed focused on this critical work during the COVID19 pandemic and developed, with the basin, a strategic vision for management and enhancement of water resources critical to improving instream flows for fish, sustaining municipal water supplies and an agricultural economy."

If you have any questions regarding this report or would like more information, please contact me by phone at (509) 952-5080 or by email at thomas.tebb@ecy.wa.gov. If you would like hard copies of the report, contact Colleen Smith by phone at (509) 571-0921 or by email at colleen.smith@ecy.wa.gov.

Sincerely,

G. Thomas Tebb, L.Hg., L.E.G.
Director
Office of Columbia River

Judith S. Johnson
Chair
Walla Walla Watershed Management Partnership

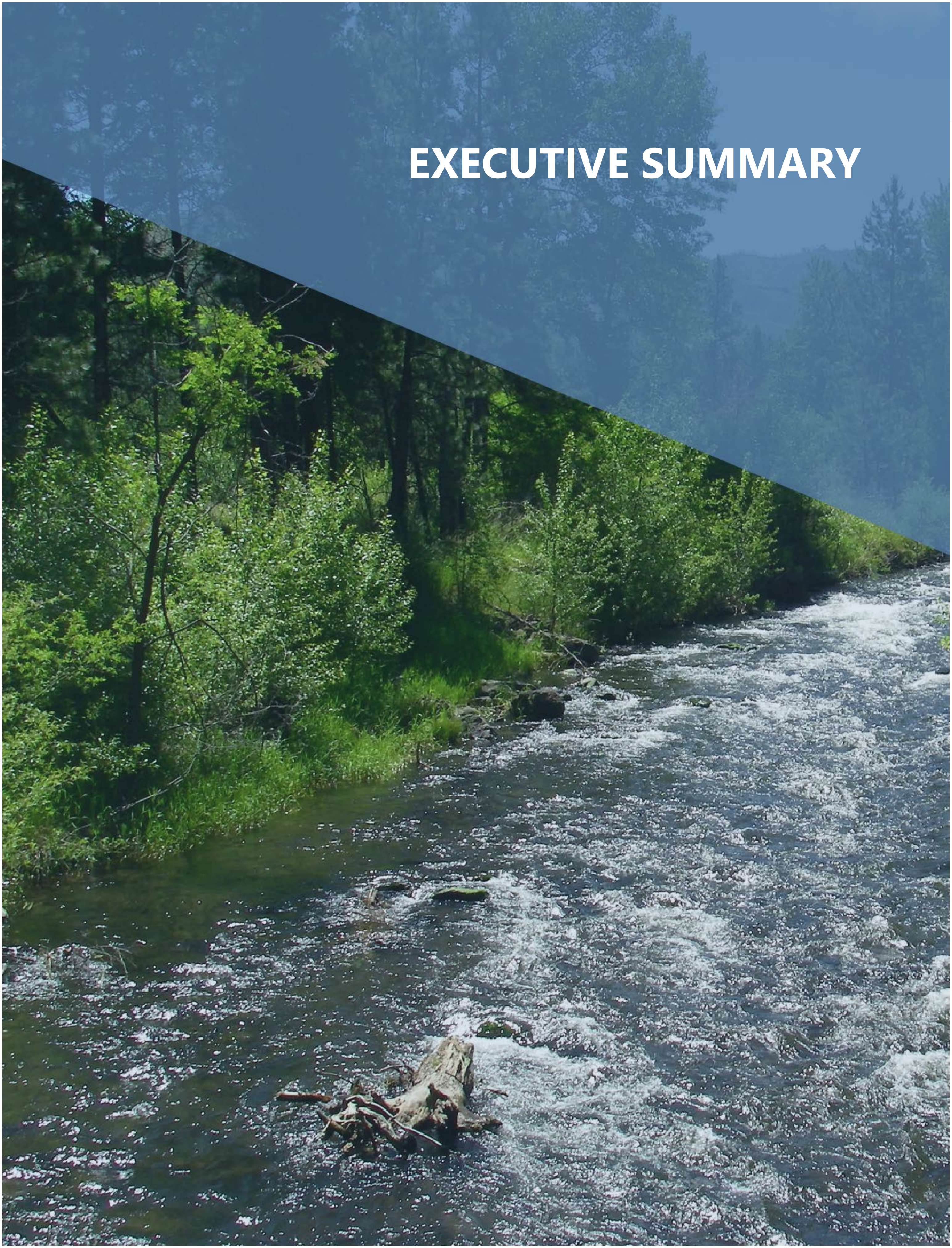
TABLE OF CONTENTS

ABBREVIATIONS

Abbreviation	Defined
AMI	Advanced Metering Infrastructure
ANTD	Agreements Not to Divert
ASR	Aquifer Storage and Recharge
AVA	American Viticultural Area
BMLT	Blue Mountain Land Trust
BMP	Best management practices
CCD	Columbia Conservation District
cfs	Cubic feet per second (unit of measure for volumetric rate of water flow)
CLFP	Critical Low-Flow Plan
CM	Creek mile
CPRAS	Columbia Plateau Regional Aquifer System
CRBG	Columbia River Basalt Group
CREP	Conservation Reserve Enhancement Program
CRP	Conservation Reserve Program
CTUIR	Confederated Tribes of the Umatilla Indian Reservation
CURB	Creating Urban Riparian Buffers Program
CWA	Clean Water Act
DEQ	Oregon Department of Environmental Quality
DFC	Desired Future Conditions
DOH	Department of Health
Ecology	Washington State Department of Ecology
EDT	Ecosystem Diagnostic Testing
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ESA	Endangered Species Act
GFID	Gardena Farms Irrigation District #13
GHG	Greenhouse Gas
GMA	Growth Management Act
GPD	Gallons per day
GSI	Green stormwater infrastructure
GWIS	Geographic Water Information System

Abbreviation	Defined
HBDIC	Hudson Bay District Improvement Company
HPA	Hydraulic Project Approval
HUC	Hydrologic Unit Code
IFIM	Instream Flow Incremental Methodology
IPCC	Intergovernmental Panel on Climate
ISF Rule	Instream Flow Rule
LWP	Local water plans
LWWR	Little Walla Walla River
MAR	Managed Aquifer Recharge
MCWG	Mill Creek Work Group
MFWCD	Milton-Free Water Control District
NAIP	National Agriculture Imagery Program
NASS	National Agricultural Statistics Service
NEPA	National Environmental Policy Act
NFWF	National Fish and Wildlife Foundation
NGO	Non-governmental Organization
NOAA	National Oceanic and Atmospheric Administration
NRCS	National Resources Conservation Service
NRI	Natural Resource Investment
OCR	Office of the Columbia River
ODW	Office of Drinking Water
OHA	Oregon Health Authority
OR	Oregon
ORDEQ	Oregon Department of Environmental Quality
OWRD	Oregon Water Resources
Partnership	The Walla Walla Watershed Management Partnership
PCB	Polychlorinated biphenyls
PCSRF	Pacific Coastal Salmon Recovery Fund
PEIS	Programmatic Environmental Impact Statement
PHABSIM	Physical Habitat Simulation System
RCP	Representative Concentration Pathway
RCO	Washington State Recreation and Conservation Office
RM	River mile
SEPA	State Environmental Policy Act

Abbreviation	Defined
SMA	Shoreline Management Act
SMP	Shoreline Management Program
SRSRB	Snake River Salmon Recovery Board
SPAC	Strategic Plan Advisory Committee
SWMPA	Serious Water Management Problem Area
SWSMP	Small Water System Management Program
TMDL	Total Maximum Daily Load
UGA	Urban growth area
UGB	Urban growth boundary
UIC	Underground Injection Control
USACE	U.S. Army Corps of Engineers
USDA	United States Department of Agriculture
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VSP	Voluntary Stewardship Program
WA	Washington
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WRIA	Washington’s Water Resource Inventory Area
WRTS	Water Rights Tracking System
WSDA	Washington State Department of Agriculture
WSDOT	Washington State Department of Transportation
WSP	Water System Plan
WST	Water Science Team
WSU	Washington State University
WUE	Water Use Efficiency
WWBWC	Walla Walla Basin Watershed Council
WWCCD	Walla Walla County Conservation District
WWRID	Walla Walla River Irrigation District
WWT	Washington Water Trust
WWTP	Wastewater treatment plants
WWW2050	Walla Walla Water 2050


EXECUTIVE SUMMARY

INTRODUCTION

The Walla Walla Basin was once an ecologically healthy and thriving region—the fertile lands and many waters supported tribal life and ensured an abundance of First Foods. Throughout the 20th century, the basin has transformed into an economically prosperous agricultural hub with thriving urban centers, a flourishing tourist destination, and a popular outdoor recreation area. However, the steady development over this century has had measurable environmental impacts on the basin, leading to issues such as overused water, channelized and fragmented floodplains, and population declines and extirpation of certain native wildlife species.

Today, the Walla Walla Basin is a hydrologically, jurisdictionally, and biologically complex watershed, extending across Washington and Oregon state lines. **Ensuring adequate water—for people, irrigated agriculture, and instream flows for fish and wildlife**—is a challenge in the basin, particularly in the summer when demand is the highest. Despite the myriad of organizations and entities who have worked for years to improve water quality and address water management issues in the basin, its health and productivity are constrained by the factors below:

- Low streamflows compounded by irrigation diversions.
- Concrete and/or incised stream channels, levees, weirs, and other alterations.
- Point-source and non-point-source pollution.
- Declining water levels in the alluvial and basalt aquifers.
- Increased stream temperatures and degraded habitat for fish and other species.
- Climate change driving drastic changes in temperature and habitats.
- Over-allocated water supply for out of stream uses.
- Historic loss of fisheries production (salmonids).

Over the last three decades there have been significant efforts to address water management in the basin with several collaborative planning processes and completion of many on the ground projects. To further respond to a need for leadership on basin water resource management, the Walla Walla Watershed Management Partnership (the Partnership) kicked off in 2009 as a 10-year pilot program that allowed local decision-making and flexibility in water management.

The 2019 Washington State Legislature (the Legislature) extended this pilot through June 30, 2021, to allow the pilot to perform internal and external evaluations, build upon previous pilot program efforts, continue Walla Walla River flow enhancement technical work, and develop this 30-year integrated water resource management strategic plan. This plan aims to **identify and prioritize key strategies to balance and harmonize the basin's threatened ecosystem health with the continued growth and prosperity of its human inhabitants**.

LEGISLATIVE AUTHORIZATION

The Legislature passed Senate Bill 5352 in 2019 which tasked the Partnership and the Washington Department of Ecology (Ecology) to collaboratively develop a 30-year strategic plan for water management in the Walla Walla Basin. Together with the Confederated Tribes of the Umatilla Indian

Reservation (CTUIR) and stakeholders on both sides of the state border, the partners began this process, dubbed "Walla Walla Water 2050" (WWW2050), in late 2019. The WWW2050 process extended from July 1, 2019 to June 30, 2021. The Legislature required the following by June 30, 2021:

- The Office of the Washington State Auditor will conduct a **performance audit** and a **financial audit** to evaluate the Partnership pilot program since 2008.
- Advance the Walla Walla Basin **bi-state flow enhancement study** and its recommendations, including any necessary environmental reviews for near-term actions.
- Develop a **report to the Legislature** recommending the scope and scale of an integrated water resource management strategic plan, including a funding approach and organizational structure, to achieve desired outcomes for the basin.
- Collaborate to develop a **30-year integrated water resource management strategic plan** (including a draft and final programmatic environmental impact statement) and explore interstate agreements to maximize integrated water resource management.

PROCESS AND PARTICIPANTS

This WWW2050 Strategic Plan reflects a two-year planning effort by Ecology, the Partnership, CTUIR, and Washington and Oregon stakeholders to guide water resource decisions for the next 30 years in the Walla Walla Basin.

To facilitate the WWW2050 Strategic Plan process, Ecology, the Partnership, and CTUIR created a **Strategic Plan Advisory Committee (SPAC)** consisting of diverse and representative basin stakeholders. The SPAC met approximately monthly from May 2020 to June 2021 to develop a package of recommended strategies to achieve desired future conditions by 2050. The SPAC operated by consensus to incorporate **diverse basin stakeholder perspectives**, address the challenges of **bi-state water resource management**, and draw on **local knowledge**.

Throughout this process, a **Coordinating Committee**—comprising representatives from Ecology, the Partnership, and CTUIR—guided and supported the SPAC, providing feedback on draft materials and ensuring a smooth and effective process to meet goals and timelines.

Working Groups consisting of subject matter experts and various basin stakeholders also supported the SPAC by identifying, researching, and analyzing potential strategies for consideration. Five Working Groups convened over the course of this project, focusing on the following areas: data, studies, and monitoring; water supply needs; ecological function; land use; and implementation strategies. The Working Groups gathered and relied on completed studies and assessments, ongoing work by government agencies and private sector scientists, and the expertise of Working Group members to develop potential strategies for inclusion in the plan.

The efforts of the SPAC, Coordinating Committee, and Working Groups culminated in this strategic plan which encompasses solutions from the basin's varied stakeholders, including interests in both states; regional tribes; local residents and farmers; environmental and conservation groups; and local, state, and federal governments.

DESIRED FUTURE CONDITIONS FOR THE BASIN

The long-term health of the watershed depends on achieving specific planning goals (or "desired future conditions") over the next 30 years, summarized in Table 1 below:

Table 1. Summary of desired future conditions for the basin.

Focus Area	Desired Future Conditions
Floodplains, Critical Species, Habitat, & Water Quality The basin's critical species need **increased access to existing high-quality habitat** as well as significant **restoration of currently degraded habitat**. Functional floodplains provide benefits to instream flows, aquifers, instream and riparian habitat, and water quality. The plan seeks to **balance the restoration of healthy floodplains with adequate flood risk management** to improve ecological benefits and protect communities and the region's economy. Further, **improving water quality by meeting Total Maximum Daily Load (TMDL) requirements** in area rivers, streams, and specific river reaches will help protect and enhance both human health and aquatic species' health and habitat. Water quality conditions often directly relate to other watershed dynamics, meaning that achieving desired conditions for water quality parameters will often also assist in meeting water supply and habitat goals.	– Achieve healthy, natural floodplain function – Increase access to quality habitat – Increase riparian cover – Increase river channel complexity and naturalize channelized streams – Restore a natural sediment transport regime – Meet TMDL targets – Increase critical fish species population and abundance levels necessary to meet delisting criteria, support sustainable natural production, and provide a fishery for Tribes and the community
Water Supply, Streamflows, & Groundwater The desired future condition for streamflow means finding a **balance of meeting instream and out-of-stream water needs; supporting regional agriculture, cities, and industry; and providing for the water and habitat needs of fish and other species**' instream flow goals identified in the bi-state flow study and WWW2050 Strategic Plan. For groundwater, the desired future condition is one where all **basin aquifers have ecologically functioning and stable water levels**.	– Build resiliency and redundancy in the agricultural irrigation water supply to meet current and future water demand – Stabilize aquifer levels to support water resources and water for people and farms – Improve instream flows to meet instream flow targets for critical species – Increased natural infiltration, acreage, and duration of inundation

Focus Area	Desired Future Conditions
Land Use & Flood Control When achieved, the following goals will help achieve a healthy and thriving watershed. These goals focused on land use topics of **floodplain management, stormwater quality, and the health of the forested headwater regions** as they relate to water quality in the basin.	– Reduced flood risk for people and cities – Meet TMDL targets – Create climate resilience for basin water resources
Quality of Life **Water quality and flowing streams impact overall quality of life and the economy of the watershed**. Rivers and creeks provide direct recreation and tourism opportunities like boating, fishing, and swimming, while enhancing other activities like birding, hiking, camping, and viticulture tourism.	– Sustain and improve quality of life in the Walla Walla Valley by supporting, community health with clean and reliable water supply, opportunities for outdoor recreation and sustainable tourism
Monitoring & Metering Monitoring and metering support achievement of the desired future conditions described above.	– Increase streamflow, habitat, and water use monitoring to support better water resource management and adaptive management

RECOMMENDED STRATEGIES

The SPAC (supported by the Implementation Strategies Working Group) developed an **integrated package of strategies to achieve desired future conditions**. The Working Group provided a comprehensive list of strategies for the SPAC's consideration and the SPAC further developed and refined these strategies into a package through a series of facilitated meetings, active working sessions, and a SPAC member survey to gauge relative importance to respective member entities.

An explicit goal of the planning process was to generate strategies that (when fully implemented) **meet multiple water resource benefits** for floodplains and habitat, water quality, water supply and efficiency, and monitoring and metering. SPAC analyzed strategies across the following attributes:

- **Implementation tool**: type of action required to implement the strategy.
- **Implementation timeline**: when the bulk of the strategy will be funded and/or implemented.
- **Cost**: estimated cost of implementation.
- **Ease of implementation**: relative feasibility of implementation.

Based on these conversations and analysis, SPAC ranked the strategies into three tiers with Tier 1 being the highest priority and Tier 3 being the relatively lowest priority. These tiers were used to help illuminate priorities, given that strategies will compete for time and resources in the short-term. However, strategies in Tier 3 are not considered "low priority" and should still be considered important components of the overall package of strategies. Refer to Table 3, Table 4, and Table 5 for a summarized list of strategies in the order of the number of desired future conditions met.

NEXT STEPS

Expanding upon the SPAC's work in 2020–2021, the following additional tasks will need to be completed as a "Phase II" effort following the end of this process (after June 30, 2021):

- **Further develop implementation details for strategies**. Many strategies included in the plan need additional implementation details, such as detailed calculation of costs, funding mechanism(s), sequencing considerations, implementation lead or partners, and implementation timeline.
- **Develop an adaptive management strategy**. An adaptive management strategy will help address the inherent uncertainties and assumptions underlying this strategic plan while increasing assurance that this plan's strategies will achieve desired future conditions.
- **Develop an education and outreach strategy**. Implementation will be more effective with the development of an education and outreach strategy focused on the needs and challenges in the basin and the importance of successful implementation.
- **Develop a strong, sustainable, funding strategy**. A strong funding strategy that matches needs with potential funding sources and prioritizes competing funding needs is critical for successful plan implementation.
- **Agree upon a bi-state management approach and administrative structure**. Because the Walla Walla Basin crosses state lines between Washington and Oregon, a bi-state management approach is necessary to successfully implement this plan and provide an administrative structure that is sustainable and effective into the future.

Table 2. Strategy summary tables – legend.

Category *Primary focus area of the strategy*	**Implementation Tool** *Type of action required to implement the strategy*	**Implementation Timeline** *When the bulk of the strategy will be funded and/or implemented*	**Cost** *Estimated cost of implementation*	**Ease of Implementation** *Relative feasibility of implementation*
Water quality	Education & outreach	Short term (0-5 years)	$ <$150K	In place
Streamflows & groundwater	Land management change	Long term (>5 years)	$$ $150K - $500K	Ready to go
Water supply & efficiency	Monitoring & measuring		$$$ $500K - $1M	Not ready to go but forecasted to be straightforward
Floodplains & habitat	Physical construction		$$$$ $1M - $3M	Challenging
Monitoring & metering	Policy or regulation change		$$$$$ $3M - $10M	Very challenging
Policy & regulatory	Research and analysis		$$$$$$ >$10M	
	Transaction based			
	Water management change			

Table 3. Tier 1 strategies summary table (presented in order of number of desired future conditions met).

#	Tier 1 Strategy	Category	Tool	Timeline	Cost	Ease of Implementation	# of Desired Future Conditions Met
1.01	Reconnect floodplain and restore channel complexity Basin wide to reduce flood risk and improve habitat				$$$$$$		13
1.02	Support the ongoing analyses of the Bi-State Flow Study and work toward a recommendation on implementation of the preferred alternative				$$$$$$		12
1.03	Direct additional winter flow down the Little Walla Walla River to support alluvial aquifer recharge and stream function				$		10
1.04	Water rights acquisitions (short-term, long-term, and split season) to restore streamflows				$$		8
1.05	Improve and expand managed aquifer recharge (MAR)				$$$		8
1.06	Improve fish passage and habitat conditions in weired and concrete channel sections of flood control project in Mill Creek				$$$$$		8
1.07	Restore and protect riparian habitat along tributaries, small streams, and the Walla Walla River Basin wide				$$$$$		7
1.08	Decrease surface water diversions or substitute for basalt wells during low flow periods				$$$$		6
1.09	Protect and improve fish passage at Nursery Bridge and implement levee setback projects upstream and downstream of Milton Freewater				$$$$$$		6
1.10	Develop an overarching monitoring strategy and adaptive management plan for fish, habitat, and water to inform actions and evaluate effectiveness				$		6

#	Tier 1 Strategy	Category	Tool	Timeline	Cost	Ease of Implementation	# of Desired Future Conditions Met
1.11	Address legal implications of Bi-State surface water management and protection of instream flow across the state border and protection of instream flow within States				$		6
1.12	Improve flow and timing of fish passage through the Hofer Dam fishway				$		6
1.13	Expand and support Aquifer Storage and Recovery (ASR) to maintain groundwater quality and capacity				$$$$		5
1.14	Improve coordination and response to drought management Basin-wide				$		5
1.15	Expand and fund streamflow gages throughout the Basin				$$		4
1.16	Increase coordination and enforcement of floodplain and riparian regulations and management between Counties and State water management entities				$		4
1.17	Increase infiltration of stormwater rather than discharge to surface water bodies and improve coordination and management				$$$$$$		4
1.18	Upgrade Dayton wastewater treatment plant to meet Ecology requirements and watershed community environmental goals				$$$$$$		4
1.19	Improve fish passage at Gose Street long term				$$$		4
1.20	Improve agricultural irrigation water use metering and reporting programs in WA and OR by installing telemetry and improving data use by agencies and water users				$$		3

#	Tier 1 Strategy	Category	Tool	Timeline	Cost	Ease of Implementation	# of Desired Future Conditions Met
1.21	Additional Bi-State coordination on groundwater regulation				$		3
1.22	Implement conservation tillage and soil erosion BMPs to decrease nonpoint source pollution				$$$		3
1.23	Improve fish passage at Bennington Diversion Dam				$$$$$		3

Table 4. Tier 2 strategies summary table (presented in order of number of desired future conditions met).

#	Tier 2 Strategy	Category	Tool	Timeline	Cost	Ease of Implementation	# of Desired Future Conditions Met
2.01	Manage forested portion of the Walla Walla Watershed to maximize snow/water retention and inundation				$$		6
2.02	Strategic piping of irrigation ditches to modernize irrigation infrastructure and benefit streamflows				$$$$$$		5
2.03	Implement improved and additional municipal water conservation strategies such as detecting and repairing leaks, implementing tiered water rates, installing advanced smart meters, updating drought response programs, decreasing irrigated landscapes, and planting native species				$$$		5
2.04	Encourage on-farm Best Management Practices (BMPs) for water retention and efficiency				$$$$		5
2.05	Improve forecasting system for high-flow and flood events to help water managers make real-time and fast decisions				$$		5
2.06	Conduct education and outreach related to local flood response plans with specific guidance for				$		5

#	Tier 2 Strategy	Category	Tool	Timeline	Cost	Ease of Implementation	# of Desired Future Conditions Met
	emergency response procedures to better protect floodplain function and riparian health						
2.07	Improve on-farm irrigation application efficiency				$$		4
2.08	Update channel migration zone mapping and update flood inundation maps				$$		4
2.09	Invest in outreach to community members, elected officials, planning departments and the real estate community related to stream and riparian health				$$		4
2.10	Substitute small scale off-channel stored water for surface water diversions where possible				$$		3
2.11	Develop a detailed forest management plan for water supply in the upper Mill Creek Watershed				$$		3
2.12	Minimize impact to South Fork Walla Walla River by providing alternative access to cabins on private land				$$$$$		3
2.13	Conduct systematic surface water quality monitoring to provide baseline data and inform management				$$		2
2.14	Conduct habitat status and trends monitoring				$$		2
2.15	Incentivize hook up to city sewer systems in lieu of septic systems where feasible				$$$		2
2.16	Conduct outreach to agricultural entities and other landowners to provide tools around implementing livestock BMPs and pesticide use BMPs				$		2

#	Tier 2 Strategy	Category	Tool	Timeline	Cost	Ease of Implementation	# of Desired Future Conditions Met
2.17	Encourage Low Impact Development (LID) and urban lawn BMPs in urban areas and small towns				$$$$		2
2.18	Review existing exempt well mitigation program WA; Consider expansion of mitigation program for other uses in WA				$		1
2.19	Improve water right regulation and enforcement				$$		1

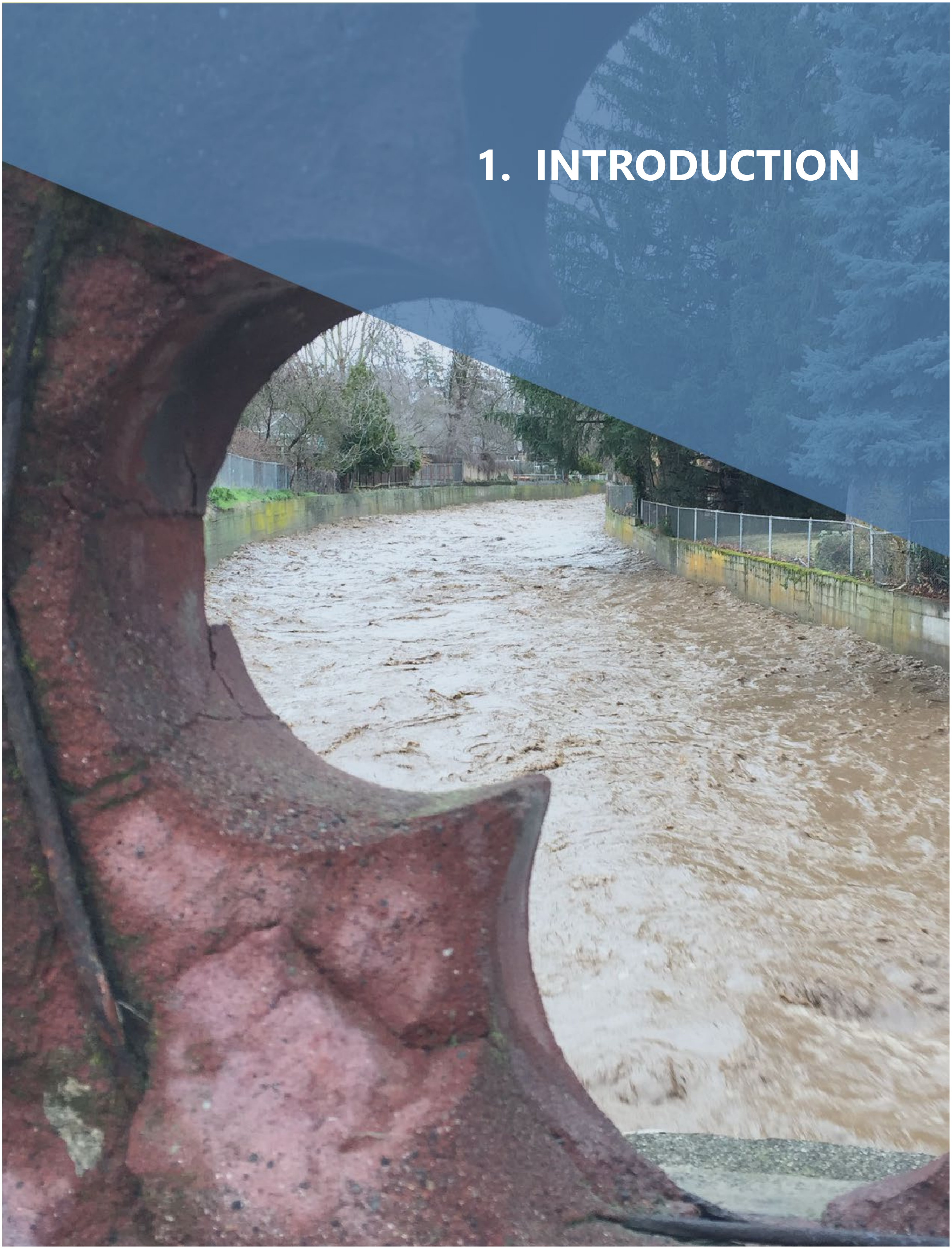
Table 5. Tier 3 strategies summary table (presented in order of number of desired future conditions met).

#	Tier 3 Strategy	Category	Tool	Timeline	Cost	Ease of Implementation	# of Desired Future Conditions Met
3.01	Restore flushing flows to Yellowhawk				$		6
3.02	Conduct targeted outreach to urban and suburban landowners located on small streams related to stream and riparian health				$$		6
3.03	Community educational opportunities to teach conservation practices and overall watershed health				$$		5
3.04	Strategically plan to supply water to development outside city limits. Encourage keeping development small and compact in urban growth areas and develop associated incentives				$$		4
3.05	Implement soil and water quality testing for MAR sites				$		4
3.06	Conduct fish status, trends, and distribution monitoring				$$		4

#	Tier 3 Strategy	Category	Tool	Timeline	Cost	Ease of Implementation	# of Desired Future Conditions Met
3.07	Provide incentives and assistance for converting from higher demand water use crops to lower water demand crops				$		3
3.08	Conduct outreach related to levee setback projects through Dayton and Waitsburg				$		3
3.09	Implement Mill Creek General Investigation (GI) action related to threshold of diversion to Bennington Lake				$$		3
3.10	Engage on salmonid recovery related policy as identified in Salmon Recovery Plans and State salmon recovery strategies				$		3
3.11	Maintain and increase public access to rivers and streams in the Walla Walla Basin through the creation of trails, parks, and public access points				$		3
3.12	Implement erosion control on roadside cut banks				$$		2
3.13	Review WDFW diversion to Bennington Lake to ensure that streamflow is not impaired				$		2
3.14	Expand stormwater monitoring				$		2
3.15	Implement incentives to encourage rural developments to annex				$$		2
3.16	Grow opportunities for employment in water reliant outdoor recreation jobs in the Basin				$		2
3.17	Basin-wide assessment of sediment and bedload management build-up				$$$$		1

#	Tier 3 Strategy	Category	Tool	Timeline	Cost	Ease of Implementation	# of Desired Future Conditions Met
3.18	Study and analyze feasibility and benefits of flow enhancement in the LWWR				$		1

1. INTRODUCTION



1.1 PURPOSE

As a requirement of RCW 90.92.050, the Walla Walla Watershed Management Partnership (Partnership) is developing a 30-year integrated water resource management strategic plan in coordination with the Washington State Department of Ecology (Ecology) and the Confederated Tribes of the Umatilla Reservation (CTUIR). The purpose of this strategic planning effort, known as Walla Walla Water 2050 (WWW2050), is to improve streamflows and water supplies throughout the bi-state watershed over the course of the next 30 years. The WWW2050 approach seeks to integrate goals and solutions from the basin's diverse stakeholders in both Washington and Oregon (including residents, farmers, environmental and conservation groups, and local, state, and federal governments) to achieve a holistic and viable long-term plan for water use in the basin.

This strategic plan intends to serve as a planning and policy-making tool that is accessible for both technical and non-technical audiences. The plan provides a broad summary of key accomplishments and ongoing work in the basin as well as a description of current watershed conditions and consensus-based desired future watershed conditions. A critical function of the plan is to present prioritized short- and long-term strategy recommendations that will help realize the desired future conditions of the watershed.

1.2 GOALS & OBJECTIVES

The overarching goals of this effort are to:

- Holistically address the basin’s longstanding struggle to balance instream and out-of-stream uses and future demand to **ensure enough water for fish, farms, and people**.
- Identify and prioritize the strategies, projects, initiatives, and/or programs needed to address challenges and **achieve short and long-term goals** for the watershed.
- Develop an **organizational structure** that ensures accountability and implement the strategy.
- Achieve clarity around **legal framework and regulatory scheme**, including bi-state coordination and water rights management.
- Obtain **adequate/dedicated funding** to support the plan.

This plan is considered a “Phase I” effort and focuses primarily y on the first and second bulleted goals above. A subsequent “Phase II” effort will begin after June 30, 2021 and will continue to address all five goals above.

1.3 PLAN AUTHORITY & SCOPE

In 2009, the Washington State Legislature (the Legislature) authorized the creation of a 10-year “Walla Walla Watershed Management Partnership Pilot Program” in the Walla Walla Basin. In 2019, Senate Bill 5352 extended the program, providing additional funding for monitoring and auditing until June 30, 2021. During the extension period, the Legislature authorized the Partnership and Ecology to collaboratively develop a 30-year strategic plan for water management in the Walla Walla Basin, as stated in RCW 90.92.050 (2) (c):

> *"Collaborate with the department in the development of a thirty-year integrated water resource management strategic plan, including a draft and final programmatic environmental impact statement, and explore interstate agreements to maximize integrated water resource management."*

RCW 90.92.050 also requires the Partnership to continue collaboratively advancing work on the Walla Walla Bi-State Flow Enhancement Study, framing the effort as a primary strategy of the overall WWW2050 Strategic Plan. Through the Bi-State Flow Study, a variety of Walla Walla Basin stakeholders are working to identify and evaluate strategies to increase streamflows in the Walla Walla River. The primary objective of the flow study is to improve Walla Walla River streamflow at levels that support harvestable populations of native fish species, while maintaining the long-term viability of agricultural, municipal, commercial, and residential uses of water. While focused on addressing the bi-state watershed, the strategic plan is funded and authorized only in the state of Washington and participation from the Oregon Water Resources Department (OWRD) is both voluntary and limited in capacity.

1.4 PLAN DEVELOPMENT PROCESS

Strategic Plan Advisory Committee (SPAC)

At the direction of the Legislature, the Partnership, Ecology, and CTUIR created a Strategic Plan Advisory Committee (SPAC) to help shape the WWW2050 strategic planning process. Consisting of diverse and representative basin stakeholders, the committee met once a month from May 2020 to June 2021. The SPAC was responsible for developing science-based recommendations for the strategic plan that (1) incorporate diverse basin stakeholder perspectives; (2) address the challenges of bi-state water resource management; and (3) draw on local knowledge, published scientific studies, and ongoing work by government agencies and private sector scientists. Due to the global COVID-19 pandemic, the SPAC met virtually using WebEx as a meeting platform.

Working Groups

Working Groups consisting of various basin stakeholders and 10-25 subject matter experts from various agencies and organizations were established to (1) aid plan development by identifying, researching, and analyzing potential strategies and (2) formulating draft recommendations for consideration by the SPAC. Representatives from the Partnership, Ecology, and other state agencies participated in Working Group meetings and working sessions. Table 6 outlines six Working Groups focused on different topics related to water use and resource management in the basin. Working Groups met on a bi-monthly or monthly basis from May 2020 to June 2021.

Table 6. Working Group structure and function.

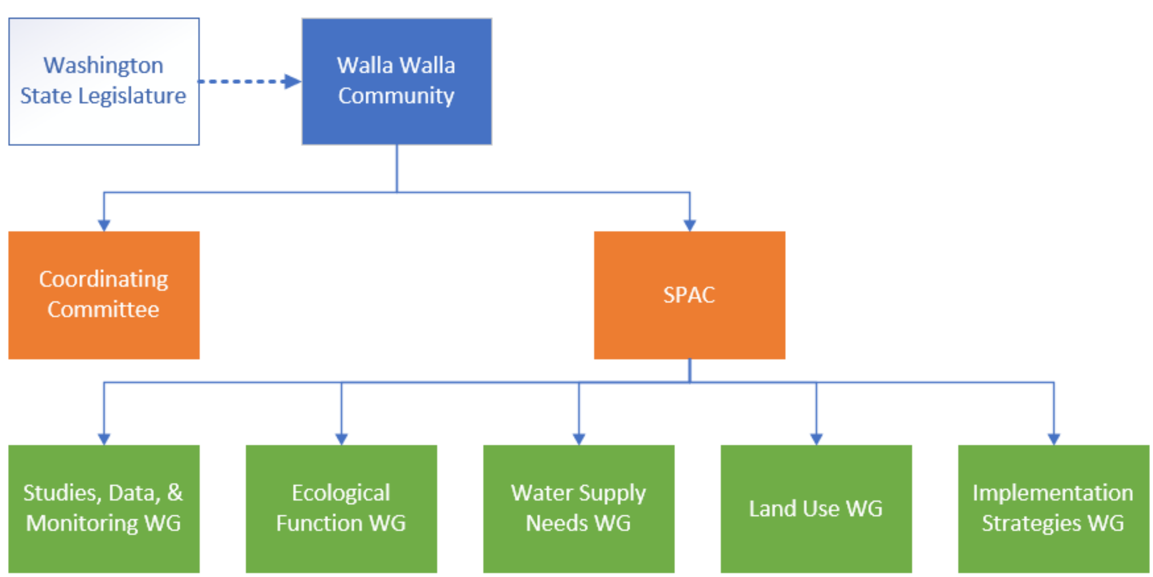
Working Group	Function
Data, Studies, and Monitoring Working Group	Develop initial list of resources, reports, studies, forecasts, plans, etc. to inform the Introduction and Watershed Overview chapters of the strategic plan and build content for use in the Instream and Out of Stream Work Groups.
Water Supply Needs Working Group	Work on Current Conditions and Desired Future Conditions (DFCs) chapters of strategic plan, specifically addressing water demand and supply across the agricultural, municipal, rural-domestic, and industrial sectors.
Ecological Function Working Group	Work on Current Conditions and Desired Future Conditions (DFCs) chapters of strategic plan, focusing on key topic areas including streamflows and groundwater, floodplains and flood control, surface water quality, habitat, and critical species.
Land Use Working Group	Consider upland management, dryland agriculture, forests, and urban/rural planning and zoning.
Implementation Strategies Working Group	Develop key implementation details around strategies and projects to achieve desired future conditions.

Coordinating Committee

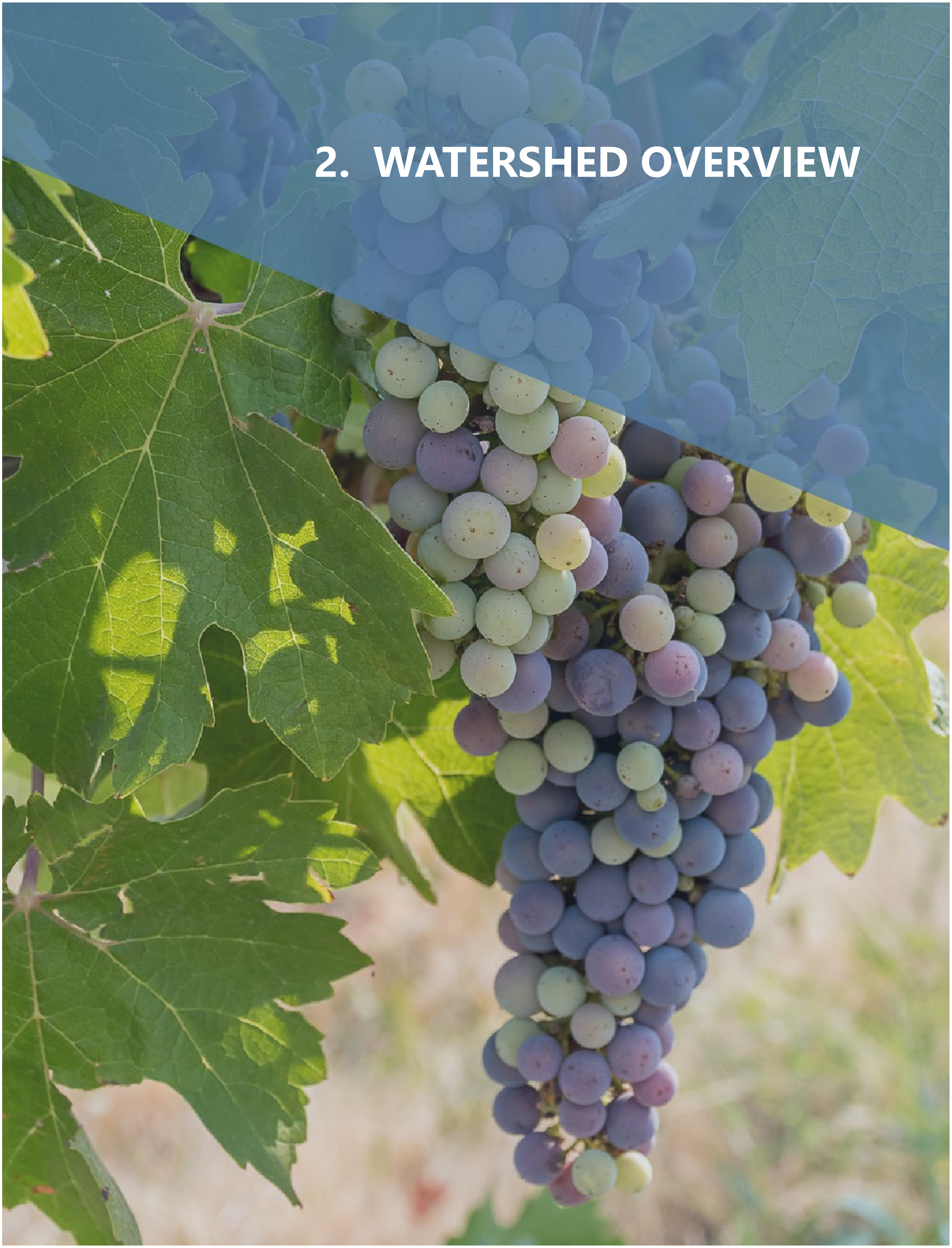
Representatives from Ecology, the Partnership, and CTUIR formed a Coordinating Committee to guide and support the SPAC; provide feedback on draft materials prepared by the SPAC and Working Groups; liaise between the SPAC and the consulting team; ensure a smooth and effective process that meets goals and timelines; and review final SPAC recommendations.

Figure 1 illustrates the organization and process flow between the SPAC, Coordinating Committee, and Working Groups. Refer to Appendix A for full list of SPAC, Working Group, and Coordinating Committee members.

Figure 1. Strategic plan participant structure.



2. WATERSHED OVERVIEW



2.1 LOCAL CONTEXT

The Walla Walla Basin is a bi-state watershed located in southeastern Washington and northeastern Oregon that encompasses an area of 1,760 square miles. Approximately two-thirds of the physical watershed lies in Washington state's Water Resource Inventory Area (WRIA) 32 (hydro unit 17070102). The remaining one-third of the watershed is in Oregon, including the headwaters of the Walla Walla River. The watershed represents part of the ancestral home of the Umatilla, Cayuse, and Walla Walla Tribes (now called the Confederated Tribes of the Umatilla Indians (CTUIR)) as well as ceded lands of the Nez Perce Tribe.

The Walla Walla River headwaters (North and South Forks) flow out of the Blue Mountains in Oregon to form the mainstem. Further downstream in the Walla Walla Valley, the river historically functioned as a series of braided streams or distributaries. Over time, it has been confined to a mainstem channel and some distributaries have been converted to function as water management and irrigation conveyance systems. Other historic distributary channels still exist and flow from the mainstem and back into the river further downstream; for example, the East and West Little Walla Walla Rivers (LWWR) flow out of the Walla Walla River at Milton-Freewater and partly back in via surface water and groundwater infiltration downstream. The LWWR system and other distributaries more broadly across the basin are hydraulically connected to localized springs that form aquatic habitat, supply water, and host unique landscapes.

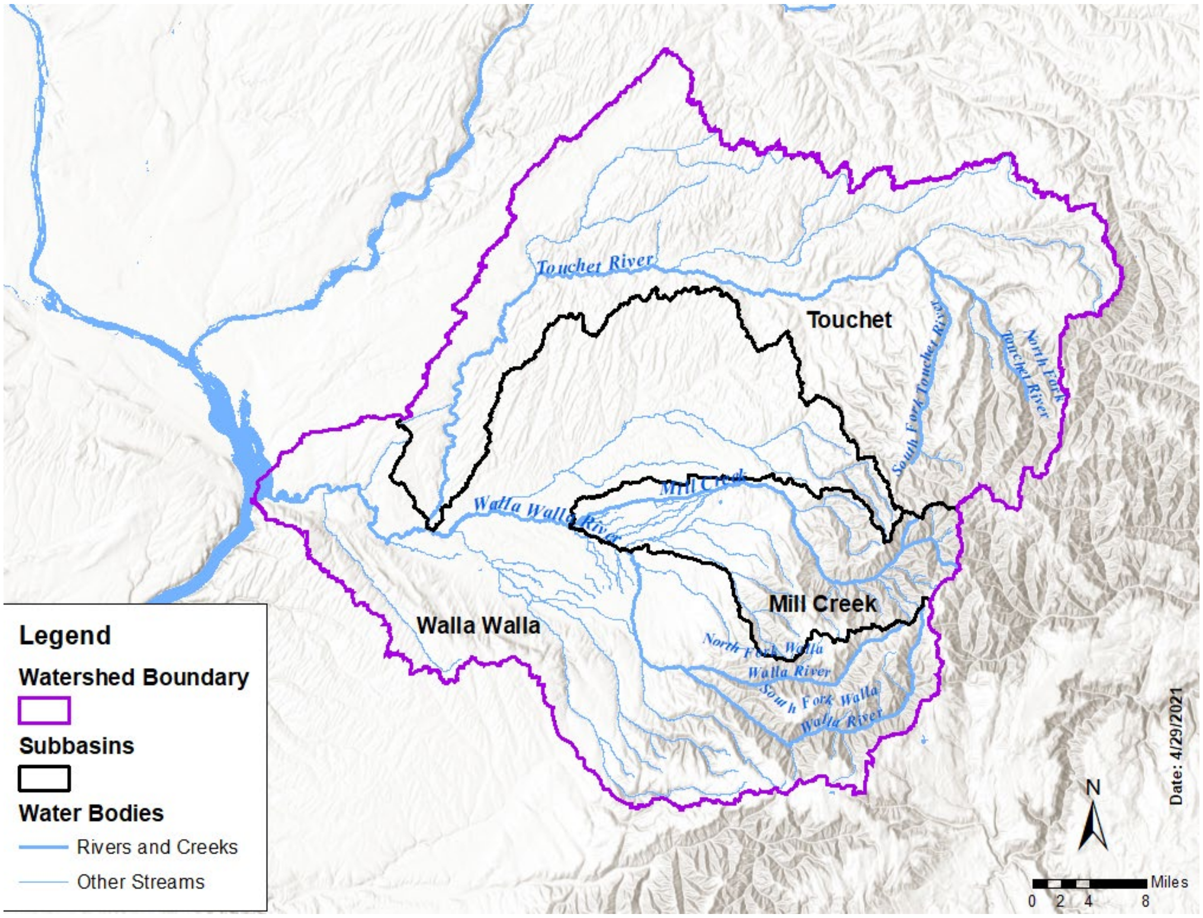
The largest tributaries to the Walla Walla River are the North and South Forks of the Walla Walla River, Mill Creek, and the Touchet River—all of which flow out of headwater areas in the Blue Mountains. Like the mainstem, Lower Mill Creek was also historically a braided channel system with spring-fed tributaries and distributaries. The largest of these distributaries is Yellowhawk Creek, which currently serves as an irrigation conveyance system with a headgate delivering water to one of the largest irrigation diversions in the Washington side of the basin. The Touchet River is the largest tributary and flows from the north into the lower Walla Walla, downstream of the confluence with Mill Creek. Downstream of the confluence with the Touchet River, the Walla Walla River enters the Columbia River.

This strategic plan divides the watershed into three subbasins (Figure 2):

- Walla Walla River
- Touchet River
- Mill Creek

Several distributary creeks, including Yellowhawk Creek, are aggregated into the Mill Creek subbasin due to their geographic proximity or co-management history with Mill Creek. Where appropriate, tributaries, smaller regions within each subbasin, and specific river reaches are used to focus the geographic scope of the plan.

Figure 2. The Walla Walla Watershed and subbasins; Washington State Department of Ecology, 2021. See Figure 4 for more detailed map of the LWWR System.



This region of the Pacific Northwest exhibits an arid climate with hot summers, cold winters, and precipitation occurring mostly within the months of October through March. Temperatures in the basin can experience significant seasonal variation with maximum temperatures rising above 38°C (100°F) in the summer and falling below -18°C (0°F) in the winter [1].

The Walla Walla Basin serves as a critical habitat for various aquatic and terrestrial species. It was historically home to many fish species including spring and fall Chinook, chum, Coho, sockeye salmon, and several trout varieties. At present day, remaining native fish populations include summer steelhead and bull trout, both of which are classified as threatened under the Federal Endangered Species Act (ESA), as well as Redband trout, reintroduced spring Chinook salmon (Oncorhynchus tshawytsca), Pacific lamprey (Entosphenus tridentatus), Western Brook lamprey (Lampetra planeri), and other species [2]. In addition to these important aquatic species, the basin is also home to diverse bird, plant, terrestrial, and riparian species that depend on rivers, springs, wetlands, and upland habitats closely interconnected to the region's hydrology.

Due to lack of substantial snowpack in the relatively low-elevation Blue Mountain range, natural streamflows are typically low year-round, particularly in the drier summer months. In addition to surface flows, basin water users depend heavily on groundwater sources as both a primary and supplemental water supply. **The basin's groundwater supply is derived from the Blue Mountain range's underground aquifer systems, which consists of both shallow alluvial and basalt aquifers.** The shallow alluvial aquifer, which is roughly 190 square miles and lies under a lowland portion of the basin, consists of a mixture of sedimentary rocks and water-bearing alluvial sediments overlying basalt. Comparatively, basalt aquifers span a much larger area of approximately 2,500 total square miles and extend beyond the watershed boundaries [3]. The U.S. Geological Survey's (USGS) Columbia Plateau Regional Aquifer System (CPRAS) reports broadly characterized these basalt aquifers, which generally consist of porous interflow zones that occur between dense, low permeability basalt flow interiors. While considered the most productive of volcanic aquifers, basalt aquifers have varying levels of surface level connectivity and permeability with typically less permeability in the center layers. The Blue Mountain range's underground aquifer systems are hydrologically interconnected with the Walla Walla River and tributaries, discharging to the river via springs and flowing through the streambed in some places while recharging tributaries and the river in other areas.

In Washington, the Walla Walla Basin resides primarily in Walla Walla County; the Touchet River headwaters are in Columbia County. The Oregon portion of the basin is primarily in Umatilla County with small portions of Wallowa and Union Counties. **The watershed serves as a source of drinking and municipal water to several cities with burgeoning urban centers and growing populations.** Additionally, increasing numbers of rural and domestic water users in both Walla Walla and Umatilla counties rely on the watershed for their water supply. Of the estimated 142,000 residents of Walla Walla, Columbia, and Umatilla Counties, roughly 63,440 reside in the cities of Walla Walla, Milton-Freewater, College Place, Dayton, Waitsburg, and other rural and unincorporated areas that fall within the boundaries of the Walla Walla Watershed.

The Walla Walla Basin has long been an important center for agricultural production. While dryland farming is prevalent in the region, much of the basin's lowlands and floodplain are irrigated to support production of the region's well known sweet onions, alfalfa seed, fruit orchards, vineyards, and row crops. **Agricultural irrigation accounts for the majority (overall percent of water use in the basin by sector) of both surface and groundwater use in the basin.** Many of the watershed's natural surface water channels, including significant reaches of the Walla Walla River and Mill Creek through the City of Walla Walla, have been diked, channelized, straightened, or otherwise altered to serve as conveyance systems that primarily control flooding. The channels also deliver water to farms and make space for additional irrigated lands at the expense of suitable habitat for native aquatic species.

Population, industry, and tourism growth projections threaten to compound the basin's long-standing struggle to meet competing water needs across various socio-economic sectors, while ensuring instream flows that sustain healthy ecosystem functions. According to state population growth projections, the combined population of Walla Walla, Columbia, and Umatilla counties is projected to reach164,293 by 2050.[1] The projected 11 percent population increase from 2025 signals further reliance on the water resource systems of the Walla Walla Basin [4] [5].

Agricultural production has continued to serve as one of the top industries in the area, growing at a rate of nearly 1 percent per year and employing nearly 13 percent of the population within Walla Walla County [6]. Throughout the last two decades, the basin has seen tremendous winery development and growth, with over 180 established wineries bringing significant economic value to the region. These two industries are highly water dependent and face ongoing challenges around securing water to sustain current and future demand.

Hydrogeologic and Cultural Overview

Columbia River Basalt Group

The hydrogeology of the Walla Walla Basin has evolved over the last 17 million years in a sequence of events that began with the formation of the Columbia River Basalt Group (CRBG). The CRBG covers an area that extends over 82,000 square miles (210,000 square kilometers) within what is now Washington, Oregon, and Idaho. The CRBG comprises over 350 discrete lava flows that erupted as "flood basalts" over a period of 11 million years, with most eruptions occurring over just a 1.5-million-year period. Between eruptions, sediment deposits formed shale, sandstone, and local carbonate rocks that became interbedded within the lava flows. The CRGB attains thicknesses exceeding 4,000 feet and comprises most of the rock mass above an older bedrock core within the Walla Walla Basin. The CRBG basalts form much of the Blue Mountains, which uplifted, folded, and faulted in response to regional tectonic forces. They are locally overlain by a residual soil mantle that has been weathered from the basalt rock.

Glacial events and Missoula floods

The region underwent a series of glaciations, with the most recent occurring between 16,500 and 14,000 years ago. Various Missoula flood events that deposited fine-grained flood and lake sediments (such as the Touchet beds) in lower-lying parts of the basin marked this cold period. Wind later transported these sediments (post-glaciation) to form thick layers of "loess"—the rich, silty soil of the Palouse region that mantles much of the basin landscape and supports dryland grain crops.

Formation of stream network and sediment features

The modern system of rivers, distributary creeks, and springs began forming near the end of the last glacial period. These features issue from alluvial fans consisting of sand, gravel, and cobbles that formed from flows emanating from the Blue Mountains (via the Touchet River, the Walla Walla River, and Mill Creek). Sediments are coarsest at the apex of the alluvial fans—for example, at the Rocks

[1] Other population projections for Umatilla (Coordinated Population Forecast for Umatilla County, its Urban Growth Boundaries (UGB), and Area Outside UGBs 2019-2069) and Walla Walla (Wall Walla County Comprehensive Plan) exist and are not substantially different than these OFM projections.

District American Viticultural Area (AVA)in the Milton-Freewater vicinity—and become finer toward the downstream areas.

Groundwater and surface water occurrence

Groundwater occurs in both alluvial and basalt aquifers in the Walla Walla Basin. Within alluvial aquifers, pore spaces between sediments (sand and gravel) store groundwater. In the CRBG aquifers, groundwater is stored within vesicular, fractured, and faulted basalt and porous sedimentary rocks. For millennia, Blue Mountain snowpack and annual rainfall has fed surface water in the region's rivers and creeks. Winter and year-round precipitation replenishes alluvial and basalt aquifers; river and creeks recharge aquifers directly in some locations, or groundwater flowing upward from basalt and or alluvial aquifers may recharge aquifers. Historically, the lakes and floods at the end of last glacial event likely increased recharge to the alluvial and basalt aquifers during that period.

Indigenous peoples and water

The Columbia River Basin and its water resources have sustained the CTUIR and their First Foods since time immemorial. The First Foods—water, fish, big game, roots, berries, and other plants—remain central to the CTUIR's culture, religion, economy, and sovereignty. In the Treaty of 1855 between the CTUIR and the United States, the CTUIR reserved rights to fish, hunt, and gather the First Foods at usual and accustomed places, including the Walla Walla River Basin. The Walla Walla River Basin is a CTUIR priority basin for restoring, protecting, and enhancing the First Foods, their habitats, and the ability for CTUIR members to exercise associated Treaty reserved rights.

Agricultural and urban development in the basin

In the mid-1800s, European Americans settled in the basin and began growing food crops. To support these agricultural practices, they diverted and channeled surface water and dug wells (by hand) in the alluvial aquifer, equipping them with pumps. In the early to mid-1900s, farms expanded, population increased, fuel prices dropped, and dams on the Columbia River system brought cheap hydroelectric power. The availability of water up to this point enabled skilled farmers to develop today's economic engine and food security network in the basin. However, over time, **water supply in the basin would become over-appropriated**, meaning distributed paper water rights to allow water use exceeded the amount of water physically available.

The founding of the City of Walla Walla in the mid-late 1800's, followed closely by the cities of Dayton, Waitsburg, Milton, and Freewater (later to form the City of Milton-Freewater), signaled the start of large-scale urban development in the region. **As the natural landscape began transforming to include urban and agricultural infrastructure, numerous small and large-scale flood reduction efforts began to take shape. These modifications drastically altered the distributary systems of the Walla Walla River and Mill Creek systems.** Mill Creek and its distributaries and tributaries, known as the Mill Creek-Yellowhawk complex, have been significantly altered as an estimated 60 percent of the City of Walla Walla is in the Mill Creek floodplain.

In response to flood risks, the U.S. Army Corps of Engineers (USACE) constructed a major flood control project on Mill Creek in the 1940s which confined Mill Creek through the city and created a flood control reservoir (Bennington Lake). The Mill Creek USACE flood control project includes significant leveed reaches and a concrete channel through and under the City of Walla Walla to help reduce flood impacts. The concrete channel portion provides minimal habitat for fish and presents fish passage barriers [7].

USACE also constructed levee system in Milton-Freewater between 1949 and 1952 to protect the City of Milton-Freewater from flooding. The Milton-Freewater flood control project includes four separate levees along approximately five miles of the Walla Walla River. The Nursery Bridge Dam was constructed in 1967 to help protect the bridge from downcutting. The dam's fish passage structure has been damaged and does not provide adequate fish passage. Levees were also built along the Touchet River in the mid-1960s as it flows through Waitsburg and Dayton. Privately constructed dikes are also located along some reaches of the Walla Walla and Touchet Rivers.

While reducing some flood impacts, **levees and concrete structures have also had significant impacts on habitat, fish populations, basin hydrology, and groundwater recharge.** These structures present fish passage barriers and severely reduce critical habitat. Furthermore, concrete is an impervious surface, which amplifies and speeds urban and agricultural runoff during heavy precipitation events, resulting in exacerbated flood impacts throughout the basin's urban centers. Because runoff is not absorbed and is instead concentrated and accelerated by non-impervious surfaces, it impacts both water quality and basin hydrology. Enhanced runoff easily transports and discharges pollutants such as fertilizers, chemicals, oil, and other toxins to basin waterways, contributing to reduced water quality and suitable habitat for fish. Concrete structures also increase flow velocities that modify channel structures, create passage barriers, and reduce habitat complexity.

The LWWR was once a system of meandering and spring-fed branches of the Walla Walla River; however, through water management efforts and agricultural diversions, distributaries and branches were modified to facilitate farming. Today, the overall impact of these systematic changes to LWWR surface flows—along with increased groundwater pumping for agricultural irrigation use—has led to declines in the natural recharge of the shallow alluvial aquifer and significantly reduced downstream spring branch flows [8]. As a result, **water rights holders in Washington lack adequate water to meet their needs from mid-summer to mid-autumn.** Reductions in alluvial groundwater have also resulted in increased use of and dependence on water from the area's basalt aquifers, which in turn have also experienced declines.

2.2 HISTORY & ACCOMPLISHMENTS

Significant Lawsuits & Adjudications

Existing water rights in the Walla Walla Basin were largely allocated and adjudicated through a series of intra-state court disputes nearly a century ago. Oregon enacted its surface water code in 1909 and its groundwater code in 1955, while Washington enacted its surface and groundwater codes in 1917 and 1945, respectively. In both Washington and Oregon, surface and groundwater rights are allocated based on the prior appropriation doctrine, whereby during water short periods, senior rights holders are entitled to their allocated water, while junior users may have their allocated water curtailed [9]. Adjudications in both states did not acknowledge terms of the 1855 Treaty between CTUIR and the United States, which reserved in perpetuity certain pre-existing rights including the right to fish at all usual and accustomed sites, hunt, gather roots and berries, and pasture animals on unclaimed lands [10].

Surface water rights on the Washington side of the Walla Walla Basin were adjudicated from 1922-1929, except for Dry Creek (a Walla Walla mainstem tributary, adjudicated in 1952) [11]. Many surface water rights on the Oregon side of the Walla Walla Basin were adjudicated as early as 1913, with the remainder settled in 1933 after the state of Washington filed a lawsuit against the state of Oregon, alleging Oregon irrigators were diverting a disproportionate amount of water. In 1936, the U.S. Supreme Court ruled in favor of Oregon, concluding that Oregon diversions were not wasteful or harmful to water users in Washington and allowing potential diversion of the entire flow of the Walla Walla River in Oregon. The Supreme Court supports separate state-based management of water rights and stipulates that both states entitled to their equitable proportions of the water of the Walla Walla, on the basis of priority of appropriations [12].

In response to potential ESA violations resulting from irrigation diversions on the Walla Walla River, U.S. Fish and Wildlife Service (USFWS) reached an agreement with Hudson Bay District Improvement Company (HBDIC), Walla Walla River Irrigation District (WWRID), and Gardena Farms Irrigation District #13 (GFID)—the basin's three largest irrigators. The 2001 agreement required WWRID and HBDIC to bypass river flows at 25 cfs[2] (27 cfs in June) and GFID to bypass flows at 18 cfs (19 cfs in June) at their diversions and maintain minimum instream flows. This important agreement has helped keep more water instream to sustain bull trout and other aquatic life and increased conservation, both on-farm and conveyance; however, it has also increased irrigation dependence on groundwater sources. In addition, the federal response absent coordination with Oregon and Washington had a limited impact, as it lacked an authority to enforce the agreed upon bypass flows.

Furthermore, **while the bypass agreement did improve flows, additional instream flow gains are necessary for fish recovery.** The bypass agreement expired in 2007 and has been voluntarily implemented since that time. CTUIR contracted a study in 2013 to (1) identify ecological and fish flow needs in all major waterways in the Walla Walla Basin and (2) develop instream flow prescriptions that protect and enhance conditions for all life stages of priority and federally protected fish species throughout the region [13].The study compiled all instream demand data collected by the Washington State Department of Ecology (Ecology) and the Washington Department of Fish and Wildlife (WDFW) using Instream Flow Incremental Methodology (IFIM), Physical Habitat Simulation System (PHABSIM), Tennant, and Toe-Width studies. These flow prescriptions have the potential to ensure sufficient water for protecting and restoring fish habitat, consistent with the goal of fish abundance in the basin and can help basin irrigators avoid potential ESA violations and the threat of further litigation; however, there has not been formal agreement to adopt the instream flow targets identified in the 2013 study.

[2] cfs is an abbreviation of "cubic feet per second," a unit of measurement of water in motion.

Recent Studies

In recent years, state and federal agencies, CTUIR, and basin stakeholders have conducted several key studies and assessments that make up the foundational body of knowledge around the basin's current conditions and future water needs. To fill outstanding gaps in basin-wide metering and monitoring data needed to establish accurate baselines, two large-scale studies are underway today. The study findings intend to inform surface water flow improvement and groundwater storage strategies as well as broader watershed management and planning efforts. A list of additional key reports that represent significant work recently conducted within in the Walla Walla Watershed are found in Appendix B.

Walla Walla Bi-State Flow Enhancement Study

With the initiation of the Walla Walla Water 2050 (WWW2050) strategic planning initiative in 2020, the Walla Walla River Bi-State Flow Study (Flow Study) was reframed as one primary project in the broader context of the WWW2050 Strategic Plan. An associated task was included within the current Flow Study scope of work to coordinate the ongoing development of the Flow Study with the more recent 2050 strategic planning effort.

The overarching purpose of the Flow Study is to improve streamflow in the reach of the Walla Walla River mainstem extending from the controlled diversion into the LWWR near Cemetery Bridge in Milton-Freewater, Oregon, to the confluence with the Columbia River near Wallula, Washington. **The primary objective of the Flow Study is to sustain streamflow at levels that support naturally sustaining harvestable populations of native fish species, while maintaining the long-term viability of agricultural, municipal, commercial, and residential uses of water.**

The Flow Study identifies streamflow targets of 65 cfs for the low flow period between July 1 and November 30, and 150 cfs during the spring migration period of April 1 to May 31. A transitional flow of 100 cfs is the target for June 1 to July 1. The Flow Study aims to sustain these streamflow targets throughout the entire reach of the Walla Walla River from Cemetery Bridge to the mouth.

Another objective of the Flow Study is to return to irrigators the portion of the historically diverted streamflow that they voluntarily and temporarily agreed to bypass for fish in 2000. Water conserved through implementation of publicly funded conservation projects will remain instream as required by individual conservation funding agreements and Oregon conserved water statutes.

Proposed Flow Study projects may also present opportunities to accomplish secondary objectives, including addressing reduced tributary stream flow, recharging depleted groundwater, and supplementing water supply for irrigation and domestic uses.

The Flow Study Steering Committee was formed in 2014 and funded by Ecology's Office of the Columbia River (OCR) as part of OCR's mission to develop water supply to benefit instream and out-of-stream uses. It is co-led by the Walla Walla Watershed Management Partnership (the Partnership) and the Walla Walla Basin Watershed Council (WWBWC) to find collaborative solutions to chronic Walla Walla River mainstem instream flow problems. The Steering Committee comprises a diverse array of stakeholders and sovereigns interested in the management and performance of the Walla

Walla River, including representatives of local, state, and federal agencies, tribes, irrigated agriculture, municipalities, and environmental organizations.

