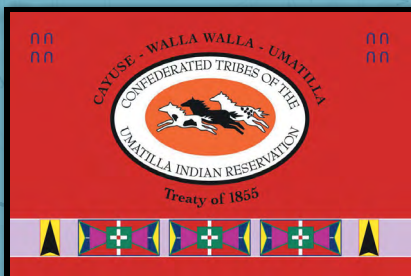


Lower Mill Creek Final Habitat and Passage Assessment and Strategic Action Plan

JUNE 2017



*The Confederated Tribes of the
Umatilla Indian Reservation*

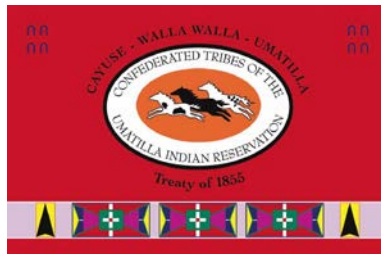


TETRA TECH

Lower Mill Creek

Final Habitat and Passage Assessment and Strategic Action Plan

Submitted to:



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Acronyms and Abbreviations

°C	degree Celsius
Accords	Columbia Basin Fish Accords
ACS	American Community Survey
ADD	average daily demands
ASR	Aquifer Storage and Recovery
Assessment	Lower Mill Creek Habitat and Passage Assessment
BA	Biological Assessment
bgs	below ground surface
BiOp	biological opinion
BPA	Bonneville Power Administration
CAP	continuing authority program
cfs	cubic feet per second
City Comp Plan	City of Walla Walla Comprehensive Plan
County Comp Plan	Walla Walla County Comprehensive Plan
CRWE	Columbia River Water Exchange
CTUIR	Confederated Tribes of the Umatilla Indian Reservation
CURB	Creating Urban Riparian Buffers
DNR	CTUIR Department of Natural Resources
DPS	distinct population segment
E&W Act	Energy and Water Development Appropriations Act
EA	Environmental Assessment
EC	Executive Committee
Ecology	Washington Department of Ecology
EDT	Ecosystem Diagnosis and Treatment
EIM	Environmental Information Management
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FCRPS	Federal Columbia River Power System
FEMA	Federal Emergency Management Agency

FMO	foraging, migration, and overwintering
FY	Fiscal Year
GI	General Investigations
GIS	Geographic Information System
GMA	Growth Management Act
HEC-RAS	Hydrologic Engineering Centers River Analysis System
HQUSACE	Headquarters U.S. Army Corps of Engineers
HUC	Hydrologic Unit Code
IRRM	interim risk reduction measure
IWFM	Integrated Water Flow Model
km	kilometer
LWD	large woody debris
MAR	Managed Aquifer Recharge
MCFCP	Mill Creek Flood Control Project
MCFCZD	Mill Creek Flood Control Zone District
Mid-C	Middle Columbia River
MDD	maximum daily demands
mph	mile per hour
MSL	mean sea level
NFIP	National Flood Insurance Program
ng/L	nanogram per liter
NMFS	National Oceanic and Atmospheric Administration – National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NWI	National Wetland Inventory
ODEQ	Oregon Department of Environmental Quality
OHWM	ordinary high water mark
PAS	Planning Assistance to States
PCB	polychlorinated biphenyl

PED	Preconstruction, Engineering, and Design
PFD	percent of floodplain disconnected
Project	Lower Mill Creek Habitat and Passage Assessment and Strategic Action Plan
RCI	river complexity index
RCPP	Regional Conservation Partnership Program
RCW	Revised Code of Washington
River Vision	CTUIR Umatilla River Vision
RM	river mile
ROW	right-of-way
RPA	Reasonable and Prudent Alternative
RUIP	Recovery Unit Implementation Plan
SAP	Strategic Action Plan
SEWMU	Southeast Washington Management Unit
SMA	Shoreline Management Act
SMP	Shoreline Master Programs
SRFB	Salmon Recovery Funding Board
SRSRB	Snake River Salmon Recovery Board
TAC	Technical Advisory Committee
TMDL	Total Maximum Daily Load
UIC	underground injection control
UGA	Urban Growth Area
USACE	U.S. Army Corps of Engineers
U.S.C.	U.S. Code
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WQIP	Water Quality Implementation Plan
WRDA	Water Resources Development Act

WRIA	Water Resource Inventory Area
WRRDA 2014	Waters Resources Reform Development Act of 2014
WSDOT	Washington State Department of Transportation
WWBWC	Walla Walla Basin Watershed Council
WWCC	Walla Walla County Code
WWCCD	Walla Walla County Conservation District
WWMC	Walla Walla Municipal Code
WWRID	Walla Walla River Irrigation District
WWTP	Wastewater Treatment Plant
WWWMP	Walla Walla Watershed Management Partnership

Definitions

Bennington Diversion Dam – located at Mill Creek river mile (RM) 11.4, this dam diverts flood water from Mill Creek into an 1,800-foot-long canal that empties into Bennington Lake. It consists of a concrete dam spillway, low-flow outlet, fish ladder, headworks gates at entrance to Bennington Lake canal, two rotating drum fish screens in one of the four intake gates in the headworks, a levee extending 2,200 feet upstream from the north side of the spillway, and debris barriers in the forebay (USACE 2011a).

Bennington Lake – an off-channel flood storage reservoir covering approximately 52 surface acres when filled at the 1,205-foot elevation “conservation” pool level (the level the U.S. Army Corps of Engineers [USACE] maintains for recreational purposes), with a maximum storage capacity of 8,300 acre-feet. Its depth varies from about 10 to 80 feet. During flood flow diversions, Bennington Lake can be filled to the maximum allowable level of 1,265 feet (or about 225 surface acres); however, the USACE does not allow the lake’s water level to maintain above 1,235 feet for more than 15 days to prevent high hydrostatic pressures from developing at the toe of the Bennington Lake Dam (USACE 2015a). Water can be discharged if the water level rises above 1,212 feet elevation via the intake tower into the Mill Creek Return Channel or the Russell Creek Outflow Channel.

Bennington Lake Dam – a rolled earth-fill structure, 125 feet high, 3,200 feet long, and 20 feet wide at the crest, and 800 feet wide at the base, with a crest elevation of 1,270 feet, located off-channel from Mill Creek and creates Bennington Lake (USACE 2015a).

Distributary– division of stream channels that flow away from the main channel, as on a delta or alluvial fan, usually into a larger stream, lake, or other receiving water body (Armantrout 1998). Distributary streams form when deposition exceeds erosion (Armantrout 1998). A distributary system is composed of mainstem branches, groundwater-fed spring-creeks, and distributary channels (WWBWC 2010a).

Division Works Dam – a water control structure located at Mill Creek RM 10.5 that consists of a fish ladder, headworks, and four vertical lift gates (each 25 feet wide by 2 feet high) that are raised (opened) or lowered (closed) to divert flow from Mill Creek (USACE 2015a) southward through a radial gate and into the 500-foot-long Yellowhawk/Garrison canal for flood control and irrigation purposes (NMFS 2011).

Intake Tower – located in Bennington Lake, the intake tower is used to release water from the lake into the Mill Creek Return Canal and the Bennington Lake outflow channel (USACE

2015a). Outflow gates are located below the top of the tower, the lowest of which is at an invert elevation of 1,187 feet and the outflow elevation of the tower is 1,212 feet (USACE 2015a).

Mill Creek Channel – generally refers to the portion of Mill Creek from RM 4.8 (Gose Street) to RM 11.5 (just past Bennington Diversion Dam). The channel consists of two major channel types—a concrete flume type and a channel-spanning sills or weirs type (Burns et al. 2009). The portion of the channel from RM 4.8 to approximately RM 10.4 (just downstream from the Division Works Dam) is maintained and operated by the Mill Creek Flood Control Zone District. The portion of the channel from RM 10.4 to RM 11.5 (just past the Bennington Diversion Dam) is owned, maintained, and operated by the USACE (USACE 2015a). According to the USACE, the purpose of the Mill Creek Channel is to protect creek banks and increase the capacity of Mill Creek to pass up to 3,500 cubic feet per second (cfs) flows (USACE 2015a).

Mill Creek Return Channel – a 1-mile-long canal composed of various sections of shotcrete-lined open channel, corrugated metal pipe, and unlined (soil) open channel. The channel is designed to discharge up to 190 cfs of flow into Mill Creek just upstream of the Division Works Dam near the USACE project office (USACE 2015a). This return canal is only used when flood diversions have filled Bennington Lake to an elevation above 1,216 feet mean sea level, the last time being in 1997 (USACE 2015a).

Mill Creek Flood Control Project (MCFCP) – includes all structures associated with flood control on Mill Creek from RM 4.8 to RM 11.5 including all levees, mainstem dams, flood diversion system, 612 acres of land and open water including Bennington Lake, and the first 500 feet of distributaries Yellowhawk and Garrison Creeks (USACE 2015a, 2016a). The lower 6 miles of the Mill Creek Channel (RM 4.8 to 10.4) are managed by the Mill Creek Flood Control Zone District and include riprapped levees, channel-spanning weirs, and 2 miles of concrete flume. The remainder of the MCFCP footprint is owned and operated by the USACE (USACE 2015a).

Mill Creek Flood Control Zone District (MCFCZD) – originally established as the Walla Walla County Mill Creek Flood Control District in 1948 but reorganized into the current entity in 1974. It is directed by the Walla Walla County Commissioners and is responsible for the normal operations and maintenance of the non-federal portion of the Mill Creek Channel. The MCFCZD boundary includes 7,994 acres in and near the city of Walla Walla. The MCFCZD boundary includes Mill Creek RM 4.8 to RM 12.1; however, the Mill Creek Channel from RM 10.4 to 11.5 is owned by the USACE and RM 4.8 to 10.4 and 11.5 to 12.1 is maintained by the MCFCZD.

Mill Creek Flume – includes the concrete flume type portion of the Mill Creek Channel, which extends from RM 6.7 to 8.4 through downtown Walla Walla and includes the 1,400-foot underground portion of the channel. The flume is generally 50 feet wide, with vertical concrete walls, and has a 9-foot-wide, low-flow trench (or trenches) with staggered baffles, and either a sloped or horizontal shoulder (overbank area) between the trench and the vertical walls.

Mill Creek Watershed – The Mill Creek watershed (HUC 1707010202) covers 113.7 square miles in southeastern Washington and northeastern Oregon. Mill Creek travels a length of 37.4 miles from its headwaters in the western slopes of the Blue Mountains in the Umatilla National Forest to its confluence with the Walla Walla River. The watershed elevation ranges from 6,250 feet mean sea level (MSL) at the headwaters to 590 feet MSL at the mouth.

Primary Focus Area – the extent of the Project Area that includes the lower Mill Creek corridor from RM 0 to near RM 15 at 7 Mile Bridge, and includes the historical and current distributary system running around and through the urbanized area of Walla Walla, Washington, and includes Russell Creek and its tributaries.

Project Area – the area along Mill Creek from its confluence with the Walla Walla River (RM 0) to its headwaters and including the historical and current distributary system (e.g., Titus, Yellowhawk, Garrison, and Stone creeks).

Russell Creek Outlet Channel – a 7,300-foot-long, concrete-lined, open outlet channel located at the bottom of Bennington Lake Dam with a design discharge capacity of 250 cfs. The outflow channel was constructed to convey emergency flows (flood water storage above 1,216 feet in Bennington Lake) and non-emergency flows (water storage below 1,216 feet) into Russell Creek about 1.25 miles from the dam. The outflow channel was last used for flood diversion in 1996 and is used every November by the USACE to release water from Bennington Lake in order to maintain gate valves in the intake tower. The amount of water released varies and depends on existing flows in Russell Creek (USACE 2015a).

Secondary Focus Area – the extent of the Project Area that extends upstream of RM 15 at the 7 Mile Bridge to the Mill Creek headwaters.

Second Division Works – located approximately 500 feet down the Yellowhawk/Garrison Canal from the Division Works Dam and Mill Creek. It consists of a control structure that divides the flow between Yellowhawk and Garrison creeks. It includes a fish screen on Garrison Creek (installed in 2009) to prevent fish from entering Garrison Creek (USACE 2015a).

Yellowhawk/Garrison Canal – an approximately 480-foot-long conveyance channel that connects flow from the Division Works Dam to the Second Division Works where Yellowhawk and Garrison creeks begin (USACE 2015a).

Executive Summary

PROJECT UNDERSTANDING

“Water was created first, life and land were created next, land promised to take care of all life, all life promised to take care of the land.” (CTUIR 2016a)

For more than 10,000 years, the Walla Walla and Umatilla river peoples, and Cayuse tributary fishermen, shared the Columbia River and its river valleys draining out of the Blue Mountains (CTUIR 2016a). Originally, the Umatilla lived along both sides of the Columbia River downstream of the Walla Walla tribal area, with the Cayuse adjacent to the upper Umatilla, Walla Walla and Grande Ronde rivers (Stem 1998). Several tribes often used some of the same territory, at the same time, for hunting, fishing, and gathering purposes (Dickson 2010). All three of these tribes live by a philosophy called Tamanwit, or Natural Law, which describes the reciprocal responsibility the people have to their traditional foods. The people have the responsibility to respectfully care for, harvest, share, and consume traditional foods, or the foods may be lost as neither can survive without the other (Sampson 2006).

The Walla Walla, Umatilla, and Cayuse people lived, traded, and expanded in the Walla Walla River drainage over the course of time until the 1800s when external forces (European settlement, disease, and other factors) directly impacted Indian economics, politics, and social structure (CTUIR 2016a). Not long after Lewis and Clark traveled through the Walla Walla area in 1806, the fur trade began gathering momentum in the Pacific Northwest. Fort Nez Perce, later known as Fort Walla Walla, was established as a fur trading post in 1818 near the mouth of the Walla Walla River (OHS 2016). Immigrants and missionaries followed, including the founding of the Whitman Mission at Waiilatpu, west of what is now the town of Walla Walla, in 1836 (CTUIR 2016a). The relationships between the Walla Walla, Umatilla, and Cayuse people and settlers were originally peaceful, but overexploitation of resources by the immigrants, the spread of disease, and encroachment on lands by settlers led to conflict, including the killings at the Whitman Mission and the “Cayuse War” of 1847 to 1850 (CTUIR 2016a). To end the conflicts and open the region for immigration, the United States government negotiated treaties to purchase Indian land and move the Walla Walla, Umatilla, and Cayuse people to reservations (CTUIR 2016a).

The Treaty of 1855 (Treaty) was signed between the United States and members of the Walla Walla, Cayuse, and Umatilla people on the banks of Mill Creek six miles above Waiilatpu in the Walla Walla valley on June 9th, near what is now the center of the City of Walla Walla (CTUIR

2016a). This Treaty, and subsequent ratifications by Congress, created the Umatilla Indian Reservation and formed the Confederated Tribes of the Umatilla Indian Reservation (CTUIR). In exchange for the CTUIR ceding over 6.4 million acres of land, the Treaty guaranteed Tribal rights to fish in their traditional and accustomed places, as well as to hunt and gather food and medicines on public lands across the ceded lands (CTUIR 2016a). However, if these fishing, hunting, and gathering rights are to be meaningful, the rivers and floodplains must be ecologically healthy, function naturally, and be capable of sustaining robust communities of native fish, wildlife, and plants. In 2007, the CTUIR Department of Natural Resources (DNR) adopted the River Vision, to protect, restore, and enhance the First Foods – water, salmon, deer, cou, and huckleberry – for the perpetual cultural, economic, and sovereign benefit of the CTUIR (Jones et al. 2008). The First Foods are based on the significant foods ritualistically served in a tribal meal and are the minimum ecological products necessary to sustain CTUIR culture (Quaempts et al. 2014). The First Foods and River Vision (Jones et al. 2008) frameworks create clear links to treaty rights and resources and set direction and goals that relate to preservation of the CTUIR’s culture.

The entire Mill Creek drainage holds ecological and cultural significance to the CTUIR as this system is integral to the CTUIR’s First Foods and River Vision. Although the headwaters of Mill Creek offers excellent habitat and pristine water quality, the lower portions of the Mill Creek drainage residing throughout and downstream of the City of Walla Walla have lost significant channel and floodplain function and no longer provide adequate fish habitat or passage. This is due to decreased flows, physical and thermal barriers, and highly managed creek channels resulting from agricultural development, urbanization, and flood control activities.

Resolving fish passage, restoring fish habitat, maintaining or improving flood protection, and creating economic and community amenities in the lower portions of the Mill Creek drainage will require creative solutions and a system-wide examination of the entire Mill Creek drainage. Returning the lower portions of the Mill Creek drainage to an uncontrolled, completely natural river that floods frequently is not likely feasible due to the flood protection needs of the surrounding community including the City of Walla Walla, part of the City of College Place, and areas of unincorporated Walla Walla County. However, improvements to fish passage and habitat are necessary in order to address Endangered Species Act (ESA)-listed salmonids and Tribal treaty rights. In addition, given the urban context of the lower portions of the Mill Creek drainage, opportunities to create economic and community amenities and to reconnect the urban community to the water and its natural ecosystem must be explored.

LOWER MILL CREEK HABITAT AND PASSAGE ASSESSMENT AND STRATEGIC ACTION PLAN

Over the past two decades, a number of assessments and planning efforts focused on water resources, fish, wildlife, and habitat have been conducted for the lower portions of the Mill Creek drainage, as well as the entire Mill Creek watershed. Multiple agencies and stakeholder groups have implemented various projects to improve fish passage and habitat throughout the Mill Creek watershed. However, existing efforts have been constrained by working only within the current flood control infrastructure and water management, and as a result do not fully resolve fish passage for all life stages, do not provide for spawning, rearing, and migration habitat, and do not meet the goals of the CTUIR First Foods and River Vision (Jones et al. 2008) frameworks. Therefore, the CTUIR initiated this Lower Mill Creek Habitat and Passage Assessment and Strategic Action Plan (the Project) in order to look holistically at the lower portions of the Mill Creek drainage, including the incorporation of previous plans and assessments, and to identify management scenarios that will restore the lost ecological function, enable the exercise of Tribal fishing rights, and meet the community's need for flood control, recreation, and economic value.

Specifically, the Project goal is to:

Make ecologically and physically measurable progress toward fully resolving fish passage, improving fish habitat, and improving the conditions of River Vision touchstones (Jones et al. 2008), while maintaining or improving flood control, recreation, and economic values, and facilitating support among key stakeholders.

The CTUIR has identified a threefold strategy to address this goal:

1. Develop this Assessment of current fish habitat and passage conditions;
2. Develop the Lower Mill Creek Strategic Action Plan (SAP) and system-wide management scenarios that restore fish passage, improve habitat and River Vision touchstones (Jones et al. 2008), maintain or enhance flood control capacity, recreation, and economic values, and address key stakeholder concerns; and
3. Work with key stakeholders to facilitate support for the Lower Mill Creek SAP and to identify immediate, urgent, short-term, and long-term actions for implementation of the plan.

Because of the cultural and ecological importance of Mill Creek, the CTUIR is dedicated to finding a long-term solution for lower Mill Creek that considers the full system context and that

will require a collaborative implementation approach across many organizations and jurisdictions.

WHAT THIS DOCUMENT ACCOMPLISHES

The CTUIR has completed this Assessment and developed a SAP in order to assess existing conditions in the Mill Creek watershed and to use that information to propose actions for improving conditions for fish while maintaining or improving flood control. Sections 1 through 4 of this document comprise the Assessment portion of the Project while Section 5 is the SAP.

The Assessment consolidates all of the existing data, reports, and input from agencies, organizations, and other stakeholders into one resource document, and identifies historic and existing conditions, current problems and opportunities, and possible future conditions of the lower portions of the Mill Creek drainage. Extensive coordination among numerous agencies, organizations, and other stakeholders with vested interests in the welfare of Mill Creek was conducted, and stakeholders were given the opportunity to review the Assessment. Their feedback was integral to the development and finalization of the document.

The SAP provides a high-level strategy for achieving the Project's goal and objectives. A high-level strategy is needed because conceptual system-wide management scenarios that address the Project's objectives must first be identified and evaluated before approaches to resolving specific segment-level issues can be developed and investigated. Also, system-wide management scenarios described in the SAP must focus on long-term strategies and approaches for enhancing ecosystem benefits, recreation, and other objectives while maintaining or enhancing flood control, as a long-range vision is needed to ensure all actions to improve the Mill Creek system are working toward the same goal. However, short-term actions are also identified in the SAP as they are needed to ensure impacts to focal species are mitigated to the extent practicable during the ongoing long-range planning process.

The system-wide scenarios suggested and evaluated in the SAP are conceptual ideas at this stage of planning and are not at the level of constructability. Further analysis of one or more system-wide management scenarios will be needed during any future feasibility studies. Through ongoing collaboration with the stakeholders, it is the CTUIR's intent that this Lower Mill Creek Habitat and Passage Assessment (Assessment) and SAP will 1) inform future decision-making processes in any proposed U.S. Army Corps of Engineers (USACE) Feasibility Study or other technical planning/design vehicle or authority prepared independent of the USACE, and 2) demonstrate that, through an objective-driven evaluation process, certain management scenarios meet multi-use, multi-purpose objectives better than others.

Stakeholders can use the Assessment and SAP to advocate, in a proposed USACE Feasibility Study or other technical planning/design vehicle or authority, that there are more effective ways to manage the Mill Creek system than continuing to address issues through a single focus such as flood control and minimum fish passage criteria.

The SAP does demonstrate that certain management scenarios meet the Project's goal and objectives better than other management scenarios. It is the CTUIR's intent that the work conducted in the Assessment and SAP will help direct the selection of alternatives in the United States Army Corps of Engineers Feasibility Study and provide evidence that there are more effective ways to manage the Mill Creek system than continuing to address issues through any single focus such as flood control and minimum passage criteria.

DOCUMENT ORGANIZATION

The remainder of this document is organized as follows:

- **Section 1** – Identifies the Project goal, objectives, and metrics; describes the Project Area and Assessment process; and establishes the Project context. The Project context subsection goes into further detail regarding the significance of Mill Creek and associated resources, the local jurisdictional framework, and recent and ongoing stream improvement efforts by other entities.
- **Section 2** – Describes the historic and existing conditions of the Project Area, using information provided by existing data and reports.
- **Section 3** – Identifies problems and action opportunities in the Project Area, based on the historic and existing conditions described in Section 2 and that are tied to the Project's goal, objectives, and metrics.
- **Section 4** – Describes physical, jurisdictional, and legal constraints that must be considered when developing system-wide management scenarios for restoration actions.
- **Section 5** – Includes the SAP, a broad-based approach for identifying stakeholder-supported management scenarios that support the Project's goal and objectives.
- **Section 6** – Provides the conclusion of the document.
- **Section 7** – Lists references cited.

1. Introduction

Flowing from the Blue Mountains down to the Walla Walla Valley in southeast Washington, Mill Creek has served as a lifeline for fish and for people since each arrived in the river valley. Before its current confinement by urbanization and flood control infrastructure, Mill Creek flowed in a multi-channel braided pattern across the alluvial plain. Mill Creek is part of a complex alluvial aquifer system that includes a network of distributary channels, mainstem branches, and groundwater-fed spring creeks. This multi-threaded creek system historically supported thriving salmonid fisheries due to its year-round base flows fed by cool groundwater and abundance of off-channel habitat (WWBWC 2004). Wildlife such as beaver, deer, elk, and black bear and plants such as huckleberry and cous were also plentiful in this valley.

Mill Creek and its distributaries hold ecological and cultural significance to the Confederated Tribes of the Umatilla Indian Reservation (CTUIR). The Treaty of 1855 (Treaty) was signed between the United States and members of the Walla Walla, Cayuse, and Umatilla tribes on the banks of Mill Creek in the Walla Walla valley on June 9, near what is now the center of the City of Walla Walla (CTUIR 2016a). This Treaty, and subsequent ratifications by Congress, created the Umatilla Indian Reservation and formed the CTUIR. Through the ceding of over 6.4 million acres of land in exchange for a 510,000-acre reservation¹ in northeast Oregon, the Treaty guaranteed Tribal rights to fish in their traditional and accustomed places, as well as to hunt and gather food and medicines on public lands across the ceded lands (CTUIR 2016a, Trafzer 2016). For these fishing, hunting, and gathering rights to be meaningful, the rivers and floodplains must be ecologically healthy, function naturally, and be capable of sustaining robust communities of native fish, wildlife, and plants.

However, as human settlement increased with the arrival of settlers and the founding of the City of Walla Walla, so did the pressure on Mill Creek to provide water not only for fish but also for agriculture and public consumption. In addition, the flood waters that once flowed freely out over the floodplain now posed a threat to homes, businesses, and infrastructure built along lower Mill Creek. Starting in the 1930s, flood control infrastructure was built to manage these floods and protect the towns, confining or altering lower Mill Creek substantially from its

¹ Although the Umatilla, Walla Walla, and Cayuse tribes reserved 510,000 acres of land to live on under the Treaty of 1855, when the reservation was surveyed, only 245,000 acres were included. Encroachments allowed by the U.S. Congress in the late 1800s further reduced the total acres of the Umatilla Reservation to 172,882 acres, of which 52 percent is in Indian ownership and 48 percent is owned by non-Indians (CTUIR 2016a).

natural condition. While successful in meeting flood management objectives, the physical transformation of lower Mill Creek, in combination with water use withdrawals, has led to degraded and at times lethal stream conditions for fish.

Although upper Mill Creek offers excellent habitat and pristine water quality, the lower portions of the Mill Creek drainage residing throughout and downstream of the City of Walla Walla have lost significant channel and floodplain function and no longer provide adequate fish habitat or passage. This is due to decreased flows, physical and thermal barriers, and highly managed creek channels resulting from agricultural development, urbanization, and flood control activities. The amount of high quality habitat upstream that is currently inaccessible, as well as the rearing and spawning habitat in lower Mill Creek that has been lost, have made the current condition of lower Mill Creek a major regional bottleneck in the restoration of populations of endangered salmonids.

Because of the cultural and ecological importance of Mill Creek, CTUIR is dedicated to finding a long-term solution for lower Mill Creek that considers the full system context and that will require a collaborative implementation approach across many jurisdictions. The CTUIR is undertaking this Lower Mill Creek Habitat and Passage Assessment and Strategic Action Plan (the Project) to assess existing conditions in the Mill Creek watershed (Hydrologic Unit Code [HUC] 1707010202), and to use that information to propose actions for improving conditions for fish while maintaining or improving flood control.

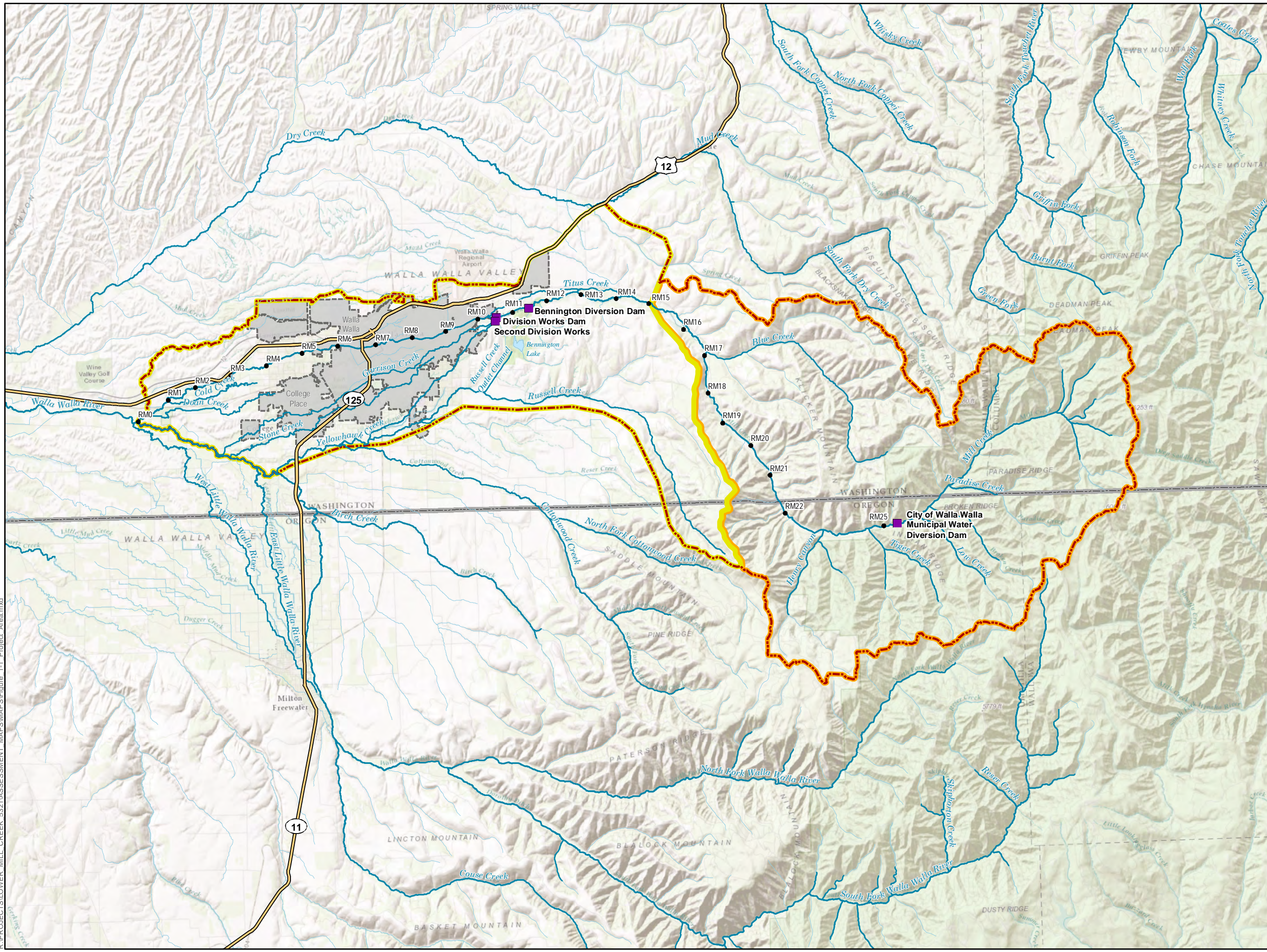
Section 1 through 5 of this document comprise the Assessment portion of the Project while Section 6 is the Strategic Action Plan (SAP). As part of the Assessment, the CTUIR seeks to evaluate and report on historic and existing conditions in the Project Area, including the area along Mill Creek from its confluence with the Walla Walla River (river mile [RM] 0) to its headwaters, and its historic and current tributary system. The Project Area is divided into a Primary Focus Area and Secondary Focus Area. The Primary Focus Area includes the lower Mill Creek corridor from RM 0 to near RM 15 at 7 Mile Bridge, as well as the historic and current tributary system running around and through the urbanized area of Walla Walla, Washington. The Secondary Focus Area includes the upper Mill Creek corridor from the 7 Mile Bridge to the Mill Creek headwaters. Figure 1-1 shows the boundaries of the Project Area, Primary Focus Area, and Secondary Focus Area.

LOWER MILL CREEK HABITAT AND PASSAGE ASSESSMENT

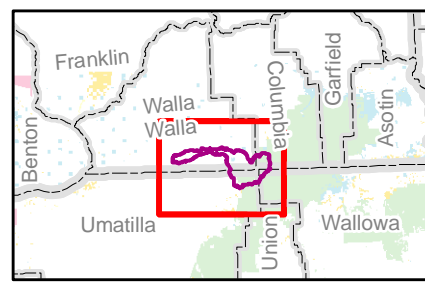
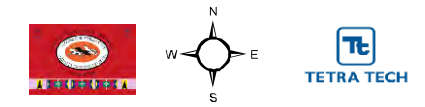
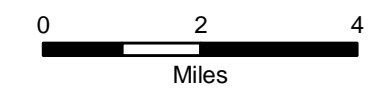
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**FIGURE 1-1
MILL CREEK PROJECT AREA**

- River Miles
- Dam
- Major Stream
- Minor Stream
- Waterbody
- ▭ Project Area
- ▭ Primary Focus Area
- ▭ Secondary Focus Area
- ▭ Cities



Sources: CTUIR, Walla Walla County, StreamNet, USACE



1.1 PROJECT PURPOSE AND NEED

The purpose of the Project is to identify historic and existing conditions, current problems and opportunities, and possible future conditions of Mill Creek in order to fully understand, document, and propose actions to improve fish habitat and passage in lower Mill Creek. The Project's Primary Focus Area has been impacted significantly by agriculture, urbanization, and flood control activities. Fish passage, habitat, and stream flows in Mill Creek are highly compromised, and sections of the flood control infrastructure show evidence of deterioration.

The CTUIR is completing this Assessment to consolidate all of the existing data, reports, and input from agencies, organizations, and other stakeholders into one resource document, and then use the results to develop a SAP (included in Section 6) that can serve as a high-level strategy for achieving the Project's goal and objectives.

CTUIR has identified a threefold strategy to address this need:

1. Develop the Assessment of current fish habitat and passage conditions;
2. Develop the Lower Mill Creek Strategic Action Plan and system-wide management scenarios that restore fish passage, improve habitat and River Vision touchstones (Jones et al. 2008), maintain or enhance flood control capacity, recreation, and economic values, and address key stakeholder concerns; and
3. Work with key stakeholders to facilitate support for the Lower Mill Creek Strategic Action Plan and to identify regulatory and funding pathways for implementation of the plan.

1.2 PROJECT GOAL, OBJECTIVES, AND METRICS

The Project goal is to:

Make ecologically and physically measurable progress toward fully resolving fish passage, improving fish habitat, and improving the conditions of River Vision touchstones (Jones et al. 2008), while maintaining or improving flood control, recreation, and economic values, and facilitating support among key stakeholders.

To support the Project goal, the following objectives were identified for the Project Area:

1. Review and analyze available data related to Project objectives 3 through 8 (below) based on identified metrics and methods that can be utilized to evaluate measurable progress toward achieving the Project goal. Based on reviewing and analyzing available

data, identify data gaps and prioritize those to be filled through collecting additional Project data.

2. Develop conceptual system-wide management scenarios that are integrated into the SAP based on the Assessment that addresses Project objectives 3 through 8. Incorporate River Vision touchstones (Jones et al. 2008) into the conceptual scenarios and identify any reason(s) that the touchstones, and ultimately the CTUIR First Foods Mission, cannot be fully met.
3. Recommend alternatives as part of the conceptual system-wide management scenarios that fully resolve fish passage for focal fish species, including bull trout (*Salvelinus confluentus*), steelhead (*Oncorhynchus mykiss*), spring Chinook salmon (*O. tshawytscha*), and Pacific lamprey (*Entosphenus tridentatus*), and identify opportunities to increase spawning, rearing, and migration habitat for these species by increasing habitat quantity and quality, improving habitat connectivity, and restoring processes that sustainably maintain a diversity of high-quality habitat.
4. Create conceptual system-wide management scenarios using empirical and analytical methods that increase floodplain connectivity supportive of re-establishing natural processes while considering the historic floodplain as well as current flood control and public safety needs.
5. Estimate and evaluate the historic hydrologic patterns and conditions to inform and establish recommended target Mill Creek flows capable of supporting multiple life stages for the focal fish species.
6. Identify opportunities to re-establish natural processes along the Mill Creek corridor by increasing native riparian vegetation and hydrologic connectivity through increased floodplain connectivity and replenishment of the aquifers through water exchange.
7. Create conceptual system-wide management scenarios for natural and economic amenities along the Mill Creek corridor that enhance the community's support, interaction, and understanding of the natural processes, qualities, and characteristics of the corridor through the integration of passive and active open spaces for a range of user groups.
8. Engage with key stakeholders to facilitate support for the SAP and to identify regulatory and funding pathways for implementation of the plan.

These objectives were developed to provide mechanisms for measuring existing conditions, alternatives, and potential outcomes associated with the Project's proposed actions by which the CTUIR can measure progress toward achieving the Project goal. Metrics have been developed under each objective to evaluate whether system-wide management scenarios measurably address the Project goal and objectives. In the SAP, metrics are applied at a qualitative level to evaluate potential system-wide management scenarios, which have been developed to present and evaluate conceptual high-level approaches for addressing flood control and fish passage/habitat improvement. These scenarios are not comprehensive, but are meant to serve as an initial identification of possible system-level approaches for addressing the identified challenges in the lower portions of the Mill Creek drainage and to preliminarily assess which components of these management scenarios could provide fish passage and habitat improvements while providing flood control.

The Project metrics are identified in Table 1.2-1 for Project Objectives 3 through 6, and in Table 1.2-2 for Project Objectives 7 and 8. Project Objectives 1 and 2 are achieved by submitting the Project's key deliverables. In addition to evaluating progress toward achieving the Project goal and objectives, the metrics in Tables 1.1-1 and 1.1-2 connect directly to documentation of key factors associated with conditions within the Project Area. The documentation includes the River Vision touchstones (Jones et al. 2008), Columbia Basin Fish Accords (Three Treaty Tribes-Action Agencies 2008), ecological concerns (NMFS 2009), and limiting factors (EPA 2003, NPCC 2005; NMFS 2009; SRSRB 2011, USFWS 2014).

Table 1.2-1. Program Objectives, Limiting Factors, River Vision Touchstones, Project Objectives, Project Metrics, and Methods for Project Objectives 3 through 6

CTUIR Walla Walla Habitat Program Objectives	Limiting Factors ^{1/}	River Vision Touchstones ^{2/}	Project Objectives	Project Metrics	Evaluation Method
Improve and maintain passage/connectivity for adult and juvenile fish	Passage/Entrainment ^{3/}	Aquatic Biota Hydrology Connectivity	Recommend alternatives that fully resolve fish passage for focal fish species and identify opportunities to increase spawning, rearing, and migration habitat for these species by increasing habitat quantity and quality, improving habitat connectivity, and restoring processes that sustainably maintain high-quality habitat.	Fish Passage Conditions	Identify historic and current fish inventories. Identify historic and current upstream juvenile and adult fish movement and associated flows. Identify fish passage barrier (e.g., ladders, steps, concrete, etc.) locations and what passage criteria is not being achieved with each barrier. Identify where fish passage meets passage criteria, and where there are fish passage barriers, identify associated flows with each barrier.
				Flows and Barriers	Identify minimal/required and then optimal flows required and barriers modified or removed for upstream movement of focal fish species. Identify minimal/required and then optimal flows needed and barriers removed to provide year-around up- and downstream movement of focal fish species and restore processes that sustainably maintain high-quality habitat.
				Primary Channel Length	Identify historic and current and then minimal and optimal as measured by channel geometry from GIS layers.
				Secondary Channel Length	Identify historic and current and then minimal and optimal as measured by channel geometry from GIS layers.
Increase in-stream morphological diversity, complexity, and function	In-channel Characteristics ^{5/}	Aquatic Biota Connectivity Geomorphology Hydrology Riparian Vegetation	Recommend alternatives that fully resolve fish passage for focal fish species and identify opportunities to increase spawning, rearing, and migration habitat for these species by increasing habitat quantity and quality, improving habitat connectivity, and restoring processes that sustainably maintain high-quality habitat.	Bankfull Width ^{4/}	Identify current and then minimal and optimal as measured by channel geometry from GIS, surveys, CAD, and models.
				Bankfull Depth ^{4/}	Identify current and then minimal and optimal as measured by channel geometry from GIS, surveys, CAD, and models.
				Bankfull Cross-Sectional Area ^{4/}	Identify current and then minimal and optimal as measured by channel geometry from GIS, surveys, CAD, and models.
				Bankfull Width/Depth Ratio ^{4/}	Identify current and then minimal and optimal as measured by channel geometry from GIS, surveys, CAD, and models.
				Wetted Width	Identify current and then minimal and optimal as measured by stream dimensions from GIS, surveys, CAD, and models.
				Wetted Depth	Identify current and then minimal and optimal as measured by stream dimensions from GIS, surveys, CAD, and models.
				Cross-Sectional Area	Identify current and then minimal and optimal as measured by stream dimensions from GIS, surveys, CAD, and models.
				Stream Velocities	Identify current and then minimal and optimal as measured by stream dimensions from GIS, surveys, CAD, and models.
				Gradient	Identify historic and current and then minimal and optimal as measured by channel gradient from GIS layers.
				Sinuosity ^{4/}	Identify historic and current and then minimal and optimal as measured by channel length and valley length from GIS layers.
Improve sediment sorting and routing	Floodplain/Riparian ^{6/}	Aquatic Biota Connectivity Geomorphology Hydrology Riparian Vegetation	Recommend alternatives that fully resolve fish passage for focal fish species and identify opportunities to increase spawning, rearing, and migration habitat for these species by increasing habitat quantity and quality, improving habitat connectivity, and restoring processes that sustainably maintain high-quality habitat.	Average Meander Pattern	Identify historic and current and then minimal and optimal as measured by average meander length from GIS layers.
				Braided-Channel Ratio ^{4/}	Identify historic and current and then minimal and optimal as measured by the ratio of total channel length to the primary channel length (Friend and Sinha 1993) from GIS layers.
Increase side channel length	Sediment ^{7/}	Aquatic Biota Connectivity Geomorphology Hydrology Riparian Vegetation	Recommend alternatives that fully resolve fish passage for focal fish species and identify opportunities to increase spawning, rearing, and migration habitat for these species by increasing habitat quantity and quality, improving habitat connectivity, and restoring processes that sustainably maintain high-quality habitat.	River Complexity Index ^{4/}	Identify historic and current and then minimal and optimal as measured by sinuosity times the number of nodes unitized by valley distance (Brown 2002) from GIS layers.
				Pool Frequency or Spacing ^{4/}	Identify current and then minimal and optimal as measured by the count of number of pools per channel length or spacing between pools (Montgomery et al. 1995; Beechie and Sibley 1997).
Restore natural temperature regime suitable for native salmonids	Water Quality – Temperature ^{8/}	Aquatic Biota Connectivity Geomorphology Hydrology Riparian Vegetation	Recommend alternatives that fully resolve fish passage for focal fish species and identify opportunities to increase spawning, rearing, and migration habitat for these species by increasing habitat quantity and quality, improving habitat connectivity, and restoring processes that sustainably maintain high-quality habitat.	Percent Pool Area ^{4/}	Identify current and then minimal and optimal as measured by the percentage of wetted area classified as pools (Beechie and Sibley 1997).
				Relative Habitat Abundance	Identify current and then minimal and optimal as measured by pool, riffle, and glide habitat percent of primary channel length.
Restore natural hydrograph suitable for native salmonids	Water Quantity – Flow ^{9/}	Aquatic Biota Connectivity Geomorphology Hydrology Riparian Vegetation	Recommend alternatives that fully resolve fish passage for focal fish species and identify opportunities to increase spawning, rearing, and migration habitat for these species by increasing habitat quantity and quality, improving habitat connectivity, and restoring processes that sustainably maintain high-quality habitat.	Relative Feature Abundance	Identify current and then minimal and optimal as measured by count of designated rock or LWD structures (total number of structure types).
				Relative Abundance of Spawning and Rearing Habitat	Identify current and then minimal and optimal as measured by relative abundance of spawning and rearing habitat from hydraulic modeling, fish preferences, and fish surveys.
Improve riparian function and extent	Water Quantity – Flow ^{9/}	Aquatic Biota Connectivity Geomorphology Hydrology Riparian Vegetation	Recommend alternatives that fully resolve fish passage for focal fish species and identify opportunities to increase spawning, rearing, and migration habitat for these species by increasing habitat quantity and quality, improving habitat connectivity, and restoring processes that sustainably maintain high-quality habitat.	LWD Counts ^{4/}	Identify current and then minimal and optimal as measured by total wood above threshold size of by size class (Montgomery et al. 1995; Beechie and Sibley 1997).
				LWD Budget	Identify current and then minimal and optimal as measured by input and output of LWD pieces.

Table 1.2-1. Program Objectives, Limiting Factors, River Vision Touchstones, Project Objectives, Project Metrics, and Methods for Project Objectives 3 through 6 (cont.)

CTUIR Walla Walla Habitat Program Objectives	Limiting Factors ^{1/}	River Vision Touchstones ^{2/}	Project Objectives	Project Metrics	Evaluation Method						
(continued from previous page)				Substrate Quality and Quantity	Identify current and then minimal and optimal as measured by available sediment size in channel, bars, and floodplain.						
				Sediment Budget	Identify current and then minimal and optimal as measured by the input and output of sediment materials and quantities from impoundments.						
				Temperature Regime ^{4/}	Identify current and then minimal and optimal as measured by the 7-day maximum moving average (ODEQ 1995) or longitudinal temperature profile (Torgerson et al. 1999).						
				Hydrology ^{4/}	Identify historic and current and then minimal and optimal as measured by flows at incremental levels that influences fish life stages (Rantz 1982; USGS 1983; Olden and Poff 2003; Grayson et al. 2004).						
				Riparian Vegetation ^{4/}	Identify historic and current and then minimal and optimal as measured by historic documentation and comparison of vegetation cover using GIS layers and LiDAR.						
				Canopy Cover ^{4/}	Identify historic and current and then minimal and optimal as measured by overhanging vegetation from historic documentation and using GIS layers and LiDAR.						
Increase side channel length Increase floodplain connectivity				Floodplain/Riparian ^{6/}		Aquatic Biota Connectivity Geomorphology Hydrology Riparian Vegetation		Create conceptual system-wide management scenarios using empirical and analytical methods that increase floodplain connectivity supportive of re-establishing natural processes while considering the historic floodplain and current flood control and public safety needs.		Primary Channel Length	Identify historic and current and then minimal and optimal as measured by channel geometry from GIS layers.
										Secondary Channel Length	Identify historic and current and then minimal and optimal as measured by channel geometry from GIS layers.
										Braided-Channel Ratio ^{4/}	Identify historic and current and then minimal and optimal as measured by the ratio of total channel length to the primary channel length (Friend and Sinha 1993) from GIS layers.
										River Complexity Index ^{4/}	Identify historic and current and then minimal and optimal as measured by sinuosity times the number of nodes unitized by valley distance (Brown 2002) from GIS layers.
										Percent of Floodplain Disconnected ^{4/}	Identify historic and current and then minimal and optimal floodplain connectivity as measured by percentage of floodplain area disconnected from the primary channel from GIS layers.
										Floodplain Inundation ^{4/}	Identify historic and current and then minimal and optimal floodplain connectivity as measured by percentage of floodplain area connected to the primary channel from GIS layers and HEC-RAS inundation mapping (Ackerman et al. 2010).
										Relative Abundance of Floodplain Habitats	Identify current and then minimal and optimal as measured by wetland areas from GIS layers.
										Channel Migration Rate ^{4/}	Identify historic and current and then minimal and optimal floodplain connectivity as measured by channel migration from multiple sequential aerial photographs (Latterell et al. 2006).
										Flood Control and Public Safety	Identify the current land use requirements and flood control policies for all applicable jurisdictions that would be regulatory side-boards to increasing floodplain connectivity.
										Current Adjacent Land Use	Identify opportunities to increase floodplain connectivity by mapping existing and future zoning and land uses, existing infrastructure and buildings, and existing open spaces (undeveloped) using aerial photography and GIS layers.
Restore natural temperature regime suitable for native salmonids Restore natural hydrograph suitable for native salmonids Improve riparian function and extent				In-channel Characteristics ^{5/} Floodplain/Riparian ^{6/}		Aquatic Biota Geomorphology Hydrology Riparian Vegetation		Estimate and evaluate the historic hydrologic patterns and conditions to inform and establish recommended target Mill Creek flows that are able to support multiple life stages for the focal fish species.		Temperature Regime ^{4/}	Identify current and then minimal and optimal as measured by the 7-day maximum moving average (ODEQ 1995) or longitudinal temperature profile (Torgerson et al. 1999).
										Focal Fish Species Timing	Review historic and current fish inventories.
										Focal Fish Species Distribution	Review historic and current fish inventories and GIS layers.
										Focal Fish Species Habitat Use	Review historic and current fish inventories and GIS layers.
										Relative Habitat Abundance	Identify current and then minimal and optimal as measured by pool, riffle, and glide habitat percent of primary channel length.
										Relative Feature Abundance	Identify current and then minimal and optimal as measured by count of designated rock or LWD structures (total number of structure types).
										Relative Abundance of Spawning and Rearing Habitat	Identify current and then minimal and optimal as measured by relative abundance of spawning and rearing habitat from hydraulic modeling, fish preferences, and fish surveys.
				Hydrology ^{4/}	Identify historic and current and then minimal and optimal as measured by flows at incremental levels that influences fish life stages (Rantz 1982; USGS 1983; Olden and Poff 2003; Grayson et al. 2004).						

Table 1.2-1. Program Objectives, Limiting Factors, River Vision Touchstones, Project Objectives, Project Metrics, and Methods for Project Objectives 3 through 6 (cont.)

CTUIR Walla Walla Habitat Program Objectives	Limiting Factors ^{1/}	River Vision Touchstones ^{2/}	Project Objectives	Project Metrics	Evaluation Method
(continued from previous page)				Riparian Vegetation ^{4/}	Identify historic and current and then minimal and optimal as measured by historic documentation and comparison of vegetation cover using GIS layers and LiDAR.
Increase floodplain connectivity	In-channel Characteristics ^{5/}	Aquatic Biota	Identify opportunities to re-establish natural processes along the Mill Creek corridor by increasing native riparian vegetation and hydrologic connectivity through increased floodplain connectivity and replenishment of the aquifers through water exchange.	Land Management Areas	Identify land management areas where vegetation is controlled from management plans and GIS layers.
				Percent of Floodplain Disconnected ^{4/}	Identify historic and current and then minimal and optimal floodplain connectivity as measured by percentage of floodplain area disconnected from the primary channel from GIS layers.
Restore natural temperature regime suitable for native salmonids	Floodplain/Riparian ^{6/}	Connectivity		Floodplain Inundation ^{4/}	Identify historic and current and then minimal and optimal floodplain connectivity as measured by percentage of floodplain area connected to the primary channel from GIS layers and HEC-RAS inundation mapping.
Restore natural hydrograph suitable for native salmonids	Water Quality - Temperature ^{8/}	Geomorphology		Floodplain Storage	Identify current and estimated historic floodplain storage and opportunities to increase floodplain storage and replenish aquifers through water exchange as measured by existing documentation/reports and removal of constraints.
Improve riparian function and extent	Water Quantity - Flow ^{9/}	Riparian Vegetation		Hydrology ^{4/}	Identify historic and current and then minimal and optimal as measured by flows at incremental levels that influences fish life stages (Rantz 1982; USGS 1983; Olden and Poff 2003; Grayson et al. 2004).
				Riparian Vegetation ^{4/}	Identify historic and current and then minimal and optimal as measured by historic documentation and comparison of vegetation cover using GIS layers and LiDAR.
				Canopy Cover ^{4/}	Identify historic and current and then minimal and optimal as measured by overhanging vegetation from historic documentation and using GIS layers and LiDAR.
				Percent of Bank with Vegetation	Identify historic and current and then minimal and optimal as measured by historic documentation and comparison of vegetation cover only along the bank using GIS layers and LiDAR.

1/ Although primary limiting factors identified in the Columbia Basin Fish Accords (Three Treaty Tribes-Action Agencies 2008) only included In-channel Characteristics, Passage/Entrainment, Riparian/Floodplain, and Sediment, the factors Water Quality – Temperature, and Water Quantity – Flow were included for the purposes of this Assessment.

2/ River Vision touchstones are based on the CTUIR Umatilla River Vision (Jones et al. 2008).

3/ Corresponding NOAA Ecological Concerns (NMFS 2015a): 1.1 Habitat Quantity: Anthropogenic Barriers; 1.2 Natural Barriers; 1.3 HQ-Competition

4/ The metric and evaluation method were developed in collaboration with the Physical Habitat Monitoring Strategy (Jones et al. 2015).

5/ Corresponding NOAA Ecological Concerns (NMFS 2015a): 6.1 Bed and Channel Form; 6.2 Instream Structural Complexity

6/ Corresponding NOAA Ecological Concerns (NMFS 2015a): 4.1 Riparian Condition – Riparian Vegetation; 4.2 LWD Recruitment; 5.2 Floodplain Condition

7/ Corresponding NOAA Ecological Concerns (NMFS 2015a): 7.1 Decreased Sediment Quantity; 7.2 Increased Sediment Quantity

8/ Corresponding NOAA Ecological Concern (NMFS 2015a): 8.1 Temperature

9/ Corresponding NOAA Ecological Concern (NMFS 2015a): 9.2 Decreased Water Quantity

Table 1.2-2. Project Objectives, Project Topics, and Project Metrics and Methods for Project Objectives 7 and 8

Project Objectives	Project Topics	Project Metrics	Evaluation Method	
Create conceptual system-wide management scenarios for natural and economic amenities along the Mill Creek corridor that enhances the community's support, interaction, and understanding of the natural processes, qualities, and characteristics of the corridor through the integration of passive and active open spaces.	River Identity	Visibility of Mill Creek Corridor	Viewshed analysis of visibility of stream corridor from public and private observation points Review historic and current interactions Amount of corridor daylighted Number of pedestrian access points to corridor	
	Open Space and Recreation Uses	Amount of Open Space throughout Mill Creek Corridor	Amount of open spaces as measured by aerial photography, land use analysis, and land cover analysis	
		Connectivity of Mill Creek Corridor to System of Open Space and Recreation	Amount of open space and recreation uses Amount of bike path and multi-use trail networks	
	Water Quality	Stormwater, Streetscape, and Landscape Best Management Practices (BMPs)	Amount of features utilizing BMPs for stormwater/groundwater quality control	
		Water Quality Treatment	Amount of landscape-based water quality treatment features	
		Vegetation Along Bank and Adjacent Open Space	Amount of area conducive to enhancement of native vegetation	
	Education and Culture	Access to Mill Creek Corridor	Number of public access points to corridor	
		Educational Features	Number of permanent educational kiosks features	
	Economic Amenity	Visibility of Mill Creek Corridor	Viewshed analysis of visibility of stream corridor from public and private observation points Amount of corridor daylighted Number of pedestrian access points to corridor	
		Development Orientation to Mill Creek Corridor	Viewshed analysis of visibility of stream corridor from public and private observation points Amount of bike path and multi-use trail networks Amount of real estate development oriented to Mill Creek	
		Value of Watershed	Water quality resulting from healthy watershed vs cost of filtration plants and retention ponds Natural flood control vs. flood control projects	
		Fishery Benefits to Individuals and the Region	Net economic benefit to recreational fishing Net economic benefit to commercial fishing	
	Engage with key stakeholders to facilitate support for the strategic action plan and to identify regulatory and funding pathways for implementation of the plan.	Key Stakeholder Engagement	Opportunities for Involvement	Number of Project related notifications, communications, emails, meetings, and presentations, interviews, data sharing, web site, stakeholder matrix, and funding
		Regulatory Pathway	Identify Regulatory Sideboards and Constraints	Assessment of regulatory constraints
Identify Regulatory Pathways and Opportunities			Assessment of regulatory pathways	
Funding Pathway	Funding Opportunities for Implementation	Amount of government and/or public funding mechanisms, private investment, and/or philanthropic investment		

1.3 PROJECT AREA AND ASSESSMENT PROCESS

1.3.1 Location of Project Area

As noted earlier and in Figure 1-1 above, the Project Area is divided into a Primary Focus Area and Secondary Focus Area. The following provides a brief overview of the Project Area's regional context, and then further detail about the Primary and Secondary Focus Areas.

1.3.1.1 Regional Setting

As a tributary of the Walla Walla River, Mill Creek flows from the Blue Mountains of southeastern Washington and northeastern Oregon to its confluence with the Walla Walla River just west of the cities of Walla Walla and College Place. The Walla Walla River is a tributary to the Columbia River, and the Walla Walla subbasin is one of the 62 subbasins that make up the Columbia River basin. The Walla Walla subbasin is approximately 1,758 square miles (4,553 square kilometers) in area; the Mill Creek watershed makes up approximately 4 percent of the subbasin's drainage area and contributes approximately 15 percent of the subbasin's runoff volume (NPCC 2005). See Figure 1.3-1 for a map of the Walla Walla subbasin including the Mill Creek watershed.

1.3.1.2 Primary Focus Area

The Primary Focus Area includes the lower Mill Creek corridor from RM 0 to near RM 15 at 7 Mile Bridge, as well as the historical and current distributary system running around and through the urbanized area of Walla Walla, Washington. Although the entire Mill Creek distributary system is considered in this Assessment, the evaluation of historic and current resource conditions focuses on Garrison and Yellowhawk creeks as they offer possible alternative flood water and fish scenarios. Evaluation of other creeks within the Primary Focus Area (e.g. Titus and Russell) will be discussed as applicable to a specific topic.

The Primary Focus Area includes the Mill Creek Flood Control Project (MCFCP, see Figure 1.3-2) which includes all flood control structures located on Mill Creek between RM 4.8 (Gose Street) and RM 11.4 (Bennington Diversion Dam). The lower 6 miles (RM 4.8 to 10.4) are managed by the Mill Creek Flood Control Zone District (MCFCZD) and include what is known as the Mill Creek Channel, consisting of riprapped levees, channel-spanning weirs, and a 2-mile concrete flume. The upper mile of the MCFCP (RM 10.4 to 11.5) is managed and owned by the U.S. Army Corps of Engineers (USACE) and includes levees, two mainstem dams, a flood diversion system, the first 500 feet of the distributaries Yellowhawk and Garrison creeks, and 556 acres of nearby land and open water.

The two mainstem dams on Mill Creek include the Division Works Dam, located at Mill Creek RM 10.5, and the Bennington Diversion Dam, located at RM 11.4. The Division Works Dam consists of four arm gates that are raised (opened) or lowered (closed) to divert flow from Mill Creek southward through a radial gate and into the 500-foot-long Yellowhawk/Garrison Canal for flood control and irrigation purposes (USACE 2011a). From here, water flows through a Second Division Works where flow is divided between Yellowhawk and Garrison creeks. The Bennington Diversion Dam diverts flood water from Mill Creek into a canal that empties into Bennington Lake. The USACE also owns and maintains Bennington Lake Dam, an earth fill structure 125 feet high located off-channel from Mill Creek. The Bennington Lake Dam forms Bennington Lake, an off-channel flood storage reservoir with a maximum storage capacity of 8,300 acre-feet. Figure 1.3-2 is a map of the MCFCP and its various components.

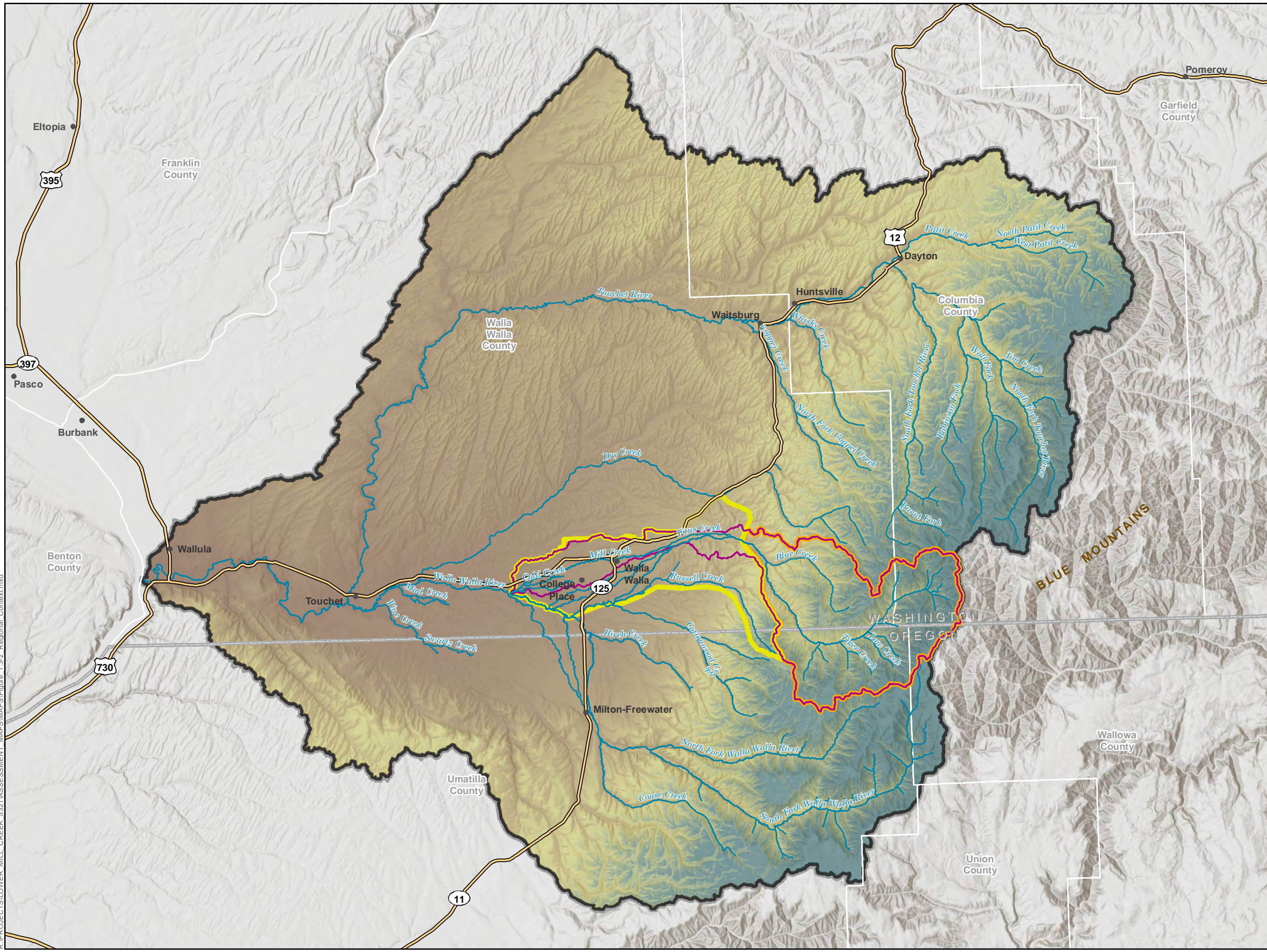
1.3.1.3 Secondary Focus Area

The Secondary Focus Area includes the upper Mill Creek corridor from the 7 Mile Bridge to the Mill Creek headwaters. The Secondary Focus Area, or upper Mill Creek watershed, is considered in the Assessment because upriver conditions influence downstream factors such as hydrology and sediment. This area includes Blue Creek, the primary tributary to Mill Creek, and the City of Walla Walla's public water supply intake near RM 25.4, which supplies 90 percent of the City's water supply each year (City of Walla Walla 2013a). Passage concerns have been raised at the City's municipal water diversion dam (Figure 1-1) and evaluations are expected to continue. A 36 square mile area of the watershed is roadless and closed to the public to protect the City's drinking supply. This area contains high quality habitat for fish.

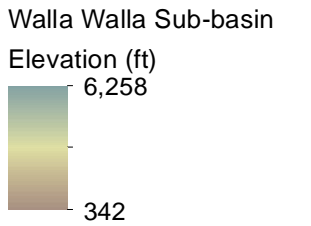
**LOWER MILL CREEK
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ASSESSMENT**

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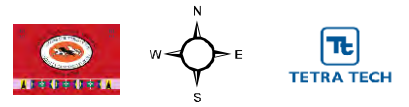
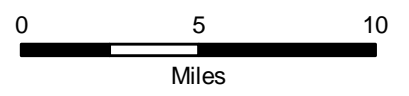
**FIGURE 1.3-1
MILL CREEK
REGIONAL CONTEXT**



- Major Stream
- Primary Focus Area
- Secondary Focus Area
- Mill Creek Watershed



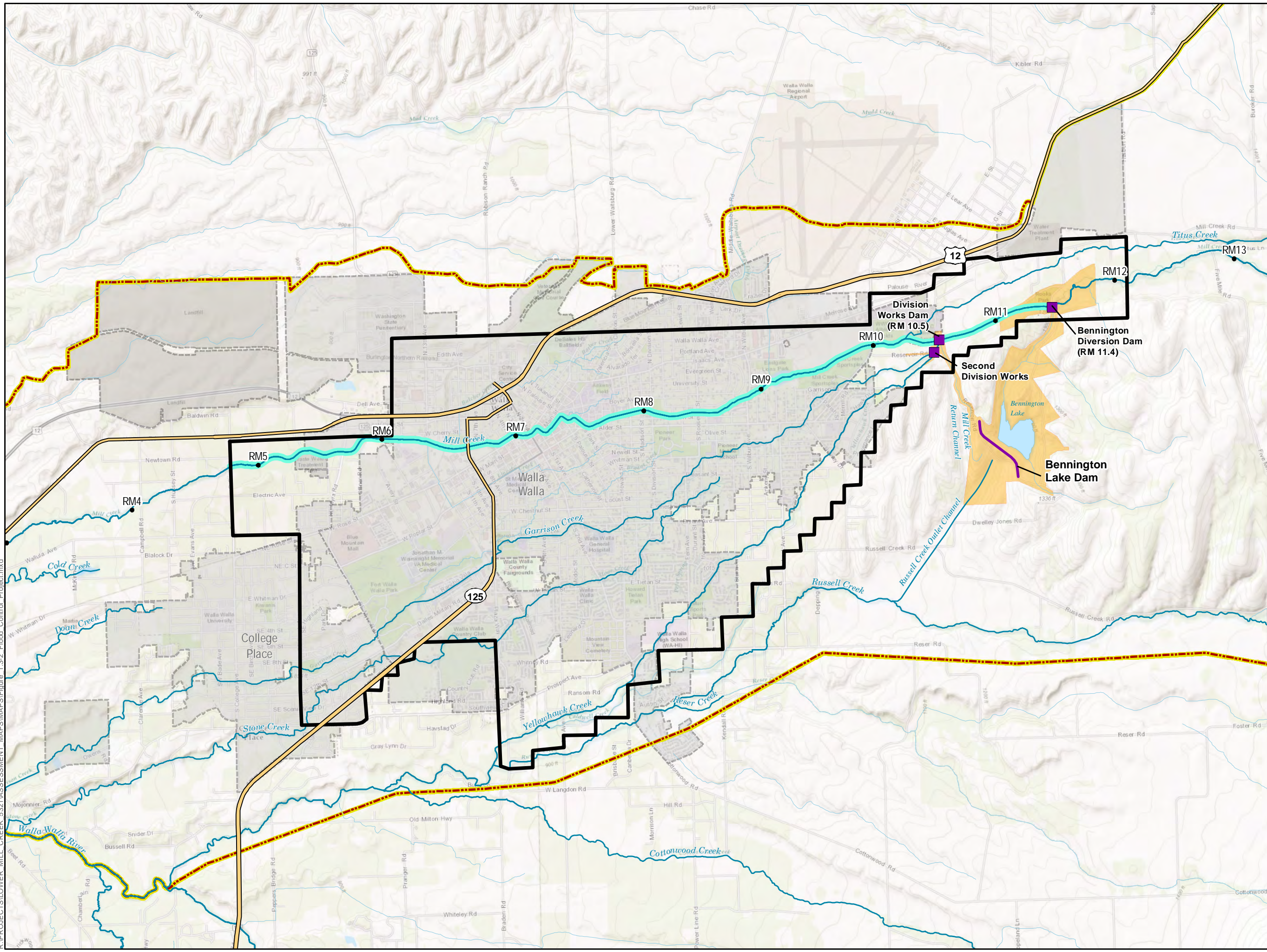
Sources: CTUIR, StreamNet



**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

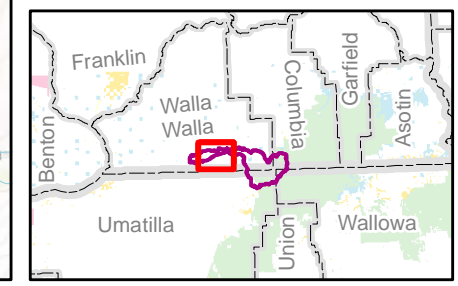
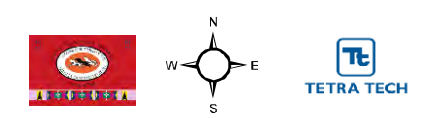
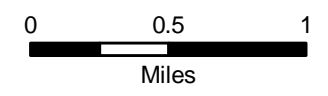
CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE 1.3-2
MILL CREEK
FLOOD CONTROL PROJECT**



- River Miles
- Dam
- Major Stream
- Minor Stream
- Mill Creek Channel
- Waterbody
- ▭ Mill Creek Flood Control Zone District Boundary
- ▭ Project Area
- ▭ Primary Focus Area
- ▭ Federal Footprint
- ▭ Cities

Sources: CTUIR, Walla Walla County, StreamNet, USACE



R:\PROJECTS\LOWER MILL CREEK_5321\ASSESSMENT_MAPS\MAPS\Figure 1.3-2 Flood Control_Project.mxd

1.3.2 Identification of Segments

The Primary Focus Area has been segregated into five segments for the purposes of organizing this Assessment, developing system-wide management scenarios, and presenting the SAP. The segments divide the Mill Creek main channel based on past assessments, planning efforts, and existing management plans and ownership, as well as channel characteristics and adjacent land use. The various distributaries were not broken into segments, but instead evaluated as individual drainages (e.g., Yellowhawk Creek). The Secondary Focus Area was also evaluated as one complete segment. This is because of both the particular challenges along lower Mill Creek that can vary dramatically by segment (e.g., flood control infrastructure), and, by comparison, the relative consistency of conditions within each of the distributaries and the Secondary Focus Area.

Before determining the five Primary Focus Area segments, several studies and plans were reviewed in detail that identified various segments and/or reaches on Mill Creek. The following briefly reviews the various approaches that have previously identified segments and/or reaches on Mill Creek:

- **The Mill Creek Fish Passage Assessment (Burns et al. 2009).** The Mill Creek Fish Passage Assessment identified 12 reach types along Mill Creek, starting at Gose Street (RM 4.8) and extending to the Bennington Diversion Dam (RM 11.4). However, the identification of reach types was not a linear location-based breakdown of the channel, but rather an identification of various cross sections that are present in the channel. For example, in some cases one reach type can occur in multiple locations along the channel (e.g., Reach Type 3). From an existing channel standpoint, this approach provides a solid foundation for hydraulic analysis, but may not be applicable to the larger scale zoning approaches needed for this Project.
- **The Shoreline Analysis Report for Shorelines in Walla Walla County and the Cities of Walla Walla, Prescott, and Waitsburg (The Watershed Company et al. 2014).** The Shoreline Analysis Report identified 15 reaches based primarily on adjacent land uses. From a land use and zoning standpoint, this approach provides a solid foundation, but may break Mill Creek into too many segments for the purposes of this Project.
- **The Walla Walla Subbasin Plan (NPCC 2005).** The Subbasin Plan has three breaks in the Primary Focus Area, with two other breaks extending into the Secondary Focus Area. From a planning standpoint, this approach is effective for describing subbasin

and watershed characteristics, but presents challenges from hydraulic, land use, and zoning perspectives for the purposes of this Project.

After reviewing these documents and further considering conditions throughout the Primary Focus Area, segments were identified by seeking to balance consideration of the channel type and adjacent land use context. The Primary Focus Area was segregated into areas where common conditions and approaches would apply. The segments are described below and illustrated in Figure 1.3-3.

- Segment 1 – RM 0 (mouth) to RM 4.8 (Gose Street). This segment is characterized by a semi-natural channel with no flood control structures.
- Segment 2 – RM 4.8 (Gose Street) to RM 6.7 (just downstream of 9th Avenue Bridge). This segment is characterized by both sheetpile and concrete weirs between levees. RM 4.8 is where the MCFCZD begins, and the adjacent land uses along Mill Creek in Segment 2 provide potential opportunities for conceptual scenarios.
- Segment 3 – RM 6.7 (just downstream of 9th Avenue Bridge) to RM 8.4 (just upstream of Roosevelt Street Bridge). This segment includes the downtown flume section (i.e., Mill Creek flume). Conceptual scenario planning may provide a “zoomed in” subsegment for the portion of the flume that is underground or within a highly urbanized context. This segment is very constrained by existing land uses, so there is potential to have strategies for improving the creek within a relatively narrow right-of-way (ROW).
- Segment 4 – RM 8.4 (just upstream of Roosevelt Street Bridge) to RM 12.1 (end of the MCFCZD). This segment includes the spanning sill/weir channel section with a wider ROW than Segment 3 and open space adjacent land uses that may provide restoration opportunities.
- Segment 5 – RM 12.1 (end of MCFCZD) to just downstream of RM 15 (7 Mile Bridge). This segment is characterized by a natural channel and may have opportunities for increasing floodplain connection and flood water storage.

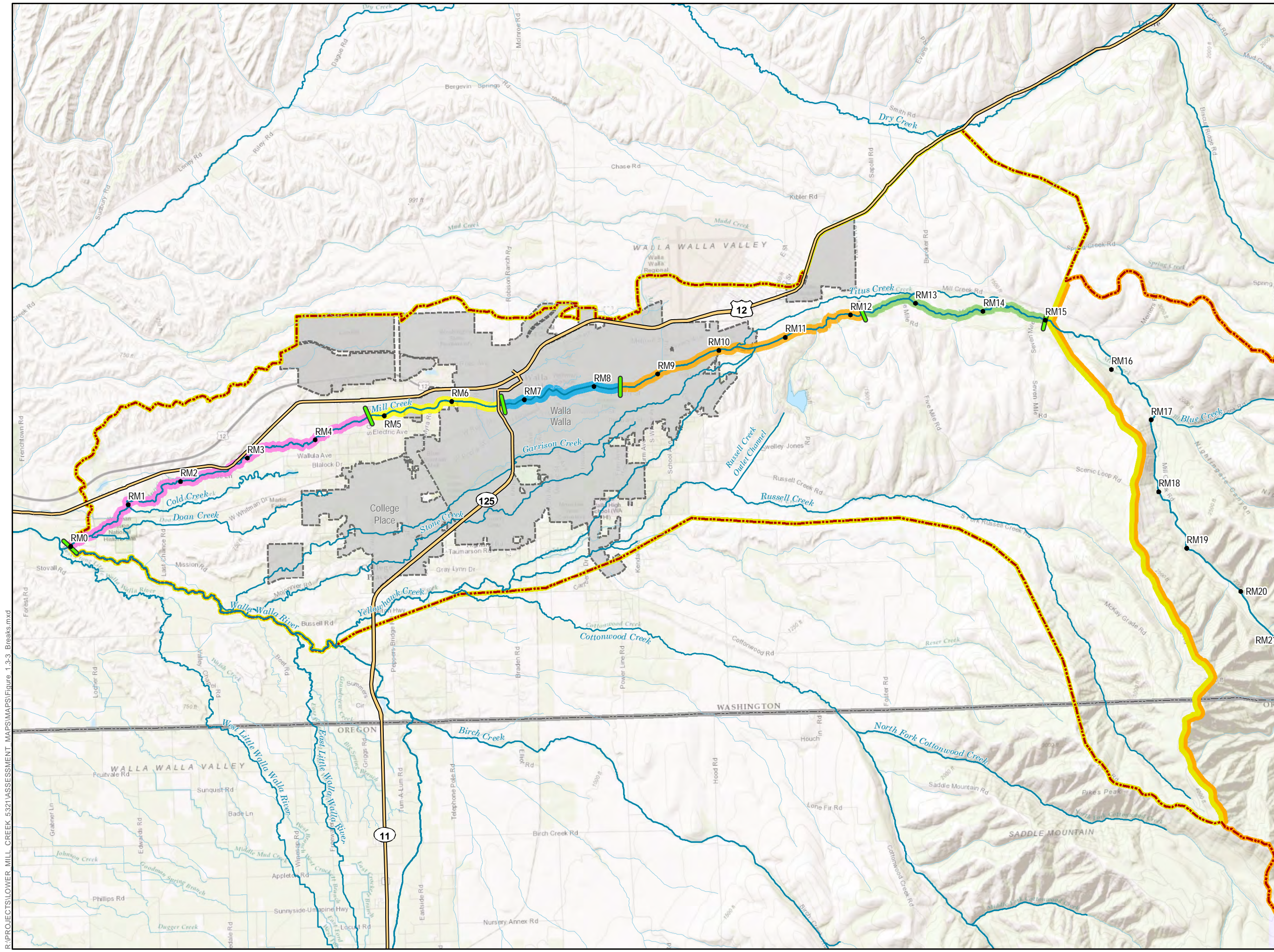
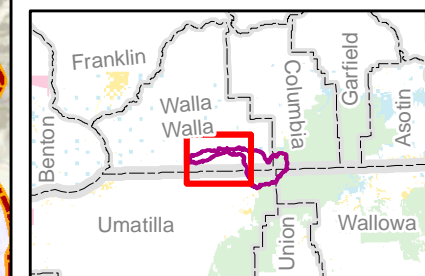
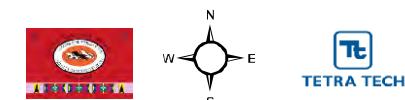
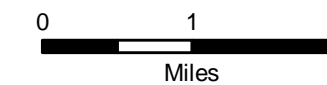
LOWER MILL CREEK HABITAT AND PASSAGE ASSESSMENT

CONFEDERATED TRIBES OF THE UMATILLA INDIAN RESERVATION

FIGURE 1.3-3 IDENTIFICATION OF MILL CREEK PROJECT SEGMENTS

- River Miles
- Major Stream
- Minor Stream
- Project Area Breaks
- Segment 1
- Segment 2
- Segment 3
- Segment 4
- Segment 5
- Waterbody
- ▭ Project Area
- ▭ Primary Focus Area
- ▭ Secondary Focus Area
- ▭ Cities

Sources: CTUIR, Walla Walla County, StreamNet



R:\PROJECTS\LOWER MILL CREEK_5321\ASSESSMENT_MAPS\MAPS\Figure 1.3-3_Breaks.mxd

1.3.3 Assessment Steps

The purpose of the Assessment is to identify historic and existing conditions, current problems and opportunities, and possible future conditions of Mill Creek to fully understand, document, and address fish habitat and passage in lower Mill Creek. To accomplish this, the Assessment included four main steps:

- **Collect and organize existing data.** Existing data sources were evaluated to identify and define data adequacy (i.e., sufficient data quantity and quality) as well as data needs (i.e., data gaps). The identified data gaps were prioritized according to what is necessary to be filled through subsequent studies or field surveys. All sources of data received were input into a Microsoft Excel spreadsheet to support the review of data in the development of the Assessment.
- **Stakeholder interviews.** Key stakeholders were identified and sent letters or other forms of communication inviting stakeholders to participate in the Project process. Stakeholder interviews and distribution of questionnaires were conducted early in the Assessment process so that information from key stakeholders could be obtained and integrated into the Assessment. See Section 1.3.4 for more details about the stakeholder involvement process and the feedback received.
- **Draft Assessment.** The existing data was reviewed and analyzed and a Draft Assessment was developed. The Draft Assessment was provided to the members of the Project Executive Committee (EC), Technical Advisory Committee (TAC), and other key stakeholders for review and comment. There were multiple rounds of review of the Draft Assessment and several stakeholder meetings held between September 2016 and December 2016 to solicit comment on the Draft Assessment as well as on the initially identified system-wide management scenarios (see below for more information on management scenarios).
- **Final Assessment.** After receiving feedback from key stakeholders, the Assessment was updated accordingly and finalized.

1.3.4 Stakeholders, Project Participants, and Coordination

Extensive coordination among numerous agencies, organizations, and other stakeholders with vested interests in the welfare of Mill Creek has been conducted and will continue to be conducted throughout the Project. The CTUIR understands that it is critical to engage with the various stakeholder interests to develop a strong base of support for implementing any

proposed changes to Mill Creek. To accomplish this, the CTUIR developed a stakeholder involvement process that consists of meetings, questionnaires, interviews, and targeted outreach. The stakeholder involvement process is intended to identify, assess, and address the wide range of interests within the framework of the CTUIR goal and objectives for Mill Creek. Appendix A provides a Stakeholder Involvement Summary that describes the Project's stakeholder involvement process and the feedback received through this process.

The information gathered through the stakeholder involvement process was used to identify opportunities for collaboration and develop conceptual system-wide management scenarios that address the various stakeholder interests. Outreach efforts involving interviews and the distribution of the stakeholder questionnaires were completed early in the assessment process. The input from this early outreach was used to identify existing data sources, identify regulatory constraints, and help draft and refine a range of potential future conditions for Mill Creek.

Based upon the review of the 30 completed questionnaires and 18 interviews conducted to date, key issues, concerns and visions identified for Mill Creek include:

- Preserve and maintain upper Mill Creek and its headwater conditions.
- Maintain flood control function and capacity.
- Retain and enhance Mill Creek's natural resources and functions, including habitat, fisheries, water supply, water quality, in-stream flows, and creation of an open channel.
- Retain and enhance public access, channel visibility, and outdoor recreation opportunities including paths for pedestrians and bicyclists.

The stakeholder involvement process will continue throughout the development of the Assessment and SAP, but will focus on the distribution of work products for stakeholder review and the presentation of these materials at the EC and TAC stakeholder meetings.

1.4 PROJECT CONTEXT

1.4.1 Resource Significance

1.4.1.1 CTUIR First Foods and River Vision

First Foods Mission

The Cayuse, Umatilla, and Walla Walla Indians have lived in the Columbia River region for more than 10,000 years. Until the early 1900s, they followed a yearly cycle of travel from

hunting camps to fishing spots, to celebration and trading camps (CTUIR 2016b). Generations of tribal families have held First Food feasts to celebrate the renewal of life and the responsibility the people have to care for the foods, just as the foods care for the people. The First Foods serving ritual in the longhouse mirrors the order in which the foods promised themselves to the people in the tribal creation belief (Jones et al. 2008). Water is first in the traditional serving order, as it is a resource in its own right and critical for supporting the production of the remaining First Foods (Jones et al. 2008). Each of the remaining First Foods represents a grouping of ecologically related foods. The range of river-derived foods in the salmon category reveals the use of the native aquatic community as First Food resources throughout the annual cycle (Jones et al. 2008).

In 2007, the CTUIR Department of Natural Resources (DNR) adopted a First Foods focused Mission, stated as follows:

To protect, restore, and enhance the First Foods – water, salmon, deer, cous, and huckleberry – for the perpetual cultural, economic, and sovereign benefit of the CTUIR. We will accomplish this utilizing traditional ecological and cultural knowledge and science to inform: 1) population and habitat management goals and actions; and 2) natural resource policies and regulatory mechanisms. (Jones et al. 2008)

The CTUIR considers First Foods to be the minimum ecological products necessary to sustain CTUIR culture, and to provide a diverse table setting of native foods for the tribal community. First Foods is a cultural strategy for natural resource management that incorporates spatial and phenological considerations as these resources are used throughout the Walla Walla basin and throughout the year based on availability. The First Foods framework prioritizes efforts to re-naturalize the processes that sustain the First Foods and provides a direct and culturally appropriate means for monitoring and reporting restoration progress to the tribal community (Jones et al. 2008).

River Vision

The CTUIR Umatilla River Vision (River Vision) facilitates the sustained production of First Foods by establishing a vision for the desired ecological characteristics of river water quality and resource management (Jones et al. 2008). The River Vision requires a functional river to be “dynamic, and shaped not only by physical and biological processes, but [by] the interactions and interconnections between those processes” (Jones et al. 2008). The five key ecological characteristics (or touchstones) of functional rivers that are considered by the River Vision to be vital in the management and restoration of river ecosystems, and which are tied directly to the

CTUIR’s First Food Mission, include hydrology, geomorphology, habitat and network connectivity, riverine biotic communities, and riparian vegetation (Figure 1.4-1). Each of these touchstones has been incorporated into the Project’s metrics in Table 1.2-1 above.

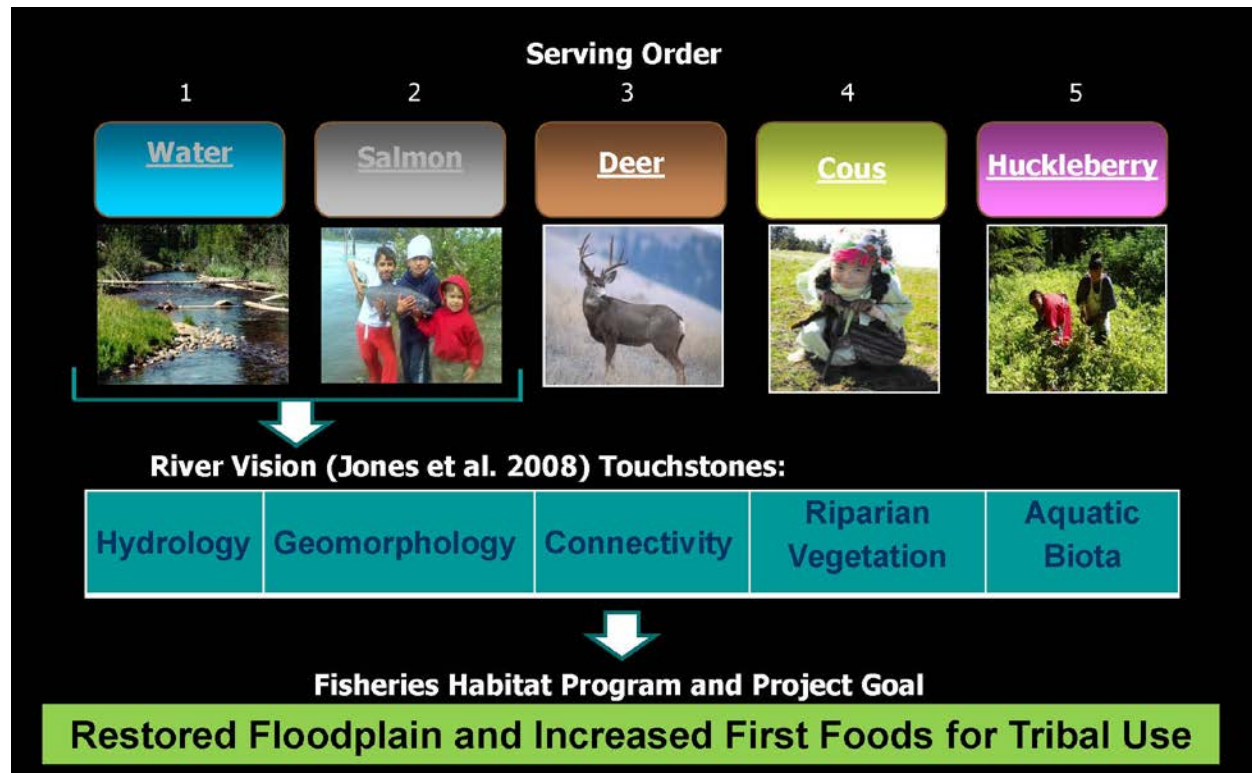


Figure 1.4-1. First Foods Serving Order

1.4.1.2 Endangered Species Act

The Endangered Species Act (ESA) and its implementing regulations in Title 50 of the Code of Federal Regulations Section 17 prohibit the take of any fish or wildlife species that is federally listed as threatened or endangered without prior approval pursuant to either Section 7 or Section 10 of the ESA. The ESA also expects federal agencies to conserve listed species, and to consult with the Services (National Oceanic and Atmospheric Administration – National Marine Fisheries Service [NMFS] and/or U.S. Fish and Wildlife Service [USFWS]) on effects of federal actions. Two fish species that occur in Mill Creek have been listed as threatened under the ESA: steelhead and bull trout. Middle Columbia River (Mid-C) steelhead were listed as threatened under the ESA in March 1999 (64 Federal Register 14517), with that status reaffirmed on January 5, 2006 (71 Federal Register 834). Mill Creek was designated as critical habitat for Mid-C steelhead in 2005, and the NMFS cited in their 2006 Federal Register listing that the USACE will improve passage, screening, and flow management in the Walla Walla River subbasin, and alter the flood operating rule for Mill Creek or alternatively screen the diversion into Bennington

Lake. Columbia Basin bull trout were listed as threatened on July 10, 1998, and Mill Creek was included in the critical habitat designation for bull trout in 2010.

Mid-Columbia spring Chinook salmon are not currently listed by federal or Washington State agencies because they were extirpated from the Walla Walla system, including Mill Creek, in the last century. The CTUIR nevertheless considers this stock culturally and ecologically important to the region, and initiated reintroduction efforts in 2002 and 2003 (SRSRB 2011) that remain ongoing. Pacific lamprey are identified as an ESA species of concern and have also been extirpated from Mill Creek.

In 2008, NMFS issued a biological opinion (BiOp; NMFS 2008) for the operation and maintenance of the Federal Columbia River Power System (FCRPS). This BiOp describes a comprehensive set of actions to ensure the operational effects of the FCRPS on 13 listed salmon and steelhead species and their critical habitat in the Columbia River basin (including the Mill Creek drainage), compliant with Section 7(a)(2) of the ESA. These actions, called a Reasonable and Prudent Alternative (RPA), are intended to address and improve factors limiting fish survival across all life stages to reduce or mitigate for the adverse effects of the hydropower system.

Of significance to the Assessment are the actions addressing estuary and tributary habitat improvements targeted under the updated 2014 FCRPS Supplemental BiOp (NMFS 2014). While several projects that addressed enhancement of in-stream flows, improvement of screening diversions, and removing a push-up dam were implemented prior to 2009, there are no supplemental RPA actions specifically identified for the Walla Walla basin for the 2010 to 2018 period (NMFS 2014). However, the Bennington Diversion Dam and the Mill Creek Channel have been noted as significant factors limiting recovery for the Walla Walla population of Mid-C steelhead. Therefore, actions taken in Mill Creek relative to habitat, passage, and flood control channels could have significant influence on allowing the recovery of the Mid-C steelhead. Without improvement in these areas, recovery of the species in this area may not be achievable.

The USFWS issued a BiOp for the MCFCP in October 2007 (USFWS 2007) regarding the effects of the ongoing operations and maintenance of the MCFCP on bull trout. It concluded that ongoing operations would not likely jeopardize the continued existence of bull trout but it did require the USACE to improve fish passage at Bennington Diversion Dam. In September 2011, NMFS issued a BiOp for the MCFCP (NMFS 2011) regarding the effects of the ongoing operations and maintenance of the MCFCP on Mid-C steelhead. NMFS concluded that ongoing

operations of the MCFCP would likely jeopardize the continued existence of the Mid-C steelhead and it will result in the destruction or adverse modification of designated critical habitat for Mid-C steelhead. NMFS is currently in re-consultation with the USACE regarding the operation of the MCFCP (pers. com., Diane Driscoll, Fisheries Biologist, NMFS, Ellensburg, Washington, May 3, 2017). See “USACE Biological Assessment for MCFCP Operation and Maintenance” under Section 1.4.3.5 for more information on these two BiOps and the ongoing re-consultation process between the USACE and NMFS.

1.4.1.3 Recovery Planning

Walla Walla Subbasin Plan

The Walla Walla Subbasin Plan (NPCC 2005) establishes locally defined biological objectives and strategies for fish and wildlife enhancement in the Walla Walla subbasin. The Subbasin Plan provides a framework within which fish and wildlife projects are proposed for Bonneville Power Administration (BPA) funding to implement the Northwest Power and Conservation Council’s Columbia Basin Fish and Wildlife Program (NPCC 2005) and also informs ESA recovery planning by NMFS and USFWS.

The Subbasin Plan discusses fish barriers and lack of fish habitat in Mill Creek and its distributaries, and makes recommendations to give priority for protecting Mill Creek (except for the extent from Gose Street to the Bennington Diversion Dam), upper and middle Mill Creek tributaries, and the Blue Creek drainage (NPCC 2005).

The Subbasin Plan also recommends that the flood control channel obstructions and imminent threats (including Titus Creek) should be considered a priority to be addressed, but also recognizes the complexity of this system and that unique solutions will need to be considered by a wide array of stakeholders. It further recommends that the Mill Creek Working Group be considered an avenue to continue work on addressing this area’s issues (NPCC 2005).

The Subbasin Plan also includes a specific recommendation that action on Titus Creek, in particular the obstruction culvert at the mouth of Titus Creek, should be part of the overall solution for Mill Creek. The Subbasin Plan notes that valuable summer rearing areas within Titus Creek could provide an alternative to sections of Mill Creek and recommends pursuit of a solution that provides connections from the springs that feed Titus Creek to the mouth (NPCC 2005).

2008 Columbia Basin Fish Accords

On May 2, 2008, BPA, USACE, and the Bureau of Reclamation entered into a set of agreements, known as the Columbia Basin Fish Accords (the Accords; Three Treaty Tribes-Action Agencies 2008), with initial signatories including four tribes (CTUIR, Confederated Tribes of the Warm Springs Reservation, Confederated Tribes and Bands of the Yakama Nation, Confederated Tribes of the Colville Indian Reservation), the Columbia River Inter-Tribal Fish Commission, and two states (Idaho and Montana) (CRBFC 2013). Since 2008, Washington State, the Shoshone Bannock Tribes, and the Kalispel Tribe of Indians also signed onto the Accords with the three lead federal agencies (CRBFC 2013). The Accords address fish affected by the FCRPS through various commitments, including funding and implementation of habitat projects, to address the needs of ESA-listed fish, in particular salmon and steelhead. The Accords provide almost 1 billion dollars of funding between 2008 and 2017.

The types of alternatives/projects that would be identified and recommended as part of this Project would be consistent with potential funding outlined in Subsection A.2 of the Accords and as identified in the Accords' Attachment B, and also in support of the FCRPS BiOp and the Columbia Basin Fish and Wildlife Program implementation.

Middle Columbia River Steelhead Distinct Population Segment ESA Recovery Plan, 2009

The NMFS has developed a recovery plan for the Mid-C steelhead that includes actions to address limiting factors (NMFS 2009). This is a non-regulatory document to guide federal agencies charged with species recovery. The Mid-C steelhead recovery plan has sought to actively integrate the various planning projects to achieve consistency, to the extent possible, among the various recovery plans and to make use of data and information from the other plans. The NMFS recovery plan offers options for future actions that strive to secure the survival of species and includes a list of recovery strategies and actions (see Table 7-3 in NMFS 2009) for the Umatilla/Walla Walla Major Population Group. These actions include restoring juvenile rearing conditions in tributary mainstem rearing areas and increasing smolt survival during outmigration through improvements to the spring flow and temperature regimes in the tributary mainstems and the Columbia River. The NMFS recovery plan also refers to the recovery plan specific to the Southeast Washington Management Unit (SEWMU) developed by the Snake River Salmon Recovery Board. See the following for a description of the Southeast Washington Recovery Plan (SRSRB 2011) and its relevance to Mill Creek.

Snake River Salmon Recovery Plan for Southeast Washington, 2011

The Snake River Salmon Recovery Board (SRSRB) developed the Snake River Salmon Recovery Plan for SE Washington (SRSRB 2011), also known as the Southeast Washington Recovery Plan, to address salmon recovery in the Walla Walla River. Originally finalized in 2006, this plan was updated in 2011 and is part of a comprehensive Snake River Basin Sub-Domain Salmon and Steelhead Recovery Plan, coordinated and developed by NMFS and other local stakeholders. The primary purpose is to present implementable actions that can lead to the delisting of populations of salmon, steelhead, and bull trout within the SEWMU.

The SRSRB developed an interlocal agreement with the affected counties and the CTUIR to achieve salmon, steelhead, and bull trout recovery through habitat restoration and protection in the SEWMU. The SRSRB works to ensure that the Southeast Washington Recovery Plan is consistent with local watershed plans, the subbasin plans, and the Environmental Protection Agency's (EPA) Total Maximum Daily Load (TMDL) criteria for specific water quality parameters. Recommendations made as a part of this Assessment are consistent with this recovery plan.

Subsection 5.5.2 of the Southeast Washington Recovery Plan identifies limiting habitat factors for Mid-C steelhead in the Walla Walla subbasin and specifically acknowledges that fish habitat from Bennington Diversion Dam to Gose Street is severely limited. However, upstream of Bennington Diversion Dam, Mill Creek is classified as a priority restoration reach because the Snake River Regional Technical Team envisions that passage through lower Mill Creek will be restored soon (SRSRB 2011). Specific habitat strategies for Mill Creek and Yellowhawk Creek are proposed in the Southeast Washington Recovery Plan including tributary habitat strategies for major and minor spawning areas in Mill Creek and strategies for improved fish passage in both creeks (SRSRB 2011).

Draft Mid-Columbia Recovery Unit Implementation Plan for Bull Trout Recovery Plan, 2015

The USFWS has developed a recovery plan for bull trout that includes actions to address limiting factors (USFWS 2015a). This draft Recovery Unit Implementation Plan (RUIP) describes the threats to bull trout and the site-specific management actions necessary for recovery of the species within the Mid-Columbia Recovery Unit (Mid-C), including the Walla Walla River and Mill Creek, and contains estimates of time and cost required for the actions.

Table C-3 of the draft RUIP (USFWS 2015a) identifies the major actions needed in eastern Washington and northeastern Oregon watersheds to allow connectivity between foraging,

migration, and overwintering (FMO) habitat and spawning/rearing habitat. Recommended actions specific to Mill Creek include the following:

- Provide recommendations to improve bull trout passage through the entire MCFCP;
- Determine appropriate in-stream flows in Mill Creek, identify probable low-flow scenarios, and prepare an operational plan to minimize impacts;
- Improve passage at the City of Walla Walla intake upstream fish ladder;
- Implement fish screens at the Bennington Diversion Dam or establish flow diversion criteria to ensure bull trout are rarely swept into Bennington Lake;
- Ensure that the Bennington Diversion Dam fish ladder is adequate for upstream migration;
- Modify existing weirs to ensure upstream passage on Mill Creek;
- Establish connectivity between Mill Creek and the Walla Walla River through the Yellowhawk/Mill Creek channel complex and prevent entrainment and stranding;
- Implement corrective action to address fish stranding in Titus Creek/Ditch; and
- Take corrective action to address stormwater runoff problems in urban areas along Mill Creek.

1.4.1.4 Public Recognition

Public attention to Mill Creek has increased since the ESA listings of bull trout and Mid-C steelhead in 1998 and 1999, described above. This interest was further heightened when Mill Creek was designated as critical habitat for Mid-C steelhead in 2005 and for bull trout in 2010. In response to concerns regarding fish passage and habitat, a technical work group formed in 2003 to evaluate, provide feedback, and facilitate habitat and passage improvement projects in and along Mill Creek. The Mill Creek Working Group consists of federal and state regulators, local governments, local tribes, and nongovernmental organizations. The Mill Creek Working Group was a proponent and catalyst for preparation of the Mill Creek Fish Passage Assessment, finalized in October 2009 (Burns et al. 2009). A comprehensive timeline summary of fish passage and salmon recovery efforts on Mill Creek (from 1931 to 2015) was written and provided to the CTUIR by Glen Mendel and is included in Appendix B.