The Steering Committee is currently engaged in its third phase of study after completing the Walla Walla Basin Integrated Flow Enhancement Study in 2017 and the 2019 Flow Study Update. Since its inception, **the Steering Committee has considered dozens of independent projects and project combinations, seeking to identify a preferred alternative to achieve the stated streamflow targets.** To date, the Flow Study has identified three primary projects and about a dozen secondary projects that are currently being evaluated in greater detail.

- The three **primary projects** under consideration include a water source exchange (Columbia River Pump Exchange) and two new water storage reservoirs (Pine Creek Reservoir and Warm Springs Reservoir).
- The **secondary projects** include managed aquifer recharge (MAR), aquifer storage and recovery (ASR), piping of open canals and ditches, a water market and other water conservation strategies.

In 2019, the proposed site of the Pine Creek Reservoir was shifted from an upper site to a lower site in response to changes in site availability. The feasibility of the Lower Pine Creek Reservoir site is being investigated under the current scope of work, along with a new Warm Springs Reservoir site proposed in 2020.

During the 2021–23 biennium, the Steering Committee intends to work with the WWW2050 planning initiative to include review of Flow Study objectives and projects within the Programmatic Environmental Impact Statement (PEIS) required by the Washington State Legislature (the Legislature) for the WWW2050 Strategic Plan. Once a preferred alternative is further refined, a project-level Environmental Impact Statement (EIS) will likely be required in the future to meet the National Environmental Policy Act (NEPA) and State Environmental Policy Act (SEPA) requirements.

Walla Walla River Basin Groundwater Study

To improve understanding of the Walla Walla Watershed's hydrologic system and fill significant data gaps in groundwater use, the Oregon Water Resources Department (OWRD), Ecology, and CTUIR are collaborating with the USGS to conduct a groundwater study of the watershed. By developing and refining a quantitative conceptual understanding of the Walla Walla Basin groundwater-flow system and hydrogeologic framework and budget, **the study aims to inform the development of reliable flow modeling and help guide long-term watershed management and planning across state lines** [14]. Furthermore, by helping strengthen the understanding of surface and groundwater dynamics, this study will inform ongoing and future management decisions and projects, including strategies identified through the WWW2050 Strategic Planning process, related to future water use, restoration, protection, MAR, and other actions to stabilize alluvial aquifer water levels in the vicinity of gaining reaches.

The study is planned to be conducted over four years for a total cost of approximately $4 million, of which 40 percent will be covered by federal funds, with the remaining cost split between Oregon and Washington. The participating agencies are committed to keeping the public and basin stakeholders informed and involved over the course of the study. OWRD has developed a public participation plan to guide engagement with local stakeholders and other interested parties over the course of the study. Virtual public presentations are to commence in spring of 2021, with an in-person event each fall. Beginning in fall 2021, a technical advisory group will convene to allow for an ongoing exchange of information and feedback as the study progresses. The study also seeks to develop and execute strategies to increase equitable access to public participation activities by better understanding specific participation needs and barriers of basin stakeholders.

Prior Work and Accomplishments

With growing concern around management of basin resources, stakeholders and sovereigns range across state and federal agencies, environmental groups, regional tribes, and irrigators. These entities have pursued a variety of efforts to mitigate impacts of development and implement conservation measures within the basin. Measurable progress has been made in the areas of irrigation efficiency, water conservation, groundwater recharge and storage, water quality improvement, and floodplain and habitat restoration. Appendix C details major accomplishments by program/project implementors and sponsors in further detail.

Walla Walla Watershed Management Partnership

Since its inception through Washington state legislation in 2009, the Partnership has built its program on the premise that a flexible management approach for conservation, flow restoration, and protection of ecological functions is key for success. Representing a breadth of basin stakeholders, the Partnership consists of irrigators, government representatives, local tribes, and environmentalists who have collaborated to pilot flexible and voluntary water management approaches and tools, such as public water rights forums, local water plans, water banking, and voluntary agreements not to divert. **A key Partnership accomplishment has been its ability to facilitate productive conversations and consensus building among diverse basin interests and goals regarding water use and watershed planning** [15].

There are currently 143 water rights enrolled in the Partnership's water banking program, with a cumulative total quantity of 18,698 acre-feet[3] of water. Through the Exempt Well Mitigation Exchange program, the Partnership sells mitigation credits that represent the preservation of water and in the exchange, compensate both seller and buyer and help to reduce strain on the water table. The bank contains 24.84 acre-feet of water and sold 2.75 acre-feet of water as credits to five homes; the remaining balance in the bank is capable of supplying credits to 45 additional houses (as of 2018). Furthermore, 374 acre-feet of water has been left instream through three partially implemented Local Water Plans (LWP), with a potential for 1,543 acre-feet to be left instream through an additional four approved LWPs (which are yet to be implemented or have expired).

National Oceanic and Atmospheric Administration

Since 2000, Congress has provided funding for the protection, conservation, and restoration of Pacific salmon and steelhead. Through the Pacific Coastal Salmon Recovery Fund (PCSRF), the

[3] Acre-foot (af) is a unit of measurement of water stored or impounded.

National Oceanic and Atmospheric Administration (NOAA) distributes those funds to states and tribes through competitive grants. Eligible projects include all phases of habitat restoration and protection activities that contribute to recovering Pacific salmon and steelhead listed under the ESA or supporting Pacific salmon and steelhead species important to tribal treaty fishing rights and subsistence fishing. **Since 2000, NOAA has awarded an average of $74 million per year; appropriated 1.48 billion; leveraged 1.78 billion non-PCSRF contributions; and protected, restored, or created 1,120,000 acres of salmon habitat.**

City of Milton-Freewater

The City of Milton-Freewater has addressed issues of water conservation and clean water supply as well as fish and wildlife habitat protection. The City has decreased annual water usage from over 900 million gallons a year in the early 2000s to 600-650 million gallons a year over the last five years. Water conservation efforts include the Smart Water Meters program established in 2010 to help identify leaks. In partnership with WWBWC, **the City is conducting an ongoing study on the potential impacts to future water supplies in the upper watershed and an ASR feasibility study and design project for one of the city's basalt wells.** Through this partnership, the City has also removed a fish passage barrier on Couse Creek to improve fish habitat.

For the provision of clean water supply, the City decommissioned 36 underground injection control (UIC) facilities to reduce potential inputs to the groundwater system and worked with the state of Oregon to provide clean drinking water to urban growth boundary (UGB) areas. With considerations of various benefits (including flood control, habitat protection, and clean water), the City, Milton-Freewater Water Control District (MFWCD), and WWBWC collaborated on the recertification of levees along the Walla Walla River.

Confederated Tribes Umatilla Indian Reservation (CTUIR)

CTUIR has a long and successful history of habitat restoration, fish passage, and streamflow improvement work throughout the basin. The CTUIR has helped bring tens of millions of fish recovery funding to the basin to improve ecological conditions for fish and to help with ESA compliance. The CTUIR co-sponsored the USACE Flow Enhancement General Investigation, which has provided the foundation for the ongoing collaborative Walla Walla Basin Integrated Flow Enhancement Study.

Working with basin partners, including Blue Mountain Land Trust (BMLT) and Walla Walla County Conservation District (WWCCD), the CTUIR has **acquired over 2,800 acres of critical habitat (including riparian and upland areas) for protection, conservation, and reconnection purposes**. Much of the acquired land has already received various improvements including floodplain reconnection, improved fish passage, and increased native vegetation. Additionally, CTUIR has facilitated the removal of 4,000 linear feet of levees, installed numerous log and boulder structures, and constructed side-channels within acquired land easements, improving stream complexity and habitat conditions. Appendix C provides a comprehensive list of significant project accomplishments from 2008-2018.

Tri-State Steelheaders (Regional Fisheries Enhancement Group)

Tri-State Steelheaders Salmon Enhancement Group **works to restore sustainable populations of native salmon, steelhead, and bull trout by enhancing habitat, providing public education, and promoting recreational opportunities around the Blue Mountain region.** Current habitat restoration projects include participation in the ongoing Mill Creek Fish passage project, a collaborative effort with federal, state, and local governments, non-governmental organizations (NGO), and regional tribes. The effort focuses on addressing fish passage problems along a two-mile concrete channel in the City of Walla Walla.

The group also leads restoration work on the Walla Walla River, which started in 2010 with the removal of a half a mile of levee and the installation of large woody debris between the bridges at McDonald and Lowden-Gardena roads. Further improvement is planned for the remaining reach through bank stabilization, off-channel area and pool installation, and riparian planting. Additionally, the Tri-State Steelheaders is working to mitigate adverse impacts of a Garrison Creek dam at Lion's Pond. The goals of the project include improvement of water quality and elimination of safety hazards.

Kooskooskie Commons

Kooskooskie Commons focuses on stream restoration efforts of the basin. The Walla Walla nonprofit works—in partnership with inmates from the Washington State Penitentiary— to **remove invasive plant species and replant native plants to develop riparian buffers.** Past efforts have restored areas of the basin, including Russell Creek, LWWR, Yellowhawk at Wa-Hi, Garrison Creek, Yellowhawk Creek, and Whitney Spring Creek. Kooskooskie Commons also regularly collaborates with landscape architecture students to envision ways to increase the ecological, economic, and cultural improvements of Mill Creek through downtown Walla Walla.

Washington Water Trust

Washington Water Trust (WWT) is a private, nonprofit organization with a mission to improve and protect streamflows for the benefit of fisheries, irrigated agriculture, water quality, and recreation. WWT takes a voluntary, non-regulatory, and market-based approach to on-the-ground projects that work for landowners and for streams. WWT has been working with water right holders in the Walla Walla Basin for two decades, completing their first instream flow acquisition in 2001.

With the support of CTUIR, National Fish and Wildlife Foundation (NFWF), Ecology, WDFW, and other partners, **WWT has worked with willing landowners to successfully shepherd 13 projects through the Trust Water Rights Program in this area.** These efforts have left approximately 2,150 acre-feet and 14.6 cfs of water instream in the Walla Walla River, Touchet River, and Mill Creek.

In 2010, WWT completed its largest Walla Walla Basin water right purchase in collaboration with a family on the Touchet River, purchasing up to three cfs of water to be permanently protected instream for more than 30 miles of river. WWT partnered with the City of Walla Walla and CTUIR to reduce the City's surface water diversion on Mill Creek through ASR. This approach will keep about 5.5 cfs of water instream for almost 14 river miles of Mill Creek, and support passage for threatened summer steelhead and bull trout to quality upstream habitat.

Blue Mountain Land Trust

BMLT works to enhance and protect the climate, soil, food, water and species in the Blue Mountain Region through conservation, education, and recreation. BMLT communicates directly with over 3,000 households and maintains a robust presence on Facebook and Instagram, promoting awareness of human relationships with the land. BMLT has collaborated with the National Resources Conservation Service (NRCS), the Washington State Recreation and Conservation Office (RCO), CTUIR, and the Snake River Salmon Recovery Board (SRSRB) on a number of conservation easements in the Walla Walla River Basin, protecting agricultural lands, fish and wildlife habitat, riparian areas and water resources.

BMLT's educational offerings promote appreciation and understanding of natural resources by connecting people with the land, its stewards, flora, and fauna. Thousands of people have participated in BMLT events, including film screenings, online webinars, film festivals, and programs including Learning on the Land, Nature Kids, Farm Kids, and Blue Mountain Field Science. Past field trips included visits to fish hatcheries, the Walla Walla Watershed and intake, Mill Creek dam, and riparian restoration sites, as well to farms featuring sustainable farming practices which impact water quality, soil health, and carbon sequestration. Other excursions feature recreation on local waterways, such as fly fishing and paddle boarding.

The Blues Crew (BMLT's recreation program) has maintained, improved, and built trails in the Blue Mountain Region for three seasons, and maintains Horseshoe Prairie Nordic Ski Area in the winter. In their fourth year, Blues Crew has hosted volunteers from around the region, collaborating with USACE, U.S. Department of Agriculture (USDA) Forest Service (USFS), Washington State Parks, McNary Wildlife Refuge, and National Audubon Society to complete thousands of trail work hours to improve outdoor recreation experiences. The Road Patrol enlists community volunteers to collect trash from along county roadways popular with recreationists, which both beautifies the area and helps keep toxins from drainage ditches.

Lower Snake River Salmon Recovery Board

The SRSRB harnesses the expertise of scientists and local communities to coordinate and support high priority salmon recovery projects in southeastern Washington. With the support of representative organizations including CTUIR, Ecology, and WDFW, **the board provides technical, legislative development and funding assistance to recover populations of salmon and steelhead such as the Walla Walla River summer steelhead.** The board focuses on habitat restoration, monitoring of watersheds, and identification of data gaps to assess best approaches for recovering and supporting healthy salmon and steelhead populations in the region [16].

Walla Walla 2020

Walla Walla 2020 is a civic group that seeks to envision, plan for, and undertake projects to help realize a livable community in the Walla Walla area—now and for the future. **Since its founding in 1988, the group has been promoting practices and systems which will protect and enhance residents' quality of life.** Its Trees, Landscaping, and Natural Resources Committee maintains a demonstration garden (Xeriscape[4] Park) at the corner of North Rose and East Isaacs Avenue. The park is landscaped with flowers, shrubs, trees, and groundcover which require little or no additional watering and a very small lawn of two drought tolerant grasses. Walkways through the area help showcase the plantings and benches encourage visitors to stay awhile to enjoy them. The group's website includes a map of the park with names of each variety of vegetation, along with the Seven Principles of Xeriscape.

Washington Department of Fish and Wildlife

WDFW is dedicated to preserving, protecting, and perpetuating the state's fish, wildlife, and ecosystems while providing sustainable fish and wildlife recreational and commercial opportunities. WDFW's multi-program composition spans an array of management objectives and corresponding actions, making it uniquely suited to inform policy and natural resource management. Within the context of the WWW2050 process, **one of WDFW's primary objectives is to inform and advance actions that achieve restoration targets for ESA-listed species within the Walla Walla River and its tributaries.**

WDFW's Water Science Team (WST) is intimately familiar with the present habitat needs. Working closely with NGOs, tribes, and state and federal agencies, the WST plays a crucial role in improving habitat for ESA-listed salmonids. These actions include cooperative efforts and beneficial review of Irrigation Efficiencies Grant Program projects and Trust Water acquisitions within the basin. In 2015, the WST conducted a pulse flow in the lower Walla Walla River that triggered a number of spring Chinook salmon to move upstream. Through the Columbia Basin Water Transaction Program, the WST also monitors stream flows where there are water acquisitions, including in the Touchet River. The Team has also developed the Columbia River Instream Atlas, a scoring mechanism for streamflow projects throughout the Columbia River that includes the Walla Walla and its numerous tributaries.

WDFW's Habitat Program works closely with local sponsors to develop and implement stream restoration projects. WDFW developed the Cooperative Compliance Program that provided a cost share for local farmers to get ESA-compliant fish screens for their irrigation diversions. WDFW also provides technical assistance to landowners and local government entities for fish passage and other stream related issues.

WDFW and CTUIR are co-sponsors for the Mill Creek Work Group (MCWG). The MCWG members also include NOAA Fisheries, USFWS, City of Walla Walla, Walla Walla County, WWCCD, Tri-State Steelheaders, SRSRB, USACE, and interested citizens. The group has been working to improve conditions and fish passage through the Walla Walla Flood Control Project and past the City of Walla Walla. The Mill Creek Fish Passage Project will benefit ESA threatened Mid-Columbia Basin Steelhead and Bull Trout in the Walla Walla Basin and provide important habitat for CTUIR's efforts to restore Spring Chinook Salmon to the basin.

Finally, WDFW strives toward a no net-loss goal related to the hydraulic project approval (HPA) permit authority and work in and around streams and rivers. This work is particularly important during times of crisis, like the recent flooding in February 2020. Mitigation requirements also help

[4] Xeriscape refers to landscaping for water conservation.

towards the no-net loss goals. Recently, Washington State Department of Transportation (WSDOT) and WDFW worked together on mitigation for the Highway 12 expansion project. WSDOT provided funding for ferruginous hawk nesting platforms to mitigate future project impacts to their nest sites. WDFW has already observed successful use of two new nesting territories.

US Army Corps of Engineers

The Walla Walla District of the USACE **develops, constructs, and maintains regional infrastructural projects aimed at flood reduction, water resource management, and economic growth.** USACE coordinates maintenance of one mile of the Mill Creek Channel and Bennington Lake Dam, which provides flood risk management, recreation, and habitat for wildlife. An estimated $75 million in potential flood damages have been avoided through the construction of the channel and off-stream reservoir in 1942. As the only public lake within 45 miles of the City of Walla Walla, the reservoir also provides valuable recreational opportunities [7].

In the Mill Creek Channel, USACE installed two fish ladders to improve passage and added large boulders to create resting places for migratory fish. In 2001, USACE installed fish screens at the intake on the diversion structure of Bennington Lake to reduce the incidence of fish trapping. To improve fish migration in Yellowhawk Creek, USACE also installed fish screens at the gate of Garrison Creek [17].

Both USACE and the TriState Steelheaders have tested designs for notching the weirs in the leveed reach by modifying prototypes in the leveed reach, with the intent to provide a low-flow channel. Plans are in development for the Corps to undertake large-scale notching of the weirs for fish passage.

The City of Walla Walla

In 1999, the City of Walla Walla implemented an ASR program, which involves conveying surplus treated drinking water from Mill Creek into the city’s wells for storage [18]. Under the City’s ASR permit, the City can recover up to 2,310 acre-feet of the 3,850 acre-feet of water it is permitted to store annually. In January of 2018, net storage in Well #1 peaked at 500 acre-feet of water stored, while net storage in Well #6 peaked in September of 2018 with just over 2,000 acre-feet of water stored. A surface water main damaged in the historic flood of 2020 and the renovation efforts of the City’s water treatment plant have led to increased dependence on groundwater, resulting in reduced net storage for both Well #1 and #2 in 2019-2020 [19].

The City of Walla Walla has reduced water loss by 513 million gallons over the past decade through conservation and efficiency efforts. These efforts include detection, notification, and repair of leaks; waterline and service line replacements; and adoption of advanced metering infrastructure (AMI) [19]. The City has also broadened education and outreach programs, providing residents with water conservation tips and guidelines through email and the City’s Public Works website.

The City has also coordinated with the CTUIR and WDFW to complete a report assessing strategies to improve the use of Mill Creek. The City and two partners formed a working group and produced a final report in May of 2018 that outlined projects intended to enhance the City's water system as well as instream flows at Mill Creek.

Walla Walla County Conservation District

Through landowner grants, on-the-ground technical assistance, and cost-sharing programs, the WWCCD provides basin-wide assistance to landowners, irrigation districts, and other water users to implement water conservation and natural resource protection measures. Notable programs include:

- **USDA Conservation Reserve Enhancement Program (CREP)**: through CREP, WWCCD has planted nearly 1.5 million native trees and shrubs and protected nearly 197 miles of stream bank [20].
- **Creating Urban Riparian Buffers Program (CURB)**: the CURB program resulted in 41 installed urban buffers, 11,928 feet of restored stream bank, and over 7,200 trees, shrubs and perennials planted [21].
- **Stream restoration projects**: these projects can improve flood resiliency, increase ESA-listed fish habitat, and provide increased connectivity between surface waters and shallow aquifers. Recent projects cost $500,000 per river mile, and at least five years from inception through engineering design, permitting, and construction. The restoration needs are greater than current available funding.
- **Fish screen/barrier removal and flow meter programs**: in fall 2020, WWCCD audited fish screens and flow meters installed throughout the WWCCD as part of the Voluntary Stewardship Program (VSP). The VSP is an alternative to regulation that falls under the county critical areas ordinance where critical areas intersect with agricultural activities. The audit results showed fewer than anticipated functional flowmeters and problematic fish screens. The WWCCD acknowledges the limiting factors of current metering technology. Long-term success and use of flowmeters will depend on the development improvements by the manufacturers on alternative flowmeter technology that has longer battery life and is designed to withstand sediment build up.
- The WWCCD worked with several landowners and irrigation districts **improving irrigation efficiencies**, such as variable frequency drives and infrastructure upgrades. Over 20 years, the WWCCD and irrigators converted over 41 miles of leaking earthen canals to piped systems.

Columbia Conservation District

The Touchet Basin watershed is an integral place for natural resources and the Columbia County community. **The Columbia Conservation District's (CCD) stewardship efforts have helped producers adopt and implement conservation practices.** The CCD's program opportunities include: Conservation Reserve Program (CRP), CREP, Natural Resource Investment (NRI), VSP, soil education demonstration projects for soil health, irrigation efficiencies, fish screens and metering, and salmonid habitat restoration programs. These programs help producers and the community invest significant time and effort toward ensuring the quality of life and maintaining the culture that natural resources provide.

Most recently, CCD sponsored the Touchet River Geomorphic Assessment and Restoration Prioritization, which provides valuable resource analysis and data that will help guide restoration efforts within the basin. Currently within the Touchet watershed there are approximately 8,000 acres in the CRP and about 620 acres protected by CREP. NRI has been a staple for livestock access control, watering facilities, spring developments, and shelter belts, while VSP is a new option gaining momentum for numerous better management practices. There are also 31 producers and 40 sites that are involved in CCD's ongoing soil education project.

The CCD's projects all directly or indirectly impact the water quality of the Touchet River Basin within the county. As CCD, producers, and the community look to continue their efforts toward natural resource enhancements, process evaluations, technical advances, and programs will continue to ensure the best methods are being utilized and remain economically feasible.

Walla Walla Basin Watershed Council

In collaboration with major basin irrigators and other partners, the WWBWC **focuses on addressing reduced and declining groundwater levels through alluvial aquifer recharge projects.** By recharging the shallow alluvial aquifer during the high flow season (between November and May), MAR programs provide increased groundwater for a variety of uses, including agricultural irrigation. Using MAR to increase groundwater levels that help sustain spring branch flows has potentially measurable co-benefits for not only irrigators in this area, but the overall ecosystem function as well.

Since the development of the first aquifer recharge site in 2004, led in partnership by WWBWC and HBDIC, multiple recharge projects have been implemented on both sides of the state line [22]. Currently there are a total of 14 recharge sites in Oregon and four sites in Washington. Source water from the Walla Walla River is diverted at the Little Walla Walla Diversion in the City of Milton-Freewater and delivered through existing irrigation infrastructure connecting to each Oregon site.

From 2017-2019, total recharge volume from Oregon's combined sites was 14,659 acre-feet [23]. Total recharge volume from Washington's combined active sites was 1,287 acre-feet [24] from 2014-2017. The Last Chance Road and Washington Mud Creek sites were constructed in 2015 but have not been active due to funding challenges around water quality testing. Other factors including reduced flows in the mainstem Walla Walla River, water rights, and issues related to ESA and Clean Water Act (CWA) present barriers to expanding recharge efforts.

The WWBWC also works in partnership with individual landowners, irrigation districts, CTUIR, Milton-Freewater Municipal Golf Course, and others on 14 Oregon projects (nine completed; five ongoing), resulting in 39.9 cfs plus 20.1 cfs completed instream water rights, benefitting the Walla Walla River and Mill Creek. In Washington, WWBWC manages 14 projects (seven completed; five ongoing; one designed; one proposed), resulting in 46.1 cfs plus 19.5 cfs completed instream water rights, benefitting the Walla Walla River, Mud Creek, Mill Creek, and the Lower Touchet River [25].

The WWBWC is currently working on a project in the upper South Fork of the Walla Walla River, focused on documenting the springs responsible for the base flow of the Walla Walla River and the effects of climate change on the upper watershed spring system.

Walla Walla Basin Irrigators

In 2000, the three major irrigation districts in the basin entered into an agreement with USFWS to bypass river flows at their diversions and maintain minimum instream flows. Following a 2002 amendment to the agreement, GFID has pledged to maintain bypass flows at 18 cfs throughout the year and both WWRID and HBDIC are leaving 27 cfs (0.7641 cubic meters per second) from January 1 to June 30 and 25 cfs (0.706 cubic meters per second) from July 1 to December 31 each year [26]. As a result of the agreement, less water has been allowed to flow into the LWWR during critical low flow summer months to provide much needed flows for fish in the mainstem.

As of 2019, WWRID, HBDIC, and GFID Oregon and Washington irrigation districts, in collaboration with WWBWC, local governments, landowners, and other partners, have developed numerous agricultural irrigation and water efficiency infrastructure projects. WWRID-led projects have resulted in completed instream water rights of 11 cfs and HBDIC completed projects totaling 12.4 cfs completed instream water rights [26]. Through collaborative partnerships, the WWBWC, irrigation districts, and other stakeholders have constructed a series of MAR sites within the LWWR subbasin. Additionally, irrigators have placed roughly 11.8 cfs into the Washington State Trust through such actions as installation of more efficient irrigation application systems and canal piping.

Oregon Water Resources Department

OWRD regulates Oregon's waterways and protects instream water rights to ensure sufficient water humans and ecological function. **The department has achieved measurable gains in increasing streamflow throughout Oregon,** with over 3,924.78 cfs left instream through 536 current instream leases, instream transfers, allocations of conserved water, and conversions of hydro-electric rights. Benefits of these instream flow increases include improved fish habitat, pollution abatement, and increased recreational use of waterways [27]. In the Oregon portion of the Walla Walla Basin, OWRD has approved 26 instream water right certificates since of the passage of the 1987 water rights act. [28]. These water rights are junior and likely do not contribute to meeting instream flow targets during critical periods.

Regulating groundwater use statewide since 1955, OWRD functions as the lead permitting and reporting authority overseeing the 2016 rule change that designates the basalt aquifers in the Walla Walla subbasin as a Serious Water Management Problem Area (SWMPA). The changes to groundwater regulation classify future groundwater appropriation in the subbasin for exempt uses only and the SWMPA designation requires basalt wells with water rights to have functioning flowmeters and owners to report. This program reports a near 100 percent user compliance rate.

Washington State Department of Ecology

Ecology provides technical, regulatory, and financial assistance to local jurisdictions and organizations to protect water systems in the state. Ecology's numerous programs contribute to water conservation and protection efforts:

- The **Water Quality Program** applied the Total Maximum Daily Load (TMDL) process for WRIA 32 to assess the water quality and reported measures for the region to improve water quality.

- The **Water Resource Program** focuses on adaptive and sustainable management of water resources for the current and future benefits of people and the natural environment. Its contributions helped form the Partnership pilot program and the implementation of RCW 90.92.070, which authorizes Walla Walla water banking and the Walla Walla Instream Flow Rule (Washington Administrative Code (WAC) 173-532-030).
- The **Environmental Assessment Program** collects streamflow discharge, develops rating curves, and maintains five active gages in the basin.
- The **Shoreline and Environmental Assistance Program** supports communities to protect shorelands, wetlands, and floodplains. The program coordinated a USACE Silver Jackets project to conduct channel migration zone study on Mill Creek and the Walla Walla River. It also contributed funding to a levee setback and habitat restoration project on the North Touchet River.
- OCR contributed **funding** to the WWW2050 and the Bi-State Flow Study, while all the programs provided technical and regulatory input for WWW2050.

Washington State Department of Health

The Washington State Department of Health (DOH) Office of Drinking Water (ODW) is the regulatory authority for Group A public drinking water systems in Washington, operating under state law and in agreement with the U.S. Environmental Protection Agency (EPA) and the federal Safe Drinking Water Act. It is ODW's mission to protect the health of the people of Washington by ensuring safe and reliable drinking water.

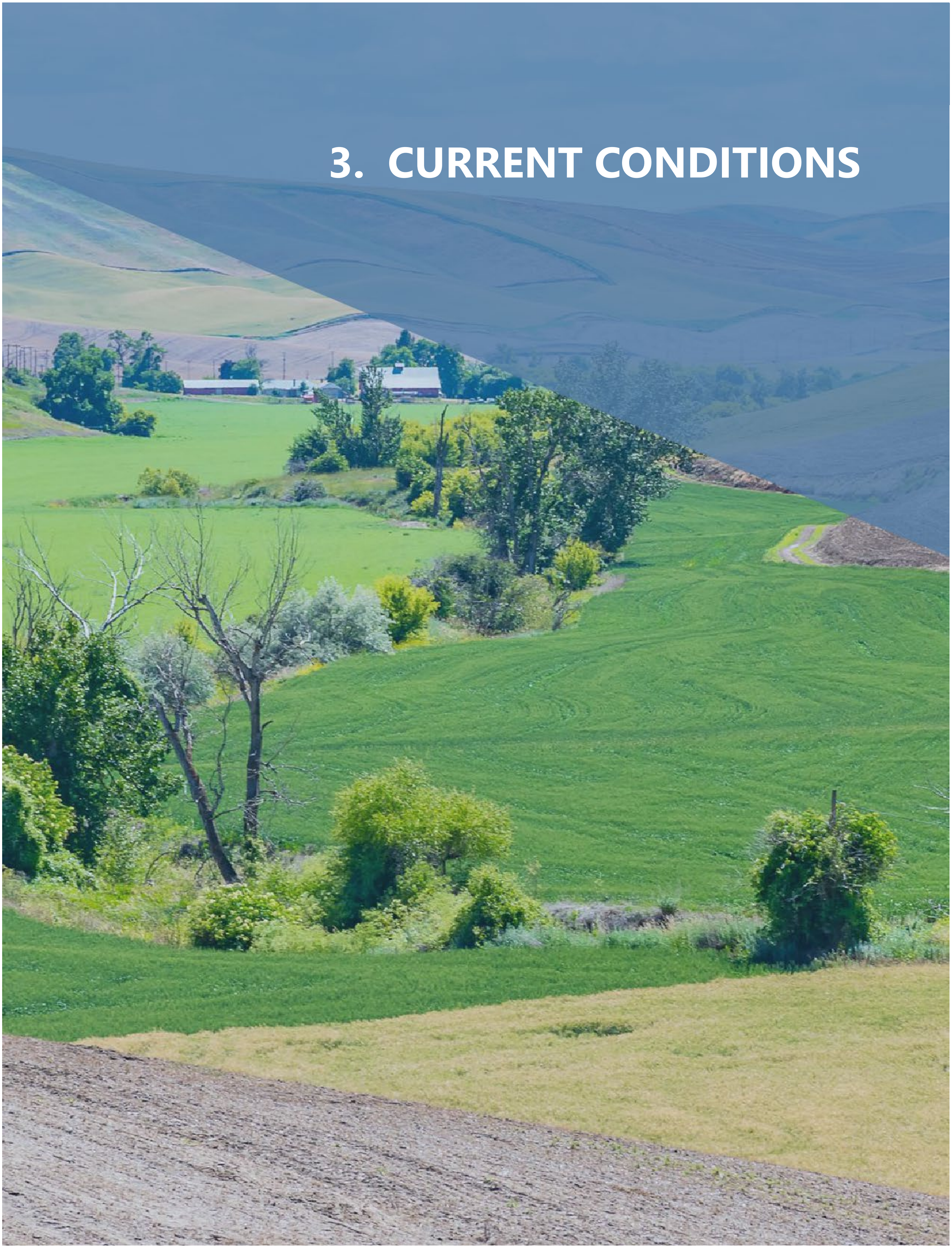
ODW regulates through planning, design, and water quality standards as set by EPA and WAC 246-290. In addition to design and engineering approvals, Group A water systems (surface and groundwater) are required to have either a Water System Plan (WSP) or Small Water System Management Program (SWSMP) that includes such elements as: ownership and operations information, water system design standards, water supply characteristics and reliability, capacity and hydraulic analyses, water rights evaluation, growth projections and demand forecasts, asset management, water use efficiency, source water protection, emergency preparedness and response, water quality monitoring, cross connection control, capital improvement program, and financial program.

ODW has regional staff that work directly with water systems in the Walla Walla Watershed and centralized staff in Tumwater that provide program specific guidance and technical assistance. Staff from both offices are committed to participation and assistance on the WWW2050 project.

ODW's requirements in the Walla Walla Watershed that have **resulted in measurable progress in water conservation are those originating from Washington's Municipal Water Law (2003) and implemented by ODW through Water Use Efficiency (WUE) requirements** per 246-290 WAC, Part 8. Per WAC, all Group A systems must include WUE in their WSP or SWSMP and complete a WUE Annual Report. The WUE program includes metering (source and service) requirements, WUE goals and implementable conservation measures, distribution system leakage evaluation, consumer education, and projected water savings from conservation. The Annual Report requests annual updates on the WUE elements and additionally requests water production and consumption, depth-to-water measurements for groundwater sources, and water shortage response.

The Walla Walla Department of Community Health is the regulatory authority over Group B public water systems, shared-party wells, and the permitting of individual private wells. The Oregon Health Authority runs a similar program to ODW's in Oregon.

3. CURRENT CONDITIONS



3.1 INTRODUCTION

The following chapter provides a high-level overview of current conditions throughout the Walla Walla Watershed. Despite the myriad of organizations and entities who have worked for years to improve water quality and address water management issues in the basin, its health and productivity are constrained by the factors below (addressed in further detail in subsequent sections of this chapter):

- Low streamflows, compounded by irrigation diversions.
- Concrete and/or incised stream channels, levees, weirs, and other alterations.
- Point-source and non-point-source pollution.
- Declining water levels in the alluvial and basalt aquifers.
- Increased stream temperatures and degraded habitat for fish and other species.
- Historic loss of fisheries production (salmonids).
- Over-allocated water supply for out of stream uses.

3.2 SURFACE WATER CONDITIONS

Aptly called the "land of many waters," the Walla Walla Watershed contains diverse surface water sources, including precipitation-fed (snow and rain) and spring-fed systems, and meandering and partly channelized stream systems, as described below:

The headwaters of the Walla Walla River—the **North and South Fork Walla Walla Rivers**—flow out of the Blue Mountains in Oregon and combine to form the beginning of the mainstem (Figure 3). The **Walla Walla River Mainstem** (known as the "Tumalum branch" in Oregon) historically functioned as a series of braided streams. Over time, the river has been locally confined to a mainstem channel. Historic distributary channels still exist and flow from the mainstem and back into the river further downstream; for example, the **East and West Little Walla Walla Rivers'** (LWWR) primary source water flows out of the Walla Walla River at Milton-Freewater and partly back in via surface water and groundwater discharge to the mid to lower Walla Walla River (Figure 4).

Primary tributaries are:

- **Mill Creek.** Historically a system with spring-fed distributaries creeks, today Mill Creek flows through the City of Walla Walla as an engineered channel with a series of distributaries, including **Yellowhawk and Garrison Creeks** (both managed by the U.S. Army Corps of Engineers (USACE)). Yellowhawk Creek flows are controlled at its headgate and used as an irrigation conveyance. Garrison Creek is diverted from a headgate off Yellowhawk Creek, just below the Yellowhawk diversion from Mill Creek.
- **Touchet River.** The Touchet River is rain- and snow-fed by the North and South Forks and other significant headwater tributaries—including Robinson Fork, Wolf Fork, Patit Creek, and Coppei Creek—and flows into the Walla Walla Mainstem.

Due to the complexity of the river systems as well as the bi-state nature of the watershed, surface water sources can have conflicting names. Table 7 indicates the different nomenclature in Oregon and Washington, as well as what is listed on the U.S. Geological Survey (USGS) quad maps for interstate streams in the Walla Walla River Basin.

Figure 3. Walla Walla Watershed streams (map created by Washington Department of Ecology, 2021).

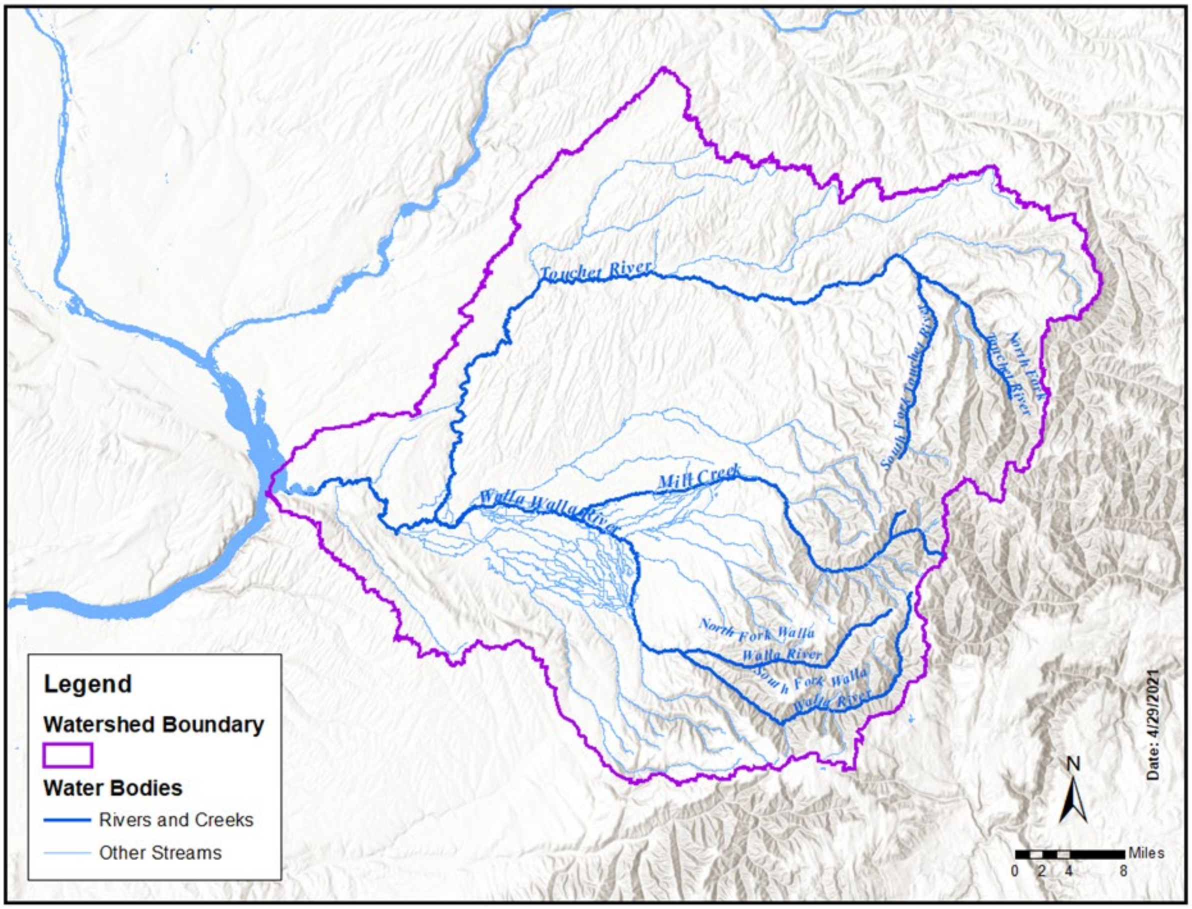


Figure 4. The Little Walla Walla River system (map created by Washington Department of Ecology, 2021).

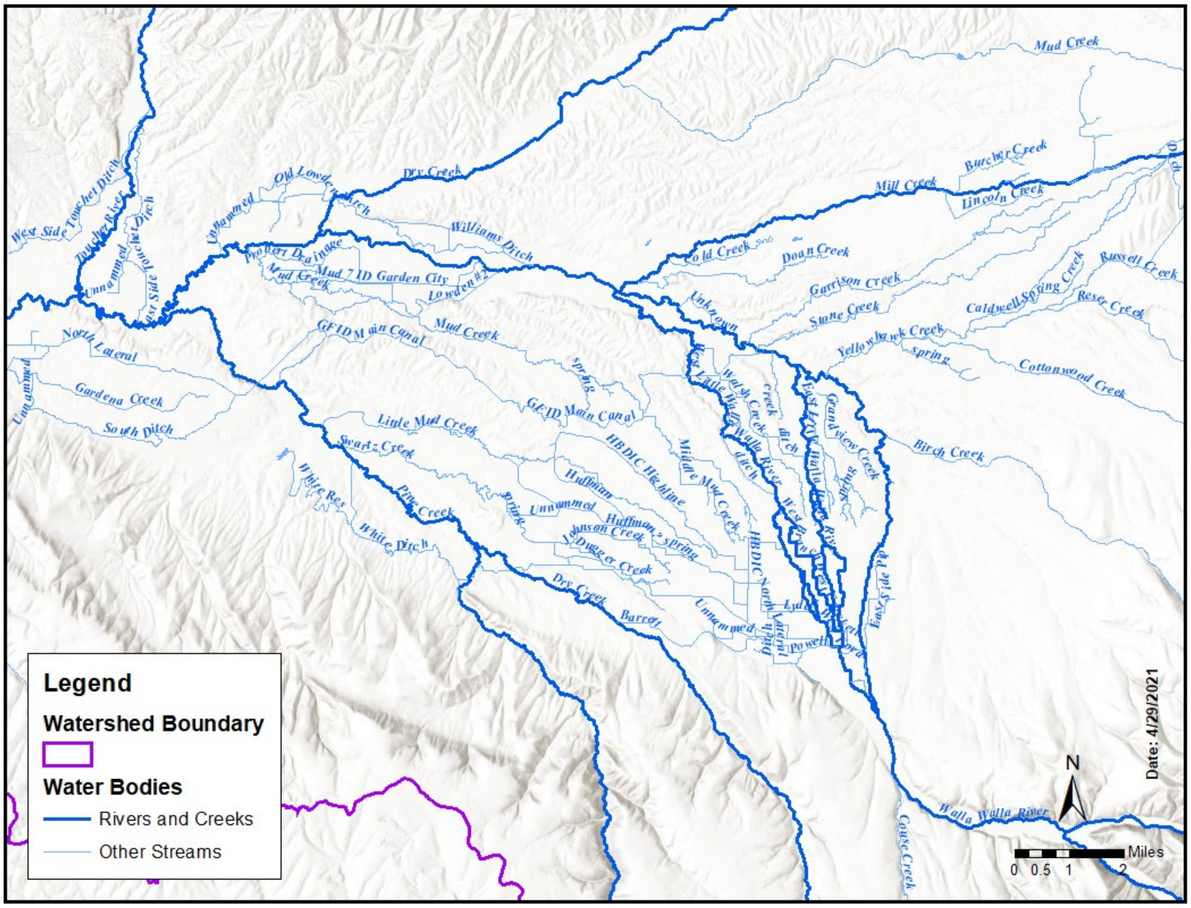


Table 7. Walla Walla Basin interstate streams, east to west from Highway 125.

Washington	Oregon	USGS Quads *Walla Walla & College Place 7.5′*
Spring Branch (14-6/35)	Grandview Creek	Unnamed
Big Spring Branch (14-6/35)	Big Spring Branch	Big Spring Branch
Spring Branch (14-6/35)	Buell Spring Branch	Unnamed
East Spring Branch (14-6/35)	East Prong Little Walla Walla River	East Little Walla Walla River
Walsh Creek (15-6/35)	Lewis Spring Branch	Walsh Creek
Little Walla Walla River (16-6/35)	West Prong Little Walla Walla River	West Little Walla Walla River
Mud Creek (17-6/35)	East Mud Creek	Mud Creek
Little Mud Creek (15-6/34)	South Mud Creek	Little Mud Creek
USGS names are for the Walla Walla and College Place 7.5′ quads only. The Milton-Freewater and Waterman quads that cover Oregon reference many of the same streams differently in Oregon than they do in Washington.		

Wetlands, springs, and spring-fed creeks are also an important part of the hydrology of the basin. Historically, numerous springs existed across the Walla Walla Watershed, many of which fed small creeks. As the water levels in the shallow aquifers in the valley have declined (due in part to floodplain development and disruption of natural aquifer recharge), many of these springs have been significantly impacted. Springs provide critical cool-water flow into streams—especially late summer and early fall in the mainstem from Milton-Freewater to the confluence with Mill Creek, the Little Walla Walla River, and in the lower portions of Mill Creek [1].

Streamflows

The inland region of the Pacific Northwest between the Cascades and the Rocky Mountains is semi-arid with relatively small, lower-elevation mountain ranges. Surface water in the Walla Walla River and its primary tributaries follows a typical runoff pattern for these regions—the **system responds rapidly to precipitation and snowmelt events and has minimal late spring through late fall baseflows**.

The hydrographs presented in this section show **annual streamflow variation** for representative river reaches in the Walla Walla, Touchet, and Mill Creek subbasins.[5] Naturally low flows occur annually from late June through the end of October and are compounded by the impact of irrigation diversions, groundwater withdrawals, hydraulic alterations for flood control, climate change, and other factors that can represent a significant portion of the rivers' and creeks' flow on a given day during base flow conditions in summer/early fall (e.g., <1 to 80 percent) [29].[6]

The **hydrographs below represent normal, wet, and dry year flows during the water year** (October 1 through September 30). These hydrographs are meant to be illustrative of typical flow conditions in each subbasin and are not exhaustive of available streamflow data. Figure 5 below shows a subset of active gauging station locations in the basin; sites highlighted with an orange marker correspond with Instream Flow Rule (ISF Rule)[7] flow prescriptions, while those with a blue marker do not. [3].

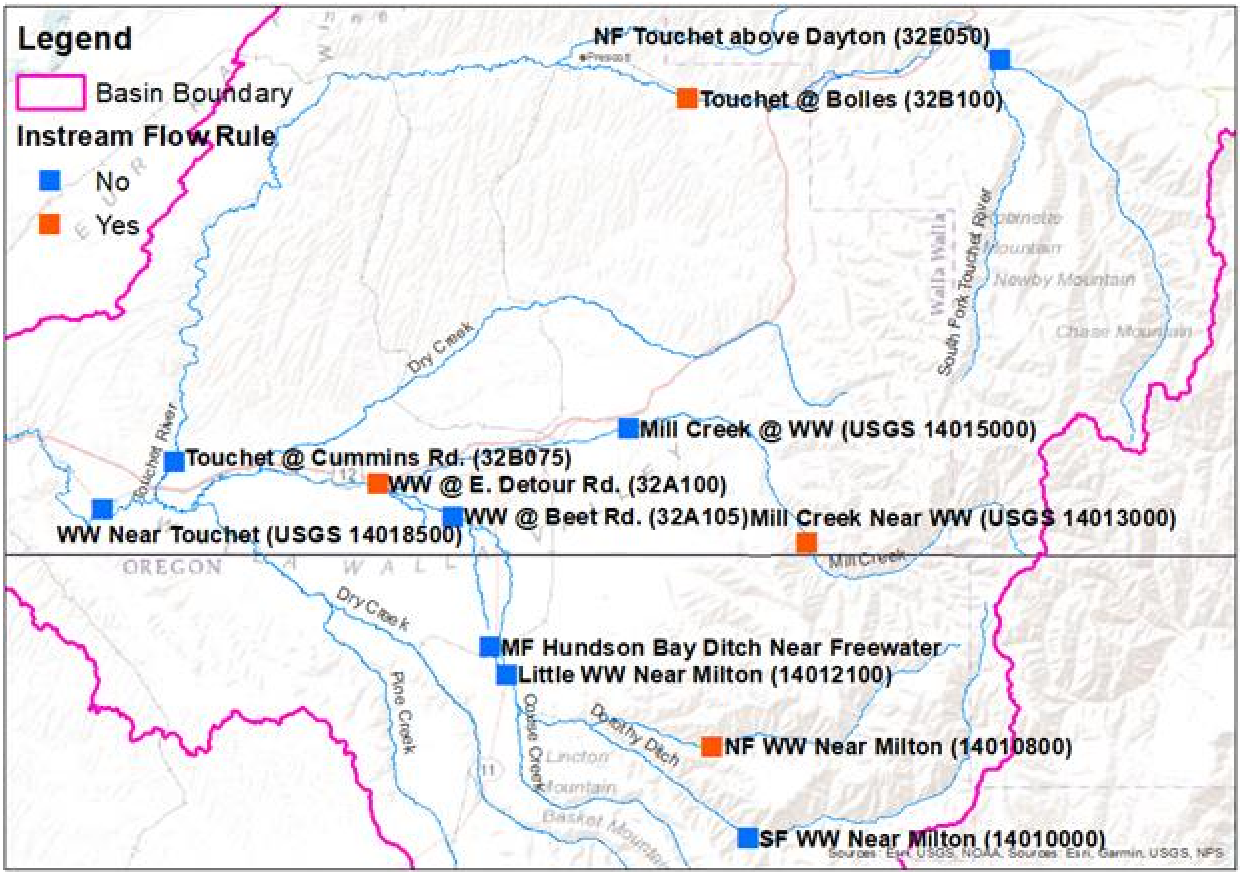
---

[5] Selected gage locations: Walla Walla River at Detour Road (32A100), Mill Creek at Walla Walla (USGS14015000), and Touchet River at Cummins (32B075).

[6] Irrigation diversion as a percentage of flow exceeds this range at certain locations (for example, LWWR diversion).

[7] *"Washington State law requires that enough water is kept in streams and rivers to protect and preserve instream resources and values such as fish, wildlife, recreation, aesthetics, water quality, and navigation. One of the most effective tools for protecting streamflows is to set instream flows, which are flow levels adopted into rule. Instream flows cover nearly half of the state's watersheds and the Columbia River*" [128].

Figure 5: Location of listed active gages that record streamflow.[8]



During normal and dry years, the **Walla Walla River at E. Detour Road** (Figure 6 and Figure 7) can experience low flows below ISF Rule levels during the winter months. However, the biggest gap appears from the end of April into June where low flows were significantly below the ISF Rule level. Flows in all representative years remain low from June through the end of the water year in September. This hydrograph demonstrates the significant impact on flows in the Walla Walla River from irrigation diversions, groundwater withdrawals and climate change upstream of the gage site.

As with the Walla Walla River, the Touchet River is severely impacted by irrigation diversion in the lower reach (Figure 8 and Figure 9). Increasingly, groundwater use from the alluvial and basalt aquifers and climate change also contribute to low flows. Flows drop to near zero in the **Lower Touchet at Cummins Road** gage in the representative dry year during the late summer months and are only slightly higher in representative wet and normal years.

Finally, Figure 10 and Figure 11 show the hydrograph of **Mill Creek at the City of Walla Walla** and the depiction is much the same as the preceding hydrographs. Late summer low flows are clear in every representative year type. In dry years, flows drop precipitously in May (because the

---

[8] Map developed by Ecology using USGS, NOAA, Esri, Garmin, and NPS data sources. Map includes only active gages that record streamflow. USGS gage 14012000 (Walla Walla at Milton-Freewater) does not record streamflow data.

Washington Department of Ecology (Ecology) has directed water from Mill Creek be diverted to Yellowhawk Creek to satisfy water rights) and persist through the end of September. Wet and normal years see a shift in the timing of the drop to base flows, moving from May to June and July. August and September in all cases see extremely low flow levels.

Table 8 shows **representative mean and low flow ranges for July through September in the Walla Walla River, Touchet River, and Mill Creek**. While Table 8 shows typical summer low flows which occur from July through September, flows can be much lower to the point of going nearly dry in some locations. Many of the lower reaches of the Walla Walla River, Touchet River, and Mill Creek have been dewatered during low flow periods; however, water management efforts have had a positive impact on low flows in some reaches [1].

For example, Hudson Bay District Improvement Company (HBDIC) and Walla Walla River Irrigation District (WWRID) in Oregon and Gardena Farms Irrigation District #13 (GFID) in Washington signed an agreement with the U.S. Fish and Wildlife Service (USFWS) in 2002 to keep a minimum water flow in the river. The Oregon irrigation districts agreed to leave 27 cfs from January 1 to June 30 and 25 cfs from July 1 to December 31 each year. GFID agreed to bypass 18 cfs throughout the year [30]. While this settlement has expired, Oregon irrigation districts have elected to continue to voluntarily bypass water as outlined in the agreement. Further, significant irrigation efficiency projects have been completed that decrease diverted quantities from the Touchet and Walla Walla Rivers.

Table 8. Range of flows for representative locations in the watershed.

	Walla Walla River at East Detour Road			Touchet River at Cummins Road			Mill Creek at Walla Walla		
	Jul	Aug	Sep	Jul	Aug	Sep	Jul	Aug	Sep
Mean flows (CFS)	43	42	55	33	12	19	6	4	7
Low flows (80% Exceedance, CFS)	33	32	44	12	3	10	4	2	2
Gauging station ID	32A100			32B075			1401500		
Time period	2010 – 2018			2010-2018			2010 – 2018		

Range of mean and low (20th Percentile) July, August, and September flows for representative locations in the Walla Walla River, Touchet River, and Mill Creek.

Figure 6. Walla Walla at E. Detour Road (32A100) dry, normal, and wet year streamflows.

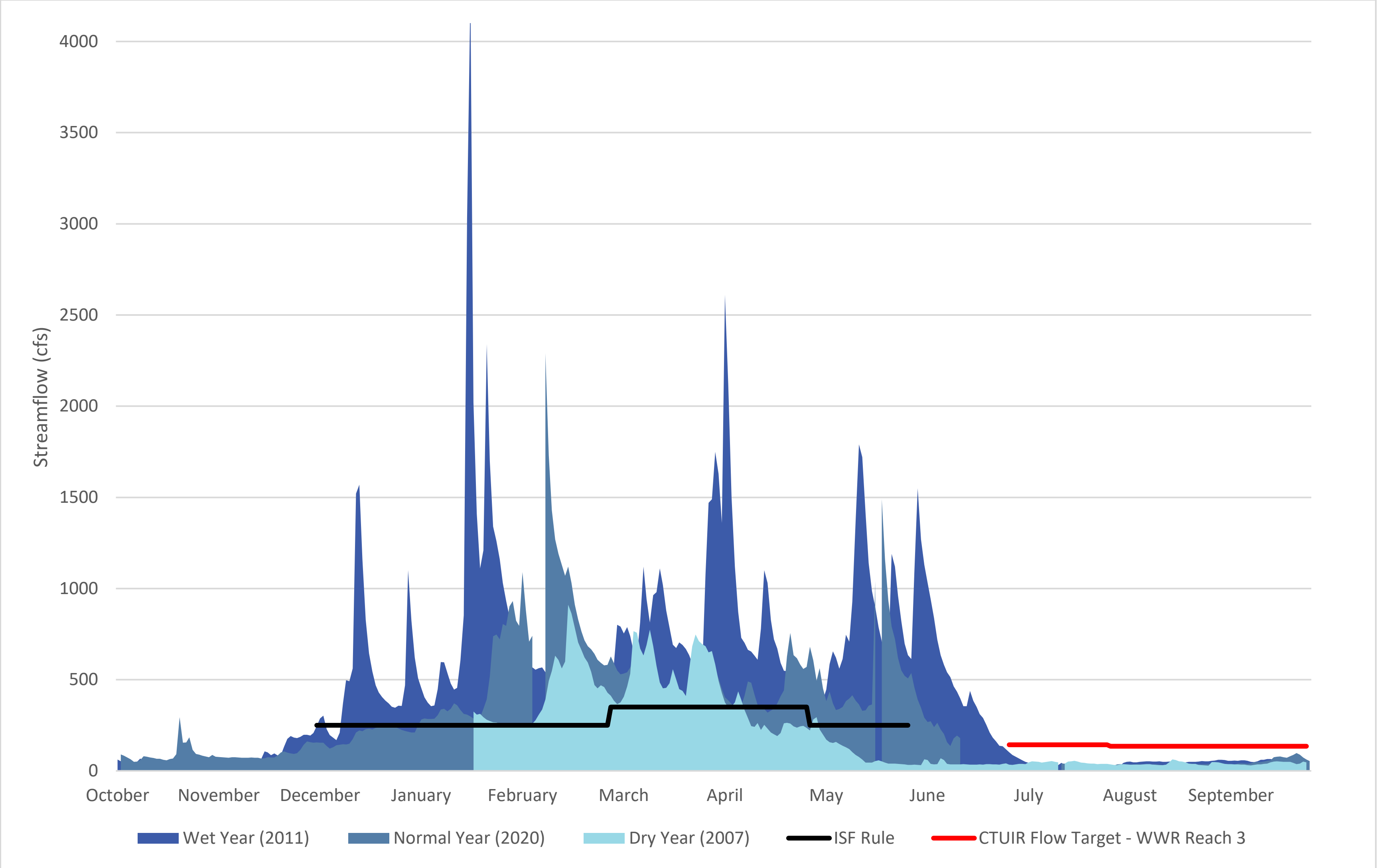


Figure 7. Walla Walla at E. Detour Road (32A100) dry, normal, and wet year streamflows (July through September).

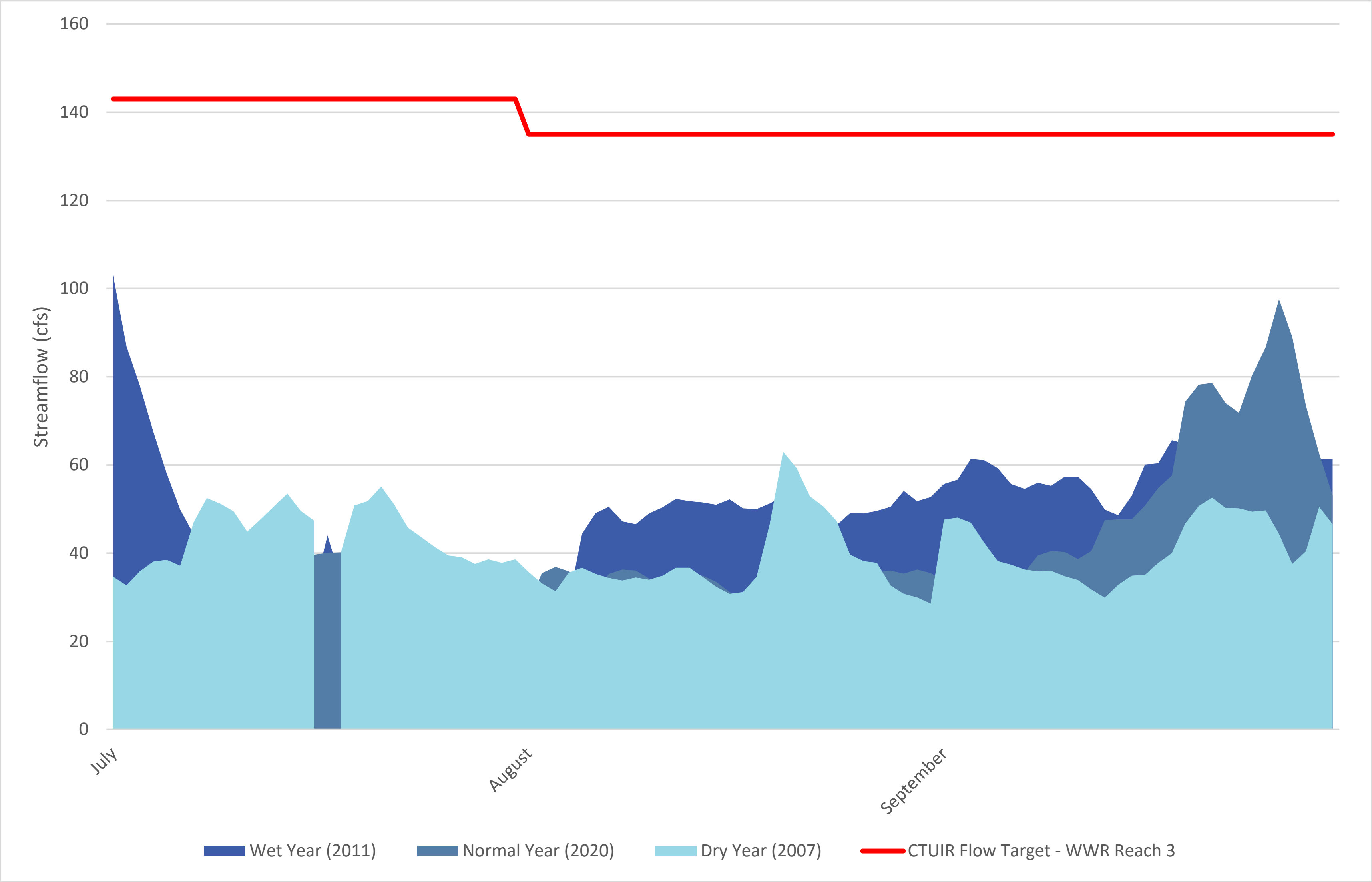


Figure 8. Touchet at Cummins Road (32B075) dry, normal, and wet year streamflows.

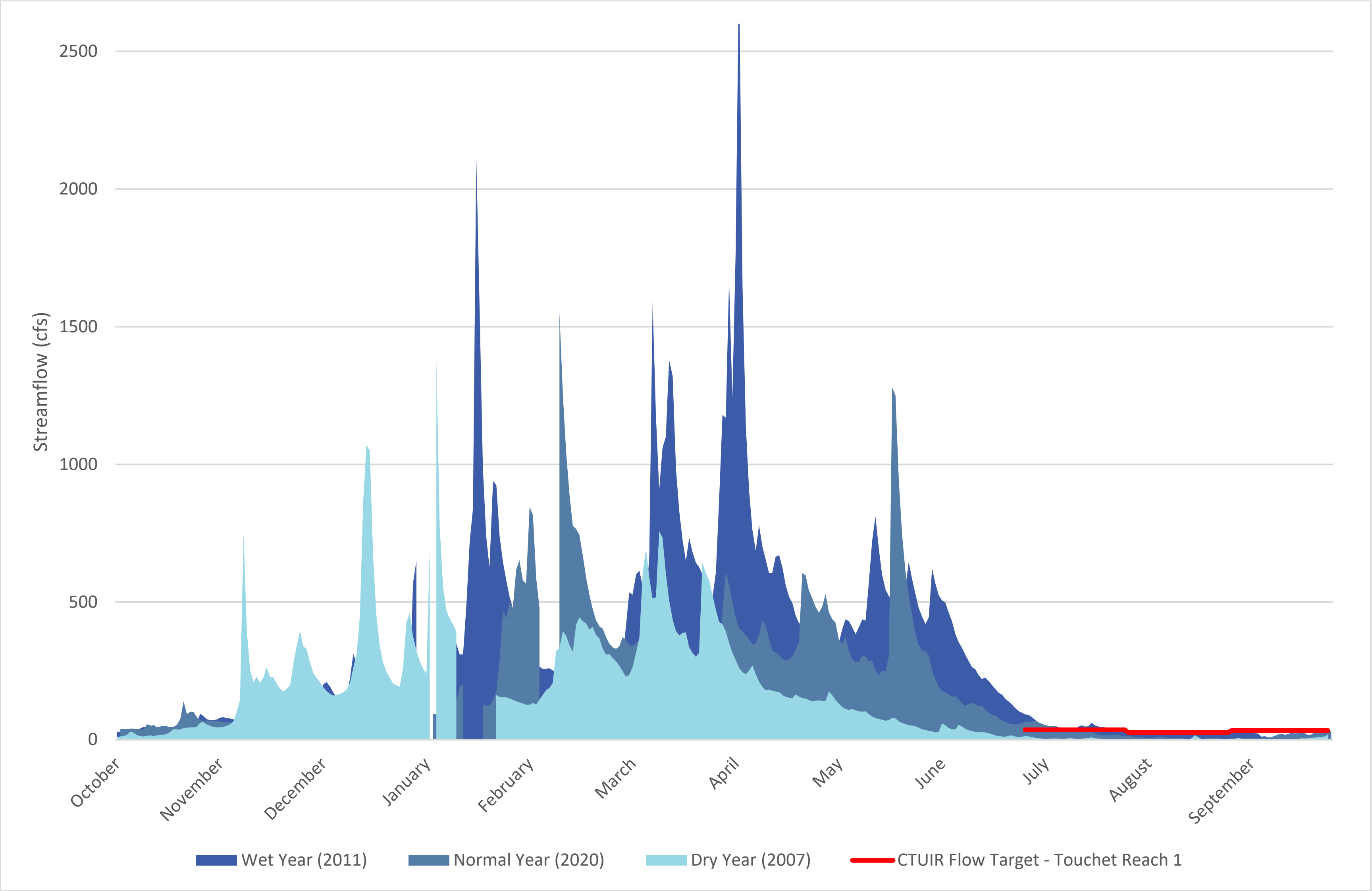


Figure 9. Touchet at Cummins Road (32B075) dry, normal, and wet year streamflows (July through September).