In addition to heightened public awareness of the conditions for fish passage and habitat in Mill Creek, public concern for flood control continues to increase. The aging MCFCP has been a topic of discussion in the Walla Walla community since the 1996 flood. In 2010, the USACE's

Periodic Inspection Report rated the condition of the Mill Creek Channel as minimally acceptable (USACE 2013a). In June 2016, the USACE released the results of a screening-level risk assessment of the MCFCP, the Levee Safety Action Classification (LSAC), which ranked the left bank of the MCFCP at LSAC 2 and the right bank at LSAC 3, on a 1 to 5 scale with 1 being the worst and 5 being the best (Porter 2016; USACE 2016a). The LSAC assessed the risks associated with the system's performance and the consequences of a levee failure during extreme flow conditions (Porter 2016; USACE 2016a). The consequence of both banks of the MCFCP failing is estimated by the USACE as placing a population of 21,700 at risk, along with 9,600 structures, and causing estimated damages of \$1.2 billion (USACE 2016a).

In response to the 2010 minimally acceptable rating by the USACE, the City of Walla Walla, Walla Walla County (through the MCFCZD), and the Walla Walla Downtown Foundation requested the assistance of the USACE, under the Planning Assistance to States (PAS) Program, to identify and conduct a preliminary assessment of alternatives for channel improvements and develop a plan for anadromous fish habitat and passage in the Mill Creek Channel (Shawa and Tompkins 2010). In 2013, after the USACE presented the results from the PAS study, the County, City, Port of Walla Walla, and Downtown Foundation formed the Mill Creek Coalition. In May 2015, the Mill Creek Coalition submitted a letter to the USACE committing to sign a Feasibility Cost Sharing Agreement to initiate a Mill Creek Feasibility Study and stating that the study of flood risk presented by Mill Creek is a high priority within the local community (Dozier et al. 2015). The USACE Walla Walla District is working to get the study included in the agency's budget request; however, as of the finalization of this Assessment, funding is not yet available.

1.4.2 Jurisdictional Framework

1.4.2.1 States of Washington and Oregon

The Mill Creek watershed is located in both Oregon and Washington. Both the Washington Department of Ecology (Ecology) and the Oregon Department of Environmental Quality (ODEQ) regulate water quality in Mill Creek. More information regarding water quality regulations relevant to Mill Creek and its tributaries is included in Section 2.6.

In addition, a number of flow diversions from Mill Creek impact the monthly in-stream flows. Some of these diversions are tied to water rights under the state of Washington and some are from the State of Oregon. Specifically, the City of Walla Walla's most senior water rights for its drinking water intake are under an Oregon water right. A detailed discussion of existing water rights is included in Section 2.4.

1.4.2.2 Water Resource Inventory Area 32

Mill Creek is within the Water Resource Inventory Area (WRIA) 32 Planning Unit, which encompasses the portion of the Walla Walla River Subbasin located within Washington State. Under Washington's Watershed Management Act (Revised Code of Washington [RCW] Chapter 90.82), a watershed plan for WRIA 32 (e.g., the Walla Walla Watershed Plan) was prepared by Ecology, Walla Walla County, Columbia County, City of Walla Walla, and Gardena Farms Irrigation District 13 in 2005, and adopted by the Walla Walla and Columbia counties' Boards of Commissioners later that year.

The Walla Walla Watershed Plan seeks to provide a method for balancing competing water resource demands, e.g., water quantity, water quality, aquatic habitat and in-stream flow (WWWPU 2005). It sets specific management actions for Mill Creek including recommended adoption of new rules to regulate in-stream flow levels and use of winter and spring high flows for water storage projects to improve stream flows for salmon. These new rules (amendments to Chapter 173-532 of the Washington Administrative Code [WAC]) were adopted on August 2, 2007, and include new in-stream flow requirements for Mill Creek.

1.4.2.3 Shoreline Master Programs

In compliance with the Washington Shoreline Management Act (SMA; RCW 90.58), Walla Walla County and the City of Walla Walla adopted Shoreline Master Programs (SMPs) in the 1970s and 1980s for the administration and enforcement of shoreline development. SMPs include goals, policies, and regulations to protect state shoreline environmental resources, give priority to uses that require a shoreline location, and promote public access and enjoyment opportunities. Consistent with the Washington Growth Management Act (RCW 36.70A.480), the County and City SMPs are considered subarea plans to their respective comprehensive plans. The regulatory elements of the SMPs are part of the City's and County's development regulations. See Section 1.4.2.4 for more information about the County of Walla Walla's Comprehensive Plan and Section 1.4.2.5 for more information about the City of Walla Walla's Comprehensive Plan.

Shoreline Master Program Update

In 2003, the legislature updated the SMA, including a mandate that all counties and cities update their SMPs by June 2016. In May 2013, Walla Walla County and three cities (Walla Walla, Waitsburg, and Prescott) entered into an agreement to collaborate on SMPs to avoid duplication of work and provide regulatory consistency, as the shorelines of affected rivers and streams cross jurisdictional boundaries. The county and participating cities provided oversight

of the SMP update through a project management team consisting of one member from each jurisdiction plus a project team leader. A regional working group consisting of property owners, recreationists, conservationists, business interests, tribes, planning commission members, and local, state and federal agencies acted as an advisory group to the project management team during the update process. The City of Walla Walla locally adopted the SMP update May 25, 2016 and Walla Walla County adopted the SMP update June 14, 2016. As of the publication of this Assessment, the SMP updates were still pending final approval by Ecology.

SMP Applicability to Mill Creek and its Tributaries

Mill Creek's shoreline is subject to both the Walla Walla County SMP and City of Walla Walla SMP. The shorelines of lower Yellowhawk Creek and Bennington Lake are subject to the county SMP. According to the SMA, shoreline jurisdiction includes land within 200 feet of the ordinary high water mark (OHWM) of the waterway, as well as floodways, floodplains within 200 feet of a mapped floodway, and associated wetlands (City of Walla Walla 2016a). The OHWM for Mill Creek through the Mill Creek Channel is determined to be either the tops of the levees or tops of concrete walls. The underground portion of the channel is excluded from required use preferences and height restrictions, but is subject to applicable city zoning regulations. Yellowhawk Creek above the confluence with Cottonwood Creek is not addressed, because it does not meet the SMA minimum threshold flow of 20 cubic feet per second (City of Walla Walla 2016a).

Both the county and city SMPs identify nine "Environmental Designations" with management policies and development standards specific to each. The policies and standards do not apply to existing development. Chapter 6 of both SMPs include a list of new, expanded, or altered shoreline activities, uses, developments, and modifications that are allowed or are prohibited within each environmental designation of the shoreline jurisdiction. Shoreline restoration and enhancement projects and in-stream structures for the protection, restoration, or monitoring of ecological functions or processes are permitted in all environmental designations, but may require issuance of a shoreline substantial development permit.

Critical Area Designations

The Washington Growth Management Act (GMA; RCW 36.70A) requires cities and counties to designate critical areas which include wetlands, aquifer recharge areas, fish and wildlife habitat conservation areas, frequently flooded areas, and geographically hazardous areas. Where these designated critical areas fall within the SMA jurisdiction, all proposed land uses and development activity are subject to the city or county SMP. The city or county will not approve

any permit to construct or alter any structure in, over, or on a critical area or associated buffer without first ensuring the proposed action complies with the requirements contained in Appendix A of the applicable SMP. The county and city SMPs have set a minimum shoreline buffer width (measured from the OHWM) for non-water-dependent developments of the following:

- 75–100 feet for Yellowhawk Creek below the confluence with Cottonwood Creek (determined by a riparian habitat buffer determination or established as a standard 100-foot-wide buffer);
- 50 feet for Yellowhawk Creek from Russell Creek to Mill Creek;
- 0 feet for Mill Creek from N. 3rd Avenue to S. Colville Street where flow is underground;
- 35 feet for all other area of Mill Creek within the MCFCP; and
- 100 feet for Mill Creek outside the MCFCP.

Conservation and restoration activities are allowed activities within the critical areas designations. Critical areas not subject to SMA jurisdiction may still be subject to regulation under the respective county and city critical areas ordinances.

1.4.2.4 County of Walla Walla Comprehensive Plan

Walla Walla County adopted the 10-year update of its Comprehensive Plan (County Comp Plan) in 2007. The County Comp Plan guides decisions about future development in the unincorporated areas of the county. It seeks to balance the need to accommodate population growth with the need to protect the environment. It embraces the principles of the Washington GMA (RCW 36.70A) through the incorporation of county-wide planning policies, designation of planning areas, establishment of a critical areas ordinance, and incorporation of comprehensive plans of communities, and corresponding urban growth areas. The County Comp Plan adopts and is consistent with its SMP (see Section 1.4.2.2).

As discussed above, the County Comp Plan establishes five primary types of critical areas and regulates uses in these areas under Walla Walla County Code (WWCC) Chapter 18.08. The purpose of these regulations is to "designate and classify ecologically sensitive and hazardous areas and to protect these areas and their functions and values, while also allowing for reasonable use of private property" (WWCC 18.08.005). Mill Creek, Titus Creek, Garrison Creek, Yellowhawk Creek, Doan Creek, and Russell Creek are all designated as critical areas with applicable riparian habitat buffers. The SMP designations are consistent with these habitat

buffers. See Table 1.4-1 for designations of stream habitat buffers within the Primary Focus Area. All proposed structures and activities must be located outside of the habitat buffers unless the structure or activity is an allowed use per WWCC Chapter 18.08 or has obtained an approved critical area report. These restrictions do not apply to existing structures. Allowed uses include conservation and restoration activities aimed at protecting the soil, water, vegetation, or wildlife (WWCC Chapter 18.08.085.B.)

Table 1.4-1. Walla Walla County Recommended Minimum Streamside Buffer Widths^{1/}

River Reach	Minimum Streamside Buffer Width ^{2/3/}
Mill Creek (Walla Walla River to Gose Street)	100 feet
Mill Creek (Gose Street to Bennington Diversion Dam)	35 feet (35 foot tree removal restriction along concrete channel sections)
Mill Creek (Bennington Diversion Dam to County Line and Upper Headwaters)	100 feet
Titus Creek	35 feet
Yellowhawk Creek	50 feet
Garrison Creek (College Place Wastewater Treatment Plant Outfall to Confluence with Walla Walla River)	50 feet
Garrison Creek (Yellowhawk to Lions Park)	35 feet
Doan Creek (Headwaters to Last Chance Road)	75 feet
Stone Creek (Headwaters to Teal Street)	35 feet
Russell Creek	35 feet

1/ Recommended buffer widths are identified in the critical area designation map. A riparian habitat shall have at least the buffer width recommended in this Table, unless a greater width is required pursuant to WWCC 18.08.674, or a lesser width is allowed pursuant to WWCC 18.08.675.

2/ In stream segments where Conservation Reserve Enhancement Program (CREP) buffers are established, and are larger than the minimum buffer listed in this table, then CREP buffers become the minimum streamside buffer width.

3/ Buffer width is measured for the ordinary high water mark.

Source: WWCC Chapter 18.08.650 Table 8

In waterbodies used by anadromous fish, all activities, uses, and alterations proposed to be located in these waterbodies must adhere to specific standards outlined in WWCC Chapter 19.08.650.C. These standards include the requirement that any impacts to the functions or values of the habitat conservation area where anadromous fish are present must be mitigated in accordance with an approved critical area report.

1.4.2.5 City of Walla Walla Urban Area Comprehensive Plan

The City of Walla Walla's Comprehensive Plan (City Comp Plan) was adopted November 2008 and sets a road map for how Walla Walla will develop and accommodate growth for the next 20 years. The City Comp Plan identifies the density, type, and intensity of land uses throughout the city, as well as the character and capacity of public facilities and services like streets and

utilities. It serves as the basis for the city's adoption of development regulations such as zoning, annexation and subdivision standards (City of Walla Walla 2008).

The City Comp Plan contains a series of goals, objectives, policies and actions intended to guide sound decision-making and sustainable practices to preserve the city's environment and natural resources. Policies specific to Mill Creek include:

- **Environment & Natural Resources Policy 9.** A Mill Creek Corridor Plan should be completed with a focus on the opportunity to “daylight” Mill Creek through the downtown.
- **Parks & Recreation Policy 13.** Mill Creek is a community resource and continuous access to it for recreation and appreciation should be encouraged through easement and land acquisition.

The City Comp Plan's Implementation Matrix (located in Element 3 of the Plan) assigns timeframes to each of its identified tasks for implementation of the Plan. Tasks relative to Mill Creek include:

- Task 24 – Initiate efforts to protect habitat while enhancing flood and water supply protection; timeframe ongoing.
- Task 25 – Initiate a Mill Creek Master Plan; timeframe medium term (5 to 10 years).
- Task 26 – Initiate a downtown Mill Creek daylighting demonstration project; timeframe long term (10 to 15 years).
- Task 93 – Prepare an acquisition plan for Mill Creek access; timeframe short term (1 to 5 years).

The City Comp Plan also describes the following future opportunities for Mill Creek in Element 17.0 titled “Appendix – Designing the Future”:

The main east-west trail corridor would be continuous along Mill Creek. The creek should be day-lighted at all possible locations and naturalized along its entire length. Mill Creek should become an ecological spine that unifies the entire City.

A first phase demonstration naturalization project could be developed next to the Army Corps of Engineers as part of an overall Master Plan for the Mill Creek Watershed that would outline improvements that would need to be made to address flooding hazard while enhancing and celebrating the creek throughout the City.

The City Comp Plan recognizes the need to maintain flood protection for the community, but also reflects a community vision that values and embraces the preservation and enhancement of Mill Creek as a natural system and urban amenity (City of Walla Walla 2008). The City Comp

Plan also offers conceptual designs that illustrate how the naturalizing of Mill Creek could be implemented. In one of these conceptual designs, Mill Creek is visualized as a naturalized creek through the downtown corridor that can still protect the community from flooding. Figure 1.4-2 is a simulation from the City Comp Plan illustrating a walkway cantilevered over the creek offering access, and a community mural – in this case the salmon – celebrating the community’s arts and artists.



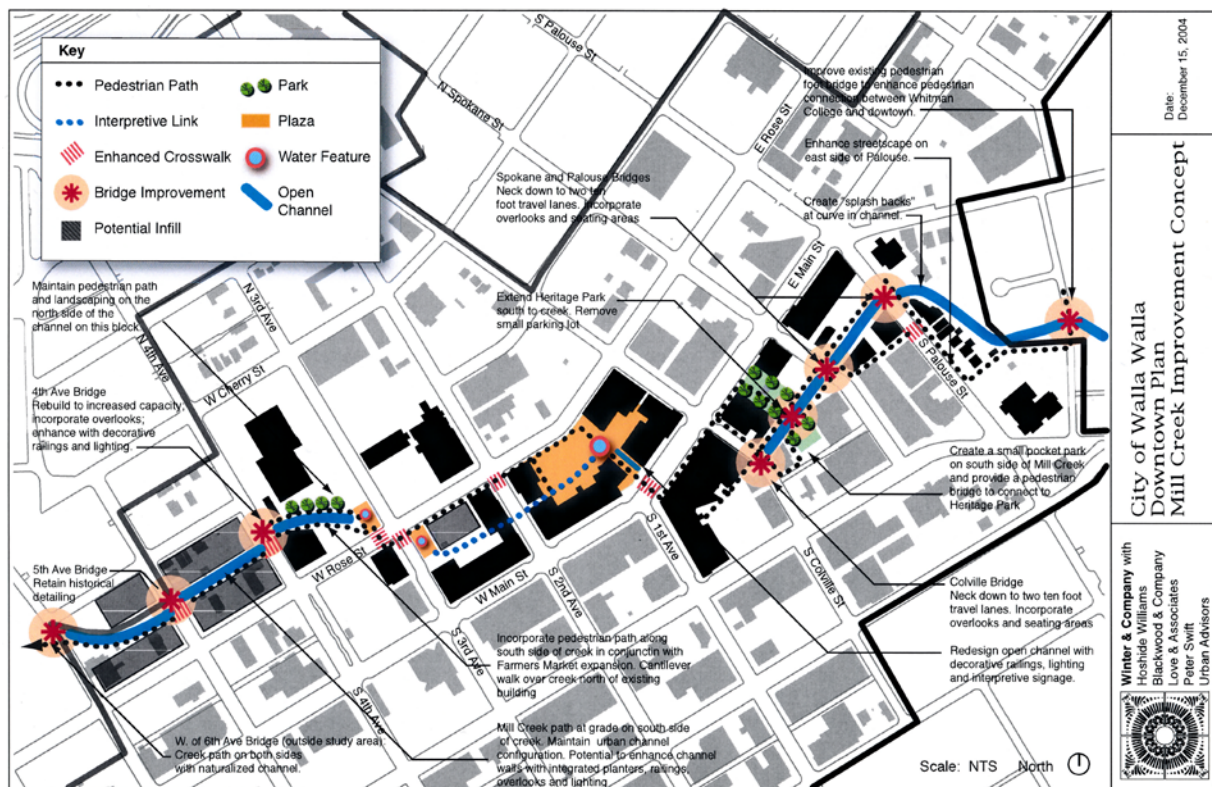
Source: City of Walla Walla (2008)

Figure 1.4-2. Mill Creek Rendering from City of Walla Walla Comprehensive Plan

The city has also identified critical areas in accordance with the GMA, which are regulated by the city’s critical area ordinance (Walla Walla Municipal Code Chapter 21.04). Mill, Titus, Garrison, Yellowhawk, Doan, and Russell creeks are all designated as critical areas with applicable riparian habitat buffers. These habitat buffers are consistent with the Walla Walla County critical area ordinance. The SMP designations were checked for consistency with the critical area ordinance habitat buffers. Implementation of these buffers is directed toward preserving the fish and wildlife resources by precluding development incompatible with these areas. See Section 1.4.2.3 above for more information on applicable riparian area buffers within the Primary Focus Area.

1.4.2.6 City of Walla Walla Downtown Master Plan

The City of Walla Walla Downtown Master Plan was adopted in December 2004 as a subarea plan to the City Comp Plan. The Downtown Master Plan is designed to direct high-quality infill and redevelopment to the downtown area, with a goal of providing a framework for the local and regional decision makers to use in planning for the future of downtown. Key strategies in the plan include the identification of Mill Creek as a vital community asset and proposed structural improvements to enhance the channel while preserving its flood protection function (City of Walla Walla 2004). The Downtown Master Plan envisions a revitalized Mill Creek that “flows cold, clear, and clean through Downtown” and includes direct pedestrian access and trail connections to neighborhoods and the regional trail system (City of Walla Walla 2004). The “Framework Strategy” in the Downtown Master Plan states, “Improve Mill Creek as a ‘spine’ of amenities that give special identity to the area. The channel structure should be rehabilitated and plazas and overlooks should be constructed. A creek trail also should be developed. In some places, this uses City sidewalks” (City of Walla Walla 2004). In addition, the “Public Amenities” chapter of the plan provides recommendations for future changes to Mill Creek and includes an improvement concept diagram (see Figure 1.4-3).

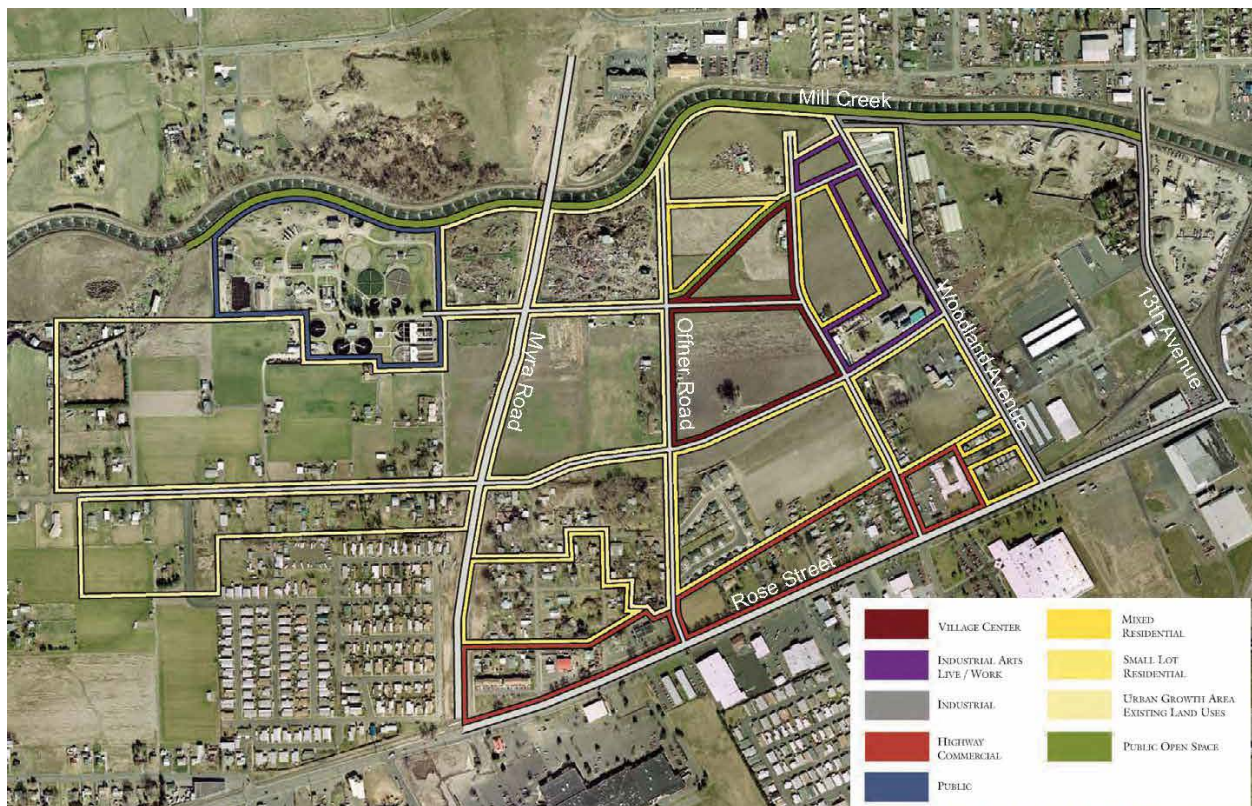


Source: City of Walla Walla (2004)

Figure 1.4-3. Mill Creek Improvement Concept from Walla Walla Downtown Master Plan

1.4.2.7 City of Walla Walla Myra Road Sub Area Concept Document

In 2007, the Development Services Department began formulating a strategy to manage development within a 290-acre area located in immediate vicinity to the Myra Road Extension Project. The Myra Road Sub Area Plan (adopted in 2009 as part of the City Comp Plan) was prepared in an effort to address the issue of compatible land use, and fulfill commercial and residential needs for the city. The area's northern boundary is Mill Creek, the eastern boundary is 13th Avenue, the southern boundary is Rose Street, and the western boundary is the Urban Growth Area boundary. One of the goals for the neighborhood includes providing a public greenway along Mill Creek (Figure 1.4-4; City of Walla Walla 2009a). Implementation will be guided by the policies of the City Comp Plan and the Myra Road Sub Area Plan.



Source: City of Walla Walla (2009a)

Figure 1.4-4. Myra Road Sub Area Plan

1.4.3 Recent and Ongoing Stream Improvement Projects

Various entities in the Walla Walla area have undertaken projects designed to improve fish habitat and/or passage conditions in lower Mill Creek and associated streams within the past 10+ years. Notable restoration-oriented projects sponsored by the Tri-State Steelheaders, Walla

Walla County Conservation District (WWCCD), Walla Walla Community College, and Blue Mountain Land Trust are summarized below.

1.4.3.1 Tri-State Steelheaders

The Tri-State Steelheaders have completed three key projects in the Primary Focus Area and have several current projects under way.

Mill Creek Fish Passage Assessment, 2009

In October 2009, Tri-State Steelheaders finalized the Mill Creek Fish Passage Assessment (Burns et al. 2009). The Mill Creek Working Group served as the steering committee for this assessment and provided technical input and direction for the assessment team. The study includes a detailed assessment of fish passage through the non-federal concrete portion of the Mill Creek Channel and conceptual designs for fish passage improvement. The objectives of this assessment were to identify the location and type of fish passage barriers, develop a prioritized list of fish passage problems, and prepare conceptual design options and cost estimates for correction of the problems (Burns et al. 2009). The assessment used hydraulic models and a fish energetics model to characterize the nature of barriers and determine passage ability. The design option selected was a retrofit roughened channel with resting pools. The assessment also identified a need for a low-flow channel in the concrete sill portion of the channel to address water quality and stranding issues.

Kooskooskie Dam Passage, Mill Creek Project, 2005

The Tri-State Steelheaders completed the Kooskooskie Dam Passage, Mill Creek Project in 2005. This project included the removal of a decommissioned 9-foot-high concrete dam that had been a water diversion for the City of Walla Walla. The dam blocked 32 miles of pristine spawning habitat in the upper Mill Creek watershed. The dam was constructed in 1907 and remained on the landscape for decades although it had been decommissioned. The dam and sediment that had accumulated upstream were removed, and over 680 feet of stream and associated riparian habitat was restored. This project was funded by the Washington Salmon Recovery Funding Board (SRFB) and the Washington Department of Fish and Wildlife (WDFW).

Yellowhawk Barrier Removal

This recently completed project involved design and implementation for removal of a dam on Yellowhawk Creek that had been constructed to create an irrigation withdrawal pool and was recognized as a fish barrier. The project included development of a series of weirs in the stream to improve fish passage and add pool frequency.

Ongoing Projects

The Tri-State Steelheaders currently have two projects underway:

- **Mill Creek Passage Project.** This project seeks to implement the fish passage design strategies described in the Mill Creek Fish Passage Assessment (Burns et al. 2009). These designs were further refined by Waterfall Engineering, LLC in a November 2010 report, Mill Creek Passage Conceptual Designs Final Report (Waterfall Engineering 2010). The Tri-State Steelheaders acquired funding from the SRFB, BPA, and CTUIR to implement these fish passage projects in the concrete channel of Mill Creek near and in downtown Walla Walla. Project work includes fixes to passage problems at the channel transitions at the Roosevelt Street and at 9th Street bridges, design and installation of weirs, baffles, and roughness panels that provide slower-velocity resting areas for upstream migrating steelhead through the concrete channel, and the notching of four sills near the Tausick Way Bridge to provide low-flow passage similar to the three sills the USACE notched for low flow passage upstream of the Division Works Dam.
- **Creating Urban Riparian Buffers.** This project includes the restoration of native riparian vegetation along numerous creeks in the cities of Walla Walla and College Place. The project was initially funded by Ecology and implemented through a partnership with Tri-State Steelheaders, Kooskooskie Commons, Walla Walla Basin Watershed Council, the WWCCD, and participating landowners. The project offered technical assistance, supplies, materials, and labor to landowners for the restoration of native riparian vegetation, which will improve water quality, stabilize stream banks, and provide shade, nutrients, and food for aquatic species. While state funding for the project has been cut, the WWCCD continues to offer technical assistance to landowners for planting riparian buffers along backyard streams.

1.4.3.2 Walla Walla County Conservation District

The primary mission of the WWCCD is to obtain grants to assist landowners in implementing conservation practices that protect natural resources. The organization offers technical assistance and cost sharing when possible. WWCCD programs help landowners reduce erosion, protect fish species and habitats, improve water quality, and conserve soil.

Completed and Active WWCCD Projects

Active, proposed, dormant, conceptual, and completed WWCCD-sponsored projects are identified on a web-based map (WWCCD 2016a), and Table 1.4-2 includes a list of completed and active projects being undertaken by the WWCCD.

Table 1.4-2. WWCCD Completed and Ongoing Projects^{1/}

Project Name/Description	Status	Sponsor ^{2/}	Funding Source ^{2/}
Gose Street Fish Passage	Completed	WWCCD	BPA, SRFB, CTUIR
Mill Creek Irrigation Fish Screens.	Completed	WWCCD	BPA, LCS, SRFB, CTUIR
Jones Ditch – passage, screening, and habitat. Project will design a restructured diversion entrance, including fish compliant screens on Mill Creek and exit to Yellowhawk Creek to allow water into Jones Ditch year-round. The ditch will become a 1.4-mile passage/rearing habitat distributary for salmonids.	Active	WWCCD, WDFW	SRFB, USACE
Conservation Reserve Enhancement Program (CREP). Land enrolled in CREP is removed from production and grazing under 10- or 15-year contracts. Landowners plant trees and shrubs to stabilize the stream bank. Active programs on Mill Creek include the Mill Creek Restoration and Protection Reaches.	Active	WWCCD	LCS, USDA
Cold Creek Habitat Assessment/Design. Project would assess the potential of reconnecting Cold Creek to Doan Creek or Mill Creek where appropriate, and a 30% design would be developed for channel construction.	Conceptual	WWCCD	Not funded
Doan Creek Culvert Project. Project would work to relocate a culvert stream crossing that may be a fish barrier, replacing the culvert with an open bottom box.	Conceptual	WWCCD, WDFW	Not funded
Doan Creek Habitat Work in College Place. Project would lengthen and improve a portion of Doan Creek, which was historically straightened, ditched, and diverted into a pipe. The project would extend the benefits of previous similar projects on Doan Creek.	Conceptual	WWCCD, WDFW	Not funded
Mill Creek Recreation Fields (Schulke) Ditch. This project will design and install fish screens to prevent fish from entering the Schulke ditch on Mill Creek.	Conceptual	WWCCD	Not funded

1/ Source of project list: Shoreline Restoration Plan (The Watershed Company 2015).

2/ Funding Source Abbreviations: Walla Walla County Conservation District (WWCCD); Bonneville Power Administration (BPA); Landowner Cost Share (LCS); Salmon Recovery Funding Board (SRFB); Confederated Tribes of the Umatilla Indian Reservation (CTUIR); Washington State Department of Fish and Wildlife (WDFW); U.S. Army Corps of Engineers (USACE); U.S. Department of Agriculture (USDA).

Titus Creek Diversion Fish Passage and Screening Project

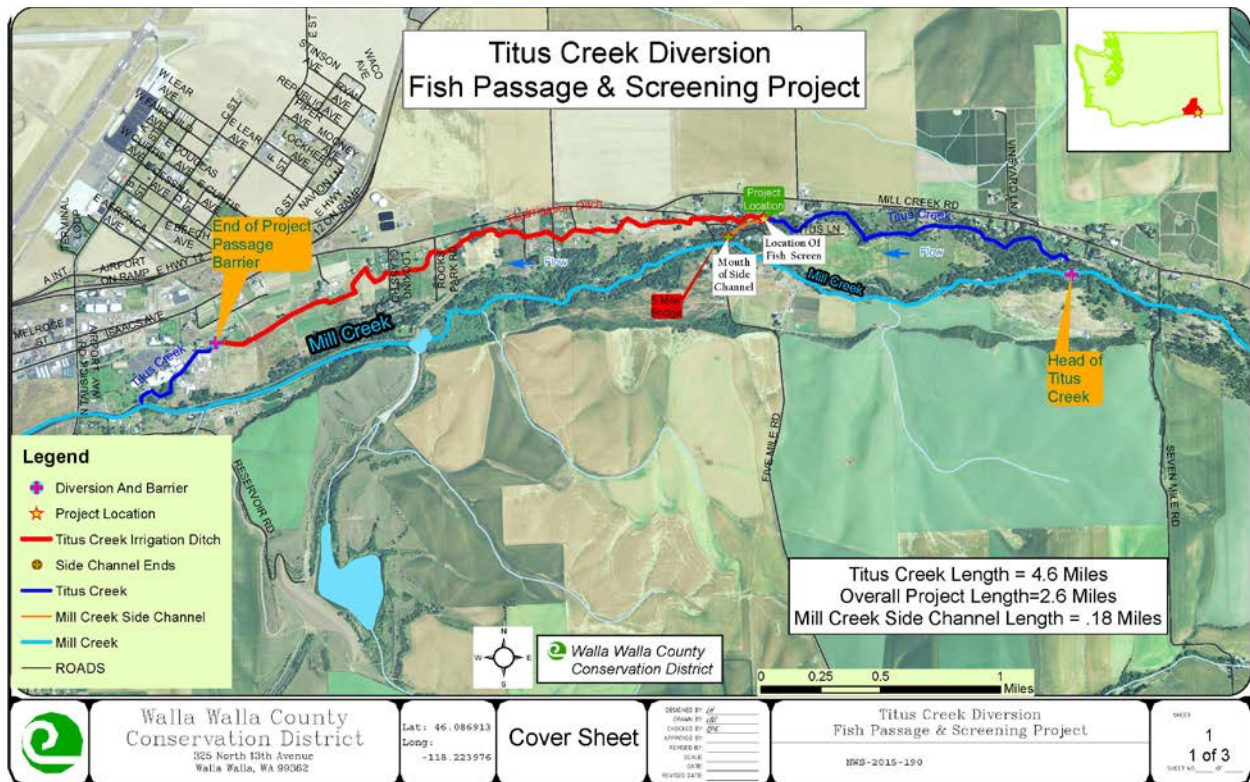
In addition to the projects listed in Table 1.4-2, the WWCCD partnered with WDFW to design and implement the Titus Creek Diversion Fish Passage and Screening Project (see Figure 1.4-5). Titus Creek is a side channel within the Mill Creek floodplain that originates at Mill Creek RM 14.5 and is supplemented with spring-fed flow towards the lower end. The inlet to upper Titus Creek is maintained by private landowners in the spring and summer to provide water for Mill Creek water rights that are drawn from Titus Creek (USFWS 2011). Upper Titus Creek flows approximately 2 miles west, parallel to Mill Creek, to a point where the majority of the water was diverted into the Titus Creek Irrigation Ditch by a concrete and riprap barrier. At this diversion point, a small side channel (0.18 miles long) connects upper Titus Creek back to Mill

Creek. The side channel has good habitat qualities for all stages of salmonids; however, the diversion structure blocked fish migration through the side channel and effectively forced juvenile fish into the Titus Creek Irrigation Ditch, where they could become stranded as portions of the ditch ran dry in the winter (WWCCD 2015). The Titus Creek Irrigation Ditch services 18 separate irrigation pumping stations (WWCCD 2014) and currently has limited fish habitat.

This project removed the diversion structure, re-graded the entrance into the side channel from Titus Creek, and installed three rock-sill grade control structures to provide a step-pool fish way entrance into the lower side channel. A modular 5 cubic feet per second (cfs) rotary drum fish screen was installed at the diversion location to prevent fish from moving downstream through the Titus Creek Irrigation Ditch, and instead direct them through a bypass into the side channel that returns them downstream to Mill Creek. The project also included enhancement of riparian cover and large woody debris in the side channel to improve fish habitat (WWCCD 2014).

There is also a lower section of Titus Creek (lower Titus Creek) that starts from an active spring (pond) and runs through the Walla Walla Community College campus and back into Mill Creek. The Titus Creek Diversion Fish Passage and Screening Project also included retrofitting an existing structure at the spring to block passage upstream into the Titus Creek Irrigation Ditch from the spring pond (WWCCD 2014).

The Titus Creek Diversion Fish Passage and Screening Project does not preclude any future actions to improve and restore additional reaches of Titus Creek as Titus Creek has the potential to provide side channel rearing habitat. NMFS has corresponded with WWCCD and both are in agreement that the proposed, removable fish screen and bypass channel work is not a permanent structure and may be removed if future restoration proposals are developed for other areas of Titus Creek (NMFS 2015b). The CTUIR also recognizes the important side channel habitat Titus Creek historically and currently provides and seeks to enhance habitat in this creek and eventually remove fish passage barriers to and within this stream.



Source: Walla Walla County Conservation District

Figure 1.4-5. Titus Creek Diversion Fish Passage and Screening Project

1.4.3.3 Walla Walla Community College

Lower Titus Creek flows through the Walla Walla Community College campus, and the college’s Water and Environmental Center is located within 50 yards of the creek. Starting in 2008 and completed in 2010, the college was able to restore 1,000 feet of lower Titus Creek and demonstrate desired habitat conditions for salmonid recovery. With the help of a grant from SRSRB, the college was able to remove the cement lining to the spring-fed pond, replace it with in-stream habitat and native riparian plantings, install a buffer to divert the water into the natural channel, and improve fish passage and habitat on lower Titus Creek. The project helps lower water temperature and improve the quality of water reaching Mill Creek.

1.4.3.4 Blue Mountain Land Trust

The Blue Mountain Land Trust is a non-profit organization that works with landowners to create conservation easements on private property to preserve land in the Blue Mountain region for recreation, education, open space, habitat, farming, forestry, and historical purposes. Blue Mountain Land Trust currently holds two easements along Mill Creek, totaling 75 acres. These easements are managed to protect aquatic values, fish and wildlife habitat, and working farm

lands, and help protect against stream channelization, grazing, development, flood control structures, and other alteration of the natural stream course.

1.4.3.5 USACE Activities

The USACE operates and maintains the portion of the Mill Creek flood control channel for approximately 1 mile from the Bennington Diversion Dam downstream to the Division Works Dam at RM 10.5. The USACE owns the portion of the Mill Creek Channel from RM 10.5 to RM 11.5 (USACE 2015a) but has designated all portions of the channel downstream from the Division Works Dam to Gose Street (RM 4.8) to be operated and maintained by the MCFCZD. Flow diversions for irrigation are determined by the Walla Walla County Water Master, operating under guidance from Ecology. The USACE determines the flows to be released through and over Bennington Diversion Dam or diverted to Bennington Lake using operating procedures that were put in place after the 1996 flood and from the interim risk reduction measures (IRRM) put in place from the dam safety evaluation of Lake Bennington (USACE 2015a). The USACE prepares master plans to guide management of project resources and provide a vision for future project conditions. The USACE issued a draft master plan update in September 2015 and adopted the final Mill Creek Project Master Plan in January 2016 (USACE 2016b). The agency has also undertaken a number of other study efforts associated with the Mill Creek Project in recent years, as summarized below.

USACE Biological Assessment for MCFCP Operation and Maintenance

The USACE submitted a draft Biological Assessment (BA) to NMFS and USFWS in March 2003 that evaluated the effects of continued operations and maintenance of the federally owned portion of the MCFCP. The BA was prepared pursuant to Section 7(a)(2) of the ESA. Formal consultation with NMFS and USFWS began with the submission of the draft BA. In October 2003, NMFS met with the USACE to discuss temporary adjustments to operations and maintenance of the MCFCP during the consultation process.

In October 2007, the USFWS issued a BiOp for the MCFCP (USFWS 2007) regarding the effects of the ongoing operations and maintenance of the MCFCP on bull trout. It concluded that ongoing operations would not likely jeopardize the continued existence of bull trout or destroy or adversely modify designated critical habitat for bull trout. However, the BiOp's terms and conditions did require the USACE to construct a low-flow channel within the Mill Creek Channel between Bennington Diversion Dam and the Division Works Dam by April 2012 and to improve fish passage at Bennington Diversion Dam by October 2012. To date, neither of these terms and conditions have been met; however, in 2013, the USACE completed some low-

flow notching to three weirs in the Mill Creek Channel between the Division Works Dam and the Bennington Diversion Dam (USACE 2015a).

In September 2011, NMFS issued a BiOp for the MCFCP (NMFS 2011) regarding the effects of the ongoing operations and maintenance of the MCFCP on Mid-C steelhead. NMFS concluded that ongoing operations of the MCFCP would likely jeopardize the continued existence of the Mid-C steelhead and result in the destruction or adverse modification of designated critical habitat for Mid-C steelhead. NMFS identified RPAs for the USACE to avoid take (harm, injury, and/or mortality of) Mid-C steelhead. The RPAs included five elements:

- Element 1: The USACE development of an interim vegetation variance that promotes the development of riparian vegetation in the forebay and on the levees, as well as development of a plan to redesign the existing levee structures to include planting benches, overbuilt levee prism, or levee setback areas where riparian vegetation can develop.
- Element 2: The USACE will work with the local flood zone district, local governments, and other stakeholders to implement levee management consistent with the habitat and water quality requirements of steelhead.
- Element 3: The USACE will construct a low-flow channel along the south bank of Mill Creek and will modify or replace fish passage structures at Bennington Diversion Dam and at the Division Works Dam to meet NMFS passage criteria by October 2015 or will reinitiate consultation with NMFS.
- Element 4: The USACE will salvage fish in the Mill Creek channel downstream of the first division works when flows become too low for fish to pass over the sills and move out of declining habitat conditions.
- Element 5: The USACE will initiate unscreened diversion into Bennington Lake only in response to flood events that are expected to exceed 3,500 cfs in Mill Creek.

In February 2012, the USACE sent a letter to NMFS that refused acceptance of the NMFS RPAs or findings in the BiOp stating that the RPAs were outside the authorities of USACE and could not be implemented without additional Congressional action. The letter also indicated that the USACE would reinitiate consultation with NMFS upon completion of an updated BA for the ongoing operation and maintenance of the MCFCP. A series of meetings were held between the USACE, NMFS, and USFWS from March to June 2012 resulting in the determination that the

USACE would provide an updated BA to NMFS and would reinitiate consultation with the USFWS.

In June 2015, an updated BA (USACE 2015a) was submitted by the USACE to the USFWS and NMFS for review. Formal consultation is still ongoing; however, because the USACE is currently preparing a supplemental Environmental Impact Statement (EIS) for the operations and maintenance of the MCFCP, NMFS will wait to issue the Draft BiOp until after USACE determines their final alternative under the NEPA process (pers. com., Diane Driscoll, Fisheries Biologist, NMFS, Ellensburg, Washington, May 3, 2017).

Mill Creek Low-Flow Channel Study

In 2011, USACE published an Environmental Assessment proposing construction of a section of low-flow channel within the federal portion of the Mill Creek Channel to test low-flow fish passage options and construction methods (USACE 2011a). The agency conducted this assessment in response to the USFWS and NMFS BiOp guidance. The low-flow channel is designed to reduce or delay high summer water temperatures and improve connectivity and migration at low flows for Mid-C Steelhead and bull trout. The USACE identified the best options and construction methods that could potentially be used in the future to create a low-flow channel within the entire federally owned channel. Three weirs were modified in 2012 by notching (cutting out approximately 21.5 feet), creating one double-drop and two single-drop fishways in the test section of the channel.

In November 2014, USACE reported to the Mill Creek Working Group that further modification of weirs would occur as operations and maintenance budget would allow. The USACE staff noted that at the current rate, it would take more than 20 years to complete the modification of all of the weirs within the federally controlled portion of the Mill Creek Channel (Mendel 2015).

Section 1135 Fish Passage Improvement at Bennington Lake Diversion Dam

Under its Section 1135 program for Project Modifications to Improve the Environment, the USACE prepared a Detailed Project Report and Environmental Assessment to present analysis and recommendations for a fish passage improvement project at Bennington Diversion Dam (USACE 2012a). The primary problem is with the left-bank fish ladder that limits the ability of some fish, including ESA-listed fish, to move upstream past the dam. The existing ladder, built in 1982, does not meet Washington State fish passage standards, nor does it meet NMFS fish passage criteria for ESA-listed steelhead. As described above, the inadequacy of the ladder is also noted in the USFWS 2007 BiOp and the NMFS 2011 BiOp regarding operation of the MCFCP.

The Section 1135 process began in spring 2002 when WDFW engaged with the USACE regarding this effort and offered to be a local sponsor. Progress was made slowly through late 2003 when the process began to delay due to funding, contractual issues, and lack of leadership at the USACE (Mendel 2008). The draft Section 1135 Feasibility Report was eventually released by the USACE in September 2012 (without a completed National Environmental Policy Act document and Finding of No Significant Impact or final designs). The report states that, in addition to problems with the Bennington Diversion Dam ladder, ESA-listed and other fish have been trapped in the stilling basin and have died when the water is drained out. The current configuration of the low-flow outlet, the primary downstream passage route for fish, is also less than ideal because of its effects on fish that pass through the outlet and the approach conditions to the fish ladder.

Alternatives evaluated included a new fish ladder on the right bank, a swim-through channel, a roughened channel, and a pool and weir channel. Feasibility-level design drawings were included for the final array of alternatives. A new fish ladder on the right bank was identified as the preferred alternative because it had the least cost and most benefit while meeting the requirements of WDFW. The estimated total project cost at Fiscal Year 2013 price levels was \$8.11 million. Because there is a \$5 million statutory limit on the federal cost for a Section 1135 project, the cost share for the non-federal sponsor would therefore be much higher than the standard 25 percent share. WDFW originally agreed to be the local sponsor; however, the draft Section 1135 Feasibility Report identified the local sponsor as being responsible for providing perpetual maintenance funding of the fish ladder (Mendel 2015). WDFW withdrew as the local sponsor in February 2013 and the report was never finalized due to lack of a cost-share sponsor agreeing to proceed with construction and taking responsibility for future operation and maintenance costs.

In November 2014, the USACE reported to the Mill Creek Working Group that the designs for the Bennington Diversion Dam ladder and the low-flow channel were complete or nearly complete but would be shelved until further funding became available. Also, in response to NMFS's requirement to modify or replace the fish passage structure at the Division Works Dam by October 2015 (NMFS 2011) the USACE completed fish ladder modification designs for the Division Works Dam in 2013 under a separate authority than Section 1135 but implementation of these modifications is on hold until further funding becomes available (USACE 2015a). In April 2015, the USACE reported to the Mill Creek Working Group that they did not receive funding for 2015 or 2016 for fish passage improvements at Bennington Diversion Dam or the Division Works Dam (Mendel 2015).

Assessment of Storage Potential at Bennington Reservoir

In collaboration with Ecology, the USACE explored potential use of Bennington Lake as a storage reservoir by capturing the tail end of spring flows after the seasonal flood potential has diminished. These flows would be stored in the lake and released later to increase base flows in Mill Creek during the irrigation season for the benefit of salmon. The assessment determined that the reservoir has structural deficiencies that prevent its use for this purpose, and that retrofit costs would be too high (Cummings 2006).

Dam Safety Action Classification

The USACE conducted evaluations under the Dam Safety Action Classification program in 2009 to 2010 as a result of seepage and piping issues at the Bennington Diversion Dam and the contiguous levee. The report identifies the deficiencies considered in the analysis to support development and implementation of the appropriate IRRMs to ensure public safety. Some of the IRRMs have been implemented, and the USACE is monitoring the project's performance and will take appropriate actions if necessary. The USACE is also pursuing funding to implement remaining IRRMs and longer-term solutions to correct deficiencies and reduce risk to the Walla Walla community.

Mill Creek Planning Assistance to States

In 2011, the USACE MCFCZD and Walla Walla County Public Works Department signed a Letter of Agreement to conduct a study under the PAS Program. The goal of the study was to identify when the Mill Creek Flood Control Channel has reached the end of its effective design life, to determine the costs and benefits of bringing the flood control channel into compliance with federal standards, and establish whether the channel is still capable of providing its intended level of flood risk reduction to the City of Walla Walla and surrounding areas. The USACE completed the study in May 2013, concluding that implementing the repair/maintenance schedule outlined in the 2011 Levee Deficiency Correction Plan would minimize the impacts of deferred maintenance and repairs and allow the project to continue to provide reliable flood risk reduction. The assessment team believed that the Mill Creek Channel was aging well, that there was no reason to expect the system was approaching the end of its economic life, and that rebuilding the channel would cost far more than would continued maintenance (USACE 2013a).

Mill Creek Feasibility Study

As stated in Section 1.4.1.4, the Mill Creek Coalition submitted a letter to the USACE in May 2015 with a commitment that they would sign a Feasibility Cost Sharing Agreement to initiate a

Mill Creek Feasibility Study. The letter stated that the study of flood risk presented by Mill Creek is a high priority within the local community (Dozier et al. 2015). The USACE Walla Walla District requested funding for a Mill Creek feasibility study to be part of the President's Fiscal Year (FY) 2017 budget proposal to Congress that was submitted in February 2016. While it was ultimately not included in the President's FY 2017 proposed budget, there are indications that it could be on the list within the next three years. As noted above, all Mill Creek Coalition members are prepared to provide cost-share funding. The proposed feasibility study would likely focus on flood control and may not fully consider measures and alternatives to address the complete range of ecological issues in lower Mill Creek.

Mill Creek Levee Vegetation Removal

The USACE (2015b) released an Environmental Assessment/Finding of No Significant Impact in September 2015 regarding a proposed action to remove woody vegetation from the landward side of the levees along the federally owned portion of the flood control channel to meet flood risk maintenance requirements in accordance with updated USACE regulations and policies. This policy mandates that a corridor including the levee structure plus 15 feet from the landward and riverward levee toes remain free of all woody vegetation to provide access to and along the levee for surveillance, inspection, maintenance, monitoring, and flood-fighting. The USACE asserts that tree root systems within the levee structure compromise the integrity of the levee and create safety concerns during high water events, though other stakeholders disagree and alternative vegetation management criteria have been adopted by the USACE elsewhere. To date, vegetation on the riverward side levees has been maintained in grasses and small shrubs, which are allowable under the policy. Vegetation clearing was completed in December 2015.

2. Characterization of Historic and Existing Conditions

2.1 CLIMATE AND PRECIPITATION

The Project Area lies within the eastern portion of the Walla Walla subbasin, within the rain shadow of the Cascade Mountains. This results in an arid steppe habitat, especially within the lower subbasin (NPCC 2005). Within the subbasin, the Mill Creek watershed ranges in elevation from just under 600 feet at the confluence of Mill Creek with the Walla Walla River to 6,250 feet at Table Rock, the highest point in the watershed. The Mill Creek watershed generally has a temperate climate; however, conditions vary considerably between the warmer, drier conditions in the west and cooler, wetter conditions in the Blue Mountains to the east. The area is characterized by cooler winters and warmer summers (see Figure 2.1-1).

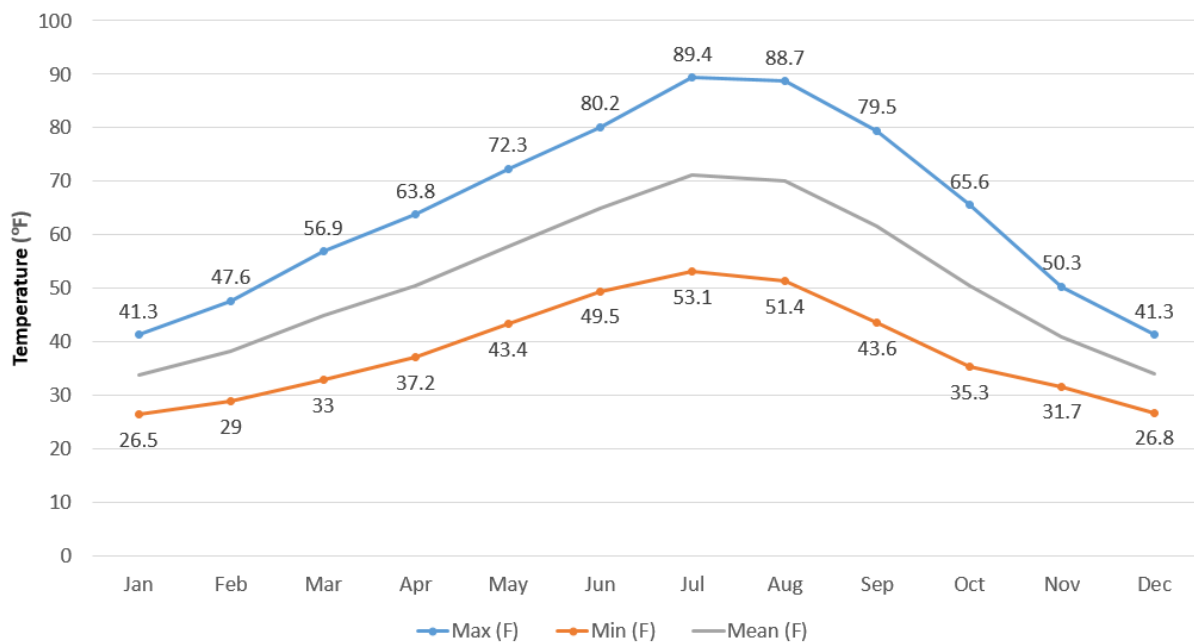


Figure 2.1-1. Average Monthly Air Temperatures at Whitman Mission, Station 459200 near the Mouth of Mill Creek (1962 – 2012)

Within the Project Area, the majority of the precipitation falls as rain, with very little occurring during the summer (Figure 2.1-2). Average annual precipitation ranges from around 14 inches near Whitman Mission (WWRC 2016a) to 20 inches near Walla Walla Regional Airport and Bennington Diversion Dam (WWRC 2016b, 2016c). Precipitation is considerably higher in the

headwaters, with an average of approximately 40 inches of precipitation annually near the Oregon-Washington border (WWRC 2016d).

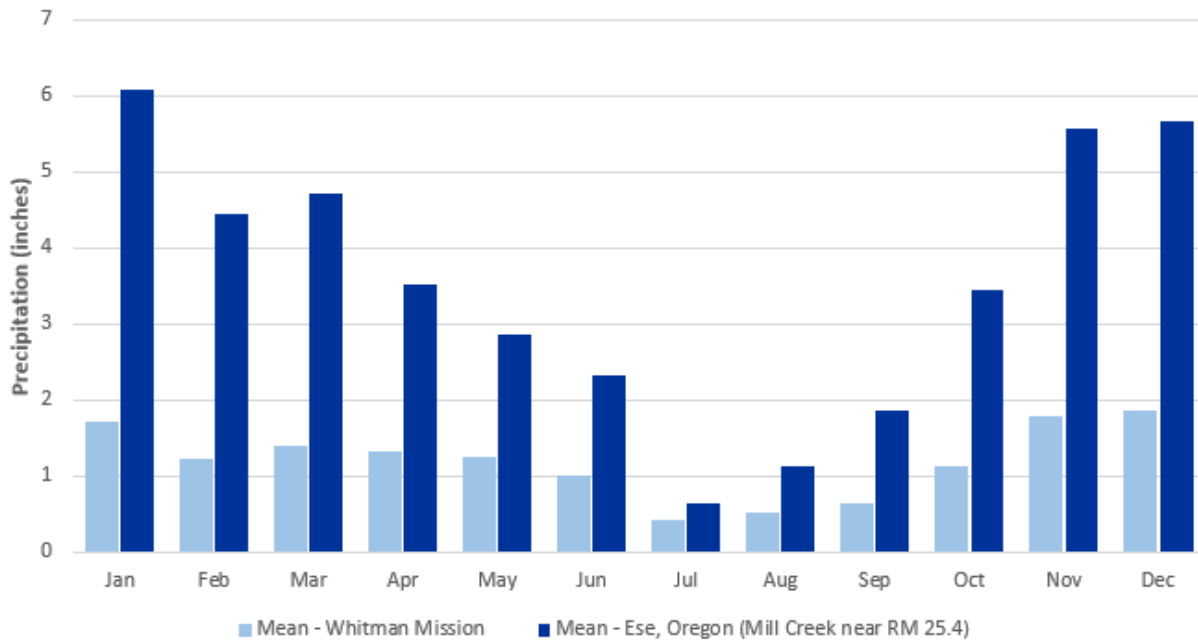


Figure 2.1-2. Average Monthly Precipitation (in inches) for Mill Creek Watershed at Whitman Mission and at Ese, OR (RM 25.4)

Snowfall is higher near the headwaters of Mill Creek, averaging 40 to 65 inches per year (WWRC 2016d). Within the Project Area, snowfall averages around 10 inches near Whitman Mission (WWRC 2016a), 12 inches near Bennington Diversion Dam (WWRC 2016b), 65 inches near RM 25.4 (WWRC 2016e), and 16 inches per year near the Walla Walla Regional Airport (WWRC 2016c).

Winds vary throughout the year, with the highest winds—average maximum wind speed of 17 miles per hour (mph)—generally occurring mid-March to mid-April (WeatherSpark 2016). Average daily means are around 7 to 10 mph. Winds are generally from the south and southwest (approximately 32 percent and 19 percent of the time, respectively; WeatherSpark 2016).

Climate change is likely to result in warmer air temperatures, with more precipitation in the winter and less in the summer (FEMA 2011). In addition, it is predicted that more winter precipitation will fall as rain, including in the headwaters. This could change peak flow timing and magnitude (USFWS 2011). Furthermore, reduced snowpack would limit summer water supply (Mote et al. 2003). Recent analysis of projected climate change impacts in the lower Blue

Mountain region indicates that 7-day average water temperatures could increase on the order of 3.2 degrees Celsius (°C) by 2065, and the 100-year 24-hour flood flow could increase by up to 21 percent by mid-century (Tetra Tech 2015). At the same time, critical low flows would decrease (Tetra Tech 2015).

2.2 GEOLOGY AND SOILS

2.2.1 Geologic History and Conditions

The Mill Creek watershed is located just southeast of the middle of the Columbia River Plateau. The present day landscape of the Mill Creek watershed and surrounding region exhibits a patchwork of surfaces that are the result of the basalt bedrock, folding and faulting, cataclysmic glacial outburst floods during the ice age, the redistribution of wind-blown silts, and the constant action of streams and rivers reworking the valley floor.

The bedrock of the Walla Walla basin is a part of the Columbia Basin Basalt group (see Figure 2.2-1). In the Miocene epoch large eruptions resulted in extensive lava flows accompanying subsidence of the earth's crust, forming the depression of the Columbia Basin (Carson and Pogue 1996). The Grande Ronde Basalt is among the oldest of these lava flows and upwelled through numerous fissures, called dikes, throughout central Washington. These lava flows flowed westward. Later, the Wanapum Basalt (Frenchman Springs Member, Columbia River Group) flows followed a similar path, on top of the Grande Ronde Basalt group. The Saddle Mountain Basalts are more limited in distribution and are on top of the Wanapum Basalts (Lindholm and Vaccaro 1988). These basalt layers have heterogeneous hydraulic properties, resulting in multiple aquifers of varying recharge capacity (Lindholm and Vaccaro 1988).

The Wanapum basalts form the bowl-shaped topography of the Walla Walla basin, which is bounded by the Blue Mountains to the east, Horse Heaven Hills to the south, Palouse Slope to the north, and the Divide Anticline to the west, all of which are underlain by these basalts. This basin was filled with clastic (i.e., fragmented older rock) sediments derived from the Blue Mountains millions of years ago, during the Miocene. These sediments occur in two distinct layers: fine-grained sediments (i.e., silt, sand, and clay) predominant of basalt origin on the bottom, and a coarser conglomerate layer (i.e., coarse rounded clasts within a matrix of finer material) deposited from continued erosion during ongoing uplift of the Blue Mountains on the top (Derkey et al. 2006). The area is also crossed by the Hite fault and the Olympic-Wallowa lineament (Carson and Pogue 1996). The geologic cross section in Figure 2.2-2 illustrates the geology underlying lower Mill Creek, along with local faults.

During the Pleistocene ice age, a series of glacial outburst floods dramatically altered the Walla Walla Valley and surrounding area (Bretz 1969, Bjornstad 2006). Glacial flood waters encountered a severe bottleneck at the bedrock constriction known as Wallula Gap, resulting in impoundment of flood waters that covered the Pasco basin and extended up many tributaries, such as the Snake River, Yakima River, and the Walla Walla Valley (Bretz 1969, Bjornstad 2006), reaching up to 50 feet deep where the City of Walla Walla is today. Fine sediments, known as rhythmites, deposited in slackwater areas during these glacial flood events, developing into what are now known as the Touchet Beds, which can be hundreds of feet thick (Bjornstad 2006). Throughout the Pleistocene, winds redistributed flood sediments; creating a blanket of silt, known as loess (Newcomb 1965). The loess covered existing rolling hills and terrace landforms (Newcomb 1965).

Throughout the current Holocene Epoch, beginning 12,000 to 11,500 years ago, streams have reworked and deposited alluvium (i.e., sediments deposited by flowing water) in the valleys (Derkey et al. 2006). As shown in Figures 2.2-1 and 2.2-2, extensive alluvium deposits are found adjacent to lower Mill Creek.

These geological conditions affect many processes within the Mill Creek watershed. Folding and faulting of the bedrock resulted in the bowl-shaped basin that accumulated sediments from various sources (clastic, colluvial, and alluvial). Glacial flood deposits were influenced by the bedrock constrictions, and the wind-blown loess blanketed the topography of the Walla Walla basin. The bedrock and colluvial/alluvial deposits result in various geologic layers containing deep bedrock aquifers as well as the shallower gravel and alluvial aquifers in the Mill Creek watershed.

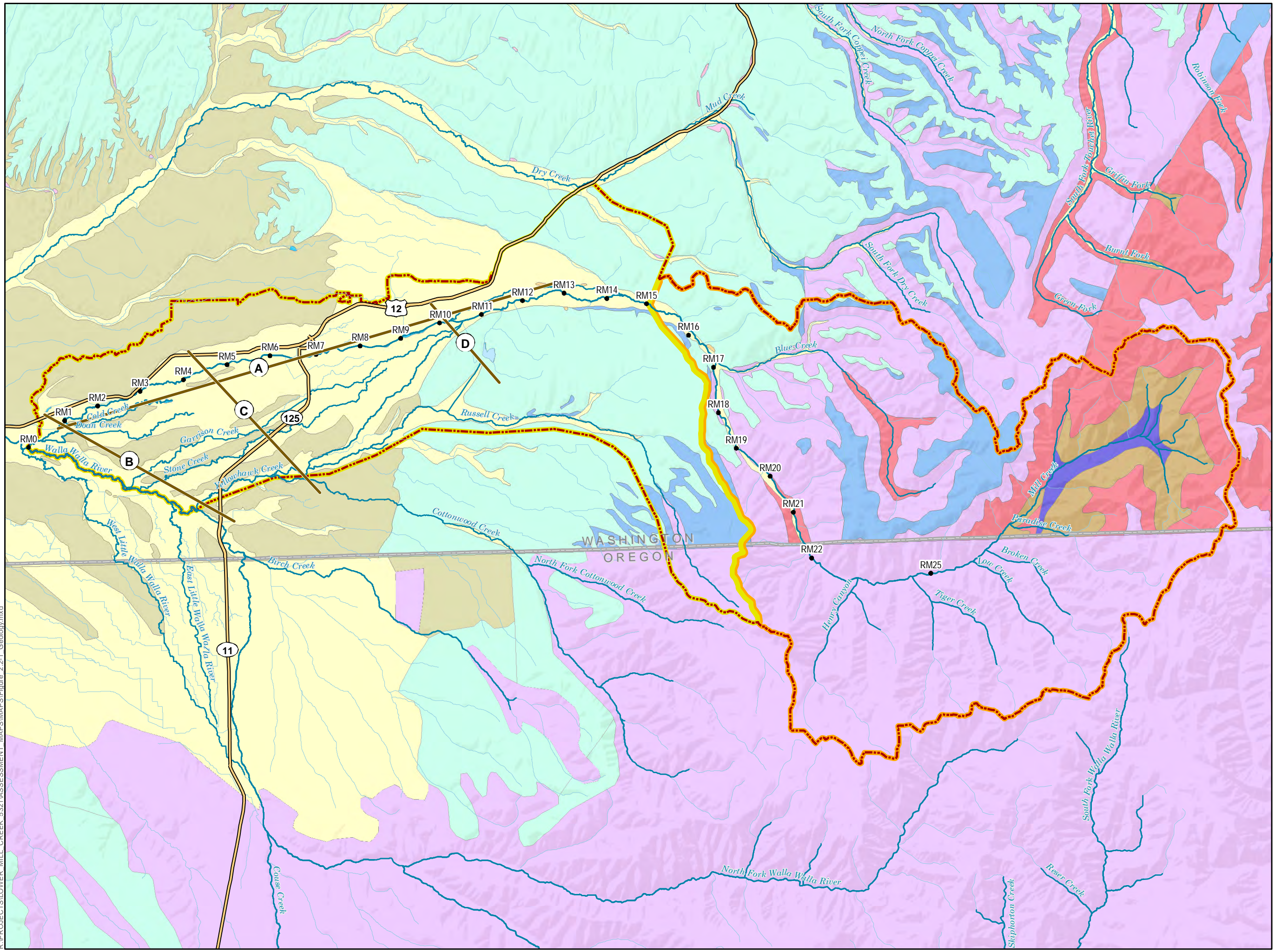
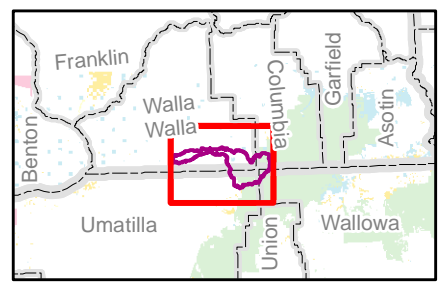
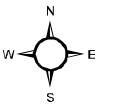
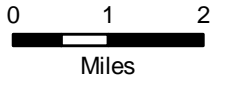
LOWER MILL CREEK HABITAT AND PASSAGE ASSESSMENT

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE 2.2-1
GEOLOGY**

- River Miles
 - Cross-Section (See Profile Figures 2.2.3a-2.2.3d)
 - Highways
 - Major Stream
 - Minor Stream
 - Waterbody
 - Project Area
 - Primary Focus Area
 - Secondary Focus Area
- Geologic Unit
- Mv(gN1): Grande Ronde Basalt, N1 (CRB)
 - Mv(gN2): Grande Ronde Basalt, N2 (CRB)
 - Mv(gR1): Grande Ronde Basalt, R1 (CRB)
 - Mv(gR2): Grande Ronde Basalt, R2 (CRB)
 - Mv(wfe): Frenchman Springs and Eckler Mountain Members, Wanapum Basalt
 - Mv(wfs): Frenchman Springs Member, Wanapum Basalt
 - QMcg: Quaternary-Miocene conglomerates
 - Qa: Quaternary alluvium
 - Qfs(t): Touchet Beds, glacial Lake Missoula
 - Ql: Palouse Formation
 - wtr: Water

Sources: CTUIR, Walla Walla County, StreamNet, Dept. of Geology



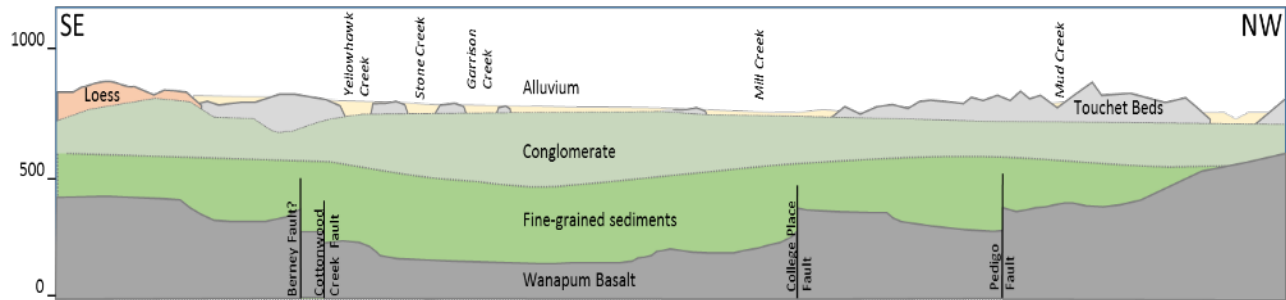


Figure 2.2-2. Cross-Section of the Mill Creek Alluvial Fan through College Place; from the southeast (SE) to northwest (NW) (modified from Derkey et al. 2006)

As an illustration of these layers, the following figures provide cross-sections developed using a U.S. Geological Survey (USGS) three-dimensional hydrogeological model. These model results provide an additional view of the geology of the Mill Creek watershed and conditions that influence other watershed processes, as noted above and discussed further in Section 2.5.5, Groundwater. Figure 2.2-3a shows a longitudinal cross-section of the Primary Focus Area (roughly west to east), while Figures 2.2-3b through 2.2-3d illustrate cross-sections through the Mill Creek alluvial fan (roughly south to north), from downstream to upstream.

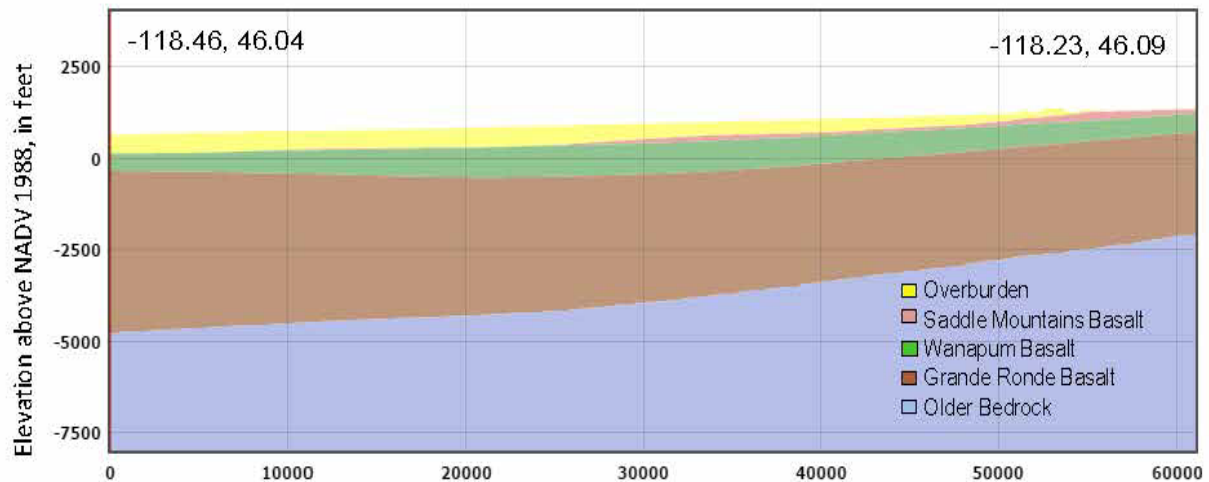


Figure 2.2-3a. Longitudinal Cross-Section of the Underlying Geology of Mill Creek within the Primary Focus Area (Model Results from USGS 2012)

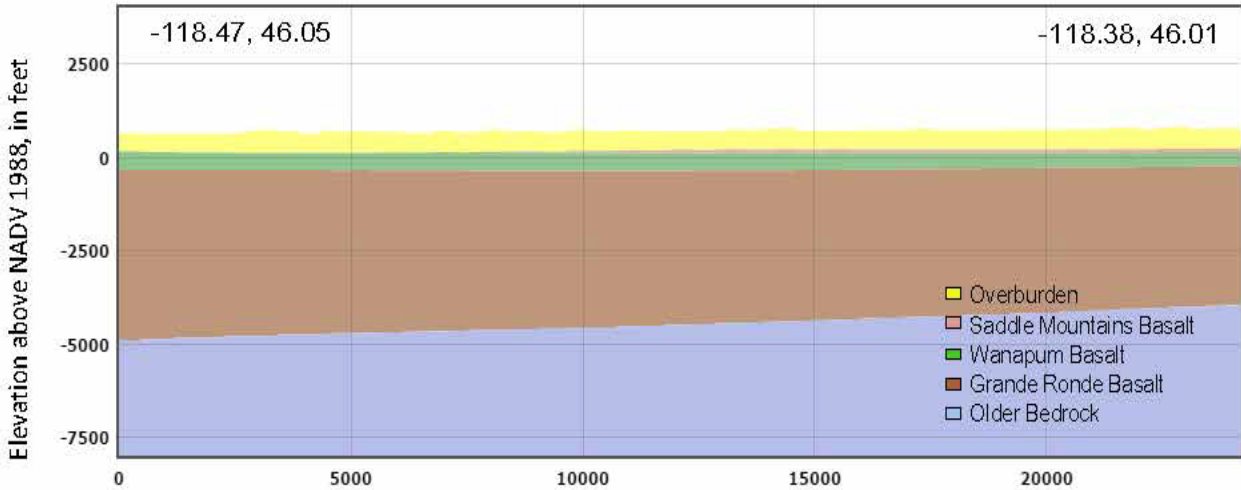


Figure 2.2-3b. Cross-Section of the Underlying Geology of Mill Creek Alluvial Aquifer across the Mouth of Mill Creek and Yellowhawk Creek (Model Results from USGS 2012)

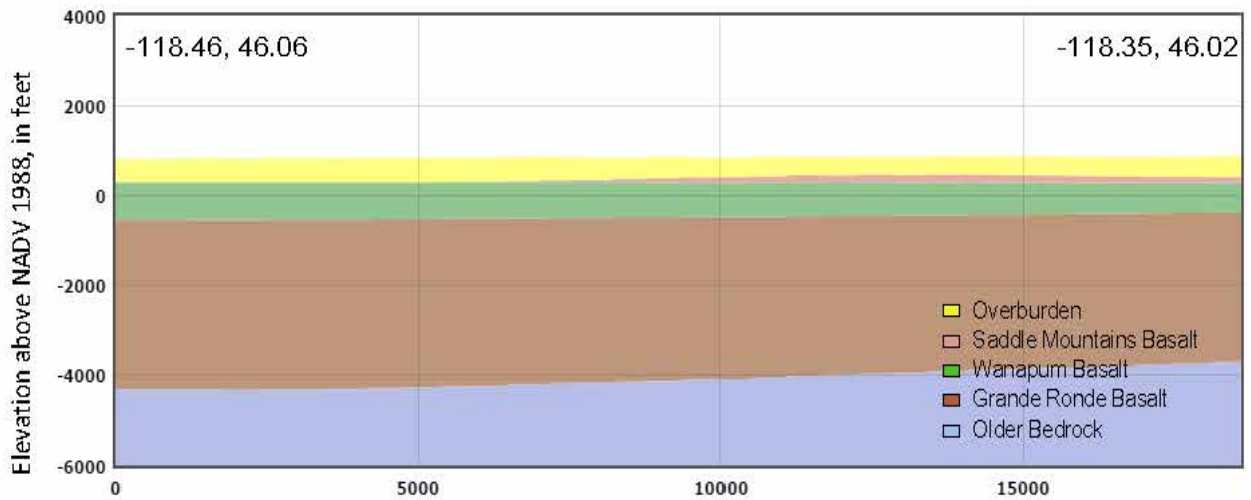


Figure 2.2-3c. Cross-Section of the Underlying Geology of Mill Creek Alluvial Aquifer just Upstream from College Place, Crossing Mill Creek and Yellowhawk Creek (Model Results from USGS 2012)

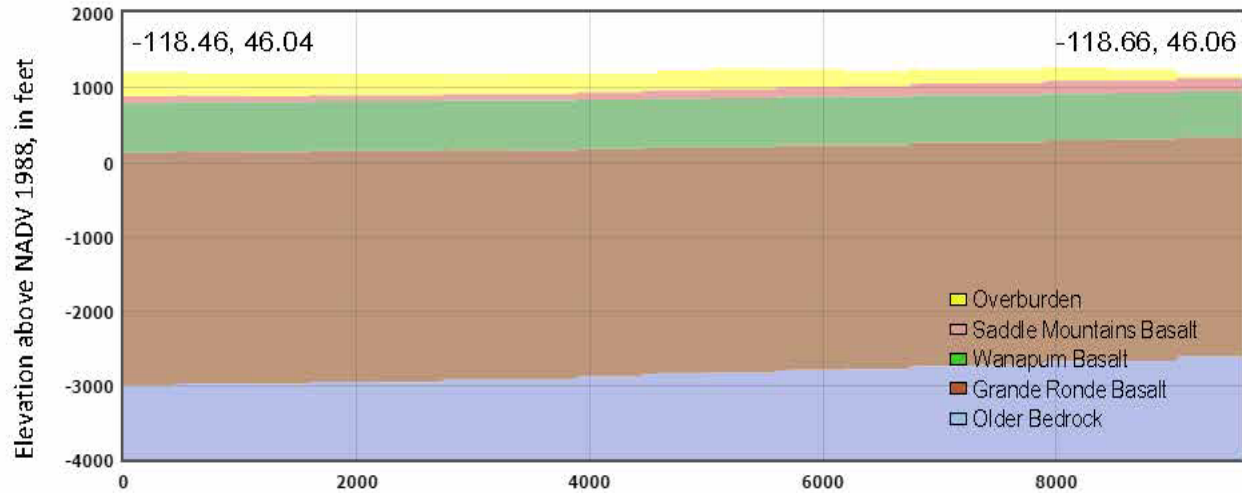


Figure 2.2-3d. Cross-Section of the Underlying Geology of Mill Creek Alluvial Aquifer, Crossing Mill Creek and Yellowhawk Creek between the Airport to just below Bennington Lake (Model Results from USGS 2012)

2.2.2 Project Area Soils

The Touchet Beds, loess, and alluvium deposits described above have been fundamental for developing the rich agricultural soils of lower Mill Creek and the Walla Walla Valley in general. These soils are exceptionally fertile and currently support a wide variety of agricultural crops that dominate the local industry. The U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) (2016a) provides information on soil groups and types within the Mill Creek watershed. Figure 2.2-4 shows the soil-type distribution for the Primary Focus Area, including Mill Creek and its distributaries and tributaries downstream from Blue Creek. Figure 2.2-5 provides soil-type information for the Secondary Focus Area, including the upper watershed.

Soils within the Primary Focus Area are dominated by silt loams. The Yakima Silt loam makes up the majority of the channel bottom and upper third of the Mill Creek alluvial fan, surrounded by Walla Walla silt loam. The lower third of the Primary Focus Area (up to approximately RM 8) is comprised of a mix of many different silt loams, including Hermiston, Touchet, Ahtanum, Stanfield, Catherine, Umapine, Yakima, Walla Walla, and others (See Figure 2.2-4). Within the lowest portion of the alluvial fan, from the Walla Walla River up to about RM 6, the mix of soils are poorly to moderately drained, leading to more frequent springs and wetlands than in the upper portions of Primary Focus Area. Soils in the upper two-thirds of the

Primary Focus Area are moderate to well-drained. Bennington Lake, for example is in an area of moderate-drained soils (NRCS 2016a).

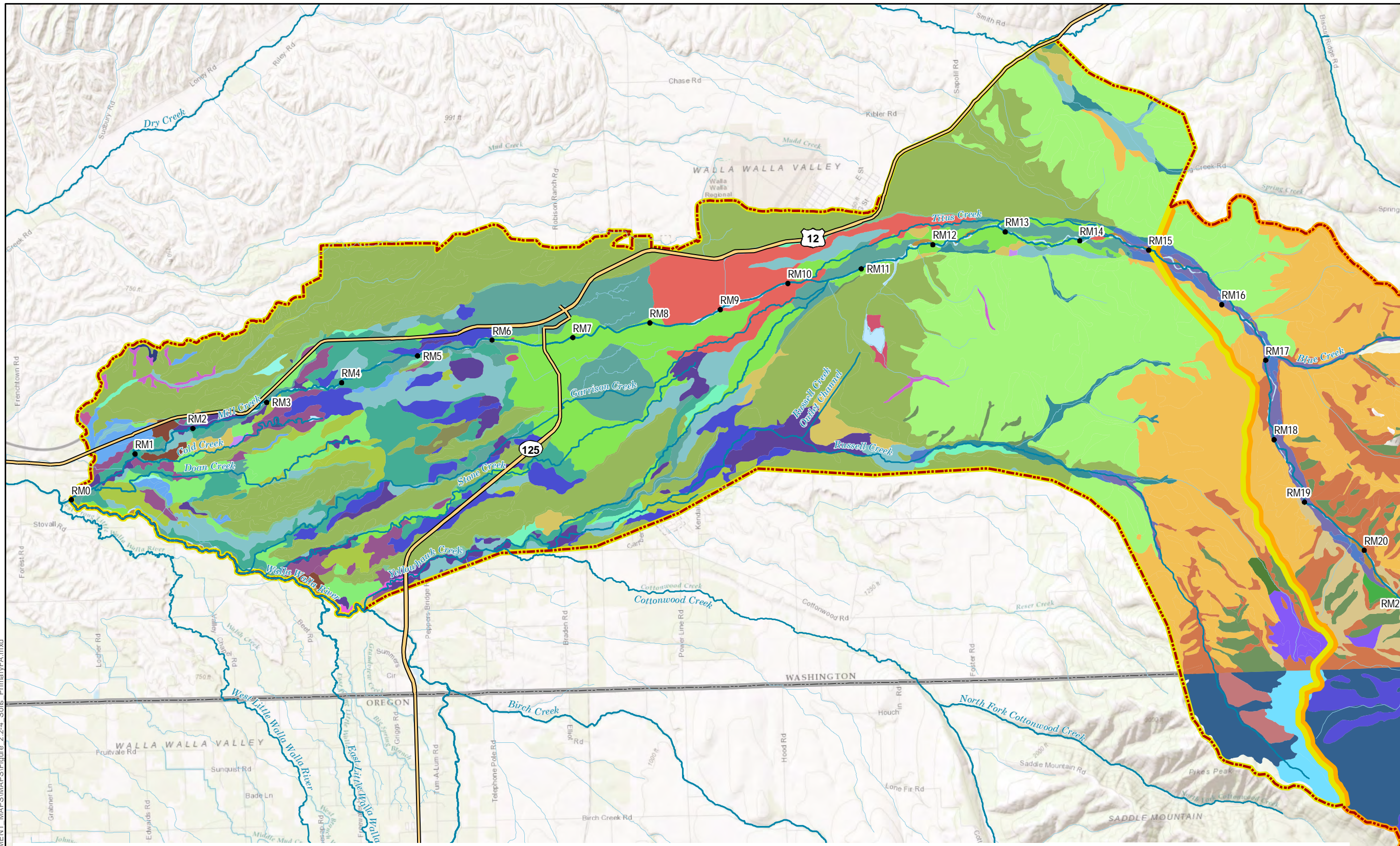
The Secondary Focus Area has exposed rock in the Gwin-Klicker Rock and Gwin-Rock outcrop complexes as well as the Basalt rockland. The Umatilla-kahler-Gwin association and Tolo silt loam are the dominant soil types in the Umatilla County area of the upper watershed, while Couse silt loam, Gwin rock silt loam, Helmer silt loam, Klicker rocky silt loam, Palouse silt loam and Klicker-Gwin-Rockland complex comprise most of the Walla Walla County portion of the watershed (See Figure 2.2-5).

There are many existing reports describing the geology and soils of the Mill Creek area. In particular, Newcomb (1965), and Derkey et al. (2006) provide in-depth descriptions of the area's geology and geomorphology. The USDA NRCS soil survey for Walla Walla County provides a detailed description of areas soils (Harrison et al. 1964). In addition, the NRCS Web Soil Survey maintains and provides the most current soils data available (NRCS 2016a).

**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

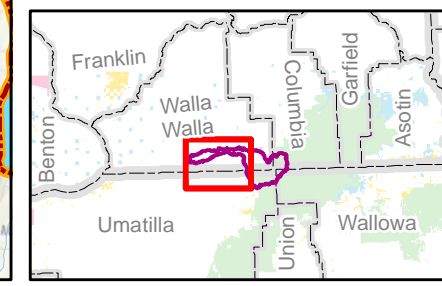
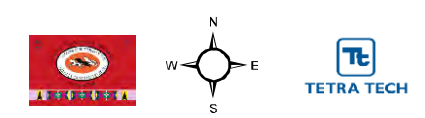
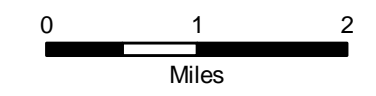
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UMATILLA INDIAN RESERVATION

**FIGURE 2.2-4
SOIL TYPES
PRIMARY FOCUS AREA**



- River Miles
- Major Stream
- Minor Stream
- Waterbody
- Project Area
- Primary Focus Area
- Secondary Focus Area

Sources: CTUIR, Walla Walla County, StreamNet, USDA, NRCS



Washington Soil Types

- | | | | |
|--|--------------------------------|--------------------------------|---------------------------------------|
| Ahtanum silt loam, 0 to 3 percent slopes | Esquatzel silt loam | Patit Creek cobbly silt loam | Snow silt loam, 0 to 3 percent slopes |
| Alluvial land | Gwin rocky silt loam | Patit Creek silt loam | Stanfield silt loam |
| Athena silt loam | Helmer silt loam | Pedigo silt loam | Terrace escarpments |
| Basalt rockland | Hermiston silt loam | Ritzville silt loam | Touchet gravelly silt loam |
| Borrow pits | Hermiston very fine sandy loam | Ritzville very fine sandy loam | Touchet silt loam |
| Catherine silt loam | Klicker rocky silt loam | Riverwash | Umapine silt loam |
| Couse silt loam | Onyx silt loam | Sagemoor silt loam | Umapine very fine sandy loam |
| Ellisforde silt loam | Palouse silt loam | Sagemoor very fine sandy loam | Walla Walla silt loam |

Oregon Soil Types

- Umatilla-Kahler association
- Unatilla-Kahler-Gwin association
- Xerofluvents
- Gwin-Klicker-Rock outcrop complex
- Gwin-Rock outcrop complex
- Tolo silt loam
- Water
- Yakima cobbly loam
- Yakima gravelly silt loam
- Yakima silt loam

National Forest Soil Types

- Miscellaneous Land Types
- Surface Flow Volcanics-Basalts, Andesites, Rhyolite

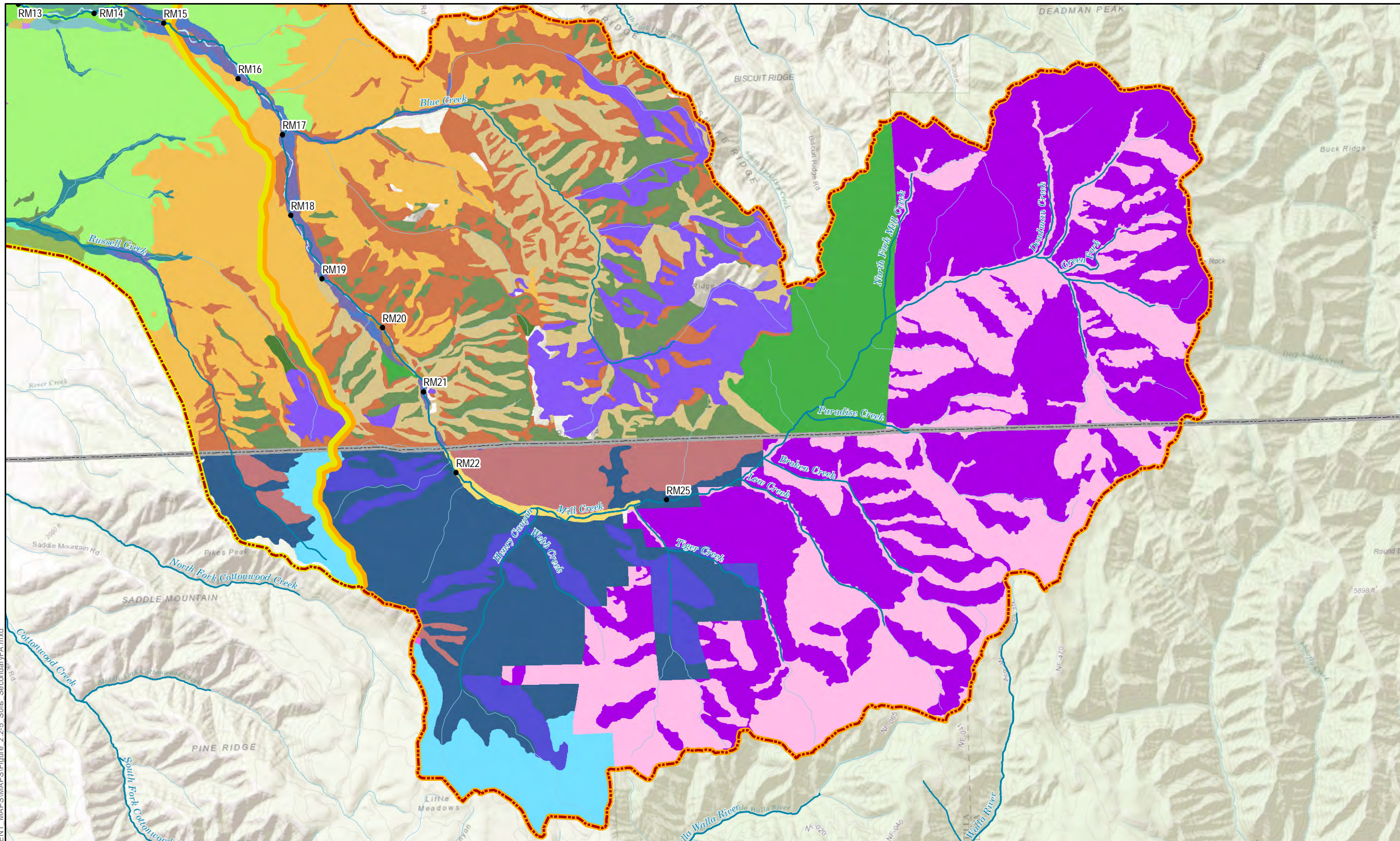
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**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

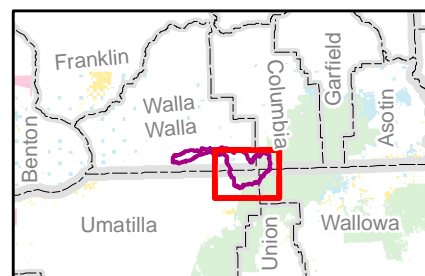
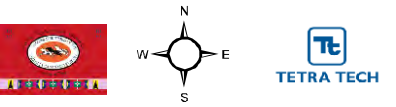
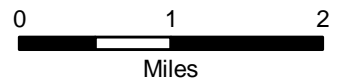
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**FIGURE 2.2-5
SOIL TYPES
SECONDARY FOCUS AREA**

- River Miles
- Major Stream
- Minor Stream
- Waterbody
- Project Area
- Primary Focus Area
- Secondary Focus Area



Sources: CTUIR, Walla Walla County, StreamNet, USDA, NRCS



Washington Soil Types

Ahtanum silt loam, 0 to 3 percent slopes	Esquatzel silt loam	Patit Creek cobbly silt loam	Snow silt loam, 0 to 3 percent slopes
Alluvial land	Gwin rocky silt loam	Patit Creek silt loam	Stanfield silt loam
Athena silt loam	Helmer silt loam	Pedigo silt loam	Terrace escarpments
Basalt rockland	Hermiston silt loam	Ritzville silt loam	Touchet gravelly silt loam
Borrow pits	Hermiston very fine sandy loam	Ritzville very fine sandy loam	Touchet silt loam
Catherine silt loam	Klicker rocky silt loam	Riverwash	Umapine silt loam
Couse silt loam	Onyx silt loam	Sagemoor silt loam	Umapine very fine sandy loam
Ellisforde silt loam	Palouse silt loam	Sagemoor very fine sandy loam	Walla Walla silt loam

Oregon Soil Types

Umatilla-Kahler association
Unatilla-Kahler-Gwin association
Xerofluvents
Gwin-Klicker-Rock outcrop complex
Gwin-Rock outcrop complex
Tolo silt loam
National Forest Soil Types
Miscellaneous Land Types
Surface Flow Volcanics-Basalts, Andesites, Rhyolite

R:\PROJECTS\LOWER MILL CREEK\ASSESSMENT MAPS\MAPS\Figure 2.2-5 Soils SecondaryFA.mxd

2.3 LANDSCAPE AND TOPOGRAPHY

The Project Area contains a varied landscape that ranges from the steep mountainous terrain of the Blue Mountains to the westward-sloping alluvial fan on the Walla Walla River valley floor (Figure 2.3-1). Mill Creek is part of a complex alluvial aquifer system in which the surface and subsurface waters are closely connected. This complex relationship between the surface and subsurface waters is displayed through Mill Creek's distributary system where the mainstem branches off into spring-fed streams and distributaries (WWBWC 2004). This distributary system historically provided habitat for all life stages of salmonids due to its year-round base flows fed by cool groundwater and abundance of off-channel habitat (WWBWC 2004). However, Euro-American settlement in the



region and its associated urban and agricultural development altered many of these distributaries. In many cases, distributaries were converted into irrigation canals or otherwise impacted by irrigation practices, resulting in reduced flows (WWBWC 2004).

As the landscape of the Project Area has dramatically changed over time due to urban development and agriculture, this section is organized into two subsections: Pre-Settlement (prior to 1800) and Post-Settlement (1800 to present day). The Pre-Settlement landscape is characterized by natural geologic and hydrologic processes, as well as

the hunting and gathering subsistence practices of the Native Americans. The Post-Settlement landscape describes a rapidly changing watershed due to anthropogenic impacts chiefly caused by the introduction of irrigated agriculture, livestock and forestry, urban development, and flood control infrastructure.



2.3.1 Pre-Settlement Landscape



The Walla Walla subbasin's principal geographic elements are the Blue Mountains and the river valleys, which are composed of plains and terraces (Newcomb 1965). From its headwaters in the Blue Mountains, Mill Creek flows downstream as a sinuous single channel through steep mountain canyons for about 17 miles until it enters a semi-confined valley surrounded by

rolling hills, or terraces, that are characteristic of the Palouse Prairie. At approximately RM 12,

Mill Creek enters the broad, gently sloped Walla Walla River valley where the river's flow spreads out and slows down, thus reducing the stream's capacity to transport coarse sediment. Over time, sediment has accumulated and mounded, forcing Mill Creek to find new channels and eventually form a broad alluvial fan.

As Mill Creek enters the alluvial fan, it transforms into a low sinuous multi-channel braided pattern that is part of a system of distributary channels that branch off from the main channel. The distributary system includes spring channels, ponds, and channels with flow that completely disappears into the permeable soils (silt, sand, gravel, loess) of the valley, only to reappear as springs farther down the valley before merging with the Walla Walla River. Figures 2.3-2a and 2.3-2b show historic channel alignments from 1853, 1858, 1919, and 1933. Although these figures show post-settlement channel alignments, major impacts to Mill Creek's channel did not occur until the 1940s with the construction of the MCFCP. As illustrated, Mill Creek's channel has stayed in the same general alignment over time and was historically braided with multiple locations to deposit sediment. Present-day Mill Creek is still somewhat braided upstream of the Bennington Diversion Dam but is constrained to a single channel through the MCFCP. These figures also show the historic distributary network characteristic of the alluvial fan.

Terraces also form portions of the Walla Walla River valley floor and are located on both sides of Mill Creek from RM 5 extending west towards Lowden. These terraces are eroded remnants of older alluvial fans (Mapes 1969) and appear as island-like rises along the stream channels descending down the valley towards the mouth of Mill Creek (Newcomb 1965).

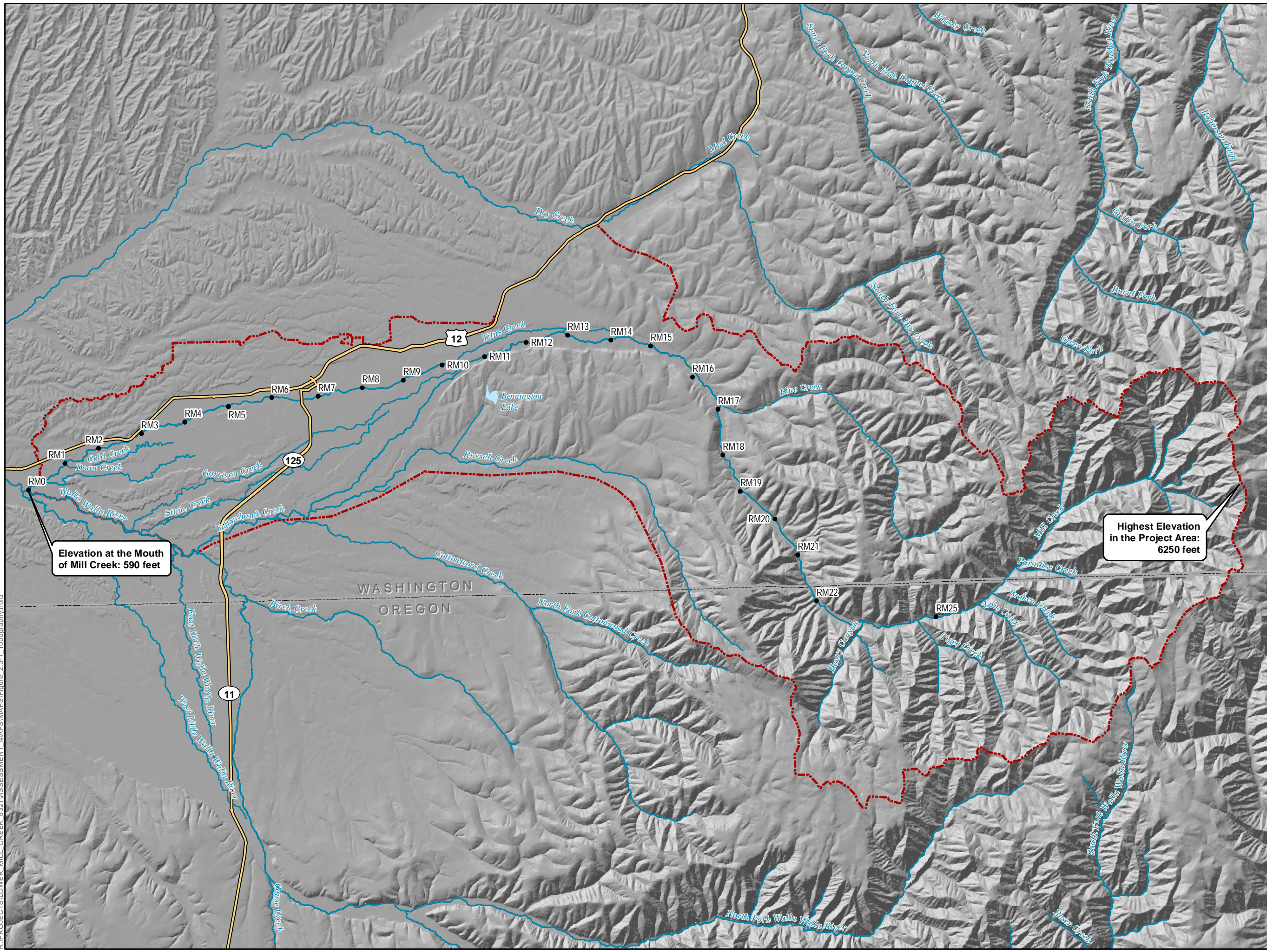
The earliest known inhabitants of the Walla Walla River basin were the people of the Cayuse, Walla Walla, and Umatilla tribes (WWBWC 2004). These people have lived in the Columbia River region for more than 10,000 years (CTUIR 2016a) and primarily sustained themselves as nomadic hunters and gatherers (WWBWC 2004) (see Sections 1.0 and 2.10 for further discussion). Vegetation in the Walla Walla River valley was influenced by the native tribes through the use of fire to manipulate the proper environmental conditions for subsistence hunting and gathering (WWBWC 2004). The primary vegetation of this region included timber and brush mixed with forbs and grass in the mountains, bunch grasses in the mid-elevations, and wild rye and sagebrush in the valleys (USDA Forest Service 1941). The introduction of horses to the Walla Walla River valley in the 1730s (WWBWC 2004) and the adoption of their use by the native tribes also had an impact on the historic landscape, although to what extent is unknown.