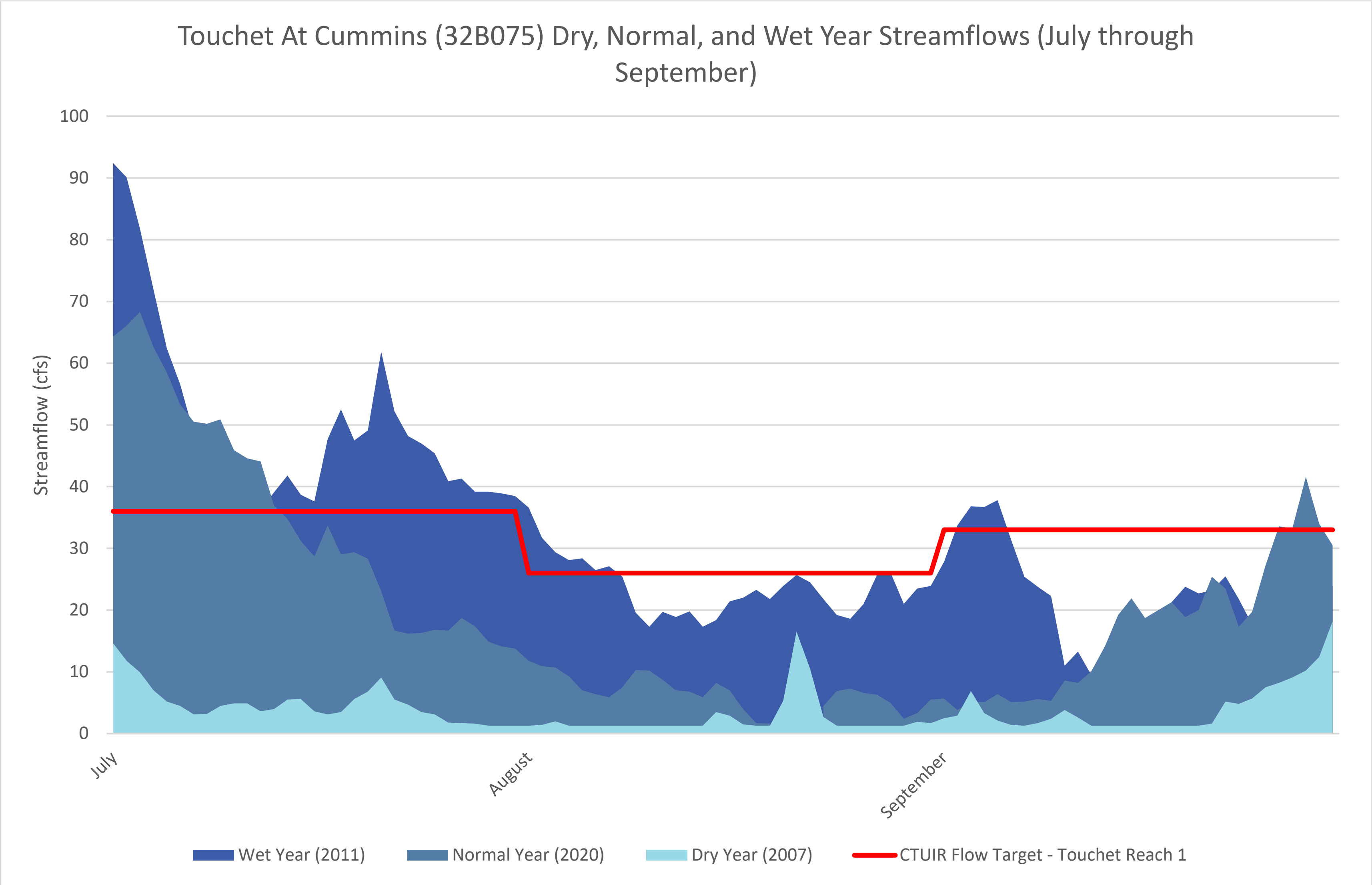


Figure 10. Mill Creek at Walla Walla (14015000) dry, normal, and wet year streamflows.

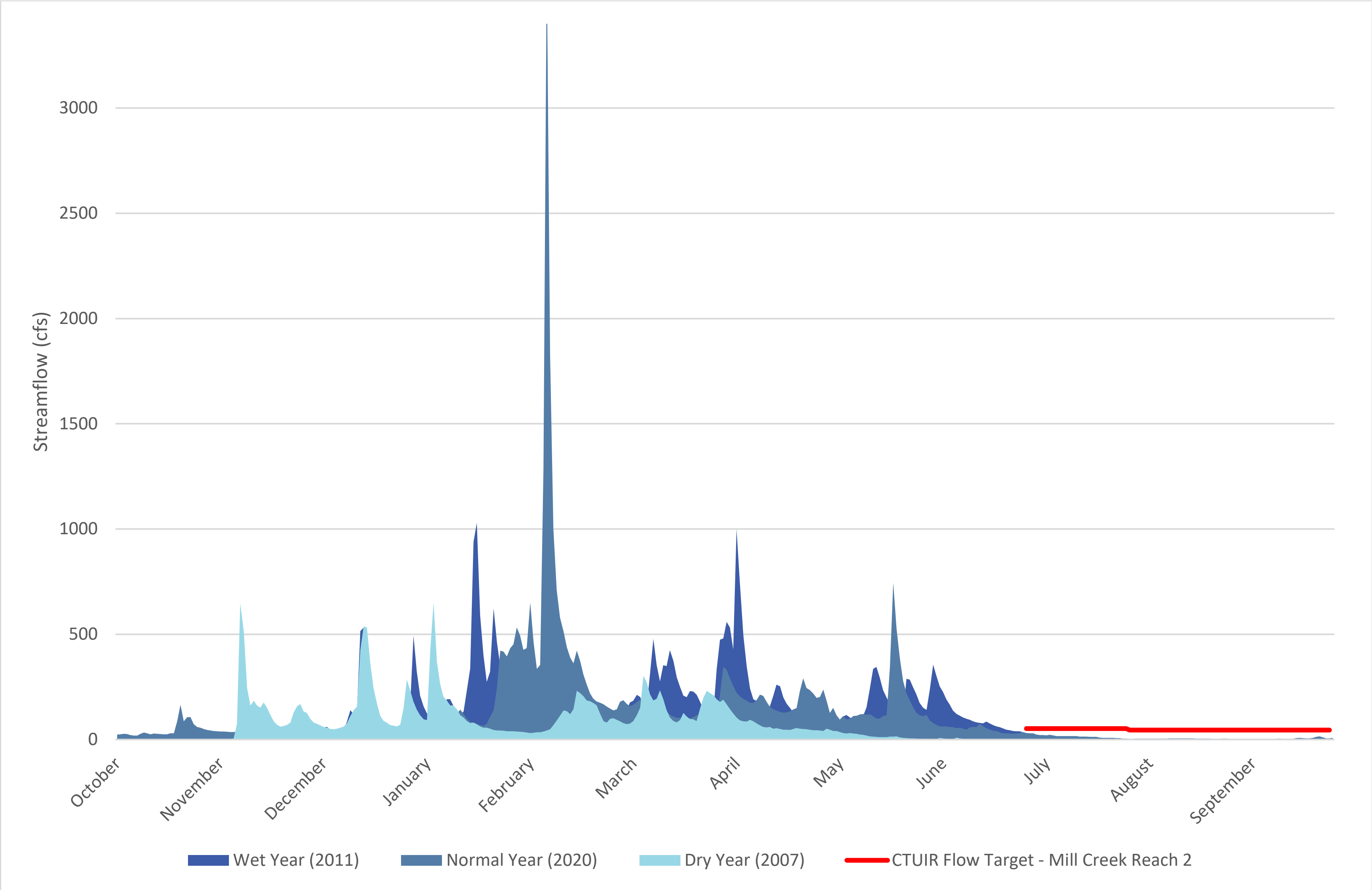
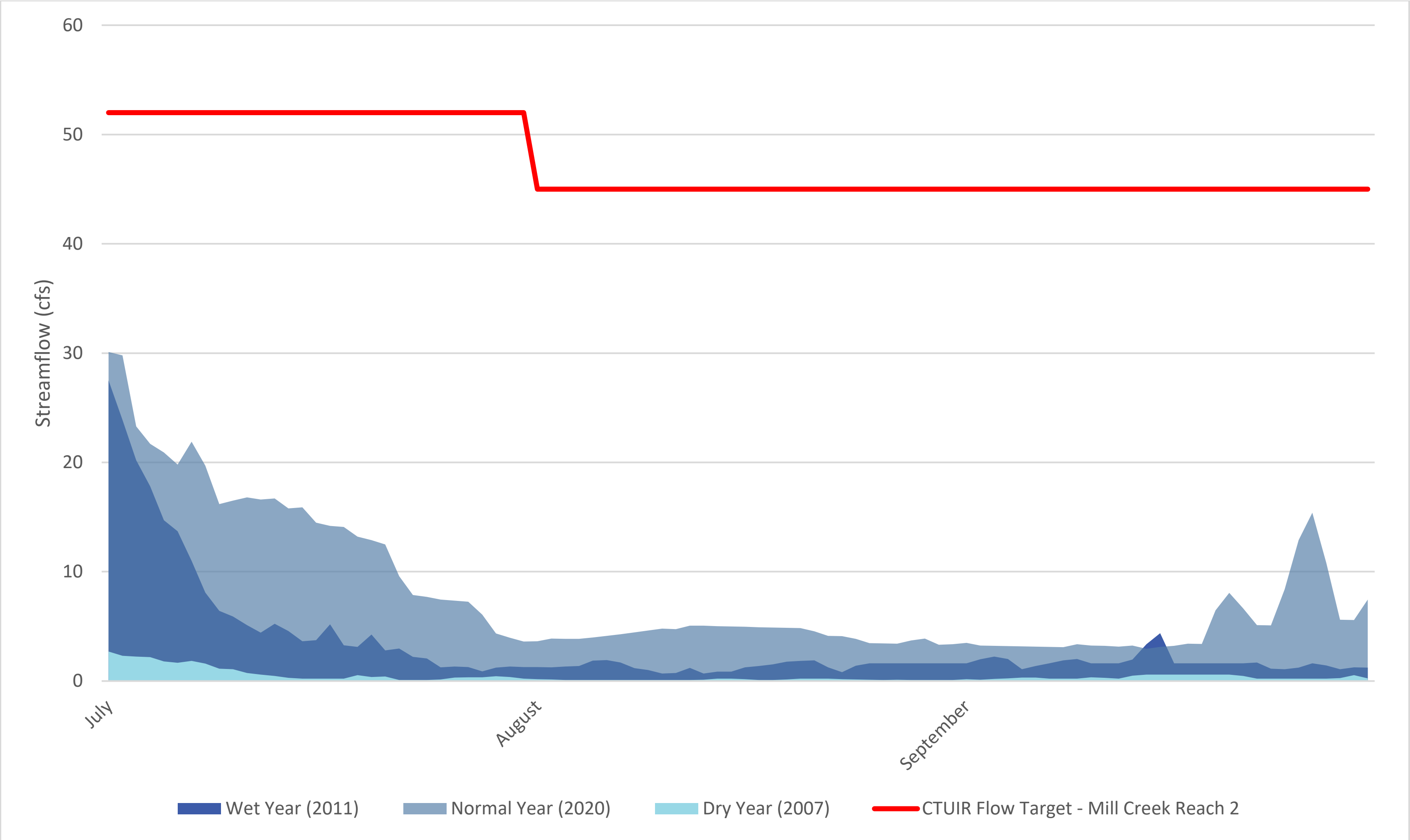


Figure 11. Mill Creek at Walla Walla (14015000) dry, normal, and wet year streamflows (July through September).



The **Washington portion of the Walla Walla River is closed to new appropriations from July to November** and open only to new consumptive appropriations that qualify as environmental enhancement projects from November to July [31]. On the Oregon side of the basin, the river is closed to new appropriations between May and December with some limited availability from January to April [32].

The majority of reaches on the Walla Walla River, Touchet River, and Mill Creek also have **low flow prescriptions** to meet the needs of fish, as outlined in several documents including:

- Washington's Water Resource Inventory Area (WRIA) 32 Walla Walla Watershed Plan [3].
- Washington's Walla Walla Instream Flow Rule (WAC 173-532 [33]).
- Instream water rights held by the Oregon Water Resources Department (OWRD) on the Oregon side of the basin.
- Washington and Oregon's irrigation district agreements [30].

More recently, the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) commissioned a **study using the best available science to assess ecological flow needs across the basin** (determine what is needed to sustain the most sensitive life stages present in a given reach at a given time) and provide flow recommendations [13]. Table 9 shows the relationship between these resulting target flow reaches and the gages presented in Figure 5.

Other gages currently exist or historically existed throughout the basin. To the extent that these gages can be used and brought back online, the basin would be better able to monitor flows and manage out-of-stream diversions and instream flows. Strategic Plan Advisory Committee (SPAC) members provided input on potential additional gage sites in Washington. There is potential for Ecology's Office of Columbia River (OCR) to allocate money in the next biennium to address data gaps in the Walla Walla Basin, including funding stream gages. Table 10 lists new and historic gages in the basins, as well as the sites that were included in the OCR internal proposal to Ecology.

Table 11 presents ecological flow targets for the reaches identified in Table 9 and Table 10 for July, August, and September. Additional streamflow targets have been set for late summer months and for reaches that do not correspond to gages listed above. The full suite of flow targets are presented in the "*Walla Walla River Ecological Flows – Recommended Stream Flows to Support Fisheries Habitat and Floodplain Function*" report, prepared by Stillwater Sciences (September 2013).

Flows start rising again when autumn rains begin towards the end of October. Table 12 summarizes high flows for the Walla Walla River, Touchet River, and Mill Creek—typically occurring from January through May. Flood events may exceed these typical high flow ranges—as discussed in the Flooding & Flood Control section below.

Table 9: Listed active gages that record streamflow and corresponding ecological flow target reaches.[9]

Gage Name and ID	Corresponding Ecological Flow Target Reach
SF WW Near Milton (14010000)	S. Fork Walla Walla River
NF WW Near Milton (14010800)	N. Fork Walla Walla River
Little WW Near Milton (14012100)	(No target flow for this reach)
MF Hudson Bay Ditch Near Freewater	n/a
WW @ Beet Rd. (32A105)	WWR Reach 4
WW @ E. Detour Rd. (32A100)	WWR Reach 3
WW Near Touchet (USGS 14018500)	WWR Reach 2
Mill Creek Near WW (USGS 14013000)	Mill Creek Reach 5
Mill Creek @ WW (USGS 14015000)	Mill Creek Reach 2
NF Touchet above Dayton (32E050)	N. Fork Touchet River
Touchet @ Bolles (32B100)	Touchet River Reach 2
Touchet @ Cummins Rd. (32B075)	Touchet River Reach 1

Table 10: New streamflow gages and historic gage locations to be considered for re-establishment.

Stream	Location	Notes
New Locations (Most Currently monitored by WWBWC)		
Pine Creek	@Sand Pit Road	The site represents the contribution of Pine and Dry Creek (Oregon Dry Creek) to the Walla Walla River.
East Little Walla Walla River	@the mouth with the mainstem WWR	Represents the contribution from the East LWWR and Big Spring. The East LWWR contributes significant summer surface flow with cooler water temperatures to the Walla Walla River.*
Yellowhawk Creek	@Hwy 125	Represents the total flow contribution to the Walla Walla River from not only Yellowhawk Creek, but also Cottonwood, Caldwell, and Russell Creeks.*
Walla Walla River	@McDonald Road	The location is downstream of the last large irrigation diversion on the Walla Walla River.
Walla Walla River	Between Cemetery and Nursery Bridge	Assist OWRD with managing instream water rights on the Walla Walla River.
Touchet River	@Sims Road	Ecology opted for a comparable location to the Touchet River @Luckenbill Rd site (below) due to access and data needs.*
Stream	**Location**	**Notes**
Historic Streamflow Gauging Locations to Reestablish		
Walla Walla River	Below Lowden	Station ID 32A080
Walla Walla River	Near Lowden	Station ID 32A090
Walla Walla River	@Pepper Bridge Rd	Station ID 32A120*

[9] Table includes only active gages that record streamflow. USGS gage 14012000 (Walla Walla at Milton-Freewater) does not record streamflow data.

Stream	Location	Notes
Touchet River	@Luckenbill Rd	Station ID 32B090
Touchet River	@ County Walla Walla Columbia County Line	Station ID 32B110
Touchet River	Above Dayton	Station ID 32B140
Yellowhawk Creek	@the Mouth with WWR	Station ID 32D050
Yellowhawk Creek	Near mouth	Station ID 32D060
NF Touchet	Above Jim Creek	Station ID 32E150
Dry Creek	Near mouth	Station ID 32F060
Dry Creek	@Hwy 125	Station ID 32F150
Coppei Creek	Near mouth	Station ID 32G060
Coppei Creek	Near Coppei	Station ID 32G100
East Prong of Little Walla Walla	@Stateline	Station ID 32H090
Robinson Fork	Above Wolf Fork of Touchet Rover	Station ID 32J070
Wolf Fork Touchet R	@ Mountain Home Pk	Station ID 32K070*
S.F. Touchet R.	Near Mouth Above Dayton	Station ID 32L070
Cottonwood Creek	Near Mouth	Station ID 32M060
Cottonwood Creek	@Hood Road	Station ID 32M100
Russell Creek	Near Langdon	Station ID 32N070

*indicates site was included in OCR gage proposal.

Table 11: Summer ecological flow targets for reaches with a corresponding gage.

Ecological Flow Target Reach	Recommended Summer Flow (CFS)		
	July	August	September
S. Fork Walla Walla River	70	70	70
N. Fork Walla Walla River	11	6	7
WWR Reach 5	90	90	90
WWR Reach 4	91	90	90
WWR Reach 3	143	135	135
WWR Reach 2	146	137	137
Mill Creek Reach 5	51	44	44
Mill Creek Reach 2	52	45	45
N. Fork Touchet River	1	1	1
Touchet River Reach 2	35	25	32
Touchet River Reach 1	36	26	33

Table 12. Range of high flow statistics from January to May.

	Walla Walla River at Detour Rd	Touchet River at Cummins Rd	Mill Creek at Walla Walla
High flows (20% and 2% exceedance, CFS)	504 – 1,405 cfs	403 - 1,170 cfs	146 - 511 cfs
USGS station	32A100	32B075	14015000
Time period	2010 – 2018	2010 – 2018	2010 – 2018

Flooding & Flood Control

Annual **high flow events** occur in the watershed as well as less common—but more impactful—**major flood events**, which most recently occurred in the winters of 1996–1997 and 2020. Floods typically occur during winter and spring in the watershed and may be caused by intense rain, rapid snowmelt, or both. Frozen ground conditions can exacerbate flooding during the winter, but summer floods can still occur from large thunderstorm events. Significant channel migration, erosion, and sediment and debris deposition can be associated with large floods in the basin.

The Walla Walla River has experienced major flooding during the winter, with one of the largest floods on record occurring in 1964 near Touchet, with an estimated peak discharge of 33,400 cfs. Streams in the Walla Walla Basin have experienced significant floods in 1906, 1931, 1949, 1951, 1964, 1972, 1985, 1996, and 2020. The flood of 2020 may have been higher than recorded as the max stage at the gage near Touchet exceeded the station limit. Five of these major events have occurred in the month of February. High velocities of up to 14 feet per second can occur in the floodplain [34, 35, 36]. Figure 12 shows Walla Walla River annual high flows.

The Touchet River system has experienced major flooding on a similar timeframe. The largest recorded flood event occurred in 1964 with a peak discharge of 9,350 cfs at Bolles and 11,500 cfs near the mouth of the Touchet River. Peak streamflow measurements were discontinued on the Touchet River in 1989, although major flood events were observed in 1996 and 2020 [34, 37, 36]. The annual high flow from 1925 to 1989 at the USGS gage on the Touchet River at Bolles is shown in Figure 13.

Mill Creek experiences frequent flooding with bankfull flows (over 600 cfs measured at the USGS Gage on Mill Creek Near Walla Walla) occurring in 64 out of 83 years of the historical record (Figure 14). Mill Creek can also see flash flood events over short periods, typically caused by intense rain during times when soils are already saturated [34, 35, 36]. See Figure 14 for data detailing these flood events.

The numerous tributary and distributary creeks in the Walla Walla Basin are also subject to periodic flooding, although with limited gage data and historic records. The occurrence and characteristics of floods are similar to Mill Creek, having a rapid response to winter rainfall and snowmelt with short-lived but intense high flows. There is also the potential for flooding from summer thunderstorms. Russell Creek, Lower Yellowhawk Creek, Coppei Creek, and Dry Creek are known to have suffered from flooding in the past century. Patit Creek is a major source of flooding in the City of Dayton, and Mustard Hollow is another potential flooding source [34, 37].

Figure 12. Annual peak streamflow: Walla Walla near Touchet (USGS 14018500).

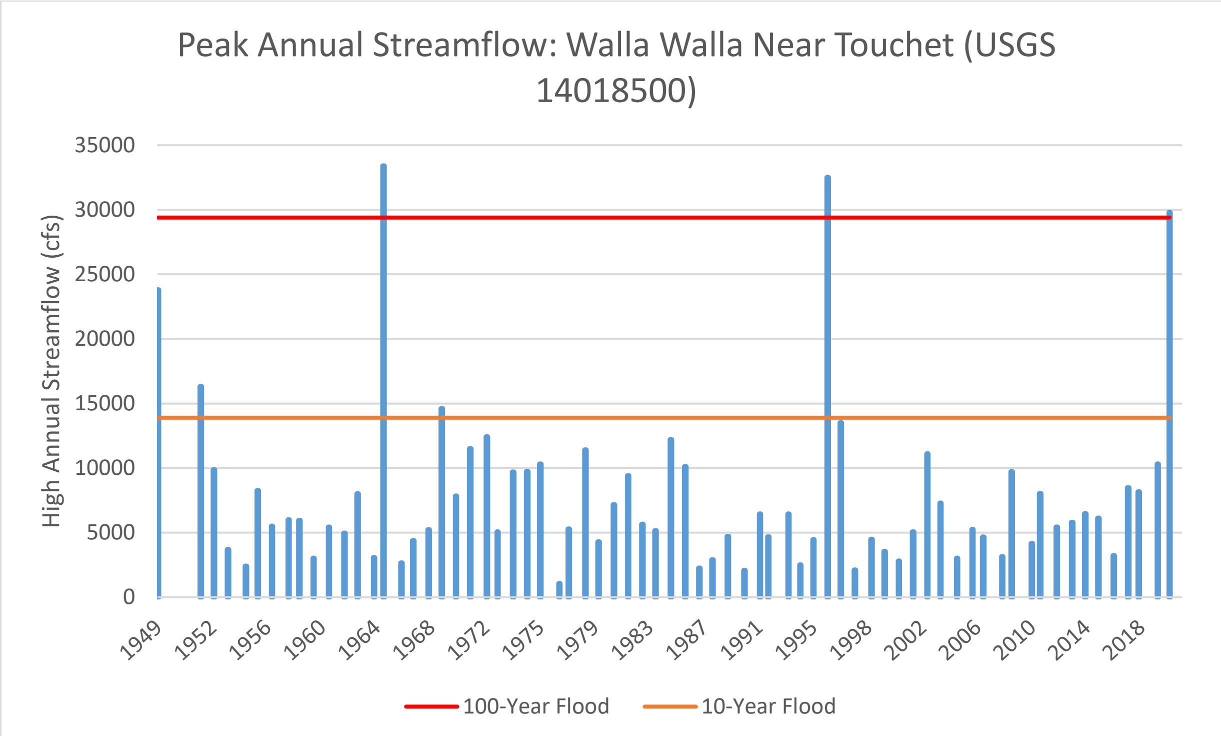


Figure 13. Annual peak streamflow: Touchet at Bolles (USGS 14017000).[10]

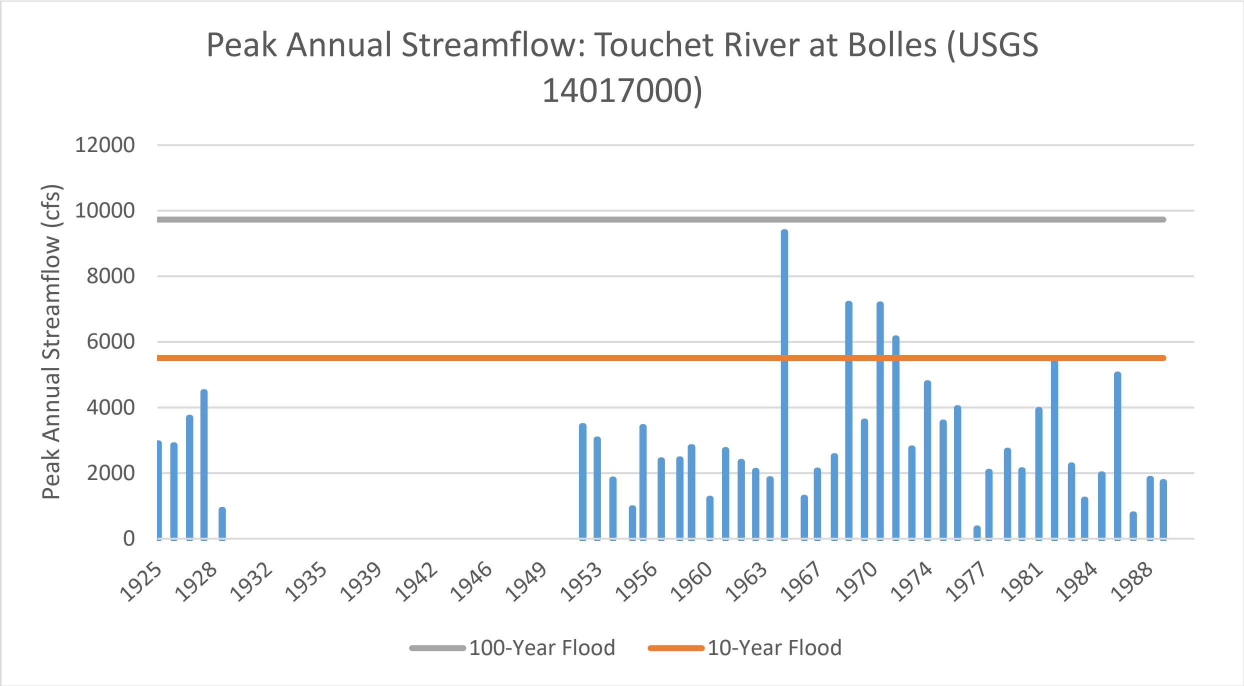
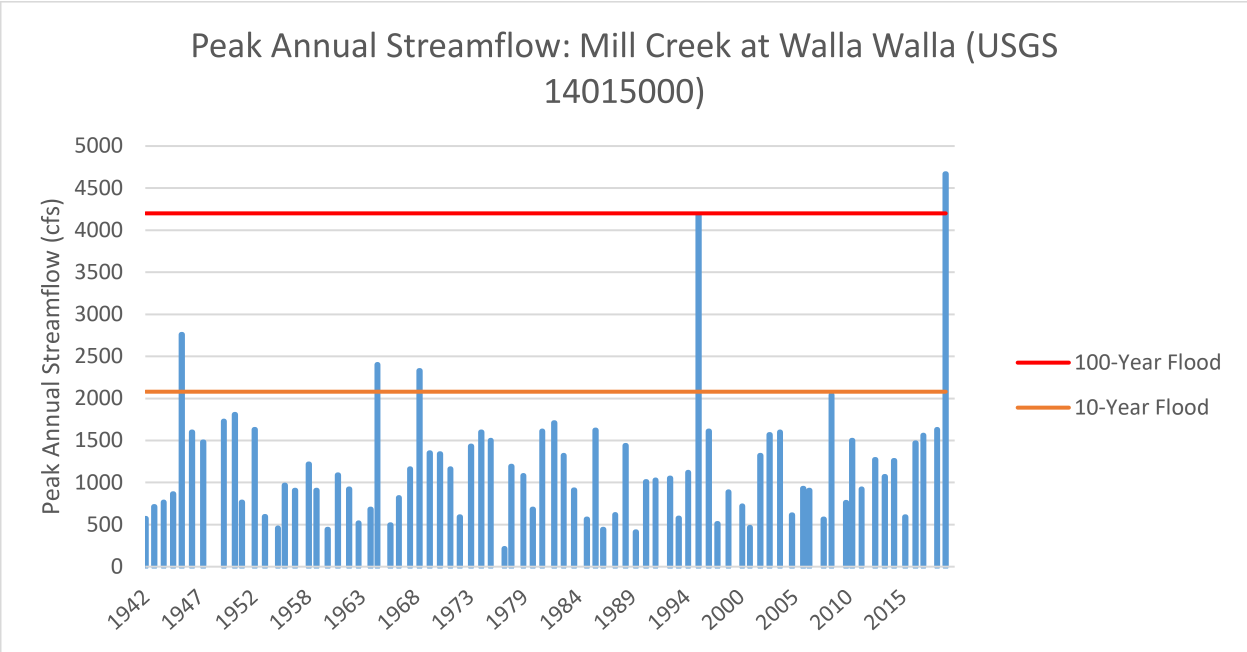


Figure 14. Annual peak streamflow: Mill Creek near Walla Walla (USGS 14015000).



[10] 1988 is last available peak streamflow statistic data from USGS. This gage is still active but has not recorded peak streamflow data since that time.

In February 2020, heavy rains and quickly melting snow caused major flooding and significant damage throughout the region. Mill Creek and the Walla Walla River experienced some of their highest flow events in recorded history. The Mill Creek gage near Kooskooskie upstream of Walla Walla recorded flows of 7,450 cfs that translated to a record flood, the largest in the 83-year historical record for this area. Mill Creek downstream of the Bennington Lake and Yellowhawk Creek diversions experienced its second largest flood in the 76-year historical record with flows recorded at 4,164 cfs (about a 100-year flood event). Similarly, the Walla Walla River near Touchet recorded flows of 30,109 cfs that resulted in an over 100-year flood event [38, 36].

The flow levels that result in 10-year (i.e., floods having a 10 percent chance of occurring any given year), 100-year (1 percent annual chance), and 500-year (0.2 percent annual chance) flood events for select locations in the three main rivers in the watershed are show in Table 13.

Table 13. Peak flow recurrence intervals, calculated through 2014 [39].

Water Body	Location	10-Year Flood Peak Flow (cfs)	100-Year Flood Peak Flow (cfs)	500-Year Flood Peak Flow (cfs)
Walla Walla River	Near Touchet, WA	13,900	29,400	44,100
Touchet River	At Bolles	5,510	9,730	13,000
Upper Mill Creek	Near Kooskooskie	2,080	4,200	6,180

Changes to stream channels throughout the basin have both helped and exacerbated flood impacts. The Mill Creek flood control project and storage reservoir (Bennington Lake, capacity 8,300 acre-feet) was constructed upstream of the City of Walla Walla to reduce flood flows through the city [34, 7]. Sections of Mill Creek were converted into a concrete channel (a portion of which flows underground through City of Walla Walla) and a weir-lined channel with riprapped levees through the City of Walla Walla to help mitigate flood and erosion impacts. The flood control channel is designed to allow flows of up to 3,500 cfs while maintaining additional freeboard from the water level to the top of the channel. The City of Walla Walla has not flooded since this facility was constructed.

Likewise, much of the Walla Walla River mainstem in Oregon is bounded by levees put in place for flood protection. The Nursery Bridge drop structure was designed to protect the bridge by addressing headcutting while allowing for fish passage; however, channel incision and fish passage remains a challenge at this site. Along the Touchet River, levees constructed to protect the cities of Waitsburg and Dayton have (1) been breached in high-flow events, (2) altered floodplain processes, and (3) reduced the amount of available habitat for critical species [40, 41]. At the same time, additional stream channel alterations—such as narrowing of formerly broad stream channels to facilitate irrigation diversions or building of dikes to protect agricultural and residential properties—have made high flow events more likely to result in damaging flooding [7].

Historically local landowners and farmers have built levees and dikes along Mill Creek, the Walla Walla River, and the Touchet River throughout the basin to stabilize stream banks and reduce flooding. Other local and federal agencies have also implemented channel clearing and emergency levee construction in some areas. However, these measures are not considered adequate to protect against larger floods (e.g., 100-year flood events) [34]. Likewise, much of the Walla Walla River mainstem in Oregon is bounded by levees put in place for flood protection.

Flood control efforts, such as levees and concrete structures, can have significant impacts on habitat. These structures disconnect the channel from its natural floodplain, impacting alluvial aquifer exchange, riparian habitat, wood and sediment recruitment, high flow refugia and habitat complexity for fish, and a myriad of water quality concerns. The Mill Creek flood control channel presents a fish passage barrier at low flows and provides minimal habitat for fish. Leveed sections of rivers, commonly found in the Walla Walla Basin, can also have severely incised channels. While high flows used to dissipate energy across the floodplain, levees focus energy from high flow events into the channel, scouring sediment away [7]. When this energy becomes focused on a leveed bank, it can result in levee failure. Further, impervious surfaces in urban landscapes increase rapid runoff during high intensity precipitation and exacerbate scouring and water quality degradation.

Water Quality

Two primary types of pollution reduce surface water quality within the Walla Walla Watershed [42]:

- **Point source pollution** comes from a discrete source. In the watershed, point source pollution primarily comes from industrial activity and wastewater treatment plants (WWTP) for the cities of College Place, Dayton, Walla Walla, and Waitsburg. Leaks from historic landfills within floodplains may also contribute point source pollution to streams.
- **Non-point pollution** comes from widely distributed sources. A variety of land use practices—including forest and agricultural practices, urban landscaping practices, fertilizer and pesticide application, and stormwater runoff—contribute to non-point pollution. Stormwater is the biggest contributor to water quality problems in urban areas while agricultural practices are the largest source of non-point pollution in rural areas.

The **Clean Water Act** (CWA) regulates both sources of pollutant discharges into U.S. waters and regulates water quality standards. The CWA requires states to develop a **Total Maximum Daily Load** (TMDL) plan for each water body on the states' polluted waters list (**Section 303(d) list**). The acronym "TMDL" refers to the highest amount of a pollutant that a surface water body can receive and still meet standards and includes a technical study followed by a water quality clean-up and monitoring plan.

Table 14 lists completed TMDLs for the Walla Walla River, Mill Creek, and the Touchet River, as reported by the Ecology and the Oregon Department of Environmental Quality (DEQ). Not all reaches share these overarching subbasin water quality concerns.

Table 14. Summary of TMDLs in Walla Walla Watershed [43, 44].

Pollutants	Walla Walla River (Washington side)	Walla Walla River (Oregon side)	Touchet River	Mill Creek
Chlorinated pesticides	✔		✔	✔
PCBs[11]				✔
Fecal coliform	✔		✔	✔
Temperature	✔	✔	✔	✔
pH & dissolved oxygen	✔		✔	✔

In addition to these major streams, there are 28 total streams—including many tributaries—on the 2004[12] 303(d) list and individual TMDL reports provide additional detail on pollutants and affected reaches [42]. While there are no TMDLs published for sediment in the basin, **sediment is a significant water quality concern throughout the watershed** and can exacerbate many other water quality problems [3]. The absence of a TMDL in a given location does not necessarily mean there is no water quality impairment there. Resources for monitoring and enforcing water quality are limited, so TMDLs and 303(d) listings may simply represent places where sufficient monitoring has occurred.

Ecology has established limits for the pollutants in Table 14 according to their **potential impacts on both human and ecological health in the basin**. Chlorinated pesticides and PCBs are suspected human carcinogens, can render fish unhealthy to eat, and can bioaccumulate in human and animal tissues leading to health problems [42]. Likewise, fecal coliform bacteria causes illness in people. Excessive temperature, pH, and dissolved oxygen individually and together contribute to unhealthy conditions for the watershed's aquatic species. Fecal coliform, PCBs, pesticides, and pH water quality problems can occur in and downstream of both urban and rural areas. Solutions to mitigate their impacts are limited for many of these factors, including the high background (natural) phosphorus and pH values that are geologically induced as opposed to human-caused [45] .

Road building, farming, development, and other land-alterations are **non-point sources** of pollutants and can lead to sediment runoff into area streams. In addition to carrying pollutants, high sediment loads can clog the substrate of area streams that fish depend on for spawning and can decrease dissolved oxygen levels below optimal levels for aquatic species.

Elevated temperature is the most widely documented water quality issue in the Walla Walla Basin. Temperature problems occur throughout the basin. Drivers of temperature problems include discharge of warm, treated municipal wastewater into area streams, lack of riparian shade combined with low stream flows, and reduced cold water inflows via spring and groundwater seepage into streams. Human alteration of the watershed, including channel straightening and simplification, has

---

[11] Polychlorinated Biphenyls (PCBs) are ubiquitous in the watershed and have a ripple effect. For example, the cost of monitoring PCBs is so burdensome, the Walla Walla Basin Watershed Council (WWBWC) halted all four manage aquifer recharge (MAR) site operations and future site development on the Washington side of the basin.

[12] Ecology notes a new list is currently under internal review and uses data gathered in 2018. Ecology anticipates completing this work and making it available to the public by end of 2021.

resulted in the loss of hyporheic exchange (a major contributor to stream cooling in many locations) and removed significant amounts of streamside vegetation, leading to widespread temperature problems in area rivers and streams. Low flows and lack of channel complexity exacerbate temperature issues caused by lack of riparian shade: low flows allow water to heat up faster while lack of channel complexity leaves streams without the pools and wood structures that help cool water.

Washington TMDL Details

Washington's water quality standards are based upon protection of beneficial uses according to Chapter 173-201A of the Washington Administrative Code (WAC). These uses are broken into:

- **Recreational uses**: Water contact recreation (e.g., wading, swimming, etc.), sport fishing, boating, and aesthetic enjoyment.
- **Aquatic life uses**: Salmonid and other fish migration, rearing, spawning, and harvesting. Salmonid species in the Walla Walla Basin include: Spring Chinook salmon (Oncorhynchus tshawytscha), Rainbow/Steelhead Trout (Oncorhynchus mykiss), Bull Trout (Salvelinus confluentus), and Mountain Whitefish (Prosopium williamsoni). The lower reaches of the Basin are mainly used by these species for migration and some rearing, while the headwaters provide a majority of the spawning habitat.
- **Water supply uses**: Agriculture extracts water for irrigation and stock watering and the City of Walla Walla uses Mill Creek as a drinking water source.

Washington previously used a classification system to categorize standards for each stream. Now fresh waters are classified by beneficial use (e.g., fish habitat, swimming, water supply), rather than by class (AA, A, B, C, and Lake classes), to make the standards less complicated to interpret and provide future flexibility as the uses of a water body evolve. Table 15 highlights changes over time to fish usage classification in the Walla Walla Basin.

Table 15. Water quality standards revisions from the previous classification system to beneficial use system.

1997 Standards Classification	Water Quality Parameter	2006 Use Revision	2006 Criteria
Class AA	Temperature	Char Spawning and Rearing	12°C 7-DADMax
		Core Summer Salmonid Habitat	16°C 7-DADMax
	DO	Either of above	9.5 mg/l 1-DMin
	pH	Either of above	6.5 to 8.5 units
	Bacteria	Either of above	50 cfu/100ml
	Turbidity	Either of above	5NTU and 10%
	TDG	Either of above	110%
Class A	Temperature	Char Spawning and Rearing	12°C 7-DADMax
		Salmonid, Spawning Rearing, and Migration	17.5°C 7-DADMax
	DO	Char Spawning and Rearing	9.5 mg/l 1-DMin
		Salmonid, Spawning Rearing, and Migration	8.0 mg/l 1-DMin
	pH	Either of above	6.5 to 8.5 units

1997 Standards Classification	Water Quality Parameter	2006 Use Revision	2006 Criteria
	Bacteria	Either of above	50 cfu/100ml
	Turbidity	Either of above	5NTU and 10%
	TDG	Either of above	110%
Class B	Temperature	Salmonid Rearing and Migration Only	17.5°C 7-DADMax
	DO		6.5 mg/l 1-DMin
	pH		6.5 to 8.5 units
	Bacteria		200 cfu/100ml
	Turbidity		10NTU and 10%
	TDG		110%

Ecology mapped **non-point source TMDLs on the Walla Walla River** to assist with prioritizing funding and technical assistance to meet targets. The prioritization was twofold, including riparian and upland areas. Within riparian areas, Ecology separated spaces for primary and secondary restoration and for primary protection as shown in Figure 15. Restoration work in the basin has altered conditions such that a prioritization today might have different results. Figure 15 nonetheless provides a broad perspective on where Ecology prioritizes work towards meeting non-point source TMDL goals.

As part of developing a water quality implementation plan, Ecology crafted a list of stormwater management **best management practices (BMPs)** that, when implemented, can **support meeting TMDLs**. Ecology divided the BMP list between rural and urban practices. While this plan does not present the comprehensive/voluminous list of BMPs, **many overlap with strategies proposed in this plan** to address water quality impairment, habitat, floodplain, groundwater, and surface water health. For example, revegetation of riparian zones and additions of large woody debris help improve stream temperatures while being important habitat restoration measures. Similarly, increasing streamflows helps reduce stream temperatures in addition to its habitat and hydrologic benefits. Adding stream length and sinuosity to increase hyporheic exchange also helps to decrease stream temperatures. Urban BMPs generally focus on managing stormwater but are also important for flood control, groundwater health, conservation, and runoff prevention.

The **primary regulated point sources in the watershed are cities and their wastewater treatment plants** including the cities of Dayton, College Place, Walla Walla, and Waitsburg (Table 17).[13] Ecology requires (1) any construction site one acre or larger to obtain a construction stormwater permit; and (2) industrial sites that discharge stormwater into surface sources or a storm drain system that connects to surface water to have a permit.

Table 16 summarizes non-point source load allocations in the Washington portion of the basin for the Walla Walla River, Touchet River, and Mill Creek. Table 16 also presents the **temperature and pH/dissolved oxygen TMDLs set for all reaches. Fecal coliform reduction targets exist for most**

[13] City of Milton-Freewater stores its treated wastewater and irrigates non-edible crops.

reaches and range from 6 percent up to 94 percent in Mill Creek at Ninth Street in Walla Walla. The only reach in Table 16 with a PCB TMDL is Mill Creek at the mouth.[14]

Ecology proposes using **total suspended solids (TSS) and turbidity** for the Walla Walla River to measure water quality and the amount of chlorinated pesticides. Compared to the metric of chemical concentration, these metrics are (1) more affordable, (2) easier to monitor, and (3) provide a more direct connection to what meeting these targets actually mean for the community and environment. For instance, targets based on TSS and turbidity more clearly convey [46]:

- The implications of meeting these targets in land use practices.
- Environmental health, including the health of aquatic species.
- The associated aesthetic benefits of the environment.

[14] The full list of Washington non-point source TMDLs and specific TMDL documentation are available on Ecology's website: https://apps.ecology.wa.gov/publications/SummaryPages/0810094.html

Table 16. Washington non-point source load allocations by TMDL type for Walla Walla, Touchet, and Mill Creek reaches [42].

		January – June				June – October	July – August	May – October
		Chlorinated pesticide and PCB				Fecal Coliform	Temperature	pH & Dissolved Oxygen
Location		Total suspended solids (lbs/day)			PCBs (gm/day)	Target reduction (%)	Increase in shade (%)	(mg/L)
		50 mg/L	30 mg/L	15 mg/L				
Walla Walla River	Peppers Bridge (OR state line)	120,000	69,000				System potential mature riparian vegetation (vegetation capable of growing and reproducing on a site given climate, elevation, soil properties, plant biology, and hydrologic processes)	Natural background concentration of dissolved inorganic nitrogen and soluble reactive phosphorous
	Cummins Rd.	450,000	270,000			32		
	Hwy. 125					6		
	Last Chance Rd.					35		
	Detour Rd.					33		
	Touchet-Gardena Rd.					60		
Touchet River	Mouth	120,000	121,500					
	Hart Rd.					86		
	Hwy 125					72		
	Pettyjohn Rd.					46		
	Lamar Rd.					16		
	Cummins Rd.					81		
	Hwy. 12					78		
Mill Creek	Mouth	47,790	28,674		0.023	62		
	Roosevelt					76		
	9th St.					94		

This table does not include all the various tributary load allocations in the Washington portion of the basin.

Figure 15. Priority water quality protection and restoration areas in the Washington portion of the Walla Walla Basin (map created by Ecology, 2008).

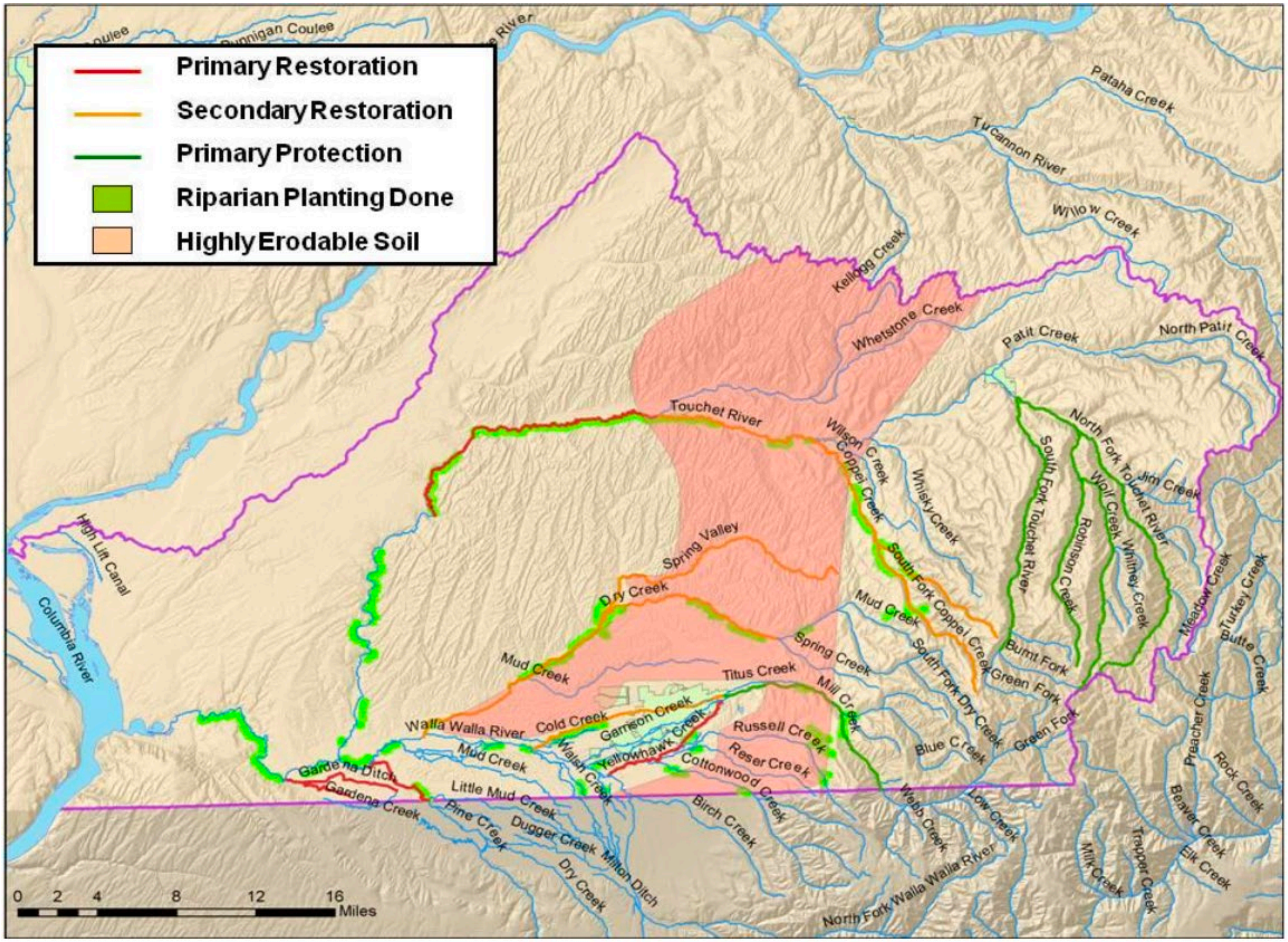


Table 17. Washington point source wasteload allocation by TMDL parameter and WWTP [42].

TMDL Critical Period →	January–June	June–October	July–August	May–October
Location	**Chlorinated Pesticides & PCBs**	**Fecal Coliform**	**Temperature**	**pH & Dissolved O_2**
Dayton WWTP*	Did not include in the study	Current permit limits	21.8 °C	• 0.28 lb/day for dissolved inorganic nitrogen (sum of nitrate, nitrite, and ammonia). • 0.2 lb/day for organic nitrogen. • 0.13 lb/day for soluble reactive phosphorus. • 0.09 lb/day for organic phosphorus.
College Place WWTP	• PCBs: 0.011 gm/day • TSS: current permit limits	2005 permit limits	Current permit limits	Remove effluent from receiving waters
Walla Walla WWTP	• PCBs: 0.0062 gm/day • TSS: current permit limits	Current permit limits (does not discharge during this time)	Does not discharge during this time and is in compliance	Does not discharge during this time and is in compliance
Waitsburg WWTP**	Did not include in the study	N/A – discharges to wetland	N/A – discharges to wetland	Requires further investigation to determine if the treatment plant's wetland is a source of nutrients. If so, prevent groundwater continuity between the wetland and the Touchet River.

** Ecology is currently working with Dayton and CTUIR to remove this discharge site.*

*** Waitsburg WWTP currently discharges to a wetland that is hydraulically connected to the Touchet River through hyporheic transport. Ecology's 2010 study (ECY Pub No. 10-03-028) identified low levels of nutrients (ammonia and total phosphorus) transmitted through the hyporheic zone to the Touchet River from the treatment wetlands.*

Oregon TMDL Details

The sole TMDL focus in Oregon is water temperature (Table 18). Unlike the Washington portion of the basin, Oregon has few point source pollutants. Point sources include the Town of Weston's wastewater treatment facility and CTUIR's fish acclimation facility on the South Fork Walla Walla River. Because none of the Oregon point sources discharge during the season of concern for temperature, and because they only discharge insignificant heat loads, the collectively issued temperature wasteload allocation for Oregon point sources is zero [47].

Table 18. Oregon temperature TMDLs [47].

Source	River Mile	Season
Mill Creek	22.9 to 26	Summer
North Fork Walla Walla River	0 to 18.7	Summer
South Fork Walla Walla River	0 to 27.1	Summer
Walla Walla River	40.6 to 50.6	Summer

Oregon's water quality standards for temperature are biological targets. **Biologically based temperature thresholds** in the Walla Walla subbasin include:

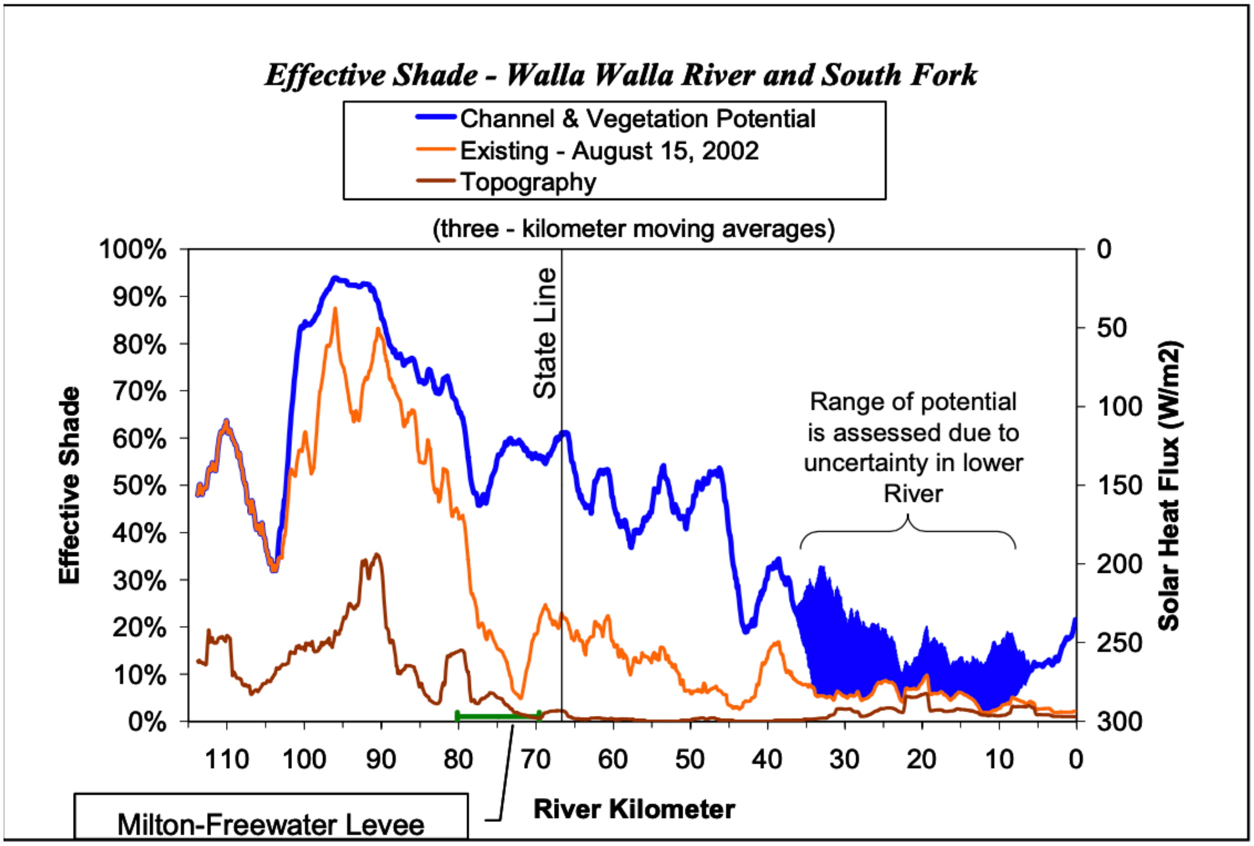
- **Salmon and trout rearing and migration** criterion (18°C), applicable at all times when not superseded by cooler criteria.
- **Core cold water habitat** criterion (16°C), applicable year-round in waters draining the mainstem in Oregon, except where cooler criteria apply.
- **Salmon and steelhead spawning** criterion (13°C), applicable above the state border to upstream part of the City of Milton-Freewater from January 1 through June 15.
- **Bull trout spawning and juvenile rearing** criterion (12°C), applicable above the state border during times of spawning and rearing.

Oregon's approach to meeting temperature TMDLs uses three surrogate measures in place of a single load allocation:

- **Site-specific effective shade** (Walla Walla River, South Fork Walla Walla River, and Skiphorton Creek only).
- **Effective shade curves**.
- **Channel width, stream type, and width/depth ratios** (Walla Walla River, South Fork Walla Walla River, and Skiphorton Creek only).

DEQ developed a temperature/hydrologic simulation model for the Walla Walla River and the South Fork Walla Walla River (Figure 16). The highest river mile in the model is on the South Fork Walla Walla River; river miles count down from there to the mouth. This model can calculate the required standard for revegetation based on river mile. For any given river mile in Oregon, the blue line represents the target revegetation/shade potential, above conditions that existed in August 2002 (orange line).

Figure 16. Temperature/hydrologic simulation for Walla Walla River and South Fork Walla Walla River [47].



Groundwater Quality

In addition to their direct impact on surface water in the basin, some of the pollutants discussed above also have implications for groundwater recharge projects. Water quality—most-specifically related to chlorinated pesticides, PCBs, nitrogen/phosphorous, total suspended solids, and turbidity—is an important factor in permitting MAR projects and aquifer storage and recovery (ASR) projects.

The four existing Washington MAR sites (inactive since 2017) have been well characterized with respect to PCB concentrations in soil. Operating sites have sufficient data to demonstrate that PCBs are not being conveyed through infiltration operations to groundwater. These data are being considered in deciding what (if any) additional PCB monitoring may be needed. Nutrient transport in groundwater to surface water likely contributes to instream dissolved oxygen deficits identified in TMDL. Future monitoring of nutrient content in groundwater at MAR sites will support ongoing efforts to manage and improve instream water quality.

Ecology and WWBWC co-managed the Washington MAR sites and understand the associated monitoring costs. The challenge in re-activating Washington's MAR sites (as well as in developing new sites) is planning that includes cost effective compliance monitoring and/or feasible source water quality treatment prior to MAR site infiltration.

Oregon currently has 14 active MAR sites and groundwater quality downgradient of MAR facilities was good during Water Year 2020. Groundwater quality data collected during aquifer recharge activities indicate that aquifer recharge activities are not degrading groundwater quality; rather, recharge activities typically improve groundwater quality due to the generally high quality of the source water [48].

Responsible parties are charged with treating water injected into the subsurface for ASR to drinking water quality standards, which imposes high analysis and treatment costs. Consequently, the City of Walla Walla and the U.S. Forest Service (USFS) actively protect water quality in the Upper Mill Creek watershed, which is the source of surface water for municipal supply and ASR wells. Maintaining low total suspended solids and turbidity in Mill Creek source water directly benefits the City of Walla Walla by reducing water treatment costs for the City's ASR program.

3.3 GROUNDWATER CONDITIONS

Groundwater conditions vary across the basin. In general, groundwater occurs in two aquifer systems, simplified for the purpose of this Plan:

- **Alluvial aquifer** consists of Pliocene to recent age water-bearing sediments and sedimentary rocks with local, poorly permeable interbeds.
- **Basalt aquifer** comprises multiple aquifers occurring in Miocene age rocks of the Columbia River Basalt Group (CRBG) [49]. Individual aquifers generally consist of porous basalt interflow zones that occur between dense, low-permeable basalt flow interiors.

Recharge and discharge rates, surface water connectivity, and groundwater movement between and within the alluvial and basalt aquifer differ laterally and vertically in the basin. Locally, the geometric and hydraulic properties of aquifers tapped by wells also vary and control short- and long-term groundwater supply rates.

Figure 17 shows the geographic distribution of alluvial and basalt wells in Oregon and Washington. The wells in this dataset originate from OWRD. Oregon wells have been field located by OWRD staff or mapped from legal descriptions in water rights. Washington well locations are from older USGS studies, primarily Newcomb (1965) [50]. The "unspecified wells" (shown in grey dots on map) are currently unspecified by aquifer—some of these wells are in the alluvial aquifer and others in the basalt aquifer.

The following sections discuss groundwater level trends for a select number of alluvial and basalt aquifer wells (shown in Figure 18).

Figure 17. Subset of wells in the basin (OWRD, February 2021) [51].

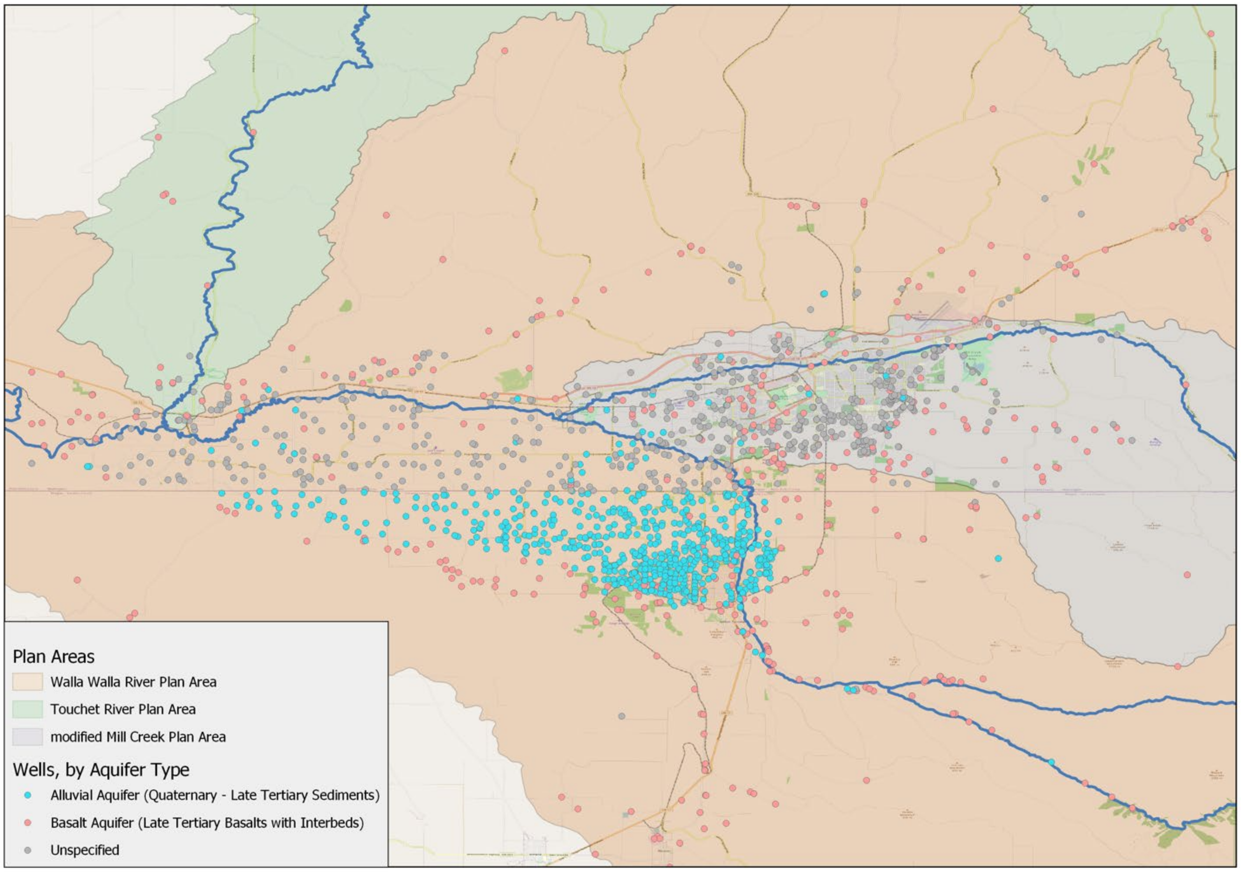
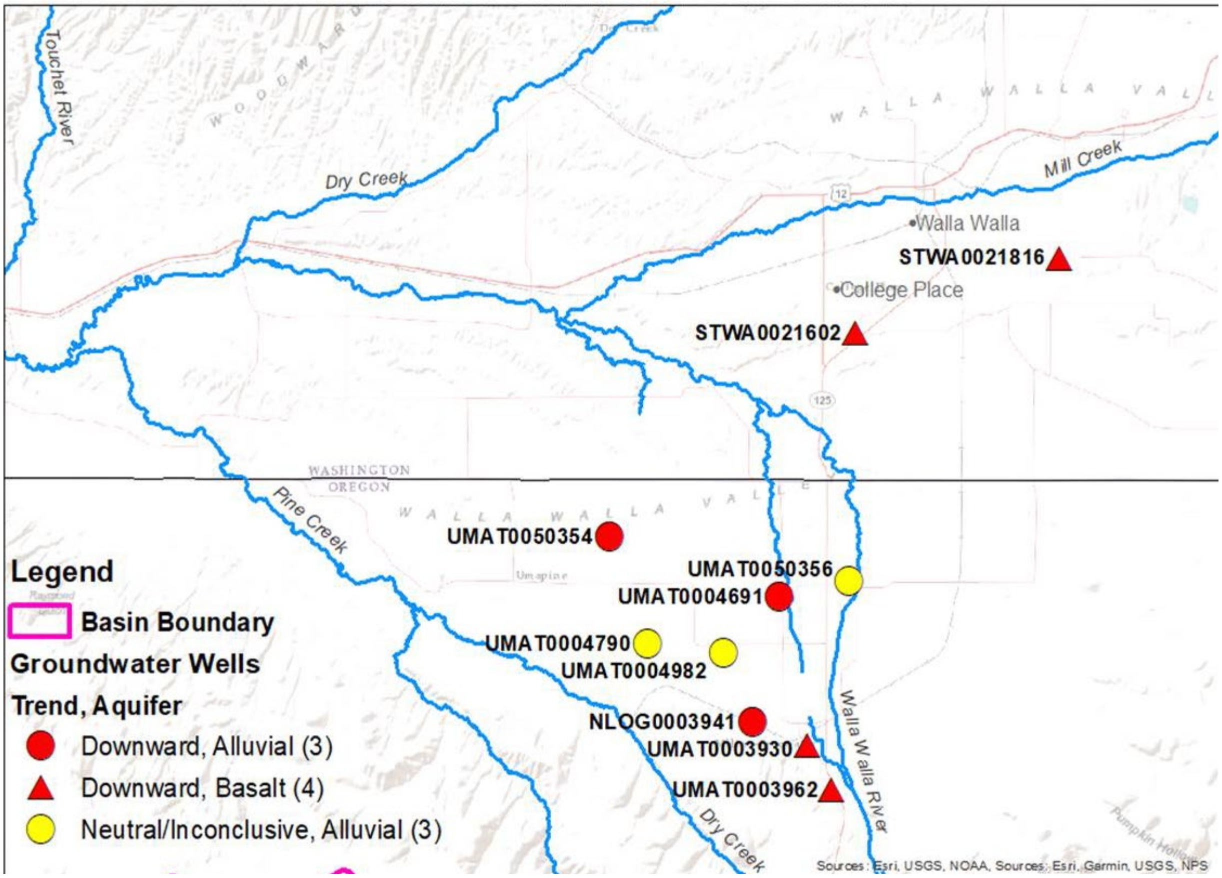


Figure 18. Select alluvial and basalt aquifer wells [51]. Wells were selected based on sufficient length of the period of record, number of data observations, and those not associated with ASR or MAR projects. Groundwater trend was determined based on the entire period of record for each well.



Alluvial Aquifer

The alluvial aquifer is an important **source of water for the agricultural sector and rural communities**, where many wells are constructed. Aquifer thickness ranges from tens to several hundreds of feet. The alluvial aquifer interacts with the Walla Walla River, Touchet River, Mill Creek, and many of the distributary networks of streams and springs. In gaining reaches, the alluvial aquifer discharges cool, high-quality water locally to the Walla Walla River, Touchet River, and Mill Creek (and their tributaries) and feeds wetlands, springs, and seeps. In losing reaches, the river loses water to the alluvial aquifer and recharges it.

Although groundwater levels rise seasonally near some MAR sites, **water levels are declining throughout a significant portion of the basin**. Long-term trends (over a period of 70 years) in Oregon and Washington indicate water level declines. As a result, cool groundwater discharging to rivers, creeks, and springs is declining, and the amount of water available to irrigation and rural-domestic wells has decreased.

Historic and current water level declines in the alluvial aquifer are attributable to **management changes affecting hydrologic and floodplain systems** and include [52]:

- River and creek channelization, resulting in loss of recharge in historic floodplains and across the Walla Walla River and Mill Creek alluvial fans.
- Diversion of surface water from stream reaches where recharge occurred historically.
- Groundwater withdrawals for water supply (irrigation and domestic) and its reduction of alluvial aquifer water storage.
- Efficiency in agricultural water conveyance and irrigation, locally and more recently, reducing recharge beneath the uppermost soil layer.

Figure 19 and Figure 20 provide example hydrographs illustrating long-term, downward trends in portions of the aquifer in Oregon. Many alluvial wells throughout the basin show tens of feet of water level decline over many decades as water was withdrawn at a rate faster than replenishment. Table 19 summarizes long-term water level trends analyzed for six alluvial wells in the Oregon part of the basin. All show long-term declines; **rates of decline range from 0.03 to 0.4 feet per year**.

Figure 19. Hydrograph (depth to water level) for alluvial aquifer well UMAT4982 (GW16) in Oregon [23].

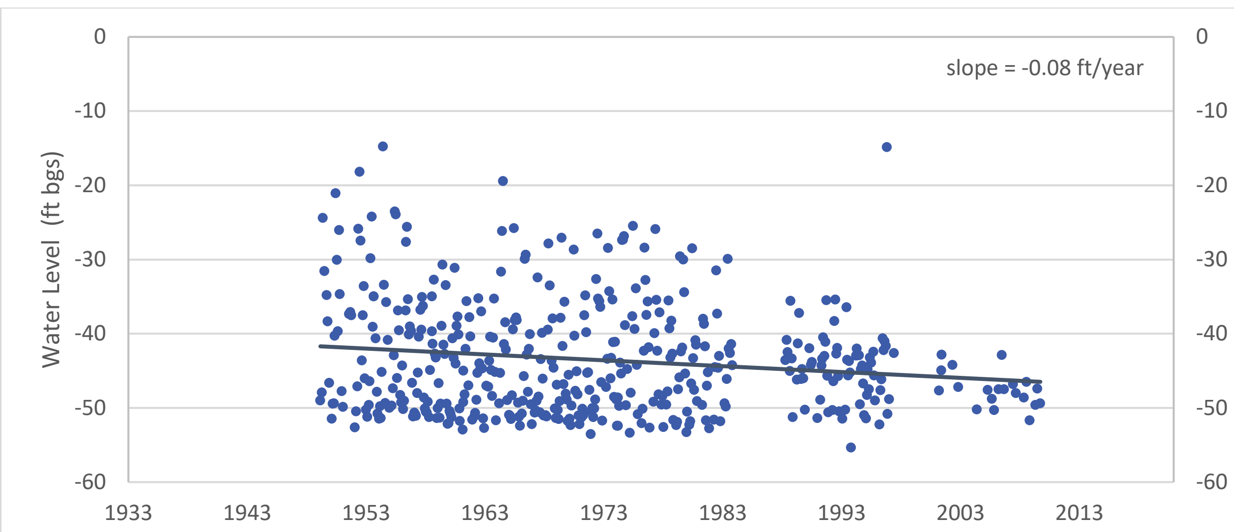


Figure 20. Hydrograph (depth to water level) for alluvial aquifer well UMAT4691 (GW19) in Oregon [23].

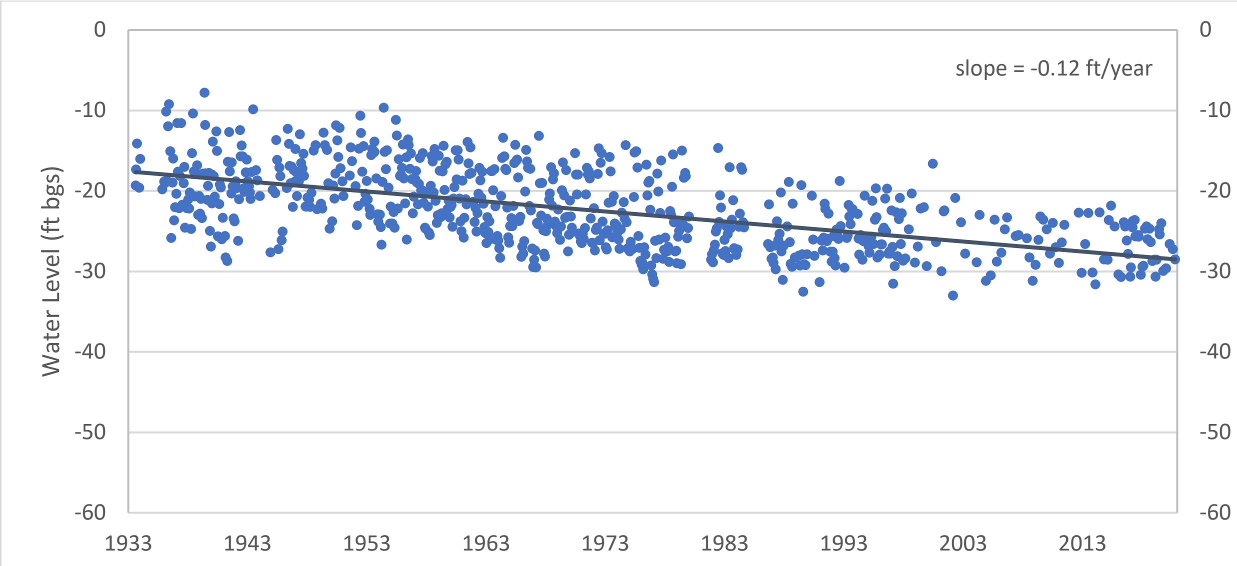


Table 19. Water level trends in alluvial wells [53].

Well ID	Period of Record (From)	Period of Record (To)	Location	Water Level Linear Trend (-down, +up, ft/year)
NLOG0003941	1986	2016	OR	-0.38
UMAT0050354	1933	2020	OR	-0.20
UMAT0004691 (GW19)	1933	2020	OR	-0.12
UMAT0004790	1932	2009	OR	-0.09
UMAT0004982 (GW16)	1949	2009	OR	-0.08
UMAT0050356	1933	2020	OR	-0.03

No new consumptive, unmitigated water rights have been issued for the alluvial aquifer on the Washington side of the basin since 2003. The aquifer was closed to new consumptive (non-domestic) water rights in accordance with the Basin Management Rule in 2007. On the Oregon side, alluvial and basalt groundwater is restricted for exempt well use only [54].

Conclusions about the local causes for water level declines at individual wells in the alluvial aquifer are beyond the scope of this Plan. In the coming years, the USGS and its partners may shed light on these causes, correlations, and conditions.

Basalt Aquifer

The basalt aquifer is an important source of water for the agricultural sector, municipalities, and industrial/commercial entities. Water wells may be constructed across hundreds of feet of basalt to yield water from multiple, thin water-bearing zones. Locally, and in the headwater areas of rivers and creeks, these aquifers occur at land surface and provide a significant source of flow to streams. Declines in water levels and storage in the basalt aquifers vary across the basin. **Recharge rates and storage properties are typically low, and the declining water levels, indicate that water use**

exceeds recharge in some areas. Faulting can impede flow in parts of the basalt aquifer and exacerbate these dynamics.

The hydrographs shown in Figure 21 and Figure 22 contain water level data for winter (January and February) and other non-pumping conditions. These hydrographs illustrate long-term, downward trends in portions of the aquifer in Washington and Oregon.

Figure 21. Winter/non-pumping hydrograph (depth to water level) for basalt aquifer well STWA21602 in Washington [53].

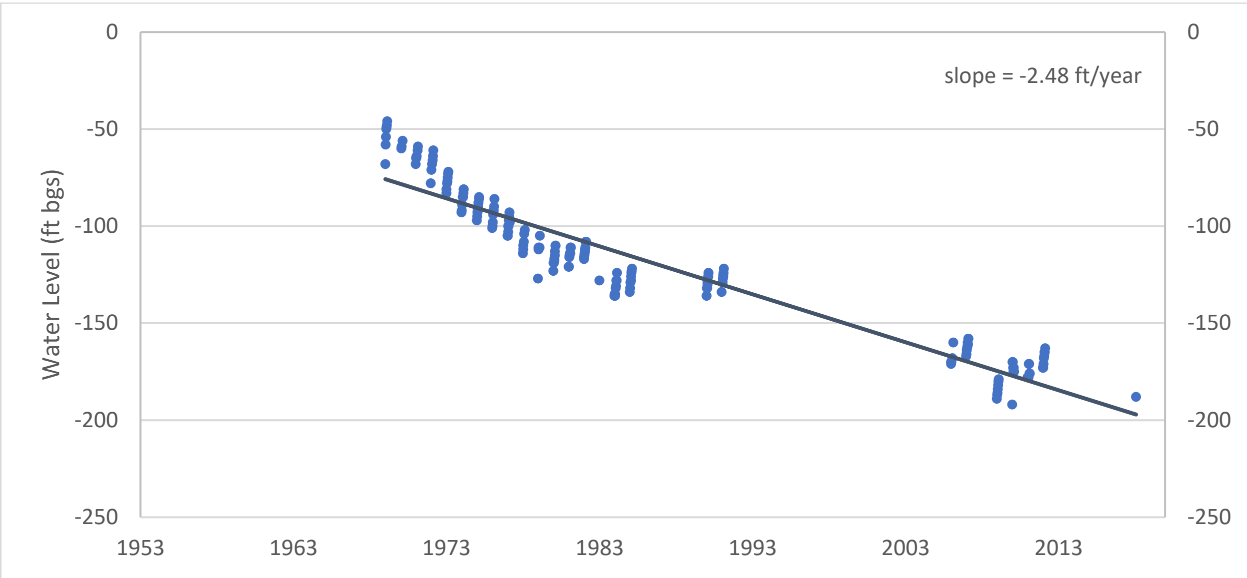


Figure 22. Winter/non-pumping hydrograph (depth to water level) for basalt aquifer well UMAT0003930 in Oregon [53].

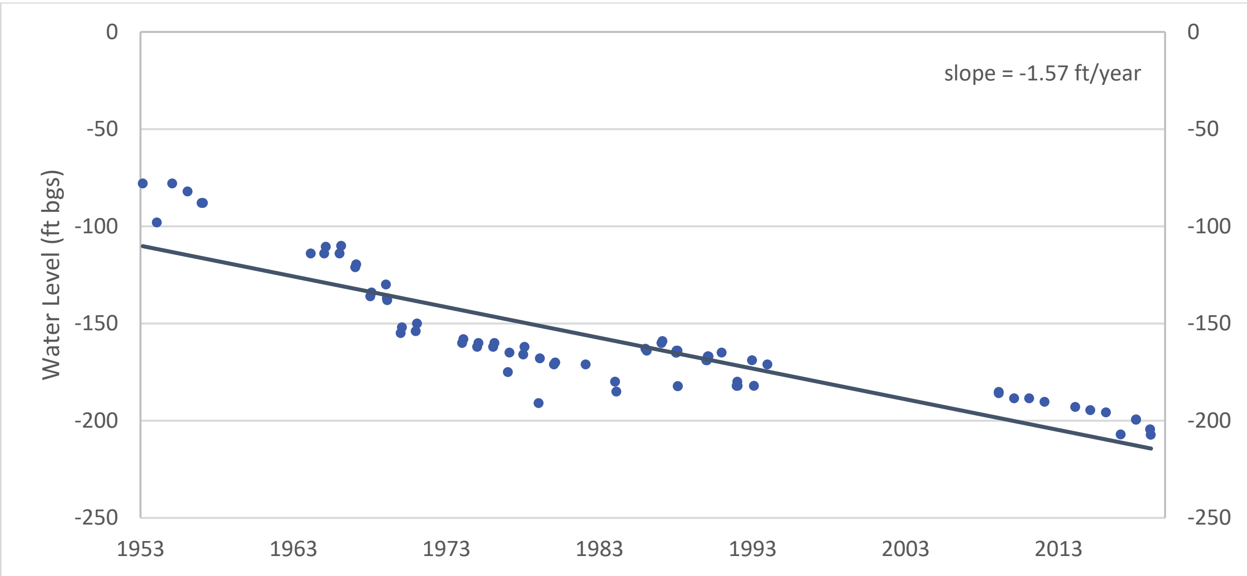


Table 20 summarizes long-term water level trends analyzed for four basalt wells in the basin. All show long-term declines; rates of decline are approximately one to three feet per year.

Table 20. Winter/non-pumping water level trends in basalt wells [53].

Well ID	Period of Record From	Period of Record To	Location	Water Level Linear Trend (-down, +up, ft/year)
STWA0021602	1969	2018	WA	-2.48
UMAT0003930	1953	2019	OR	-1.57
UMAT0003962	1955	2021	OR	-1.56
STWA0021816	1958	2018	WA	-1.38

Reasons for Water Level Declines

Over the last 70 years, water levels in the basalt aquifer have been declining at rates of approximately one to four feet per year on the Oregon side of the basin [55], with total declines of over 100 feet in some areas. Similar declines have occurred on the Washington side. These declines not only limit supplies for irrigators and municipalities, but also increase pumping costs [56]. Locally, **declines are substantial where wells withdraw water from the parts of the aquifer that receive low amounts of recharge relative to withdrawal rates**. In other areas, recharge may be limited by faults that "bound" blocks of the basalt aquifer.

Recent work by von Stolk shows that the age of water in the basalt aquifer ranges locally from 5,000 to 15,000 years [57].[15] These ages may indicate relatively long groundwater flowpaths from recharge areas in the Blue Mountains to water wells where groundwater is withdrawn. Alternatively, they may indicate shorter flowpaths, where and when recharge occurred at higher rates than what we see today. Such periods may have occurred during the last glacial period (10,000-15,000 years ago), when more water was present in the basin due to flood events and lakes. Regardless of whether recharge occurred via long or short flowpaths, these age dates, combined with long-term water level trends, provide important metrics to examine the sustainable yield from wells constructed in the basalt aquifer.

Implications of Water Level Declines

Long-term water-level declines suggest that the **current withdrawals from this water source are unsustainable**. Such declines can be reduced by either decreasing withdrawals (pumpage) or increasing recharge. In some areas, declining water levels may indicate the presence of basalt "blocks" that are somewhat hydraulically isolated and may therefore be favorable for aquifer storage and recovery (ASR). In these hydrogeologic settings, recharged water may be reasonably contained, so that treated "source" water can be injected, stored, and then pumped out for use as needed.

[15] Approximate age of the water—as measured from the time a drop hits the ground and infiltrates, then travels along a groundwater flow path to a water well where it is pumped out, and in this case, sent to a lab for carbon-14 dating.

For decades, the City of Walla Walla has been researching, developing, and utilizing basalt ASR facilities to treat Mill Creek flows so that the City can store and later supply this recharged water to its customers. This technology could potentially be expanded to provide additional supplies, while leaving more water instream at critical times of the year. The City of Milton-Freewater and WWBWC have also investigated basalt ASR and the treatment of "surplus" winter river water for storage in the basalt aquifer for municipal and irrigation water use.

3.4 CRITICAL SPECIES & HABITAT CONDITIONS

The Walla Walla Watershed is home to several critical fish species and supports other regional plant and animal life, integral to the diets and culture of the CTUIR. Several factors threaten the health of the watershed's habitats, ranging from channel instability caused by human development activities to high temperatures that can reduce fish survival rates. This plan focuses specifically on the habitat conditions in the Walla Walla River, Touchet River, and Mill Creek subbasins. This section summarizes the current habitat conditions in these regions and the limiting factors impacting the health of all plant and animal species.

Critical Species

The Walla Walla Watershed is home to two fish species listed as threatened under the federal Endangered Species Act (ESA):

- **Bull Trout** are threatened by lack of stable stream channels, clean gravel, and complex and diverse cover; migratory passage obstructions [58]; and water temperatures that exceed the maximum (53.6 °F).
- **Middle Columbia River Steelhead** are threatened by sediment load, lack of habitat diversity, migratory passage obstructions, elevated stream temperatures, channel instability, reduced instream flow, and lack of key habitat [41]. The current 10-year average annual adult steelhead count is 750 fish compared to historical estimates as high as 16,500 fish [59].

Among the basin's fish species, bull trout have the most specific habitat needs (especially related to cold water) and as such, have a somewhat limited distribution. Conversely, steelhead spawn in every tributary that has sufficient passage and flows and rear year-round throughout the basin where there is sufficient water quantity and quality.

Beginning in 2000, CTUIR has led an effort to reintroduce and recover Spring Chinook in the basin. While not federally listed due to previous extirpation from the basin, Spring Chinook are another critical fish species. The current ten-year average adult Spring Chinook return count is 322 fish, only 6 percent of the basin return goal of 5,250 adults. The watershed is also home to other important species like resident Redband Trout, Pacific and Western Brook Lamprey, and freshwater mussels. The watershed supports traditional foods central to the diets and cultures of the CTUIR, such as deer, cous, and huckleberry. Further, important macroinvertebrate species living in the watershed provide food for fish and are an indicator of ecological health.

Habitat Conditions

While the Walla Walla Basin contains a variety of habitat types, this plan focuses on the nexus between water management and instream, riparian, and floodplain habitat conditions:

- **Instream habitat** comprises the vegetation, sediment, and wood within the water; it supports fish and other instream species.
- **Riparian habitat** is found along stream banks, supporting a variety of vegetation and wildlife.
- **Floodplain habitat** includes the stream and the adjacent valley bottom, which is naturally subject to flooding. It occurs along river corridors and includes wetlands, side channels, and riparian forests that are infrequently inundated. During flood events, floodplains provide refuge for fish, promote groundwater recharge and sediment dynamics, provide "seeding" for riparian growth, and recruit large, woody debris that contributes to habitat complexity.

Multiple limiting factors can constrain these habitats, including [41]:

- **Channelization and floodplain disconnection**. Human development activities (from adjacent crop production, levees, diking and urban development) can channelize streams and disconnect them from their floodplains, which in turn reduces habitat diversity and quality. Impaired streambed conditions can reduce egg, juvenile, and adult fish survival. Channelization and channel straightening/simplification can also result in a loss of hyporheic exchange with colder groundwater.
- **Reduced habitat diversity and quantity**. Fish depend on complex habitat, including wood, boulders, and pools. Reduced instream and riparian habitat availability, diversity, and/or degradation limits the number of salmonids and other fish species a river can support.
- **Invasive species**. Invasive fish species can compete with native fish species for food and habitat.
- **Flows**. Unnaturally low flows (due to irrigation or municipal diversion and/or declining groundwater levels) can reduce habitat suitability and exacerbate water quality and other limiting factors for fish; likewise, some high flow events in reaches without adequate floodplains can also degrade habitat.
- **Obstructions**. Dams, leveed reaches, and other built structures impede fish migration and bedload movement. Healthy bedload movement helps maintain habitat diversity and avoid sediment loading problems.
- **Sediment load**. Fine sediment can smother eggs and reduce the quality of juvenile rearing habitat. Lack of natural sediment transport (e.g., below Bennington Diversion Dam) can also degrade instream habitat due to an absence of coarse grain material.
- **High temperatures**. High temperatures can reduce fish survival at all life stages.

Table 21 summarizes key limiting factors facing species in the Walla Walla Watershed, per the Snake River Salmon Recovery Plan for Southeast Washington. Note that there are additional limiting factors not included in this table—for example, invasive plant species in many riparian areas such as Yellowhawk Creek and Garrison Creek, and the Little Walla Walla River branches.

The following sections briefly outline habitat conditions specific to the Walla Walla River, Touchet River, and Mill Creek Subbasins individually. While the subbasins share many limiting factors, each has unique limitations and issues; for example, low flow and high-water temperatures are a consistent challenge in all the subbasins, but channel conditions and other water quality parameters vary greatly across the landscape. Fish species and life stage presence also vary by subbasin, with important implications for management goals.

Table 21. Summary of limiting factors for the Walla Walla Basin.

	Channel stability	Habitat diversity	Habitat quantity	Invasive species	Flows	Obstructions	Sediment load	Temperature
Walla Walla River Subbasin								
Headwaters (North/South Forks)	X	X			X		X	X
Upper Mainstem	X		X		X	X	X	X
Lower Mainstem		X			X		X	X
Little Walla Walla River – Spring Branch				X	X	X		
Touchet River Subbasin								
Headwaters (North/South Forks)	X	X	X				X	
Mainstem	X	X			X		X	X
Mill Creek Subbasin								
Headwaters		X	X			X		
Lower Mill Creek		X	X		X	X	X	X
Yellowhawk/Garrison Distributaries	X		X		X	X		

Table Notes:

Summary of limiting factors for the Walla Walla Basin, **as described in Snake River Salmon Recovery Plan** for Southeast Washington [41]. Channel Stability is a term defined as, "Stability of the reach with respect to its streambed, banks, and its channel shape and location. The more unstable the channel, the lower the survival of eggs and juvenile fish." Channelization and floodplain disconnection are not limiting factor terms referenced by the Salmon Recovery Plan Analysis however they are now considered important factors in evaluating quality habitat and thus are listed in the bulleted list of factors above.

Walla Walla River Subbasin

Under current conditions, the highest quality habitat for species of concern is in the Upper Mainstem (upstream of the town of Milton-Freewater) and in the North and South Forks of the Walla Walla River. The upper mainstem extends from the confluence of the North and South forks to the town of Milton-Freewater. A further distinction on the mainstem includes the Tum-a-lum Branch which extends from Nursery bridge to the state line. The Little Walla Walla River includes the historic branches of the Walla Walla River from Nursery Bridge North and West to encompass the land watered by this branch of the Walla Walla River. The Lower Mainstem is a long reach—extending from Milton-Freewater across the Washington state line to the Columbia River. Primary habitat issues and fish use are described briefly by reach below:

- **Headwaters.** The Walla Walla River Headwaters are fairly pristine. Habitat diversity, flows, and water temperatures help support significant spawning and rearing habitat for all three critical species as well as Pacific Lamprey. Summer steelhead use both the North and South Fork for spawning and rearing; bull trout inhabit both forks. Primary limiting factors include water temperatures and low flows, stemming from downstream reaches.
  - The **South Fork** contributes 30 percent of the basin's total runoff [1]. The upper reaches of the South Fork provide significant amounts of cold-water habitat and some of the highest quality bull trout and other fish habitat in the entire basin. The South Fork is also the primary habitat for spring Chinook spawning and rearing. Agricultural irrigation diversions reduce flows as the river flows downstream to its confluence with the North Fork [13]. Road crosses the South Fork River 13 times, presenting a significant impact to instream channel habitat. The road washes out during high flows and unauthorized road repairs have often had a negative impact in instream conditions.
  - The **North Fork** contributes 8 percent of the basin's total runoff [1] and its flows are more limited, both naturally in its upper reaches and due to diversions for irrigated agriculture in its lower reaches. The lack of flow means that the North Fork is most suitable as rearing habitat for juvenile summer steelhead, though it has the potential to provide habitat for all critical species if low flows can be addressed [13]. Bull trout also use the North Fork [60].
- **Upper Mainstem**. Between the confluence with the forks and Milton-Freewater, the river lacks channel complexity, with moderate impacts from irrigation diversions. Below the town of Milton-Freewater, major irrigation withdrawals and the USACE leveed flood control channel significantly compromise flows and habitat. Milton Freewater Water Control District owns and operates this leveed reach; USACE certifies this levee system, making it eligible for rehabilitation with USACE assistance if damaged by high flow events. This channel includes dikes, levees, and the Nursery Bridge Dam, which creates a fish passage challenge. Downstream of Nursery Bridge, the river has little to no connectivity with its floodplain and very little riparian vegetation is present to maintain water quality through the summer. Below a flow of 150 cfs at Nursery Bridge Dam, CTUIR has documented impairment of adult Chinook and bull trout migration due to high water temperatures and a physical barrier at the dam [61].
- **Little Walla Walla River Branches.** LWWR is a historic distributary of the Walla Walla River and is currently managed by a headgate to control streamflow. LWWR branches suffer from low flows, invasive riparian plants, and poor riparian habitat. Fish are screened out of the top of the system but may enter from the downstream confluence with the lower Walla Walla River.

- **Lower Mainstem**. The lower mainstem is a critical over-winter rearing area for all salmonids. It is also an important migratory corridor for critical fish species, used primarily to access spawning and rearing habitat in tributaries, and is a critical link for anadromous fish in the watershed. Primary limiting factors are low flows and high-water temperatures. The lower part of the reach also experiences some water quality impairments in addition to high temperatures. Fish survival monitoring indicates about 50 percent of fish are lost in this area due to lack of channel complexity, hiding cover, and predator avoidance.
- **Pine Creek.** Pine Creek is a primary tributary to the Walla Walla River and enters the lower Walla Walla at River Mile 23.4. The Interior Columbia River Technical Recovery Team identified Pine Creek as a major spawning area for the Walla Walla summer steelhead population, with spawning and rearing occurring in lower reaches. Current steelhead spawning distribution is substantially reduced relative to the historical distribution, and there are several total or partial fish passage barriers in Pine Creek. Flow, habitat diversity, sediment load, obstructions, and key habitat quantity are the primary limiting factors for steelhead in Pine Creek [62] [63].

Touchet River Subbasin

Flowing out of the Blue Mountains, the headwaters of the Touchet include the North and South Forks and their tributaries which come together to form the Touchet River just upstream of Dayton. The Touchet Basin contributes 40 percent of the surface runoff for the Walla Walla Basin [1]. The middle Touchet River spans from the Touchet River downstream of Dayton to just below Waitsburg and includes Coppei and Whiskey Creeks. The Lower Touchet extends from the confluence of Coppei Creek to the confluence with the Walla Walla River. Major limiting factors in the Touchet River subbasin include lack of habitat diversity, low flows, channel instability, high temperatures, and sediment [41, 1]. Primary habitat issues and fish use by reach are described briefly below:

- **Headwaters**. Development in the floodplain threatens riparian function in some lower headwater reaches [41]. The South Fork primarily supports juvenile steelhead rearing and spawning—both limited by high water temperatures, low flows, and degraded channel conditions, especially in the lower reaches. Despite these limiting factors, the North Fork supports all three critical fish species [13].
- **Middle Touchet.** While some salmon spawning has been observed in this reach, it primarily supports rearing habitat for steelhead and Chinook salmon [61]. Low flows, high-water temperatures, and lack of habitat diversity affect all fish species and life stages in this reach [3]. Levees throughout this reach negatively impact floodplain function and habitat quality/quantity for critical species [41, 40].
- **Lower Touchet.** The Lower Touchet is a critical over-winter rearing area for all salmonids. It serves as a migration corridor for fish to access upper reaches of the river and tributaries. It also provides some juvenile steelhead rearing habitat in the fall and winter months [13]. High water temperatures and low streamflows (exacerbated by a lack of intact riparian vegetation and habitat) limits the presence of priority fish species during the summer [61]. Channelization and the resulting lack of functioning floodplain habitat also adversely impact much of the reach. Excessive sediment is a major limiting factor for all life stages of critical species [1]. Fish passage can be a challenge during low flows at the Hofer Irrigation Diversion

Dam. Fish survival monitoring indicates about 50 percent of fish are lost in this area due to lack of channel complexity, hiding cover, and predator avoidance.

Mill Creek Subbasin

While the headwaters and mouth of Mill Creek are in Washington, the creek crosses into Oregon for approximately five river miles in its upper reaches before crossing back into Washington. Mill Creek contributes 15 percent of the Walla Walla Basin's total runoff [1].

Upper Mill Creek includes two reaches: (1) the headwaters to the confluence with Blue Creek and (2) the Blue Creek confluence to the starts of the U.S. Army Corps of Engineers (USACE) Flood Control project. Lower Mill Creek begins at the Bennington Diversion Dam and extends to the end of the flood control project at Gose Street in College Place. Gose Street to the mouth of Mill Creek is also a critical reach for habitat restoration. Significant habitat alterations and passage barriers exist in this reach including lack of intact riparian areas and floodplains, and a lack of spawning gravels caused by bedload transport due to high energy flows resulting from upstream channelization.

The Mill Creek subbasin also includes several distributary channels, tributaries, and groundwater fed streams [64]. High water temperatures, disrupted sediment transport, low summer flows, high peak flows, and lack of floodplain connection occur throughout the subbasin. Generally, habitat conditions degrade as the creek flows downstream and experiences lower flows, higher stream temperatures, and significant channel alteration. Primary habitat issues and fish use are described briefly by reach below:

- **Upper Mill Creek**. The headwaters of Mill Creek are protected as the municipal drinking water supply to the City of Walla Walla on land owned by the City and the USFS. Due to the lack of public access to the creek's upper reaches, habitat in Upper Mill Creek is more intact than much of the rest of the basin. Habitat diversity, flows, and water temperatures help Upper Mill Creek support significant spawning and rearing habitat for all three critical species as well as Pacific Lamprey.
- **Lower Mill Creek** has severe habitat concerns starting with fish passage obstructions at the Bennington Diversion Dam, which divert water into a flood control reservoir [64]. The current Bennington Diversion Dam includes a fish ladder which is not fully functional and presents a fish passage barrier during parts of the year. Downstream of the dam, the channel is managed for flood control with levees and weirs. Eventually the stream is directed into a concrete channel through the City of Walla Walla and controlled with levees as it flows out of the city. The flood control project ends at Gose Street (RM 4.8). The engineered channel does not support any natural habitat for fish species of concern; fish primarily use the channel as a migratory route to better upstream habitat. In addition to fish passage barriers in the weired concrete sections and at Gose Street, the engineered channel also impacts natural bedload transport, resulting a lack of suitable substrate and attendant poor habitat quality.
- **Yellowhawk Creek** is the most significant distributary of Mill Creek. Flows are managed into Yellowhawk Creek for both flood control and for senior Yellowhawk and Garrison Creek water rights. The Yellowhawk channel is confined in the city limits of Walla Walla due to residential

development but maintains a natural channel for most of its length. Low flows and elevated temperatures largely prevent Yellowhawk from being suitable habitat for spawning and rearing of critical fish species. Despite the unsuitable conditions, some steelhead spawning has been documented in the creek. Because lower Mill Creek can be impassable due to low flow conditions, Yellowhawk Creek provides an important alternate migration corridor for fish to reach upper Mill Creek [13].

3.5 OUT OF STREAM WATER USES

In addition to providing critical ecosystem services that support native plant species and fish and wildlife habitat, the Walla Walla Watershed is a source of water for **agricultural, municipal-commercial-industrial, and rural-domestic uses** throughout the basin. The basin's water supply has been **over-allocated since the late 1800s**. Decades of development for irrigated agriculture, growing local populations, and climate change have compounded water shortage issues, particularly during warmer and drier months. However, more recent basin-wide concern for ecological protection and restoration has led to reallocation of irrigation water to instream flow.

Existing water rights in the basin were largely allocated and adjudicated through a series of intra-state court disputes nearly a century ago. In both Washington and Oregon, surface and groundwater rights are allocated based on the prior appropriation doctrine: during water-short periods, senior right holders are entitled to their allocated water, while junior users may have their allocated water curtailed [65]. This priority water rights system is applied only to major surface water diversions.

Overall, there is an estimated 186,000 acre-feet of annual water (surface water plus groundwater, rounded to 1,000 acre-feet) used for agricultural[16], municipal-commercial-industrial[17], and rural-domestic[18] purposes within the combined Oregon and Washington portions of the Walla Walla Watershed. Table 22 provides a snapshot of overall Walla Walla Basin water use (surface water plus groundwater) by state and sector:

- Oregon's **total annual water use** in the basin (76,000 acre-feet) is roughly two-thirds of the total annual water used in Washington's side of the basin (109,800 acre-feet).
- At 85 percent and 93 percent respectively, the **agricultural** sectors in Washington and Oregon account for most of the annual water used in the basin (along with most basins in eastern Washington).

---

[16] The agricultural sector accounts for water diverted for the production of food crops, orchards, vineyards, and feed crops for livestock.

[17] The municipal-commercial-industrial sector aggregates water diverted for (1) municipal facilities (as defined in WAC 246-290-010 (170)), (2) nonmanufacturing business establishments, including hotels, motels, restaurants, wholesaler and retail stores, and health, social, and educational institutions, and (3) companies that produce goods for construction and manufacturing. Water use for these sectors is aggregated because some municipalities also serve commercial and industrial operations.

[18] The rural-domestic sector accounts for self-supplied water use, typically from permit-exempt water wells in areas not served by municipalities.

- **Municipal-commercial-industrial** water use constitutes 12 percent of total water used in Washington and 5 percent in Oregon.
- The Washington **rural-domestic** sector uses 3 percent of total annual water use in the basin, while Oregon's rural-domestic sector accounts for 2 percent.

"Water use" in this section of the plan is defined as water diverted from surface water bodies or withdrawn from water wells and used to irrigate cultivated land, supply municipal-commercial-industrial customers, and/or self-supply rural-domestic residents. The water use volumes, percentages, and rates presented throughout this chapter are 'working' estimates made to provide a first approximation of water use for different water sectors. These working estimates will likely differ from the improved estimates made by the current Walla Walla Basin study conducted by the USGS, OWRD, Ecology, and the Tribes. We expect that the basin study will provide the best available water use estimates based on more rigorous and comprehensive methods than those provided in this plan.

Table 22. Overview of estimated water use by sector in the Walla Walla Watershed.[19]

Water Sector	Total annual surface and groundwater use (acre-feet)		% of WA total	% of OR total
	Washington [a]	Oregon [b]		
Agriculture	93,000	71,000	85 %	93 %
Municipal-Commercial-Industrial[c]	13,200	3,400	12 %	5 %
Rural-Domestic[d]	3,600	1,600	3 %	2 %
Totals	**109,800**	**76,000**		

Notes

a. **Washington's agricultural use** estimates are derived from the WRIA 32 Watershed Plan and GFID data. Municipal-commercial-industrial use estimates are sourced from the cities, Washington Department of Health's (DOH) database, and the Port of Walla Walla tenants. Rural-domestic use estimates are sourced from the Bi-State Flow Study (2019) and Ecology well database.

b. **Oregon's agricultural use** estimates are based on OWRD (excludes alluvial wells), WWRID, and HBDIC data. Municipal-commercial-industrial use estimates are based on data from the cities and Oregon Health Authority (OHA). Rural-domestic use estimates are based on data from OWRD.

c. The **City of Walla Walla** utilizes a 28 cfs (18.1 million gallons per day) Oregon water right on Mill Creek as the main supply. The water is diverted at the downstream end of a protected watershed. The City also has a second Oregon winter water right, which currently allows 10 cfs to be used for ASR recharge or returned to Mill Creek, if in-stream flows are met during winter months. Source: Water System Plan, City of Walla Walla (March 2020).

d. **Rural-domestic water use** is from groundwater sources only.

Agricultural Land and Water Use

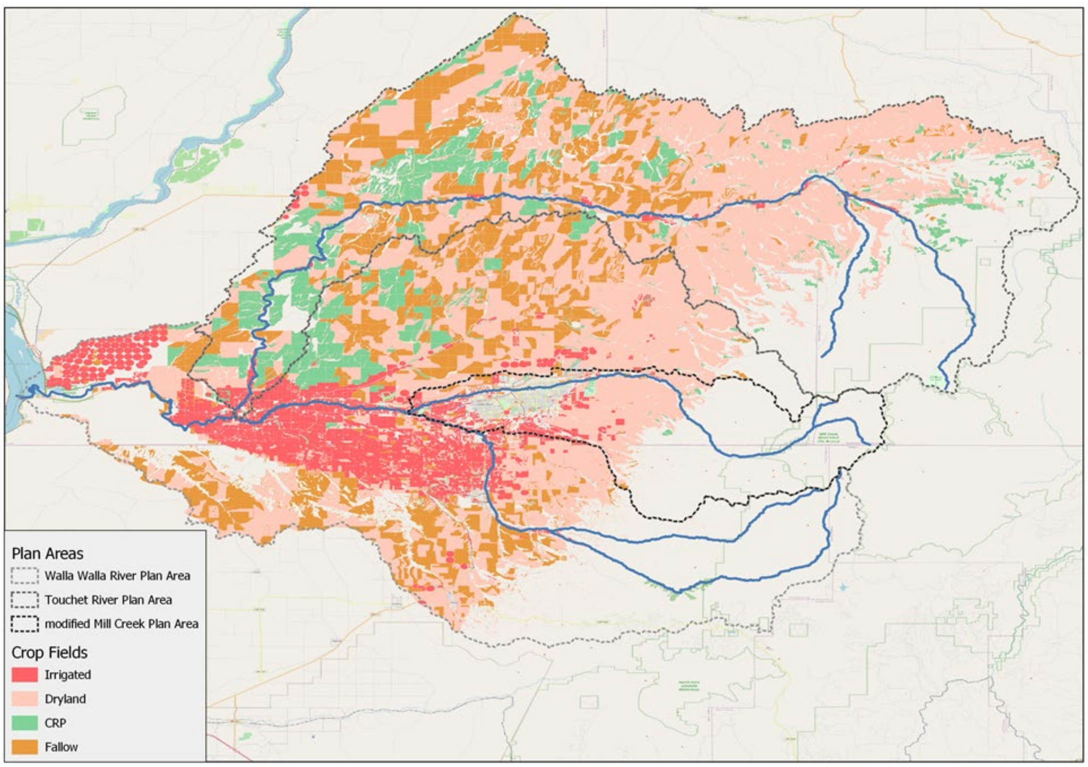
The Walla Walla River Basin has long been a center for agricultural production for both dryland and irrigated farming. The first large-scale irrigation projects were constructed in the late 1800s, giving rise to the orchards and fertile farmland that support a variety of fruit and crop production today,

[19] Water use values for each sector shown to one or two significant digits.

including alfalfa seed, grapes, and Walla Walla's famous apples and sweet onions. According to 2015 data from the Washington State Department of Agriculture (WSDA), gross annual sales from the agricultural food processing industry in Walla Walla County are roughly $1.1 billion and $407,000 in Columbia County [66]. The market value of agricultural products sold in Oregon's Umatilla County is roughly $375 million [67].

While much of the basin's dryland wheat production is sustained by natural precipitation, the Walla Walla Basin is extensively irrigated with water from the Touchet River and Walla Walla River, the basalt and alluvial aquifers, and (to a lesser degree) Mill Creek [1]. Figure 23 shows the distribution of agricultural land categorized as irrigated, dryland, fallow/idle, or Conservation Reserve Program (CRP).

Figure 23. Agricultural land in the Walla Walla Watershed (see notes in Table 23 for source data).



For the purposes of presenting land area, lands categorized as dryland, fallow/idle, and CRP are aggregated together as "total dryland area," shown in Table 23. **Oregon's irrigation diversions** for agriculture account for 93 percent (Table 22) of annual water use. Roughly 19 percent of cropland in Oregon is irrigated using water diverted from the Walla Walla River and groundwater sources. Total annual irrigation requirements are 71,000 acre-feet of water, with 70 percent sourced from surface flows, roughly 18 percent from the basalt aquifer, and 11 percent from the shallow alluvial aquifer (Table 23).

Washington's agricultural irrigation accounts for 85 percent of total annual water used in the basin (Table 23), with 60 percent of irrigation water sourced from surface flows and the remaining 40 percent pumped from groundwater sources. Eleven percent of cropland in Washington is irrigated with water sources from surface flows and groundwater in the Walla Walla Watershed.

Table 23. Agricultural land, annual water use, and water rights estimates.

<table>
<tr><th></th><th>Washington</th><th>Oregon</th></tr>
<tr><td>Land</td><td></td><td></td></tr>
<tr><td>Total Dryland Area (acres)</td><td>484,000</td><td>100,000</td></tr>
<tr><td>Total Irrigated Area (acres)</td><td>61,000</td><td>24,000</td></tr>
<tr><td>Water Use</td><td></td><td></td></tr>
<tr><td>Total Irrigation (acre-feet)</td><td>93,000</td><td>71,000</td></tr>
<tr><td>Surface Water for Irrigation (acre-feet)</td><td>56,000</td><td>50,000</td></tr>
<tr><td>Basalt Groundwater for Irrigation (acre-feet)</td><td rowspan="2">37,000</td><td>13,000</td></tr>
<tr><td>Alluvial Groundwater for Irrigation (acre-feet)</td><td>8,000</td></tr>
<tr><td>Water Rights</td><td></td><td></td></tr>
<tr><td>Surface Water Certificates and Permits (acre-feet)</td><td>261,877</td><td rowspan="2">Ranges from 69,000-92,000</td></tr>
<tr><td>Groundwater Certificates and Permits (acre-feet)</td><td>169,602</td></tr>
</table>

Notes

Washington Data

- Estimated values of total dryland and irrigated land (Figure 23) from GIS processing of Washington State University (WSU) coverages, derived from 2018 Cropland Data Layer (U.S. Department of Agriculture National Agricultural Statistics Service (USDA - NASS)) and WSDA crop data.
- Estimate of **total irrigation:** Source: HDR/EES, 2005; Walla Walla Watershed Plan, Planning Unit Final, May 2005.
- Estimate of **surface water for irrigation:** 261,877 / (261,877 + 169,602) * 93,000. Note surface water rights make up approximately 65% of total water rights.
- Estimate of **groundwater for irrigation:** 169,602/ (169,602+261,877) * 93,000. Note groundwater rights make up approximately 35% of total water rights.
- Estimate of **surface and groundwater certificates and permits and primary rights** includes primary rights and portion of supplemental rights that are additive. Source: WSU Water Center.

Oregon Data

- Estimated values of total dryland and irrigated land (**Figure** 23) from GIS processing of WSU coverages, derived from 2018 Cropland Data Layer (USDA - NASS) and IrrMapper Irrigated Lands (University of Montana/Montana Climate Office).
- Estimate of **total irrigation** is sum of surface water irrigation, basalt groundwater irrigation, and alluvial groundwater irrigation.
- **Surface water estimates** based on WY2020 diversion volume at the Frog for WWRID+HBDIC, and an 'upriver' irrigation estimate of 2,730 ac-ft. Note: estimate also includes 'Eastside' diversion of 873 ac-ft (WY2020), plus HBDIC's Pine Creek diversion of 648 ac-ft (WY2020).
- **Basalt well** use derived from all metered and reported basalt wells for 2019, OWRD.
- **Alluvial well** use based on same water duty for Basalt: (13,000 ac-ft use / 14,000 ac primary basalt rights) x 9,000 ac primary alluvial rights = 8,357 ac-ft ~ 8,000 ac-ft (rounded to nearest 1,000)
- Estimates for **water rights** from OWRD.

Today on the Washington side of the watershed, agricultural irrigators hold annual surface-water rights of 261,877 acre-feet and groundwater rights of 169,602 acre-feet.[20] However, the actual amount of on-the-ground agricultural irrigation water use (93,000 acre-feet/year) is much less than the total amount of water rights on paper. This discrepancy can be attributed to **historic over-allocation of water resources, which is common across Washington and Oregon** (i.e., more rights were allocated than the amount of physical water available). When water rights were originally claimed and/or allocated, the amounts needed were often larger than present-day irrigation requirements. In some cases, efficiencies and/or crop type changes have decreased water needs. Current water resource management is complicated by the fact that (1) historic water rights appropriation did not consider the need for water to be left instream, and (2) water rights holders may have expectations that differ from physical water availability.

Estimating total irrigation water use in Oregon is complicated by water availability and by a lack of clearly defined irrigation season and annual duty restrictions for some Walla Walla River water rights [68]. However, a working estimate of total water rights (surface water plus groundwater) can be calculated by multiplying the primary right land area of 23,000 acres[21] (basalt and alluvial) by a range of water duty from three to four acre-feet/acre to get a range of rights from 69,000 to 92,000 acre-feet (Table 23).

With over 124,000 acres of cropland in Oregon's portion of the basin and 545,000 acres in Washington, the Walla Walla Basin boasts large areas of both dryland agriculture and intensive irrigated farming. Most agriculture in the Walla Walla Basin consists of row-crop farming, grain production, orchards, and vineyards. Table 24, Table 25, and Table 26 illustrate predominant crops grown in the basin, irrigation needs, and percentage of cropland used to cultivate each crop type. Roughly 13 percent of cropland throughout the river basin is irrigated.

Table 24. Top five crops (by crop area) for dryland agriculture in Washington and Oregon.[22]

Rank	Washington			Oregon		
	Crop Type	Crop Area (acres)	% of Total Cropland[23]	Crop Type	Crop Area (acres)	% of Total Cropland[23]
1	Wheat	228,000	42 %	Winter wheat	46,000	37 %
2	Wheat fallow	119,000	22 %	Fallow/idle	39,000	31 %
3	CRP/conservation	76,000	14 %	Peas	5,000	4 %
4	Dry pea	25,000	5 %	Spring wheat	4,000	3 %
5	Garbanzo bean	19,000	3 %	Other hay/non-alfalfa	2,000	2 %

[20] Includes primary rights and portion of supplemental rights that are additive. Source: WSU Water Center.

[21] OWRD provided estimate (via email); June 2020.

[22] Washington crop values from GIS processing of WSU coverages, derived from 2018 Cropland Data Layer (USDA NASS and WSDA crop data). Oregon crop values from GIS processing of WSU coverages, derived from 2018 Cropland Data Layer (USDA - NASS) and IrrMapper Irrigated Lands (University of Montana/Montana Climate Office).

[23] Total cropland includes both dryland and irrigated land.

Table 25. Estimates of top five crops (by crop area) for irrigated agriculture in Washington.[22]

Rank	Crop Type	Crop Area (acres)	% of Total Cropland[23]	Irrigation Requirement (annual, ac-ft of water per acre of crop)[24]
1	Spring wheat single crop	18,000	3 %	2.3
2	Alfalfa seed	11,000	2 %	2.8-3.9[25]
3	Alfalfa hay single crop	7,000	1 %	3.7
4	Pasture single crop	5,000	1 %	2.9
5	Potato single crop	3,000	1 %	2.7

Table 26. Estimates of top five crops (by crop area) for irrigated agriculture in Oregon.[22]

Rank	Crop Type	Crop Area (acres)	% of Total Cropland[23]	Irrigation Requirement (annual, ac-ft of water per acre of crop)[26]
1	Alfalfa hay single crop	14,000	11 %	3.7
2	Apples	3,000	2 %	3.7
3	Spring wheat single crop	2,000	2 %	2.3
4	Clover hay single crop	1,000	1 %	3.7
5	Corn single crop	1,000	1 %	2.0

Table 23, Table 24, Table 25, and Table 26 show that agriculture in the watershed is dominated by dryland farming, making up more than 89 percent of cropland in Washington and 81 percent in Oregon (as calculated from WSU WRC vector, raster, and model data). Among irrigated crops, spring wheat is planted on the most acres in Washington, while alfalfa dominates in Oregon. However, looking at only the top five crops by area obscures the diversity of crops grown in the watershed. In addition to these top five crops, other irrigated and non-irrigated crops grown in the watershed include a range of other commercial vegetable and fruit crops. While these crops may not account for significant areas of land, they are nonetheless significant to the basin's economic output and its irrigation needs.

Wine grapes (one of the higher-valued fruit crops) comprise approximately 3,000 acres of irrigated land across the valley in Washington and Oregon. With an annual irrigation requirement of roughly 3,000 acre-feet, wine grapes require considerably less water (one acre-foot per acre) than most crops. Walla Walla's wine industry as a whole was estimated to generate revenues of $430 million in 2018 [69].

---

[24] Irrigation Requirement from online WSU Extension Irrigation Calculator, 21 Point Crop Coefficients (day of year), gross irrigation water requirement; assuming 75% irrigation efficiency, using mean of values from stations: 'Garden City Heights', 'Touchet', 'Walla Walla 3 W', 'Walla Walla City County AP', 'Walla Walla WSO', 'Whitman Mission'.

[25] Gross irrigation requirement range (assuming irrigation efficiency of 75 percent) based on survey of alfalfa seed experts and growers in the Walla Walla basin.

[26] Irrigation Requirement using online WSU Extension Irrigation Calculator with Washington stations; station data is assumed to be reasonably similar in Oregon.

Cropland irrigation in the basin is supplied by both surface water and groundwater, with WWRID, HBDIC, and GFID diverting most of the surface water from the mainstem Walla Walla River (Table 27).

Table 27. Estimated annual irrigation district diversions.

Irrigation District	Diversion from Walla Walla River (acre-feet/year)	Note
WWRID	22,000	Water Year 2020; measured at the Frog
HBDIC	24,000	Water Year 2020; measured at the Frog
GFID	27,000	Calendar Year 2020

Both WWRID and HBDIC divert water for much of the year (except from February to early March and sometimes during the summer, depending on the year) from the Walla Walla River in Oregon. Washington-based GFID typically shuts off diversions in the summer months. Other smaller irrigation districts within the basin include Smith, Lowden No. 2, Bergevin/Williams, Garden City, Old Lowden, West End irrigation Ditch, East End Irrigation Ditch, Hearn Irrigation Ditch, Fruitvale Water Users Association, and Rec. Fields Ditch.

In 2000, the three major irrigation districts entered into an agreement with USFWS to bypass river flows at their diversions and maintain minimum instream flows. Following a 2002 amendment to the agreement, GFID pledged to maintain bypass flows at 18 cfs throughout the year, and both WWRID and HBDIC are leaving 27 cfs (0.7641 cubic meters per second) from January 1 to June 30 and 25 cfs (0.706 cubic meters per second) from July 1 to December 31 each year [70]. As a result of the agreement, less water has been allowed to flow into the Little Walla Walla River during critical low flow summer months when flows are needed for fish in the mainstem.

See Appendix D for Ecology's map depicting the locations and approximate size (in cfs) of the permitted seasonal irrigation diversions during the non-growing season (typically October 1 through April 1). Ecology delineated these maps into four subbasins (Walla Walla River, Touchet River, Mill Creek, and Dry Creek), aligned with how Ecology adjudicates and regulates these diversions in the Walla Walla Basin. Maps were generated using the following source data: (1) National Hydrography Dataset; (2) USDA National Agriculture Imagery Program (NAIP) 2017 (Washington) and 2016 (Oregon); (3) Ecology's Geographic Water Information System (GWIS) point of diversion data and GPS coordinates; (4) Ecology's Hydrologic Unit Code (HUC) watershed boundaries; and (5) Ecology's Water Rights Tracking System and other data. As such, these diversions do not necessarily represent active irrigation diversions.

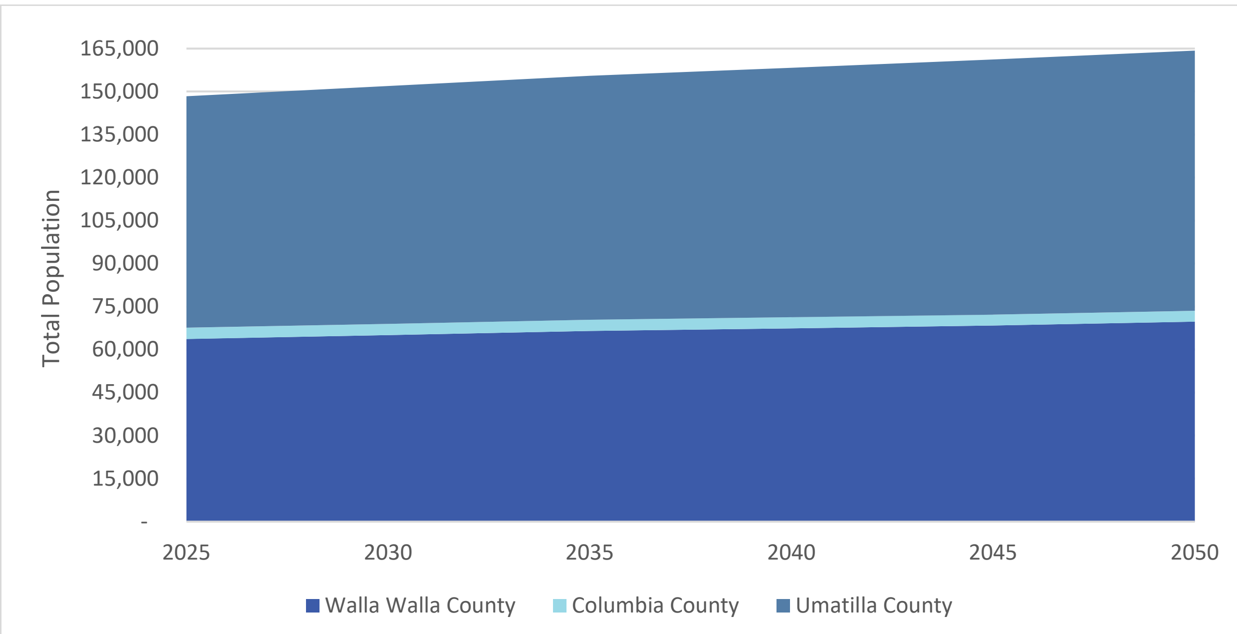
Appendix D also contains OWRD's map showing the location of year-round diversions on the Walla Walla River system, south of the Washington-Oregon state line. These map locations represent the surface water points of diversion for the water rights of record, which are found in Oregon's water rights database. Not all these diversions are active at this time. Nearly all active diversions convey water to agriculture fields with one of the largest active diversions at the LWWR. One exception is the municipal diversion right held by the City of Milton-Freewater (currently not being used).

Municipal-Commercial-Industrial Water Use

Municipal-Commercial Water Use

Population and urban development have grown steadily in recent decades around the Walla Walla River Basin. Total population across Walla Walla, Columbia, and Umatilla counties is projected to increase by 11 percent from 2025 to 2050 (Figure 24), likely further increasing demand on reliable municipal water supplies.

Figure 24. Population forecast across Walla Walla County, Columbia County, and Umatilla County (2025-2050) [4] [5].



Several cities and jurisdictions around the basin rely exclusively on water from the Walla Walla River, Mill Creek, and groundwater sources for municipal-commercial use. Washington municipalities (including the cities of Walla Walla, Waitsburg, College Place, Dayton, Prescott) and Group A and B public water systems account for 14 percent of annual basin water use.[27] The Oregon cities of Milton-Freewater and Weston account for four percent of annual water diverted in the Oregon portion of the basin.

Table 28 summarizes municipal surface and groundwater use for 2016-2019. Average daily water use ranges from 241 gallons per capita in the City of Walla Walla to 141 gallons per capita in College Place. The City of Walla Walla collects accurate water use data from its various customers. **Total annual water production by the City in 2020 was 9,293 acre-feet (3,028 million gallons) for a population of 34,400.** This equates to annual average water use of 241 gallons per capita per day.

[27] Group A water systems have 15 or more service connections or serve 25 or more people 60 or more days per year. Group B water systems serve fewer than 15 connections and fewer than 25 people per day.

Further refinement of the City's customer water use indicates residential water use is 110 gallons per capita per day, and the combined parks, commercial, industrial, and residential water use is 196 gallons per capita per day. Walla Walla's daily water use includes leaks in their system, which the City has worked actively to improve. While the City of Walla Walla has grown by 20 percent over the last 20 years, total water use had dropped by 33 percent [71] The remaining municipalities within the basin, including WA Group A and B systems and OR public systems, use a combined annual 6,024 acre-feet of water.

Table 28. Estimated municipal-commercial water use in the Walla Walla Watershed.[28]

City/Town	Average Daily Water Use (gallons per capita)	Total Annual Water Use (acre-feet)	Population Served
Walla Walla	241	9,293	34,400
Milton-Freewater	237	1,931	7,278
WA Group A and B Systems	189	1,373	6,471
OR Public Systems	179	430	2,146
Waitsburg	149	217	1,300
College Place	141	1,250	7,915
Dayton	189	581	2,740
Weston	179	168	840
Prescott	189	74	350
Spokane[29]	217	-	-
West Richland	197	-	-
Total		**15,500**[30]	**63,440**

Wine production has been growing steadily over the course of the last few decades in Walla Walla Watershed. Separate from annual irrigation requirements to grow grapes, wineries use water to clean equipment used in the wine making process. Table 29 provides estimates for average annual water use associated with wine processing for wineries served by the City of Walla Walla's municipal water system, as well as total wineries operating within the Walla Walla Basin boundary.

Table 29. Estimated average annual processing water use among wineries in the Walla Walla Basin.

Boundary	Wineries Served	Total Annual Water Use (acre-feet)
Wineries Served by City of Walla Walla	18*	30
Total Wineries in the Walla Walla Basin	180**	300
* Estimate provided by the City of Walla Walla (includes Port of Walla Walla estimates).		

[28] Total annual water use includes surface and groundwater sources. Data was provided by municipalities, except for Washington Group A & B, Dayton, Waitsburg and Prescott, which were estimated based on averages. Some commercial entities are included in the municipal-commercial category because distinct municipal versus commercial uses are not readily separated from the Group A and B water systems.

[29] Spokane and West Richland included for comparison only.

[30] Rounded to the nearest 500 acre-feet.

Boundary	Wineries Served	Total Annual Water Use (acre-feet)
** Based on recent information from basin stakeholders, industry representatives, and the Walla Walla County profile [6].		

Walla Walla Basin jurisdictions treat municipal wastewater and discharge flows for a variety of beneficial uses including agricultural irrigation, commercial use, and shallow alluvial aquifer recharge. As shown in Table 30, the City of Walla Walla treats their wastewater to reclaimed water standards in their Water Reclamation Plant and discharges a daily average of 7.13 cfs to Mill Creek from December to May and to several irrigation districts during the summer and fall [72]. Milton-Freewater discharges treated wastewater at 4.9 cfs per day. Treated flows are piped to a City-owned land application facility and used for cropland irrigation [73].

Table 30. Municipal wastewater discharge rates.

Municipality	Permit No.*	Average Daily Discharge Volume (gallons)	Average Daily Discharge (cfs)	Population Served
Walla Walla	WA0024627	4,600,000	7.13	31,700
College Place	WA0020656	1,000,000	1.55	10,500
Dayton	WA0020729	229,000	0.35	2,750
Waitsburg	WA0045551	131,000	0.20	1,230
Touchet/WW Watershed District 2	ST0008040	21,000	0.03	510
Milton-Freewater	S-50962	3,168,000	4.90	7,278
Weston	102951	121,000	0.19	650
Data derived from survey of individual water utility managers and some water system plans. * "WA" prefix indicates surface-water discharge and "ST" prefix indicates land application.				

Industrial Water Use

Overall, industrial water use in the basin makes up approximately one percent and less than one percent of the annual water used in the Oregon and Washington, respectively. Water use at the Port of Walla Walla Eastside accounts for 0.2 percent of the industrial water use in Washington. Although the Port of Walla Walla also leases property to industrial entities in Wallula and Burbank along the Columbia River, these locations are outside the watershed boundary.

Rural-Domestic Water Use

Groundwater wells serve as water sources for rural and domestic homeowners or groups who are not connected to municipal water supply systems throughout the Walla Walla Basin. Rural-domestic water users who use less than 5,000 gallons per day can withdraw water from groundwater sources without acquiring a water right permit [74]. While current permit-exempt well water use represents a small fraction of annual water use in the basin (three percent in Washington and two percent in Oregon), **monitoring and regulation of new permit-exempt wells and land development near streams, creeks, and floodplains are critical for balancing population growth and water supply**. Currently, there are an estimated 3,726 permit-exempt wells basin-wide that pump roughly 5,200 acre-feet of water annually from the alluvial and basalt aquifers (Table 31). The projected growth in rural/unincorporated populations within the basin indicates a future increase in new individual permit-exempt wells that will rely on alluvial or basalt groundwater to meet domestic water needs.

Table 31. Estimated rural-domestic water use in Oregon and Washington.

	Oregon	Washington	Total
Estimated annual water use (acre-feet)	1,600	3,600	5,200
Potential number of permit-exempt alluvial and basalt wells	1,179	2,547	3,726

- Assumes indoor and outdoor water use of 1,250 gallons per day, based on use per well in Bi-state Flow Study, 2019. Use could be potentially as high as 5,000 gallons per day.
- Oregon estimate of potential permit exempt wells provided by OWRD.
- Washington estimate of potential permit exempt wells from six-inch diameter well count (obtained from Ecology's online data for WRIA 32); as such, estimate may be high for Washington.
- Estimated annual permit-exempt well water use rounded to 100 acre-feet.

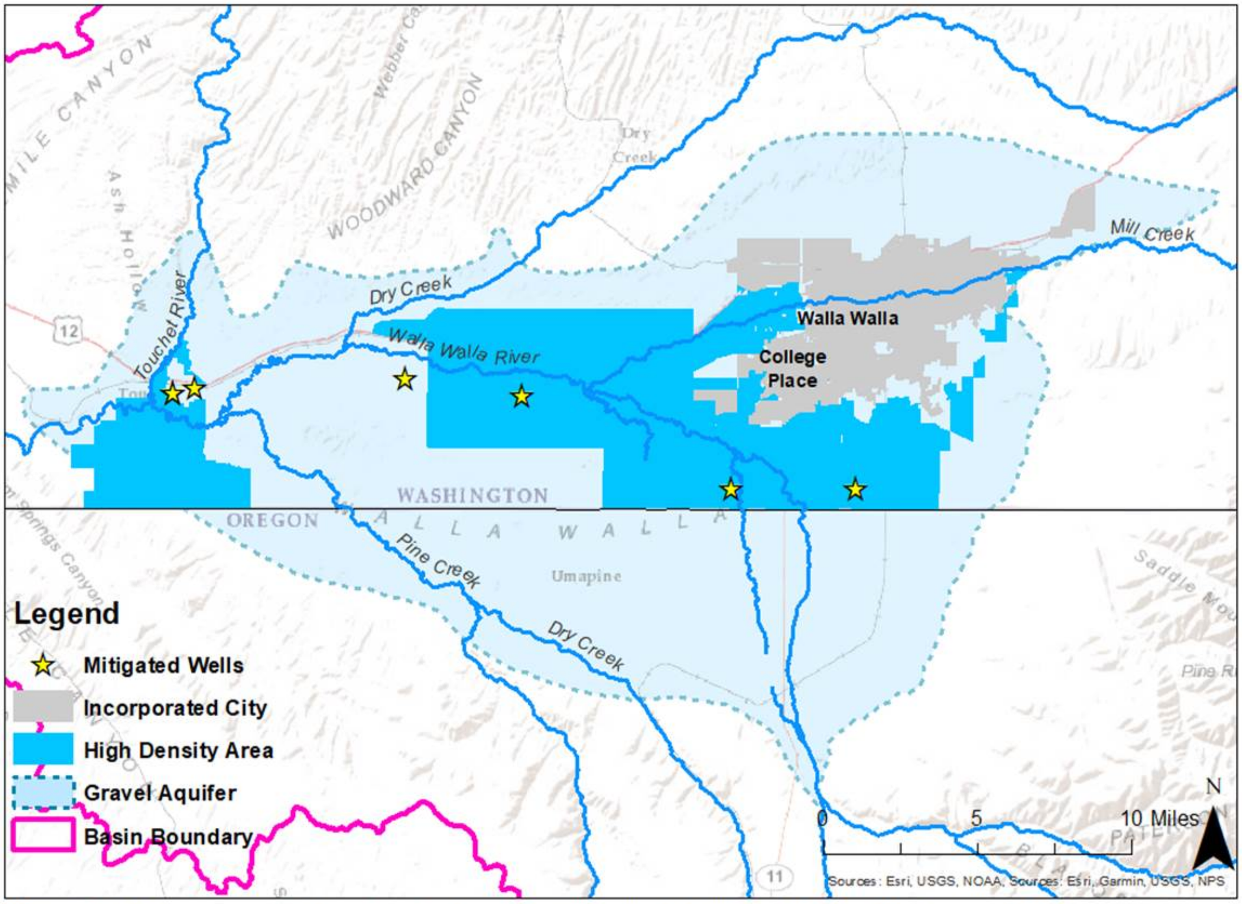
Washington Exempt Well Mitigation Program

In Washington, a permit-exempt well is required to mitigate for summer outdoor consumptive water use under the 2007 Basin Management Rule (WAC 173-532) if water is drawn from the shallow gravel aquifer in a high-density area. Requirements of the rule include daily use limits, mitigation for 0.55 acre-feet per year of outdoor water use from May to November, and metering and reporting of water use from May 1st to November 1st of each year [74].

Figure 25 shows the shallow gravel aquifer and high-density area where the mitigation program applies and the approximate location of wells that have received mitigation. Determining if a mitigation certificate is necessary for new construction can be complicated because of various existing water rights and may require detailed analysis. Landowners that believe they need a mitigation certificate to cover their outdoor use from a permit-exempt well should contact the Walla Walla County Community Development Department.

There are currently no permitting, metering, or mitigation requirements for permit-exempt well users in Oregon.

Figure 25. Mitigation program area and approximate location of mitigated permit-exempt wells (map created by Ecology, 2021).