**LOWER MILL CREEK
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**FIGURE 2.3-1
PROJECT AREA TOPOGRAPHY**

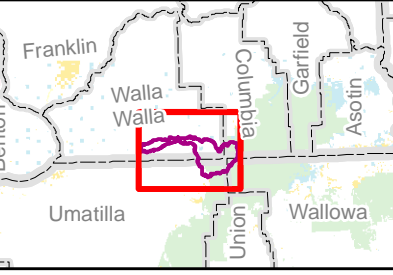
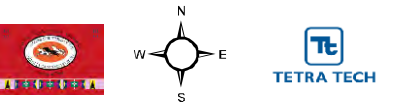
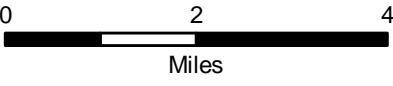
- River Miles
- Major Stream
- Waterbody
- Project Area



Elevation at the Mouth
of Mill Creek: 590 feet

Highest Elevation
in the Project Area:
6250 feet

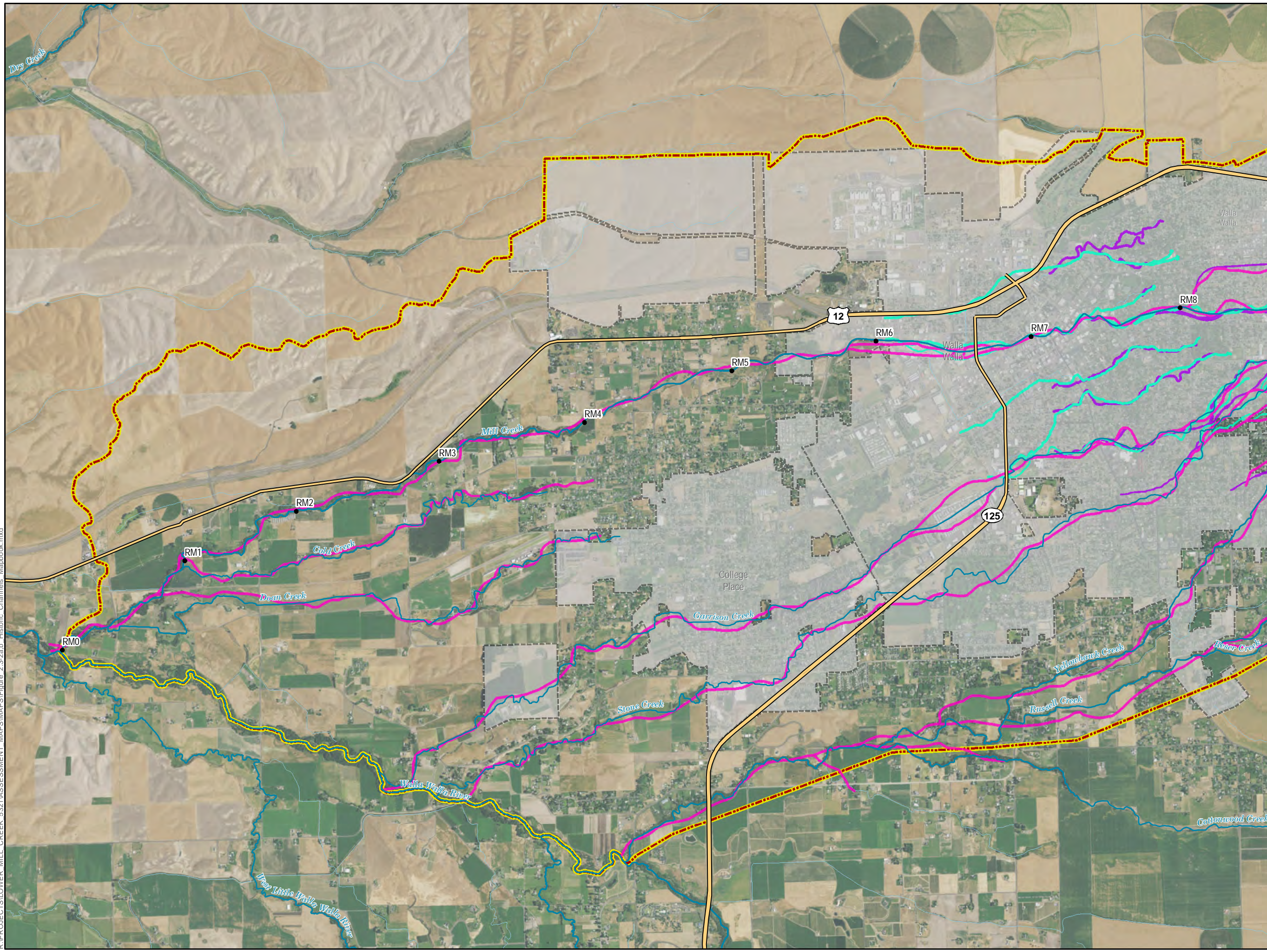
Sources: CTUIR, ESRI, StreamNet



**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

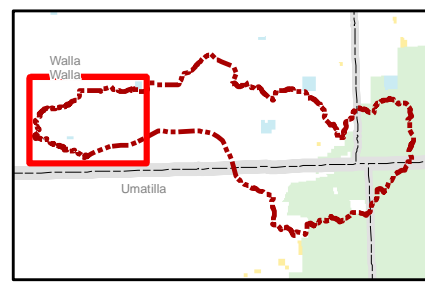
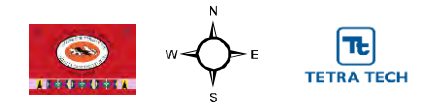
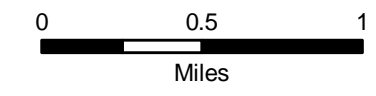
CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE 2.3-2a
HISTORIC CHANNELS**



- River Miles
- Current Major Stream
- Current Minor Stream
- 1853 Channel
- 1919 Channel
- 1933 Channel
- ▭ Project Area
- ▭ Primary Focus Area
- ▭ Secondary Focus Area
- ▭ Cities

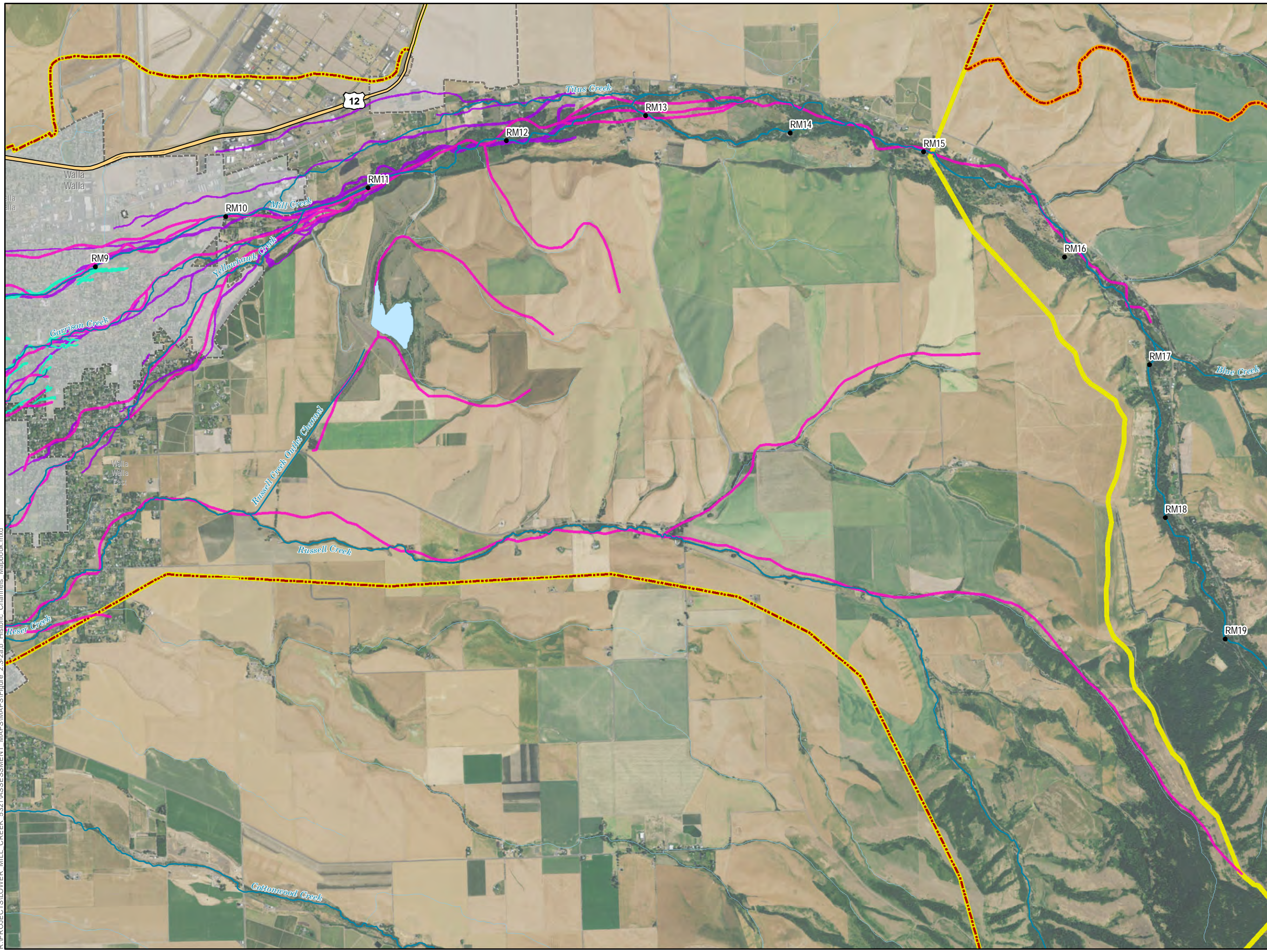
Sources: CTUIR, Walla Walla County, StreamNet



**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

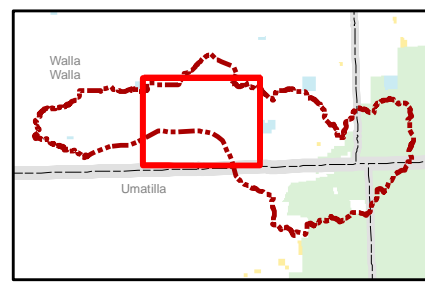
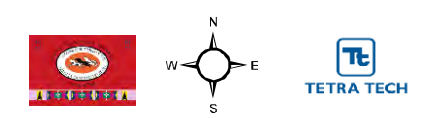
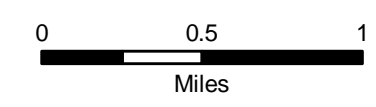
CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE 2.3-2b
HISTORIC CHANNELS**



- River Miles
- Current Major Stream
- Current Minor Stream
- 1853 Channel
- 1919 Channel
- 1933 Channel
- ▭ Project Area
- ▭ Primary Focus Area
- ▭ Secondary Focus Area
- ▭ Cities

Sources: CTUIR, Walla Walla County, StreamNet



R:\PROJECTS\LOWER MILL CREEK 5321\ASSESSMENT MAPS\MAPS\Figure 2.3-2a,b Historic Channels Mapbook.mxd

2.3.2 Post-Settlement Landscape

During the early 1800s, not long after Lewis and Clark traveled through the Walla Walla area and made note of the Walla Walla River during their return trip in 1806 (Moulton 1991), the fur trade began gathering momentum in the Pacific Northwest. Fort Nez Perce, later known as Fort Walla Walla (the first of two locations for Fort Walla Walla) was established as a fur trading post by the Montreal-based North-West Company in 1818 near the mouth of the Walla Walla River (OHS 2016). The fur trade eliminated the beaver (*Castor canadensis*) within the Walla Walla subbasin, which may have altered the landscape by affecting the riparian communities due to the reduction of ponds and water table levels (WWBWC 2004).

Immigrants and missionaries followed the fur traders, including the founding of the Whitman Mission at Waiilatpu, west of what is now the town of Walla Walla in 1836 (CTUIR 2016a). The relationships between Indian tribes and settlers were originally peaceful, but overexploitation of resources by the immigrants, the spread of disease, and encroachment on lands by settlers led to conflict, including



Arrival of the Nez Perce Indians at Walla Walla Council May 1855

Source: Washington State Historical Society

the killings at the Whitman Mission and the “Cayuse War” of 1847 to 1850 (CUTIR 2016a). To end the conflicts and open the region for immigration, the United States government negotiated treaties to purchase Indian land and move the Indians to reservations (CTUIR 2016a). The Treaty of 1855 (Treaty) was signed between the United States and members of the Walla Walla, Cayuse, and Umatilla tribes on the banks of Mill Creek six miles above Waiilatpu in the Walla Walla valley on June 9, near what is now the center of the City of Walla Walla (CTUIR 2016a). This Treaty, and subsequent ratifications by Congress, created the Umatilla Indian Reservation and formed the CTUIR.

Agriculture played a significant role in altering the landscape in the Walla Walla subbasin. The earliest noted agriculture in the Walla Walla River valley occurred in about 1825 at Fort Nez

Perce. By 1836, the Whitman Mission was established and began farming wheat, corn, onion, melons and various other crops. By the mid-1800s, following the Treaty of 1855 and the establishment of a new Fort Walla Walla in 1856 (located in the present-day City of Walla Walla), more Euro-American settlers began arriving in the Walla Walla area. By 1850, small amounts of cropland were situated along the river bottoms, including some utilizing irrigation (WWBWC 2004). According to Gilbert (1882), the settlers of this area lived along the creeks and rivers.



Source: U.S. Army (1858)

Figure 2.3-3. Fort Walla Walla to Mill Creek as mapped in 1858 by U.S. Army in Military Reconnaissance Map

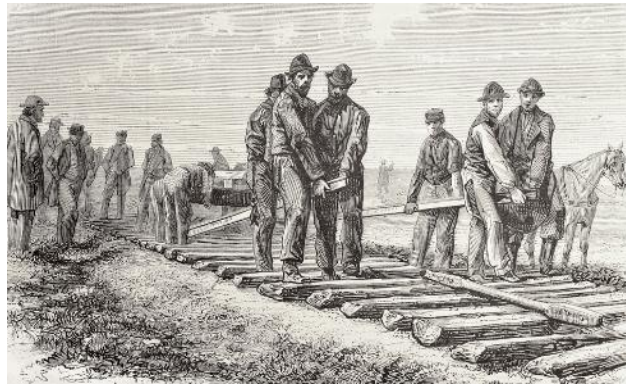
In 1858, Lieutenant John Mullan of the U.S. Army completed a survey map of the military reconnaissance conducted from Fort Walla Walla to Fort Taylor, Washington County (see Figure 2.3-3 for an excerpt from this map). The purpose of this survey was to find a wagon trail route to connect the Puget Sound to the east coast. This map shows the chosen trail route along the Walla Walla River and turning northeast along Mill Creek. This map also shows existing farms along the Walla Walla River and Mill Creek as well as cottonwood groves, willows, and brushwood. A note on this map describes the rolling hills of this region being covered with “luxuriant bunch-grass” and the valleys containing “fine farming land” (U.S. Army 1858). The “cloud-like” curves drawn on this map are topographic reliefs of 100 feet each. Mill Creek’s complex distributary system is also visible on this map.

Development continued near Fort Walla Walla and by the 1860s the City of Walla Walla was incorporated. The fort’s barracks were constructed on the north side of Mill Creek along what would eventually be mainstreet of the new city (Gilbert 1882). The City of Walla Walla



Source: shutterstock.com

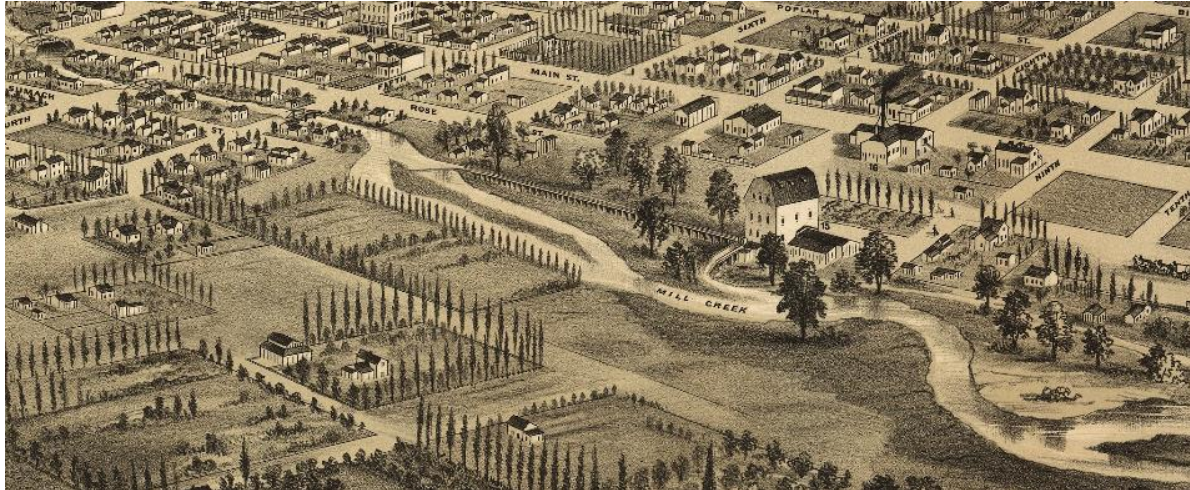
grew quickly due to the influx of gold miners traveling east along the established wagon trail route along Mill Creek into the mountains. In 1866, the city obtained a municipal water right to withdraw their primary water supply from Mill Creek (City of Walla Walla 2013a). To support the gold rush, the number of livestock in the area



Source: shutterstock.com

proliferated leading to the long-term degradation of the Mill Creek watershed from grazing (WWBWC 2004). Timber harvesting in the Blue Mountains also increased to supply the growing town of Walla Walla, the expansion of the railroad, and the mining camps. The first of several sawmills was built along Mill Creek in 1845 by Marcus Whitman (Orchard 1982). In 1878, Dr. Dorsey Baker constructed a flume down Mill Creek to access lumber harvested from the upper Mill Creek drainages (Orchard 1982). Clearcutting was the common logging practice and streams and spawning grounds were often destroyed from yarding logs across streams (WWBWC 2004). Also, the City of Walla Walla became a major commercial and financial center during this time, leading to urbanization of the valley floor and the development of the city's downtown on the banks of Mill Creek.

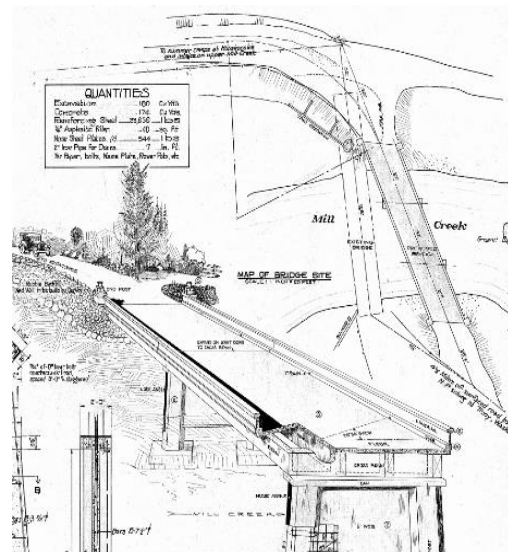
During this period of rapid population growth by Euro-American settlers, the Walla Walla River valley continued to be developed into homesteads and farms, many located near water and riparian areas. By 1864, thousands of acres of land were being cultivated and dryland wheat was being cultivated in the hills surrounding the City of Walla Walla (Paulus 2008). Many of Mill Creek's distributaries were turned into irrigation ditches and water was appropriated to agricultural users (WWBWC 2004). Portions of the Mill Creek Channel was altered prior to the turn of the century to facilitate irrigation and agricultural development. By the 1870s, agriculture had replaced mining supply as the City of Walla Walla's economic mainstay and this continued throughout the turn of the century. In 1875 a water reservoir was built on Mill Creek and pipes were laid into the city (Gilbert 1882) assumedly for irrigation. Figure 2.3-4 shows a bird's eye view of the Walla Walla in 1876. This historic image shows farms along Mill Creek and water being diverted to the Standard Flour Mill.



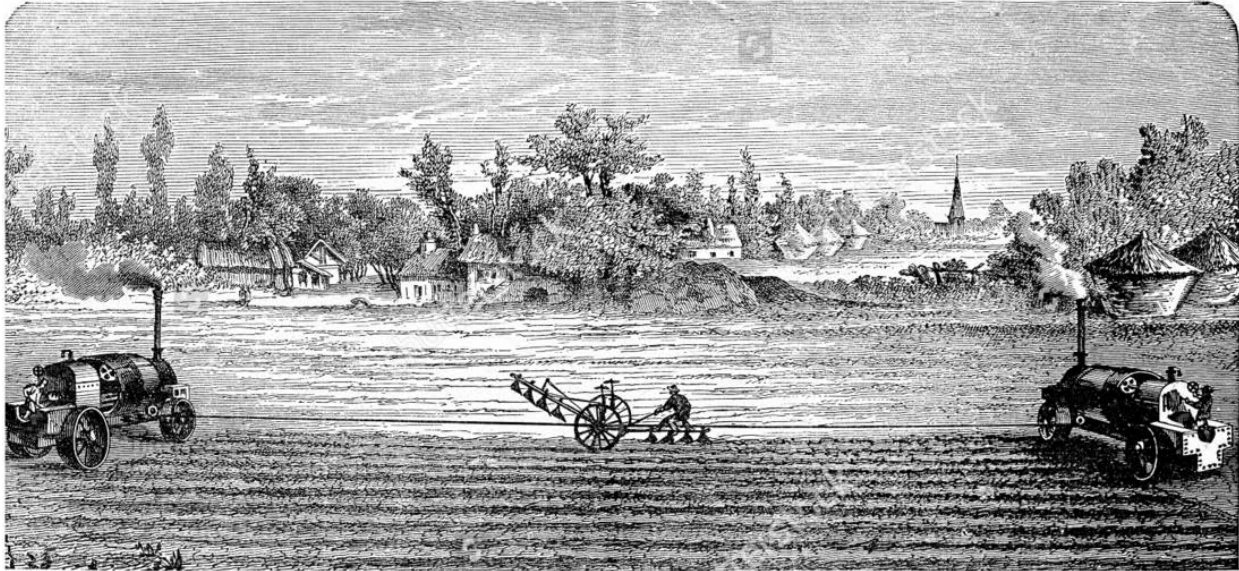
Source: Clover (1876)

Figure 2.3-4. Zoom-in of 1876 City of Walla Walla Bird's Eye View Map Looking East

With urbanization of the valley came the construction of roads and stream crossings, removal of riparian areas to construct buildings, as well as attempts to stabilize and straighten the stream channels by using riprap and heavy equipment. At the turn of the century, steam- and diesel-powered tractors were available in the Walla Walla River valley (Figure 2.3-5) and farmers began using them to clear riparian areas and straighten channels (WWBWC 2004). By 1910, more than 90 percent of the agriculture in the Walla Walla River valley was based in orchards, grains, and row crop farming (WWBWC 2004) and the population of Walla Walla had risen to just under 20,000 people (U.S. Census Bureau 1910). Figure 2.3-6 shows a City of Walla Walla plat map from 1909 in which development and parcel ownership is encroaching upon the Mill Creek channel, constraining its natural braiding patterns.

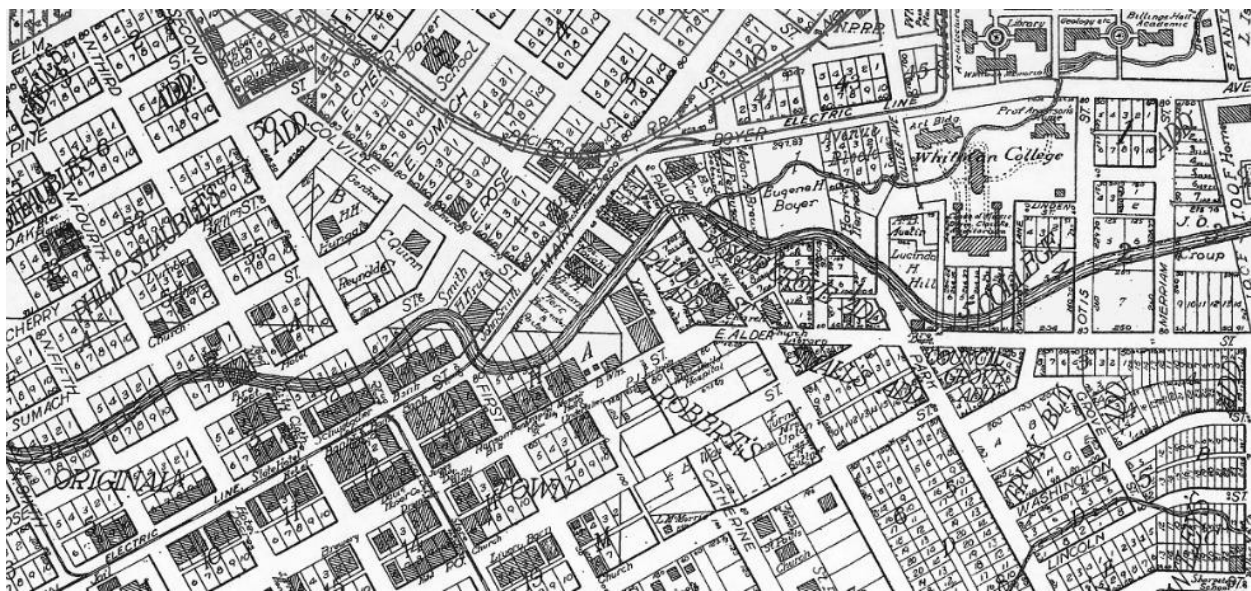


Wickersham Bridge Over Mill Creek Designed in 1925 (Walla Walla County 1925)



Source: shutterstock.com

Figure 2.3-5. Steam Engines Used in Agriculture Farming



Source: Ogle & Co. (1909)

Figure 2.3-6. Plat Map from 1909 of City of Walla Walla near Whitman College

With the development of the City of Walla Walla and other homesteads and farms encroaching along Mill Creek, historic flood events that damaged property began occurring regularly. Major floods that caused considerable damage in 1867 and 1875 are mentioned by Gilbert (1882). After the 1931 flood caused major devastation in the City of Walla Walla, the Flood Control Act was passed by Congress in 1938 which called for the construction of the MCFCP. The USACE completed the construction of the Bennington Diversion Dam and Bennington Lake in 1942 and

completed the Mill Creek Channel in 1948 (USACE 2016b) (see Section 2.4 for further details about flood control infrastructure). Although the MCFCP has successfully prevented flood damage to the City of Walla Walla, it has created serious fish passage problems for ESA-listed steelhead and bull trout in the Walla Walla subbasin (Mendel 2015). See Section 2.8 for more information about existing fish passage barriers and lack of fish habitat along Mill Creek.



Source: USACE

Construction of Bennington Lake Dam and Reservoir

The populations of Walla Walla County and the City of Walla Walla continue to increase. The 2010 U.S. Census reports approximately 58,800 people in Walla Walla County (U.S. Census Bureau 2010a) and 31,731 in the City of Walla Walla (U.S. Census Bureau 2010b). Population growth will continue to put development pressure on Mill Creek and its distributaries, as well as Mill Creek's water supply, considering the City currently obtains the majority of its municipal water from Mill Creek.

Today, agriculture continues to be a major feature shaping the landscape in Walla Walla County. Wheat was cultivated on over 192,000 acres, winter wheat on over 166,000 acres, and vegetables on over 19,600 acres in 2012 (USDA 2012). In addition, the Walla Walla Valley was established as a unique American Viticultural Area and, by 2007, there were more than 1,200 vineyard acres in the Walla Walla American Viticultural Area (Paulus 2008). According to the

USDA (2012), over 645,000 acres of Walla Walla County are in farms, or 79 percent of the total area in the county.

Looking back at the history of Mill Creek, the Walla Walla River valley's landscape was influenced by increased population, livestock, timber removal, agriculture, the use of heavy machinery, and urban development (see timeline Figure 2.3-7). Although these forces promoted economic prosperity in the region, they also adversely impacted the natural flora and fauna of the valley and valley streams, impacted the availability and use of First Foods by the tribes, and accelerated soil erosion and the incising of streams. As development increased around lower Mill Creek, the lateral connectivity of the multi-braided system was limited and overall function of the alluvial fan changed. The dynamic nature of the streams that once meandered across the floodplain have been replaced by constrained stationary channels, and the controlled flood waters of Mill Creek and the other streams in the valley no longer deposit their rich sediment loads throughout the Mill Creek floodplain. Conversion of native habitats to agricultural lands has altered, destroyed, and fragmented much of the grassland and riparian/floodplain habitat within the subbasin (Ashley and Stovall 2004, as cited in the NPCC 2005). In addition, the loss of riparian vegetation, extirpation of beaver, loss of wetlands and ponds from urbanization, and impacts to ground and surface water connectivity due to limited impounded stored water and increased impervious surface have all led to a changing landscape that no longer functions as it did historically before settlement and urbanization.

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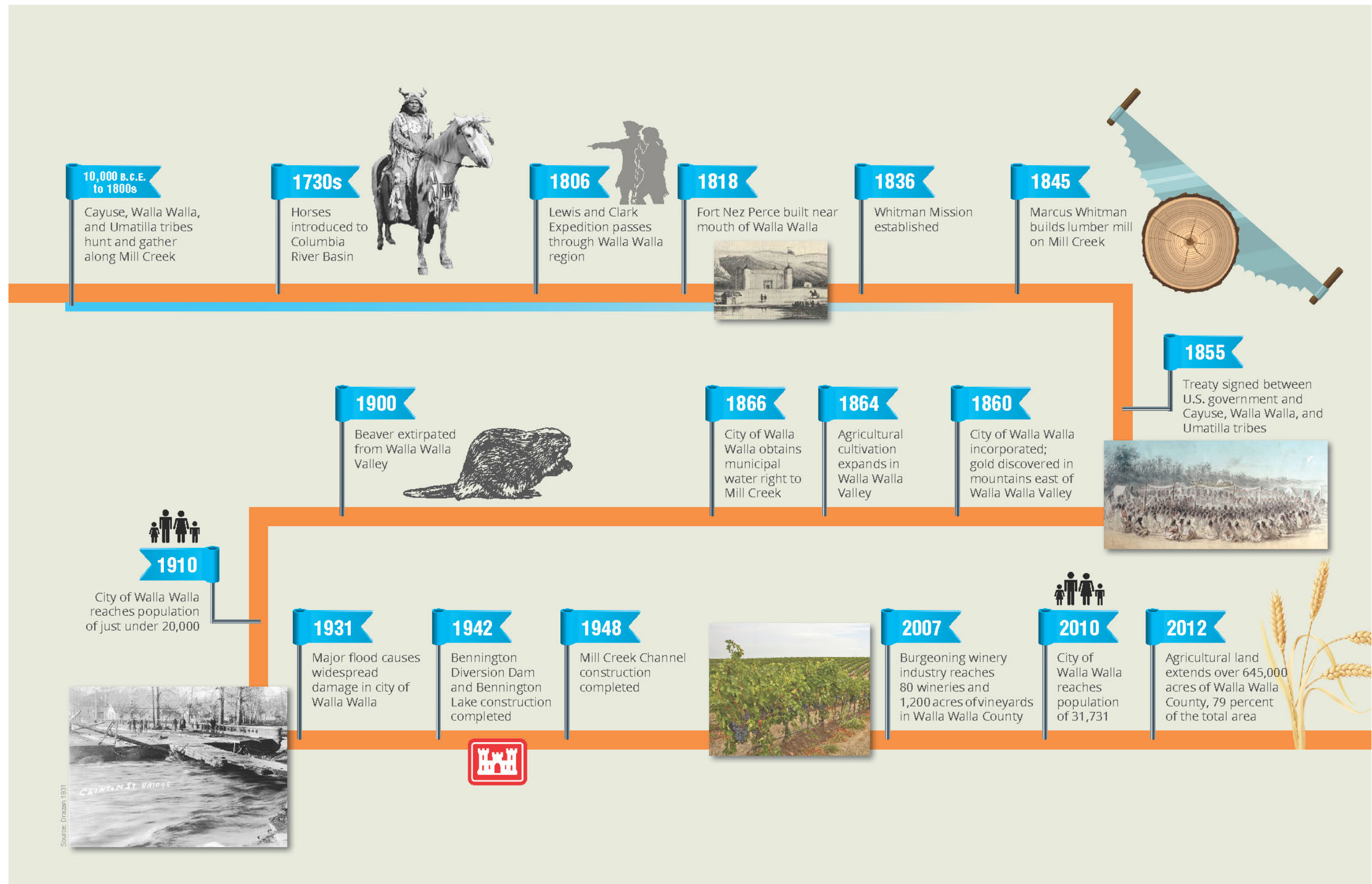


Figure 2.3-7. Timeline of Events Influencing Walla Walla Regional Landscape and Topography

2.4 BUILT ENVIRONMENT

2.4.1 History of Land Use Changes

The City of Walla Walla was incorporated in 1862 and underwent a rapid growth period that led to the establishment of the downtown and development of surrounding areas along Mill Creek (City of Walla Walla 2008). Whether due to the temporary location of the U.S. Army Fort Walla Walla near Mill Creek (built in 1856) or the desire to be located near the water, the city's downtown was constructed along the banks of Mill Creek, thus encroaching on the creek, constraining the floodplain, and making the city vulnerable to flooding. Looking at one downtown block as an example, Figure 2.4-1 shows a series of historical Sanborn maps illustrating buildings and parcels increasingly impacting the Mill Creek Channel. Development continued along this trajectory of building the urban realm over or immediately adjacent to the stream throughout the city. For example, the historic Liberty Theater (currently occupied by the Macy's department store) was completed in 1917 and partially covered the original Mill Creek stream channel. It was not until the 1931 flood that the City of Walla Walla and its residents realized the consequences of building in Mill Creek's floodplain. In response, the MCFCP was authorized by the Flood Control Act of 1938 and the USACE began construction of the Bennington Diversion Dam and Bennington Lake Dam in 1942.

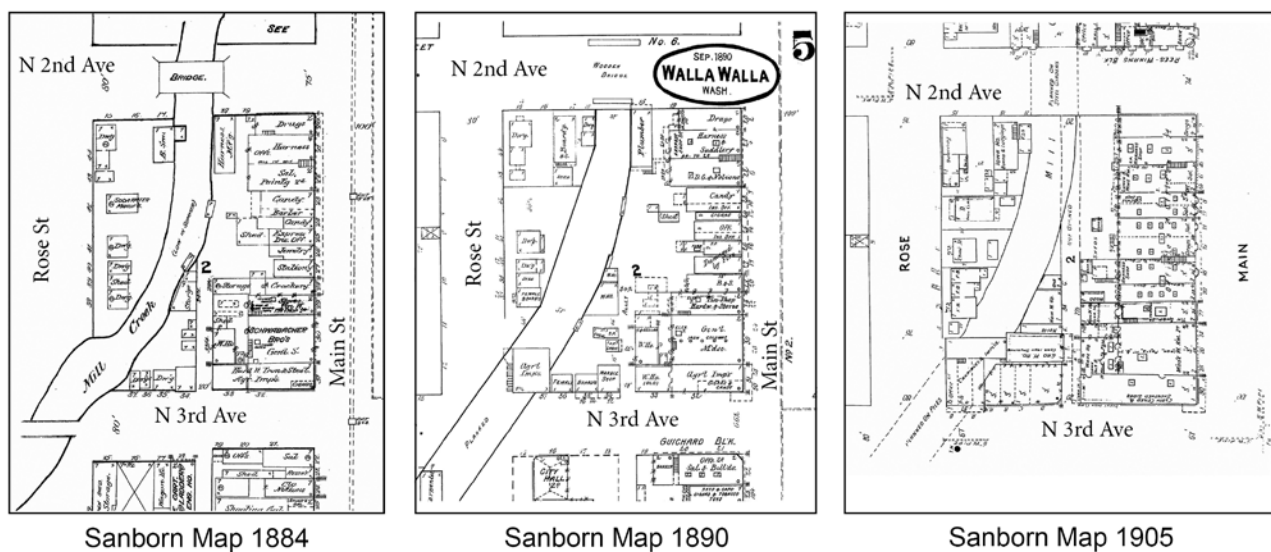


Figure 2.4-1. Block Comparison of Downtown Walla Walla from Historic Sanborn Fire Insurance Maps (Sanborn Map Company 1884, 1890, 1905)

2.4.2 Existing Land Use

Review of existing land uses within the Primary Focus Area adjacent to Mill Creek, Garrison Creek, and Yellowhawk Creek is important because it indicates current impacts to these creeks and influences future opportunities for modification and restoration. Land use within the Primary Focus Area is regulated by Walla Walla County and the Cities of Walla Walla and College Place based on their respective Comprehensive Plans (Comp Plans) and zoning, which specify permitted land uses and corresponding development regulations. As mentioned in Section 1.4.2.3, the county and city Shoreline Master Programs (SMPs) are considered subarea plans to their respective comprehensive plans and the regulatory elements of the SMPs are part of the city's and county's development regulations. The SMPs include critical area regulations that are applicable to the shoreline jurisdiction and controls land use over the critical area regulations adopted under the Growth Management Act. Both the county and city SMPs identify nine "Environmental Designations" with management policies and development standards specific to each.

Encroachment on Mill Creek and its distributaries has been occurring since the mid-1800s (see Sections 2.3.2 and 2.4.1); however the SMPs attempt to constrain development encroachment through its established critical area buffers and required setbacks. According to Table 6-2 in both the county and city SMPs, all buildings are to be set back five feet from the landward boundary of the critical area buffer of a SMP waterbody. Mill Creek has a buffer width of 35 feet within the MCFCP with the exception of downtown from N. 3rd Avenue to S. Colville Street where there is no buffer width (see Section 1.4.2.3 for a list of designated critical area buffer widths for Mill and Yellowhawk Creeks). However, existing nonconforming uses or developments that were lawfully constructed or established prior to the effective date of the SMP are allowed to continue as long as there are no alterations, expansions, or restorations to the structure or new activities associated with the structure proposed. Therefore, much of the existing encroachments on Mill Creek and its distributaries will be allowed to continue under the SMPs.

Review of the county and city Comp Plans and respective zoning and environmental designations indicates that land use varies significantly within the Primary Focus Area. Although Mill Creek is viewed by some as a valued natural resource and potential amenity, few of the existing land uses take advantage of their proximity to Mill Creek and instead most adjacent landowners appear to consider Mill Creek a liability. However, the potential exists to develop conceptual alternatives within each segment that encourage and promote a renewed relationship with Mill Creek that recognizes its ecological and economic value.

The following provides an analysis of existing land use along Mill Creek, organized by segment. A general description of existing land use along Garrison Creek and Yellowhawk Creek is also included.

2.4.2.1 Existing Land Use Along Mill Creek

Segment 1 – RM 0 (mouth) to RM 4.8 (Gose Street)

Segment 1 is located within unincorporated Walla Walla County and is subject to the county's Comp Plan and zoning. The Comp Plan land use designations for this segment are Agriculture Residential, Primary Agriculture, and Rural Residential 5 (Figure 2.4-2). The corresponding zoning designations are Agriculture Residential 10 and Rural Residential 5 (Figure 2.4-3). The updated Walla Walla County and City of Walla Walla SMPs have designated Mill Creek's shoreline in this segment as



Mill Creek Segment 1 Example Land Use Context (Photo: Starkey 2015a)

primarily Rural Conservancy with the south bank or both banks being designated Rural Residential from the Wallula Avenue Bridge until Gose Street. The area is predominately rural in character and development includes small acreage farms and ranches. In this segment, there are no flood control structures along the semi-natural channel; however this segment is confined by agricultural development on both banks which has led to a degraded incised main channel with limited floodplain connectivity and the area is subject to seasonal flooding.

However, most adjacent development is located upland of the channel. Due to these existing land use conditions, there may be opportunities to widen the channel, mitigate erosion, and improve habitat in Segment 1.

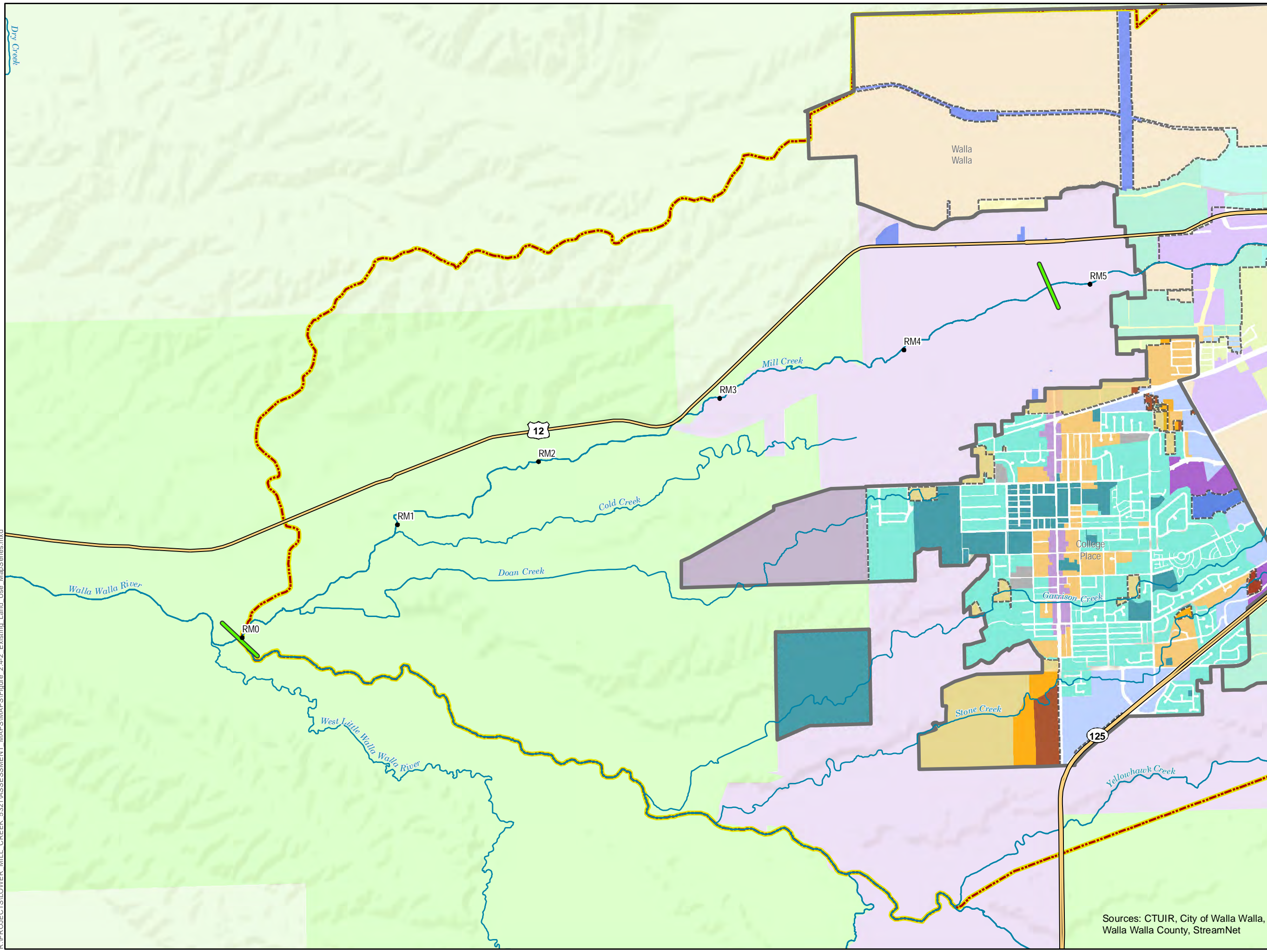
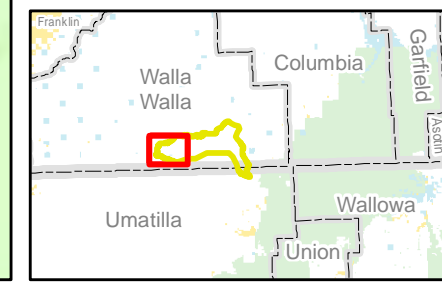
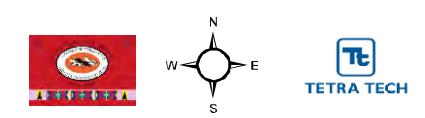
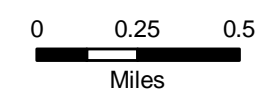
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LOWER MILL CREEK HABITAT AND PASSAGE ASSESSMENT

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE 2.4-2
EXISTING LAND USE
(Comprehensive Plan Designations)
SEGMENT 1**

- River Miles
 - Project Area Breaks
 - Stream
 - Waterbody
 - ▭ Project Area
 - ▭ Primary Focus Area
 - ▭ Secondary Focus Area
 - ▭ City Limits
 - ▭ Urban Growth Area Boundaries
- City of Walla Walla Land Use**
- Commercial
 - Industrial
 - LD Residential
 - MD Residential
 - Public
 - Residential
- Walla Walla County Land Use**
- AGRICULTURE RESIDENTIAL
 - COMMERCIAL
 - INDUSTRIAL
 - LOW DENSITY RESIDENTIAL
 - MEDIUM DENSITY RESIDENTIAL
 - MULTIPLE FAMILY RESIDENTIAL
 - PRIMARY AGRICULTURE
 - PUBLIC RESERVE
 - RURAL RESIDENTIAL 5
- City of College Place Land Use**
- COLLEGE AVE DISTRICT
 - COMMERCIAL
 - COMMERCIAL/LIGHT INDUSTRY MIX
 - LIGHT INDUSTRY
 - MULTIPLE FAMILY RESIDENTIAL
 - PUBLIC RESERVE
 - URBAN RESIDENTIAL 4-7 DU/ACRES

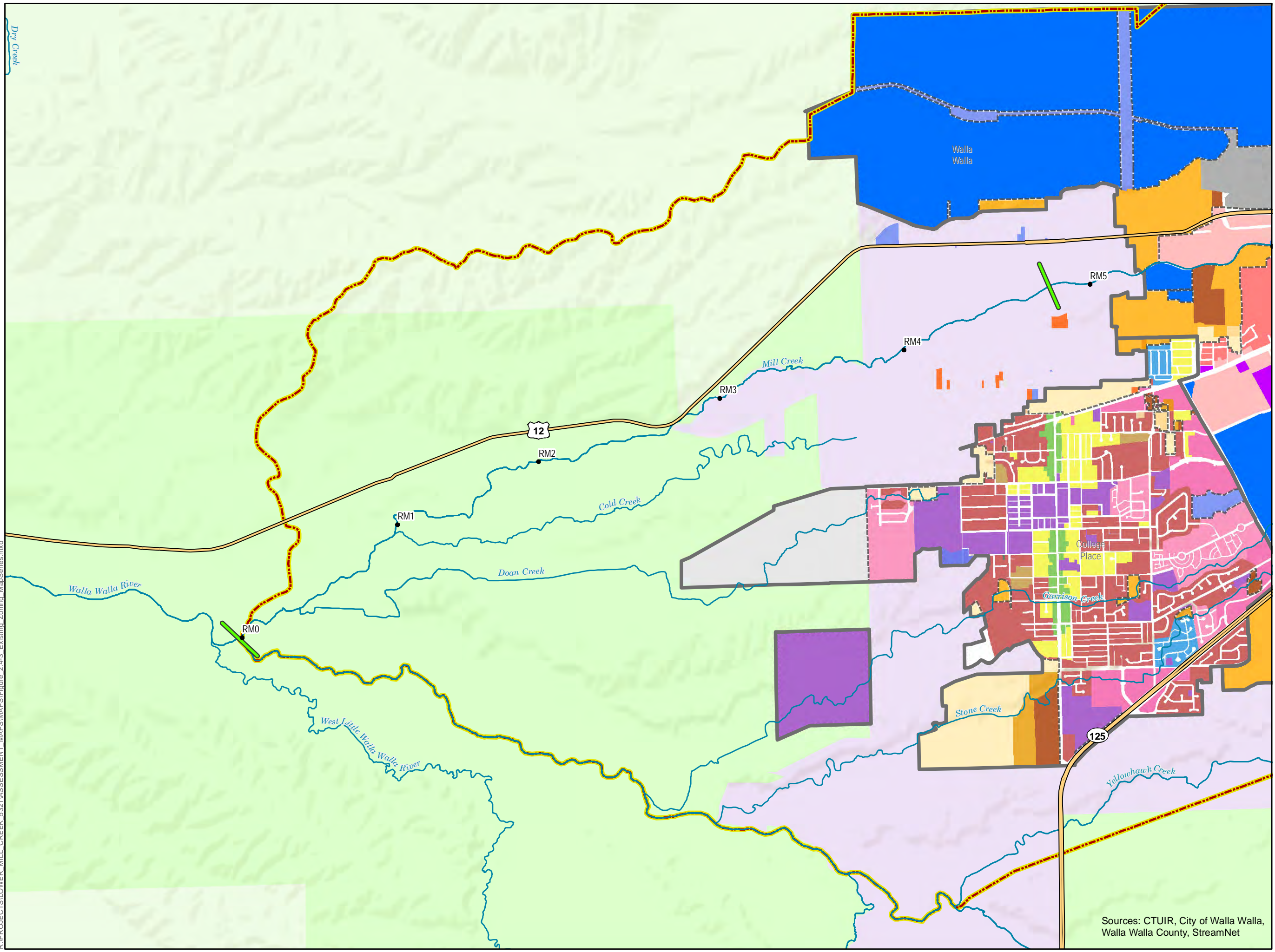


Sources: CTUIR, City of Walla Walla,
Walla Walla County, StreamNet

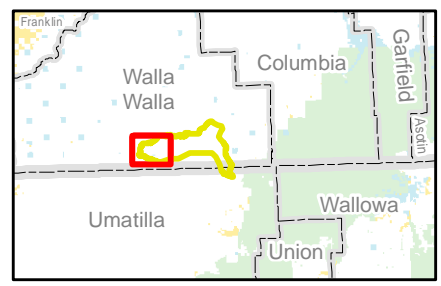
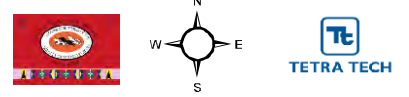
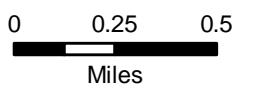
**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE 2.4-3
EXISTING ZONING
SEGMENT 1**



- River Miles
- ▬ Project Area Breaks
- ▬ Stream
- ▬ Waterbody
- ▬ Project Area
- ▬ Primary Focus Area
- ▬ Secondary Focus Area
- ▬ City Limits
- ▬ Urban Growth Area Boundaries
- City of Walla Walla Zoning**
- ▬ Highway Commercial
- ▬ Multi-Family Residential
- ▬ Public Reserve
- ▬ Single Family Residential
- Walla Walla County Zoning**
- ▬ AGRICULTURE RESIDENTIAL 10
- ▬ GENERAL COMMERCIAL
- ▬ HEAVY INDUSTRIAL
- ▬ LIGHT INDUSTRIAL
- ▬ MULTIPLE FAMILY RESIDENTIAL
- ▬ NEIGHBORHOOD COMMERCIAL
- ▬ PRIMARY AGRICULTURE 40
- ▬ PUBLIC RESERVE
- ▬ R-60 SINGLE-FAMILY RESIDENTIAL
- ▬ R-72 SINGLE-FAMILY RESIDENTIAL
- ▬ R-96 SUBURBAN RESIDENTIAL
- ▬ RURAL RESIDENTIAL 5
- City of College Place Zoning**
- ▬ DOWNTOWN MIXED USE DISTRICT
- ▬ GENERAL COMMERCIAL
- ▬ LIGHT INDUSTRIAL DISTRICT
- ▬ MANUFACTURED HOME PARK DISTRICT
- ▬ MULTIFAMILY RESIDENTIAL
- ▬ NEIGHBORHOOD COMMERCIAL
- ▬ PLANNED UNIT DEVELOPMENT
- ▬ PUBLIC RESERVE DISTRICT
- ▬ SINGLE-FAMILY RESIDENTIAL



Sources: CTUIR, City of Walla Walla,
Walla Walla County, StreamNet

Segment 2 – RM 4.8 (Gose Street) to RM 6.7 (downstream of 9th Avenue Bridge)

The portions of Segment 2 located within the City of Walla Walla have been assigned several city Comp Plan designations including Commercial, Industrial, Low Density Residential, and Public (Figure 2.4-4). The corresponding City zoning designations are Public Reserve, Single Family Residential, Heavy Industrial, and Light Industrial (Figure 2.4-5). The developed areas contain a mix of land uses including the City’s wastewater treatment plant, hotels/restaurants with related commercial uses, industrial storage buildings, a concrete batch plant operation, Washington Park, and some small lot residential uses.



Mill Creek Segment 2 from 13th Street Looking Upstream at Railroad Bridge

The updated Walla Walla County and City of Walla Walla SMPs have designated Mill Creek’s shoreline in this segment as Rural Residential from Gose Street to the Walla Walla

Water Treatment Plant where upon the shoreline environmental designation changes to a mixture of High Intensity and Urban Residential until the 9th Street Bridge. There is a small section of Urban Conservancy along the north bank at Washington Park at the 9th Street Bridge.

The Mill Creek Flood Control Zone begins at RM 4.8, and consists of a channel bounded by levees with access roads on top of the levees. The bottom of the channel is constructed with a series of concrete and sheet pile baffles. Few of these existing land uses are oriented to Mill Creek. This segment provides potential opportunities for stream restoration; however, the expansion of the existing channel ROW is constrained due to existing and ongoing development along Mill Creek.

Segment 3 – RM 6.7 (downstream of 9th Avenue) to RM 8.4 (upstream of Roosevelt Street)

This segment is located entirely within the City of Walla Walla, includes the downtown flume section, and is the most diverse segment in terms of land use. The city has assigned Comp Plan designations of Historic Downtown, Downtown, Commercial, Public, and Residential to lands adjacent to this segment (Figure 2.4-4). The intensity of land use is highly urban in character for the majority of Segment 3. However, different extents of this segment have different predominant land uses and urban character that offer different conditions for Mill Creek.

West of Downtown (9th Avenue to 6th Avenue). Properties west of Downtown along the Mill Creek Channel include a range of uses such as Washington Park, a convenience store, gas station, bulk agricultural chemical supply, an electrical substation, the Courtyard Marriott Hotel, restaurants and miscellaneous commercial uses. Many of these parcels have an open area used for staging/storage immediately adjacent to Mill Creek. With the exception of the Courtyard Marriott Hotel, which includes a pathway along the south bank of Mill Creek, most of the uses are oriented away from the creek. Corresponding zoning designations are predominately Public Reserve and Light Industrial (Figure 2.4-5). The updated Walla Walla County and City of Walla Walla SMPs have designated Mill Creek's shoreline from 9th Avenue to 6th Avenue as primarily High Intensity.

Downtown (4th Avenue to Whitman College). The Downtown area contains a mix of retail, office, personal services, public open space, and parking lot uses. Unlike the areas west of downtown, most of the downtown parcels have an 85 to 95 percent lot coverage (meaning the building on the parcel takes up the majority of the lot). There are also several public and private parking lots downtown, three of which cover portions of the Mill Creek Channel. Corresponding zoning designations are predominately Central Commercial and Public Reserve in the Downtown area (Figure 2.4-5). The primary points for public viewing of the channel occur at road/bridge crossings, near the USACE Walla Walla District Office and the Vue 22 condominiums (where there is a pathway along the north side of the channel), at the Land Title Plaza at the intersection of 1st and Main Streets, and from parking lots adjacent to Heritage Park west of Spokane Street. Except as noted, most of the existing land uses in Downtown are oriented away from Mill Creek. The Downtown represents a highly urbanized setting, and offers an excellent opportunity for development of several concept alternatives as well as reorientation of uses towards Mill Creek.

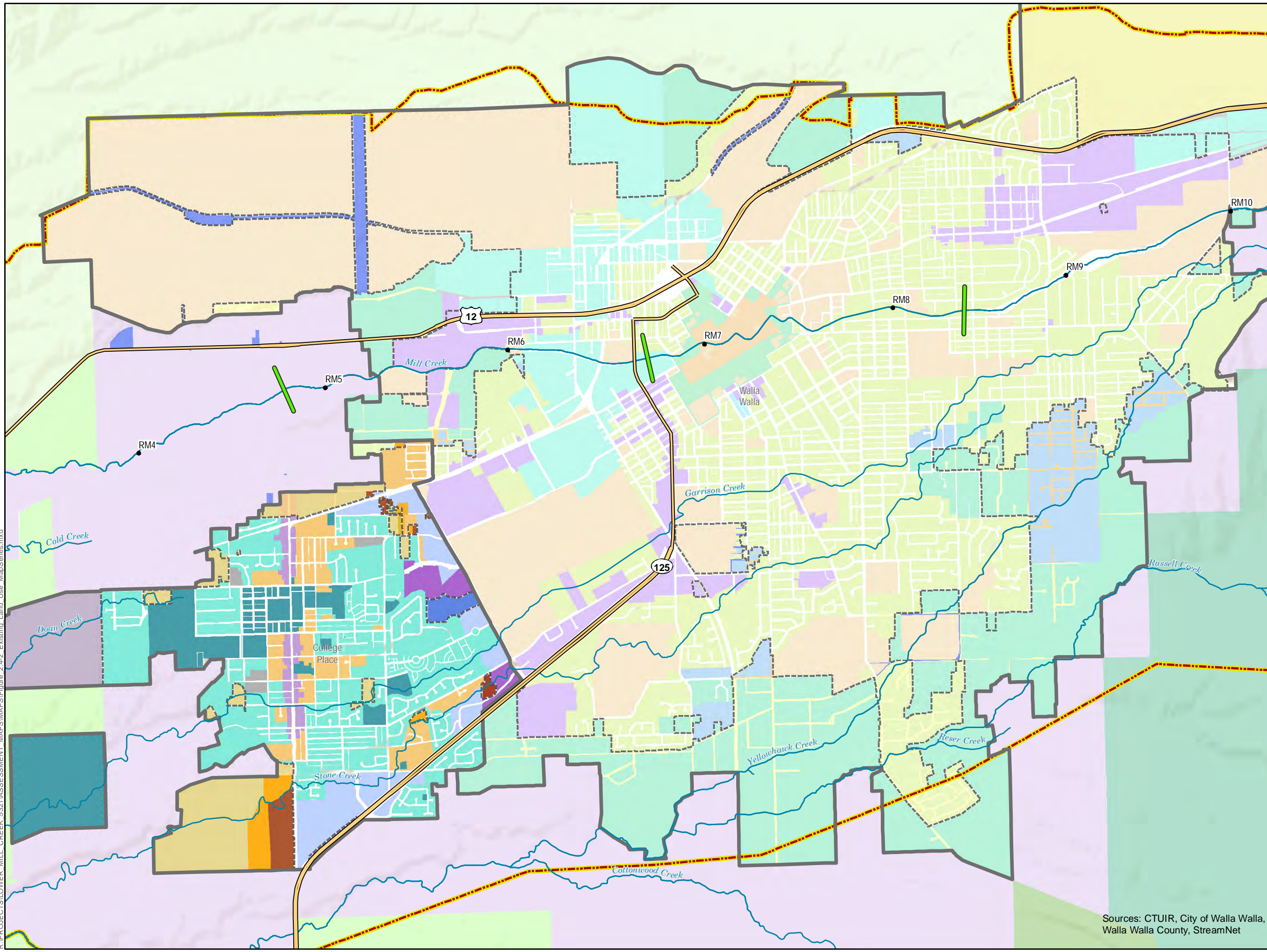
The Downtown flume section of the Mill Creek Channel is incised into the landscape, and consists of vertical concrete walls with a sloping concrete bottom. With few exceptions, this section is also very constrained by existing land uses and urban development, so the potential strategies for conceptual alternatives will be similar and reflective of a narrow ROW.

The updated Walla Walla city and county SMPs have designated Mill Creek's shoreline from 4th Avenue to Colville Street as Urban Downtown and from Colville to Whitman College Campus as High Intensity.

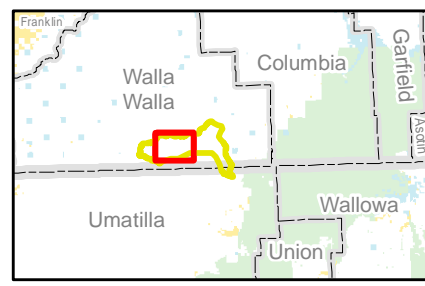
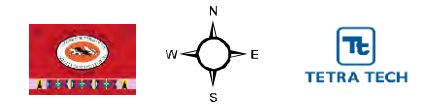
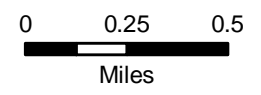
LOWER MILL CREEK HABITAT AND PASSAGE ASSESSMENT

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE 2.4-4
EXISTING LAND USE
(Comprehensive Plan Designations)
SEGMENTS 2 AND 3**



- River Miles
 - ▬ Project Area Breaks
 - ▬ Stream
 - ▬ Waterbody
 - ▬ Project Area
 - ▬ Primary Focus Area
 - ▬ Secondary Focus Area
 - ▬ City Limits
 - ▬ Urban Growth Area Boundaries
- City of Walla Walla Land Use**
- Airport
 - Commercial
 - Downtown
 - Historic Downtown
 - Industrial
 - LD Residential
 - MD Residential
 - MF Residential
 - Public
 - Residential
- Walla Walla County Land Use**
- AGRICULTURE RESIDENTIAL
 - AIRPORT
 - COMMERCIAL
 - EXCLUSIVE AGRICULTURE
 - GENERAL AGRICULTURE
 - INDUSTRIAL
 - LOW DENSITY RESIDENTIAL
 - MEDIUM DENSITY RESIDENTIAL
 - MULTIPLE FAMILY RESIDENTIAL
 - PRIMARY AGRICULTURE
 - PUBLIC RESERVE
 - RURAL RESIDENTIAL 5
- City of College Place Land Use**
- COLLEGE AVE DISTRICT
 - COMMERCIAL
 - COMMERCIAL/LIGHT INDUSTRY MIX
 - LIGHT INDUSTRY
 - MULTIPLE FAMILY RESIDENTIAL
 - PUBLIC RESERVE
 - URBAN RESIDENTIAL 4-7 DU/ACRES



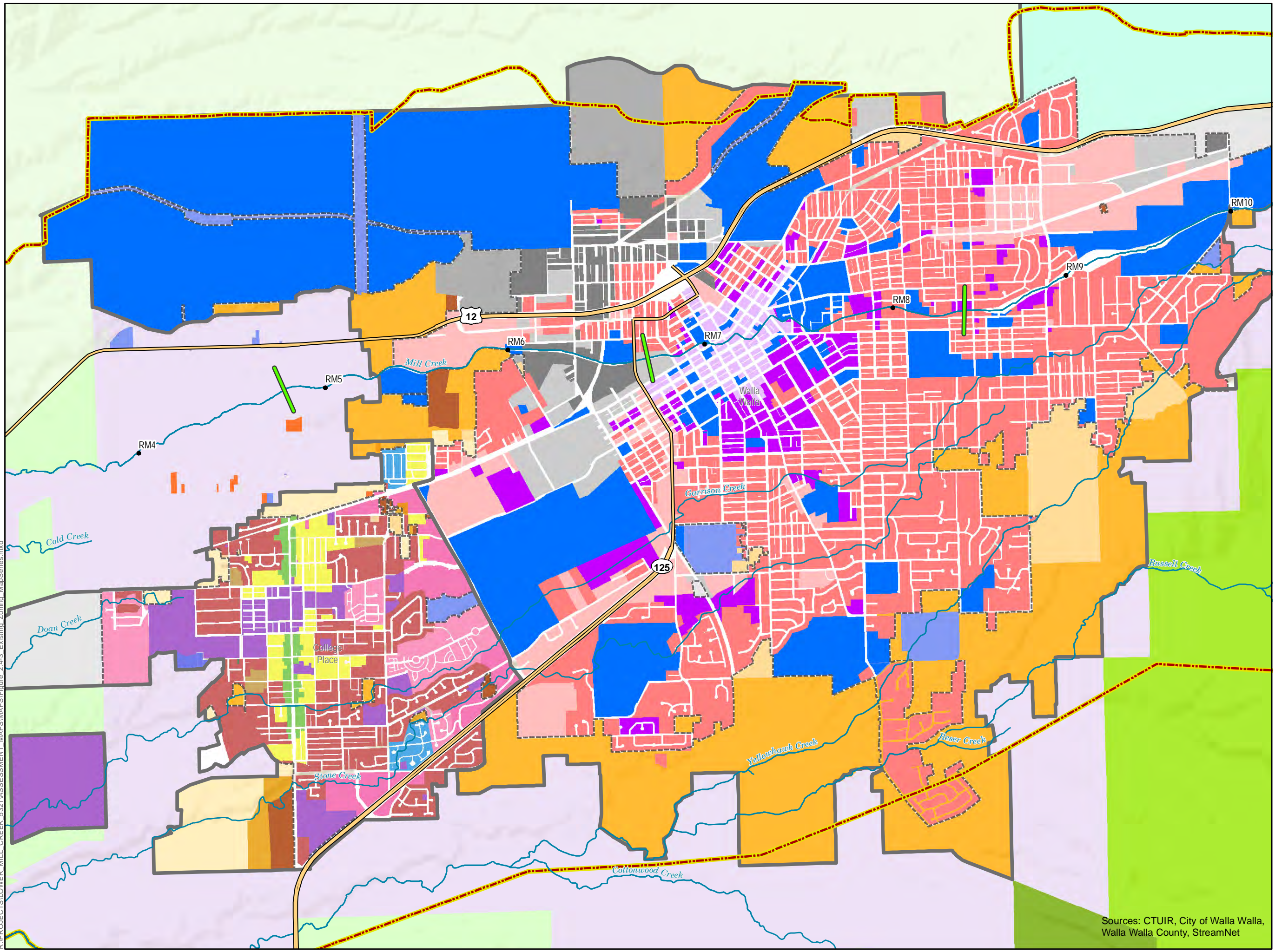
Sources: CTUIR, City of Walla Walla, Walla Walla County, StreamNet

R:\PROJECTS\LOWER_MILL_CREEK_5321\ASSESSMENT_MAPS\MAPS\Figure 2.4-2_Existing Land Use_MapSeries.mxd

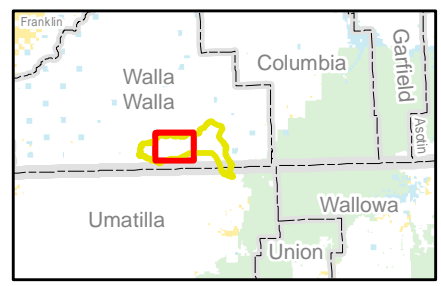
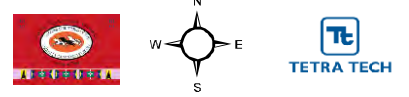
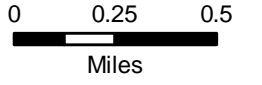
**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE 2.4-5
EXISTING ZONING
SEGMENTS 2 AND 3**



- River Miles
- Project Area Breaks
- Stream
- Waterbody
- Project Area
- Primary Focus Area
- Secondary Focus Area
- City Limits
- Urban Growth Area Boundaries
- City of Walla Walla Zoning**
- Central Commercial
- Heavy Industrial
- Highway Commercial
- Light Industrial/Commercial
- Multi-Family Residential
- Public Reserve
- Single Family Residential
- Walla Walla County Zoning**
- AGRICULTURE RESIDENTIAL 10
- AIRPORT DEVELOPMENT
- EXCLUSIVE AGRICULTURE 120
- GENERAL AGRICULTURE 20
- GENERAL COMMERCIAL
- HEAVY INDUSTRIAL
- LIGHT INDUSTRIAL
- MULTIPLE FAMILY RESIDENTIAL
- NEIGHBORHOOD COMMERCIAL
- PRIMARY AGRICULTURE 40
- PUBLIC RESERVE
- R-60 SINGLE-FAMILY RESIDENTIAL
- R-72 SINGLE-FAMILY RESIDENTIAL
- R-96 SUBURBAN RESIDENTIAL
- RURAL RESIDENTIAL 5
- City of College Place Zoning**
- DOWNTOWN MIXED USE DISTRICT
- GENERAL COMMERCIAL
- LIGHT INDUSTRIAL DISTRICT
- MANUFACTURED HOME PARK DISTRICT
- MULTIFAMILY RESIDENTIAL
- NEIGHBORHOOD COMMERCIAL
- PLANNED UNIT DEVELOPMENT
- PUBLIC RESERVE DISTRICT
- SINGLE-FAMILY RESIDENTIAL



Sources: CTUIR, City of Walla Walla,
Walla Walla County, StreamNet

R:\PROJECTS\LOWER MILL CREEK_5321\ASSESSMENT_MAPS\MAPS\Figure 2.4-3 Existing Zoning_MapSeries.mxd



Pedestrian Pathway – USACE Building



Building Orientation – Vue 22 Condominiums



Channel looking upstream towards Palouse St.



Exposed portion of underground channel off Main St.

Mill Creek Segment 3 Example Photos of Land Use Context Downtown

East of Downtown (Whitman College to Roosevelt Street). Properties east of Downtown have been assigned a zoning mix of Public Reserve, Single-Family Residential (High Density), Single-Family Residential (Medium Density), and Multi-Family Residential (Figure 2.4-5). The Mill Creek Channel runs along the southern boundary of the Whitman College campus, and extends through an area developed primarily with a mix of single-family and multi-family residential uses. Prominent features along this stretch of Segment 3 include the Whitman College campus, two pedestrian bridges across the channel linking Alder Street with the Whitman campus, a pedestrian pathway along the north bank next to the Fouts Center for the Visual Arts, a small open space area east of the Red Cross building on Park Street, several historic bridges, and Wildwood Park. Several of the houses on the Whitman campus, which have been converted to student residences, face the Mill Creek Channel. However, most of the development is not oriented to the channel. Similar to the Downtown corridor, existing development constrains the channel to a relatively narrow ROW. Opportunities for development of conceptual alternatives

include the site of a proposed residence hall at the west end of the Whitman campus, pedestrian crossings, future restoration or reconstruction of historic bridge crossings, and Wildwood Park.



Pedestrian Bridge – Alder St. to Whitman Campus



Historic Bridge – Otis Street

Mill Creek Segment 3 Example Photos of Land Use Context Near Whitman College

The updated Walla Walla County and City of Walla Walla SMPs have designated Mill Creek’s shoreline from Whitman College Campus to Roosevelt Street as primarily Urban Residential with some patches of High Intensity and Urban Conservancy (Wildwood Park) along the northern shoreline.

In summary, Segment 3 provides potential opportunities for stream restoration as well as urban amenities; however, expansion of the existing channel ROW will be constrained due to the highly urbanized setting and existing development along Mill Creek.

Segment 4 – RM 8.4 (upstream of Roosevelt Street) to RM 12.2 (end of Flood Control Zone)

Segment 4 contains a mix of unincorporated land and land incorporated within the City of Walla Walla. The Mill Creek Channel in this segment consists of levees and in-stream concrete baffles and includes a wider ROW than most of Segments 2 and 3 and is dominated by a series of constructed flood control sills, which act as a long series of step pools. Although the wide ROW provides opportunities for floodplain restoration, the quality of the pools is low as the wide ROW and weirs present significant thermal and physical barriers at low flows.

The incorporated lands within the City of Walla Walla along Mill Creek in Segment 4 include the Edison Elementary School campus, a mixture of single- and multi-family housing, Eastgate Lions Park, Mill Creek Sports Complex, and Walla Walla Community College. The City of Walla Walla has assigned Comp Plan designations of Commercial, Industrial, Public, Residential and Medium Density Urban Residential to these areas and corresponding zoning

designations of Highway Commercial, Light Industrial, Public Reserve, Single-Family Residential (High Density), Single-family Residential (Medium Density), and Multi-Family Residential (Figures 2.4-6 and 2.4-7).

Eastgate Lions Park, located on the north side of the channel east of Wilbur Avenue, includes a basketball court, play equipment, the city's Little League fields, and the west entrance of the Mill Creek Recreation Trail, a multi-use pathway along the channel's northern bank stretching from the Eastgate Lions Park to Bennington Lake.



Mill Creek Segment 4 Photo of Mill Creek Recreation Trail at Eastgate Lions Park

East of the Eastgate Lions Park is a large vacant parcel where the old Walla Walla landfill was originally located. The area west of Tausick Way and south of the channel includes the Mill Creek Sports Complex and an existing multi-use pathway along the southern channel levee. East of Tausick Way is the Walla Walla Community College Campus. Titus Creek flows through a former floodplain on the Walla Walla Community College campus and returns to Mill Creek through a 12-inch pipe that is a fish passage barrier. This portion of Segment 4 may provide an excellent opportunity for re-establishment of some of the former floodplain functions and development of a living laboratory for the Walla Walla Community College Water and Environmental Center.



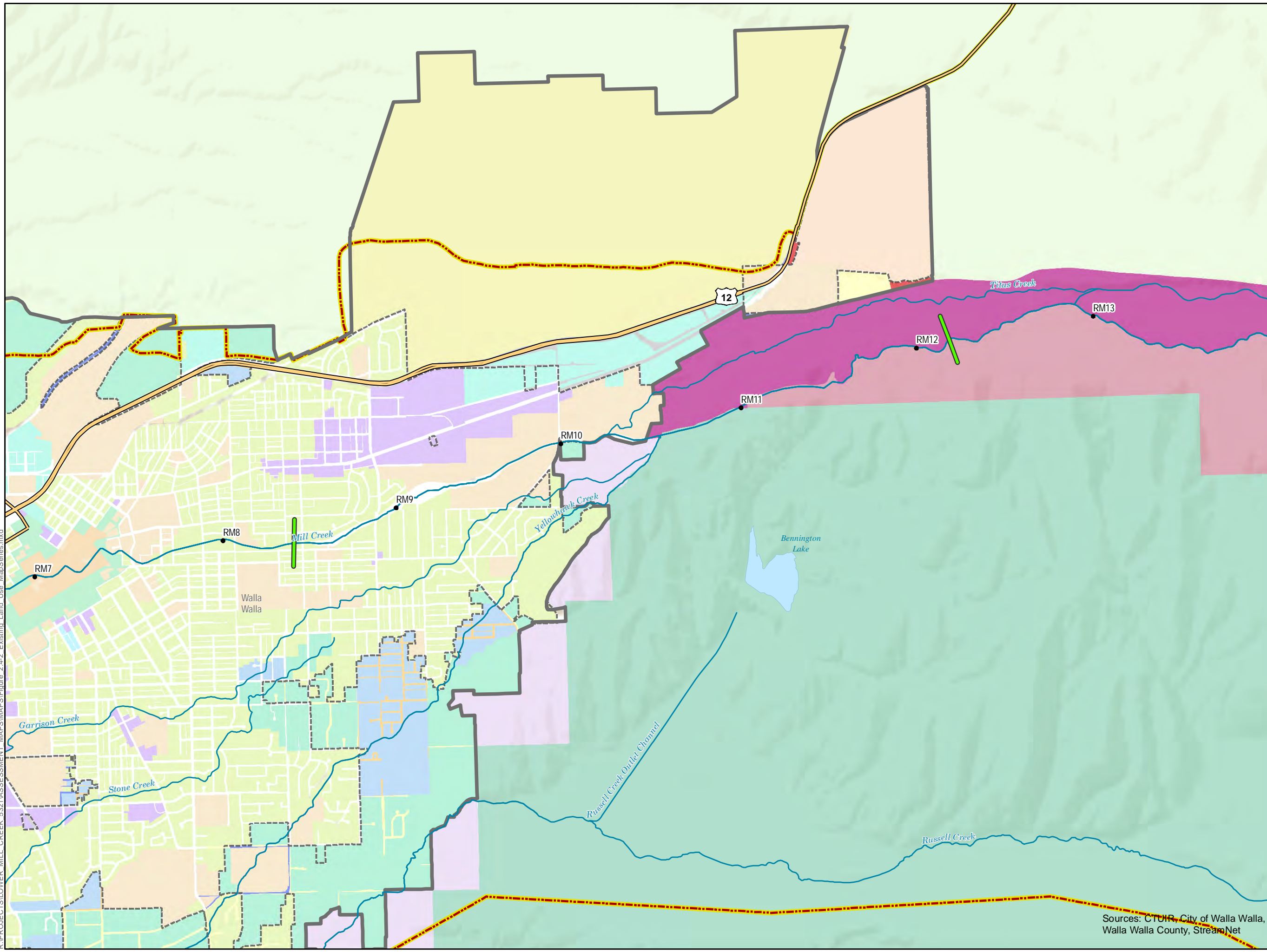
Mill Creek Segment 4 Photo of Mill Creek During High Flows Near Walla Walla Community College.

The unincorporated areas of Segment 4 generally located east and south of Walla Walla Community College have been assigned a county Comp Plan designation of Exclusive Agriculture, Rural Remote, and Rural Residential Mill Creek, with corresponding zoning designations of Light Industrial, Rural Remote 20, Rural Residential Mill Creek 5, Rural Residential 5, and R-96 Single-family Residential (Figures 2.4-6 and 2.4-7). The area is predominately rural in character and includes some small acreage farms and ranches, the USACE Mill Creek operations compound and flood control works, the Klicker's strawberry farm, and Rooks Park. Titus Creek and the Titus Creek Irrigation Ditch extend through the area, providing irrigation to adjacent properties. The USACE properties include recreational amenities such as the Mill Creek Recreation Trail, Rooks Park, and Bennington Lake (see Section 2.12). With the exception of the multi-use pathway, development is not oriented to Mill Creek in Segment 4.

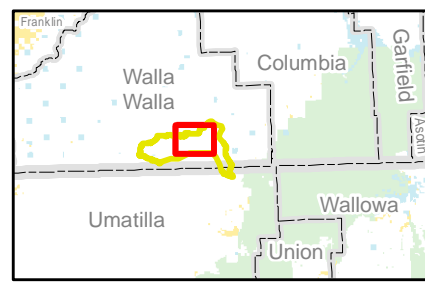
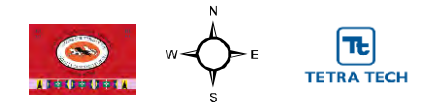
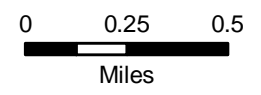
**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE 2.4-6
EXISTING LAND USE
(Comprehensive Plan Designations)
SEGMENT 4**



- River Miles
 - Project Area Breaks
 - Stream
 - Waterbody
 - ▭ Project Area
 - ▭ Primary Focus Area
 - ▭ Secondary Focus Area
 - ▭ City Limits
 - ▭ Urban Growth Area Boundaries
- City of Walla Walla Land Use**
- ▭ Airport
 - ▭ Commercial
 - ▭ Downtown
 - ▭ Historic Downtown
 - ▭ Industrial
 - ▭ LD Residential
 - ▭ Master Planned Community
 - ▭ MD Residential
 - ▭ MF Residential
 - ▭ Public
 - ▭ Residential
- Walla Walla County Land Use**
- ▭ AIRPORT
 - ▭ COMMERCIAL
 - ▭ EXCLUSIVE AGRICULTURE
 - ▭ INDUSTRIAL
 - ▭ LOW DENSITY RESIDENTIAL
 - ▭ MASTER PLANNED COMMUNITY
 - ▭ MEDIUM DENSITY RESIDENTIAL
 - ▭ PRIMARY AGRICULTURE
 - ▭ PUBLIC RESERVE
 - ▭ RURAL REMOTE
 - ▭ RURAL RESIDENTIAL 5
 - ▭ RURAL RESIDENTIAL MILL CREEK



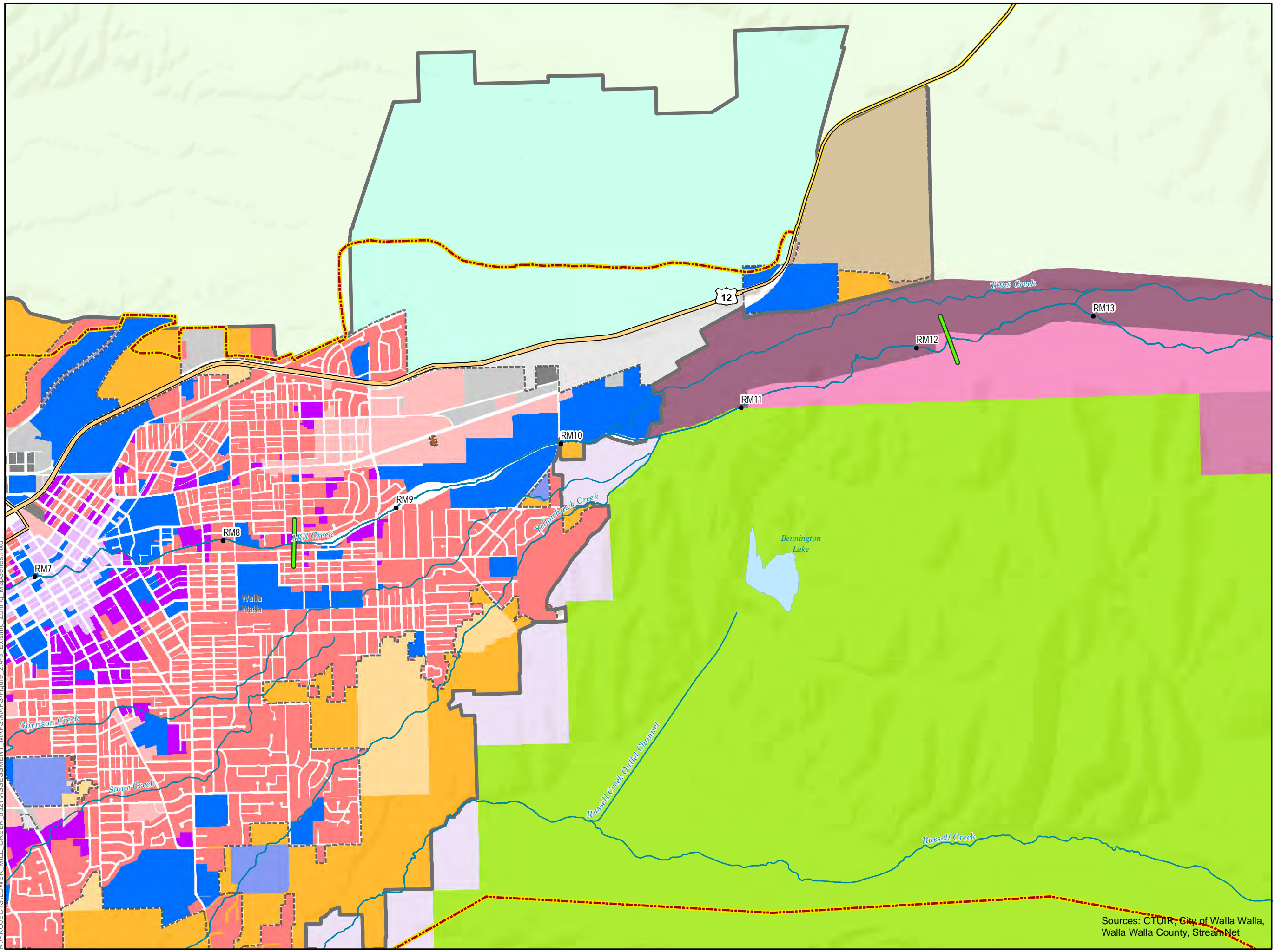
Sources: CTUIR, City of Walla Walla, Walla Walla County, StreamNet

R:\PROJECTS\LOWER_MILL_CREEK_5321\ASSESSMENT_MAPS\MAPS\Figure 2.4-2_Existing_Land_Use_MapSeries.mxd

**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

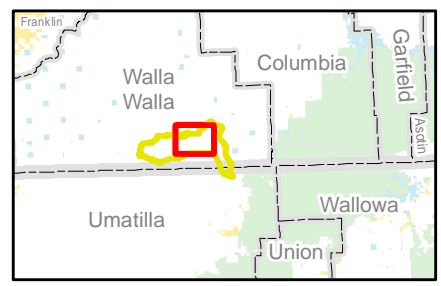
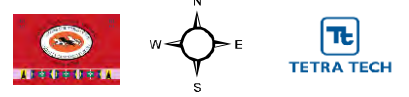
CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE 2.4-7
EXISTING ZONING
SEGMENT 4**



- River Miles
 - Project Area Breaks
 - Stream
 - Waterbody
 - - - Project Area
 - Primary Focus Area
 - Secondary Focus Area
 - - - City Limits
 - Urban Growth Area Boundaries
- City of Walla Walla Zoning**
- Central Commercial
 - Heavy Industrial
 - Highway Commercial
 - Light Industrial/Commercial
 - Multi-Family Residential
 - Public Reserve
 - Single Family Residential
 - Urban Planned Community
- Walla Walla County Zoning**
- AIRPORT DEVELOPMENT
 - EXCLUSIVE AGRICULTURE 120
 - GENERAL COMMERCIAL
 - LIGHT INDUSTRIAL
 - PRIMARY AGRICULTURE 40
 - PUBLIC RESERVE
 - R-72 SINGLE-FAMILY RESIDENTIAL
 - R-96 SUBURBAN RESIDENTIAL
 - RURAL REMOTE 20
 - RURAL REMOTE 40
 - RURAL RESIDENTIAL 5
 - RURAL RESIDENTIAL MILL CREEK 5
 - URBAN PLANNED COMMUNITY

0 0.25 0.5
Miles



Sources: CTUIR, City of Walla Walla, Walla Walla County, StreamNet

R:\PROJECTS\LOWER_MILL_CREEK_5321\ASSESSMENT_MAPS\MAPS\Figure 2.4-3_Existing_Zoning_MapSeries.mxd

The updated Walla Walla County and City of Walla Walla SMPs have designated Mill Creek's shoreline from Roosevelt Street to past Wilbur Ave as primarily Urban Residential with some sections of High Intensity. Where Mill Creek flows along Eastgate Park, the shoreline environmental designation changes to Urban Conservancy on both banks until Tausick Way where the designation changes to Urban Residential and then Rural Residential along the south bank. Upstream of Walla Walla Community College until the end of the Flood Control Zone, the northern bank is designated Rural Residential and Rural Conservancy and the southern bank is designated Rural Conservancy.

Segment 5 – RM 12.2 (end of Flood Control Zone) to RM 15 (7 Mile Bridge)

Segment 5 is located within unincorporated Walla Walla County and is subject to the county's Comp Plan and zoning. The county Comp Plan designations for the area include Exclusive Agriculture, Rural Remote, and Rural Residential Mill Creek, with corresponding zoning designations of Exclusive Agriculture 120, Rural Remote 40, Primary Agriculture 40, and Rural Residential Mill Creek 5 (Figures 2.4-8 and 2.4-9). The updated Walla Walla County and City of Walla Walla SMPs have designated Mill Creek's shoreline from the end of the Flood Control Zone through RM 15 as a combination of Rural Residential and Rural Conservancy. The area is rural in character and developed with agriculture and related uses as well as residential uses. There are also several vineyards and wineries in the area. Some of the development is oriented to Mill Creek. This segment is characterized by a natural channel and may have opportunities for floodplain connection and flood water storage.

Mill Creek Upstream of Segment 5 (Secondary Focus Area)

The Secondary Focus Area is located within unincorporated Walla Walla County and extends into Oregon. The Walla Walla County Comp Plan designations for the area are Primary Agriculture, Exclusive Agriculture, and Rural Residential Mill Creek, with corresponding zoning classifications of Exclusive Agriculture 120, Primary Agriculture 40, Rural Remote 20, and Rural Residential Mill Creek 5. The updated Walla Walla County and City of Walla Walla SMPs have designated Mill Creek's shoreline from upstream of RM 15 to the county boundary as a combination of Rural Residential and Rural Conservancy. The area is rural in character and developed with large- and small-scale agricultural uses, and residential homes, some of which are oriented to Mill Creek. This segment is characterized by a natural channel, with some banks that have been hardened to help minimize bank erosion.

2.4.2.2 Existing Land Use Along Yellowhawk and Garrison Creeks

Garrison Creek

Garrison Creek is located in unincorporated Walla Walla County at its confluence with the Walla Walla River until it crosses into the city limits of College Place near the City of College Place Waste Water Treatment Plant. From there, Garrison Creek crosses through unincorporated lands until it enters back into the jurisdiction of College Place near Grandview Avenue. Through College Place, Garrison Creek winds through lands designated by the City of College Place Comp Plan as Urban Residential 4-7 Du/Acre, Commercial, and Public Reserves. Garrison enters into the City of Walla Walla at SE Myra Road near Fort Walla Walla Park. From there, the creek winds northeast through lands designated by the City of Walla Walla Comp Plan as Single Family Residential (R-60, R-72, and R-96), Multiple Family Residential, Highway Commercial, and Public Reserve. Eventually, Garrison Creek leaves the City of Walla Walla near the Mill Creek Sports Complex and crosses land designated by the county Comp Plan as Rural Residential Mill Creek 5, where it intersects with Mill Creek at the USACE-owned Division Works Dam.

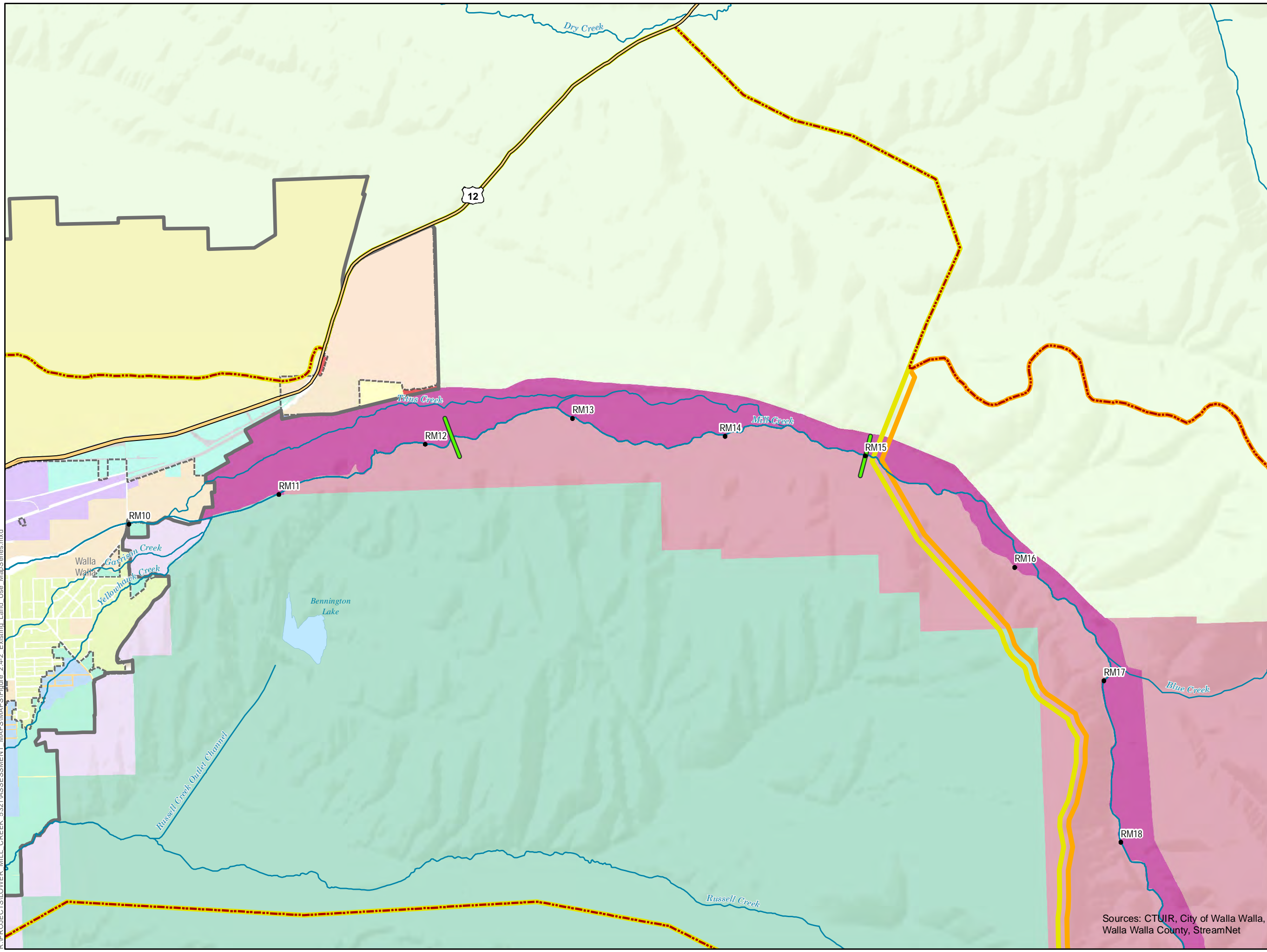
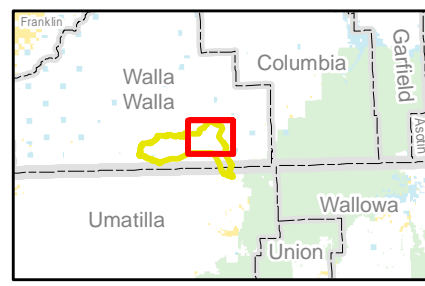
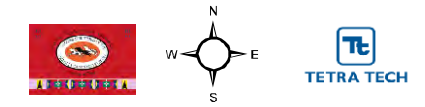
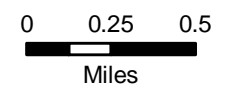
The portions of Garrison Creek within the Urban Growth Area (UGA) boundary are highly urbanized with several sections of this creek being reduced to only a 7-foot-wide corridor. Although Garrison Creek is not designated as an SMP waterbody and therefore has no established shoreline buffer under the SMP, riparian habitat areas are designated by the SMP for portions of Garrison Creek. According to the Walla Walla County Critical Areas Ordinance Best Available Science Review (Walla Walla County 2008), Garrison Creek's riparian width from the mouth to the edge of the UGA boundary averages approximately 15 feet with a maximum riparian width of 70 feet and a minimum of 20 feet (including both stream sides). Within the UGA boundary, the riparian width average ranges from 7 to 12 feet with the maximum width of 201 feet and a minimum of 7 feet (including both stream sides). The recommended riparian buffer width for Garrison Creek from the Second Division Works to the College Place Wastewater Treatment Plant is 35 feet and from the Wastewater Treatment Plant to the confluence with the Walla Walla River, the riparian buffer width is 50 feet. However, non-shoreline waterbodies are only subject to these riparian buffer widths when passing through shoreline jurisdiction. Therefore these riparian buffer widths are only enforceable where Garrison Creek is within 200 feet of the OHWM of Mill Creek, Yellowhawk Creek, or the Walla Walla River.