Notes: The mitigation program for permit-exempt domestic wells applies to high density areas within the gravel acquifer.

3.6 QUALITY OF LIFE

The Tamástslikt Cultural Institute in Pendleton, Oregon provides a glimpse into the long history of the Cayuse, Umatilla, and Walla Walla Native American Tribes, who have depended on the abundant runs of salmon, steelhead, and bull trout of the Walla Walla rivers and streams. Whitman National Historic Park, Fort Walla Walla Museum, and Frazier Farmstead Museum tell the stories of the first European Americans who, beginning with the Lewis and Clark expedition in 1806, trekked across the Oregon Trail to discover the braided streams of Walla Walla's abundant waters that would later sustain local farming and large-scale agriculture.

Educational institutions emerged early in the history of the Walla Walla Watershed. Today, Whitman College offers degrees in Environmental Studies, and Walla Walla Community College is home to the William A. Grant Water and Environment Center, which serves as a watershed information resource for the region and helps facilitate collaboration. The Sustainable Living Center, which was established to promote awareness of and facilitate sustainable living practices, also serves as a co-locator for

CTUIR and the Partnership. Student volunteers from these institutions provide assistance to many non-profit organizations in the City of Walla Walla and other cities/towns in the basin.

On average, Washingtonians spend an estimated 56 days a year participating in outdoor recreational activities, resulting in $21.6 billion in annual expenditures statewide [75]. Of these expenditures, the highest expenditures are associated with reactional use of public waters. According to a 2015 economic analysis report, **Walla Walla County supports over 650 jobs within the recreational industry and generates over $70,000 dollars in annual expenditures from recreation on public lands**.

Within the Walla Walla Basin, water quality and flowing streams significantly contribute to the overall quality of life and the economy of the watershed. Rivers and creeks provide direct recreation and tourism opportunities like boating, fishing, and swimming. However, **current water recreation—including fishing, swimming, and boating—is very limited on Walla Walla Basin streams due to low summer flows, regulations around the threatened local fish species, and a lack of public access**. Furthermore, extensive flood control measures and channelization of Mill Creek have stymied fish passage in summer due to low flows and hot water temperatures in the concrete channel. The flood control structures also prevent human access to enjoy the stream, disrupt floodplain connection, and prevent natural stream processes. Only a small portion of the urban creek area—along a mile-long walking and biking path on the east end of town—is available for public recreation.

Walla Walla's many waters also enhance other activities like wildlife viewing and photography, birdwatching, hiking, camping, and tourism. Birdwatching, or "birding", is the fastest growing outdoor recreational activity. The Walla Walla River arises from snowpack in the upper forested reaches of the Blue Mountains, flows downhill into the valley below, and then out to its confluence with the Columbia River, providing a multitude of diverse habitats for both resident and neotropical migratory species. From old growth pine, fir, and spruce forests to valley streams, semi-arid sage brush, and bunch grass habitats near the Columbia River, these diverse habitats invite many species of birds. Since the 1880s, 352 species of birds have been documented in Walla Walla County.

In the last 50 years, an estimated one in four birds have disappeared in North America [76]. In Walla Walla County, the Greater Sage Grouse, Columbia Sharp-Tailed Grouse, California Condor, Upland Sandpiper, American Redstart, and White-Headed Woodpecker have vanished due to habitat loss. Similarly, the Brewers Sparrow, Sage Thrasher, Western Burrowing Owl, Short-Eared Owl, Long-Billed Curlew, and Ferruginous Hawk have nearly disappeared.

These rivers, creeks, and springs are also integral to the character and aesthetics of the region. Notably, the natural beauty of the Walla Walla River and watershed supports both the production of wine grapes and draws tourists to the watershed. Within the last two decades, the Walla Walla Watershed has experienced significant growth related to the viticulture, fine dining, and tourism industries—which have all been fueled by a sharp increase in the establishment of vineyards and wineries in the area. For example, there were less than 50 wineries in the valley in 2000, and today there are more than 180. Additionally, tourism has both fueled operations at the Walla Walla Regional Airport and influenced the growth of new home and building construction in the valley.

This development brings significant economic value for the region. Between 1993 and 2002, **the wine industry was attributed to boosting hotel employment by 40 percent and eating and drinking place employment by 14.4 percent** [77]. In 2018, business sales associated with the wine industry were estimated at $430 million, with a labor income of $114 million [69]. However, a limiting factor to this growth is finding the water that vineyards and wineries require. Many wineries met their water needs by using existing surface or groundwater rights or sometimes by purchasing available water. Wine production also requires water, the majority of which is used for cleaning equipment. Wine production facilities in the valley are required to use evaporation ponds for treating wastewater.

In response to the rapid growth of the wine industry, over 60 winegrowers and wineries have voluntarily formed the Walla Walla Valley Winegrower's Sustainable Trust. This organization seeks to align environmental, economic, and social sustainability considerations with the production of grapes and wine in the Walla Walla Watershed. Their mission is to develop and implement an internationally recognized sustainable vineyard management program that promotes strict environmental standards and high-quality farming practices.

3.7 CURRENT LAND USE & COVER

Urban and agricultural development has severely altered land use and land cover in the Walla Walla Basin over the last century and half. For example, the 2004 Walla Walla Subbasin Plan estimates that there was an 84 percent loss of native grasslands, 98 percent loss of wetlands and 32 percent loss of riparian wetlands from historic pre-settlement conditions in 1850 to 1999 [1]. This figure may underestimate the loss of riparian vegetation, which is critical for providing food for fish and other resources, providing shade to keep temperatures cool, maintaining channel complexity, filtering runoff, and providing bank stability—all of which are necessary for the health of aquatic species [41].

Today the vast majority (90 percent) of land in the Walla Walla Basin is used for irrigated agriculture and falls under private ownership [62]. The remainder of land is under federal and state ownership, which hold nine percent and one percent of the land, respectively. CTUIR owns approximately 8,700 acres in the Walla Walla Basin [62]. The majority of cropland is dryland agriculture, while irrigated land makes up only a small portion (Figure 26) [1].

While dryland crops dominate, the eastern edge of the basin supports evergreen forests that are home to the headwaters of the Walla Walla River and its tributaries (Figure 27). Irrigation, the largest source of water use in the basin, is concentrated in the Walla Walla River valley to support various crops [1].

This section offers a summary of land use topics relevant in the water management context. It does not provide a full survey of land use practices in the basin and touches only on high-level land use topics that are directly related to water management in the Walla Walla Basin.

Figure 26. Land use in the Walla Walla Basin (Walla Walla Subbasin Plan, 2004 [62]).

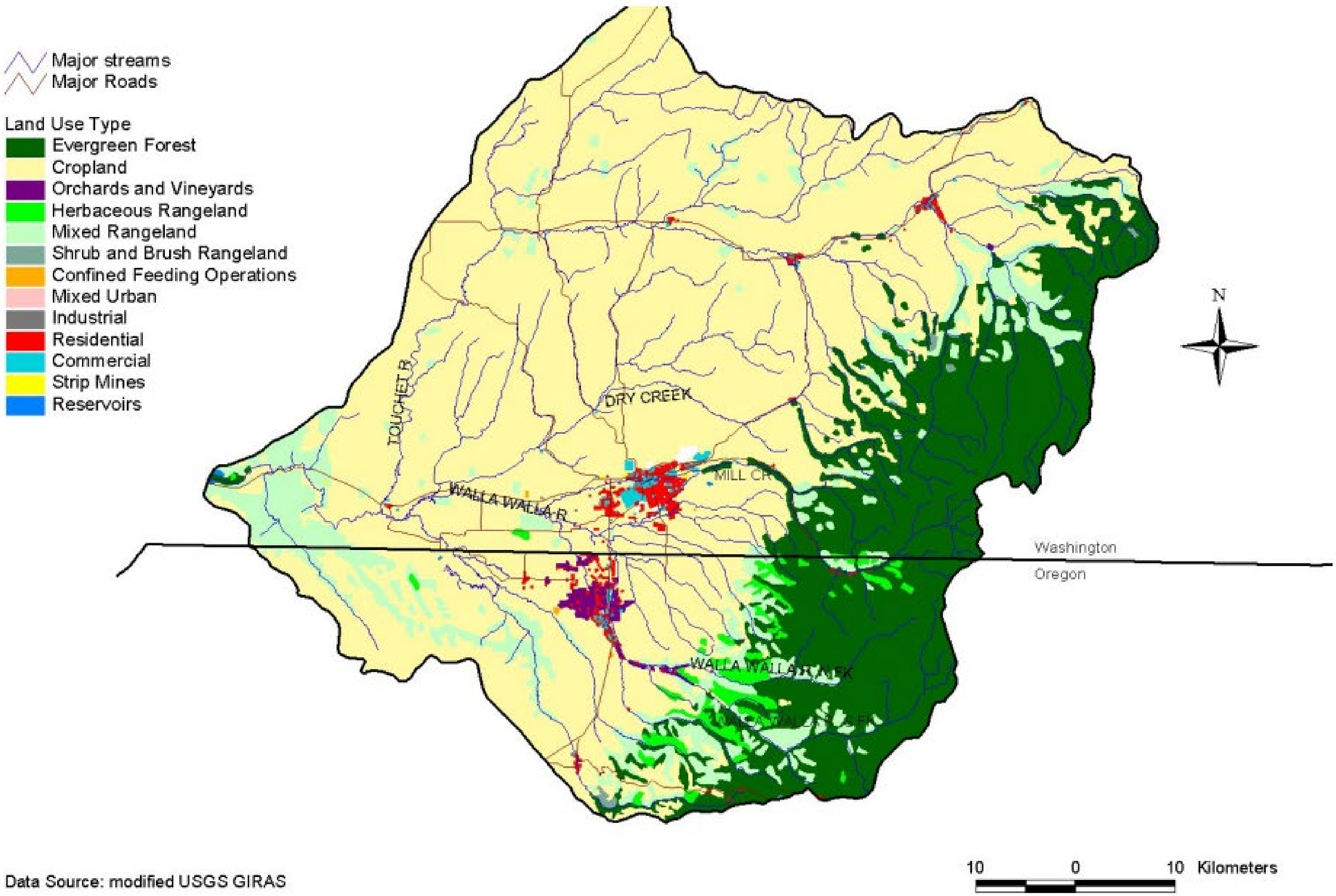
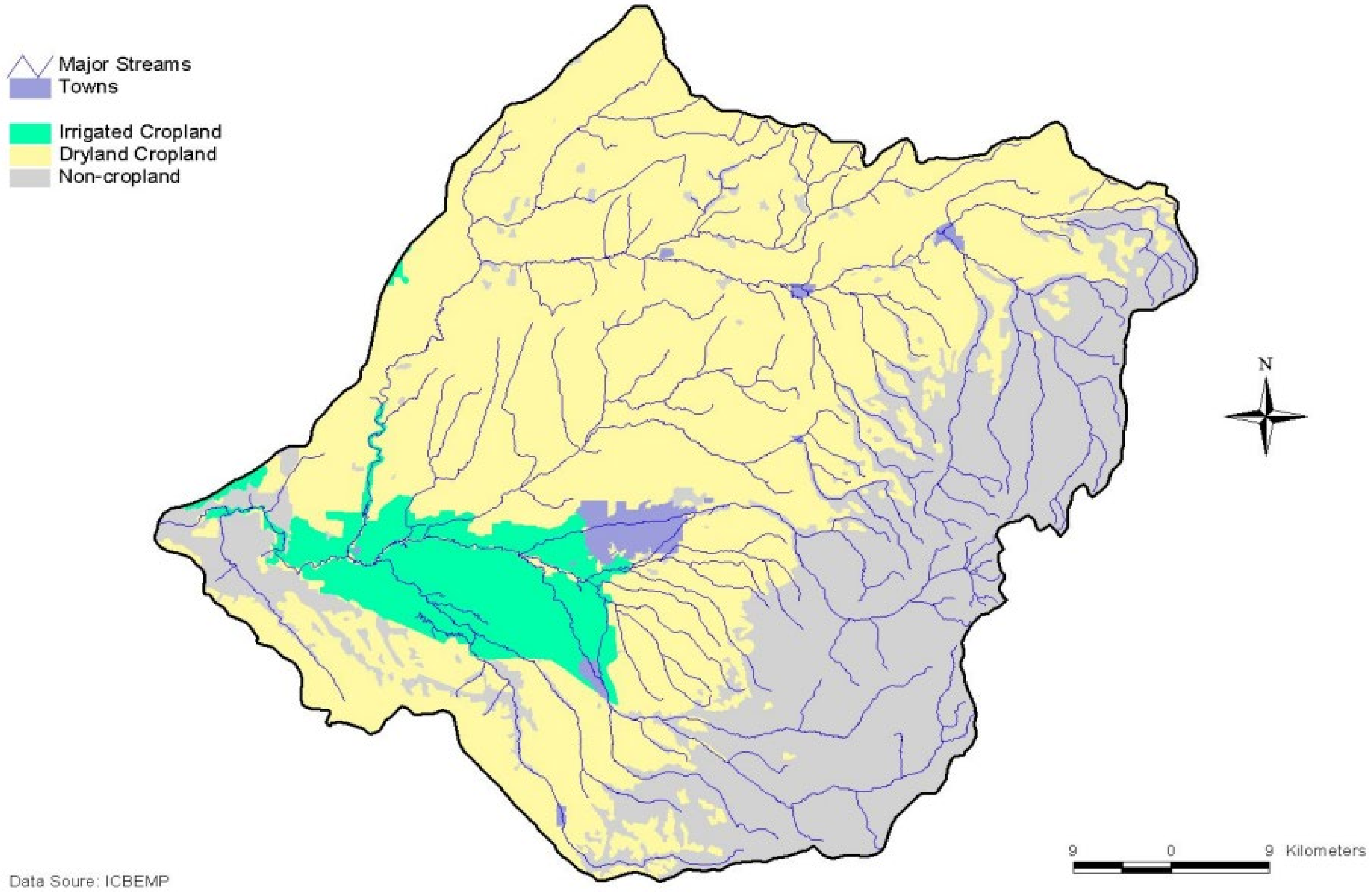


Figure 27. Water use in the Walla Walla Basin (Walla Walla Subbasin Plan, 2004 [62]).



Land Use Regulation and Water Management

Washington statutes such as the Growth Management Act (GMA) [78] and Shoreline Management Act (SMA) require that local jurisdictions adopt critical area ordinances and shoreline master programs (SMP) [79] that set development restrictions in and adjacent to river and streams, wetlands, frequently flooded areas, and critical aquifer recharge areas.

The GMA requires that each city, town, and county adopt a critical areas ordinance which classifies ecologically sensitive and hazardous areas. The goal is to protect these areas' functions and values, while allowing for reasonable use of private property. These regulations must be periodically reviewed and updated if necessary. The next update deadline for Walla Walla County jurisdictions is 2026 and for Columbia County is 2027. Both counties opted into the Voluntary Stewardship Program (VSP) authorized under the GMA, so certain agricultural uses are not subject to critical areas regulations.

Similarly, the **SMA is intended to manage and protect shorelines of the state by regulating shoreline area development,** limiting adverse impacts along shorelines, encouraging the use of soft shoreline stabilization, limiting development in channel migration zones, and requiring no net loss of shoreline ecological function. Walla Walla County's regional SMP, which includes the cities of Prescott, Waitsburg, and Walla Walla took effect in 2018. Effective about a year earlier, Columbia County's SMP is the product of a larger effort by the Southeast Washington Coalition which also includes Asotin and Garfield counties, the City of Clarkston, and the Town of Starbuck. SMPs must be updated every eight years.

There are limitations as to which waterways and surrounding areas these regulations apply to [80] and rules vary between cities and land classifications. For example, in Walla Walla County, "both the county and individual city SMPs identify nine 'Environmental Designations' with management policies and development standards specific to each" [81].

In addition, the State Environmental Policy Act (SEPA) checklist incorporates a review of both surface and groundwater as environmental elements. For project actions, the quantity of well withdrawals must be estimated. For non-project actions, the checklist includes more general evaluation of natural resources depletion. Critical areas and shoreline impacts must be evaluated for both project and non-project actions.

In Oregon, the Forest Practices Act provides guidelines for land management in the forested headwater regions of the basin [82]. The Umatilla County Comprehensive Plan guides development and requires habitat preservation in many floodplains and headwater regions [83]. Similarly, the Walla Walla County Comprehensive Plan and the Columbia County Comprehensive Plan also lay roadmaps for development and set goals for environmental protection [84] [85].

Wetlands provide many vital functions, such as habitat and groundwater recharge. They are designated critical areas that are commonly present along perennial drainageways, seasonally wet ponds and prairies, riparian areas, and in the forested upland areas of the basin [85] [86]. Many floodplain wetlands in the area have been in size or eliminated for agricultural purposes, while constructed wetlands have also been created as a result of development such as crop irrigation practices [86]. Wetlands are regulated at multiple levels of governance:

- At the **local** level, RCW 36.70A of the GMA and RCW 90.58 of the SMA provide guidance.
- In **Washington**, RCW 90.48 of the WPC Act and WAC 173-201A set standards within the basin.
- On a **federal** level, the CWA provides further regulation [87].

Rural Land Use

Rural agricultural land use dominates the Walla Walla Basin with major dryland crops including winter wheat, spring grain, and barley [88]. **One major water resource management concern associated with agricultural land use is nonpoint pollution from agricultural practices** [16]. Specific agricultural practices that most severely impact water quality in the region include pesticide use and cropping practices that increase erosion rates and sediment contribution into streams and rivers [16]. Additional detail on Walla Walla Basin water quality is found in *Chapter 3.1 Water Quality*.

Private agricultural landowners have made significant efforts in dryland tillage practices and overall agricultural land management in the basin since the late 1980s. These changes improved land stewardship practices in ways that benefit aquatic resources, particularly related to reductions in soil sediment discharge. For example, there are an estimated 358,056 acres of land enrolled in CRP in Walla Walla, Columbia, and Umatilla counties which enhances habitat, reduces sediment delivery, and improves soil health and water quality through various conservation practices [89]. The Walla Walla Basin only encompasses a portion of the land area in these counties (though the basin includes most of the area in Walla Walla County), but the participation in these federal conservation programs is significant.

While there are several hundred thousand acres of dryland agriculture in the basin, an estimated 58,000 acres of land are irrigated and irrigation has been rising since the mid-1800s [1]. Hay (produced for both pasture and alfalfa), alfalfa seed, fruit orchards, and vineyards are the most common crops throughout the basin that require irrigation [88]. Other irrigated crops include onions, potatoes, and other row crops.

While rural land use is dominated by agriculture, low density rural development is occurring in much of the basin, increasing impacts to surface water and groundwater, adding points of runoff, increasing impervious surfaces, and further altering riparian areas [88]. Additional development activities impacting rural areas include general population growth [88] and urban sprawl, such as ranchettes pushing into previously less-developed spaces within the Walla Walla Subbasin [1].

Urban Land Use

Urban areas of the basin include the cities of Walla Walla, College Place, and Milton-Freewater, as well as the smaller towns of Dayton, Waitsburg, Prescott, and Touchet. Water quality issues associated with urban land use include stormwater runoff containing sediment, pathogens, toxics, fecal coliform, and decreased oxygen content [88].

The U.S. Environmental Protection Agency (EPA) regulates stormwater under the CWA and Ecology administers the stormwater provisions of the CWA. Ecology issues stormwater permits in the basin for five-year periods, adding new requirements with each update. Many jurisdictions in eastern Washington are covered under the same stormwater permit. For example, the cities of Walla Walla and College Place and parts of Burbank and unincorporated Walla Walla County are included under the same EPA stormwater permitting area. This situation illustrates **an existing issue of permits generated to deal with urban pollution having a lack of applicability over areas with a diversity of land use, meaning that the permit requirements do not always function as intended** [90].

For Walla Walla County, current stormwater management projects include adopting a Shoreline Master Program, disconnecting piped outfalls, working with the City of Walla Walla and College Place to meet TMDL waste load allocation reductions, managing sediment from construction projects, and coordinating with other agencies on stormwater management [90]. Columbia County also adopted a SMP in 2016 to protect shorelines in Columbia County and any construction along shoreline habitat requires permitting [91].

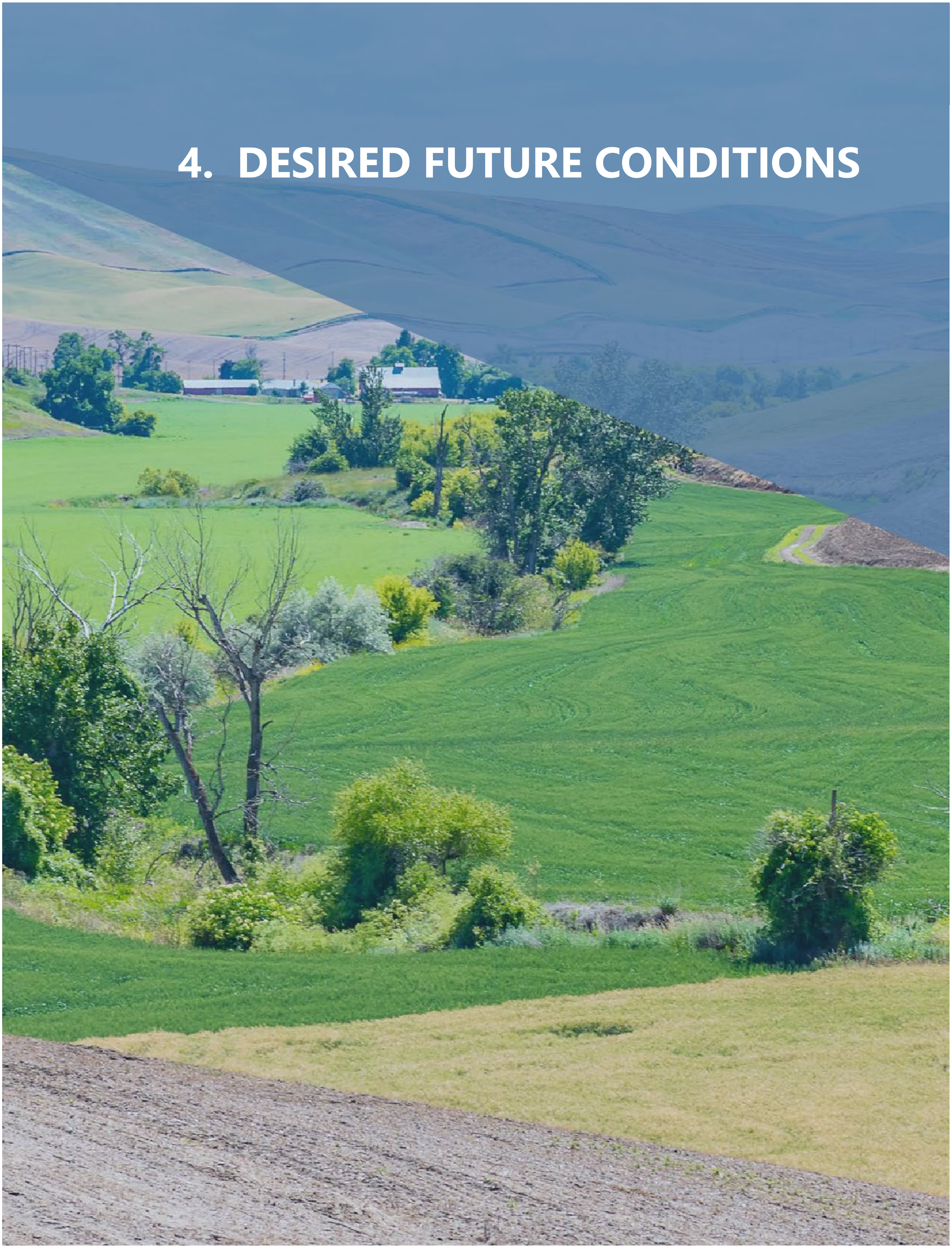
Forest Management

The basin's headwaters are forested; USFS manages most of this forestland, with the remaining areas under private and state control. Much of the forested portion of the basin is protected as the Mill Creek municipal drinking water watershed (established as a cooperative agreement between the City of Walla Walla and USFS in 1918) or is not accessible by roads and therefore not actively managed for timber harvest [92]. As a land manager, the four ranger districts of Umatilla National Forest collaborate with tribes, private landowners, and representatives of recreation in the basin to manage the forested upland regions in the Umatilla National Forest. The areas of these forested lands totals 157 square miles.

USFS forest practices are guided by a multitude of federal directives, most significantly: 1972 CWA; 1973 ESA; 1976 National Forest Management Act; and 1990 Umatilla National Forest Plan. Embedded in these legal and management directives is significant guidance on protecting water quality and quantity. Many forest practices focus on priorities such as fuel hazard reduction for fire resilience, road maintenance to minimize impact to water quality, and snow retention to support water supply and overall hydrologic health. For example, to minimize solar radiation of mountain snowpack, the USFS seeks to limit canopy gap diameter and obtain a 30 percent canopy closure.

Climate change has impacted this region such that areas of higher elevation are becoming increasingly rain dominated. Projected snowpack decline for the Blue Mountains over the next 30 years is set between 40-50 percent. Initial studies have found that timber harvest treatments can substantially increase snowpack retention when 20 percent or more of the forest is harvested. The major barrier to implementation of this practice is current forest plan guidance allowing for only 15 percent harvest [92].

4. DESIRED FUTURE CONDITIONS



4.1 PROJECTED IMPACTS OF CLIMATE CHANGE

Climate change is a global phenomenon caused largely by anthropogenic greenhouse gas (GHG) emissions. Globally, the Intergovernmental Panel on Climate Change (IPCC) estimates that on average, combined air and sea temperatures are already 1°C (1.8°F) higher than pre-industrial temperatures [93]. As global GHG emissions continue, climate change will have wide-ranging effects on human and natural systems worldwide, particularly if global average temperatures reach 1.5°C (2.7°F) of warming above pre-industrial temperatures [93].

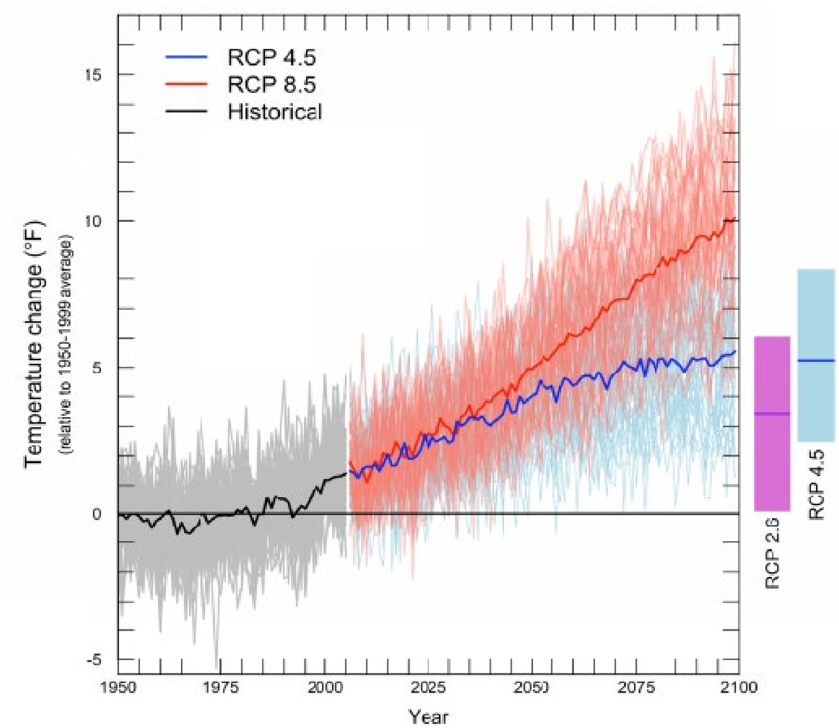
In the Walla Walla Watershed, **climate change is projected to cause long-term temperature increases and more variable precipitation patterns, which will alter hydrologic processes and available water resources and impact ecosystems, human industry, and wellbeing in the decades to come.** The section below summarizes the key impacts from climate change in Washington and the Walla Walla Watershed.

Warming Temperatures

The Pacific Northwest and the Walla Walla Watershed's average **temperatures are already rising**; they have increased by more than 1.3°F since 1895 [94]. The coldest days each year are also getting warmer—the most recent average coldest day in the Pacific Northwest is 4.78°F warmer than the average coldest days during the first half of the 20th century, and the frost-free season is 35 days longer [95]. Some year-to-year variability will continue—including from El Niño events—but overall, temperatures are predicted to steadily increase across the region [95]. Figure 28 demonstrates these predicted changes under two different greenhouse gas scenarios published by the IPCC: Representative Concentration Pathway (RPC) 4.5, a low-emissions scenario where policies and programs to mitigate climate change are largely successful, and RPC 8.5, a high-emissions scenario.

In Walla Walla County, there were an average of 17.6 days per year above 95°F from 1981-2010. In the future (even under a low-emissions scenario), projections indicate that temperatures will rise above 95°F for 35.3 days per year by 2059. By 2099, there could be 42 days that exceed 95°F per year [96].

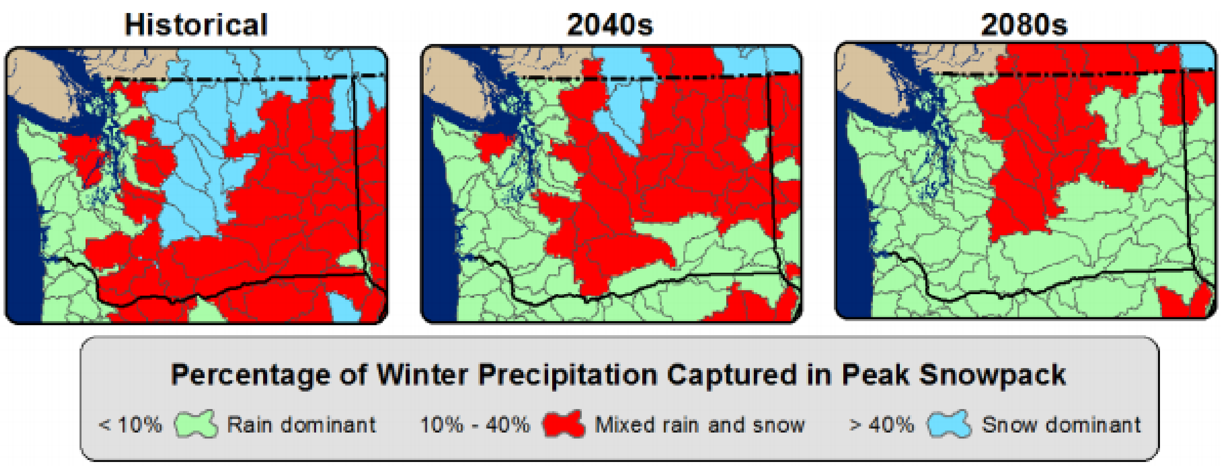
Figure 28: Projected yearly average temperature increases under all IPCC 2013 Report scenarios [95].



Reduced Snowpack

Snow, the primary mechanism for storing water, is particularly sensitive to warming mid-winter temperatures. As rain precipitation events replace snowfall, there will be less overall snowpack and an earlier snowmelt peak [97]. Average spring snowpack in Washington is projected to decline by 56 to 70 percent by the 2080s, relative to 1916-2006 [95]. The largest **declines in snowpack** levels are projected for mid-elevation basins (including the Walla Walla Watershed) that accumulate snow as 10-40 percent of their October-March precipitation [95, 98]. Relative to 1970-1999 levels, the April 1 snow water equivalent (a measure of the total amount of water contained in the snowpack) for snow that feeds the Walla Walla River is expected to decrease by upwards of 66 percent by the 2040s and upwards of 89 percent by the 2080s [98]. This shift is expected to fundamentally change the ecology of Washington watersheds, with waterways once fed primarily by snowpack increasingly fed by a higher percentage of rain (see Figure 29 below) [95].

Figure 29: Current and future watershed classifications based on the proportion of winter precipitation stored in peak annual snowpack. The historical map shows 1916-2006 averages. The 2040s map shows a 2030-2059 projection and the 2080s map shows a 2070s-2099 projection under a medium GHG scenario [95].



Variable Precipitation

Climate change has not yet caused measurable increases in **precipitation variability** in the Pacific Northwest that exceeds typical year-to-year variability. However, it is expected to cause both **more intense, heavy rains** and longer periods between precipitation events with **more pronounced droughts** [95].

Across the Northwest, heavy rainfall events are expected to become more severe by mid-century, with the average number of days with more than one inch of rain projected to increase by about 13 percent for the 2050s, relative to 1971-2000. The average heaviest rain events in Washington are projected to become 22 percent more intense by the 2080s. These heavy rainfall events are predicted to occur primarily during the fall and are expected to increase the frequency and severity of extreme flood events [95].

Meanwhile, **summer precipitation rates are widely expected to decline** in Washington, with some individual projections showing as much as a 30 percent decrease in summer precipitation rates. On average, summer precipitation is expected to decrease by between 6-8 percent. Spring, fall, and winter precipitation is projected to increase by between 2-7 percent on average [95].

Increased Wildfire Risk

The Pacific Northwest is already facing historic fire seasons [99]. In Washington, warming temperatures, reduced snowpack, low summer streamflows, and reduced summer precipitation will contribute **to longer, drier fire seasons and greater wildfire risk**. By the 2050s, Washington and Oregon are expected to have 50 percent more very high fire danger days on average each year [100]. In the Columbia River Basin, the area burned by fire is expected to triple relative to the 1916-2006 median by the 2040s [101].

Unreliable Water Availability

The effects of climate change will change **where, when, and how much water is available** to residents, businesses, industries, and the natural habitats that depend on water resources. These impacts will exacerbate existing stresses to Washington's water supply from excessive water withdrawals, water quality degradation, and increased demand for water resources [102]. More details on these impacts are detailed in the following section.

Climate Impacts by Focus Area

Climate change will have **far-reaching impacts on water resources** in eastern Washington, with important implications for both the ecology and economy of the region.

Streamflows: Extreme heat, changing precipitation patterns, and less regional snowpack are expected to change seasonal streamflow patterns and increase stream temperatures. In eastern Washington, wetter winters and springs, drier summers, and declining snowpack will lead to earlier peak streamflow, higher winter streamflow, and longer periods of low summer flows [97]. Washington rivers fed by snowmelt are already experiencing earlier peak streamflow, in some cases up to 20 days earlier than average [103].

By the 2080s, winter streamflow is expected to increase by 25-34 percent on average across the state relative to 1970-1990 levels. Meanwhile, average summer streamflow is projected to decrease by 34-44 percent [95]. Rain dominant and mixed rain and snow basins, such as the Walla Walla Basin, will show the greatest and most consistent decreases in minimum flows [104]. Warming air temperatures and lower summer streamflows are also projected to increase average stream temperatures [95]. In the Blue Mountains, projections indicate that basin-wide average August stream temperatures will increase 1°C (1.8°F) by 2040 and nearly 2°C (3.6°F) by 2080 [98].

Flood control: Cities and towns in the Walla Walla Basin have experience with floods, including a historic flood in 2020 across Walla Walla, Columbia, and Umatilla counties. These regional events are expected to become more frequent [105]. Rainier winters and more extreme precipitation events will increase the risk of seasonal flooding and strain existing flood management systems in eastern Washington. High flow rates in the Walla Walla River and its tributaries that occur between January and May are projected to become even higher on average, increasing the risk of seasonal flooding. In addition, a higher rain-to-snow ratio in the Blue Mountains is expected to cause higher peak streamflows in late autumn and winter, leading to a predicted 30 percent increase in flood risk in some areas. The increased flooding threatens to overwhelm regional culverts, many of which are reaching the end of their 25- to 75-year lifespans [98].

The increased risk of wildfire in turn increases flood risks. Wildfires dramatically change the landscape, vegetation, and soils. Burned ground is less able to absorb the falling rain, increasing runoff. Post-wildfire floods typically carry surface debris such as downed trees, boulders, and gravel, and can create debris flows and mudflows on steep terrain. Even modest rainstorms over a burned area can result in flash flooding downstream. These floods are typically much larger for a given storm event than they were before the wildfire and can impact properties that were previously considered safe from flooding [106].

Water quality: More frequent and more extreme flood events disrupt the natural balance of sediment and nutrients in floodplains and adversely impact overall water quality [107]. Wildfires have a similar effect, contaminating waters downstream with ash, sediment, and nutrients. The nutrient pollution from wildfires and flood events also increases the risk of harmful algal blooms, which contaminate drinking water and pose other health threats [108].

Groundwater conditions: Hotter, drier summers and reductions in summer streamflow can decrease groundwater recharge rates. In the Walla Walla Basin, groundwater levels are declining in both the alluvial and basalt aquifers, which has important implications for vital habitats like wetlands, as well as residents, businesses, and farmers that rely on groundwater wells [109].

Critical species and habitat: In eastern Washington, warming water temperatures and changes to streamflow rates will disrupt vital habitats and threaten fish and other species that depend on them. Variability in precipitation (and the longer dry periods and more pronounced droughts that it will cause) are projected to reduce wetland habitat extent and duration, causing changes in waterfowl movement [104]. **As ecosystems face increased frequency and severity of droughts, floods, extreme weather, and other impacts, they will be less able to adjust and recover** [95]. Fish, particularly cold-water fish species such as trout and salmon, are particularly affected by higher average temperatures, which will create thermal barriers for some migrating fish species, exceed survivable temperatures for other aquatic species, reduce levels of dissolved oxygen in the water, accelerate natural chemical reactions, and release excess nutrients into the water [110].

By 2070-2099, about 20 percent more stream locations in eastern Washington are projected to experience weekly summer stream temperatures stressful to salmon (above 67ºF). Projections for 124 stream temperatures across the state found that by 2080, the average temperature in many streams will exceed the thermal tolerance of salmon for the entire summer season [95]. Other water-dependent species, such as amphibians, will likely face habitat fragmentation and could face extinction from habitat changes caused by the increased frequency of flooding, debris flows, and landslides. [104].

Out of stream water use impacts: Along with the threats to water resources, climate impacts to eastern Washington will affect the regional agricultural industry; threaten to degrade vital infrastructure; and pose a risk to the health, wellbeing, and quality of life of residents, which in turn affects the regional tourism industry.

Because irrigation demand is highest in the summer, lower summer streamflow is expected to strain the water supply for eastern Washington's agricultural industry. At the same time, warming temperatures will result in a longer growing season, adding additional water demand and further stressing the water supply. By the 2030s, irrigation demand in eastern Washington is expected to increase by approximately four percent compared to 1977-2006, assuming historical cropping patterns [95]. Meanwhile, more extreme heat events and fewer cool days will affect the viability of certain cool weather crops, including fruits and vineyards [95]. The potential impacts to wine grapes are particularly relevant for Walla Walla County, given the significant economic value of the region's wine industry.

Climate impacts also threaten vital infrastructure. Physical hazards, such as wildfires, flooding, and landslides, threaten to destroy or degrade buildings and disrupt public lifelines including water, sewer, and energy systems. Infrastructure near floodplains—such as the areas surrounding Mill Creek in Walla Walla County—is particularly susceptible to these physical impacts [95]. As described above, increased flooding is expected to strain flood management systems in Walla Walla and across the state.

Health, wellbeing, and quality of life: Climate change—particularly related to wildfires, extreme heat, and damage to landscapes and recreational opportunities—impacts health, well-being, and quality of life. **Wildfires are the largest source of particle pollution in Washington and pose a serious public health threat.** Inhaling smoke can cause heart disease, respiratory disease, and death [111]. Extreme heat and heat waves will similarly impact public health, with higher rates of heat exhaustion, heat cramps, heat stroke, and deaths from prolonged heat exposure [112]. **Smoke and heat events will first affect vulnerable and frontline communities** [104]**.**

Climate impacts also threaten the quality of life and recreational economy in eastern Washington. Outdoor activities including boating, rafting, hunting, fishing, hiking, and backpacking are all threatened by climate change [104]. Along with enhancing quality of life, these activities contribute $51 billion in consumer spending to the region annually and provide around 451,000 jobs. Consequences to quality of life are particularly significant for regional tribes. The tribal income base depends heavily on natural resource economies and their supporting industries. In addition, fish and game under threat from climate impacts are important cultural resources [104].

Land use and cover: Overall, there is a high likelihood that land cover and soil will change significantly from climate impacts, but the specifics are uncertain. Increased frequency of droughts, floods, and heat waves will change plant communities, with subsequent effects on soil biogeochemistry. There is uncertainty about what these changes will look like because ecosystem changes are dependent on the timing, magnitude, frequency and extent of extreme events, complex biogeochemical processes, and policy and other mitigation strategies put into place [113]. Meanwhile, increased flooding can raise the risk of landslides.

4.2 UNCERTAINTIES & ASSUMPTIONS

Planning for restoration and protection of complex natural systems is difficult at any scale. At the basin level, complications are compounded by uneven distribution of data, monitoring ability, multiple jurisdictions, and varied knowledge across the landscape. Basins with significant human impacts have additional layers of complexity. In this context, a baseline level of uncertainty and the need to use assumptions to streamline analysis and decision-making are necessary tradeoffs.

With that in mind, this chapter discusses sources of uncertainty and key assumptions used in this strategic plan. Sources of uncertainty in the planning process are grouped roughly into two categories: (1) data gaps and (2) future natural and demographic variability, including unknown/unknowable changes related to climate change, population fluctuation, and similar dynamics. The uncertainties are followed by the identification and discussion of key high-level assumptions used to guide the planning process. Each of these categories includes subsections on their impacts on the planning process.

Data gaps and assumptions are inherent in any long-range, large-scale planning effort; these issues are not fatal and do not undermine the value of this plan. The presence of gaps and assumptions is less important than recognizing that they exist and have implications on plan implementation. Effective planning recognizes and describes uncertainties and assumptions and then builds adaptation into resulting strategies to compensate.

Data Gaps

The primary source of uncertainty in this planning process is missing and incomplete data. At the basin scale, and with the scope and types of activities covered by the planning process, data gaps are inevitable. This section briefly describes key missing data and other data issues that impacted the planning process. Some of these missing pieces are identified as gaps to be filled by strategies proposed in the plan while others are identified as hurdles to meeting goals or implementing strategies in the plan.

Water balance uncertainty: Water balance refers to the sum of inflows (e.g., precipitation, groundwater infiltration to surface water) and outflows (e.g., consumptive water use) in the watershed. While water balance for the basin as a whole may be relatively well known, specific knowledge of inflows and outflows is uneven across the landscape. For example, where managed aquifer recharge (MAR) sites and accompanying groundwater monitoring coexist, alluvial aquifer conditions are known with some degree of certainty. Outside of these areas however, much remains to be learned and studied about the precise interaction of alluvial groundwater with springs, surface flows, wetlands, and other landscape/hydrologic dynamics. Similarly, while consumptive water use and diversions for irrigation and other uses can be estimated from water rights, aerial photos, crop data, and other sources, many of these important data points are not known with a high degree of certainty. Fortunately, the U.S. Geological Survey **(USGS) surface water and groundwater study will address many of these gaps in our understanding of the basin's water balance and provide an excellent framework for decision-making.**

The impact of water balance uncertainty on the planning process manifests primarily as a lack of *quantified* gaps and strategy outcomes. Gaps in the planning process are defined as the difference between current conditions and desired future conditions. Many gaps related to streamflows, groundwater conditions, water use, floodplains, water quality, and other planning focus areas are described qualitatively due to lack of tributary or site-specific water balance information. This planning process will highlight specific gaps that will guide necessary work for the future success of the plan and the basin as a whole.

Monitoring infrastructure: The current deficiency in the watershed's monitoring infrastructure poses a data issue related to water balance uncertainty. Specifically, the basin **lacks a**

comprehensive surface and groundwater monitoring network that would enable detailed planning for surface water, groundwater, and out-of-stream water use strategies. However, the basin does not lack monitoring infrastructure altogether; the existing network is sufficient in detail and coverage to help identify broad trends in resource conditions, even though it is not comprehensive and specific to all sites in the basin. As mentioned previously, the USGS study will address many of these water monitoring uncertainties and provide a long-term monitoring framework to hand off to local entities and state agencies.

Data incorporated from older plans: Some of the data used to inform this plan are from a collection of older plans. For example, data for Total Maximum Daily Loads (TMDL) used to manage water quality are from the early and mid-2000s. Some habitat data used in the plan comes from a subbasin plan completed in 2004 and a Washington Department of Ecology (Ecology) watershed plan completed in 2005. Flood maps for Walla Walla and Columbia counties were last updated in the 1980s. As with other uncertainties described here, uncertainty caused by using this data is not fatal to the planning process as these older plans still provide a lot of relevant and useful information.

Relative ecological benefit of water: One major challenge in restoration planning is prioritizing restoration opportunities. **Specific data quantifying potential benefits of strategies and/or specific project outcomes is not available for all areas investigated in this planning process**. In particular, for restoring instream flow, boosting alluvial aquifer levels, and selecting areas for floodplain restoration/enhancement, no current metric fully captures the relative ecological benefit of (1) these project types or (2) of implementing these project types in different locations. While important to restore flows, groundwater levels, and floodplains across the landscape, it can be hard to determine which strategies to pursue in which place and in what order.

The impact of this data uncertainty is important but likely not a significant hinderance to the effectiveness of the plan. When it comes to on-the-ground implementation of projects, even the most detailed prioritization process could be limited by the realities of funding availability, landowner permission, stakeholder support, and other social, cultural, and economic factors.

Cost uncertainty: Although possible to identify a range of costs for implementing strategies and projects resulting from this planning work, uncertainty abounds about specific costs, especially if trying to aggregate costs or estimate the amount of money needed to reach desired future conditions in the basin. As with other sources of uncertainty described above, this is one that most, if not all, planning processes face. Project costs are highly dependent on time, location, and context. **Prices of materials fluctuate, contingencies occur, and many other dynamics affect specific project costs; these changes are impossible to accurately predict over a 30-year planning horizon**. The impact of this uncertainty on the planning process is minimal. For the scope and duration of this plan, ranges of cost estimates are sufficient and more specific cost data can be developed over time as implementation proceeds.

Climate variability: Both human-caused climate change and natural climate fluctuations (e.g., periodic droughts and floods) are sources of uncertainty over the time span covered by this plan. Modeling can help predict the most likely climate scenarios throughout the plan's duration, but variations from modeled conditions are inevitable. One of the likeliest impacts of climate change is greater variability in conditions, including more frequent extreme weather events. Rather than providing a roadblock for the planning process, recognition of **climate variability is integrated into all aspects of the plan**. Most importantly, knowing that the future climate of the basin will be unpredictable is yet another argument for adaptive management of plan strategies and implementation over time. This plan will need to be a living document to provide an effective guide for restoration and protection of the basin in the face of all sources of climate variability.

Feasibility of a Columbia River pump exchange and/or storage reservoir project: A final uncertainty is whether a large-scale capital project (as envisioned in the Bi-State Flow Study) is feasible and will be constructed. Three basic options for this project are still being considered: (1) a pump exchange on the Columbia River, (2) new above and/or below ground storage in the Walla Walla Basin, or (3) a hybrid of the two. The basic concept of the pump exchange project is to provide reliable water supplies for irrigated agriculture from the Columbia River, allowing Walla Walla irrigators to forgo diversions on the Walla Walla River, which will increase flows and provide other habitat and supply reliability benefits. A new storage reservoir or additional MAR projects (either in place of or in concert with a Columbia River pump station) would capture winter and spring runoff and use it to supply irrigation needs. Finally, hybrids of the two project types that include both a pump station on the Columbia and new storage in the Walla Walla Basin are still under consideration. Under some project scenarios, the watershed might see increased amounts of water availability for out-of-stream use and/or for aquifer recharge.

Combining the pump exchange with construction of a new above-ground reservoir or underground storage could provide additional storage for water pumped from the Columbia River during times of surplus and contribute to high flows from the Walla Walla Watershed. Although stakeholders in this strategic planning process understand the expense and difficulty of permitting and building a pump exchange or large storage reservoir project, most agree that some form of the project is likely to move forward. Uncertainty over this outcome, however, does have an impact on the planning process and would greatly impact Strategic Plan implementation. If the pump exchange runs into an unforeseen and/or insurmountable hurdle, it will greatly increase the pressure on strategies within this plan to help the basin balance agricultural and instream water uses. Therefore, this planning process does not rely solely on this project; instead, the plan proposes several different approaches that could serve either as complements to a successful large-scale capital project or could replace some of the benefits that would be lost in the absence of the project (refer to the following sections of this plan for more details: Chapter 3.1 - Current Conditions - Streamflows; Chapter 3.3 Current Conditions - Groundwater; and Chapter 3.5 Out of Stream Water Uses).

Assumptions

Assumptions are a necessary part of a long-term, broad-scale planning process. In fact, assumptions are one mechanism for dealing with baseline uncertainties as they allow planners to move ahead in light of data gaps and quality issues. This section briefly highlights the primary, high-level assumptions that underpin this strategic plan.

Geographic fungibility: The Walla Walla Basin contains diverse physical and human (semi-urban, industrial, and agricultural areas) geography. The basin's resources reflect this diversity, and no two river miles are identical. However, a long-range, basin-scale plan cannot be granular enough to plan mile-by-mile or acre-by-acre. As such, a major assumption is that, despite the physical, resource, and community diversity of the basin, **focusing on key sub watersheds and basing planning decisions on data and needs in these areas is sufficient for a plan that can be effective throughout the basin.** The Walla Walla River (including its upper headwaters tributaries), the Touchet River, and Mill Creek are the primary focus of this plan. The plan is intended to cover the entire basin, including areas outside or adjacent to these sub watersheds in Oregon and Washington. However, for practical reasons, these three sub watersheds serve as bellwethers for the whole watershed. Conditions described here are assumed to be mostly interchangeable with conditions in areas of the watershed not specifically mentioned. In addition, the appendices and prior reports (referenced throughout the plan) contain significant amounts of more specific information.

Stakeholder representation: The Walla Walla Water 2050 (WWW2050) planning process is intended to be inclusive, and the results of the planning process are assumed to be representative of broad local stakeholder guidance and acceptance. Despite best efforts to include all relevant points of view and expertise in the planning process, it is nonetheless possible that some voices are missing or underrepresented. For example, the Walla Walla Basin is a bi-state basin. Ensuring equal representation between both Oregon and Washington is a challenge and the balance could have some impact on the resulting plan. While all efforts were made to develop a balanced, inclusive plan, some amount of imbalance and underrepresentation likely occurred. One underlying assumption of this process is that **the effort and intention expended to include and balance diverse stakeholder input provides a high degree of credibility for the process and its eventual implementation** and that the plan has been developed to adapt to change, including changing stakeholder interests/perspectives, over time.

Relative importance of habitat protection/restoration to anadromous species viability: Anadromous fish have some of the most complex life histories of any species on earth. Splitting their time between small river tributaries hundreds of miles inland and the vast Pacific Ocean means that some of the key species in the Walla Walla Basin are exposed to diverse threats (many of which are not in the control of Walla Walla Watershed stakeholders and resource managers). It is possible that all of the goals of the WWW2050 Strategic Plan could be met and some species would remain threatened due to ocean conditions or Columbia River conditions. However, the assumption underlying this process is that habitat conditions in the basin are a critical factor in anadromous species viability and that progress to restore and protect habitat here will help recover these species and support their long-term thriving.

Landowner willingness: A final important assumption underlying this planning process is that through collaboration, tailored incentives, voluntary programs, and patience, restoration and protection actions that must be done on private land or involving privately held water rights are realistic. However, basin resource managers cannot impose their will on private property holders simply because an action was identified or promoted by this plan. Rather, the plan assumes that there is or will be a **path forward that balances benefits to fish and the environment with those of the basin's farms, communities, tribal members, and others.** The stakeholders and experts involved in this planning process respect private property and understand that achieving many of the plan's stated outcomes will necessitate compromise, collaboration, patience, and understanding.

4.3 DESIRED FUTURE CONDITIONS

The long-term health of the watershed depends on achieving several specific planning goals over the next 30 years. To guide the development of the overall water management strategy, the Strategic Plan Advisory Committee (**SPAC) developed 16 goals, referred to as "desired future conditions," for water resource management**. These desired future conditions are summarized in Table 32 and in the sections that follow, along with the available performance metrics to assess progress. Where possible, goals and metrics are defined quantitatively to better track progress. Where quantification is not possible, performance metrics are stated in the simplest terms; for example, as an increase in a beneficial project type or a decrease in detrimental impacts.

Table 32. Summary of desired future conditions for the basin.

Floodplains, Critical Species, Habitat, & Water Quality
– Achieve healthy, natural floodplain function
– Increase access to quality habitat
– Increase riparian cover
– Increase river channel complexity and naturalize channelized streams
– Restore a natural sediment transport regime
– Meet TMDL targets
– Increase critical fish species population and abundance levels necessary to meet delisting criteria, support sustainable natural production, and provide a fishery for Tribes and the community
Water Supply, Streamflows, & Groundwater
– Build resiliency and redundancy in the agricultural water supply to meet current and future water demand
– Stabilize aquifer levels to support water resources and water for people and farms
– Enhance instream flows to meet instream flow targets for critical species
– Increased natural infiltration, acreage, and duration of inundation
Land Use & Flood Control
– Reduce flood risk for people and cities
– Meet TMDL targets
– Create climate resilience for basin water resources
Quality of Life
– Sustain and improve quality of life in the Walla Walla Valley by supporting community health with clean and reliable domestic water supply as well as opportunities for outdoor recreation and sustainable tourism
Monitoring & Metering
– Increase streamflow, habitat, and water use monitoring to support better water resource management and adaptive management

Floodplains, Critical Species, Habitat, & Water Quality

Desired future conditions for floodplains, critical species, habitat, and water quality include a restored Walla Walla Basin in which watershed, floodplains, and riverine processes promote, improve, and achieve sustainable instream water and habitat quantity and quality for harvestable fish populations and other First Foods central for Tribal and public use. Existing and ongoing floodplain assessments (which detail limiting factors and conceptual improvements) should be used to inform restoration treatments and priorities. Future floodplain restoration, development projects, and flood response actions should all be consistent with goals and objectives outlined in this plan and additional associated assessments for floodplain restoration. It is expected that floodplain restoration needs will continue following the 30-year duration of this plan.

Functional floodplains provide benefits to instream flows, aquifers, instream and riparian habitat, growth and survival of salmonids, and water quality. The SPAC seeks to **balance the restoration of healthy floodplains with adequate flood risk management** to improve ecological benefits and protect communities and the region's economy.

Critical species in the basin have diverse habitat needs. Desired future conditions for critical species and their habitat reflect this diversity both geographically and in terms of the specific parameters that need to be met. At a high level, the basin's **critical species need increased access to *existing* high-quality habitat as well as significant restoration of currently degraded habitat**. Increasingly, research is showing that salmon and steelhead that rear in floodplain habitat for part of their life history have increased growth and resultant increase in survival.

The Confederated Tribes of the Umatilla Reservation's (CTUIR) River Vision summarizes desired future conditions for habitat as, "a river that is dynamic, and shaped not only by physical and biological processes, but the interactions and interconnections between those processes" [114]. The River Vision also provides a useful framework for characterizing current and future floodplain health through analysis of hydrology, connectivity, aquatic biota, riparian vegetation, and geomorphology. This section focuses primarily on connectivity and geomorphology with some elements that relate to riparian vegetation and aquatic biota. Hydrology, and riparian vegetation are more fully covered in the chapters of this plan that focus on surface and groundwater resources (see Chapter 3. Current Conditions). Specific priority area habitat objectives are included for some reaches in the table below. These measures of ideal future conditions come from an Ecosystem Diagnostic and Testing (EDT) protocol used to measure habitat needs in the 2005 WRIA 32 Watershed Plan [3].

For water quality, desired future conditions focus on **meeting TMDL requirements in area rivers, streams, and specific river reaches to protect and enhance both human health and aquatic species' health and habitat**. The range of sources and vectors (point and non-point) of water pollution mean that tracking progress toward meeting desired future conditions requires diverse performance metrics. At the same time, water quality conditions often directly relate to other watershed dynamics, meaning that achieving desired conditions for water quality parameters will often also assist in meeting other goals and vice versa.

Table 33. Desired future conditions for floodplains, critical species, habitat, and water quality.

DESIRED CONDITIONS	PERFORMANCE METRICS
Achieve healthy, natural floodplain function.	
Increase natural infiltration. Reconnecting rivers to their floodplains—by removing levees or by adding complexity to channels that have been straightened or otherwise impacted—increases the infiltration of water into aquifers. More infiltration can help (1) reduce impacts of groundwater pumping and (2) boost base flows as water migrates back to rivers from shallow aquifers during low flow periods. As such, increasing natural infiltration will require increasing the acreage and duration of inundation of floodplains across the basin.	▪ Improved infiltration rates. ▪ Ground water elevation change over time. ▪ Increased groundwater surface water connectivity.
Increase floodplain reconnection. Currently, at least 75-80% of streams are channelized, and development in the floodplain threatens riparian and overall ecological function. Achieving floodplain function requires significant floodplain reconnection work. A desired 30-year target would be that the approximate current level of 20% healthy floodplains be increased to at least 50%.	▪ Miles of levees set back or removed. ▪ Acres of floodplains restored.
Provide ecological benefit to shoreline function. The Shoreline Management Act (SMA) in Washington State broadly mandates that development impacting shorelines—including along rivers and streams—must be mitigated or offset to ensure that the amount of ecological function remains static. The SPAC proposed going beyond this standard to create a net benefit in shoreline ecological function.	▪ Acres of land acquired for floodplain conversion. ▪ Improved coordination within flood control projects to manage for overall ecosystem health.
Increase access to quality habitat.	
Reduce fish passage barriers. Certain fish passage barriers on the Walla Walla River, Touchet River, and Mill Creek must be addressed for upstream and downstream fish migration. These are primarily associated with USACE flood control infrastructure. **Walla Walla River** – Unimpeded access past Nursery Bridge at all flow levels for critical species.	▪ Number of fish passage barriers removed. ▪ Number of stream miles made accessible above repaired former passage barriers. ▪ Number of diversions with fish screens installed. ▪ Confinement (percent of streambank length).

DESIRED CONDITIONS	PERFORMANCE METRICS
Mill Creek – Unimpeded access past Bennington Diversion Dam and at Gose Street Bridge. – Enhanced passage through the weir and concrete sections of the creek. **Touchet River** – Improve flow and timing of fish passage through the Hofer Dam fishway.	▪ Increased fish utilization in habitat above of improved passage
Increase riparian cover.	
Increase width and height of riparian buffers. Creating and/or widening riparian buffers increases the number of acres of protected floodplain and riparian area in the watershed, which can improve riparian vegetation health and floodplain function.	▪ Linear feet/acres of restored riparian buffers. ▪ Review and update the Stormwater Master Plan to achieve outcomes.
Meet priority area habitat objectives for riparian function. **Walla Walla River** – Mill Creek to E. Little Walla Walla: At least 62% of max potential riparian function – E. Little Walla Walla to Tumalum Bridge: At least 62% of max potential riparian function – Tumalum to Nursery Bridge: At least 40% of max potential riparian function – Little Walla Walla River to N. and S. Forks: At least 50% of max potential riparian function – S. Fork Walla Walla River mouth to Elbow Creek: At least 20% of max potential riparian function. – N. Fork Walla Walla River mouth to L. Meadows Canyon Creek and L. Meadows: At least 50% **Touchet River Mainstem** Coppei to Forks and Whiskey Creek: At least 62% of max potential riparian function.	▪ Average percent tree canopy cover in the riparian zone. ▪ Average tree height. ▪ Average percentage departure in current vegetation from historical vegetation.
Increase river channel complexity and naturalize channelized streams.	
Decreased channel confinement. Confinement is a measure of the extent to which human-made structures confine or restrict flows, leading to passage barriers. Confinement targets for these reaches were listed at	▪ Feet/miles of increased sinuosity. ▪ Feet/miles of increased side channel length.

DESIRED CONDITIONS	PERFORMANCE METRICS
40-60% in the 2005 WRIA 32 Watershed Plan; however, CTUIR suggested revising them to 20% for this Strategic Plan: **Walla Walla River** – Mill Creek to E. Little Walla Walla: 20% or less – E. Little Walla Walla to Tumalum Bridge: 20% or less – Tumalum to Nursery Bridge: 20% or less – Little Walla Walla River to N. and S. Forks: 20% or less – S. Fork Walla Walla River mouth to Elbow Creek: 20% or less – N. Fork Walla Walla River mouth to L. Meadows Canyon Creek and L. Meadows: 20% or less **Touchet River Mainstem** – Coppei to Forks and Whiskey Creek: 20% or less	▪ Improved river channel complexity index score. ▪ Percentage of streambank length confined by human-made structures.
Increased river channel complexity. Increasing complexity entails projects that reconnect rivers and streams to their historic channels, construct new side channels, add woody debris, and other features in key river reaches that increase habitat complexity. These projects should be implemented across the basin opportunistically with both public and private landowners. Specific conditions include: **Walla Walla River:** Alongside levee setback projects, restore functional channels to decrease channel incision and promote development of more productive, diverse fish habitat. – Restored, natural river channel within the five-mile Milton-Freewater levee project. – Increased riparian vegetation and more natural channel below Milton-Freewater. – Reduction in future and remediation of existing channel hardening structures. **Touchet River:** Increased prevalence of natural channels and channel features that add complexity and promote high-quality habitat for critical species. **Mill Creek:** Reduce stream power and resulting channel incision above and below the USCOE flood control project.	▪ Quantify and track the baseflow/water budget contributions of the alluvial aquifer across the basin. ▪ Identify cold water refugia. ▪ Monitor water temperature in surface springs, creeks, and streams. ▪ Monitor other parameters in groundwater and connected surface water to track changes in quality. ▪ Bed scour (average depth of bed scour in spawning areas during annual peak flow events over a ten-year period. ▪ Percent increased channel access to floodplain.
Increase habitat complexity by increasing amount of large woody debris and deep pools.	▪ Number of large pools (> 20 m^2 area and > 0.80 m

DESIRED CONDITIONS	PERFORMANCE METRICS
As channelized streams are naturalized through floodplain restoration and other projects, the amount of large woody debris and deep pools will increase, improving habitat quantity and quality for harvestable fish populations.	max depth) per km stream length. ▪ Mean residual pool depth. ▪ Percentage of stream surface area covered by large wood during base flow. ▪ Number of large wood pieces (≥ 0.15 m diameter and ≥ 3 m length) within the bankfull channel per 100 m stream length ▪ Number of large wood pieces within the wetted channel during base flow per 100 m stream length.
Maintain and enhance the cold-water contribution to surface springs, creeks, and streams. Flowing springs and a healthy alluvial aquifer are the critical sources of cold surface water that anadromous fish, bull trout, and other species need. Water-reaching creeks and streams from the alluvial aquifer can be both colder and, depending on the specific area, cleaner (freer from contaminants) than water that is already flowing at the surface.	▪ Quantify and track the baseflow/water budget contributions of the alluvial aquifer across the basin. ▪ Identify cold water refugia. ▪ Monitor water temperature in surface springs, creeks, and streams. ▪ Monitor other parameters in groundwater and connected surface water to track changes in quality. ▪ Contiguous wetted area (> 1 m^2) with water temperature > 2 °C colder than the ambient river temperature.
Restore a natural sediment transport regime.	
Reduce sediment input.	▪ Total suspended solids/turbidity.

DESIRED CONDITIONS	PERFORMANCE METRICS
Upland management (including forestry, road maintenance and road building, and other actions) along with development in and near riparian areas can all result in increased sediment input to basin streams and rivers. A key desired future condition for the basin is to reduce the sediment input and resulting habitat impacts caused by these and other actions. **South Fork Walla Walla River** Provide alternative access to private cabins with minimal impacts to instream and riparian habitat	▪ Reduced sedimentation in key spawning habitat areas and other important habitats. ▪ Reduction in scouring and sediment transport in high energy, channelized stream and river reaches.
Meet priority area specific habitat objectives for embeddedness and bed scour. As channelized streams are naturalized through floodplain restoration and other projects, embeddedness and bed scour will decrease, improving habitat quantity and quality for harvestable fish populations.	▪ Substrate embeddedness percent. ▪ Bed scour (in centimeters).
Meet TMDL targets.	
Meet TMDL targets. TMDL targets are specific regulatory tools under the Clean Water Act and include specific load allocations for both point and non-point sources by reach throughout the basin. Due to the variety of pollutants, regulators set TMDL targets in concentrations (units of pollutant per unit of water), input limits (pounds or grams per day), reduction in concentrations (% reduction goals), and increases in percentage of shade. Metrics and regulations for TMDLs for temperature in Oregon differ from those in Washington. As such, goals for water quality are highly site-specific, quantitative, and backed by regulatory requirements. Meeting TMDL targets requires action by a diverse set of actors—from farmers to state transportation departments, to municipal water providers, to individuals, and others. As a result, Ecology and ORDEQ, the regulatory agencies charged with enforcing the Clean Water Act, facilitate a high level of collaboration, coordination, and engagement.	▪ (WA) Chlorinated Pesticide TMDL: meet total suspended solids targets (lbs/day) January through June. ▪ (WA) PCB TMDL: PCB concentration (gm/day) in January through June. ▪ (WA) Fecal Coliform TMDL: reduced concentration (%) June through October. ▪ (WA) Temperature TMDL: track progress toward system potential mature riparian vegetation July through October. ▪ (WA) pH and Dissolved Oxygen TMDL: concentration of dissolved inorganic nitrogen and soluble reactive phosphorous

DESIRED CONDITIONS	PERFORMANCE METRICS
	(micrograms/L) May through October (WA). ▪ (OR) Temperature TMDL: compare site specific targets as outlined in surrogate measures 1-3 for system vegetative potential.
Further evaluation of water quality. Continue evaluation of water quality in areas that currently lack a TMDL to determine additional areas of water quality concern in the basin.	▪ Funding for water quality evaluation/monitoring. ▪ Number of additional WQ monitoring sites or levels of increased monitoring at existing sites.
Increase critical fish species population and abundance levels necessary to meet delisting criteria, support sustainable natural production, and provide a fishery for Tribes and the community	
Increase fish returns and Chinook reintroductions. Quantitative goals have been set for Walla Walla Basin steelhead and Chinook populations. The goal for steelhead is 5,600 adult fish returning to the basin each year to spawn; the annual return goal for reintroduced Chinook is 5,250 adults.	▪ Annual and 10-year average adult returns.
Improve ESA recovery ratings. The ESA recovery planning process rates current fish population abundance and productivity. This rating system can be used to express goals for species level recovery targets. For the Walla Walla steelhead population, the goal is to move from the current “Maintained” status to “Viable,” while the goal for the Touchet steelhead population is to move from “High Risk” to “Maintained.”	▪ Abundance/productivity targets (Walla Walla and Touchet Steelhead populations: 10-year geomean of 1,000 and 1.35 natural origin spawner/natural origin spawner) ▪ Spatial structure/diversity rating.

Water Supply, Streamflows, and Groundwater

Water rights were developed in the basin beginning in the 1850s without regard for the impact to instream habitat or other environmental uses for surface water. By the time water rights were recognized and created for environmental purposes, the basin’s streams were already overallocated for out-of-stream needs.

Today, water withdrawn from the rivers supports a thriving, diverse, and economically important agricultural sector as well as growing cities and towns and industry. However, rivers and streams in the Walla Walla Basin are over appropriated and often fail to provide sufficient flow for fish and other species, with some areas even periodically going dry during summer low flows. Several factors, including out-of-stream water diversions, groundwater depletion in the alluvial and basalt aquifers, loss of flood plain connectivity, upland practices, and climate change, contribute to these low flow conditions. Addressing low flow rates and mitigating the impact from these contributing factors are vital to the long-term health of the watershed.

At a high level, the desired future condition for streamflow means finding a **balance instream water needs and out-of-stream and that supports regional agriculture, cities, and industry while still providing for the water and habitat needs of fish and other species** instream flow goals identified in the bi-state flow study and WWW2050 Strategic Plan. Achieving these goals will require a broad array of strategies, ranging from MAR, water conservation, and voluntary market-based instream flow restoration through water transactions to implementing one of the infrastructure solutions identified in the Bi-State Flow Study.

For groundwater, the desired future condition is one where **all basin aquifers have ecologically functioning and stable water levels.** Achieving stable water levels depends on stopping further water flow decline by (1) managing and modernizing withdrawals in some areas and (2) increasing water levels through natural and managed recharge in others. The forthcoming USGS Groundwater Surface Water Study will provide a greater understanding of the basin's hydrogeology and the interactions between groundwater and surface water which will be provide a scientific framework for future water management.

Stable water levels are particularly important in both alluvial and basalt aquifers, which groundwater analyses have demonstrated play key roles in the basin's hydrology and in enhancing baseflows and water quality in streams and springs. This section describes the desired future conditions for these two aquifers systems, along with the available performance metrics to track progress toward achieving these conditions.

Table 34. Desired future conditions for water supply, streamflows, and groundwater.

DESIRED CONDITION	PERFORMANCE METRICS
Build resiliency and redundancy in water supply to meet current and future water demand.	
Develop an anchor project to maintain or increase water supplies June through October. Planning and feasibility work are already underway to investigate options for a large anchor water supply project(s) to boost water availability for the basin during critical low flow months. There are three basic options for his project still in consideration: a pump exchange on the Columbia River, new above and/or below ground storage in the Walla Walla Basin, or a hybrid of the two.	▪ Continued progress on planning, selecting, designing, permitting, and developing an anchor water supply project. ▪ Law and policy in place, as necessary, to support anchor project development. ▪ Completion of anchor project and provision of additional

DESIRED CONDITION	PERFORMANCE METRICS
Pump exchange anchor projects have been identified to meet established flow targets that provide instream and out of stream water needs.	supply for agricultural and other water uses.
Enhance recharge to alluvial aquifer to sustain farmers dependent on this source. Recharge the alluvial aquifer to support instream and out-of-stream water use and increased hyporheic exchange. Specific MAR sites will need to be analyzed individually based on local aquifer conditions, source water availability and timing, and pumping needs.	▪ Acre-feet/CFS recharged via MAR. ▪ Surface water springs with improved flow rates.
Increase Gardena Farms water supply in October and November. An addition of 10-13 cfs of water during this shoulder season (i.e., between the usual end of active irrigation and the onset of late fall/winter) would provide water to GFID that the district has long sought. While most irrigation may be finished by this time of year, additional water during the shoulder season can help promote optimal growing conditions for the following year and potentially support a small increase in overall productivity by slightly lengthening the growing season.	
Pipe ditches and improve on-farm irrigation efficiency. Reducing transmission and on-farm irrigation losses are two important ways to increase supply reliability and access to water for irrigated agriculture. Piping ditches and replacing inefficient irrigation methods can both lead to less water diverted from area streams. At the same time, transmission and on-farm inefficiencies can also be important sources of groundwater recharge. Increases in efficiency therefore need to be balanced with MAR and other approaches (reconnecting floodplains, constructed wetlands, etc.).	▪ Miles/feet of open ditch piped and pressurized.
Ensure long-term municipal supply through ASR. Enhance the use of ASR to support municipal supply from the basalt aquifer. Maintain up-to-date and adaptable water supply plans that incorporate multiple sources of municipal supply.	▪ Acre feet of water recharged via ASR.
Balance commercial and municipal/residential development with conservation.	▪ Per capita water use over time. ▪ WUE tracks metering, water production, water consumption,

DESIRED CONDITION	PERFORMANCE METRICS
The desired future condition for municipal/commercial water use is to promote growth in the watershed while ensuring that aggressive conservation efforts are maintained and expanded to keep overall water supply needs in balance. When paired with conservation practices, including high efficiency fixtures, fixing leaks, upgrading outdated infrastructure where needed, and other efforts, growth need not drive large increases in overall water supply needs. This is illustrated by the fact that the City of Walla Walla has grown by 20% over the last 20 years but has reduced overall water use by 33% during that same period. Milton Freewater has also increased its population and decreased its total water use over time. Both incentive programs for water customers and developers along with building and land use regulations should encourage water conservation across the watershed. WA already requires municipal water suppliers to implement Water Use Efficiency (WUE) goals and measures to decrease water usage over time. This is directed by Washington's Municipal Water Law and implemented by DOH through Water Use Efficiency requirements per WAC 246-290, Part 8.	distribution system leakage, water use efficiency goals and measures, and depth-to-water measurements for groundwater sources for municipal water users.
Concentrate growth in areas served by existing municipal water infrastructure. While development will always occur in the watershed, to the extent practical, growth should be concentrated in areas that are or can be served by existing municipal infrastructure. Using and/or extending existing infrastructure is cost effective and can help ensure that future growth occurs in a context that is conducive to efficient water management. Additionally, limiting development outside of municipal service areas will help avoid additional pressure on alluvial and basalt groundwater that would likely be the only available water source for development outside of these areas. Maintaining, repairing, and upgrading municipal water supply infrastructure are costly. Managing these high costs requires distributing the burden so that conservation benefits and development burden are appropriately balanced.	▪ Total and per capita municipal/commercial water use (both current and trends). ▪ Map watershed development and track location of new development within municipal service areas vs. outside of these areas. ▪ Total and per capita industrial water use (both current and trends). ▪ Progress, spending, funding/financing availability for repair, and replacement and maintenance targets for municipal water service infrastructure.
Direct more winter flow in and through the Little Walla Walla River system.	▪ Monitoring/gauging infrastructure in place to manage/measure flows and

DESIRED CONDITION	PERFORMANCE METRICS
The Little Walla Walla River system was once a complex, braided channel system that provided significant habitat and other benefits to fish and wildlife. Among other challenges the reach faces, persistent low flows and dry reaches severely limit fish use and unfulfilled water rights. Increasing winter flow as available will help to naturally recharge the alluvial aquifer, enhance flow at springs and in spring-fed creeks, and reduce local needs for additional MAR sites. The feasibility of flow increase outside of the high flow season will require additional analysis.	groundwater impacts in the Little Walla Walla River system and local aquifer. ▪ Flow levels in the Little Walla Walla River system and local springs/spring-fed creeks. ▪ Groundwater levels in the alluvial aquifer.
Stabilize aquifer levels to support water resources and water for people and farms.	
Stabilize or increase groundwater water levels. The future health of the alluvial aquifer depends on balancing withdrawals with natural and managed recharge to stabilize water levels. Any stabilization measures must support productive agriculture and other out-of-stream uses without sacrificing surface water resources and habitats. Given the unique geology in much of the basin, the alluvial aquifer is often closely connected to surface water resources; stabilizing water levels will require more explicit recognition of, and management for, this hydrologic reality.	▪ Monitor groundwater levels at key locations throughout the basin. ▪ Characterize groundwater levels by measuring them in key locations throughout the basin. ▪ Surface water springs with improved flow rates.
Established aquifer protection zones (quality and quantity). Aquifer protection zones can be established to help ensure the quality and quantity of water in areas that overlie vulnerable or critical parts of the basalt aquifer. The creation and regulation of such zones could be flexible and tailored to site-specific needs. For example, in some zones, new pumping could be restricted; in others, existing pumping could be scaled back. Likewise, these zones could be used to encourage ASR, limit fertilizer applications, or place other needed restrictions on surface uses to protect groundwater. It will be critical to enforce any rules and regulations for each zone. Note that Walla Walla County's Critical Area Ordinance already includes protection standards for the shallow aquifer.	▪ Track the number and purpose of established protection zones. ▪ Track enforcement actions (number, frequency, content, etc.).

DESIRED CONDITION	PERFORMANCE METRICS
Enhance instream flows to meet instream flow targets for critical species where possible.	
Adopt and build consensus around meeting instream flow targets basin wide. A set of instream flow targets was adopted by the Bi-State Flow Study for the Walla Walla River. Additional flow targets are needed for the Walla Walla River's tributaries. A 2013 report from Stillwater Sciences provided one set of ecologically based flow target recommendations, which covers summer low-flow periods and flow targets for periodic high flows, as well as other flows important for channel health and other habitat requirements.	▪ Monthly target flows for all basin streams.
Increase flows in the Walla Walla River, the Touchet River, and Mill Creek during fish critical periods. Adequate instream flows are necessary to meet life cycle needs of critical species during spring, summer, and fall. Water right acquisition, irrigation efficiency, aquifer recharge, crop management, and the Bi-State Flow Study infrastructure solutions may all contribute to improving low-flow conditions.	▪ CFS restored. ▪ Percent of flow target met.
Enhance and reconnect spring-fed wetlands. Where springs historically provided, or currently provide, water for wetlands, this connection should be enhanced or reestablished. Spring-fed wetlands provide cold water to streams via shallow aquifer recharge; they also provide important habitat for birds, terrestrial species, and aquatic species.	▪ Inventory existing and historic spring-fed wetlands and identify opportunities to reestablish sites that are currently nonfunctional. ▪ Monitor water levels in existing spring-fed wetlands.
Increase natural infiltration, acreage, and duration of inundation.	
Restore floodplain habitat. Restore floodplain habitat to encourage natural infiltration and slow the flow of high flows and floodwater. By increasing the area of the floodplain, water is stored and slowly released back into the main channel, maintaining higher stream flows for longer periods.	▪ Acres of floodplain restored. ▪ Miles of levees removed.
Sustain springs flowing at historic or improved rates. One indication of a healthy alluvial aquifer is surface water springs that flow at or near their historic rates. Reduced flows at springs can indicate the overdraft of connected groundwater sources. At the same time, spring flows are	▪ Monitor spring flow rates. ▪ Monitor temperatures at points where spring flows enter streams. ▪ Monitor water levels in springs.

DESIRED CONDITION	PERFORMANCE METRICS
critical for providing cold water to streams and supporting vegetation and habitats.	
Maintain and enhance the cold-water contribution to surface springs, creeks, and streams. Flowing springs and a healthy alluvial aquifer are the critical sources of cold surface water that anadromous fish, bull trout, and other species need. Water-reaching creeks and streams from the alluvial aquifer can be both colder and, depending on the specific area, cleaner (freer from contaminants) than water that is already flowing at the surface.	▪ Quantify and track the baseflow/ water budget contributions of the alluvial aquifer across the basin. ▪ Identify cold-water refugia. ▪ Monitor water temperature in surface springs, creeks, and streams. ▪ Monitor other parameters in groundwater and connected surface water to track changes in quality.

Land Use & Flood Control

The following goals will help achieve a healthy and thriving watershed. These goals focus on **floodplain management, stormwater quality, and the health of the forested headwater regions** as they relate to water quality in the basin.

Table 35. Desired future conditions for land use and flood control.

DESIRED CONDITIONS	PERFORMANCE METRICS
Reduced flood risk to people and cities.	
Successful development management in floodplains. Protection against further encroachment, expanded area available for floodplain function, and reduced flood risks.	▪ Increase in the floodplain area over time. ▪ Length of levees removed or set back. ▪ Width of riparian buffers.
Reduce flooding risks. A major desired future condition is significantly reducing flooding risks to property, infrastructure, and communities during peak flow events. Rather than building levees, which has been done in the past, future flood control efforts should reduce flood risk while improving (or at least not degrading) the watershed's riparian and instream habitats.	▪ Annual flooding damage costs.

DESIRED CONDITIONS	PERFORMANCE METRICS
Reduce impervious surfaces and improve stormwater management. Reducing impervious surfaces in urban areas of the watershed can improve flood control by lowering runoff peaks caused by concentration of heavy precipitation in and around urban areas. As such, a key desired future condition is less impervious surfaces and an increased use of green infrastructure (such as retention and detention basins that limit runoff to rivers and streams from urban areas). Underground Injection Control (UIC) wells often create a pathway of contaminants to groundwater. They should be inventoried and eliminated where possible.	▪ Number of additional green stormwater infrastructure (GSI) best management practices (BMP) (e.g., bio swales, retention ponds, rain gardens, permeable pavement, etc.) in urban areas to increase runoff installed. ▪ Number of Underground Injection Control wells eliminated.
Meet TMDL targets.	
Use of Low Impact Development techniques (such as pervious pavement) in the public and private sectors. Developers and homeowners use technologies such as green space and swales to filter stormwater.	▪ Number, area, and capacity of new stormwater management features to handle runoff from impervious surfaces (bioswales, retention ponds, etc.).
Cost effective connection of septic system to municipal sewer. Home and business owners are able to connect to the municipal sewer system before septic systems fail.	▪ Number of septic system failures. ▪ Number of septic systems connected to municipal wastewater systems.
Stormwater management that supports excellent water quality. Stormwater is infiltrated to maintain water quality and support aquifer and stream health.	▪ Stormwater quality monitoring.
Observance of agricultural best management practices (BMPs). Outreach and incentives for agricultural landowners related to livestock BMPs and pesticide use.	▪ Number of BMPs implemented. ▪ Number of participating landowners.

DESIRED CONDITIONS	PERFORMANCE METRICS
Create climate resilience for basin water resources.	
Sustainable forest management in the upland headwater regions. Increased snow retention and groundwater recharge through forest management practices. Continued protection of the Mill Creek watershed for municipal supply while implementing management activities to maximize water supply.	▪ Amount of snow capture over time.
Increased water retention and infiltration in dryland agricultural regions through agricultural best management practices. Water retention capacity of dryland soils encouraged through conservation tillage and organic matter.	▪ Number of water retention features installed. ▪ Acres using conservation tillage techniques.
Efforts to protect and restore wetlands. Wetlands being restored and protected in agricultural, urban, and forested land use areas to provide habitat for aquatic and terrestrial species, filter runoff, recharge groundwater, and sustain surface water flows.	▪ Acres of wetlands restored or protected.

Quality of Life

Water quality and flowing streams impact overall quality of life and the economy of the watershed. Rivers and creeks provide direct recreation and tourism opportunities like boating, fishing, and swimming, while enhancing other activities like birding, hiking, camping, and viticulture tourism.

Table 36. Desired future conditions for quality of life.

DESIRED CONDITION	PERFORMANCE METRICS
Sustain and improve quality of life in the Walla Walla Valley by supporting, community health with clean and reliable domestic water supply, opportunities for outdoor recreation, and sustainable tourism.	
Increased and improved public access to streams, rivers and natural areas. Maintain and increase public access to rivers and streams in the Walla Walla Basin through the creation of trails, parks, and public access points.	▪ Number of new or improve access points. ▪ Number of acres of public parks.
Growing opportunity for employment in water-reliant outdoor recreation jobs in the basin.	▪ Number of vineyards and wineries adopting eco-friendly practices.

DESIRED CONDITION	PERFORMANCE METRICS
– Widespread adoption of environmentally friendly BMPs as endorsed by the Walla Walla Valley Vinea Trust and Salmon Safe programs. – Promote environmentally friendly vintners to increase sustainable tourism throughout the valley. – Promote bird watching, nature photography, and other types of eco-tourism.	▪ Inventory of outdoor recreation jobs related to water reliant activity. ▪ Number of activities for visitors and locals to engage with wildlife attracted to wetlands, streams, and rivers.
Educational opportunities to teach conservation practices and overall watershed health. A community that respects and understands the value of our region's water resources and how the sustainability of agriculture, wildlife, economic welfare, and livability are dependent on the balanced stewardship of the basin's water resources.	▪ Number of students reached. ▪ Number of community members participating in educational programs. ▪ Number of regional points of engagement for learning about local water resources. ▪ Annual water festival attendance.

Monitoring & Metering

Monitoring and metering support achievement of the desired future conditions described above. Note that flow metering will require additional funding and improvements at the manufacturer level.

Table 37. Desired future conditions for monitoring and metering.

DESIRED CONDITION	PERFORMANCE METRICS
Increase streamflow, habitat, and water use monitoring to support better water resource management and adaptive management.	
Adopt and utilize a basin-wide monitoring strategy and adaptive management plan. Effectively monitoring streamflow, habitat, and water use requires an integrated effort. Integration in turn requires coordination and planning. Developing a basin-wide monitoring strategy can ensure that efforts are integrated, and that monitoring data can be used for adaptive management of the basin's resources.	▪ Adoption of an integrated monitoring and adaptive management strategy. ▪ Funding for ongoing monitoring.
Apply comprehensive water use monitoring to enable real-time decision making. Achieving comprehensive water use monitoring capacity means that all surface and groundwater diversions have	▪ Percent of meters installed and functioning. ▪ Percent of meters reporting.

DESIRED CONDITION	PERFORMANCE METRICS
working water meters and that remote read meters are installed on the largest water diversions and wells. Equally important is ensuring that state agencies and water managers track and analyze metering data in a holistic way that allows for real-time management changes in response to conditions and evolving patterns of use.	
Develop a streamflow monitoring network. Enhance the existing streamflow monitoring system to allow for tracking progress toward flow targets and enforcement of established instream flows and out-of-stream water rights. Meeting this goal will require increasing the number of streamflow gages in the basin and resurrecting historic, now-decommissioned streamflow gages. Prioritizing the location of new gages should be done with flow targets, location of water use, monitoring infrastructure, and other management parameters in mind.	▪ Number of operational streamflow gages. ▪ Relationship of gage locations to flow targets and other management needs. ▪ Ability of state agencies and others to utilize monitoring data to underpin management decisions.
Build monitoring capacity. Build capacity to monitor fish, vegetation, habitat, and other responses to strategy/project implementation to provide a holistic picture of watershed health. Though complex, the basin will need to develop the capability to not only monitor individual project outcomes, but also track responses of fish, riparian and wetland vegetation, and other variables. Data of this type provides a critical feedback loop for adaptive management of the basin's resources over time and allows basin managers to monitor overall watershed health.	▪ Number of local entities with funding to implement annual and long-term monitoring. ▪ Established baselines/inventories for key resources. ▪ Numeric targets against which to measure progress and responses to strategies/projects. ▪ Site-specific monitoring designs/plans for each response to be monitored.

4.4 SUMMARY OF IDENTIFIED GAPS

Comparing desired future conditions with current conditions highlights gaps between where conditions stand today, and goals set by the SPAC for the basin's future watershed health. Identifying these gaps helps set the stage for specific strategies to move the basin toward its goals.

Streamflows

The primary gaps between current conditions and desired future conditions for streamflow are:

- Gaps between current streamflows and Stillwater Sciences (2013) flow targets.
- Extent, presence, and capacity to monitor streamflows and progress towards targets.

Potential flow targets have been identified (though not formerly agreed to) for all major Walla Walla Basin rivers and tributaries. The Bi-State Flow Study process identified flow targets for the Walla Walla River, which members of the Bi-State Flow Study Steering Committee agreed to. However, the WWW2050 plan aims to take a broader exploration of stream flow targets and thus considered a 2013 report by Stillwater Sciences with ecologically based monthly streamflow targets on stream reaches basin-wide including Mill Creek and the Touchet, which were not included in the Bi-State Flow Study report. The 2013 Stillwater target flows were informally discussed as targets by the WWW2050 SPAC but not formally adopted.

Continuous flow monitoring stations likewise exist across the basin, though there are flow targets set on streams and reaches that currently lack flow gauging or other monitoring infrastructure. For locations where a flow target corresponds with an existing gage, a flow gap can be identified and used to define a flow restoration target.

To compare flows to targets in this report, a monthly 80 percent exceedance flow was calculated for water years 2010 through 2018. This exceedance level is commonly used to identify dry years (i.e., flows low enough that they are exceeded eight out of 10 years). In turn, dry year flows compared to targets are appropriate for a gap analysis as they represent close to the maximum amount of potential flow restoration need.

Table 38 depicts 2010-2018 monthly low flows (80 percent exceedance flows) calculated using gage data. Gage locations were matched with Stillwater flow target reaches (however, it is possible that some existing gages are not ideally located to monitor the Stillwater flow prescriptions). Additional analysis can determine whether some gage/flow target reach pairs used here are not good matches. Mismatched target reach and gage locations could result in missing some areas where flow gaps exist and identifying other gaps that may not exist on the ground. Some of these gaps may be filled by using new gages and bringing historic gages identified above in Table 10 back online.

In addition to the potential flow gaps identified above, gaps in surface water knowledge also exist and these represent critical needs across the basin.

- For **reaches and tributaries with flow targets but no gages**, strategies must be developed to enable monitoring current conditions as well as progress toward attaining targets. While these areas may not always need permanent continuous flow monitoring gages installed, they nonetheless represent important gaps.
- As noted above, for the **reaches that have gages installed**, close analysis is required to determine whether the gage sites are the best place to monitor corresponding flow targets based on upstream and downstream diversions and other hydrologic conditions. It is possible that additional monitoring and/or gauging might be required even in reaches where a current gage is functioning.

This level of analysis is beyond the scope of this report, but it nonetheless highlights another important gap between current conditions and a desired future where flows and progress toward meeting flow targets can be more fully understood in all priority areas of the basin.

Table 38. Low flows (80 percent exceedance) compared to Stillwater targets.

Flows (CFS)	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
NF Touchet above Dayton (32E050)												
Low Flow (80% Exceedance)	47	55	83	103	124	117	189	108	65	45	36	40
STILLWATER Flow Target	25	46	58	55	88	102	140	124	63	43	40	25
Gap (Target and Low Flow)	22	9	25	48	36	15	49	-16	2	2	-4	15
Touchet @ Bolles (32B100)												
Low Flow (80% Exceedance)	50	74	110	152	222	224	296	141	69	36	29	39
STILLWATER Flow Target	45	60	78	96	140	196	219	148	60	35	25	32
Gap (Target and Low Flow)	5	14	32	56	82	28	77	-7	9	1	4	7
WW @ E. Detour Rd. (32A100)												
Low Flow (80% Exceedance)	39	64	182	241	331	290	244	127	39	33	32	44
STILLWATER Flow Target	138	160	170	191	215	319	471	357	237	143	135	135
Gap (Target and Low Flow)	-99	-96	12	50	116	-29	-227	-230	-198	-110	-103	-91
Mill Creek Near WW (USGS 14013000)												
Low Flow (80% Exceedance)	32	45	58	66	80	75	107	66	38	29	26	27
STILLWATER Flow Target	43	49	55	62	75	90	131	104	66	51	44	44
Gap (Target and Low Flow)	-11	-4	3	4	5	-15	-24	-38	-28	-22	-18	-17
Little WW Near Milton (14012100)												
Low Flow (80% Exceedance)	58	37	17	16	0	8	74	88	77	57	49	55
STILLWATER Flow Target	91	96	97	105	112	197	297	230	156	90	90	90

Flows (CFS)	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Gap (Target and Low Flow)	-33	-59	-80	-89	-112	-189	-223	-142	-79	-33	-41	-35
Mill Creek @ WW (USGS 14015000)												
Low Flow (80% Exceedance)	5	18	39	62	65	77	88	36	8	4	2	2
STILLWATER Flow Target	46	55	64	74	88	104	149	110	72	52	45	45
Gap (Target and Low Flow)	-41	-37	-25	-12	-23	-27	-61	-74	-64	-48	-43	-43
Touchet @ Cummins Rd. (32B075)												
Low Flow (80% Exceedance)	30	68	78	131	239	249	306	139	53	12	3	10
STILLWATER Flow Target	48	64	82	102	152	212	236	157	64	36	26	33
Gap (Target and Low Flow)	-18	4	-4	29	87	37	70	-18	-11	-24	-23	-23
WW @ Beet Rd. (32A105)												
Low Flow (80% Exceedance)	18	21	122	165	236	183	157	82	20	18	22	30
STILLWATER Flow Target	92	105	106	117	127	215	322	247	165	91	91	90
Gap (Target and Low Flow)	-74	-84	16	48	109	-32	-165	-165	-145	-73	-69	-60
WW Near Touchet (USGS 14018500)												
Low Flow (80% Exceedance)	35	119	374	519	742	800	606	278	69	21	9	22
STILLWATER Flow Target	142	169	180	208	235	338	488	367	246	146	137	137
Gap (Target and Low Flow)	-107	-50	194	311	507	462	118	-89	-177	-125	-128	-115
SF WW Near Milton (14010000)												
Low Flow (80% Exceedance)	102	112	120	134	149	171	238	207	122	104	101	101
STILLWATER Flow Target	70	70	70	70	74	85	111	122	82	70	70	70
Gap (Target and Low Flow)	32	42	50	64	75	86	127	85	40	34	31	31
NF WW Near Milton (14010800)												

Flows (CFS)	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Low Flow (80% Exceedance)	7	9	14	22	34	36	59	31	13	7	6	6
STILLWATER Flow Target	11	21	21	27	30	38	52	43	21	11	6	7
Gap (Target and Low Flow)	-4	-12	-7	-5	4	-3	7	-12	-8	-4	0	-1

Floodplains & Flood Control

One clear gap between current and desired future floodplain/flood control conditions is a **lack of quantitative metrics related to desired future conditions**. Some desired future conditions may not be capable of distillation into numeric metrics (such as "achieving healthy, natural floodplain function"). Future conditions that lack numeric metrics but are capable of quantification include increasing natural infiltration, increasing acreage and duration of inundation of floodplains, and improving the river channel complexity index. For flood risk management, it is possible to quantify the impact at a high level (in terms of water volume ranges, depending on the type of precipitation event) that the current lack of stormwater management infrastructure has on peak flood flows. This number could help guide planning for building new stormwater management infrastructure.

Another basin-wide gap is the **persistence of flood and other river control structures across the basin**, such as levees, armored/stabilized banks, straightened channels, and concrete channels that are currently preventing natural floodplain function. Almost all desired future conditions, from increasing natural infiltration to increasing channel complexity, will require closing this gap by removing or altering these flood control structures. At the same time, minimizing the risk from floods is also a desired future condition, and therefore, another identified gap is **increasing natural floodplain function without increasing flood risk**.

Water Quality

By undergoing the TMDL process described in the Current Conditions Chapter, Ecology and the Oregon Department of Environmental Quality (DEQ) have already identified the gaps between current water quality conditions and desired future conditions. TMDLs inherently identify and define gaps as the process defines the baseline and desired future conditions.

Groundwater

Pumping and other consumptive water uses, along with reductions in natural recharge, have led to declines in (1) groundwater levels in the alluvial aquifer, (2) connected surface water flows, (3) spring-fed wetlands, and (4) spring vegetation and habitats. As such, a critical gap is the **imbalance between the alluvial aquifer and connected surface and spring sources**. Bridging this gap by increasing water storage in the alluvial aquifer is critical to stabilizing both groundwater and surface water levels across the basin. A significant gap is a **lack of understanding of the region's basalt aquifers**, **due to their complexity and variation**. The forthcoming USGS study will increase understanding of both the alluvial and basalt aquifers and inform ongoing monitoring and investigations. The lack of regulatory tools that could be used to ensure sustainable use of basalt groundwater resources represents another gap—for example, aquifer protection zones and or better bi-state coordination could be used to create site-specific regulations for water and surface land use.

Critical Species & Habitat

Gap identification for critical species and habitat varies between different habitat metrics. Quantitative gaps can be identified for some but not all habitat metrics. This section summarizes gaps between current and desired habitat conditions for critical species (specifically related to fish passage barriers, channel and habitat complexity, and sediment transport).

Passage barriers: Gaps in passage can be expressed in two ways: (1) presence/absence of fish passage at a specific site or structure or (2) the amount of habitat or number of river miles that are rendered inaccessible to species due to a specific passage barrier. The Current Conditions chapter of this plan identifies specific passage barriers in the Walla Walla Basin (Nursery Bridge on the Walla Walla River, Bennington Lake diversions on Mill Creek, low flows at the Hofer Irrigation Diversion Dam, and passage through the weir and concrete sections of Mill Creek), which represent critical gaps that must be addressed to reach desired future conditions. Though it has not been specifically quantified, enhancing passage at these sites will allow freer access to miles of quality habitat in Walla Walla River and Mill Creek headwaters.

Channel complexity: Gaps between current and desired conditions for channel complexity are often expressed as the difference (in linear feet or another measure) between a straightened channel and a more sinuous channel, or between a single channel and a network of channels with multiple braids. There is no current estimate at the basin scale of current channel complexity compared with potential or historic/natural channel complexity. Instead, gaps in channel complexity should be determined at specific sites where projects will be undertaken. Individual reach assessments conducted by CTUIR and the Snake River Salmon Recovery Board (SRSRB) may have some good estimates in the near future.

Habitat complexity: The "Habitat Complexity Index" quantifies the diversity and quality of habitat within a given river reach. As with channel complexity, there is basin-wide measure of the loss of habitat complexity compared to historic/natural conditions. Instead, habitat complexity gaps need to be identified at project sites or on specific river reaches as part of small-scale (smaller than this plan) planning and design exercises. At a high level, habitat across the basin has been vastly simplified compared to ideal conditions and the gap between current conditions and the area's potential is large.

Sediment transport: Increased sediment load in rivers and streams has several different negative impacts and each of these impacts can be used to measure gaps between current and desired conditions. Two key indicators of sediment problems are total suspended solids and turbidity. These two measures focus on the amount of solid particles found in water at a given site and are a strong proxy for the amount of disturbed soils reaching waterways as a result of upland management. Another indicator is substrate embeddedness, or the amount of sediment in and around cobbles and other river-bottom substrates. High levels of embeddedness can lower dissolved oxygen levels and hamper spawning and other important life stages for critical species. A final way to measure and express gaps in sediment is to look at various measures of land disturbance.

Out of Stream Needs

For agricultural irrigation, the most important gap is the difference between current reliable, physically accessible water supplies and total water need. The difference between supply and demand can be addressed through either an increase in supply (e.g., Columbia River exchange/ large storage reservoir) or by a decrease in demand (e.g., instream leasing/transfers, voluntary water transactions, reduction in crop evapotranspiration by growing lower water use crops, etc.). The gap is partially caused by mismatches in timing or geographic location of water and infrastructure. Both the amount and location/timing gaps can be partially filled by the construction of a Columbia River pump exchange and/or new above ground storage, and/or increased MAR. These projects combined with gains in water use efficiency are outlined in more detail in *Chapter 5. Recommended Strategies*.

Related to the construction and implementation of this suite of water supply projects is the current gap in precise water use data combined with a limited understanding of aquifer levels and trends at the basin scale. Again, the USGS surface water groundwater study will quantify water use and the water budget as a whole for the Walla Walla Basin.

In short, the basin needs to (1) develop a full picture of the quantified total agricultural water need and how much of that need is filled currently by reliable, accessible supplies, and then (2) match that quantified need with projects to increase supply and decrease demand through conservation and other strategies. All this work must be carefully paired with groundwater trend data collection and analysis to ensure that conservation and other projects do not negatively impact groundwater resources. The USGS study will inform both the understanding of current out of stream water use and the state of water groundwater and surface water resources.

Municipal and commercial water use gaps identified through this planning process focus less on additional supply and more on making better use of existing supply through conservation, infrastructure upgrades, and water reuse. While it is possible that some urban areas may need additional supply as they grow, there is room to build on successful municipal water conservation efforts. As such, carefully managed use of current supplies should be the first priority for meeting municipal and commercial water needs.

Washington Municipal Water Law already requires municipal water suppliers to implement water use efficiency goals and measures to decrease water usage over time. The Washington State Department of Health (DOH) implements the law through water use efficiency requirements outlined in WAC 246-290, Part 8. The Water Use Efficiency Annual Report tracks metering, water production, water consumption, distribution system leakage, water use efficiency goals and measures, and depth-to-water measurements for groundwater sources. Group A public water systems must also provide water use efficiency information through a Water System Plan (WSP) or Small Water System Management Program (SWSMP). All WSPs and some SWSMPs are subject to review and approval by DOH regional staff.

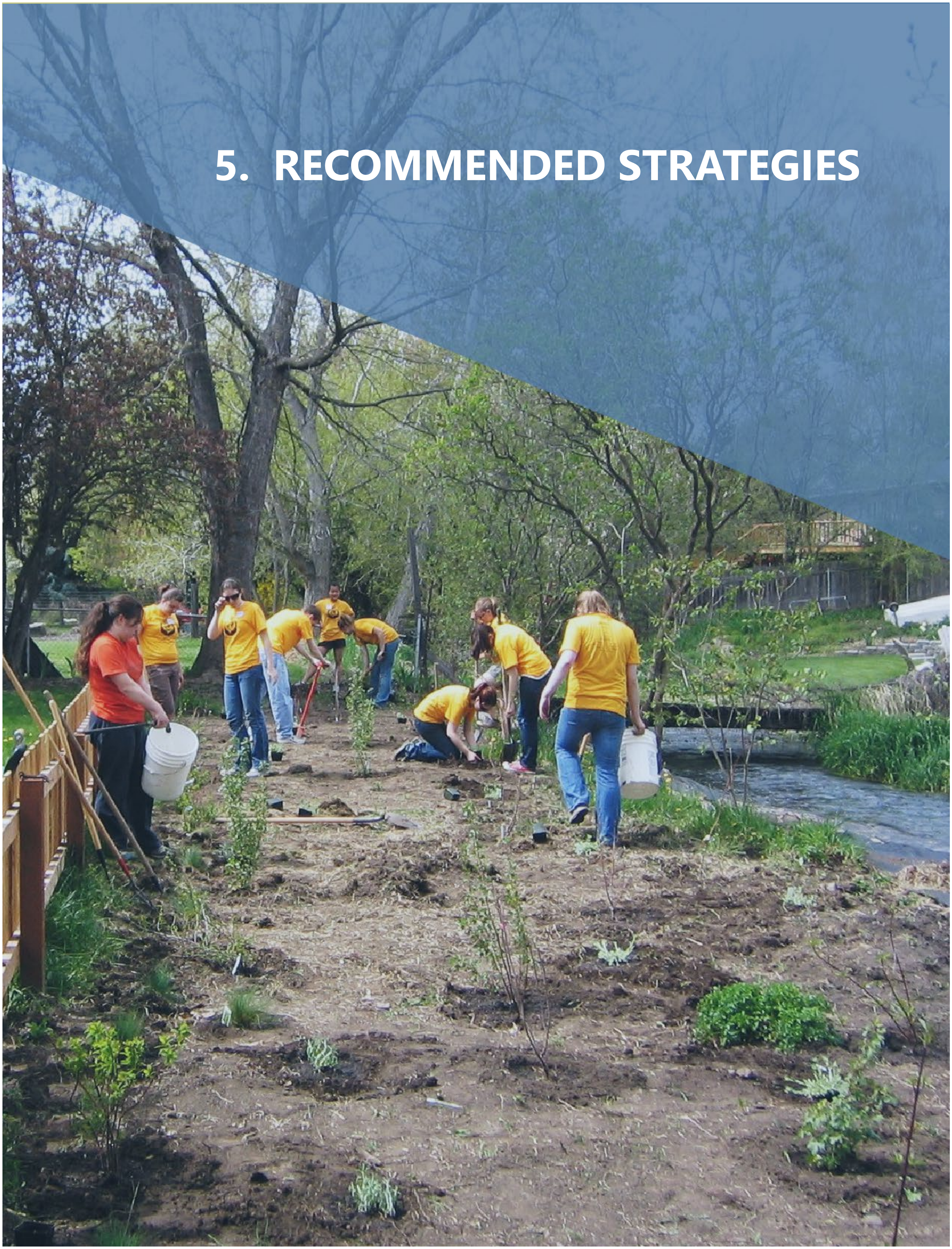
Industrial water use accounts for only a small portion of overall water use in the basin yet there are still gaps related to this sectors' water supply needs. The current and future potential for treating and reusing wastewater from industrial uses must be ascertained. As with municipal and commercial water treatment and reuse, there is currently a dearth of information on how much water might be available for treatment from this sector and infrastructure/other needs related to reuse of treated water from industrial use.

Finally, there are gaps in information about the amount and extent of rural-domestic water use in the watershed and its impact on watershed health. By its nature, rural domestic water use is difficult to track and even more difficult to influence and/or regulate. The combined impact of all rural-domestic water use in the watershed is likely significant enough to warrant close attention. Specific gaps in current knowledge and data on rural-domestic water use include the number and location of permit-exempt wells and the proportion of these wells that are metered, monitored, and mitigated. Current data and trends in permit-exempt wells over time represent significant gaps in fully understanding the basin's water supply needs.

Land Use & Cover

Gaps between current and desired future conditions can stem from a lack of knowledge, coordination, and funding to implement known best management practices. For example, the public is largely unaware of the impact of urban lawn care on stream health. Many key players in the public and private sectors lack knowledge about low impact development, rendering them unable to champion this technology. Stormwater management across multiple jurisdictions (including a state border) is challenged by lack of funding and coordination between agencies. Finally, stewards in the forested headwater regions acknowledge gaps in our collective knowledge about the many factors that go into snow retention in the forest, finding themselves challenged when planning how best to manage the whole forest ecosystem to promote snowpack retention.

5. RECOMMENDED STRATEGIES



INTRODUCTION

The scale and scope of managing water resources for multiple uses, including instream and out-of-stream benefits, in the Walla Walla Basin are immense:

- The current state of **aquatic habitat** is insufficient to support the three critical species that are the focus of this plan (ESA-listed Steelhead and Bull Trout and reintroduced spring Chinook) as well as countless other terrestrial and aquatic species.
- Habitat and water resources will be further impacted by **climate change**, making it more difficult to achieve recovery targets for these species.
- At the same time, cities and farms also face water management challenges with **flooding** causing significant property damage, while some water users find themselves **short on water for irrigation** seasonally.
- **Water quality** is also a challenge with multiple water quality problems identified across the basin.

The unprecedented challenge of ensuring (1) adequate streamflows and high-quality water for critical species and (2) enough water for irrigated agriculture and cities requires a comprehensive water management strategy. The overall goal of the WWW2050 Strategy is to provide an **integrated package of strategies that, when implemented together, can improve stream and floodplain health while supporting the agricultural economy and cities and towns of the Walla Walla Basin**. This multifaceted water management strategy aims to address water quality and quantity to support ecological health and water supply for human use. While these strategies also address land use (which directly influences water management topic areas like flood control, forest management, and stormwater management), this plan is not intended to provide a comprehensive land use strategy.

Strategies have been categorized as: floodplain and habitat, water quality, water supply and efficiency, monitoring and metering, and policy and regulatory strategies. However, **an explicit goal of the planning process was to generate strategies that meet multiple water resource benefits**, and as such, most strategies span multiple categories. For example, a single strategy may provide streamflows for fish, recharge the alluvial aquifer, and assist with flood protection for landowners.

APPROACH TO STRATEGY DEVELOPMENT

The strategies presented in the chapter were recommended by unanimous consensus by the SPAC. While the SPAC can recommend strategies for development, it does not have the authority to mandate that these strategies are implemented by respective lead entities. The initial list of strategies was developed iteratively through the process summarized below. For more information on the role of Working Groups, refer to Section 1.4 of this plan.

- The Implementation Working Group developed an **initial list of strategies that emerged from earlier working group discussions** (Ecological Function Working Group, Water Supply Needs Working Group, and Land Use Working Group) and aimed to achieve desired future conditions.

- The Implementation Working Group conducted **additional analyses to identify gaps and combine strategies** as needed to build a more robust and comprehensive package of strategies that achieve multiple benefits. The group evaluated implementation details such as timing, lead implementor, ease of implementation, anticipated barriers to implementation, ability of strategies to meet desired future conditions, and geography. The Working Group refined these strategies over a series of facilitated work sessions.
- Each SPAC member provided input on these strategies via a "Strategy Prioritization Survey." The **survey was designed to illuminate the highest priority strategies for addressing water resource management challenges** in the basin.
- Strategies were then divided into **three tiers (Tier 1, Tier 2, Tier 3) based on survey responses** where large breaks occurred between the number of responses.
- The SPAC **reviewed and refined the results** of the Strategy Prioritization Survey to finalize this package of strategic recommendations, ensuring all desired future conditions were addressed and that the package provides an appropriate mix of strategies (varying costs, timelines, lead entities, ease of implementation, categories, and tools). The tiers were adjusted to better reflect the SPACs priorities, details were refined, and strategy descriptions were clarified.
- Following the steps outlined above, the SPAC ultimately reached **consensus on the recommended strategies presented in this plan**.

PRIORITY STRATEGIES

Table 40, Table 41, and Table 42 summarize the final package of strategies for Tier 1, 2, and 3, respectively and include key implementation details. Table 43, Table 44, and Table 45 present additional detail on each strategy. Strategies are not ranked within each tier. Table 39 provides a legend for the icons in these tables.

Strategies were analyzed by tier to assess whether the full package of strategies meets multiple benefits and spans a broad range by category, implementation tool, timeline, partners/lead entity, anticipated barriers, cost, and geographic location implementation details to ensure a shared commitment to meeting the basin's goals and shared benefits of Strategic Plan implementation.

Refer to Appendix F for additional strategy details and prioritization.

Table 39. Strategies summary table legend.

Category *Primary focus area of the strategy*	**Implementation Tool** *Type of action required to implement the strategy*	**Implementation Timeline** *When the bulk of the strategy will be funded and/or implemented*	**Cost** *Estimated cost of implementation*		**Ease of Implementation** *Relative feasibility of implementation*
Water quality	Education & outreach	Short term (0-5 years)	$	<$150K	In place
Streamflows & groundwater	Land management change	Long term (>5 years)	$$	$150K - $500K	Ready to go
Water supply & efficiency	Monitoring & measuring		$$$	$500K - $1M	Not ready to go but forecasted to be straightforward
Floodplains & habitat	Physical construction		$$$$	$1M - $3M	Challenging
Monitoring & metering	Policy or regulation change		$$$$$	$3M - $10M	Very challenging
Policy & regulatory	Research and analysis		$$$$$$	>$10M	
	Transaction based				
	Water management change				

Table 40. Tier 1 Summary Table

#	Tier 1 Strategy	Category	Tool	Timeline	Cost	Ease of Implementation	# of Desired Future Conditions Met
1.01	Reconnect floodplain and restore channel complexity Basin wide to reduce flood risk and improve habitat				$$$$$$		13
1.02	Support the ongoing analyses of the Bi-State Flow Study and work toward a recommendation on implementation of the preferred alternative				$$$$$$		12
1.03	Direct additional winter flow down the Little Walla Walla River to support alluvial aquifer recharge and stream function				$		10
1.04	Water rights acquisitions (short-term, long-term, and split season) to restore streamflows				$$		8
1.05	Improve and expand managed aquifer recharge (MAR)				$$$		8
1.06	Improve fish passage and habitat conditions in weired and concrete channel sections of flood control project in Mill Creek				$$$$$		8
1.07	Restore and protect riparian habitat along tributaries, small streams, and the Walla Walla River Basin wide				$$$$$		7
1.08	Decrease surface water diversions or substitute for basalt wells during low flow periods				$$$$		6
1.09	Protect and improve fish passage at Nursery Bridge and implement levee setback projects upstream and downstream of Milton Freewater				$$$$$$		6
1.10	Develop an overarching monitoring strategy and adaptive management plan for fish, habitat, and water to inform actions and evaluate effectiveness				$		6

#	Tier 1 Strategy	Category	Tool	Timeline	Cost	Ease of Implementation	# of Desired Future Conditions Met
1.11	Address legal implications of Bi-State surface water management and protection of instream flow across the state border and protection of instream flow within States				$		6
1.12	Improve flow and timing of fish passage through the Hofer Dam fishway				$		6
1.13	Expand and support Aquifer Storage and Recovery (ASR) to maintain groundwater quality and capacity				$$$$		5
1.14	Improve coordination and response to drought management Basin-wide				$		5
1.15	Expand and fund streamflow gages throughout the Basin				$$		4
1.16	Increase coordination and enforcement of floodplain and riparian regulations and management between Counties and State water management entities				$		4
1.17	Increase infiltration of stormwater rather than discharge to surface water bodies and improve coordination and management				$$$$$$		4
1.18	Upgrade Dayton wastewater treatment plant to meet Ecology requirements and watershed community environmental goals				$$$$$$		4
1.19	Improve fish passage at Gose Street long term				$$$		4
1.20	Improve agricultural irrigation metering and reporting programs in WA and OR by installing telemetry and improving data use by agencies and water users				$$		3

#	Tier 1 Strategy	Category	Tool	Timeline	Cost	Ease of Implementation	# of Desired Future Conditions Met
1.21	Additional Bi-State coordination on groundwater regulation				$		3
1.22	Implement conservation tillage and soil erosion BMPs to decrease nonpoint source pollution				$$$		3
1.23	Improve fish passage at Bennington Diversion Dam				$$$$$		3

Table 41. Tier 2 Summary Table

#	Tier 2 Strategy	Category	Tool	Timeline	Cost	Ease of Implementation	# of Desired Future Conditions Met
2.01	Manage forested portion of the Walla Walla Watershed to maximize snow/water retention and inundation				$$		6
2.02	Strategic piping of irrigation ditches to modernize irrigation infrastructure and benefit streamflows				$$$$$$		5
2.03	Implement improved and additional municipal water conservation strategies such as detecting and repairing leaks, implementing tiered water rates, installing advanced smart meters, updating drought response programs, decreasing irrigated landscapes, and planting native species				$$$		5
2.04	Encourage on-farm Best Management Practices (BMPs) for water retention and efficiency				$$$$		5
2.05	Improve forecasting system for high-flow and flood events to help water managers make real-time and fast decisions				$$		5
2.06	Conduct education and outreach related to local flood response plans with specific guidance for				$		5

#	Tier 2 Strategy	Category	Tool	Timeline	Cost	Ease of Implementation	# of Desired Future Conditions Met
	emergency response procedures to better protect floodplain function and riparian health						
2.07	Improve on-farm irrigation application efficiency				$$		4
2.08	Update channel migration zone mapping and update flood inundation maps				$$		4
2.09	Invest in outreach to community members, elected officials, planning departments and the real estate community related to stream and riparian health				$$		4
2.10	Substitute small scale off-channel stored water for surface water diversions where possible				$$		3
2.11	Develop a detailed forest management plan for water supply in the upper Mill Creek Watershed				$$		3
2.12	Minimize impact to South Fork Walla Walla River by providing alternative access to cabins on private land				$$$$$		3
2.13	Conduct systematic surface water quality monitoring to provide baseline data and inform management				$$		2
2.14	Conduct habitat status and trends monitoring				$$		2
2.15	Incentivize hook up to city sewer systems in lieu of septic systems where feasible				$$$		2
2.16	Conduct outreach to agricultural entities and other landowners to provide tools around implementing livestock BMPs and pesticide use BMPs				$		2

#	Tier 2 Strategy	Category	Tool	Timeline	Cost	Ease of Implementation	# of Desired Future Conditions Met
2.17	Encourage Low Impact Development (LID) and urban lawn BMPs in urban areas and small towns				$$$$		2
2.18	Review existing exempt well mitigation program WA; Consider expansion of mitigation program for other uses in WA				$		1
2.19	Improve water right regulation and enforcement				$$		1

Table 42. Tier 3 Summary Table

#	Tier 3 Strategy	Category	Tool	Timeline	Cost	Ease of Implementation	# of Desired Future Conditions Met
3.01	Restore flushing flows to Yellowhawk				$		6
3.02	Conduct targeted outreach to urban and suburban landowners located on small streams related to stream and riparian health				$$		6
3.03	Community educational opportunities to teach conservation practices and overall watershed health				$$		5
3.04	Strategically plan to supply water to development outside city limits. Encourage keeping development small and compact in urban growth areas and develop associated incentives				$$		4
3.05	Implement soil and water quality testing for MAR sites				$		4
3.06	Conduct fish status, trends, and distribution monitoring				$$		4

#	Tier 3 Strategy	Category	Tool	Timeline	Cost	Ease of Implementation	# of Desired Future Conditions Met
3.07	Provide incentives and assistance for converting from higher demand water use crops to lower water demand crops				$		3
3.08	Conduct outreach related to levee setback projects through Dayton and Waitsburg				$		3
3.09	Implement Mill Creek General Investigation (GI) action related to threshold of diversion to Bennington Lake				$$		3
3.10	Engage on salmonid recovery related policy as identified in Salmon Recovery Plans and State salmon recovery strategies				$		3
3.11	Maintain and increase public access to rivers and streams in the Walla Walla Basin through the creation of trails, parks, and public access points				$		3
3.12	Implement erosion control on roadside cut banks				$$		2
3.13	Review WDFW diversion to Bennington Lake to ensure that streamflow is not impaired				$		2
3.14	Expand stormwater monitoring				$		2
3.15	Implement incentives to encourage rural developments to annex				$$		2
3.16	Grow opportunities for employment in water reliant outdoor recreation jobs in the Basin				$		2

#	Tier 3 Strategy	Category	Tool	Timeline	Cost	Ease of Implementation	# of Desired Future Conditions Met
3.17	Basin-wide assessment of sediment and bedload management build-up				$$$$		1
3.18	Study and analyze feasibility and benefits of flow enhancement in the LWWR				$		1

Table 43. Tier 1 strategy details.

#	Strategy Description
1.01	**Reconnect floodplain and restore channel complexity Basin wide to reduce flood risk and improve habitat.** Enhance the use of floodplains to increase infiltration and hydraulic connection during floods and reconnect floodplain, restore channel complexity and increase habitat diversity through the following actions: • Acquire land in the floodplain to enable physical restoration actions including levee setbacks and removal, instream, and riparian restoration. • Apply for additional funding through Floodplains by Design and other grant programs to further support acquisition of critical floodplain parcels. (Recognize the short-term and long-term costs and savings associate with these types of parcels). • Identify willing landowners for acquisitions and easements to construct projects. • Consider ‘flood’ agreements for agricultural landowners in floodplains to compensate for controlled or peak-flow event inundation. • Undertake projects including reconnecting historic river channels, constructing new channels and side channels, increasing channel length and sinuosity, and adding complexity via installation of large wood debris and other structures. • Eliminate hardening of channels and promote bioengineered bank stabilization where necessary. • Enhance use of floodplains to increase infiltration and hydraulic connection during floods. • Expand use of the CREP program for riparian buffers.
1.02	**Support the ongoing analyses of the Bi-State Flow Study and work toward a recommendation on implementation of the preferred alternative.** The primary objective of the Flow Study is to improve streamflow in the Walla Walla River mainstem to support harvestable populations of native fish species while maintaining long-term viability of agricultural, municipal, commercial, and residential uses of water. There are two major infrastructure improvements under consideration including a Columbia pump exchange a large storage reservoir.
1.03	**Direct additional winter flow down the Little Walla Walla River to support alluvial aquifer recharge and stream function.** Develop a plan to divert high flows as available down the Little Walla Walla River system to benefit shallow aquifer recharge and stream function for ecological and out of stream benefit. Any additional diversion should not deplete important channel forming and maintenance flows down the Tumalum branch.

#	Strategy Description
1.04	**Water rights acquisitions (short-term, long-term, and split season) to restore streamflows.** Work to acquire senior water rights from willing sellers Basin-wide and transfer water rights instream to help meet instream flows using various water acquisition tools such as leases, purchases, split season agreements, etc. Use Washington State Trust Water Rights Program and Oregon Conserved Water Statute.
1.05	**Improve and expand managed aquifer recharge (MAR).** • Capture more winter-early spring high flows and recharge MAR sites in the winter-early spring making more alluvial aquifer groundwater available in spring – fall. • Reactivate WA MAR sites including: Stiller Pond (pending water right change), Locher Road, Reser property on LWWR, Mud Creek and Last Chance Road. Identify new sites in or near the historic floodplain. o Reactivation will require implementing soil and water quality testing for MAR sites (See Strategy 3.05). • Incorporate information from the USGS groundwater study to inform locations of future MAR sites. • Explore options for accessing water rights under the instream flow rule (WAC 173-532) to supply MAR and any necessary. • Prioritize sites near historic floodplain to match location with the proposed use. • Acknowledge the challenge with tracking and protecting recharged water.
1.06	**Improve fish passage and habitat conditions in weired and concrete channel sections of flood control project in Mill Creek.** The flood control project includes a 7-mile-long reach of Mill Creek, fish passage and habitat conditions in both weir sections and the concrete section need improvement. Work under this strategy includes the following: • Advance the alternative analysis developed by the Mill Creek Working Group for options for passage improvements within the weir sections. There are 5-6 different weir section types, depending on the type of weir and also the width of the channel, each providing different opportunities for low flow channels, weir notching, and even floodplain connection. • Address cement portion of the levy system to avoid velocity barrier during high flows. Install additional velocity barriers in that area (concrete). Tristate Steelheaders have design funding to do more in the next few years. • Make adjustments to the concrete channel and weirs to increase flows and decrease temperatures. Complete installation of low-flow channel through weired reach of Mill Creek.
1.07	**Restore and protect riparian habitat along tributaries, small streams, and the Walla Walla River Basin wide.** • Identify priority areas for riparian restoration. Including the use of riparian buffers, bioengineering, revegetation, and other projects, focus on fostering and ensuring riparian health. • Locate areas where private or other landowners are willing to allow for projects, including riparian buffers and riparian revegetation. • Develop landowner incentive programs to encourage river friendly management in riparian areas.

#	Strategy Description

	• Manage riparian habitat and new riparian plants/revegetation to protect against encroachment by non-native plant species and provide much need tree canopy and woody debris.
	• Remove invasive riparian plant species such as knotweed, false indigo, reed canary, and kocia using various mechanical or chemical treatments.
	  o Replant with native vegetation, including shade trees.
	  o Incorporate zoning or shorelines regulations to restrict development and restore buffers.

1.08	**Decrease surface water diversions or substitute for basalt wells during low flow periods.** • Implement the plan detailed in the Mill Creek report with the City of Walla Walla and CTUIR for the city to rely less on surface flow during low flow periods in Mill Creek. • Explore options to use source switches of surface water and basalt groundwater with other municipalities Basin-wide
1.09	**Protect and improve fish passage at Nursery Bridge and implement levee setback projects upstream and downstream of Milton Freewater.** • Remove fish passage barrier at Nursery Bridge to ensure fish passage at low flows. • Organize stakeholders and arrange formal agreement (memorandum of understanding) to construct fish passage rectification improvement at the Nursery Bridge drop structure. • Complete designs to ensure reliable fish passage at the Nursery Bridge drop structure. • Obtain regulatory clearance and funding to rectify fish passage. • Construct fish passage rectification design at Nursery Bridge. • Working with USACE, assess opportunities and begin by prioritizing reaches where levee removal or set back will increase natural floodplain functioning without increasing flood risk. Then, begin to develop projects to physically remove levees and dikes or otherwise modify river channels to increase river access to floodplains and riparian vegetation. • Achieve channelized stream reduction by 25-50%. • Fish passage improvements and levee setbacks may be phased and/or implemented as distinct projects.
1.10	**Develop an overarching monitoring strategy and adaptive management plan for fish, habitat, and water to inform actions and evaluate effectiveness.** • Develop Basin-wide Adaptive monitoring strategy for fish, habitat, and water. • Include triggers to assess progress towards goals. • Determine what additional data is needed. • Integrate monitoring data across the basin. • Integrate groundwater monitoring by handing off USGS alluvial and basalt groundwater monitoring to local entities (WWBWC and WWCCD) and state agencies (OWRD and Ecology) once USGS Study is complete.

#	Strategy Description
	• Conduct hyporheic zone monitoring to understand surface to groundwater connectivity on the WA side of the Basin, in concert with the USGS Study. • Incorporate findings from other monitoring efforts to inform adaptive management (See Strategies 1.02, 1.15, 1.20, 2.05, 2.13, and 3.14).
1.11	**Address legal implications of Bi-State surface water management and protection of instream flow across the state border and protection of instream flow within States.** • Further explore and define legislative changes and a potential interstate compact (a 3-party compact between CTUIR, WA, and OR) to manage water resources in a Bi-State basin. • Explore the concept of annual water right allocations based on supply availability in a changing climate. • Protect eligible saved water from new and completed Irrigation conveyance efficiency projects instream including working with Irrigation Districts (Dayton area, Touchet area in particular) to save water instream pending issuance of Record of Examination (ROE) post irrigation efficiency project, diversion change, measurement challenges.
1.12	**Improve flow and timing of fish passage through the Hofer Dam fishway.** • Work with Touchet Eastside-Westside to address water for irrigation diversion and fishway needs in the lower reach. • Implement fish ladder improvements. • Address sedimentation issues with Hofer Dam and Eastside-Westside irrigation diversion.
1.13	**Expand and support Aquifer Storage and Recovery (ASR) to maintain groundwater quality and capacity.** • Examine and implement ways to drive more widespread ASR, if source water is available. • Continue applying water quality standards for injected ASR source water but find ways to offset costs and increase ASR feasibility. • Expand the City of Walla Walla's ASR program. • Identify and explore other opportunities for ASR in other cities and counties. • Consider ASR on agricultural lands as well (current permit in Oregon for AG land ASR).
1.14	**Improve coordination and response to drought management Basin-wide.** • Define leadership for drought response and establish an annual forum/annual meeting for drought planning, including public outreach to raise awareness and share the burden for drought. • Improve coordination during times of drought to share the burden between surface water and groundwater; develop phased steps depending on severity of the drought. • Increase coordination between OWRD/Ecology, Cities, and Agricultural water users. Build on existing drought response plans (WWWMP etc.) In WA: Consider ways to better regulate groundwater during droughts. Inform what strategies to prioritize over time given snow vs rain mix.

#	Strategy Description
1.15	**Expand and fund streamflow gages throughout the Basin**. WA Office of Columbia River submitted a request for funding 5 additional gage locations (additional funding may be needed): • Walla Walla River at Pepper Bridge • Yellowhawk Creek at Hwy 125 • Touchet River at Sims Road • East Little Walla Walla River at mouth • Wolf Fork Touchet River at Mountain Home Pk Other potential locations to fund include: • All discontinued Ecology gage sites • Pine Creek @Sand Pit Road • WWR @ McDonald • Gage between Cemetery and Nursery bridges. Fund consistent monitoring.
1.16	**Increase coordination and enforcement of floodplain and riparian regulations and management between Counties and State water management entities.** • Continue to support and enforce existing rules and regulations under Stormwater Management Plan and Critical Areas Ordinance. • Emphasis should be placed on integrating land and water management in regulatory provisions to ensure that floodplain health is adequately addressed in a holistic way. Potentially incorporate riparian buffer and surface water regulations into property deeds. • Identify and take advantage of opportunities to work floodplain health into other ongoing planning efforts including Comprehensive Plans (Walla Walla County and City 2018), the Shoreline Master Program (2018?), GMA-Voluntary Stewardship and others. • Protect current undeveloped floodplain and channel migration zone from development. Strengthen regulatory statutes to halt development in the floodplain. • Integrate funding of floodplain work across all entities causing floodplain impacts. • Enact policies requiring entities whose operations cause impacts to floodplains to help fund multi-purpose strategies to promote natural floodplain functioning. • Strengthen county land use zoning and codes that align with protecting water-dependent ecosystems, so rural water development occurs in appropriate areas. • Identify and remedy any violations of the Shoreline Management Act and Critical Areas Ordinance.

#	Strategy Description
1.17	**Increase infiltration of stormwater rather than discharge to surface water bodies and improve coordination and management.** • Disconnect outfalls from surface water when feasible. In most cases, the storm drains run under the road and disconnection of outfalls requires acquisition of additional right of way as well as road restoration which is expensive. The City of Walla Walla has 183 outfalls and 40% of these empty to Mill Creek. Walla Walla County only has a few outfalls, but the cities of Walla Walla and College Place have many, and the vast majority of disconnections are unfunded. • Improve communication and coordination for stormwater management for the following: Agricultural operations and hobby farms; new development and redevelopment that does not meet the 1-acre threshold established by the Phase II Permit; water bodies that span multiple jurisdictions.
1.18	**Upgrade Dayton wastewater treatment plant to meet Ecology requirements and watershed community environmental goals.** • The City of Dayton has been working with Ecology to evaluate alternative wastewater treatment upgrade solutions needed to meet surface water quality standards. • Alternatives for the treatment upgrades are limited by stringent Touchet River waste load allocations as well as water rights constraints. • Dayton has now partnered with the CTUIR and WWT to evaluate innovative treatment alternative options to meet Ecology requirements for water quality standards and water rights as well as to provide a holistic environmentally sustainable solution for the Touchet River with expanded benefits to the river ecosystem. • Dayton's proposed project is a mechanical treatment plant which would produce high quality effluent that would be discharged to wetlands sited adjacent to the Touchet River for additional tertiary treatment.
1.19	**Improve fish passage at Gose Street long term.** • Design and complete a permanent fix for the Gose Street fish passage ladder. (A short-term fix is complete but is not compatible with long-term flooding regimes). • Gose Street is 5.3 miles upstream of the confluence of Mill Creek and the Walla Walla River. This is the lower end of the flood control channel. • Permanent fix for Gose Street may include sediment supplementation and floodplain connection above and below to decrease stream power and incision.
1.20	**Improve agricultural irrigation metering and reporting programs in WA and OR by installing telemetry and improving data use by agencies and water users**. The goal of metering is to make real time decisions about where water is going and better understand and thus manage water use over time. • Install telemetry (remote-based) on all major diversions in the Walla Walla Basin. • Update and address operational issues with existing meters for middle and smaller water users where needed. • Fund modernization of metering database in WA to better utilize and process metering data.

#	Strategy Description
	• Develop metering database for the WW basin in Oregon. • Fund Ecology and OWRD staff time to manage the metering data. • Ongoing funding to update and maintain meters basin-wide.
1.21	**Additional Bi-State coordination on groundwater regulation.** • Use USGS study to develop regulatory framework for groundwater particularly in WA given that OR regulates groundwater on a regular basis. OR rules may need to be updated eventually. • Strengthen the legal connection and co-management between surface water rights and groundwater rights. • Use existing and new data (USGS) backed up with analysis/models to support decisions about strategic water redistribution/water management in general. • There is potential for a 3-party compact between CTUIR, WA, and OR. • Consider creation of groundwater management districts.
1.22	**Implement conservation tillage and soil erosion BMPs to decrease nonpoint source pollution.** • Implement agricultural BMPs to reduce nonpoint water pollution. • Provide technical assistance to landowners. • Implement conservation tillage and or conservation cover, and/or edge of field borders.
1.23	**Improve fish passage at Bennington Diversion Dam.** • Complete Bennington diversion dam/ ladder passage improvements. (*Note: improvement is in design stage now.* USACE in process of completing preliminary designs). • Complete final design for ladder improvement.