**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE 2.4-8
EXISTING LAND USE
(Comprehensive Plan Designations)
SEGMENT 5**

- River Miles
 - Project Area Breaks
 - Stream
 - Waterbody
 - ▭ Project Area
 - ▭ Primary Focus Area
 - ▭ Secondary Focus Area
 - ▭ City Limits
 - ▭ Urban Growth Area Boundaries
- City of Walla Walla Land Use**
- ▭ Airport
 - ▭ Commercial
 - ▭ Industrial
 - ▭ LD Residential
 - ▭ Master Planned Community
 - ▭ MD Residential
 - ▭ Public
 - ▭ Residential
- Walla Walla County Land Use**
- ▭ AIRPORT
 - ▭ COMMERCIAL
 - ▭ EXCLUSIVE AGRICULTURE
 - ▭ INDUSTRIAL
 - ▭ LOW DENSITY RESIDENTIAL
 - ▭ MASTER PLANNED COMMUNITY
 - ▭ MEDIUM DENSITY RESIDENTIAL
 - ▭ PRIMARY AGRICULTURE
 - ▭ PUBLIC RESERVE
 - ▭ RURAL REMOTE
 - ▭ RURAL RESIDENTIAL 5
 - ▭ RURAL RESIDENTIAL MILL CREEK



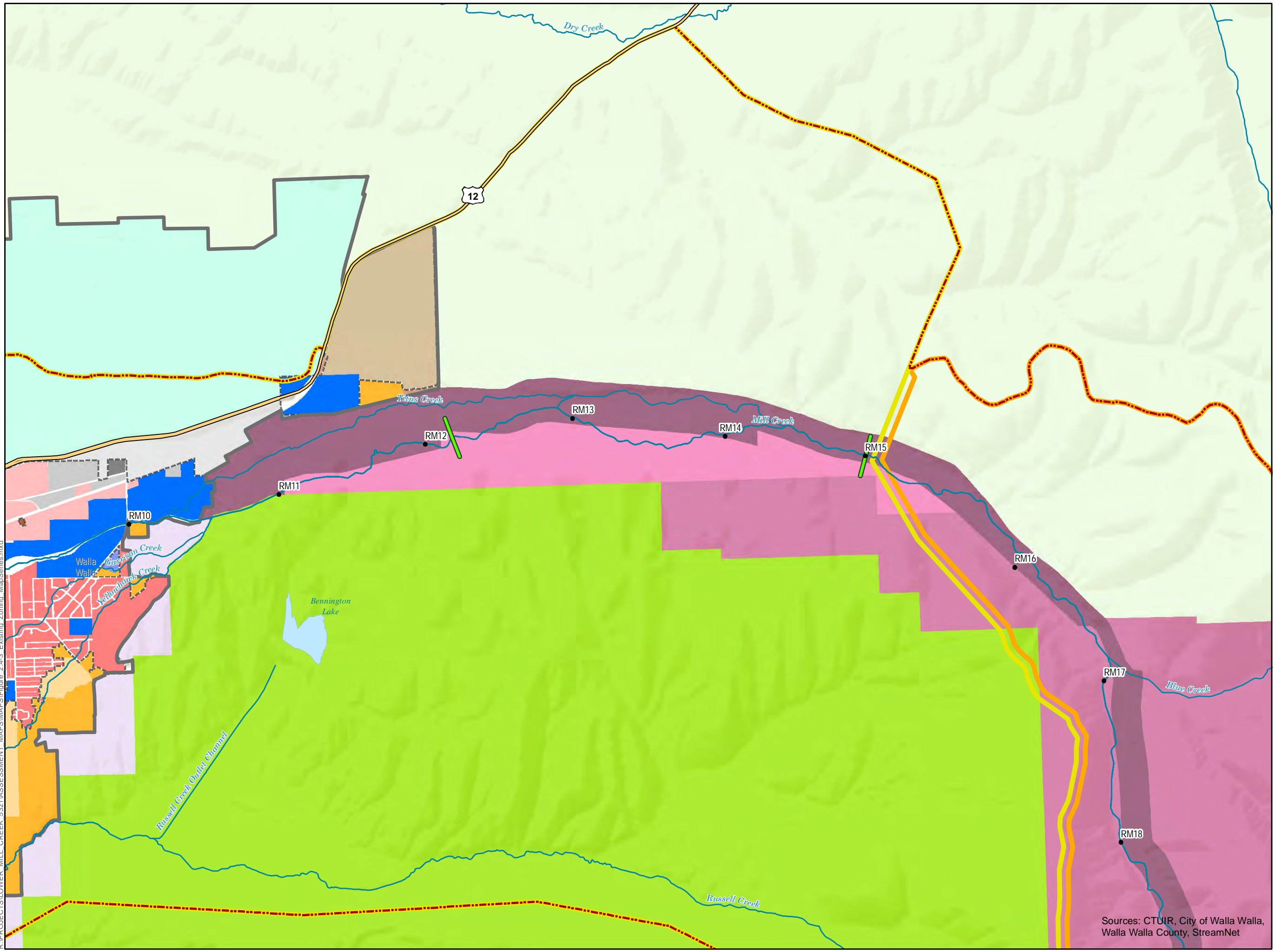
Sources: CTUIR, City of Walla Walla,
Walla Walla County, StreamNet

R:\PROJECTS\LOWER MILL CREEK_5321\ASSESSMENT_MAPS\MAPS\Figure 2.4-2_Existing Land Use_MapSeries.mxd

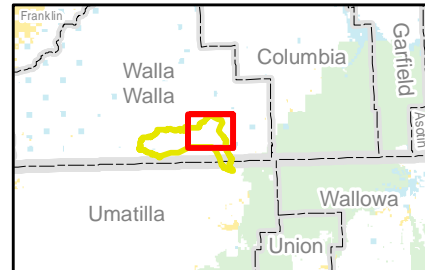
**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE 2.4-9
EXISTING ZONING
SEGMENT 5**



- River Miles
 - Project Area Breaks
 - Stream
 - Waterbody
 - - - Project Area
 - Primary Focus Area
 - Secondary Focus Area
 - - - City Limits
 - - - Urban Growth Area Boundaries
- City of Walla Walla Zoning**
- Heavy Industrial
 - Highway Commercial
 - Light Industrial/Commercial
 - Public Reserve
 - Single Family Residential
 - Urban Planned Community
- Walla Walla County Zoning**
- AIRPORT DEVELOPMENT
 - EXCLUSIVE AGRICULTURE 120
 - GENERAL COMMERCIAL
 - LIGHT INDUSTRIAL
 - PRIMARY AGRICULTURE 40
 - PUBLIC RESERVE
 - R-72 SINGLE-FAMILY RESIDENTIAL
 - R-96 SUBURBAN RESIDENTIAL
 - RURAL REMOTE 20
 - RURAL REMOTE 40
 - RURAL RESIDENTIAL 5
 - RURAL RESIDENTIAL MILL CREEK 5
 - URBAN PLANNED COMMUNITY



Sources: CTUIR, City of Walla Walla, Walla Walla County, StreamNet

R:\PROJECTS\LOWER MILL CREEK_5321\ASSESSMENT_MAPS\MAPS\Figure 2.4-9 Existing Zoning_MapSeries.mxd

Yellowhawk Creek

Yellowhawk Creek is located in unincorporated Walla Walla County at its confluence with the Walla Walla River until it crosses into the city limits of Walla Walla at Cottonwood Road south of Walla Walla High School. Yellowhawk Creek then traverses in and out of the city limits until approximately 1/5 of a mile before it converges with Mill Creek at the USACE-owned Division Works. The portion of unincorporated Walla Walla County bordering Yellowhawk Creek is designated as Rural Residential 5 by the county Comp Plan. South of Walla Walla High School, Yellowhawk Creek winds through land designated as R-96 Single Family Residential by the City of Walla Walla Comp Plan. From there, the creek traverses through the Walla Walla High School campus and heads northeast through Murr Field Park and back into R-96 Single Family Residential.

In comparison to Garrison Creek, Yellowhawk Creek is less urbanized but still constrained by existing residential development. Only the lower portion of Yellowhawk Creek (from its confluence with Cottonwood Creek to its confluence with the Walla Walla River) is designated as an SMP waterway with a shoreline buffer of 75 to 100 feet and environmental designation of Rural Residential and Rural Conservancy. However, riparian habitat areas are designated by the SMP for the remaining portions of Yellowhawk Creek. According to the Walla Walla County Critical Areas Ordinance Best Available Science Review (Walla Walla County 2008), Yellowhawk Creek's riparian width from the mouth to the edge of the UGA boundary averages approximately 21 feet with a maximum riparian width of 180 feet and a minimum of 52 feet (including both stream sides). Within the UGA boundary, the riparian width average ranges from 13 to 16 feet with a maximum width of 181 feet and a minimum of 14 feet (including both stream sides). The recommended riparian buffer width for Yellowhawk Creek from Mill Creek to its confluence with Russell Creek is 50 feet.



Example Conditions of Yellowhawk Creek

2.4.3 Existing and Future Urbanization

The GMA requires the Washington State Office of Financial Management to generate population projections for the state and counties, for use in planning for future growth, including utility and infrastructure demand. Counties are required to allocate their assigned projected population growth to cities and the unincorporated area. In 2008, Walla Walla County, in consultation with the other four jurisdictions in the County, adopted the 20-year population allocations shown in Table 2.4-1. The information contained in the table was confirmed with county staff as the current allocation.

Table 2.4-1. 2025 County Growth Projections

Jurisdiction	2004 OFM Population Estimate	Projected Growth by 2025	Projected 2025 Population
College Place	8,560	+2,265	10,825
Walla Walla	34,153 ^{1/}	+9,030	43,183
Prescott	315	+84	399
Waitsburg	1,210	+315	1,525
Rural Walla Walla County	12,462 ^{2/}	+3,330	15,792
TOTAL	56,700	+15,000 +/-	71,724

Source: Walla Walla County 2009

1/ Includes 3,653 people in the Urban Growth Area (UGA) of the City of Walla Walla

2/ Excludes 3,653 people in the UGA of the City of Walla Walla

OFM – Washington State Office of Financial Management

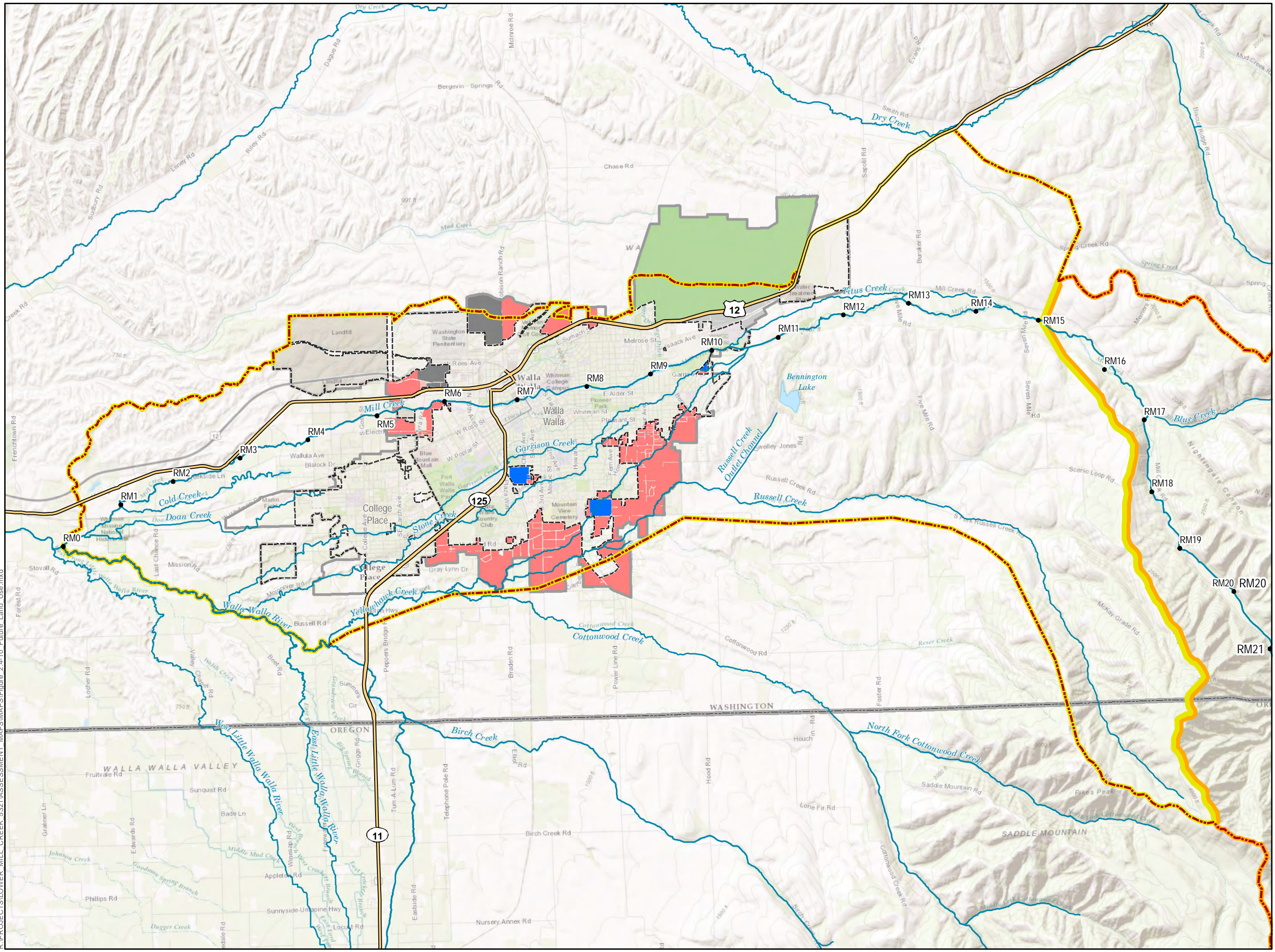
Cities and counties are also required to designate and plan for sufficient land area and infrastructure to accommodate the projected population growth, while limiting the potential for urban sprawl. In accordance with the GMA (RCW 36.70A), Walla Walla County and its cities have established UGAs to encourage growth within the urban areas and to determine where urban services are provided. There is a designated UGA for the city of College Place and City of Walla Walla that was last updated in 2005.

Buildable lands analyses were performed to ensure sufficient land was included in the UGAs to accommodate the projected population allocations. Future development needed to accommodate projected population increases is anticipated to occur through infill development (increased density), redevelopment, and development of vacant lands within the College Place and Walla Walla UGAs. The portions of primary focus area that are within these UGA boundaries may be subject to greater urbanization as these cities accommodate growth. Planned future land use types within the Walla Walla UGA are shown in Figure 2.4-10.

**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

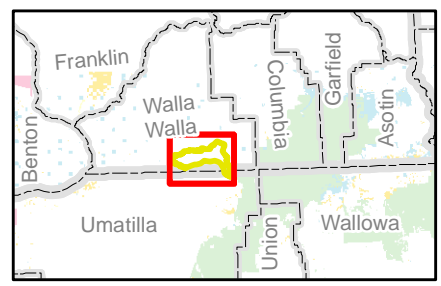
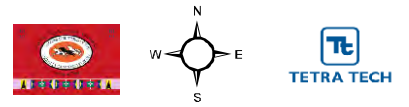
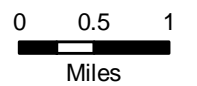
CONFEDERATED TRIBES OF THE
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**FIGURE 2.4-10
CITY OF WALLA WALLA
FUTURE LAND USE
DESIGNATIONS**



- River Miles
- Stream
- Waterbody
- ▭ Project Area
- ▭ Primary Focus Area
- ▭ Secondary Focus Area
- ▭ City Limits
- ▭ Urban Growth Area Boundaries
- City Land Use (Future)**
- ▭ Airport Development
- ▭ Heavy Industrial
- ▭ Highway Commercial
- ▭ Light Industrial/Commercial
- ▭ Public Reserve
- ▭ Single Family Residential

Sources: CTUIR, Walla Walla County, StreamNet



R:\PROJECTS\LOWER MILL CREEK\ASSESSMENT_MAPS\MAPS\Figure 2.4-10_Future Land Use.mxd

2.4.3.1 Mill Creek Existing and Future Urbanization

Segments 1 and 5 are outside of the City of Walla Walla UGA and are anticipated to remain rural and have limited development pressure. In contrast, portions of Segment 2, all of Segment 3, and portions of Segment 4 are located within the Walla Walla UGA. Most of the land within the UGA in the vicinity of Segments 3 and 4 has been developed at urban densities, with limited opportunities for new development and infill. However, opportunities for infill development west of downtown may place increased development pressure on Segment 2.

The population densities along Mill Creek vary significantly depending upon the area characteristics (rural vs. urban), Comp Plan land use and zoning designation, availability of utilities, access, and market factors, among other reasons. As properties are redeveloped within the urban area, the intensity and density of development often increases. Examples include the USACE building downtown, the Vue 22 condominiums located at the southwest corner of N. 4th Avenue and Sumach Street, Whitman College, and Walla Walla Community College. As properties along Mill Creek are redeveloped within the UGA, an increase in intensity and density of development can be expected. However, redevelopment also offers the opportunity to reconfigure new development in a manner that protects and is oriented to Mill Creek.

2.4.3.2 Garrison and Yellowhawk Creeks Existing and Future Urbanization

Garrison Creek flows through both rural and urban land uses as described in Section 2.4.2.2 and may be subject to increased development pressure within the areas where it flows through the UGAs. The majority of land adjacent to Garrison Creek within the Cities of Walla Walla and College Place is zoned single-family residential. Increased density and infill development along Garrison Creek within the City of College Place UGA will likely occur east of Grandview Avenue and west of SW Bade Avenue due to the presence of unincorporated land within the UGA and existing development patterns that are lower density than what current zoning allows. Through the City of Walla Walla, Garrison Creek flows through highly urbanized areas that will likely see limited amounts of infill as most of these areas are already built out with only pockets of vacant land or redevelopment opportunities.

As described in Section 2.4.2.2, Yellowhawk Creek flows through land that is less urbanized than that near Garrison Creek, but is still constrained by existing residential development. From its mouth to where it crosses into the City of Walla Walla UGA, Yellowhawk Creek flows through county zoned Rural Residential 5 lands that constrain development to small-scale farms, dispersed single-family homes, and other uses that do not require urban services (Walla

Walla County 2015a). However, along the southeast edge of the City of Walla Walla UGA, there are several large unincorporated areas along Yellowhawk Creek that will likely see increased residential development pressure. Specifically the portion of Yellowhawk Creek that flows from just southwest of the USACE Division Works down to Sturm Avenue may be subject to increased urbanization.

2.4.4 Impervious Surfaces

The term “impervious surfaces” refers to developed hard surface areas that prevent or delay infiltration of water into the soil or that cause water to run off the surface at greater flows than under natural conditions (Walla Walla Municipal Code [WWMC] 21.04.015). These surfaces can include rooftops, sidewalks, driveways, roads, parking lots, gravel roads, packed earth, or other development that impedes natural water infiltration (WWMC 21.04.015).

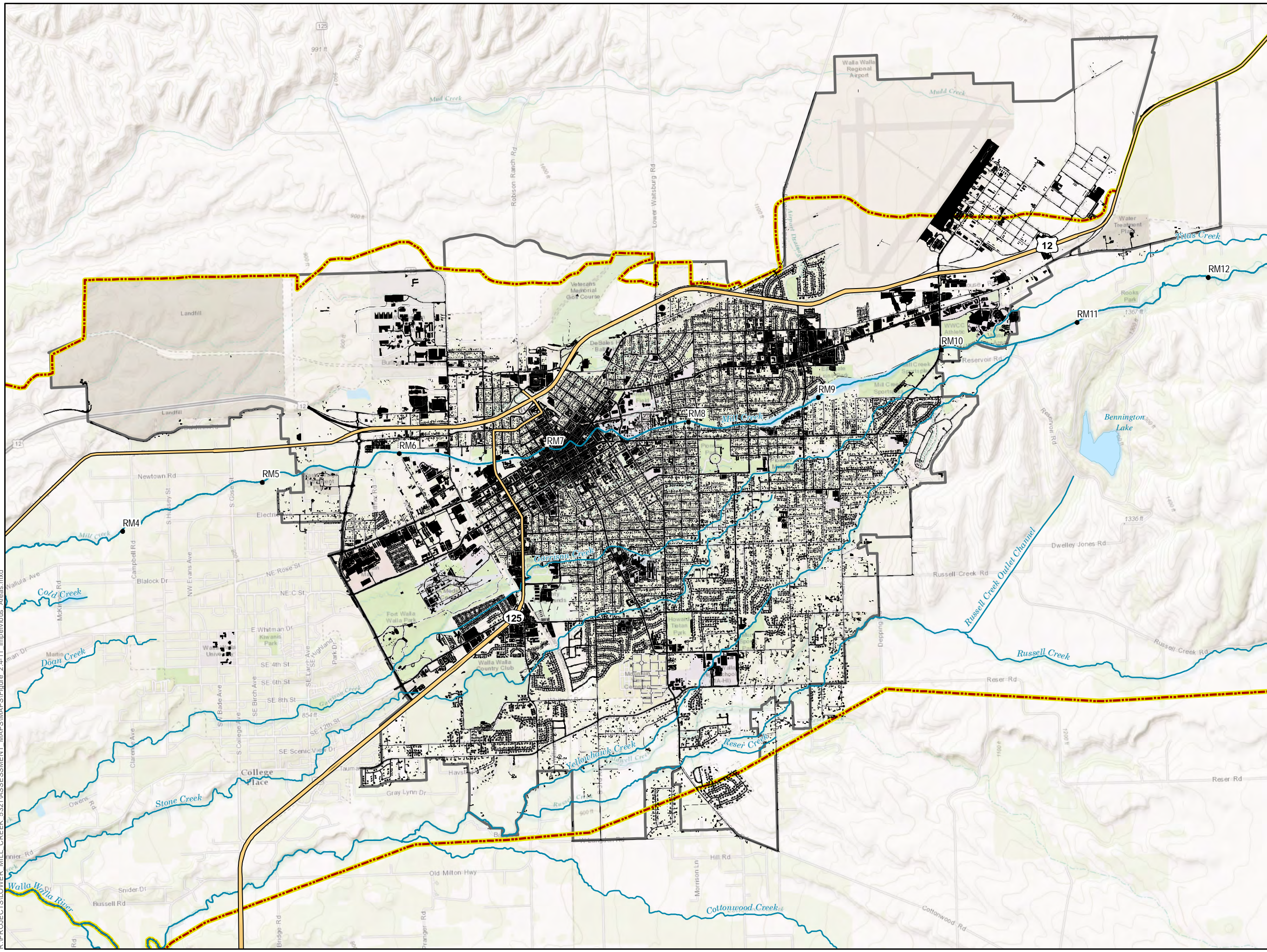
Stormwater runoff is directly affected by development of impervious surfaces (City of Walla Walla 2015a). Increased impervious area reduces water storage capacity of aquifers (as stormwater access via infiltration is reduced), increasing flows in streams during storm events (Konrad 2003). This can result in increased frequency and peak discharge of floods (Konrad 2003). Impervious surfaces in urban environments can also result in increased levels of contaminants deposited into waterbodies, as water runs off streets and lawns and other areas where contaminants may be present.

There are approximately 2,083 acres of impervious surfaces within Walla Walla’s city limits (see Figure 2.4-11). This makes up approximately 30 percent of the total land area within the city. Although the soils in the primary focus area are generally well-drained, high levels of impervious surfaces, especially near the Mill Creek Channel, prevent ground infiltration and hyporheic exchange (The Watershed Company et al. 2015).

**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

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UMATILLA INDIAN RESERVATION

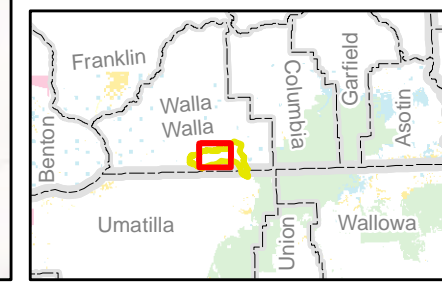
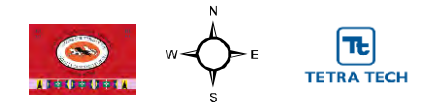
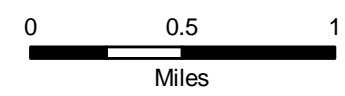
**FIGURE 2.4-11
IMPERVIOUS AREAS
WITHIN
CITY OF WALLA WALLA**



- River Miles
- Stream
- Waterbody
- ▭ Project Area
- ▭ Primary Focus Area
- ▭ Secondary Focus Area
- ▭ City of Walla Walla Urban Growth Area
- ▭ Impervious Surface

Note:
Total of 2,083 acres of impervious areas within the Urban Growth Area Boundary of the City of Walla Walla.

Sources: CTUIR, City of Walla Wall, Walla Walla County, StreamNet



R:\PROJECTS\LOWER MILL CREEK\ASSESSMENT MAPS\MAPS\Figure 2.4-11 Impervious Areas.mxd

The City of Walla Walla developed a Comprehensive Stormwater Management Plan (City of Walla Walla 2015a) to address localized flooding and aging infrastructure, and to protect streams and groundwater. This plan identified and prioritized existing drainage problem areas, including surface routing and groundwater infiltration areas (City of Walla Walla 2015a). Recommendations from this analysis include measures to mitigate the effects of these surfaces, such as adding requirements to reduce development of new impervious areas, retrofitting the existing drainage network to reduce direct runoff to surface waters, retrofitting infiltration wells, implementing strategies to reduce available contaminants in runoff, and implementing proprietary treatment strategies prior to any direct discharge to streams. The purpose of these strategies is to reduce the amount of direct runoff entering the receiving waters, and to improve the water quality of water that is discharged into surface waters.

2.4.5 Stormwater and Sanitary Infrastructure

2.4.5.1 City of Walla Walla Stormwater and Sewer Infrastructure

The City of Walla Walla has 22 stormwater drainage basins. Six of these drain into Yellowhawk Creek, one into Stone Creek, four into Garrison Creek, three into Mudd Creek, and eight into Mill Creek (see Figure 2.4-12). The City discharges stormwater to both surface and groundwater resources (City of Walla Walla 2015a). Approximately 1,000 stormdrains discharge to streams (see stormwater outfalls and stormwater basins on Figure 2.4-13), potentially impacting water quality (fecal coliform, dissolved oxygen, temperatures, nutrients and turbidity) (The Watershed Company 2015 et al.). The 2014 Comprehensive Stormwater Management Plan lists and prioritizes problem drainage areas as well as problem underground injection control (UIC) facilities. Problems include undersized culverts, improperly functioning dry wells, and clogged drainage pipes, among other impacts (City of Walla Walla 2015a). Heavily contaminated drainage and industrial and domestic wastewater is transported to the Walla Walla Wastewater Treatment Plant (WWTP) via the sanitary sewer system.

2.4.5.2 Walla Walla Wastewater Treatment Plant

The existing WWTP has been at its current location since 1928, and has undergone upgrades as the City expands and capacity and environmental requirements increase. The City is planning to upgrade the water plant with a roughing sand filter and UV light disinfection in 2017 to 2018 (pers. com. Brad Daly, Stormwater Coordinator, City of Walla Walla, Sept. 16, 2016). Since the WWTP's operation, the City has provided irrigation districts with treated wastewater "suitable for irrigation and stock watering purposes" (Ecology 2005). Water is discharged to Mill Creek

from December to April, while from April to December, it is used for irrigation (Joy et al. 2007). The current operations require that reclaimed water be treated to Class A level for distribution to the irrigation districts. Waste discharge into Mill Creek must meet TMDL requirements for discharge into Class B waters (Ecology 2005).

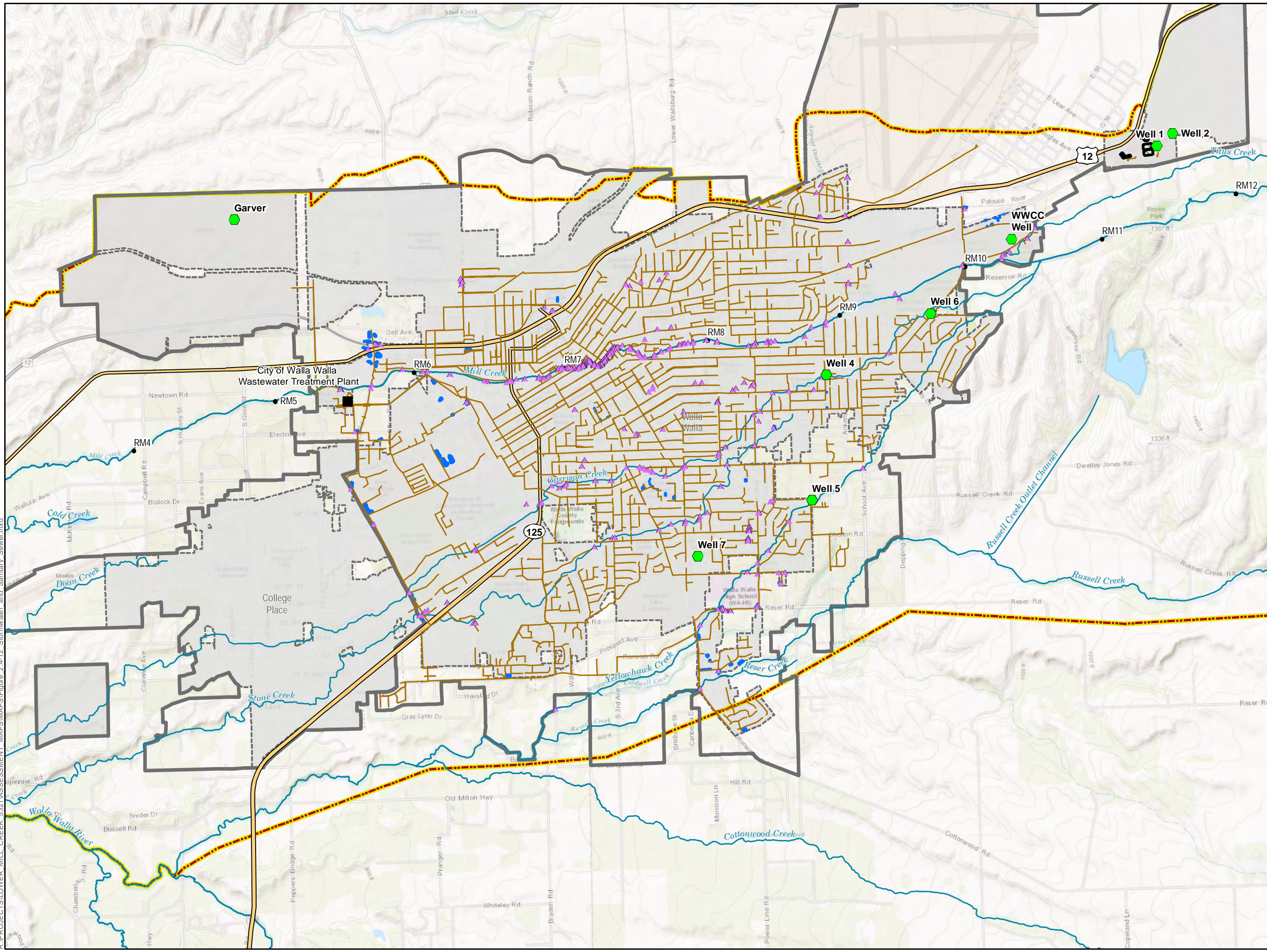
2.4.5.3 College Place Wastewater Treatment Plant and infrastructure

The original Burlingame sewer system was built in 1910 and was incorporated into the collection system developed in 1953 after the City of College Place was incorporated. The existing treatment system began operation in 1953 (Ecology 2014a) and has undergone upgrades as the city expands and capacity and environmental requirements increase. Water is discharged to Garrison Creek from November to April, while from May through October, it is discharged to wetlands for filtration to Garrison Creek (Joy et al. 2007). In the past, effluent has been used for irrigation with some discharge to the creek during low-flow periods; however, this has been discontinued due to Garrison Creek TMDL exceedance for nutrients, fecal coliform (Joy and Swanson 2005) and other contaminants due to effluent.

**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

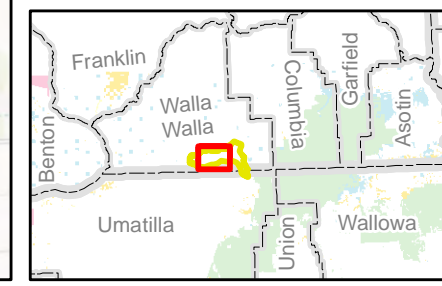
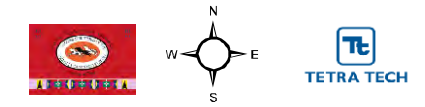
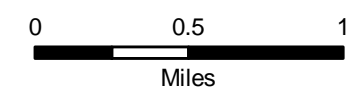
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**FIGURE 2.4-12
CITY OF WALLA WALLA
STORMWATER AND
SANITARY SEWER
INFRASTRUCTURE**



- River Miles
- ▲ Stormwater Outfall
- Potable Water Well
- Stream
- Sewer Main
- ▣ Mill Creek Water Treatment Plant
- Stormwater Basins
- Waterbody
- ▭ Project Area
- ▭ Primary Focus Area
- ▭ Cities
- ▭ Urban Growth Area Boundaries

Sources: CTUIR, City of Walla Walla
Walla Walla County, StreamNet



R:\PROJECTS\LOWER MILL CREEK_5321\ASSESSMENT MAPS\MAPS\Figure 2.4-12_Stormwater and Sanitary Sewer.mxd

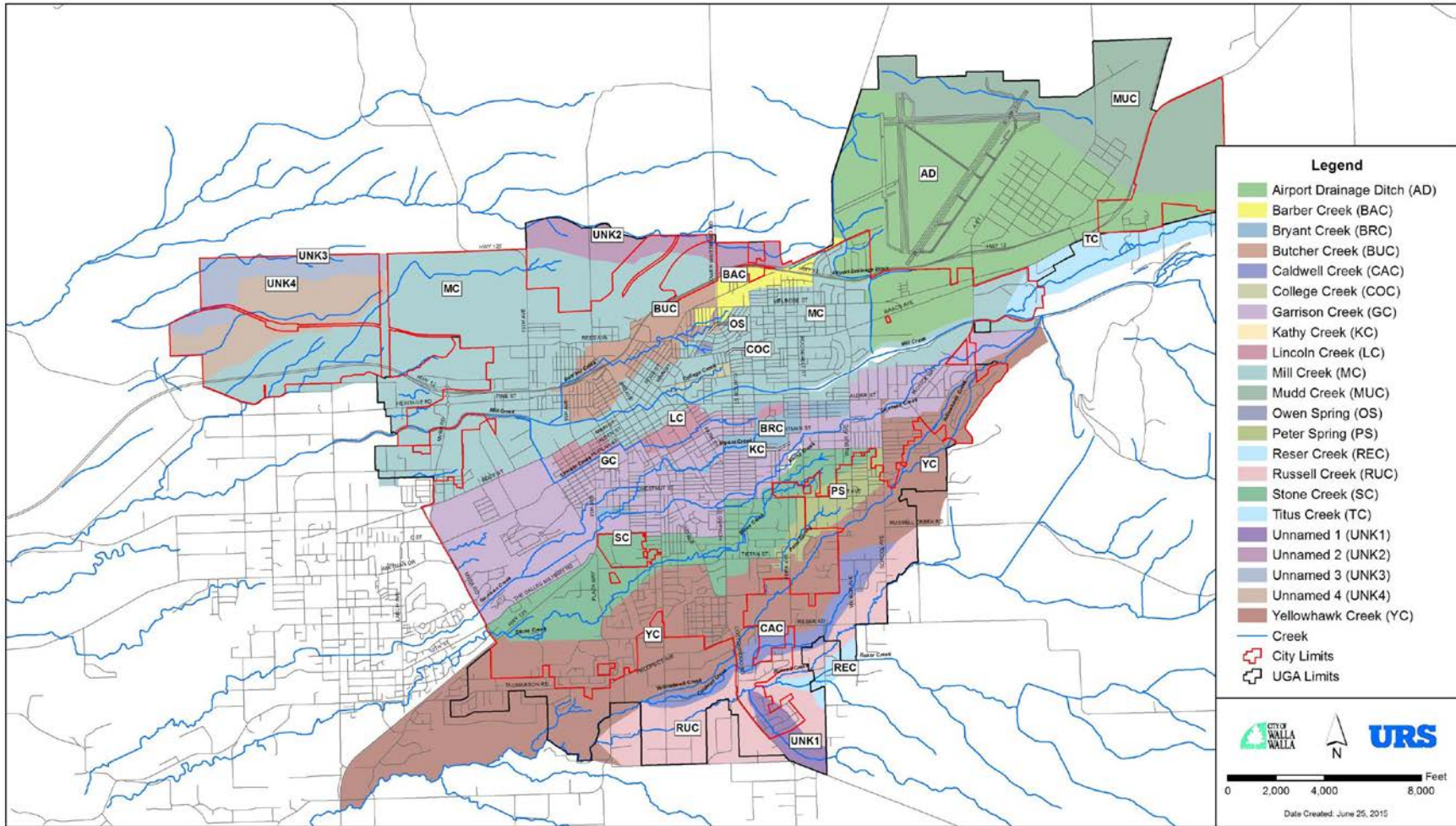


Figure 2.4-13. Stormwater Drainage Basins in City of Walla Walla (City of Walla Walla 2015a)

2.4.6 Transportation Infrastructure

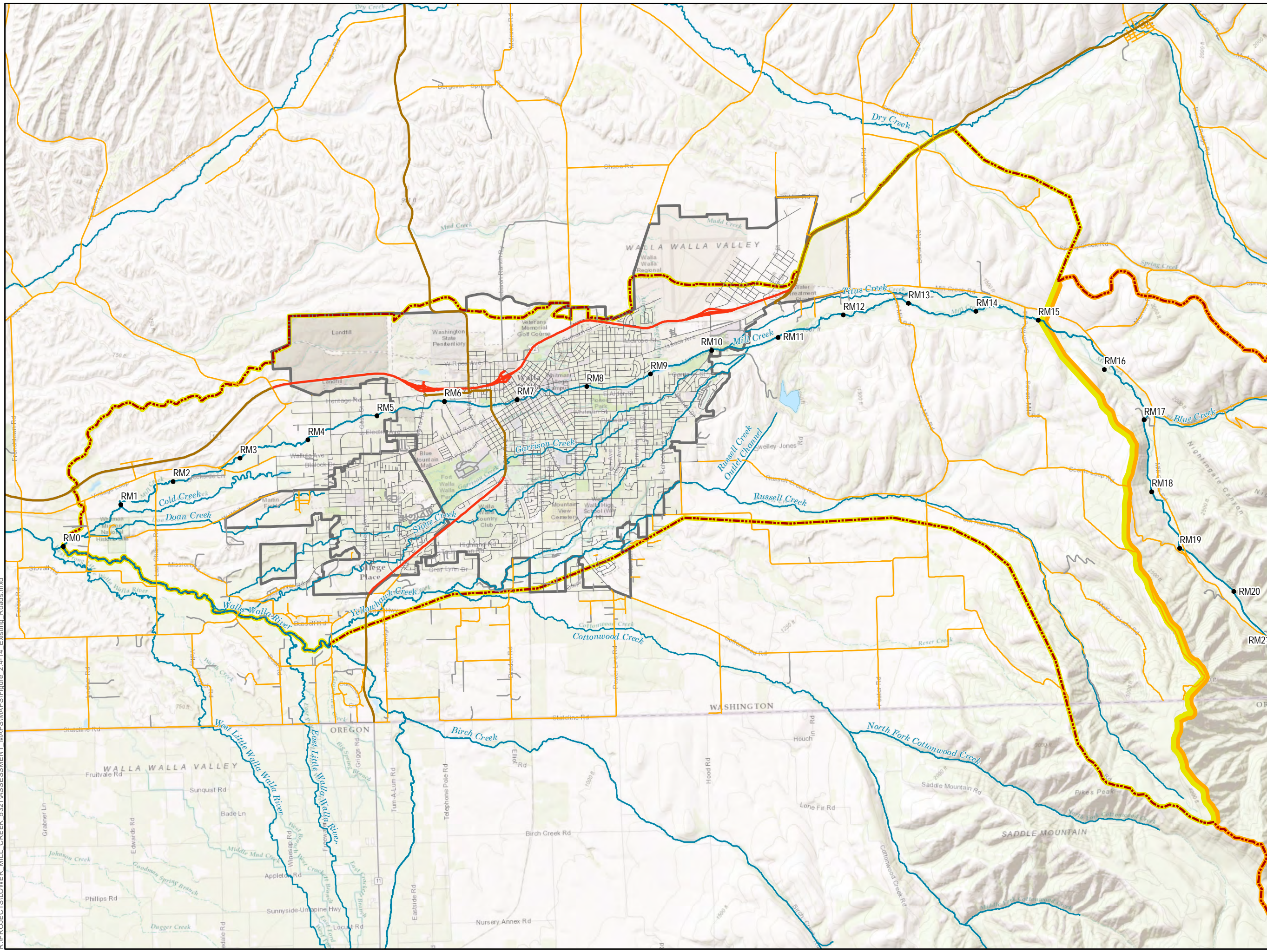
There are 27 bridge crossings over Mill Creek within the Primary Focus Area, including 23 roads, two public footbridges, one private footbridge, and one railway crossing (Figures 2.4-14 and 2.4-15). The City of Walla Walla recently had an inspection completed of the city-owned non-bridge structures that cross over the channel in the downtown area (Olson 2016). Of the 11 structures assessed, engineers found three in poor condition and in need of repairs; two of these structures were already at least partially closed, and while the third is not an immediate threat to public safety, only commuter vehicles will be allowed to cross (Olson 2016, Diaz 2016). Figure 2.4-16 shows the three locations rated in poor condition. The orange and yellow sites are the areas currently closed to public access. The extent of the closure at the orange site, a city parking lot, was expanded from half to the full parking area based on this most recent assessment (Diaz 2016). Pedestrians will still be allowed to use the alleyway shown in the yellow site (Diaz 2016). The City of Wall Walla also completed a required bi-annual inspection of all National Bridge Inventory (NBI) bridges, which included the city's 20 bridges over Mill Creek, in 2015 (pers. com., Brad Daly, Stormwater Coordinator, City of Walla Walla, Sept. 16, 2016). Eight (8) of these Mill Creek structures are posted as load rated/load restricted.

In general, there is limited bicycle and pedestrian access to Mill Creek, especially in the downtown and urbanized portions of the Primary Focus Area. On the eastern side of the City, a multi-use recreation path extends along both the north and south levee of Mill Creek from Eastgate Lions Park east to Rook's Park (see Section 2.12, Recreation Resources). Other than a few isolated bicycle paths that intersect with Mill Creek in downtown Walla Walla, pedestrian connections to the Creek are primarily sidewalks along streets that cross the channel (Figure 2.4-15). This provides limited access both physically and visually with the creek.

**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

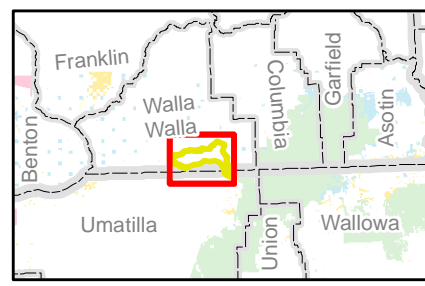
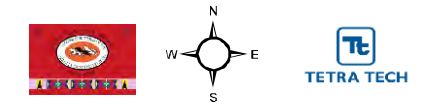
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**FIGURE 2.4-14
EXISTING ROADS**



- River Miles
- Stream
- Waterbody
- ▭ Project Area
- ▭ Primary Focus Area
- ▭ Secondary Focus Area
- ▭ Urban Growth Area Boundaries
- State Hwy Urban Freeway
- State Hwy Other
- Urban
- Rural
- Private Road

Sources: CTUIR, City of Walla Walla
Walla Walla County, StreamNet

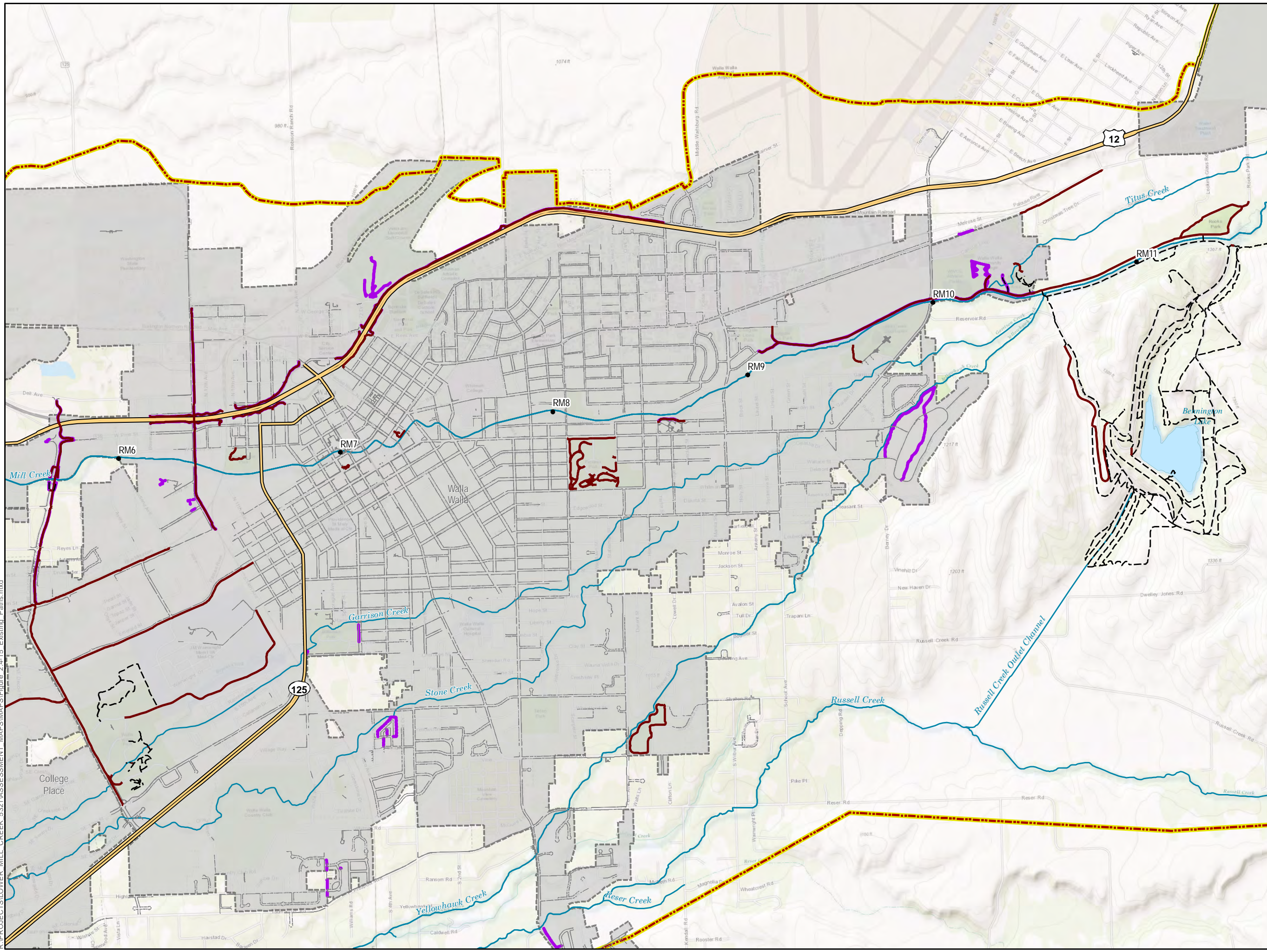


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LOWER MILL CREEK HABITAT AND PASSAGE ASSESSMENT

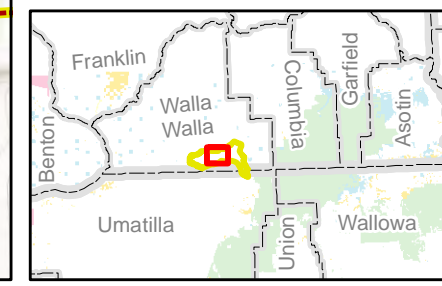
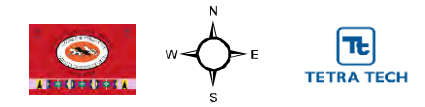
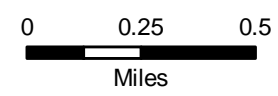
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FIGURE 2.4-15 EXISTING PEDISTRIAN AND BICYCLE PATHS



- River Miles
- Stream
- Waterbody
- Trail Surface Type**
- Asphalt; Concrete
- - - Dirt; Foot Bridge; Gravel
- Bike Path
- Sidewalk
- Project Area
- Primary Focus Area
- Cities

Sources: CTUIR, City of Walla Walla
Walla Walla County, StreamNet



R:\PROJECTS\LOWER MILL CREEK\ASSESSMENT MAPS\MAPS\Figure 2.4-15 Existing Paths.mxd



Figure 2.4-16. Downtown Walla Walla Non-Bridge Structures Rated in Poor Condition (Olson 2016)

2.4.7 Channelization and Flood Water Storage

Walla Walla Valley experienced a significant flood event in 1931, which caused substantial damage to the City of Walla Walla. As a result, the community requested federal government assistance to reduce the potential for future events. The MCFCP was authorized by the Flood Control Act of 1938, leading to construction of the current flood control works. The multi-year project consisted of construction of an in-stream dam and diversion (Bennington Diversion Dam), construction of an off-channel storage reservoir (Bennington Lake) with an outlet to Russell Creek, a series of levees, and a hardened concrete channel through downtown. The operational objective was to



Mill Creek Flood of 1931 (photo courtesy of Joe Drazan)

divert and store peak flows during flood events, with controlled release into another stream corridor.

Private property was acquired by the federal government to accommodate the planned improvements in the upper portion of the project, but as funding was depleted acquisition was



Mill Creek Channel Construction (Photo Source: USACE)

limited to easements acquired for the downstream segments. Construction of the Bennington Diversion Dam and Bennington Lake Dam was completed in 1942. The Russell Creek Outflow Channel extending from the Bennington Lake Dam to Russell Creek and the construction of additional drainage facilities at the toe of the dam were completed in 1944. Paving of Mill Creek

Channel through the City of Walla Walla was completed in 1949 (USACE 2015a). Sealing of the lake bottom, additional work on the Bennington Lake drainage system in the dam foundation, and the installation of an upstream outlet gate were completed in 1950.

Bennington Lake Dam is a rolled earth-filled structure with a heavy gravel face, and is 800 feet wide at the base, 125 feet high, 20 feet wide at the top and 3,200 feet long at the crest (USACE 2016b). Bennington Lake is an off-stream reservoir with a maximum storage capacity of 8,300 acre-feet and a 5-foot freeboard (USACE 2016b). Its depth varies from about 10 to 80 feet. During flood flow diversions, Bennington Lake can be filled to the maximum allowable level of 1,265 feet (or about 225 surface acres); however, the USACE does not allow the lake's water level to maintain above 1,235 feet for more than 15 days to prevent high hydrostatic pressures from developing at the toe of the Bennington Lake Dam (USACE 2015a). Water can be evacuated if the water level rises above 1,212 feet elevation via the intake tower into the Mill Creek Return Channel or the Russell Creek Outflow Channel. Diversion facilities connect Mill Creek with Bennington Lake, and consist of a diversion dike, diversion dam (Bennington Diversion Dam), debris facilities, and intake canal facilities (see Figure 1.3-2)



Building overhanging the Mill Creek Channel

(USACE 2016b). The Bennington Diversion Dam contains an Ambursen Ogee-Crest type spillway and outlet, which are 250 feet long and 14 feet high. The Division Works Dam was also installed downstream at RM 10.5 to allow water to be divided between Mill Creek and Yellowhawk/Garrison Creeks.

In 1982, fish ladders were installed in both the Division Works Dam and Bennington Diversion Dam. In 2001, fish screens were installed at the intake on the Bennington diversion structure to prevent trapping fish in Bennington Lake (USACE 2016b). In 2008, a fish screen was installed upstream of the headgate of Garrison Creek at the Second Division Works to exclude salmonids (especially juvenile salmonid out migrants) from migrating down Garrison due to Garrison Creek's poor passage and habitat conditions that resulted in stranding and fish mortality (see Section 2.8 for more information on habitat and passage conditions along Garrison Creek) (USACE 2016b, WWCCD 2009).

One of the more visible components of the flood control system is the Mill Creek Channel through Walla Walla. The first mile of the channel extending from the Bennington Diversion Dam downstream is owned and operated by the USACE. The remainder of the channel is owned and operated by the Walla Walla County MCFCZD (USACE 2016b). As described in more detail in Section 1.4.1.4, periodic assessments of the MCFCP's structure and operations are conducted by the USACE, including Levee Safety Program Periodic Inspection Reports and screening-level risk assessments (USACE 2013a, USACE 2016a).