Table 44. Tier 2 strategy details

#	Strategy Description
2.01	**Manage forested portion of the Walla Walla Watershed to maximize snow/water retention and inundation.** • Working with the USFS and private forest landowners as appropriate, to maximize snow retention through forest management practices in the actively managed areas of the forest (excluding roadless areas). • Protect riparian areas, locate and orient harvest units to increase snow retention and reduce evaporative losses, and promote groundwater recharge. • Identify and map all springs and wetlands in the upper Walla Walla Watershed and work with private landowners to ensure appropriate wetland buffers.

#	Strategy Description
2.02	**Strategic piping of irrigation ditches to modernize irrigation infrastructure and benefit streamflows.** • Convert the remaining 11 miles of earthen upper canal of Gardena Farms Irrigation District #13 to a piped system to save 12-15 cfs. GFID design could include a partial perforated pipe for recharge if needed. • Consider impacts to streamflow and groundwater from proposed piping projects, based on best available science and the USGS Groundwater Study. • Identify other opportunities to pipe irrigation ditches and dedicate irrigation savings instream.
2.03	**Implement improved and additional municipal water conservation strategies such as detecting and repairing leaks, implementing tiered water rates, installing advanced smart meters, updating drought response programs, decreasing irrigated landscapes, and planting native species.** Implement multiple strategies to conserve water use in the City of Walla Walla and other municipal water providers in the basin including: • Reduce leaks by fixing infrastructure delivery systems. • Implement native plant landscaping and rain gardens to reduce impervious surfaces and address stormwater runoff. • Implement tiered water rates, cash for grass programs and or appliance rebates. • Implement additional water conservation strategies during drought years including educating municipal rate payers about drought. Install and implement Advanced Metering Infrastructure (AMI)/ smart meters for municipal water use. Replace all meters and install advanced metering infrastructure (AMI) to monitor water use hourly. AMI allows WW to monitor for leaks on customer side and notify customers. They have a forgiveness program if customers fix their water leaks. Walla Walla and Milton Freewater already have these systems.
2.04	**Encourage on-farm Best Management Practices (BMPs) for water retention and efficiency.** • Improve soil-water retention capacity (e.g., by using conservation tilling, compost, and organic matter, etc.). • Implement rebates and incentives to promote water conservation via Variable Frequency Drives, soil water sensors, leaf sensors etc. • Use swales, check dams, and straw wattles to slow runoff and preserve soil moisture. • Manage soil content to conserve moisture (water holding capacity of soil is a large factor for if the ground will 'repel' water resulting in increased surface runoff, erosion, and water quality issues). 　○ Install berms to reduce runoff velocity.
2.05	**Improve forecasting system for high-flow and flood events to help water managers make real-time and fast decisions.** • Review, update, and/or improve existing flood forecasting tools so that flood and high flow-events can be better anticipated, and appropriate actions taken to safeguard people and infrastructure and manage water for environmental benefit. • Forecast how much and when water can be redistributed from the WWR Mainstem-Tumalum and conveyed strategically to locations in the valley. • Develop forecasting tool for precipitation-runoff to capture high flow events for recharge/storage (see below); potentially use 'water calendar' to communicate this information.

<table>
<tr><th>#</th><th>Strategy Description</th></tr>
<tr><td></td><td>Installation of weather and soil and other monitoring equipment to enable better real time decision making and water conservation.
Increase coordination of flood forecasting information from National Weather Service.
The intention of this strategy is to include information on high flow events as well - not just flood events. Conservation District has data on snow vs rain but data not currently available to the public.</td></tr>
<tr><td>2.06</td><td>Conduct education and outreach related to local flood response plans with specific guidance for emergency response procedures to better protect floodplain function and riparian health.
Update the Comprehensive Flood Hazard Management Plan to ensure that flood response actions do not cause harm to floodplain function. Such a response should be coordinated between landowners, regulatory, and resource agencies. This strategy should include the following elements:
Guidance for operators for new projects and emergency actions.
Work to improve regulatory processes to ensure alterations made after flood events are guided by existing plans for multi-purpose floodplain benefits and are not counter to working toward floodplain health in the basin.
Actions should be guided by the restoration plan from SMP.
Better coordination with county planning departments is needed related to bridge placement after flood events (applies to Umatilla, Walla Walla and Columbia Counties).</td></tr>
<tr><td>2.07</td><td>Improve on-farm irrigation application efficiency.
Work with landowners on a voluntary basis to convert from less efficient to more efficient irrigation systems where possible to benefit agriculture and instream flow.
For example, convert from hand lines and flood irrigation to higher efficiency methods specifically pivots- using LID nozzles.</td></tr>
<tr><td>2.08</td><td>Update channel migration zone mapping and update flood inundation maps.
Work with FEMA, USACE, and FEMA Cooperating Technical Partners (CTP) program to update flood hazard maps and other flood hazard information. Modern hydrologic and hydraulic studies are needed to update 1980’s era flood inundation mapping as well as to track progress over time. RiskMAP products address a suite of natural hazards, including wildfire, landslides, and other concerns, and can also be leveraged for FEMA mitigation funding.
There are not currently any channel migration zone maps right now for Walla Walla County. However, a future effort is funded through the Silver Jackets program which is led by USACE ($80K). This effort will not cover the full county but will focus on the developed areas that are likely to impact the channel migration zone. Ecology estimates needing roughly triple the amount of existing funding to map the other areas. Columbia County has a program, but it needs upgrading. (In process: Mill Creek and portions of Walla Walla River in Walla Walla County).
New development or new uses in shoreline jurisdiction, including the subdivision of land, should not be established when it would be reasonably foreseeable that the development or use would require structural flood hazard reduction measures within the channel migration zone or floodway. This information should be integrated into Shoreline Master Programs (SMPs) to preserve natural and beneficial functions of channel migration.</td></tr>
</table>

#	Strategy Description
2.09	**Invest in outreach to community members, elected officials, planning departments and the real estate community related to stream and riparian health.** Outreach should be targeted at: • Building support for riparian, habitat, and water management policy strategies • Raising the profile of floodplain health and flood risk • Building support through education and understanding of the general public.
2.10	**Substitute small scale off-channel stored water for surface water diversions where possible.** • Construct small scale, off-channel on-farm storage for irrigators to use in the late season where feasible. Opportunities and overall water savings may be limited.
2.11	**Develop a detailed forest management plan for water supply in the upper Mill Creek Watershed.** • Develop an updated management plan for maximizing snow capture in the upper Mill Creek municipal watershed, utilizing a partnership between USFS and the City of Walla Walla. This could build upon an ongoing forest management plan being developed by the stewardship group between USFS, NRCS, and others for Mill Creek watershed.
2.12	**Minimize impact to South Fork Walla Walla River by providing alternative access to cabins on private land.** Provide a permanent river-friendly solution to accessing cabins on the South Fork Walla Walla River via new easements with USFS and BLM. Current road crosses the SF WWR 13 times.
2.13	**Conduct systematic surface water quality monitoring to provide baseline data and inform management.** • Take a science driven approach to monitoring water quality for the following: temperature, nutrients, dissolved oxygen, and sediment. • Trace and remedy pollution sources for stormwater. • Partner with local entities (like Conservation Districts, Tri-State Steelheaders etc.) to implement WQ monitoring
2.14	**Conduct habitat status and trends monitoring.** • Review future LIDAR data sets to assess change over time in habitat quality and quantity and document improvements. • Recurring vegetation surveys around springs. • Monitoring of existing and potential beaver habitat.
2.15	**Incentivize hook up to city sewer systems in lieu of septic systems where feasible.** • Outreach and coordination with potential eligible homeowners on septic systems located near city sewer lines to provide education and incentives to hook-up to sewer systems basin-wide with the goal of reducing nitrate contamination.

#	Strategy Description
2.16	**Conduct outreach to agricultural entities and other landowners to provide tools around implementing livestock BMPs, pesticide use BMPs.** • Conduct pesticide stewardship outreach to agricultural entities and provide tools to landowners. • Provide technical assistance on these issues to landowners and implement pesticide and nutrient management practices. • Coordinate with Voluntary Stewardship Program (VSP), which is led by WWCCD in WW County. • Implement the following BMPs (generally 25-150 head of cattle operations): o Minimum buffer of 35-200 feet, depending on the size of the stream o Stream crossing o Off-stream watering o Manure management o Management of feeding operations o Range and pasture management o Proper disposal of animal mortality
2.17	**Encourage Low Impact Development (LID) and urban lawn BMPs in urban areas and small towns.** • New stormwater infrastructure should spread stormwater out and mimic natural systems. • Existing development should be retrofitted to better manage stormwater. • New development should be encouraged to utilize pervious paving options and implement LID- improve site design to better meet stormwater permit regulations. • Expand education and incentives for new developers to adopt LID techniques. • Complete pilot demonstration projects to support education and outreach. • Focus on educating private landowners on pesticide and herbicide runoff issues from urban lawn management, including preventing dumping into the creek. • Provide technical assistance around city and county ordinances regarding buffers to increase effectiveness. • Provide funding for riparian restoration and removal and management of invasive species for riparian property owners.
2.18	**Review existing exempt well mitigation program WA; Consider expansion of mitigation program for other uses in WA.** • Increase compliance with current mitigation requirements for new permit exempt wells and consider expanding mitigation program to other users in WA. • Establish communication between entities to make sure building permits are not issued without mitigation in place when required; define roles and responsibilities for the States and Counties.

#	Strategy Description
	• Improve mitigation accounting and tracking. • Create a funding structure to support the mitigation certificate implementation and enforcement. • Review current program effectiveness and mitigation costs. • Adopt the use of telemetry for metering and reporting water use make it easier for rural domestic water users to comply with requirements.
2.19	**Improve water right regulation and enforcement.** Adequately fund OWRD and Ecology in order to increase water right enforcement and regulation in Oregon and Washington to ensure that: • Water right holders do not use more than they are entitled to. • Senior water rights are regulated in favor of junior water rights. • Trust water rights are enforced.

Table 45. Tier 3 strategy details

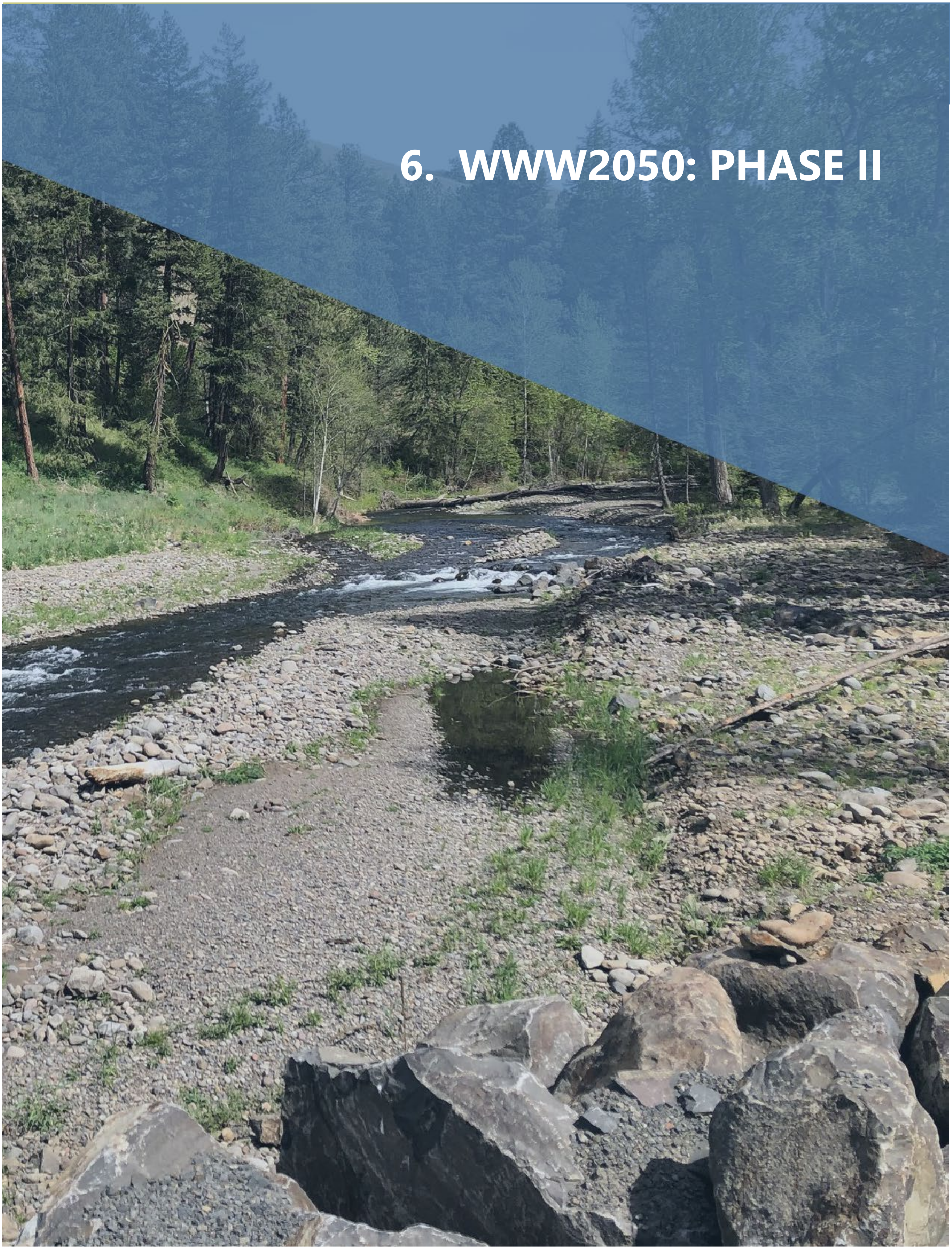
#	Strategy Description
3.01	**Restore flushing flows to Yellowhawk.** • Revisit the current USACE managed headgate and considered whether additional high flows could be directed down Yellowhawk Creek (while protecting private property) for habitat, to move sediment, and support streamflow improvements.
3.02	**Conduct targeted outreach to urban and suburban landowners located on small streams related to stream and riparian health.** Conduct outreach to private and public landowners focused on: • Potential for implementing riparian and other restoration actions • Pesticides and herbicides lawn/ yard care • Information on state and local regulations related to land use and building codes near streams/rivers • Increasing flood resiliency and options post-flood • Water use during drought Support the formation of local streamkeeper groups to encourage enforcement of floodplain zoning and other requirements.
3.03	**Community educational opportunities to teach conservation practices and overall watershed health.** • Integrate school curriculum focused on water and salmon. • Coordinate adult education programs lead by local nonprofits. • Establish an annual water festival.

#	Strategy Description
3.04	**Strategically plan to supply water to development outside city limits. Encourage keeping development small and compact in urban growth areas and develop associated incentives.** • Municipal Code requires that if a development wants to connect to city water or sewer it must be annexed into the city first. Annexation (density) supports infrastructure efficiency. • Explore other zoning changes including requiring or incentivizing development to have a smaller footprint/impact and incorporating filtration of stormwater.
3.05	**Implement soil and water quality testing for MAR sites.** Funding needed for monitoring of water and soil quality testing to support resuming aquifer recharge on both the Stiller Pond and Locher Pit sites in Washington and additional sites on the Washington side of the Basin.
3.06	**Conduct fish status, trends, and distribution monitoring.** • Operation maintenance of juvenile fish traps and basin-wide pit-tag arrays. • Funding for data and data analysis resources to inform critical data gaps related to steelhead abundance and productivity in Mill Creek and the Touchet; also likely needed for future spring Chinook reintroduction. • Identifying the magnitude and the relative timing of lower Walla Walla River predation problem and the location of predation hot spots to provide direction and strategy to address, potentially through habitat improvement or other management strategies (including flow management if available).
3.07	**Provide incentives and assistance for converting from higher demand water use crops to lower water demand crops.** • Provide incentives and technical assistance for converting to lower water demand crops where feasible and economical. For example, orchards to vineyards, alfalfa to alfalfa seed. • Fill WSU extension position (which is currently vacant) for an agronomist to guide and provide technical assistance on this issue.
3.08	**Conduct outreach related to levee setback projects through Dayton and Waitsburg.** • Outreach efforts are needed to improve coordination, response, and future efforts to alleviate flood risks in the Touchet. • Coordination of local, state, and federal government, landowners, and stakeholders is needed to make progress on levee setbacks and floodplain restoration. • Outreach should target at USACE and non-USACE levees.
3.09	**Implement Mill Creek General Investigation (GI) action related to threshold of diversion to Bennington Lake.** • Alter threshold for diversion to Bennington Lake and raise levee to accommodate up to 3,700 cfs as recommended by the Mill Creek GI Study. This is planned for implementation and being approved by USACE in Spring 2021.

#	Strategy Description
3.10	**Engage on salmonid recovery related policy as identified in Salmon Recovery Plans and State salmon recovery strategies.** • Engage on policy issues related to the current MOU with Governor's cabinet agencies to implement recovery actions: hatchery infrastructure improvements, estuary, Columbia, mainstem survival issues. • Federal support for in basin ACOE related improvements.
3.11	**Maintain and increase public access to rivers and streams in the Walla Walla Basin through the creation of trails, parks, and public access points.** • Establish new access points and more miles of trail for public use connecting people with water resources. • Collaborate with willing landowners to establish mutually agreeable public access points on regional rivers and streams. • Develop and maintain wetlands for wildlife habitat and public wildlife viewing. • Establish nature clubs, streamkeeper groups to assist with maintenance an education of natural public spaces.
3.12	**Implement erosion control on roadside cut banks.** Stabilize roadside cut banks to avoid contribution of large amounts of sediment to streams via roadside runoff ditches and municipal separate stormwater systems.
3.13	**Review WDFW diversion to Bennington Lake to ensure that streamflow is not impaired.** Consider WDFW recreational flow diversions (17cfs) to Bennington Lake and the impact on critical fish species and reconsider the diversion when flows are low in Mill Creek later in the Spring. WDFW to coordinate internally on this policy. The WDFW diversion is part of a federal mitigation program for the LSR dams. If it were changed it may need to be replaced in some manner.
3.14	**Expand stormwater monitoring.** • Implement science driven approach to monitoring stormwater to trace and remedy pollution sources. • Determine best entity to lead possibly the State agencies or a local group under contract with the States. • Incorporate regular plan for coordination and communication between jurisdictions.
3.15	**Implement incentives to encourage rural developments to annex.** • Municipal Code requires that if a development wants to connect to city water or sewer it must be annexed into the city first. Annexation (density) supports infrastructure efficiency. • Explore other zoning changes including requiring development to have a smaller footprint/impact and incorporating filtration of stormwater. • For example, the City of Walla Walla reduced its maximum lot size. This has encouraged developers to annex to the UGA to increase the number of lots. A surcharge is also applied to utility ratepayers located outside city limits. • Keep development small and compact in urban growth areas and develop associated incentives.

#	Strategy Description
3.16	**Grow opportunities for employment in water reliant outdoor recreation jobs in the Basin.** • Widespread adoption of eco-friendly BMPs as endorsed by the Walla Walla Valley Vinea Trust and Salmon Safe programs. • Promote eco-friendly vintners to increase sustainable tourism throughout the valley.
3.17	**Basin-wide assessment of sediment and bedload management build-up.** ▸ Identify problem reaches, including excess deposition and erosion areas. ▸ Develop comprehensive plan inclusive of all reaches. ▸ Develop specific solutions for severe problem areas. ▸ Develop protocol for aggregate removal and/or movement that addresses the following considerations: method of removal or placement; equipment and techniques allowed; volume limitations; permits. ▸ Issues to address: push-up dams, post flood corrections, and non-permitted disturbance of river floodplain. ▸ In Mill Creek, in order to address weired section sediment buildup, must incorporate the following elements: o Better definition of the problem and where it occurs. o Flushing higher flows needed occasionally.
3.18	**Study and analyze feasibility and benefits of flow enhancement in the Little Walla Walla River.** • Study and quantify the downstream benefits of more water flow in the LWWR system to riparian habitat aquatic species, streamflows (in the LWWR system and mainstem downstream of the confluence), alluvial aquifer and out of stream water use. • Examine current conditions and potential benefits of spring branches and lower reaches of WWR benefits. • Include analysis of water rights, streamflow data, and historic contributions of Spring Branches, as well as the impact of policy and regulations on the LWWR system.

6. WWW2050: PHASE II



Expanding upon the SPAC's work in 2020–2021, the following additional tasks should be completed as a "WWW2050: Phase II" effort following the end of this process (after June 30, 2021).

IMPLEMENTATION DETAILS

Many strategies included in the plan need additional technical and quantitative implementation details to further define the potential impact of the strategies. In Phase II, the Consulting Team will consult existing plans and reports and coordinate with Working Groups and an Advisory Committee to further define strategies. Additionally, analysis is needed to determine detailed calculation of costs, funding mechanism(s), sequencing considerations, implementation lead or partners, and implementation timeline. The Phase II analysis should include the following components:

- Scale of impact for each strategy including quantitative information on benefits to streamflows, habitat, and water supply.
- Timing of impact (seasonal and annual duration).
- Competition for water and other resource limiting factors.
- Documentation of related management actions and/or potential compounding or competing efforts.
- Defining multiple benefits or multiple inhibitors of each strategy.
- Cost benefit and/or cost effectiveness analysis.
- Analysis of how strategies increase resilience and/or mitigate climate change impacts.

The strategies included in Tier One will be the first priority for refining and further developing the analysis described above. In addition, some strategies considered during Phase I were not recommended at this time but could be added in the future if additional analyses show favorable outcomes and there is consensus on their inclusion.

ADAPTIVE MANAGEMENT STRATEGY

Developing an adaptive management strategy as part of implementation planning will help address the inherent uncertainties and assumptions underlying this Strategic Plan (see Section 4.2: Uncertainties & Assumptions for details) while increasing assurance that this plan's strategies will achieve desired future conditions.

Adaptive management is an iterative process that includes monitoring, research, tracking, and reporting key data points and indicators over time to inform decision-making and adjust the Strategic Plan as needed. The adaptive management strategy will address how to update the Strategic Plan if the strategies are not successfully implemented or do not achieve the desired results. It will also provide a mechanism to add new strategies as new ideas emerge in the basin.

EDUCATION & OUTREACH STRATEGY

Implementation will become more effective with the development of a strategic education and outreach strategy, designed to engage people throughout the basin. This includes educating people about the needs and challenges in the basin, emphasizing the importance of successful implementation, and engaging their efforts to assist and support implementation.

GOVERNANCE STRUCTURE & BI-STATE MANAGEMENT

Over the past decade, the Walla Walla Management Partnership worked with stakeholders in Washington and Oregon. However, the founding legislation of the Partnership was intended to be temporary, and the Partnership will sunset in July of 2021. Therefore, a new cooperative approach to watershed management needs to emerge that encompasses both states and the CTUIR.

These three entities will work together over the next two years, with the advice of a stakeholder Advisory Committee, to develop a new governance structure. The governance structure will lead the implementation of this plan and the Bi-State Flow Study which will include the development of a Programmatic Environmental Impact Statement.

The governance structure is envisioned to include the following components:

- A **bi-state administrative structure** with participation from Oregon, Washington, and the CTUIR which will cooperate to implement this plan.
- **Accountability mechanism** to achieve the Desired Future Conditions (DFCs) including balancing instream and out-of-stream needs, achieving meaningful fish recovery, managing surface water and groundwater conjunctively and consistently across the bi-state Walla Walla Basin, planning for climate change, and retaining the Basin's quality of life for current and future generations.
- **Advisory Committee** structure that includes diverse stakeholders and a consensus-based decision-making framework.
- **Broad stakeholder roles**, emphasizing the need for diverse input at the Advisory Committee and Working Group level from local, regional. State, Tribal, Federal, industrial, agricultural, environmental, and recreational representatives.
- Development of a clear **funding strategy** to meet the short- and long-term needs of the basin.

FUNDING STRATEGY

A strong, sustainable funding strategy is critical for successful plan implementation. Now that the implementation strategies have been identified, a next step will be to develop a funding strategy that will match needs with potential funding sources, prioritize needs where there may be competition for funding, and develop a strategic approach to leverage as much funding as possible.

APPENDIX A. ROSTERS

STRATEGIC PLAN ADVISORY COMMITTEE (SPAC)

Table 46. SPAC membership

Name	Affiliation	Interest Group
Teresa Kilmer	Walla Walla River Irrigation District	Agriculture
Allison Newhouse	Little River Group	Agriculture
Annie Byerley	Walla Walla Watershed Management Partnership	Agriculture
Mark Wagoner	Gardena Farms Irrigation District	Agriculture
Sarah Dymecki	Washington Water Trust	Environmental
Ralph Perkins	Walla Walla Basin Watershed Council	Environmental
Chris Marks	Confederated Tribes of the Umatilla Indian Reservation	Tribal Government
Dale Bambrick *(retired May 2021)*	NOAA National Marine Fisheries Service	Federal Government
Cindy Boen	US Army Corps of Engineers	Federal Government
Mark Wachtel	Washington Department of Fish and Wildlife	State Government
Chris Kowitz	Oregon Water Resources Department	State Government
Marty Hall	Columbia County	Local Government
Todd Kimball	Walla Walla County	Local Government
Steven Patten	City of Milton-Freewater	Local Government
Dan Dorran	Umatilla County	Local Government
Judith Johnson	Walla Walla Watershed Management Partnership	Ex-Officio
Tom Tebb	Washington State Department of Ecology	Ex-Officio

COORDINATING COMMITTEE

Table 47. Coordinating Committee membership

Name	Affiliation
Amanda Cronin	AMP Insights (Consulting Team)
Caroline Burney	Cascadia Consulting (Consulting Team)
Chris Marks	Confederated Tribes of the Umatilla Indian Reservation
Melissa Downes	Washington State Department of Ecology
Tom Tebb	Washington State Department of Ecology
Scott Tarbutton	Washington State Department of Ecology
Mary Verner	Washington State Department of Ecology
Brook Beeler	Washington State Department of Ecology
Jaime Short	Washington State Department of Ecology
Joye Redfield-Wilder	Washington State Department of Ecology
Matt Rakow	Washington State Department of Ecology
Austin Melcher	Washington State Department of Ecology
Chris Kowitz	Oregon Water Resources Department
Susan Gulick	Sound Resolutions (Consulting Team)
Judith Johnson	Walla Walla Watershed Management Partnership
Chris Hyland	Walla Walla Watershed Management Partnership

DATA, STUDIES, AND MONITORING WORKING GROUP

Table 48. Data, Studies, and Monitoring Working Group membership.

Name	Affiliation
Joy Bader	Walla Walla County Public Works
Jacqui Brown Miller	DOH Office of Drinking Water
Patrick Cabbage	Ecology
Anton Chiono	CTUIR
Arnold Coe	WWWMP
Amanda Cronin	Amp Insights
Llyn Doremus	Ecology
Sarah Dunn	USGS
Colleen Fagan	NMFS, NOAA
Lisl Fasser	USGS
John Fazio	Interested Citizen
John Foltz	Snake River Salmon Recover Board
Catherine Glick	Ecology
Mark Grandstaff	WDFW
Corina Hayes	DOH Office of Drinking Water
Sheryl Howe	DOH Office of Drinking Water
David Haire	CTUIR
Mike Ingham	Gardena Farms Irrigation District
Judith Johnson	WWWMP
Sue Kahle	USGS *(Retired)*
Joe Kemper	OWRD
Teresa Kilmer	Walla Walla River ID
Chris Hyland	WWWMP
Chris Kowitz	OWRD
Jonathan Kohr	WDFW
Jon LaMarche	OWRD
Ben Lee	Landau Associates
Ethan Lockwood	WWT
Jim Mathieu	NW Land and Water
Bill Neve	Water Right Solutions
Steven Patten	City of Milton-Freewater
Austin Melcher	Ecology
Tim Poppleton	Ecology
Scott Tarbutton	Ecology
Rick Valentine	Ecology
Susan Weiler	Whitman College
Brian Wolcott	Walla Walla Basin Watershed Council
Jen Woody	OWRD
Anna Zirkes	Kooskoosie Commons

WATER SUPPLY WORKING GROUP

Table 49. Water Supply Needs Working Group membership

Name	Affiliation
Susan Adams	WWT
Joy Bader	Walla Walla County Public Works
Ki Bealey	City of Walla Walla
Brenda Bernards	Interested Citizen
Ron Brown	WWRID
Amanda Cronin	Amp Insights
Jon Culp	WA Conservation Committee
Alan Davis	Walla Walla River ID
Jeff Dengel	WDFW
Sarah Dunn	USGS
Sarah Dymecki	WWT
Aaron Gagnon	Forest Service
Jamie Gardipe	DOH Office of Drinking Water
Mark Grandstaff	WDFW
Eric Hartwig	Ecology
Linda Herbert	Blue Mountain Trust Fund
David Haire	CTUIR
Mike Ingham	Gardena Farms Irrigation District
Judith Johnson	WWWMP
Sue Kahle	Retired
Chris Kowitz	OWRD
Tracy Larson	Interested Citizen
Glenn Maxted	Water Right Holder on Garrison Creek
Jim Mathieu	NW Land and Water
Sheri Miller	DOH Office of Drinking Water
Bill Neve	Water Right Solutions
Alli Newhouse	OR Irrigation at-large
Frank Nicholson	City of Walla Walla
Steven Patten	City of Milton-Freewater
Chris Pinney	US Army Corps Engineer (*Retired)*
Austin Melcher	Ecology
Tim Poppleton	Ecology
Kristina Ribellia	Western Water Market
Katherine Ryf	Landau Associates
Ernie Schrader	WWWMP
Kevin Scribner	WWBWC
Tom Scribner	City of Walla Walla
Scott Tarbutton	Ecology
Mike Talbott	Columbia County
Dan Tolleson	Ecology
Travis Trumbull	WWRID
Mark Wagoner	Gardena Farms Irrigation District
Brian Walsh	DOH Office of Drinking Water
John Warriner	Aspect Consulting

Name	Affiliation
Brian Wolcott	Walla Walla Basin Watershed Council
Anna Zirkes	Kooskoosie Commons

ECOLOGICAL FUNCTION WORKING GROUP

Table 50 Ecological Function Working Group membership

Name	Affiliation
Joy Bader	Walla Walla County Public Works
Doug Birdsall	WWWMP
Lauren Bromley	Ecology
Harmony Burright	OWRD
Patrick Cabbage	Ecology
Jon Campbell	DWWF
Anton Chiono	CTUIR
Arnold Coe	WWWMP
Amanda Cronin	Amp Insights
Llyn Doremus	Ecology
Sarah Dunn	USGS
Sarah Dymecki	WWT
Colleen Fagan	NMFS, NOAA
John Foltz	Snake River Salmon Recovery Board
Aaron Gagnon	Forest Service
Catherine Glick	Ecology
Mark Grandstaff	WDFW
Corina Hayes	DOH Office of Drinking Water
Gary James	CTUIR
Judith Johnson	WWWMP
Sue Kahle	USGS *(Retired)*
Teresa Kilmer	Walla Walla River ID
Chris Hyland	WWWMP
Jonathan Kohr	WDFW
Ethan Lockwood	WWT
Jim Mathieu	NW Land and Water
Austin Melcher	Ecology
Laura Navarrete	USFW
Ralph Perkins	WWBWC
Chris Pinney	US Army Corp Engineers *(Retired)*
Tim Poppleton	Ecology
Stephen Ranson	Ecology
Brandy Reynecke	Ecology
Kristina Ribellia	Western Water Market
Lynn Schmidt	Ecology
Jeremy Sikes	Ecology
Scott Tarbutton	Ecology
Sean Thurston	Columbia County
Brian Wolcott	Walla Walla Basin Watershed Council
Anna Zirkes	Kooskoosie Commons

LAND USE WORKING GROUP

Table 51 Land Use Working Group membership

Name	Affiliation
Brenda Bernards	Interested Citizen
Lauren Bromley	Ecology
Jacqui Brown Miller	DOH Office of Drinking Water
Jon Campbell	DWWF
Jeanne Denker	Interested Citizen
Sarah Dunn	USGS
Michael Fredrickson	Port of Walla Walla
Jamie Gardipe	DOH Office of Drinking Water
Mark Grandstaff	WDFW
David Haire	CTUIR
Alexandra James	Blue Mountain Land Trust
Sue Kahle	USGS *(Retired)*
Glenn Maxted	Water Right Holder on Garrison Creek
Austin Melcher	Ecology
Tim Poppleton	Ecology
Jeremy Sikes	Ecology
Roland Schirman	Columbia County
Sean Thurston	Columbia County
Mark Wachtel	WDFW
Scott Tarbutton	Ecology
Brian Wolcott	Walla Walla Basin Watershed Council
Anna Zirkes	Kooskoosie Commons

IMPLEMENTATION WORKING GROUP

Table 52. Implementation Working Group membership

Name	Affiliation
Susan Adams	WWT
Ki Bealey	City of Walla Walla
Chris Beard	Ecology
Doug Birdsall	WWWMP
Cindy Boen	USACE
Erik Borgen	Landau Associates
Jacqui Brown Miller	DOH Office of Drinking Water
Ron Brown	WWRID
Patrick Cabbage	Ecology
Arnold Coe	WWWMP
Alan Davis	Walla Walla River ID
Jeff Dengel	WDFW
Llyn Doremus	Ecology
Melissa Downes	Ecology
Sarah Dunn	USGS
Sarah Dymecki	WWT

Name	Affiliation
Colleen Fagan	NMFS, NOAA
John Foltz	Snake River Salmon Recovery Board
Corina Hayes	DOH Office of Drinking Water
Jon Hooper	Interested Citizen
Alexandra James	Blue Mountain Land Trust
Gary James	CTUIR
Judith Johnson	WWWMP
Sue Kahle	USGS *(Retired)*
Teresa Kilmer	Walla Walla River ID
Chris Kowitz	OWRD
Ethan Lockwood	WWT
Sheri Miller	DOH Office of Drinking Water
Frank Nicholson	City of Walla Walla
Austin Melcher	Ecology
Karl Rains	Ecology
Tim Poppleton	Ecology
Joye Redfield-Wilder	Ecology
Lynn Schmidt	Ecology
Jaime Short	Ecology
Jeremy Sikes	Ecology
Scott Tarbutton	Ecology
Travis Trumbull	WWRID
Mark Wachtel	WDFW
Brian Wolcott	Walla Walla Basin Watershed Council
Anna Zirkes	Kooskoosie Commons

APPENDIX B. ADDITIONAL REPORTS

- Walla Walla Subbasin Plan, Walla Walla Watershed Planning Unit and Walla Walla Basin Watershed Council, May 2004
- Walla Walla Watershed Plan, HDR/EES, Inc., May 2005
- Water Cleanup Plan, Washington State Department of Ecology, published February 2006, EPA approved May 2006
- Water Quality Improvement Report, Washington State Department of Ecology, published November 2006, EPA approved January 2007
- Snake River Salmon Recovery Plan, Snake River Salmon Recovery Board, 2011
- West Little Walla Walla River Habitat Assessment, Little Walla Walla Rivers Working Group, October 2012
- Walla Walla River Ecological Flows— Recommended Stream Flows to Support Fisheries Habitat and Floodplain Function, Stillwater Sciences, September 2013
- Lower Walla Walla River Geomorphic Assessment and Action Plan, Tetra Tech, December 2014
- Final Habitat and Passage Assessment and Strategic Action Plan, Tetra Tech, June 2017
- Mill Creek Report, City of Walla Walla in collaboration with the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) and the Washington State Department of Fish and Wildlife (WDFW), 2018
- Walla Walla River Basin Bacteria, pH, and Dissolved Oxygen Total Maximum Daily Load: Water Quality Effectiveness Monitoring, Washington State Department of Ecology, published November 2006, EPA approved January 2021

APPENDIX C. ACCOMPLISHMENTS

WALLA WALLA WATERSHED MANAGEMENT PARTNERSHIP

Table 53. Walla Walla Management Partnership program accomplishments.

Program/project	Goals/Desired Outcomes	Outcomes Achieved
Education	• Provide a forum for open public discussion. • Facilitate communication between different interests in the Basin whose work is often siloed in different community sectors. • Introduce public to the complexity of water rights and management.	• Hosted public "Water Rights 101" forums in 2016 and 2017 in three towns in the Walla Walla Valley.
Participate in local, state, tribal, federal, and multistate basin water planning initiatives	• Participate and help integrate work being conducted by many organizations and individuals from both states, including both government and non-governmental entities. • Move Flow Study forward	• Participates in the monthly activities of the Snake River Salmon Recovery Board, assisting and reviewing proposed fisheries enhancement projects. • Provides input and feedback to NMFS for recovery goals relating to salmon and steelhead via the Mid-Columbia Columbia River Basin group of the Marine Fisheries Advisory Committee • Provides input to ensure the project has a more holistic goal, and not just focus on flood control via the Mill Creek Working Group
Local Water Plans (LWPs)	• Flow from Flexibility Program invites water rights holders to develop plans that enhance stream flows in exchange for greater flexibility in the way they can exercise their water rights.	• Seven total LWPs approved. • Three LWPs partially implemented. • One not yet implemented. • Three expired/inactive. • 374 acre-feet left instream, potential for 1,543 to be left instream (funding present barriers)
Water Banking	• Provides options to water rights holders to voluntarily deposit water rights while protecting themselves from relinquishment. • The program relies on self-reporting and limits the penalty for non-compliance.	• Ecology identified records for 143 water rights in the Ecology's Water Rights Tracking System (WRTS) database enrolled in the Partnership water bank, with a cumulative total quantity of 18,698 acre-feet of water.
Water Transactions	• Reduce the impact of over-appropriation on vulnerable fish populations by acquiring water through purchases and leases	• 2017: two water leases totaling 2,600 acre-feet

Program/project	Goals/Desired Outcomes	Outcomes Achieved
	(contributed to the State Trust Program).	
Agreements Not to Divert (ANTD)	• Help the Walla Walla Basin deal with critical low-flow periods and extend the conservation of water downstream. These agreements are made with more junior rights, agreeing to leave them instream upon the Partnership's request; all water involved in ANTDs is placed in the Water Bank.	• Not implemented
Critical Low-Flow Plan (CLFP)	• Bring the community together to help in times of drought crisis. • Provide irrigators with a guide to provide effective drought assistance. • Option Contracts offer a payment to water rights holders to bypass water, reduce surface diversions near passage barriers, or rely on basalt wells rather than surface or shallow aquifer rights.	• No critical low-flow plans implemented since 2008.
Exempt Well Mitigation Exchange	• The Partnership sells Mitigation Credits that represent the preservation of water in the exchange, compensating both seller and buyer, and helping to reduce strain of the water table.	• The bank contains 24.84 acre-feet of water and sold 2.75 as credits to five homes; the remaining balance in the bank is capable of supplying credits to 45 additional houses (as of 2018).

WALLA WALLA COUNTY CONSERVATION DISTRICT

Table 54. Walla Walla County Conservation District Program Accomplishments

Program/project	Year(s)	Goals/Desired Outcomes	Outcomes Achieved[31]
Conservation Reserve Enhancement Program (CREP)	1999-present	• Improve degraded riparian buffer zones along streams in Walla Walla County. • Reduce soil erosion and pollution to streams. • Provide habitat for wildlife and fish. • Provide protection for farmers and ranchers from regulatory action.	• Just under 1.5 million native trees and shrubs planted in addition to grass stands. • Over 190 contracts on ~3600 acres. • Buffer widths range from 50 to 180 feet. • 196.9 miles of stream bank protected with buffers.

[31] Total streams restored and fish passage barriers removed not included.

Program/project	Year(s)	Goals/Desired Outcomes	Outcomes Achieved[31]
Creating Urban Riparian Buffers Program (CURB)	2006-2015	• Provide educational outreach on restoring riparian zones in urban areas (e.g., community workshops, public presentations and booths, informational mailings, and project tours) to urban residents.	• 41 Urban Riparian Buffers installed. • 11,928 feet of stream bank cover restored. • Over 7,200 trees, shrubs and perennials planted.
Fish Screens & Flow Meters Program	2001-2018	• Aid local landowners to comply with federal standards and cover the cost of upgrading to National Marine Fisheries approved fish screens. • Provide irrigators with modern water meters to help them use their water more efficiently. • Reduce fish mortality and increase flows through irrigation efficiencies.	• 377 fish screens installed in Walla Walla County. • 49 fish screens installed for Columbia, Benton, North Yakima and Okanogan Conservation Districts. • 529 flow meters installed on surface diversions and wells in Walla Walla County. • 67 data loggers installed with flow meters.
Irrigation Efficiency	2002-present	• Cost-sharing projects with irrigation districts to improve efficiency and reduce water loss. • Maintain area irrigation and avoid regulatory mandates.	• Assisted 6+ irrigation districts with infrastructure improvements resulting in 41+ miles of converted leaking earthen canals to piped systems. • 19+ cfs of water trusted to Ecology

WALLA WALLA BASIN WATERSHED COUNCIL

Table 55. Managed aquifer recharge sites in Oregon.

MAR Sites	Recharge Year 2017-2018	Recharge Year 2018-2019	Totals (acre-feet)
Anspach	251	135	386
Barret	179	181	360
Chuckhole	25	25	50
East Trolley	52	45	97

MAR Sites	Recharge Year 2017-2018	Recharge Year 2018-2019	Totals (acre-feet)
Fruitvale	35	51	86
Gallager	-	16	16
Johnson	3,518	2,794	6,312
LaFore	78	3	81
Locust	56	56	112
Mud Creek	32	45	77
NW Umapine	233	111	344
Ringer Road	-	111	111
Triangle Road	103	72	175
Trumbull	67	45	112
Conveyance Losses	3,710	2,631	6,341
Totals (acre-feet)	**8,338**	**6,321**	**14,659**

Table 56. Managed aquifer recharge sites in Washington [25].

MAR Sites	Recharge Year 2014	Recharge Year 2015	Recharge Year 2016	Recharge Year 2017	Totals (acre-feet)
Locher Road	180	36	-	-	216
Stiller Pond	300	214	278	279	1,071
Last Chance	-	-	-	-	-
WA Mud Creek	-	-	-	-	-
Totals (acre-feet)	**480**	**250**	**278**	**279**	**1,287**

CONFEDERATED TRIBES OF THE UMATILLA RESERVATION

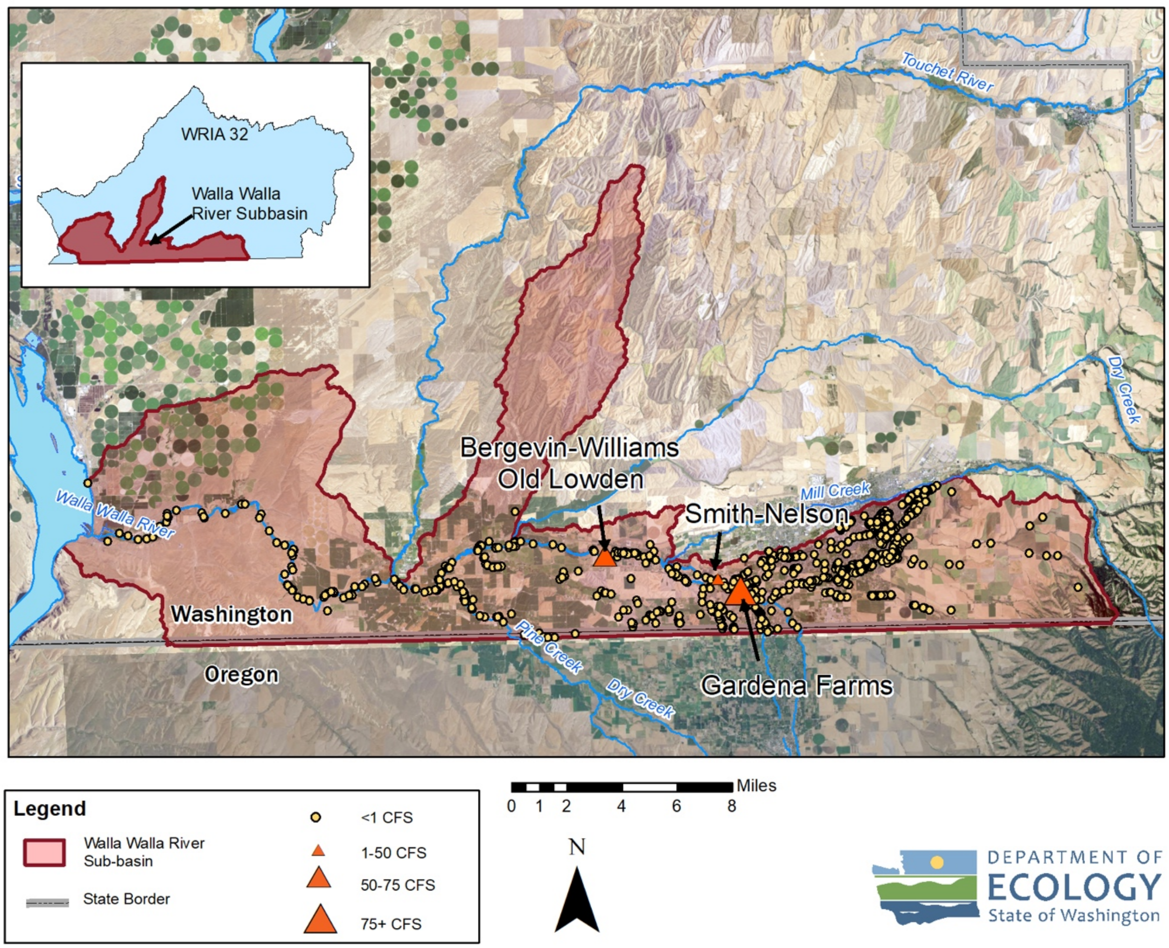
Table 57

Subbasin, Stream and Years	Project Description	Species	CTUIR River Vision Touchstones/ Habitat Limiting Factors (PLF's shaded in yellow)								Comments
			Biota-Connectivity	Geomor-phology	Connectivity		Hydrology			Riparian Veg.	
			Passage Barriers + Entrainment	In-channel Characteristics	Habitat Diversity (LWD)	Floodplain Confinement	High Temps	High Turbidity	Low Flows	Riparian + Floodplain	
Mainstem Walla Walla River (Lampson site) (2008-2011)	Complete assessment and final design and implemented levee removal, floodplain reconnection, and side channel construction. Established conservation easement, riparian planting, noxious weed control.	STS, CHS, BT, RBT		X			X	X		X	Constructed 1000' side-channel and removed over 2000' of levee. 25 acres protected and maintained – fully revegetated with native trees and grasses, noxious weed control, removal of planting tarps. Collected pre-project monitoring data (LWD counts, fish population estimates, geomorphic measurements, etc.)
Mainstem Walla Walla River (M-F Levee System) (2008-2014)	Cooperative effort to improve fish passage, habitat, channel stability and levee function through the mid-Walla Walla River reach and Milton-Freewater flood control system. Design and implement projects to improve floodplain connection and geomorphology	STS, CHS, BT, RBT	X	X	X	X	X		X	X	Cooperative with Walla Walla Basin Watershed Council, ACOE, ODFW, MF Water Control District, etc. 11 miles of LiDAR flown in December 2010.
Lower Walla Walla River Geomorphic Assessment and Conceptual Designs (2010-2014; Completed in 2014)	Cooperative effort to develop an assessment and strategy for improving channel and bank stability, floodplain function, and habitat conditions in the lower reaches of the Walla Walla River	STS, CHS, BT, RBT	X	X	X	X	X	X	X	X	Collected and assessed channel and habitat information in the lower Walla Walla River in cooperation with the WWCD to develop a restoration strategy for improving floodplain and channel conditions and developing future projects.
Walla Walla River, Bolen/Kelly Floodplain Restoration (2012-2014)	Complete assessment and design for improving floodplain function and aquatic habitat conditions.	STS, CHS, BT, RBT		X	X	X	X	X		X	Produced designs in cooperation with the WWBWC to the 60% level. Designs can be advanced to the final design level upon permission to proceed with the project if deemed high priority and landowner agreement secured.
Couse Creek (Shumway & Banks sites) (2008-2010)	Upland and riparian revegetation, weed control, livestock exclusion, construction of instream habitat and grade control structures, channel reshaped to mimic relic reach, large woody debris additions.	STS, RBT		X	X		X	X		X	1000 feet of channel reconfiguration, with the addition of large wood, riparian plantings, 2 acres of upland planting, weed control, livestock exclusion, and maintenance
Walla Walla Juvenile and Adult Passage Improvement (2008-2014)	Design and construct fish passage improvements at irrigation diversion dams and screens.	STS, CHS, BT	X								Provided cost share for: consolidation of four irrigation diversions and fish screens on mainstem WW River; new fish screen on Mill Cr.; design work for lower Mill Cr. imminent threat passage project.
Mainstem Walla Walla Bridge to Bridge Project RM 28.4 – 29.0 (2009-2013; Construction completed in 2013)	Implement levee removal and input of in-stream habitat complexity over 0.6 miles of stream.	STS, CHS, BT, RBT		X	X	X	X	X	X	X	Removal of 3,800 linear ft of levee, improved stream complexity including 3 logjam structures, 45 anchored individual log structures and 87 unanchored log structures with 474 pieces of racking material. Included treatment of riparian and floodplain with vegetation.
NFK Touchet Culvert Replacement Project RM 20	Replace a partial barrier culvert with a bottomless arch at the crossing of Forest Road 6400-650 over the North Fork of the Touchet River	STS, BT, RBT	X	X							Restored 0.25 miles of unimpeded access to additional stream habitat. Replaced existing culvert with a 98 foot long by ~8 foot tall 16-foot-wide bottomless arch with stream simulated substrate throughout.
SFK Touchet River Floodplain Connectivity/Restoration Project RM 7.75-8.5 (2014)	Implemented efforts increased floodplain connectivity, the quality and diversity of in-stream habitat for listed and non-listed species of fish, and channel morphology and in-stream processes	STS, CHS, BT, RBT	X	X	X	X	X	X	X	X	Floodplain-channel restoration over 0.5 miles of stream. Increased floodplain access by removing 300 ft berm and re-connected two blocked side-channels. Increased in-stream habitat complexity by installing 38 single log structures, two large crib structures, and 3 boulder arrays. Re-vegetated the project area including 75 live cottonwood boles, 300 conifers, and 1,000 willow whips
SFK Walla Walla Kentch Project RM 4.7-5.5 (2008-2013)	The 46-acre Kentch property was purchased in 2004 for the benefit of native species and tribal uses. This property was managed for native vegetation until a restoration project was designed and implemented in 2014-2015. See below	STS, CHS, BT, RBT								X	Land acquisition occurred in 2004. Project activities relative to the property include the boundary survey; water rights transferred, constructed livestock exclusion fence on upstream boundary; initiated groundwater monitoring effort (including stream, groundwater, air, and soil temperatures, groundwater elevations, etc.). Project site assessment and 2013 design.
SFK Walla Walla Kentch Project RM 4.7-5.5 (2014-2015)	Historically the South Fork Walla Walla River was channelized and forced against a bluff, effectively narrowing, and simplifying the river channel. The restoration project implemented in two phases in 2014-2015 consisted of constructing a brand-new main channel with extensive meandering. In addition, multiple perennial side channels were designed. Old channel sections were plugged. In addition, levees were removed, and the floodplain was regraded and designed to allow overbank floodplain inundation. This project provided extensive channel complexity and sediment sorting, thereby promoting successful spawning, and rearing of multiple salmonid species. Increased water temperature diversity (mixture of warmer and colder temperature habitats).	STS, CHS, BT, RBT		X	X	X	X			X	Floodplain-channel restoration on 0.75 miles of stream, 46 acres. Increased floodplain access to 25 acres. Increase of 285 ft of main channel and 3,608 ft of side-channel. Added 434 pieces of wood (only 13 pre-project present) and hundreds of boulders which increased pocket habitat by 4,761 M2. Instream complexity increased including overhead cover by 12%, 189% increase in habitat units, 59% improvement in wood rating, 13% more sand/gravel substrate composition. Planted riparian area with thousands of applicable tree species.

Subbasin, Stream and Years	Project Description	Species	CTUIR River Vision Touchstones/ Habitat Limiting Factors (PLF's shaded in yellow)								Comments
			Biota-Connectivity	Geomor-phology	Connectivity		Hydrology			Riparian Veg.	
			Passage Barriers + Entrainment	In-channel Characteristics	Habitat Diversity (LWD)	Floodplain Confinement	High Temps	High Turbidity	Low Flows	Riparian + Floodplain	
SFK Touchet River Floodplain Connectivity/Restoration Project RM 7.0-8.0 (2016)	Implemented efforts increased floodplain connectivity, the quality and diversity of in-stream habitat for listed and non-listed species of fish, and channel morphology and in-stream processes.	STS, CHS, BT, RBT	**X**	X	**X**	**X**	X	X	X	**X**	Floodplain-channel restoration on approximately 1 mile of stream. Increased floodplain access by at least 2 acres by opening 3 blocked side channels; Increased in-stream habitat complexity by installing 70 single log structures, one, 8 flow choke structures, 1 junction log jams and 3 flow split log jams, and 3 boulder arrays. Re-vegetated the project area including 75 live cottonwood boles, 100 conifers, and 1,000 willow whips.
Lower Mill Creek Fish Habitat and Passage Assessment and Strategic Action Plan RM 0-15 (2016-2017)	The Lower Mill Creek Fish Habitat and Passage Assessment and Strategic Action Plan was completed by the CTUIR in collaboration with a broad group of local representatives is a comprehensive review of the watershed and offers actions and recommendations to restore and promote the ecosystem function and services of Mill Creek. This plan addresses the vital touchstones characteristic of healthy river systems as identified in the CTUIR's River Vision goal of improving fish passage, creating complex fish habitat, and restoring floodplain connectivity while maintaining or improving flood control and facilitating support among key stakeholders.	STS, CHS, BT, RBT	X	X	**X**	**X**	X		X	**X**	Consolidation and holistic organization of data related to Mill Creek. Identification of strategy alternatives to address deficiencies identified in the document. Establishment of stakeholder interest groups to strategically guide advancement of concepts and associated actions as identified in study results.
South Fork Walla Walla River, Hutchison Restoration Project 2018	Design completed in 2017-2018. This project restored a straightened section of the South Fork Walla Walla River, focused on improvement of habitat complexity and floodplain attributes. Located upstream from the Kentch restoration project completed in 2015 to magnify results and extend the treatment reach.	STS, CHS, BT, RBT		X	**X**	**X**	X			**X**	The project reach is 0.6 miles in length and encompasses 30 acres. The creation of 794' of off channel habitat improvements and 11 acres of floodplain reactivation are proposed. Added large quantities of LWD in-stream for habitat complexity.
Couse Creek RM 0.1 Passage and Channel Restoration Design 2017-2018	Cooperative participation in a project with the Walla Walla Basin Watershed Council involving proposed implementation for the purpose of improving complexity and floodplain function in a reach deemed as a priority by interactive stakeholder groups.	STS, RBT	X	X	**X**	**X**	X		X	**X**	Development of engineered designs to rectify passage challenges and restore habitat complexity and reestablish 7 acres of historical increase floodplain in a most important steelhead waterway in the basin.
Walla Walla River Nursery Bridge Phase II Passage and Habitat Complexity Project Design 2017-2018	This is Phase II of a three-phase project to strategically enhance migratory passage and improve riverine processes throughout this leveed reach of the Walla Walla River. Phase II is focusing on moving an existing irrigation and installing various habitat complexity features within a 2000' reach of the Walla Walla River around the Nursery Bridge Drop Structure.	STS, CHS, BT, RBT	X	X	**X**		X	X	X		Formulation of engineered designs of a multitude of alternatives for analysis and solicitation of stakeholder input towards rectifying solutions at a priority location with a long history of detrimental conditions that have adversely affected salmonid suitability.
S. Fork Touchet watershed conservation - habitat acquisition (2009-2018)	Purchase and enhance critical instream and watershed habitats	STS, CHS, BT, RBT		X	**X**	**X**	X	X	X	**X**	Acquired 2400 acres of additional conservation easement (reduces cattle grazing); Relocated 3 mi. of road away from creek, added large quantities of LWD to stream, armored erosion prone stream banks, practiced targeted grazing on 1000 acres adjacent to stream to control invasive species. Dedloff Conservation Agreement-0.33miles;
N. Fork Touchet River (2010-2014)	Permanent conservation easement for property including reaches of both Wolf Fork and North Fork of the Touchet River	STS, CHS, BT, RBT		X	**X**		X	X		**X**	Cooperative with Blue Mountain Land Trust. Permanent conservation easement for 100 acres of riparian and upland habitat at the confluence of Wolf and North Forks of the Touchet River. Fairchild Conservation Agreement-0.8milesWolf&0.4milesNFK
Basin-wide easements O&M (2008-2017)	Ongoing maintenance of 8 riparian conservation agreements including livestock exclusion fencing, tree, and grass planting, and weed control	STS, CHS, BT, RBT		X			X	X	X	**X**	Long term conservation easements protecting approx. 10 miles of streams and approx. 200 acres of upland and riparian habitat.

APPENDIX D. IRRIGATION DIVERSIONS FOR THE NON-GROWING SEASON

Figure 30. Walla Walla River Subbasin Irrigation Diversions for the Non-Growing Season (Oct 1 – Apr 1) Based on GWIS/WRTS Record (map created by WA Department of Ecology, 2021).



DEPARTMENT OF ECOLOGY State of Washington

Figure 31. Touchet Subbasin Irrigation Diversions for the Non-Growing Season (Oct 1 – Apr 1) Based on GWIS/WRTS Record (map created by WA Department of Ecology, 2021).

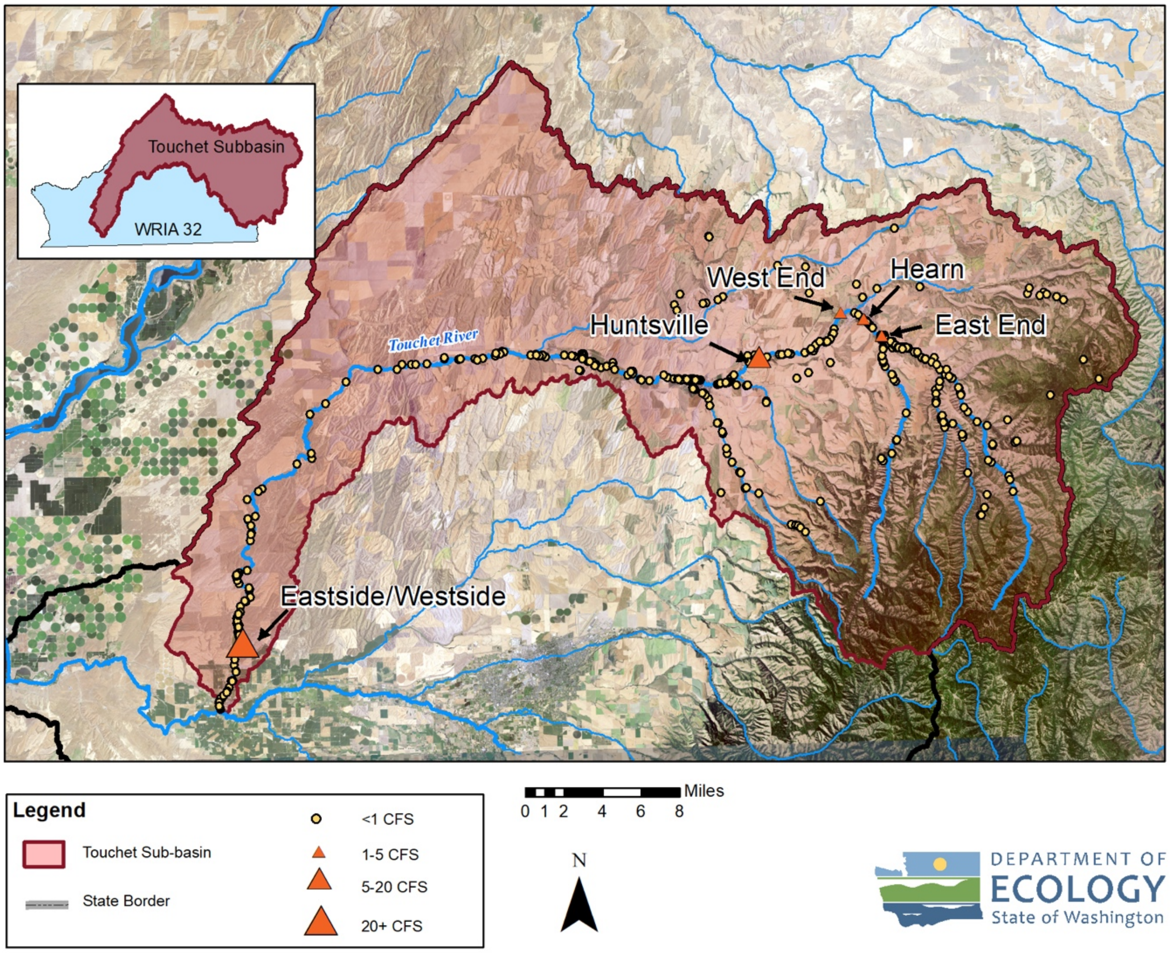


Figure 32. Mill Creek Subbasin Irrigation Diversions for the Non-Growing Season (Oct 1 – Apr 1) Based on GWIS/WRTS Record (map created by WA Department of Ecology, 2021).

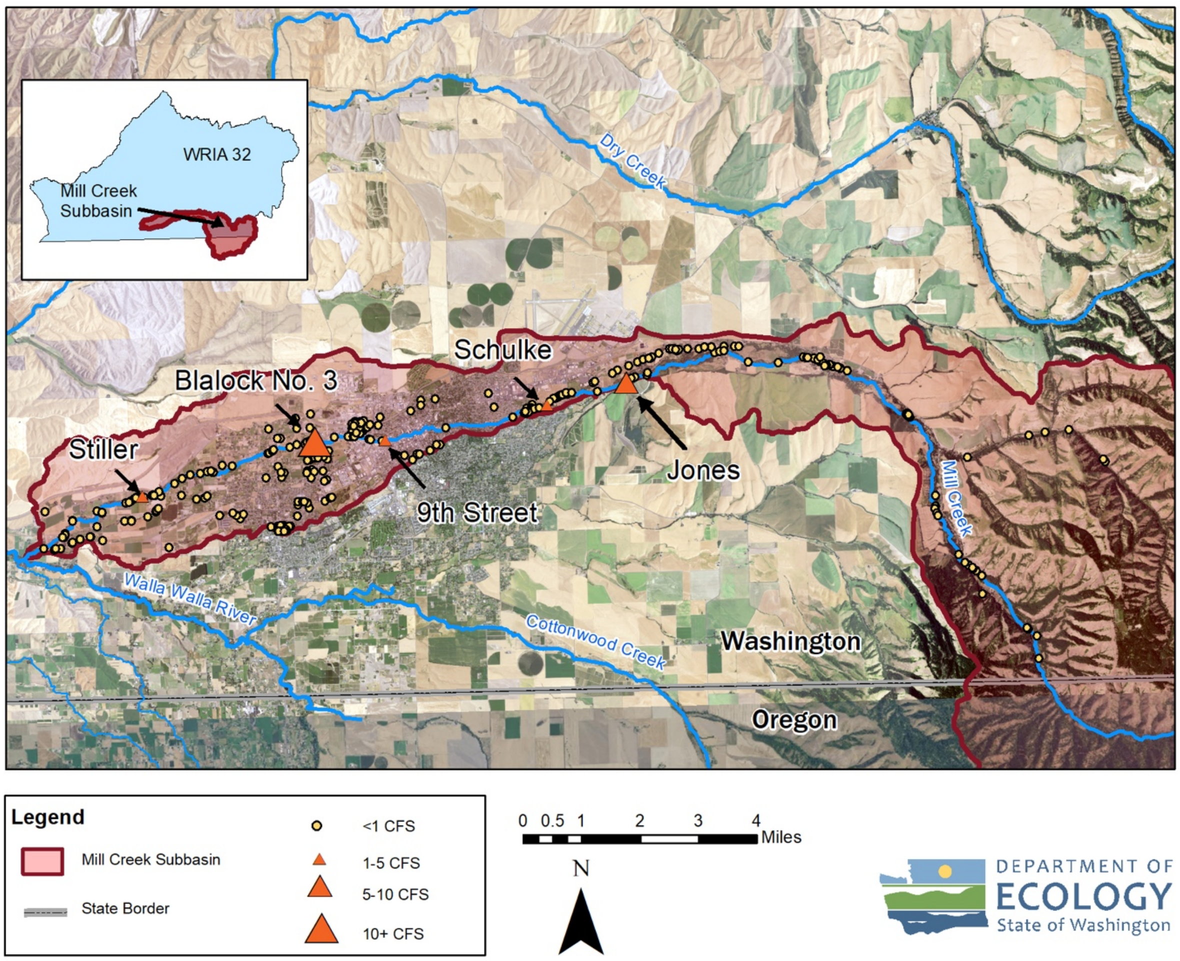


Figure 33. Dry Creek Subbasin Irrigation Diversions for the Non-Growing Season (Oct 1 – Apr 1) Based on GWIS/WRTS Record (map created by WA Department of Ecology, 2021).

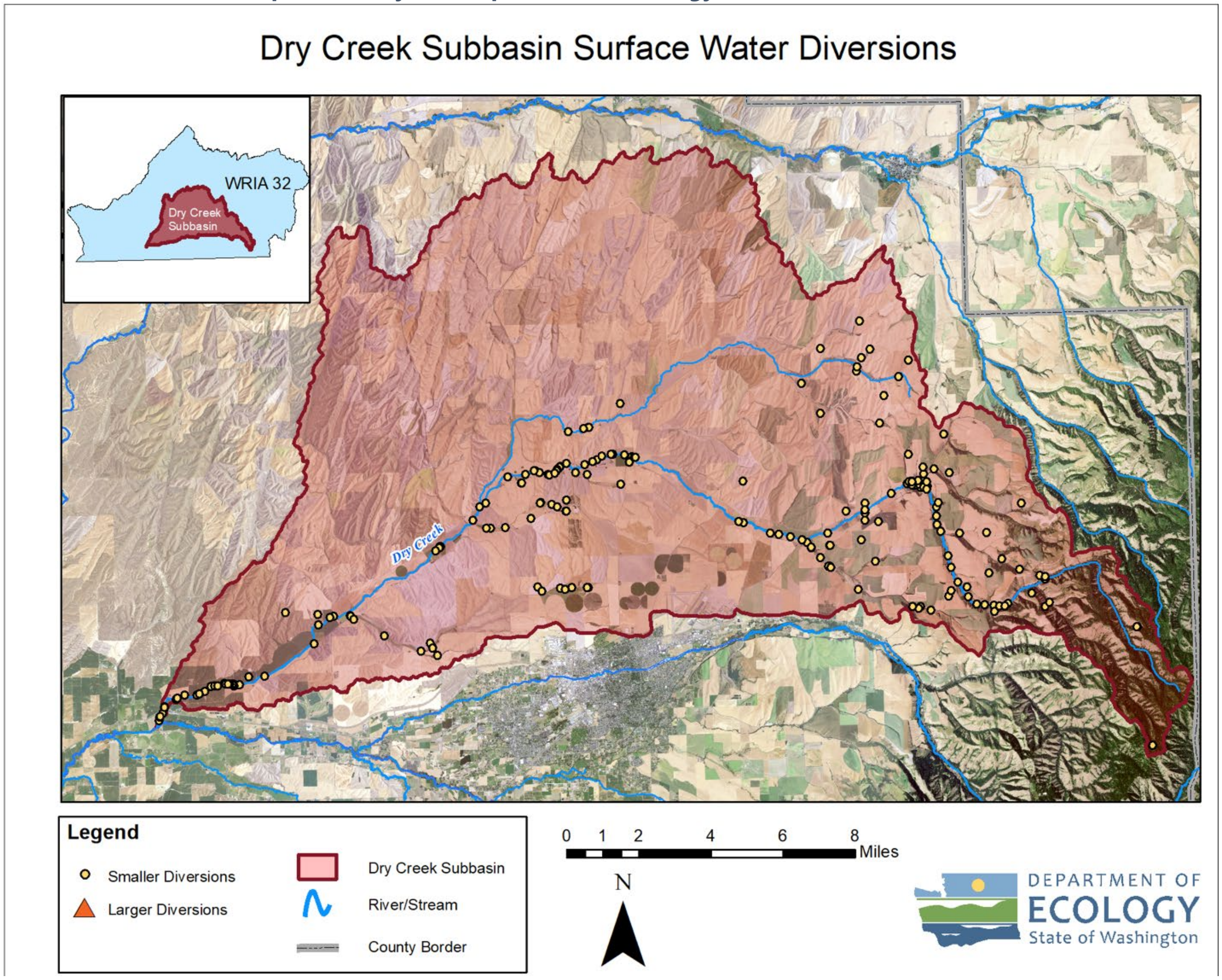
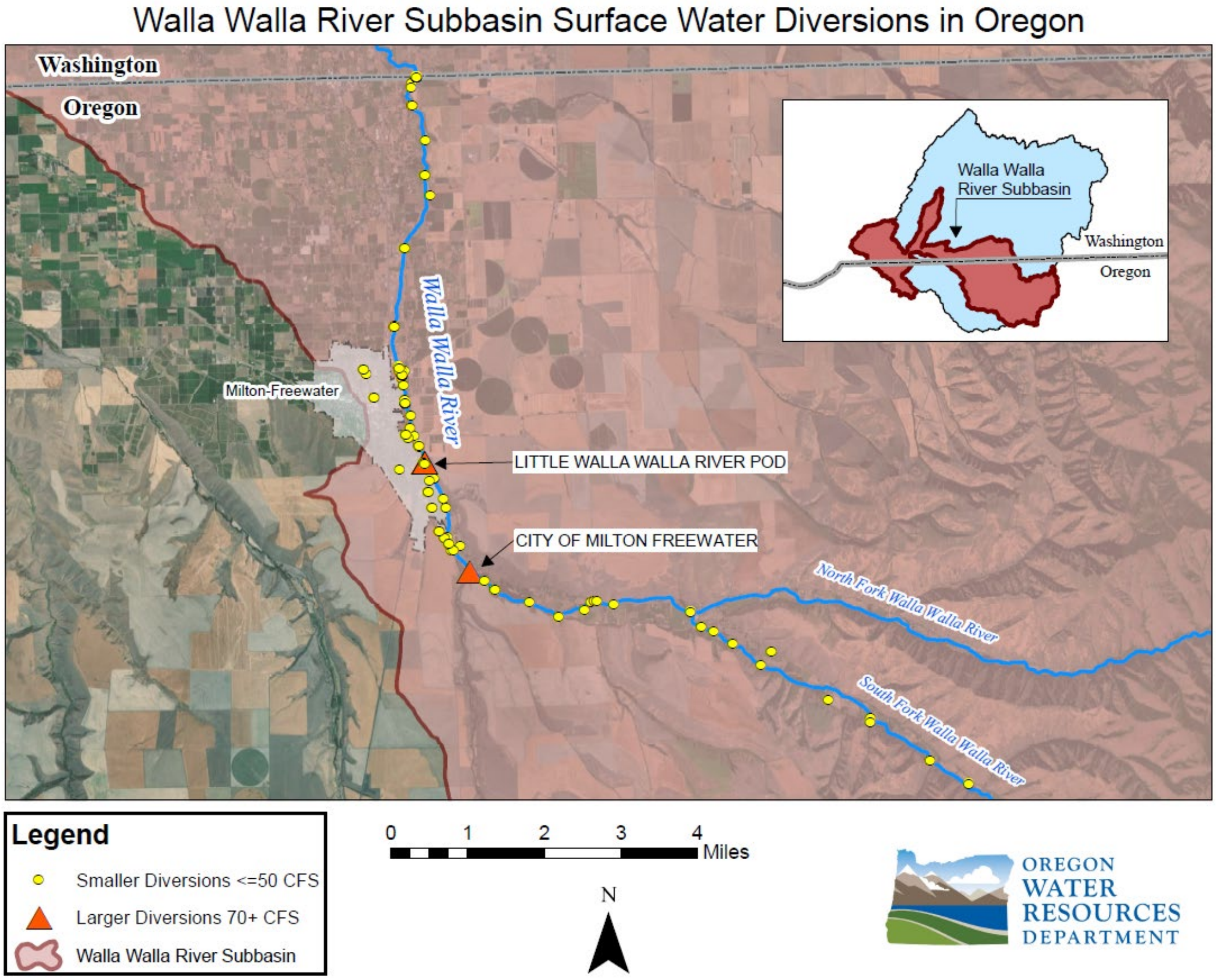


Figure 34. Walla Walla River Subbasin Surface Water Diversion in Oregon (map created by Oregon Water Resources Department, 2021).



APPENDIX E. STRATEGY DETAILS

Strategies were analyzed by tier to assess whether the package of strategies meets multiple benefits and span across a range of implementation details, ensuring a shared commitment to meeting the basin's goals and shared benefits of Strategic Plan implementation.

Figure 35. Strategies by project category and tier. Each project category is represented and fairly balanced in each tier.

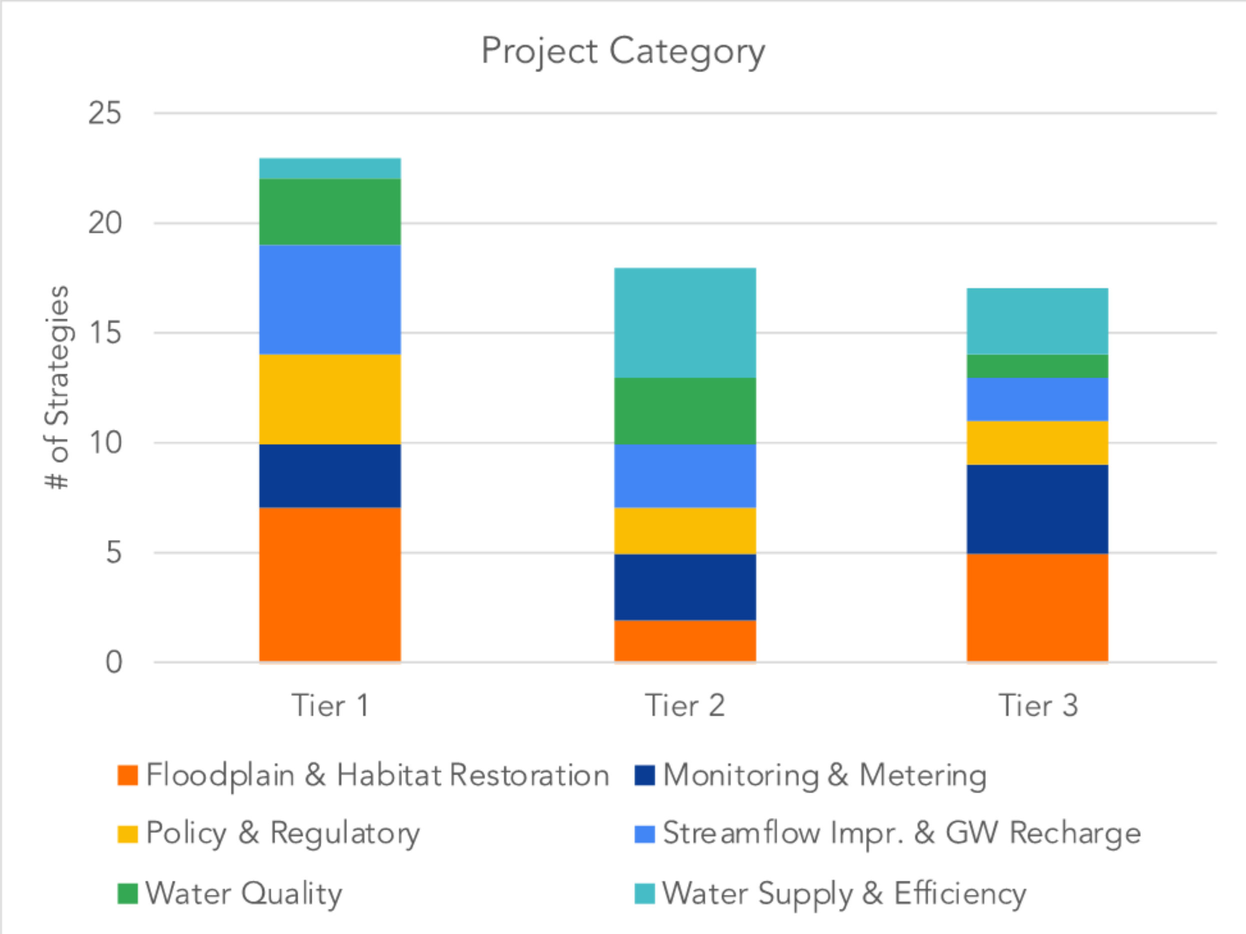


Figure 36. Strategies by implementation tool or type of action required. Overall distribution is fairly balanced but there are more physical construction projects in Tier 1 than Tiers 2 and 3.

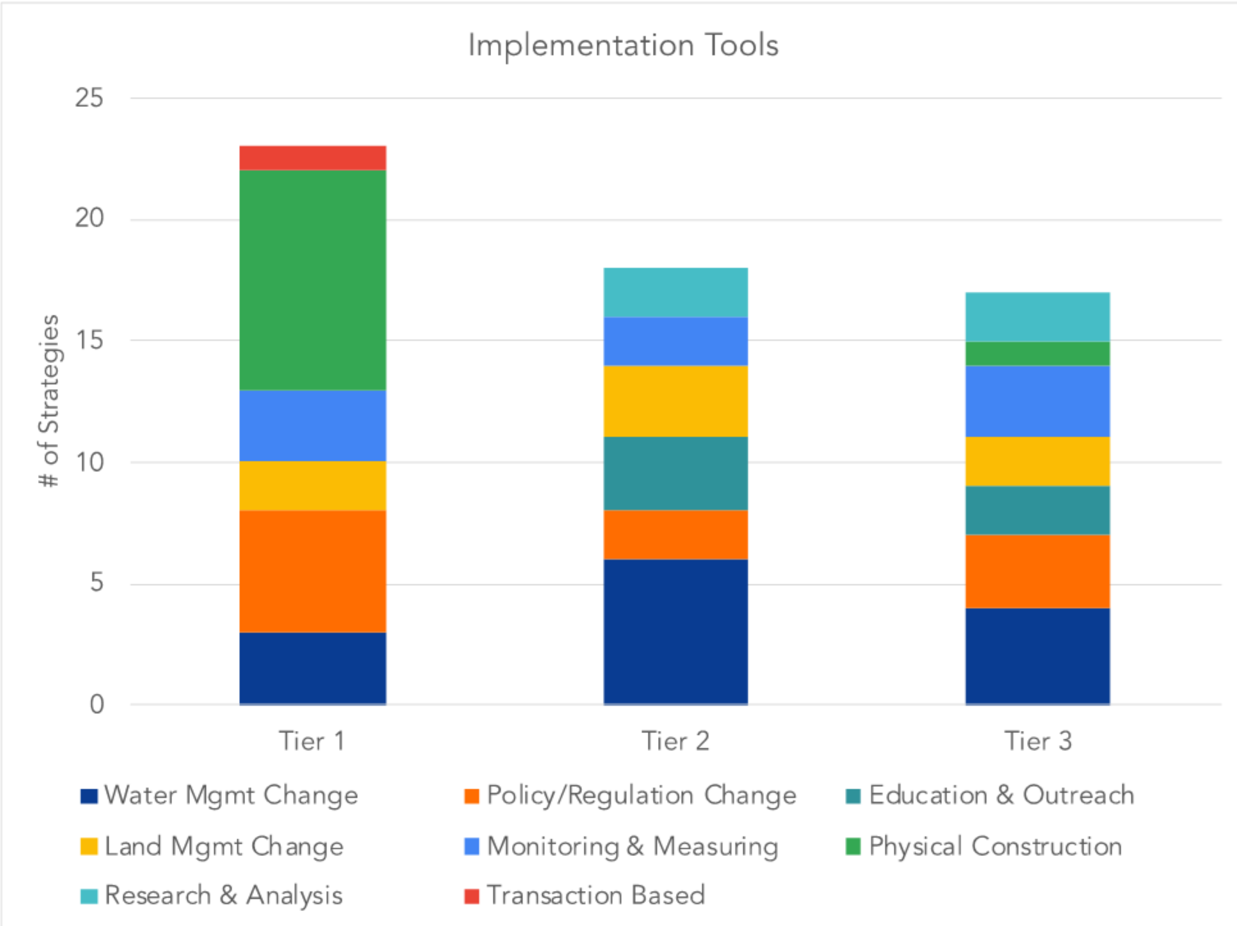


Figure 3. Strategies by ease of implementation, ranging from "ready to go" to "very challenging". Efforts already underway ("in place") were generally considered lower priority (Tier 3).

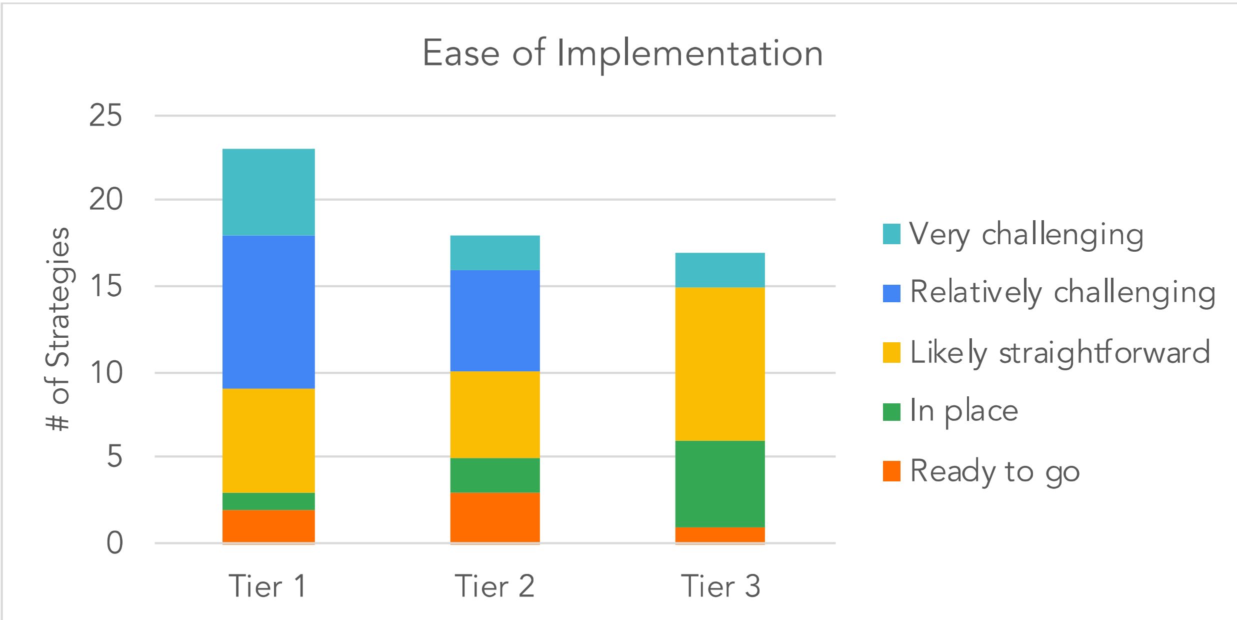


Figure 37. Strategies by cost estimate, ranging from less than $150,000 to over $10 million.

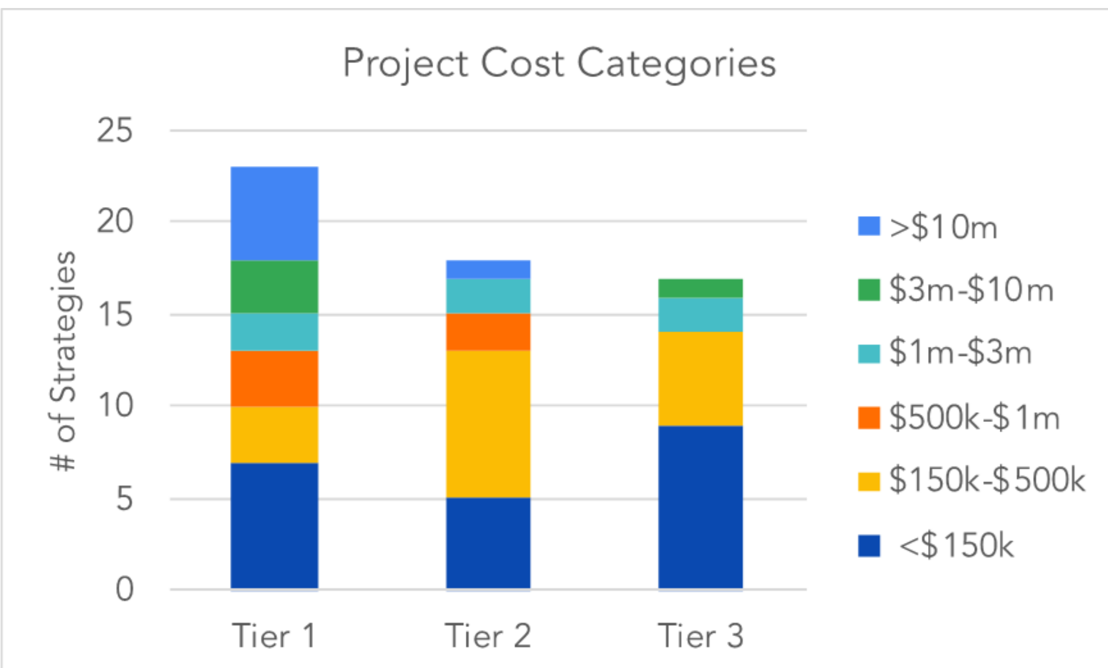


Figure 38. Tier 1 strategies comparing ease of implementation and cost estimate. Less expensive projects are typically more challenging to implement (if they were easy to implement, they would likely have already been

funded and completed). The figure also highlights that some strategies are ready to go but need significant funding.

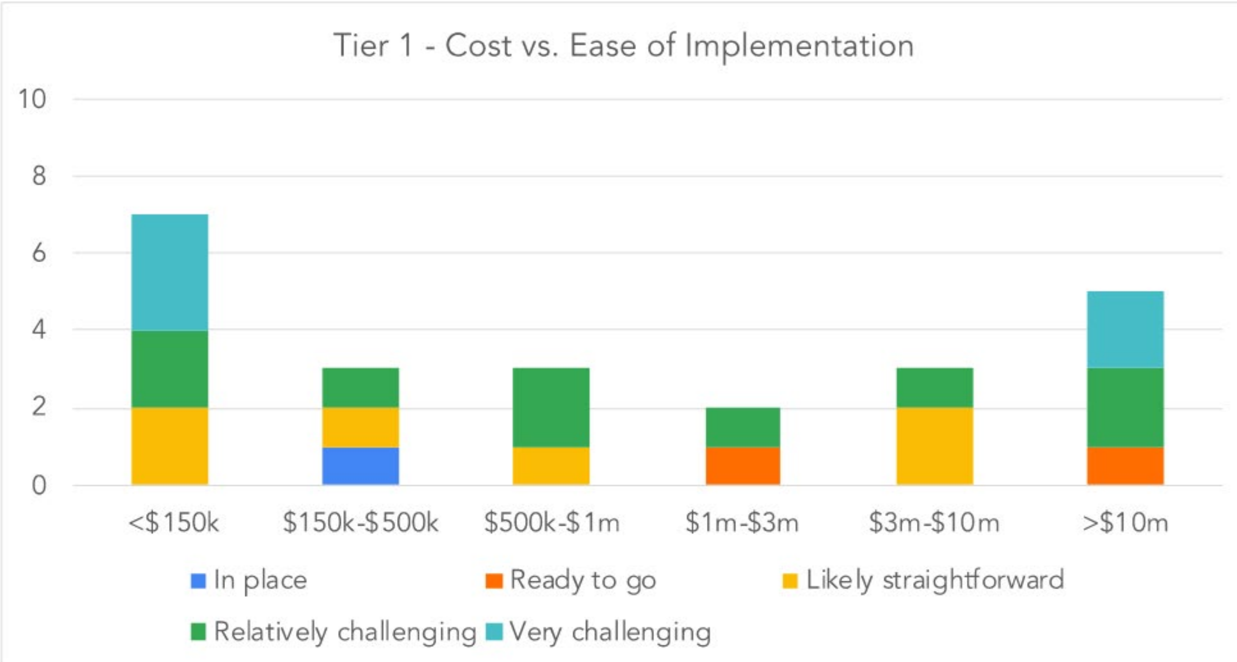


Figure 39. Tier 2 strategies comparing ease of implementation and cost estimate. Less expensive projects are typically more challenging to implement (if they were easy to implement, they would likely have already been funded and completed). The figure also highlights that some strategies are ready to go but need significant funding.

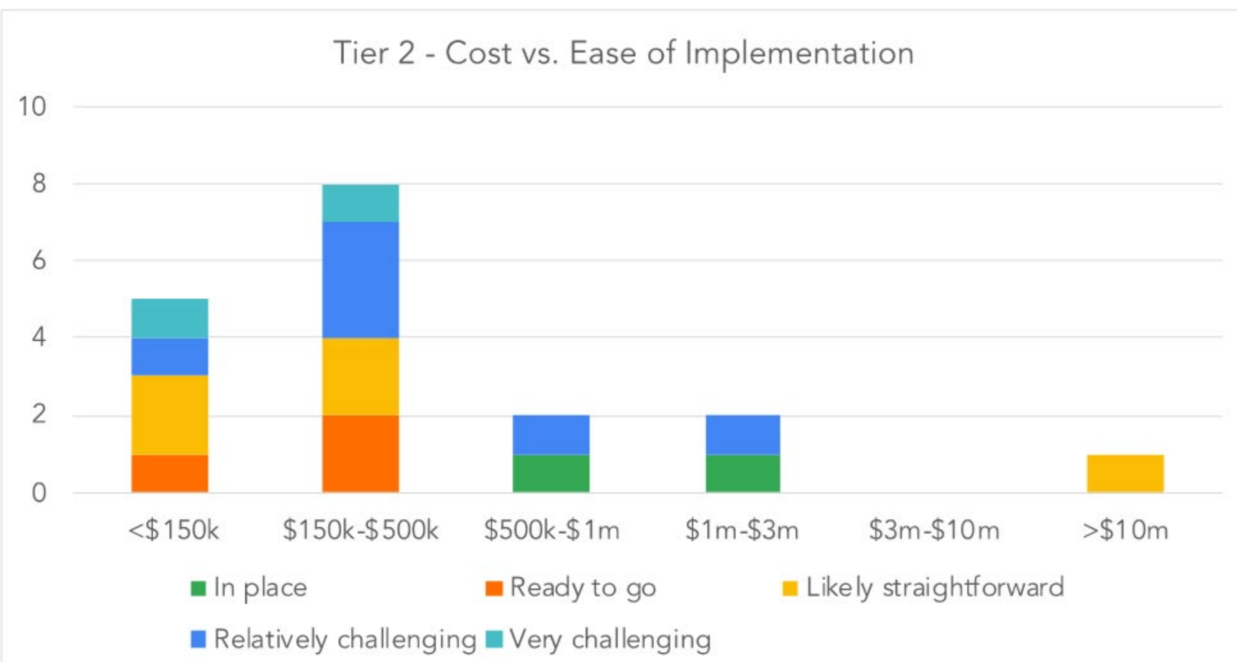


Figure 40. Strategies by lead entity type.

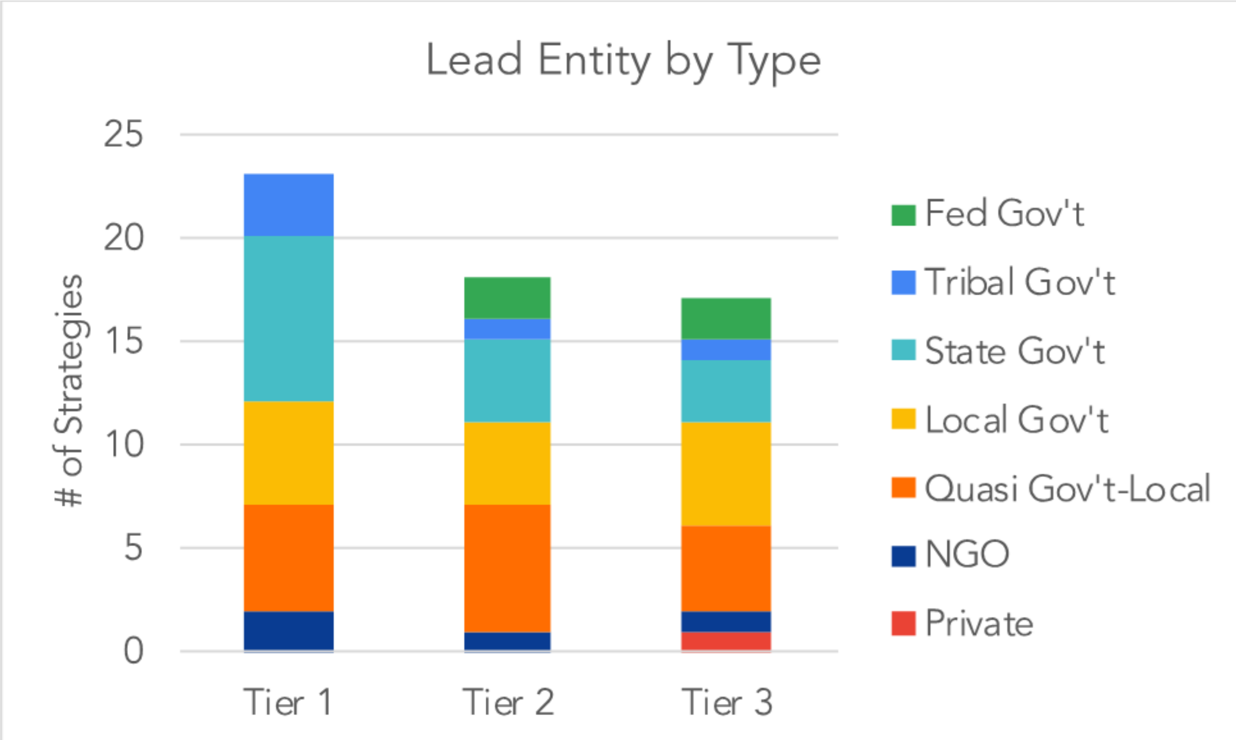


Figure 41. Priority strategies by anticipated barriers to implementation. Funding is the most common barrier, followed by landowner willingness, agency coordination, and existing agency policies.

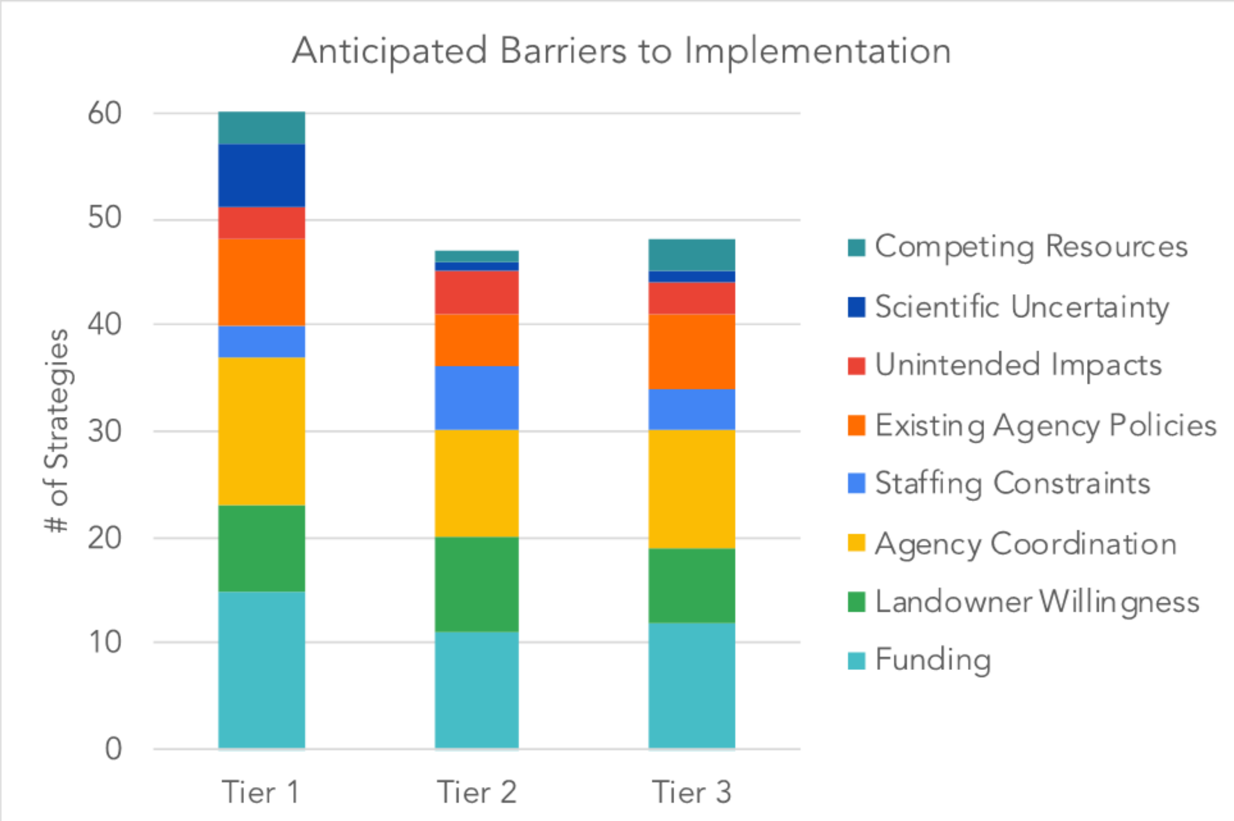


Table 57. Strategies to Achieve Desired Future Conditions (DFCs).

Desired Future Condition	Strategy #s
Floodplains, Critical Species, Habitat, & Water Quality	
Achieve healthy, natural floodplain function.	• Tier 1: 1.01, 1.02, 1.03, 1.04, 1.05, 1.06, 1.07, 1.08, 1.09, 1.16 • Tier 2: 2,06, 2.08, 2.09 • Tier 3: 3.01, 3.02, 3.08, 3.09
Increase access to quality habitat.	• Tier 1: 1.01, 1.06, 1.09, 1.19, 1.23 • Tier 2: 2.12 • Tier 3: 3.06
Increase riparian cover.	• Tier 1: 1.01, 1.02, 1.03, 1.07, 1.16 • Tier 2: 2.09 • Tier 3: 3.02
Increase river channel complexity and naturalize channelized streams.	• Tier 1: 1.01, 1.02, 1.03, 1.04, 1.06, 1.09, • Tier 2: 2.12 • Tier 3: n/a
Restore a natural sediment transport regime.	• Tier 1: 1.01, 1.02, 1.03, 1.06, 1.09, 1.19, 1.22, 1.23 • Tier 2: n/a

Desired Future Condition	Strategy #s
	• Tier 3: 3.01, 3.12, 3.17
Meet TMDL targets.	• Tier 1: 1.01, 1.02, 1.03, 1.06, 1.07, 1.08, 1.16, 1.17, 1.18, 1.22 • Tier 2: 2.04, 2.13, 2.15, 2.16, 2.17 • Tier 3: 3.01, 3.02, 3.03, 3.04, 3.05, 3.11, 3.12, 3.14, 3.16
Increase critical fish species population and abundance levels necessary to meet delisting criteria, support sustainable natural production, and provide a fishery for Tribes and the community	• Tier 1: 1.01, 1.02, 1.04, 1.06, 1.07, 1.08, 1.09 1.1, 1.11, 1.19, 1.23 • Tier 2: 2.01, 2.14 • Tier 3: 3.06, 3.1, 3.13
Water Supply, Streamflows, & Groundwater	
Build resiliency and redundancy in water supply to meet current and future water demand.	• Tier 1: 1.02, 1.03, 1.03, 1.04, 1.05, 1.08, 1.1, 1.11, 1.12, 1.13, 1.15, 1.18, 1.2 • Tier 2: 2.01, 2.02, 2.03, 2.04, 2.05, 2.06, 2.07, 2.1, 2.11 • Tier 3: 3.03, 3.04, 3.07, 3.09, 3.1, 3.11, 3.16
Stabilize aquifer levels to support water resources and water for people and farms.	• Tier 1: 1.01, 1.02, 1.03, 1.04, 1.05, 1.12, 1.13, 1.17, 1.21 • Tier 2: 2.01, 2.02, 2.04, 2.07 • Tier 3: 3.05, 3.15
Enhance instream flows to meet instream flow targets for critical species where possible.	• Tier 1: 1.01, 1.02, 1.04, 1.05, 1.08, 1.11, 1.12, 1.13, 1.15, 1.18, 1.2, 1.23 • Tier 2: 2.01, 2.02, 2.03, 2.04, 2.07, 2.1, 2.19 • Tier 3: 3.01, 3.04, 3.06, 3.07, 3.1, 3.13
Increase natural infiltration, acreage, and duration of inundation.	• Tier 1: 1.01, 1.02, 1.03, 1.05, 1.06, 1.07, 1.16, 1.17 • Tier 2: 2.01, 2.06 • Tier 3: 3.01, 3.05, 3.08
Land Use & Flood Control	
Reduced flood risk for people and cities.	• Tier 1: 1.01, 1.05, 1.07, 1.16 • Tier 2: 2.01, 2.05, 2.06, 2.08, 2.09 • Tier 3: 3.02, 3.03, 3.09
Create climate resilience for basin water resources.	• Tier 1: 1.01, 1.02, 1.03, 1.04, 1.05, 1.08, 1.1, 1.11, 1.12, 1.13, 1.15, 1.16 • Tier 2: 2.01, 2.02, 2.03, 2.05, 2.06, 2.08, 2.09, 2.1, 2.11 • Tier 3: 3.02, 3.03, 3.07, 3.1, 3.11
Quality of Life	
Sustain and improve quality of life in the Walla Walla Valley	• Tier 1: 1.01, 1.02, 1.03, 1.04, 1.05, 1.06, 1.07, 1.09, 1.1, 1.11, 1.12, 1.13, 1.17, 1.18, 1.19, 1.21, 1.22, 1.23 • Tier 2: 2.01, 2.02, 2.03, 2.04, 2.05, 2.07, 2.08, 2.09, 2.11, 2.12, 2.15, 2.16, 2.17

Desired Future Condition	Strategy #s
	• Tier 3: 3.01, 3.02, 3.08, 3.15
Monitoring & Metering	
Increase streamflow, habitat, and water use monitoring to support better water resource management and adaptive management.	• Tier 1: 1.1, 1.11, 1.15, 1.2, 1.21, 1.23 • Tier 2: 2.03, 2.05, 2.13, 2.14, 2.18 • Tier 3: 3.03, 3.04, 3.05, 3.06, 3.14, 3.18

APPENDIX F. COMMENT SUMMARY

The Consulting Team developed and distributed a Formal Draft of the WWW2050 Plan for SPAC, WG, and public review in May 2021. In total, there were 167 comments submitted on the Formal Draft. The tables below summarize the comments received.

Table 58: Summary of Comments by Entity

Entity	Number of comments
CTUIR	24
Ecology	16
Ecology (Water Quality)	3
Ecology, Water Quality Program	5
Little Walla Walla Rivers Working Group	13
NMFS	34
OWRD	2
Source Water Protection Program, Office of Drinking Water, Washington State Department of Health	11
Walla Walla County Conservation District	44
Washington State Department of Health	11
No Entity Noted	4
Total Comments	167

Table 59: Summary of Comment Categories and Actions Taken

Comment Categories	Number of comments	Action Taken	Action Not Taken	Why no action?
Addition of text - Clarity or Context	31	27	4	Plan amendments were not needed but will be taken into consideration in Phase 2. *See Chapter 6: WWW2050 Phase II for more information.*
Minor Revisions	109	108	1	
Addition of text - Clarity or Context	16	16	0	
Revision of text - Clarity or Context	54	54	0	
Formatting	17	16	1	External graphic, unable to edit.
Typo	22	22	0	
N/A - No Edit Requested	10	0	10	No edit requested.

Comment Categories	Number of comments	Action Taken	Action Not Taken	Why no action?
Revise Graph or Table Request	2	2	0	
Revision of text - Clarity or Context	15	11	4	Discussed at SPAC and decided to keep original text.
Total Comments	**167**	**148**	**19**	

Summary of Actions Taken

The comments below summarize the actions taken by the Consulting Team to incorporate the edits.

- **Minor Revisions – 109 comments**
    - A majority of the requests for revision fall under the minor revisions category. These requests pertain to typos, formatting, and very minor additions or revisions to text for context and clarity.
    - These requests are straightforward and all but 1 was incorporated in the Final Plan. This edit will not be incorporated because it is an external graphic which is not able to be edited.
- **Addition of text - Clarity or Context – 31 comments**
    - The comments that requested additional text recommended expanding upon existing content to deepen clarity.
    - Examples include defining terms, citing notable programs, referencing additional nuance and context within strategies, and simply expanding or clarifying existing text.
    - All but 4 of the edits will be incorporated in the Final Plan. Plan amendments were not needed at this time but will be taken into consideration in Phase 2.
- **Revision of text - Clarity or Context – 15 comments**
    - Revisions are intended to deepen nuance in strategy, relationship, reporting, and regulation.
    - There were 4 suggested revisions to strategies that were not incorporated in the Final Plan. These suggested revisions were discussed at the May SPAC meeting and the SPAC decided to keep the original text.
- **No Edit Requested – 10 comments**
    - There were 10 comments that did not have an edit associated with them. The comments were affirmative sentences, compliments, or encouragement for the direction of the content.
    - Examples: "Figure 6 very clear. Good job." "Very comprehensive and clear flood section. Good job."

Works Cited

[1] Walla Walla Watershed Planning Unit; Walla Walla Basin Watershed Council, "Walla Walla Subbasin Plan - May 2004," Northwest Power and Conservation Council, Spokane, WA, 2004.

[2] Bonneville Power Administration, "Walla Walla River Basin Fish Habitat Enhancement Project," December 2005. [Online]. Available: http://docs.streamnetlibrary.org/BPA_Fish_and_Wildlife/00006414-3.pdf.

[3] HDR/EES, Dr. Michael Barber, and Steward and Associates, Inc., "Walla Walla Watershed Plan - Planning Unit Final," Pasco, WA, 2005.

[4] Washington Office of Financial Management, "Growth Management Act population projections for counties: 2010 to 2040," January 2018. [Online]. Available: https://ofm.wa.gov/washington-data-research/population-demographics/population-forecasts-and-projections/growth-management-act-county-projections/growth-management-act-population-projections-counties-2010-2040-0. [Accessed 24 June 2021].

[5] Portland State University, "Coordinated Population Forecast, 2019 through 2069," 2019.

[6] A. Suljic, "Walla Walla Country Profile," 2020. [Online]. Available: https://esdorchardstorage.blob.core.windows.net/esdwa/Default/ESDWAGOV/labor-market-info/Libraries/Regional-reports/County-Profiles/Walla%20Walla%20County%20Profile_2020.pdf.

[7] US Army Corps of Engineers, "Mill Creek Dam and Bennington Lake," [Online]. Available: https://www.nww.usace.army.mil/Locations/District-Locks-and-Dams/Mill-Creek-Dam-and-Bennington-Lake/.

[8] Walla Walla Basin Watershed Council, "Little Walla Walla River Assessment and Initial Action Plan," WWWBC, Milton-Freewater, 2010.

[9] W. S. D. o. Ecology, "Water Rights," [Online]. Available: https://ecology.wa.gov/Water-Shorelines/Water-supply/Water-rights. [Accessed January 2021].

[10] Confederated Tribes of the Umatilla Indian Reservation, "NAAP-TAP Proposal," 2020. [Online].

[11] Washington Department of Ecology, "Completed Adjudications in Washington," [Online]. Available: https://apps.ecology.wa.gov/publications/documents/1911073.pdf.

[12] US Supreme Court, "Washington v. Oregon, 297 U.S. 517 (1936)," 1936. [Online]. Available: https://supreme.justia.com/cases/federal/us/297/517/.

[13] Stillwater Sciences, "Walla Walla River Ecological Flows - Recommended Stream Flows to Support Fisheries Habitat & Floodplain Function," Confederated Tribes of the Umatilla Indian Reservation, Pendleton, OR, 2013.

[14] US Geological Survey, "Walla Walla Groundwater," [Online]. Available: https://www.usgs.gov/centers/wa-water/science/walla-walla-groundwater?qt-science_center_objects=0#qt-science_center_objects.

[15] Walla Walla Watershed Management Partnership, "Backstory," [Online]. Available: https://www.wallawallawatershed.org/backstory.

[16] Snake River Salmon Recovery, "Recovery Planning," [Online]. Available: https://snakeriverboard.org/recovery-planning/.

[17] US Army Corps of Engineers, "Fish Programs," [Online]. Available: https://www.nww.usace.army.mil/Missions/Fish-Programs/.

[18] The City of Walla Walla, "Water System," Febraury 2016. [Online]. Available: https://www.wallawallawa.gov/home/showdocument?id=854. [Accessed 20 July 2020].

[19] F. Nicholson and K. Bealey, *City of Walla Walla Water System Data Request Via Email,* The City of Walla Walla, 2020.

[20] W. W. C. C. District, *Conservation Reserve Enhancement Program (CREP) 2019 Update,* 2019.

[21] W. W. C. C. District, *Creating Urban Riparian Buffers (CURB),* 2020.

[22] R. Henry, K. Lindsey, B. Wolcott, S. Patten and T. Baker, "Walla Walla Basin Aquifer Recharge Strategic Plan," Walla Walla Basin Watershed Counsil, Milton-Freewater, 2013.

[23] M. Cobb, "Oregon Walla Walla Basin Aquifer Recharge Report (Water Year 2019)," Walla Walla Basin Watershed Council, Milton-Freewater, OR, 2020.

[24] L. Doremus, *Walla Walla Aquifer Recharge Water quality Report Review,* Milton-Freewater: Walla Walla Basin Watershed Counsil, 2020.

[25] S. Patten, "Washington Walla Walla Basin Aquifer Recharge Report," Walla Walla Basin Watershed Council, Walla Walla, 2017.

[26] W. W. B. W. Council, "Walla Walla Basin Irrigation Efficiency and Conserved Water Projects: September 2018 Update," September 2018. [Online].

[27] Oregon Water Resources Department, "2020 Instream Accomplishments," 2020. [Online]. Available: https://www.oregon.gov/OWRD/programs/WaterRights/IS/FlowRestoration/Tools/Documents/InstreamAccomplishments.pdf.

[28] C. Kowitz, "Options for Instream Protection in Oregon," Oregon Water Resources Department , 2018.

[29] T. Baker, "2013 Walla Walla Basin Seasonal Seepage Assessments Report," Walla Walla Basin Watershed Council, Walla Walla, 2013.

[30] Walla Walla Basin Watershed Council, "Walla Walla Basin Habitat Conservation Plan," [Online]. Available: http://www.wwbwc.org/images/Projects/Assessments/HCP/HCP_Overview.pdf. [Accessed 4 September 2020].

[31] Washington State Legislature, "Surface and groundwater closed to further consumptive appropriations," 2007. [Online]. Available: https://apps.leg.wa.gov/wac/default.aspx?cite=173-532-040. [Accessed 11 January 2021].

[32] Oregon Water Resources Department, "Water Availability Analysis," 11 January 2021. [Online]. Available: https://apps.wrd.state.or.us/apps/wars/wars_display_wa_tables/display_wa_table.aspx?ws_id=223&exlevel=80&scenario_id=1. [Accessed 11 January 2021].

[33] Washington State Legislature, "Chapter 173-532 WAC - Water Resources Program for the Walla Walla River Basin, WRIA-32," August 2007. [Online]. Available: https://apps.leg.wa.gov/wac/default.aspx?cite=173-532. [Accessed 4 September 2020].

[34] US Federal Emergency Management Agency, "Flood Insurance Study for Walla Walla County," 18 January 2002. [Online].

[35] US Federal Emergency Management Agency, "Flood Insurance Study for Umatilla County, Oregon and Incorporated Areas," 3 September 2010. [Online].

[36] US Geologic Survey, "National Water Information System," [Online]. Available: https://nwis.waterdata.usgs.gov/nwis.

[37] US Federal Emergency Management Agency, "Flood Insurance Study for Columbia County, Washington and Incorporated Areas," 19 July 2000. [Online].

[38] Silver Jackets, "Washington Silver Jackets," [Online]. Available: https://silverjackets.nfrmp.us/State-Teams/Washington.

[39] M. Mastin, C. Konrad, A. Veilleux and A. Tecca, "Magnitude, frequency, and trends of floods at gaged and ungaged sites in Washington, based on data through water year 2014," U.S. Geological Survey, 2016.

[40] A. Amonette, "Touchet River Mile 42.5 Assessments Project," Washington Recreation and Conservation Office (RCO), Richland, WA, 2009.

[41] Snake River Salmon Recovery Board, "Snake River Salmon Recovery Plan for Southeastern Washington," Washington Governor's Salmon Recovery Office, Olympia, WA, 2011.

[42] K. Baldwin, D. Gray and J. Jones, "Walla Walla Watershed PCBs, Chlorinated Pesticides, Fecal Coliform, Temperature, pH & Dissolved Oxygen Total Maximum Daily Load - Water Quality Implementation Plan," WA Department of Ecology, Spokane, WA, 2008.

[43] WA Department of Ecology, "Walla Walla County - Water quality improvement projects," WA Department of Ecology, [Online]. Available: https://fortress.wa.gov/ecy/ezshare/wq/WaterQualityImprovement/TMDL/WallaWallaCounty.htm. [Accessed 25 August 2020].

[44] OR Department of Environmental Quality, "Total Maximum Daily Loads - Umatilla Basin," OR Department of Environmental Quality, [Online]. Available: https://www.oregon.gov/deq/wq/tmdls/Pages/TMDLs-Umatilla-Basin.aspx. [Accessed 25 August 2020].

[45] Washington State Department of Ecology , "Walla Walla River Basin pH and Dissolved Oxygen TMDL Water Quality Improvement Report," June 2017.

[46] Washington State Department of Ecology, "A Total Maximum Daily Load Evaluation for Chlorinated Pesticides and PCBs in the Walla Walla River," October 2004. [Online]. Available: https://apps.ecology.wa.gov/publications/documents/0403032.pdf.

[47] D. Butcher and B. Bower, Walla Walla Subbasin Stream Temperature Total Maximum Daily Load and Water Quality Management Plan, Pendleton, OR: Oregon Department of Environmental Quality, August 2005.

[48] Walla Walla Basin Watershed Council, "Water Year 2020 Oregon Walla Walla Basin Aquifer Recharge Report," Walla Walla Basin Watershed Council, Milton-Freewater, Oregon, 2021.

[49] B. Drost, K. Whiteman and J. Gonthier, "Geologic Framework of the Columbia Plateau Aquifer System, Washington, Oregon, and Idaho," U.S. Geological Survey, Portland, OR, 1990.

[50] R. Newcomb, "Geology and ground-water resources of the Walla Walla River basin Washington-Oregon," Washington Department of Conservation, Olympia, WA, 1965.

[51] Oregon Water Resources Department, "Groundwater Information System Mapping Tool," [Online]. Available: https://apps.wrd.state.or.us/apps/gw/gw_info/gw_map/Default.aspx. [Accessed 6 May 2021].

[52] B. Wolcott, "Little Walla Walla River Assessment and Initial Action Plan," Walla Walla Basin Watershed Council, Milton-Freewater, OR, 2010.

[53] Oregon Water Resources Department, "Search Groundwater Information System," [Online]. Available: https://apps.wrd.state.or.us/apps/gw/gw_info/gw_info_report/gw_search.aspx. [Accessed 6 May 2021].

[54] Oregon Secretary of State, "Water Resources Department - Chapter 690," Oregon Secretary of State, [Online]. Available: https://secure.sos.state.or.us/oard/viewSingleRule.action%3BJSESSIONID_OARD=153rSBStgF0ir0AFVhu_w1QsAG0IjIEKlNP71LAY1sYsQ4E9GXEP%21-1485036647?ruleVrsnRsn=241232. [Accessed 1 December 2020].

[55] J. (. W. R. D. Woody, *Personal Communication,* 2020.

[56] S. (. o. M.-F. Patten, *Personal Communication,* 2020.

[57] C. van Stolk, "Evaluation of Compartmentalized Aquifers in the Walla Walla Subbasin of Oregon Using Isotopic and Geochemical Tracers," Oregon State University, Corvallis, OR, 2019.

[58] U.S. Fish & Wildlife Service, "Environmental Conservation Online System: Bull Trout (Salvelinus Confluentus)," [Online]. Available: https://ecos.fws.gov/ecp0/profile/speciesProfile?spcode=E065. [Accessed 20 July 2020].

[59] Columbia Basin Partnership Task Force of the Marine Fisheries Advisory Committee, "A Vision for Salmon and Steelhead: Goals to Restore Thriving Salmon and Steelhead to the Columbia River Basin Phase 1 Report," May 2019. [Online].

[60] M. G. Barrows, R. C. Koch and B. P. Silver, "North Fork Walla Walla River Bull Trout Occupancy and Habitat Use Assessment," U.S. Fish & Wildlife Service, Columbia River Fisheries Program Office, Vancouver, WA, 2014.

[61] Walla Walla Watershed Flow Study Steering Committee, "Walla Walla Basin Integrated Flow Enhancement Study," Washington State Department of Ecology - Office of Columbia River, Olympia, WA, 2017.

[62] Northwest Power and Conservation Council, "Walla Walla Subbasin Plan," 28 May 2004. [Online].

[63] National Marine Fisheries Service , "Conservation and Recovery Plan for Oregon Steelhead Populations in the Middle Columbia River Steelhead District Population Segment.," 2010.

[64] Tetra Tech, "Lower Mill Creek Final Habitat and Passage Assessment and Strategic Action Plan," Confederated Tribes of the Umatilla Indian Reservation, Walla Walla, WA, 2017.

[65] Oregon Department of Agriculture, "Walla Walla Agricultural Water Quality Management Area Plan," OR Department of Ag - Water Quality Program, Salem, 2020.

[66] Washington Deptartment of Revenue and Employment Security, "http://www.wagrown.com/agriculture-map," 2013. [Online].

[67] United States Department of Agriculture, "Agriculture Census: Oregon State and County Data," 2017.

[68] R. M. (. Cooper, "Determining Surface Water Availability in Oregon," State of Oregon Water Resources Department, Salem, OR, 2002.

[69] W. B. B. a. D. Morgan, "Economic Impact of the Walla Walla Wine Industry," April 2019. [Online]. Available: https://www.wallawallawine.com/wp-content/uploads/2019/05/Economic-Impact-of-WW-Wine-Industry-April-2019.pdf.

[70] Walla Walla Basin Watershed Council, "Walla Walla Basin Habitat Conservation Plan," 2001-2008. [Online]. Available: http://www.wwbwc.org/assessment/55-ww-hcp.html. [Accessed 4 September 2020].

[71] F. Nicolson, *Personal Communication,* 2020.

[72] City of Walla Walla, "Wastewater," [Online]. Available: https://www.wallawallawa.gov/government/public-works/wastewater. [Accessed 27 August 2020].

[73] The City of Milton-Freewater, "Wastewater," [Online]. Available: https://www.mfcity.com/publicworks/page/wastewater. [Accessed 27 August 2020].

[74] WA Department of Ecology, "Water and Shorelines - Groundwater permit exemption," [Online]. Available: https://ecology.wa.gov/Water-Shorelines/Water-supply/Water-rights/Groundwater-permit-exemption. [Accessed 20 July 2020].

[75] Earth Economics, "Economic Analysis of Outdoor Recreation in Washington State," 2015. [Online]. Available: https://www.tre.wa.gov/wp-content/uploads/Willhite.pdf.

[76] K. V. R. e. al., "Decline of the North American Avifauna," *Science,* vol. 366, no. 6461, pp. 120-124, 2019.

[77] K. S. e. al., "Working Paper No. 8: The Economic Impact of the Wine Industry on Hotels and Restaurants in Walla Walla," 2007. [Online]. Available: https://www.whitman.edu/Documents/Academics/Economics/Working%20Paper%20Contents/WP_08.pdf.

[78] W. S. Legislature, "The Growth Management Act," 1990. [Online]. Available: https://apps.leg.wa.gov/RCW/default.aspx?cite=36.70a. [Accessed March 2021].

[79] W. D. o. Ecology, "Shoreline Master Programs," [Online]. Available: https://ecology.wa.gov/Water-Shorelines/Shoreline-coastal-management/Shoreline-coastal-planning/Shoreline-Master-Programs. [Accessed 22 March 2021].

[80] J. Bader, *Eastern Washington Phase II Municipal Stormwater Permit,* Walla Walla, 2021.

[81] T. C. T. o. t. U. I. Reservation, "Lower Mill Creek Final Habitat and Passage Assessment and Strategic Action Plan," 2017.

[82] O. D. o. Forestry, "Forest Practices Act," [Online]. Available: https://www.oregon.gov/ODF/Working/Pages/FPA.aspx. [Accessed 22 March 2021].

[83] U. C. D. o. L. U. Planning, "Umatilla County Comprehensive Plan," Pendleton, 2018.

[84] W. B. Consulting, "Columbia County Comprehensive Plan Update," Dayton, 2019.

[85] C. o. W. Walla, "Walla Walla County Comprehensive Plan," 2019.

[86] O. C. Strategy, "Wetlands," 2021. [Online]. Available: https://www.oregonconservationstrategy.org/strategy-habitat/wetlands/. [Accessed 22 March 2021].

[87] J. Sikes, *Walla Walla 2050 Land Use Working Group,* Walla Walla, 2021.

[88] Walla Walla Watershed Planning Unit, "Walla Walla Watershed Plan," May 2005. [Online].

[89] Environmental Work Group, "Environmental Working Group Conservation Database," [Online].

[90] J. Bader, Writer, *Eastern Washington Phase II Municipal Stormwater Permit.* [Performance].

[91] Columbia County, "Shorelines Master Program," [Online]. Available: https://www.columbiaco.com/434/Shorelines-Master-Program.

[92] Z. Napkora, Writer, *Forest Management and Hydrologic Function of Watersheds.* [Performance].

[93] O. D. J. M. T. M. B. S. B. I. C. A. D. R. D. K. E. F. E. J. G. Y. H. S. M. A. P. S. S. A. T. R. W. a. G. Z. Hoegh-Guldberg, "Impacts of 1.5ºC Global Warming on Natural and Human Systems. In: Global Warming of 1.5°C. An IPCC Special Report.," Intergovernmental Panel on Climate Change, 2018.

[94] P. W. Mote, "Trends in temperature and precipitation in the Pacific Northwest during the twentieth century," *Northwest Science,* vol. 77, no. 4, pp. 271-282, 2003.

[95] A. K. Snover, G. S. Mauger, L. C. Whitely Binder, M. Krosby and I. Tover, "Climate Change Impacts and Adaptation in Washington State: Technical Summaries for Decision Makers. State of Knowledge Report prepared for the Washington State Department of Ecology," College of the Environment, University of Washington, Seattle, 2013.

[96] E. Bush, "Think it's hot now? Here's what climate models say about the future of the Pacific Northwest," 7 August 2017. [Online]. Available: https://www.seattletimes.com/seattle-news/environment/think-its-hot-now-heres-what-climate-models-say-about-the-future-of-the-pacific-northwest/. [Accessed 14 April 2021].

[97] "Columbia River Basin Long-Term Water Supply and Demand Forecast, 2016 Legislative Report," Department of Ecology State of Washington, Union Gap, 2016.

[98] C. F. Clifton, K. T. Day, C. H. Luce, G. E. Grant, M. Safeeq, J. E. Halofsky and B. P. Staab, "Effects of climate change on hydrology and water resources in the Blue Mountains, Oregon, USA," *Climate Services,* vol. 10, pp. 9-19, 2018.

[99] L. A. Westerling, "Increasing western US forest wildfire activity: Sensitivity to changes in the timing of spring," Philosophical Transactions of The Royal Society B Biological Sciences, 2016.

[100] J. T. Abatzoglou, C. S. Juang , P. A. Williams , C. A. Kolden and A. L. Westerling, "Increasing Synchronous Fire Danger in Forests of the Western United States," 2020.

[101] J. S. Littell, E. Oneil, J. A. Hicke and D. McKenzie, "Forest ecosystems, disturbance, and climatic change in Washington State, USA," Climatic Change , 2010.

[102] Department of Ecology , "Water supplies & climate change," [Online]. Available: https://ecology.wa.gov/Air-Climate/Climate-change/Climate-change-the-environment/Water-supply-impacts.

[103] I. e. a. 2. Stewart, "Changes toward earlier streamflow timing across western North America.," Journal of Climate, 2005.

[104] C. L. J. C. M. C. J. C. M. D. S. L. G. M. P. M. A. P. G. R.-M. a. E. Y. C., "Northwest. In Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II," U.S. Global Change Research Program, Washington, DC, 2018.

[105] C. LeValley, "Flood damage recovery continues in Columbia County," Walla Walla Union-Bulletin, 11 March 2020. [Online]. Available: https://www.union-bulletin.com/news/local_governments/columbia_county/flood-damage-recovery-continues-in-columbia-county/article_37d5f77d-a8e0-55af-9a92-1c023fa7f5f1.html. [Accessed 14 April 2021].

[106] Washington Post-Wildfire Flood Committee, "After-the-Fire guide for Washington communities," Washington Post-Wildfire Flood Committee, [Online]. Available: https://afterthefirewa.org. [Accessed 16 June 2021].

[107] C. B. E. C. K. e. a. Talbot, "The impact of flooding on aquatic ecosystem services.," Biogeochemistry 141 , 2018.

[108] E. P. Agency, "Wildfires: How Do They Affect Our Water Supplies?," 2019.

[109] "Statewide Groundwater Quality Monitoring Program: Walla Walla Basin 2020," State of Oregon Department of Environmental Quality, 2020.

[110] U. EPA, "Climate Change Indicators in the United States: Stream Temperature," U.S. EPA, 2016.

[111] "Wildfire information," Washington State Department of Ecology, [Online]. Available: https://ecology.wa.gov/Air-Climate/Air-quality/Smoke-fire/Wildfire. [Accessed 14 April 2021].

[112] "Effects of Heat: Climate and Human Health," National Institute of Environmental Health Sciences, 2017. [Online]. Available: https://www.niehs.nih.gov/research/programs/geh/climatechange/health_impacts/heat/index

.cfm#:~:text=Prolonged%20exposure%20to%20extreme%20heat,%2C%20cerebral%2C%20and%20cardiovascular%20diseases.. [Accessed 14 April 2021].

[113] USGCRP, "Climate Science Special Report: Fouth National Climate Assessment, Volume 1," U.S. Global Change Research Program, Washington, D.C., 2017.

[114] K. L. Jones, G. C. Poole, E. J. Quaempts, S. O'Daniel and T. Beechie, "The Umatilla River Vision," Confederated Tribes of the Umatilla Indian Reservation Department of Reservation, Pendleton, OR, 2008.

[115] M. Cobb, "Milton-Freewater Aquifer Storage and Recovery Feasibility Study Supplemental Requirements," Walla Walla Basin Watershed Council, Milton-Freewater, OR, 2019.

[116] Confederated Tribes of the Umatilla Indian Reservation, "A Brief History of CTUIR: Background Information on Our People," [Online]. Available: https://ctuir.org/about/brief-history-of-ctuir/.

[117] Blue Mountain Land Trust, "Our Story," [Online]. Available: https://bmlt.org/our-story.

[118] Blue Mountain Land Trust, "Conservation 2020/2024: Land Protection Plan of the Blue Mountain Land Trust," [Online]. Available: https://static1.squarespace.com/static/5504d100e4b08eb858c4e8fc/t/5ebeef2f45743a48c00501c4/1589571417256/Conservation+Plan+2020-2024+WEB+051520.pdf.

[119] K. S. e. al., "Working Paper No. 8: The Economic Impact of the Wine Industry on Hotels and Restaurants in Walla Walla," Summer 2007. [Online]. Available: https://www.whitman.edu/Documents/Academics/Economics/Working%20Paper%20Contents/WP_08.pdf.

[120] Oregon Department of Agriculture, "Walla Walla Agricultural Water Quality Management Area Plan," January 2020. [Online]. Available: https://www.oregon.gov/ODA/shared/Documents/Publications/NaturalResources/WallaWallaAWQMAreaPlan.pdf.

[121] City of Walla Walla, "Water System Plan," March 2020. [Online].

[122] Walla Walla Basin Watershed Council, "Walla Walla Basin Seasonal Seepage Assessments Report," Walla Walla Basin Watershed Council, Milton-Freewater, OR, 2017.

[123] W. W. B. W. Council, "Walla Walla Basin Irrigation Efficiency and Conserved Water Projects," Walla Walla Basin Watershed Council, September 2018.

[124] Walla Wala Watershed Management Partnership and the Washington , "Walla Walla Pilot Local Water Management Program Legislative Repot to Implement 2SSB 5352," 2020.

[125] W. W. W. M. Partnership, "Walla Walla Pilot Local Water Management Program Final Progress Report," 2018.

[126] Walla Walla Watershed Flow Study Steering Committee, Walla Walla River Bi-State Flow Study, Spokane, WA: WA Department of Ecology, December 2019.

[127] United States Census Bureau, "Umatilla Countu, Oregon; Walla Walla County, Washington," [Online]. Available: https://www.census.gov/quickfacts/fact/table/umatillacountyoregon,wallawallacountywashington/PST045219. [Accessed 20 July 2020].

[128] WA Department of Ecology, "Protecting Stream Flows," [Online]. Available: https://ecology.wa.gov/Water-Shorelines/Water-supply/Protecting-stream-flows. [Accessed 3 May 2021].

[129] W. W. C. C. District, *Conservation Reserve Enhancement Program (CREP) 2019 Update*, 2019.

[130] Portland State University, "Population Forecasts," 2019. [Online]. Available: https://www.pdx.edu/population-research/population-forecasts. [Accessed 24 June 2021].