The channel characteristics vary significantly depending upon their setting, upland land use and development, available area, and opportunities for modification. The upper and lower reaches of the constructed channel are located in less constrained areas, and consist of levees with concrete channel sills to stabilize the channel bottom (grade) and aid in energy dissipation (U.S. Army 1939). Due in part to the density and proximity of existing development to the Mill Creek Channel, the middle portion, referred to as the "Mill Creek Flume," consists of a narrow and significantly incised channel with concrete walls and bottom, which in some instances has been covered with buildings and parking lots.

While some modifications have been made to the constructed channel, including the recent modifications constructed by the Mill Creek Working Group, they represent immediate, short-term solutions and do not fully restore habitat or create a stream structure suitable for long-term reestablishment of fisheries.

2.4.8 Drinking Water Systems

2.4.8.1 City of Walla Walla Drinking Water Infrastructure

Originally, the City began diverting water from Mill Creek in 1906 at Kooskooskie. In 1922, the City's intake was moved upstream about 4.5 miles across the Washington-Oregon state line at RM 25.4, which is on the western edge of the 36 square mile protected Mill Creek watershed. The City's 11-foot diversion dam is equipped with a fish ladder and fish screens (City of Walla Walla 2013a). From this point of diversion, water is conveyed downhill through a 14.5-mile buried pipeline to the Twin Reservoirs located on the eastern edge of the City of Walla Walla near the airport. Before the water enters the reservoirs, it passes through the City's hydroelectricity plant located at the head of the City's Water Treatment Plant. The City's hydroelectricity plant generates up to 2.2 megawatts and operates over a range of 5.2 to 24.6 million gallons per day. From there, the water flows through two gravity transmission mains to a weir diversion structure where flows are split between the Twin Reservoirs and a bypass return to Mill Creek (see Figure 1.3-2). Flow is bypassed to Mill Creek when the reservoirs are full or under the Oregon winter water right (see Section 2.4.8.2 for more information). Following the Twin Reservoirs, water enters the ozone treatment facility and then is stored in the Mill Creek Reservoirs. The Mill Creek Reservoirs feed the entire distribution system (City of Walla Walla 2013a).

2.4.8.2 Water Rights

The Washington State water code was enacted in 1917 and requires certain users of public waters to receive approval through a water right permit or certificate prior to using the water (Ecology 2015a). Similarly, withdrawals of groundwater from 1945 onward (when the state groundwater code was enacted) require a water right permit or certificate unless the use is specifically exempt from state permitting requirements. Washington has a prior appropriation water right system, also referred to as a system of "first-in-time, first-in-right." If a water right was established prior to the water codes, then the priority date is the date the water was first put to use. If the water right was acquired through the permitting process, the priority date is the date the application for the water right was filed with Ecology (Washington Rivers Conservancy 2009). Water rights authorize both an instantaneous and annual quantity for water use. The instantaneous quantity of a water right is the maximum rate at which water may be diverted or pumped. Annual quantity is the maximum amount of water a water right holder may use within a one-year period. Both limits apply to a water right.

Water rights can be adjudicated, whereby through court proceedings the validity and extent of all water rights in the area of adjudication are determined, including the identification of priority dates. Adjudication of the Walla Walla River was completed in 1928 and all confirmed water rights were issued an “adjudication certificate.” The water rights necessary to sustain Treaty-reserved rights were not considered or adjudicated in 1928. The CTUIR is currently working collaboratively with basin partners to restore and protect adequate stream flows while trying to maintain current out-of-stream uses and values.

Water rights can also be modified as long as the change in water right will not impair any other water right. In 2009, the Walla Walla Watershed Management Partnership (Partnership) was legislatively authorized as a unique local water management pilot program for the state of Washington. The Partnership was given the authorization to process and approve water rights changes locally in the Walla Walla basin through its “Flow From Flexibility” framework outlined in the Partnerships Local Water Plans (WWWMP 2015). If the change in water right is approved, Ecology issues a “Certificate of Change” to the water right holder.

A number of water right permits, certificates, adjudicated certificates, certificate of change, change applications, and new applications currently exist for the Mill Creek watershed. Table 2.4-2 provides a summary of these water rights.

Table 2.4-2. Mill Creek Watershed Water Rights Summary

Number of Certificates, Certificate Changes, Change Applications, Report of Examination, New Applications	Characteristic	Type	Total Flow (cfs) or Volume (ac-ft) for all claims, permits, applications, or certificates
126 Adjudicated Certificates	Surface Water	Mill Creek	61.5 cfs
1 Adjudicated Certificates	Groundwater	Wells	n/a
114 Certificates	Groundwater	Wells	33,325 ac-ft
5 Certificates	Surface Water	Mill Creek	40.6 cfs
1 Certificates	Reservoir	Stiller Reservoir	65 ac-ft
20 Certificate of Change	Surface Water	Mill Creek	2.78 cfs
5 Certificate of Change	Groundwater	Wells	n/a
12 Change Applications	Groundwater	Wells	4,459 ac-ft
15 Change Applications	Surface Water	Mill Creek	4.66 cfs
16 Change/Report of Examination	Groundwater	Wells	5,656 ac-ft
10 Change/Report of Examination	Surface Water	Mill Creek	1.74 cfs
4 New Applications	Groundwater	Wells	410 GPM

Table 2.4-2. Mill Creek Watershed Water Rights Summary (continued)

Number of Certificates, Certificate Changes, Change Applications, Report of Examination, New Applications	Characteristic	Type	Total Flow (cfs) or Volume (ac-ft) for all claims, permits, applications, or certificates
1 Permit	Reservoir	City of Walla Walla Municipal Use	6,200 ac-ft
3 Permits	Groundwater	Wells	594 ac-ft
1 Tribal Water Rights Claim ^{1/}	Surface Water	Watershed Wide	TBD

ac-ft – acre-foot; cfs – cubic foot per second; n/a – not applicable

1/ To be determined. Source: sufficient to sustain exercise of Treaty reserved rights as identified by CTUIR.

Source: Ecology (2011)

Water diversions and withdrawals can reduce base flows in Mill Creek and its distributaries resulting in negative impacts on water quality during low flow months. The instantaneous water rights on record indicate Mill Creek is over-appropriated (USACE 2005). Increasing baseflows in Mill Creek will be important for restoring hydrology to a normal hydrograph and for restoring fish populations and habitat.

City of Walla Walla Surface Water Rights

The City of Walla Walla obtains water from two sources. The primary source (88 to 90 percent of the water supply) is from Mill Creek and the secondary source is from seven basalt wells that are mainly used to supplement water supply during periods of low flow in Mill Creek (the City’s groundwater rights are discussed in more detail after the discussion on surface water rights). The City of Walla Walla has several surface water rights. The current total available surface water right capacity from Mill Creek for drinking water use is 48 cfs November 1 to April 15, 28 cfs April 15 to October 31, with a reduction to only 25.5 cfs during the months of August and September to keep more water in stream during those months (per Oregon Certificate 13276). See Table 2.4-3. In addition to surface water rights for drinking water, the City of Walla Walla also has some additional water rights (28 cfs Oregon Certificate 86106) for power generation. Each of the City’s water rights are summarized below. Per the City’s 2013 Water System Plan, the 2010 annual use of water from Mill Creek was 3,968 million gallons (City of Walla Walla 2013a).

Table 2.4-3. City of Walla Walla Total Available Surface Water Rights Capacity for Drinking Water

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
48 cfs			28 cfs			25.5 cfs		28 cfs	48 cfs		

Source: City of Walla Walla 2013a

Oregon Certificate 13276 (Certified)

This is the City of Walla Walla’s original water right dated at 1866 (prior to the passing of the 1917 state water code). Because of the age of this water right, it is quantified only as to instantaneous rate of diversion of 28 cfs and has an upper annual limit of 6,507 million gallons (Oregon Certificate 13276, City of Walla Walla 2013a). This water right was modified by an Oregon split season lease (SL-12) in July 2010 to reduce the city’s right from 28 cfs to 25.5 cfs from August 1 through September 30 to allow 2.5 cfs to remain in-stream during that period (City of Walla Walla 2013a). The City applied for the split season lease and associated diversion reduction in order to comply with the stipulations in Oregon Permit No. S-54483, Oregon Certificate 87647, and Oregon Certificate 86106, as described below. The City has the option of terminating the split season lease each year; however, as long as the City is diverting water under Oregon Permit No S-54483, Oregon Certificate 87647, and Oregon Certificate 86106, then the split season lease diversion reduction must be complied with.

Oregon Permit No. S-54483 (Partially Perfected)/Oregon Certificate 87647

Under Oregon Permit No. S-54483, the City of Walla Walla holds a partially perfected (or vested) water right with priority date 2001 for diversion of 20 cfs from Mill Creek during the period November 1 through April 15. The City also holds Oregon Certificate 87647 (issued June 2012) that certifies 10 cfs of the S-54483 20 cfs water use. However, before this in-stream diversion can take place, the in-stream flows at the Kooskooskie USGS gage (14013000) as cited in Table 2.4-4 must be met. Another condition of the Oregon Permit S-54483 and Oregon Certificate 87647 is the reduction of 2.5 cfs from August 1 through September 30 under Oregon Certificate 13276 (described above).

Table 2.4-4. Mill Creek Minimum Flows During Diversion

Month:	November	December	January	February	March	April 1-15
Flow Rate:	100 cfs	110 cfs	110 cfs	125 cfs	150 cfs	150 cfs

Source: City of Walla Walla 2013a

Oregon Certificate 86106 (Certified)

In 2010, the City was issued Oregon Water Certificate 86106 by the Oregon Water Resources Department to amend hydroelectric generation license (HE-523) and grant the City rights to use water from Mill Creek for the generation of hydroelectricity power (City of Walla Walla 2013a). The certificate includes two parts:

- A year-round 28 cfs water right with a priority date of 1984 that requires water used for hydroelectricity to be put into the municipal system; and

- A 10 cfs water right with priority date of 2009 for hydroelectric use from November 1 to April 15 where water used for hydroelectricity can be placed back into Mill Creek, placed into the municipal system, or a combination of both. Just as under the Oregon Permit No. S-54483 described above, the flows at the Kooskooskie gage cited in Table 2.4-4 must be met before the 10 cfs may be diverted under Oregon Certificate 86106.

Also, a condition of this certificate is the reduction of 2.5 cfs from August 1 through September 30 under Oregon Certificate 13276 (described above).

All water that passes through the City of Walla Walla Water Treatment Plant from the Mill Creek Watershed also passes through the hydropower generator, which produces 13,500 megawatts of electricity annually (sufficient to power approximately 1,500 homes). Revenue from the generated power is used to offset operation and maintenance costs (City of Walla Walla 2013b).

Aquifer Storage and Recovery Project

The City of Walla Walla has operated an Aquifer Storage and Recovery (ASR) type system since 1999 (Ecology 2016a) to assist in offsetting Mill Creek diversions from the summer months. Under this program, 6.4 cfs of water that is diverted from Mill Creek under the City's water right permits/certificates S-54483, 87647, and 13276 for municipal water supply, may be injected through approved injection wells (City injection wells #1 and #6) into an underground reservoir (Ecology 2016a). The injection rate may be increased if and when additional injection wells are approved (Ecology 2016a). Per the City's approved reservoir permit R3-30526, stored water may be recovered for distribution into the City's water system as needed as at rates and locations not to exceed those authorized under the reservoir permit (Ecology 2016a).

Ecology issued the R3-30526 reservoir permit to the City of Walla Walla in 2015 (Ecology 2016a). The CTUIR appealed the decision by Ecology to continue the ASR Program, and through negotiations with the City of Walla Walla was able to amend the language in the permit to require the City of Walla Walla to complete annual reporting requirements and to form a technical work group, consisting of representatives of the City, CTUIR, and WDFW, for the purpose of addressing near- and long-term issues associated with Mill Creek, including tributaries and distributaries. As required by the reservoir permit, the City of Walla Walla must develop a comprehensive report in collaboration with the technical work group that addresses the following;

- Define near- and long-term municipal and fishery water supply goals;
- Identify existing issues precluding accomplishment of water supply goals;

- Identify, analyze, and recommend near-term options, using existing infrastructure, to augment instream flow during critical timeframes for fish while maintaining and potentially enhancing the City’s ability to meet water supply goals;
- Identify, analyze, and recommend long-term infrastructure and management options to augment instream flow during critical timeframes for fish while maintaining and potentially enhancing the City’s ability to meet water supply goals; and
- Identify actions necessary to implement recommended options (Ecology 2016a).

City of Walla Walla’s Groundwater Rights

As mentioned above, the City of Walla Walla’s secondary municipal water source is from seven basalt wells that are mainly used to supplement water supply during periods of low flow in Mill Creek (see Figure 2.4-12 for location of city wells). An eighth well is owned by the Walla Walla Community College but is connected to the city’s system; it is the smallest of the groundwater wells in the system. All of these wells have water rights established under the State Groundwater Code (RCW Chapter 90.44). The maximum pumping rate (gallons per minute) and maximum annual total volume (acre feet/year) that may be drawn from the well are established under this right. These maximum groundwater right limits are listed in Table 2.4-5 for each of the city’s wells. The groundwater code also applies annual use terms to the water rights: primary rights provide for the total allocated quantity of water under the right to

Table 2.4-5. City of Walla Walla Summary of Groundwater Rights

Source	Water Right	Status	Primary or Supplemental	Water Right Limits	
				gpm ^{1/}	af/yr ^{2/}
Well No. 1	1063-D	Certification	Primary	1,900	3,040
Well No. 1	G3-20306C		Primary	600	
Well No. 2	1062-D	Certification	Primary	1,780	2,848
Well No. 3	419-A	Certification	Primary	2,000	240
Well No. 3	G3-20307C		Primary	2,000	2,960
Well No. 4	1900-A	Certification	Primary	2,800	4,480
Well No. 5	3151-A	Certification	Supplemental	1,700	2,720
Well No. 6	4081-A	Certification	Supplemental	2,600	4,160
Well No. 7	G3-01022C	Certification	Primary	3,000	4,800
WWCC ^{3/}		Certification	Agreement	1,050	400
Groundwater Subtotal:				18,380	18,363

1/ Instantaneous water right measured in gallons per minute (gpm)

2/ Annual volume limit of water right measured in acre-feet/year (af/yr)

3/ Walla Walla Community College

Source: City of Walla Walla 2013a

be used; supplemental rights provide for peaking or emergency water needs where the allocated water is used for instantaneous needs but not necessarily throughout the year (City of Walla Walla 2013a).

Per the city’s 2013 Water System Plan, the 2010 annual use of water from the seven city groundwater wells was 322 million gallons (City of Walla Walla 2013a).

2.4.8.3 Future Water Demand

The future growth areas are envisioned to be served by municipal utility services, which often accommodate more intensive development. Population growth is the primary factor influencing future water demands. The location of new population centers affects storage, transmission, and distribution of future water supplies. Therefore, population growth forecasts must be coordinated and based on approved land use plans and policies. The City of Walla Walla coordinated with Walla Walla County to generate the following population projection applied in the City’s current Water System Plan (Table 2.4-6).

Table 2.4-6. City of Walla Walla Future Service Area Population

2011	2017	2031	2061
33,649	35,719	41,058	55,340

Source: City of Walla Walla 2013a

Total system demand for the City of Walla Walla comprises several components not reflected solely in population growth. These components include demands from inter-ties, unmetered demand, authorized demands, and water loss. ASR is not included in demand projections since it functions as reserved supply taken only after actual demands are met. Table 2.4-7 summarizes the total future system average daily demands (ADD) and maximum daily demands (MDD) for key years, as estimated in the City of Walla Walla’s Water System Plan.

Table 2.4-7. City of Walla Walla Total Future System Average and MDD for Key Years (values in Million Gallons/Day)

	2010 (Actual)	2011	2017	2031	2061
Total ADD (without water use efficiency)	12.8	13.48	13.25	12.94	16.16
Total ADD (with water use efficiency)	--	13.21	12.98	12.68	15.83
Total MDD (without water use efficiency)	20.93	22.14	21.62	20.93	28.08
Total MDD (with water use efficiency)	--	21.03	20.54	19.88	26.67

ADD – average daily demand; MDD – maximum daily demand
 Source: City of Walla Walla 2013a

The total ADD and MDD over the 20-year planning period decreases even through the Water System Plan assumes an increase in service area population. This is due to the assumption that

there will be an annual decrease in water loss per year from the implementation of an infrastructure repair program. This increase in efficiency will be greater than the increase in the demand. However, by 2031 the forecasted demands begins to increase as the water loss efficiency holds around 10 percent at that point.

The City of Walla Walla did not explicitly account for climate change in its demand forecast or supply analysis. Rather, the city expects that its current focus on reducing water loss and managing water supply will allow them to effectively address climate change issues within the current planning period (City of Walla Walla 2013a). Water management options to respond to climate change will include continued improvements in water use efficiency through the Water Conservation Program; the city's Infrastructure Renewal and Replacement Program; continued development of the city's ASR program; and moving forward with the filtration plant to help protect supply in the event of forest fires in the source watershed (City of Walla Walla 2013a).

2.5 HYDROLOGY AND HYDRAULICS

2.5.1 Watershed Description

The Mill Creek watershed (HUC 1707010202) covers 113.7 square miles in southeastern Washington and northeastern Oregon. Mill Creek travels a length of 37.4 miles from its headwaters in the western slopes of the Blue Mountains in the Umatilla National Forest to its confluence with the Walla Walla River. The watershed elevation ranges from 6,250 feet mean sea level (MSL) at the headwaters to 590 feet MSL at the mouth (see Figure 2.3-1). The previous Sections 2.2 and 2.3 discuss in detail the geology, soils, and topography of the watershed and surrounding area.



Mill Creek Headwaters

Starting in Washington State, Mill Creek dips south into Oregon for 5 miles, then turns north and west through a steep and narrow canyon, through forested mountainous terrain for 12.2 miles. In this mountainous terrain, several short tributaries (Paradise, Broken, Low, Tiger, and Henry Canyon creeks) contribute runoff to Mill Creek. For the next 7 miles, from RM 21.0 to 14.0, Mill Creek flows in a semi-confined valley surrounded by rolling hills characteristic of the

Palouse Prairie. Mill Creek's largest tributary, Blue Creek, contributes 17 square miles to Mill Creek's watershed and meets Mill Creek near RM 17.

Titus Creek occupies a former channel of Mill Creek. It branches off at RM 14.5 and flows west, parallel to Mill Creek for two miles before its flow is split between the Titus Creek irrigation ditch and the Titus Creek side channel. Recently, a fish screen system was installed to prevent fish in Upper Titus from migrating down into the Titus Creek Irrigation Ditch and a bypass diverts them down a side channel back into Mill Creek (see Section 1.4.3.2 for more details on this project by the WWCCD). This modification is considered an interim habitat improvement as it eliminates take of ESA-listed fish down Titus Creek Irrigation Ditch. The Walla Walla Community College has restored some of Lower Titus Creek's habitat from the spring pond to the Mill Creek Flood Control Levee where a 12-inch pipe (a fish passage barrier) allows the flow to recombine with Mill Creek. Titus Creek is being considered as possible side-channel spawning and rearing habitat for anadromous stocks in the future (NMFS 2015b).

At approximately RM 12, Mill Creek enters the Walla Walla Valley as it transitions onto an alluvial fan. The alluvial fan was created by Mill Creek depositing sediment as it entered the relatively flat valley floor. The change in slope from mild to flat allowed the flow to spread out, losing velocity and capacity to transport coarse sediment. As the sediment accumulated and mounded over time, Mill Creek was forced to find a new path, further depositing sediment at different locations, repeating the avulsion process and eventually creating the distributary river system and fan shape (see Section 2.3).

The alluvial fan begins 3 miles east of the City of Walla Walla and is approximately 6 miles at its widest point, 11 miles long, and completely encompasses the Cities of Walla Walla and College Place. Central to the alluvial fan and its interaction with Mill Creek is a distributary river system of multiple channels that branch off from the main channel. In the past, the distributary system included spring channels, small lakes, and channels with flow that completely disappeared into the alluvium substrate. Some of the distributary channels, like Titus Creek, eventually recombined with Mill Creek, while creeks like Stone, Jones, Yellowhawk, and Garrison combined with the Walla Walla River. Furthermore, Yellowhawk Creek combined with other creeks, like Cottonwood, Reser, and Russell creeks, which are not part of the distributary system and flow to the edge to the alluvial fan from adjacent watersheds. Other creeks that are not connected directly to Mill Creek, like Lincoln, Bryant, Kathy, College, Cold, Doan, Barber, Butcher, and Peter Spring creeks, have upstream springs sources that are connected to Mill Creek via groundwater in the alluvium substrate. See Section 2.5.5 below for

a discussion of the historical and current interaction of Mill Creek with groundwater in the alluvium substrate.

The alluvial fan influences the main Mill Creek channel pattern. It is changed from a sinuous single channel upstream of the fan, to a low-sinuosity multi-channel braided pattern as Mill Creek travels over the alluvial fan (see Figure 2.5.-1).

As discussed above in previous sections (Section 2.4.7), the USACE completed the MCFCP that altered Mill Creek's channel characteristics as it travels over the alluvial fan (USACE 2011a). The next subsections will discuss the gradient, hydrology, hydraulics, and groundwater related to Mill Creek in the Primary Focus Area from a historical and current conditions context.

2.5.2 Channel Characteristics

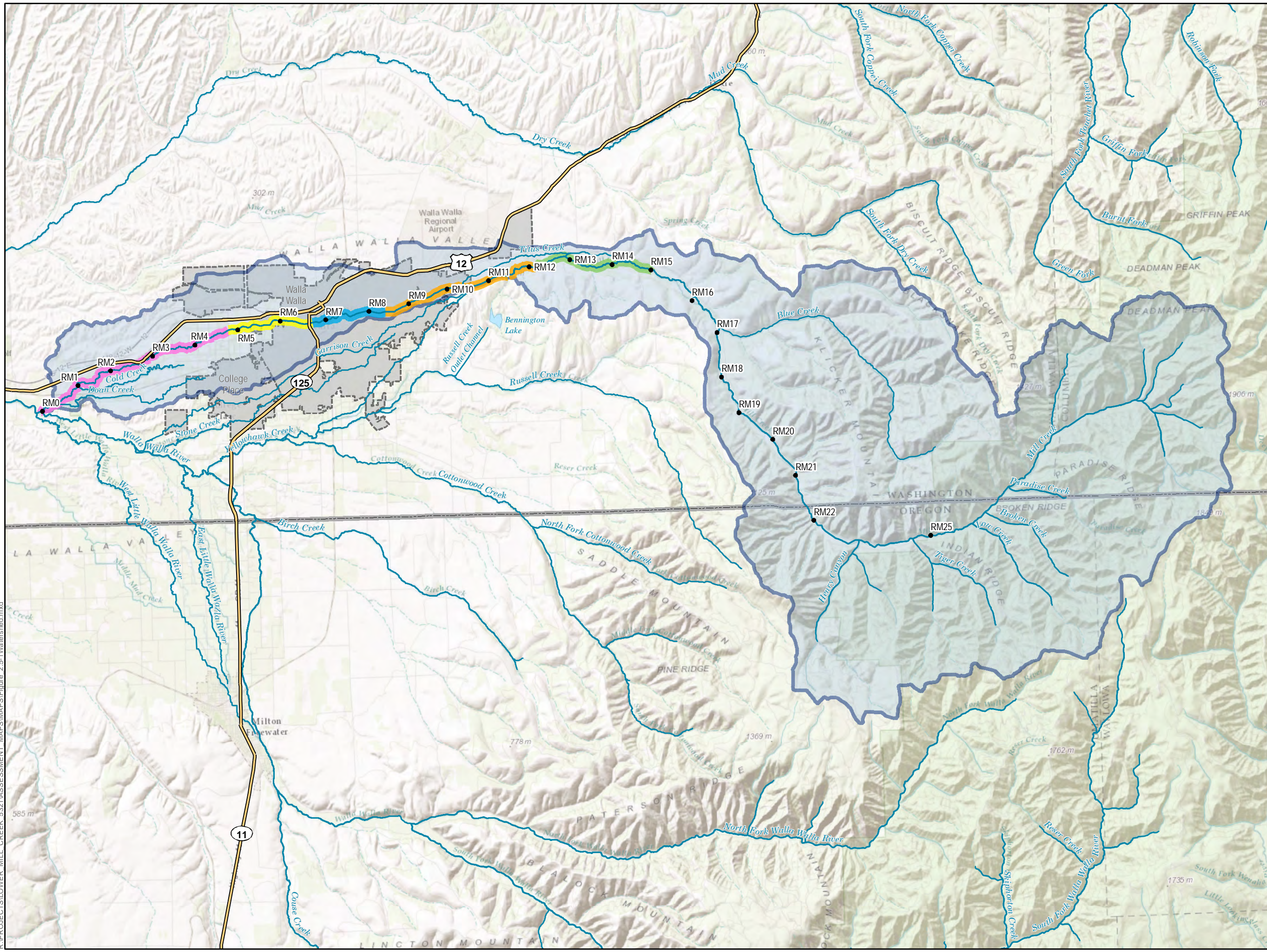
The channel characteristics of Mill Creek are controlled by fluvial processes (e.g., streamflow, sediment transport, channel migration) acting on a specific set of boundary conditions including bed and bank materials, the presence of in-stream large woody debris (LWD), and geologic or anthropogenic constraints (e.g., bed control weirs, concrete flume channel, dams, diversion, flow storage, and levees). A long history of land use activities and infrastructure development has altered the geomorphology of Mill Creek in the Primary Focus Area relative to historic conditions.

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**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

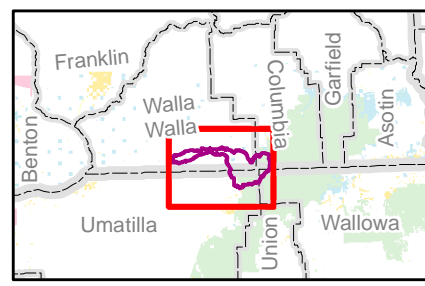
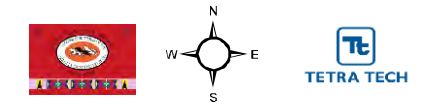
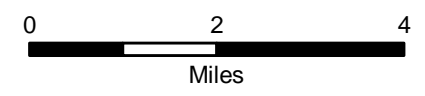
CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE 2.5-1
MILL CREEK WATERSHED**



- River Miles
- Major Stream
- Segment 1
- Segment 2
- Segment 3
- Segment 4
- Segment 5
- Waterbody
- Mill Creek Watershed
- Cities

Sources: CTUIR, Walla Walla County StreamNet



2.5.2.1 Historic

Historic mapping of the City of Walla Walla and surrounding area provides chronological snapshots of Mill Creek and its distributary system physical features. Often these snapshots show details that are useful when comparing to other time periods. Maps dated 1853, 1919, and 1933 offer a look at the location, extent, and pattern of the Mill Creek and its distributary river system before it was altered by the flood control projects. In some cases, contour and bank line information was readable and measureable, which allows for the historic gradient, channel junctions, and sinuosity to be documented.

Figure 2.5-2 below is a historic illustration of the City of Walla Walla created in 1884. While an artist's rendition that does not provide contour information, it reflects Mill Creek's extent and channel pattern by illustrating a multiple channel pattern at two locations. The white arrows were added to the illustration to assist in locating the channel patterns. The illustration is described as a "bird's eye" view and is facing the southeast as the Blue Mountains can be seen in the background. Yellowhawk and Garrison creeks can be seen at the foot of the Blue Mountains.

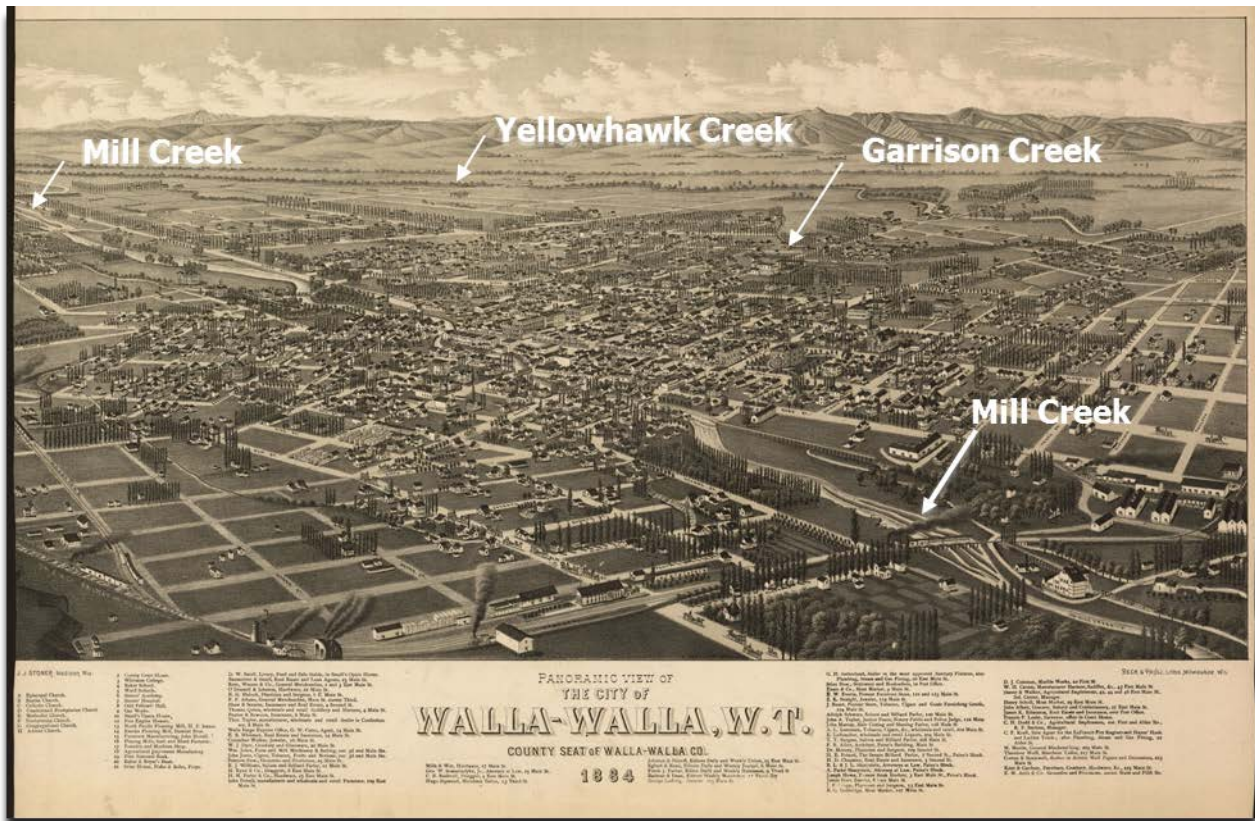


Figure 2.5-2. Historic Illustration of Walla Walla (Stoner 1884)

Figure 2.5-3 is a topographical map of the City of Walla Walla and its surrounding area created in 1919. Included in the map is Mill Creek's main channel and location and pattern of its distributary channels. Near the apex of the alluvial fan, the historic Yellowhawk and Garrison creek channels break out from the main Mill Creek channel and travel southwest. In addition, at some locations Mill Creek is shown to have multiple braided channels. Furthermore, the map demonstrates several spring channels and channels with flow disappearing (influent streams) into the alluvium substrate. Also demonstrated in the 1919 map is how the roads, city blocks, and railroad lines of the City developed around the main channel of Mill Creek.

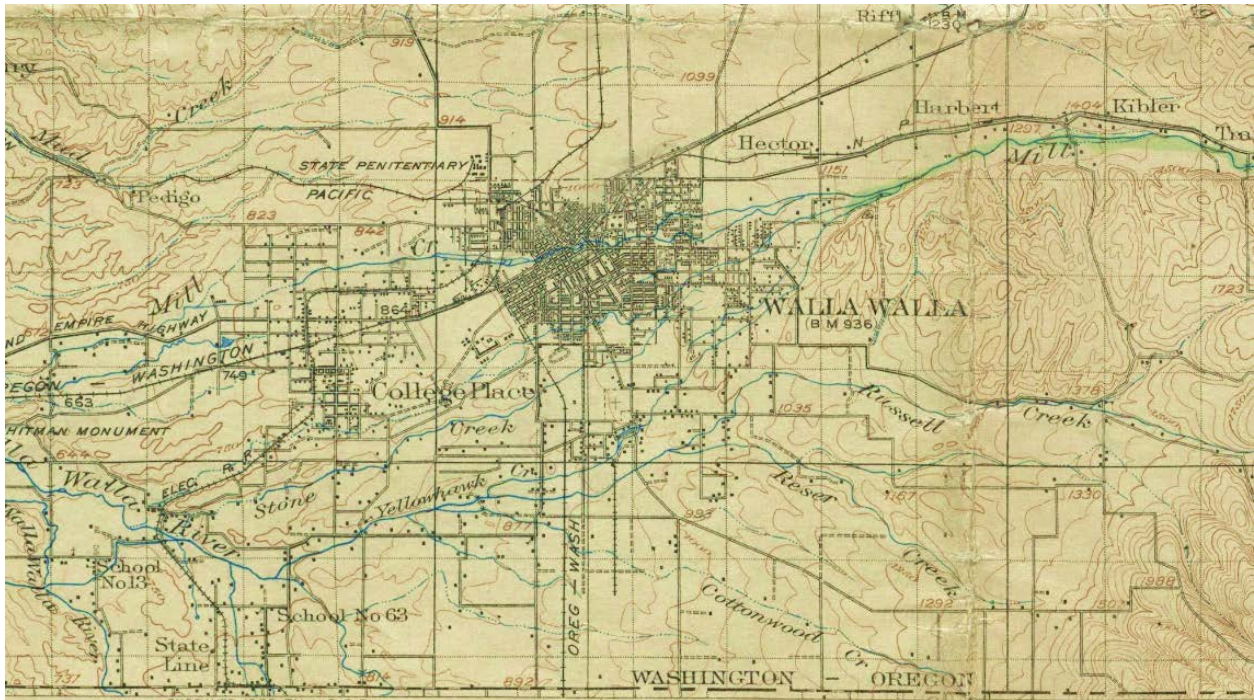


Figure 2.5-3. Historic 1919 Topographical Map of Mill Creek (USGS 1919)

Figure 2.5-4 is a conceptual blueprint dated 1933 from the City of Walla Walla Engineer's office and includes conceptual plans of the City of Walla Walla's Flood Control Project overlaid onto a layout of the City and Mill Creek (City of Walla Walla 1933). Included with the blueprint are survey Section and Range lines, and property lot lines, road ROWs, and labeled contours. It is the best source of historic gradient information for Mill Creek in the Primary Focus Area before the extensive alteration of Mill Creek was completed.



Figure 2.5-4. Portions of City of Walla Walla Flood Control Project Blueprint with Contours (City of Walla Walla 1933)

The contour information in the previous maps is reflected in the historic channel map set in Section 2.3, Figures 2.3-2a and 2.3-2b, where the historic and current flow paths of Mill Creek are plotted.

2.5.2.2 Current

Gradient

As discussed in Section 2.5.1, within the Primary Focus Area Mill Creek drops from an elevation of 1,500 feet at Seven Mile Road (RM 15) to 590 feet at the Walla Walla River confluence (RM 0.0). The overall elevation change of 910 feet represents an average gradient of approximately 60 feet per mile, or 1.1 percent. Yellowhawk Creek has an elevation drop of 750 feet over 12 miles from Division Works Dam to its Walla Walla River confluence, with an average gradient of approximately 54 feet per mile, or 1.0 percent.

Figure 2.5-5 shows the current and historic gradient of Mill Creek and current gradient of Mill, Yellowhawk, and Russel creeks through each of the Project segments. Mill Creek's gradient profile also includes major crossings such as bridges, culverts, diversion dams, and tunnels (USACE 2014a). The contour information from 1933 indicates that the current gradient is similar to the historic in that it varies between 0.007 and 0.014 feet per feet. As the City of Walla Walla developed, it grew around the primary channel of Mill Creek, confining the creek to the current path but not altering its gradient. When the flood control projects were built, it was necessary to excavate down to increase the flow capacity of the channel (see Figure 2.5-5, 1933 channel vs. current channel in Segments 3 and 4).

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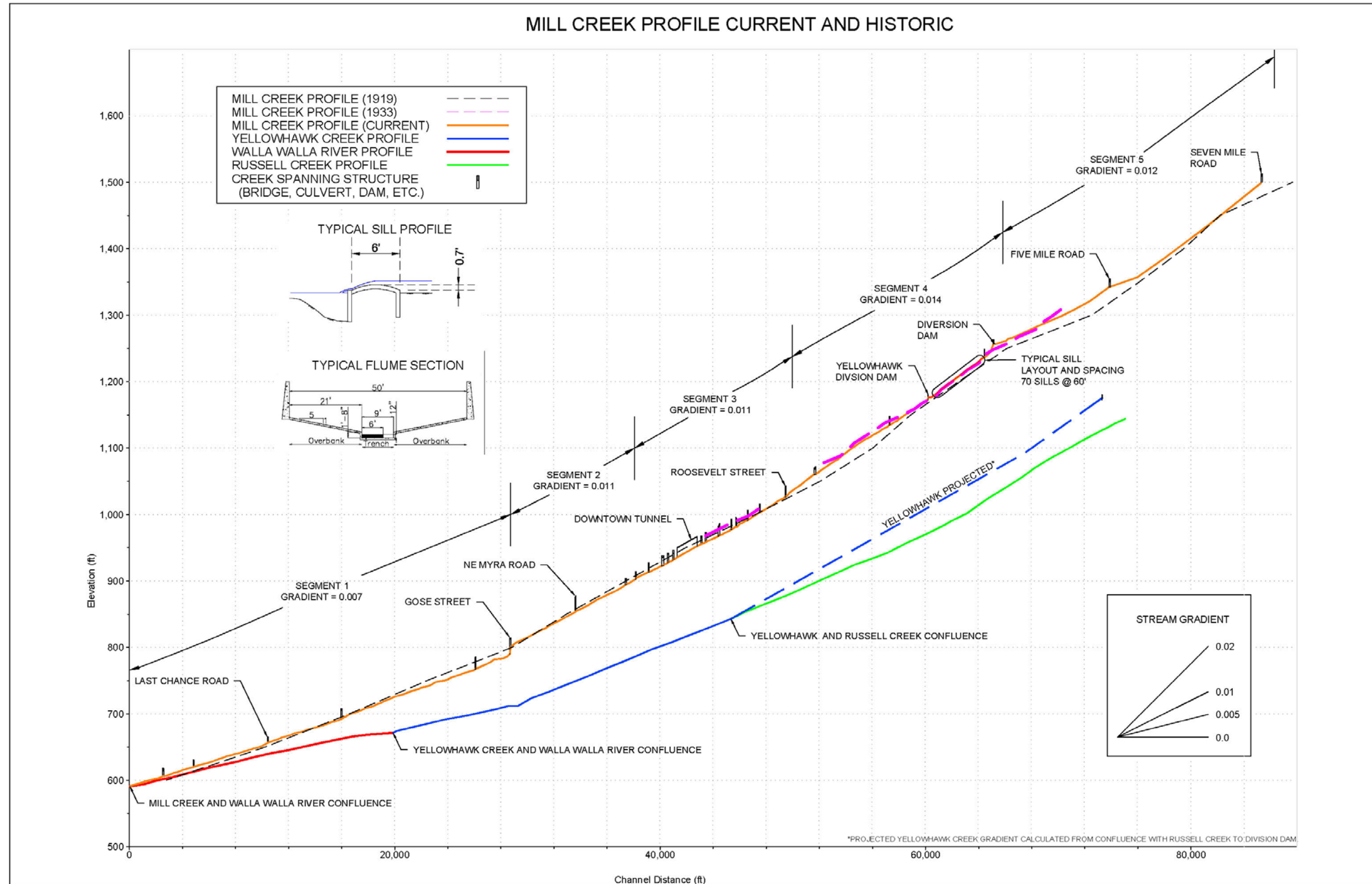


Figure 2.5-5. Mill Creek Profile Current and Historic

Sinuosity

Sinuosity of a river is the channel length as measured along its thalweg and divided by the valley length. Sinuosity is a channel characteristic closely related to streamflow and gradient that is used to classify stream type and assess altered channel conditions. Generally, rivers having a sinuosity of 1.5 or greater are determined meandering, rivers having a sinuosity below 1.5 are straight or sinuous systems.

As stated in Section 2.5.2-1, based on historic mapping, low levels (<1.1) of sinuosity are found in all segments of Mill Creek. Table 2.5-1 below lists the historic and current sinuosities for Mill Creek base on available mapping and Geographic Information System (GIS) data. The low sinuosity can be attributed to Mill Creek traveling over an alluvial fan, which typically creates channel forms that are low in sinuosity, wide, and braided. However, in Segments 1 and 5, the sinuosity is lower than expected for a historic single-channel stream with mild to low gradients. Quality of the historic mapping is a consideration when measuring the historic sinuosity, as detailed information about channel characteristics was not captured in the mapping process. In addition, the historic mapping was conducted after agriculture and urban land use was establish and the channel path was already experience confinement.

Table 2.5-1. Historic, Current, Minimal, and Optimal Sinuosity for Mill Creek

Segment	Sinuosity			
	Historic*	Current	Minimal	Optimal
1	1.01	1.17		
2	1.02	1.06		
3	1.05	1.09		
4	1.06	1.07		
5	1.08	1.11		

Sinuosity has not changed significantly from historical to current, see Figures 2.3-2a and 2.3-2b Historic Channels for historical and current overlay.

As stated in Table 2.5-1 for the minimal and optimal columns for each segment, the sinuosity has not changed significantly from historical to current. These metric goals will be close to the current as they recognize the limited available land use for all segments in the Primary Focus Area to increase sinuosity and add nodes, and the apparent low sinuosity of the historic Mill Creek channel.

River Complexity Index

The river complexity index (RCI) is a metric to describe the complexity of channel conditions in a reach. The index incorporates the sinuosity and the number of channel junctions (nodes) including secondary channels and off-channel connections. The RCI is unitized by valley distance and is calculated using the following formula, which results in a dimensionless number (Brown 2002):

$$\text{River Complexity Index} = \text{sinuosity} * (1 + \text{number of nodes}) / \text{valley distance}$$

The historic RCI is based on the data presented in Table 2.5-1 and varies in the amount of available data per segment, resulting in a varied historic RCI. For example, in Segment 1 the historic RCI is expected to be as high as in Segment 3; however, historic data for the number of nodes is limited and detailed information about channel nodes was not captured in the mapping process, resulting in a low RCI.

For Segments 1 and 5, with available opportunity to add nodes, the minimal RCI has been identified as a 30 percent increase from the current. Optimal RCI has been identified by professional judgment as an increase of 50 percent. In the highly confined and urban Segments 2 through 4, the opportunities for increasing sinuosity and adding nodes will be challenging because the available land is limited. Nevertheless, the current number of junctions is so low that adding just a few more nodes will equate to a 30 to 50 percent increase in the RCI.

Table 2.5-2 below summarizes the historic, current, minimal, and optimal RCI numbers for each Project segment within the Primary Focus Area.

Table 2.5-2. Historic, Current, Minimal, and Optimal River Complexity Index for Mill Creek

Segment	River Complexity Index			
	*Historic	Current	Minimal	Optimal
1	0.0001	0.0014	0.0018	0.0021
2	0.0010	0.0003	0.0004	0.0005
3	0.0002	0.0004	0.0005	0.0006
4	0.0012	0.0006	0.0008	0.0009
5	0.0005	0.0014	0.0019	0.0022

**Historic RCI based on limit channel junction data.*

Braided-Channel Ratio

The braided channel metric is calculated as the ratio of the total channel length (including primary and secondary channels) to the primary channel length. Distributary channels are considered separate channels altogether and are not assessed for the braided-channel ratio.

Table 2.5-3 below summarizes the historic, current, minimal, and optimal braided-channel ratio for each Project segment within the Primary Focus Area. As with the other metrics, measuring the secondary channel lengths proved to be a challenge, as detailed information about channel characteristics, such as secondary channels, was not captured in the mapping process in some segments. Where historic data were available, as with Segments 3 and 4, the braided-channel ratio could be measured but was limited by the details of the historic map, whereas for Segments 1, 2, and 5, measurable historic information was simply not available.

Current braided-channel ratios reflect the current channel form. Segment 1, being incised, is mostly disconnected from floodplain and scores a low ratio, whereas Segments 2, 3, and 4 are completely disconnected from any side channel and have ratios of 1.0 each. Segment 5 scores a relatively high ratio (1.10).

Table 2.5-3. Historic, Current, Minimal, and Optimal Braided-Channel Ratio for Mill Creek

Segment	Braided-Channel Ratio			
	Historic	Current	Minimal	Optimal
1	1.00	1.02	1.15	>1.15
2	1.00	1.00	1.15	>1.15
3	1.07	1.00	1.15	>1.15
4	1.07	1.01	1.15	>1.15
5	1.00	1.11	1.15	>1.15

The minimal Braided-Channel Ratio focuses on the opportunities in all segments to have an increasing secondary channel length, from zero to 15 percent of the main channel length. Based on professional judgment, the optimal Braided-Channel Ratio is set to increase the ratio to greater than 15 percent while recognizing that all segments have limited opportunities to add side-channel length. Nevertheless, in Segments 1 and 5 future opportunities (e.g., willing landowners, reconnected side channels, etc.) could increase the Braided-Channel Ratio by greater than 15 percent.

2.5.3 Hydrology

The flow regime is fundamental in determining the physical and ecological characteristics of a river or stream. The flow variation and duration, along with sediment transport, define Mill Creek’s channel form (e.g., width, depth, bankfull, etc.), function, and processes (Bair et al. 2010). Flows at the bankfull tend to be the primary channel-forming flows and tend to deposit sediment as bars and other features that define the channel form. Alteration of the flow regime has reduced channel conditions that provided quality aquatic habitat (Bair et al. 2010).

2.5.3.1 Historic

The seasonal precipitation pattern discussed in detail in Section 2.1 generates the rainfall and snowmelt runoff for Mill Creek. This pattern consists of high flows from November through May and low flows from June through October. Snowmelt runoff in the spring usually extends from March to May; however, flooding events tend to be the result of intense rainfall occurring on saturated ground or by rain-on-snow events in winter or spring (USACE 2011a).

Figure 2.5-6 is a graph of recorded historic flooding events in Mill Creek near the City of Walla Walla and the peak discharge on record. After the Bennington Diversion Dam was complete in 1948, the flow was measured upstream and downstream of the dam (USACE 2005).

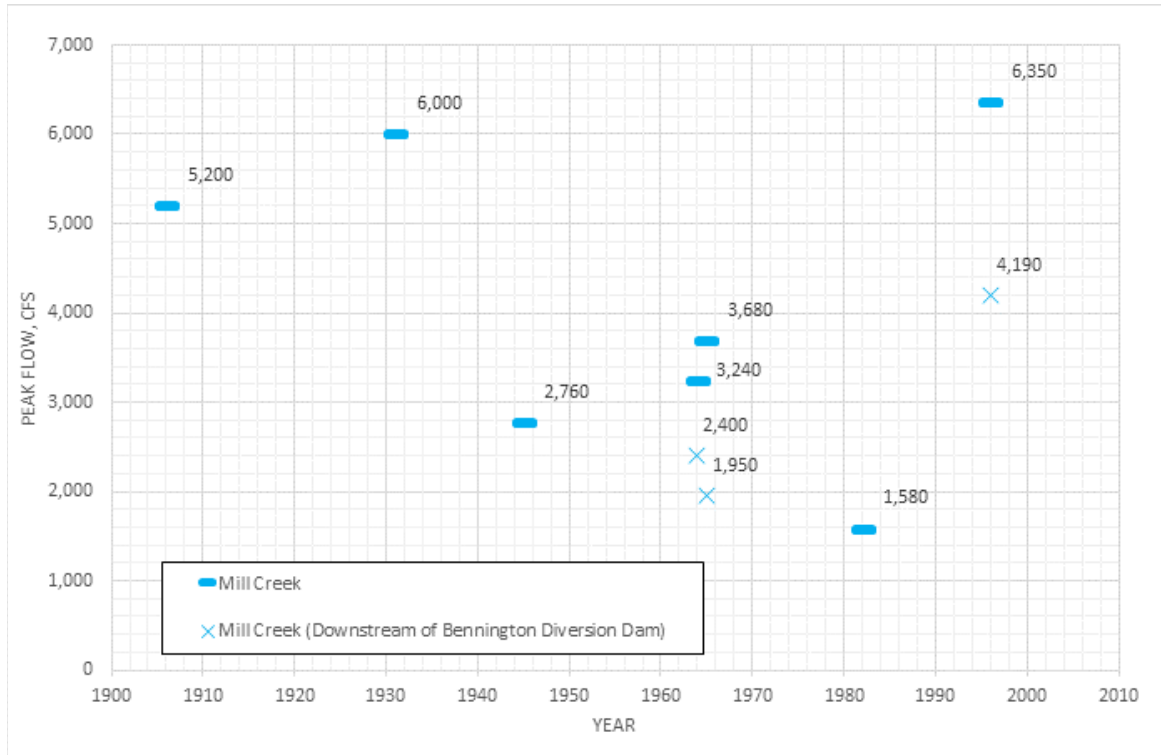


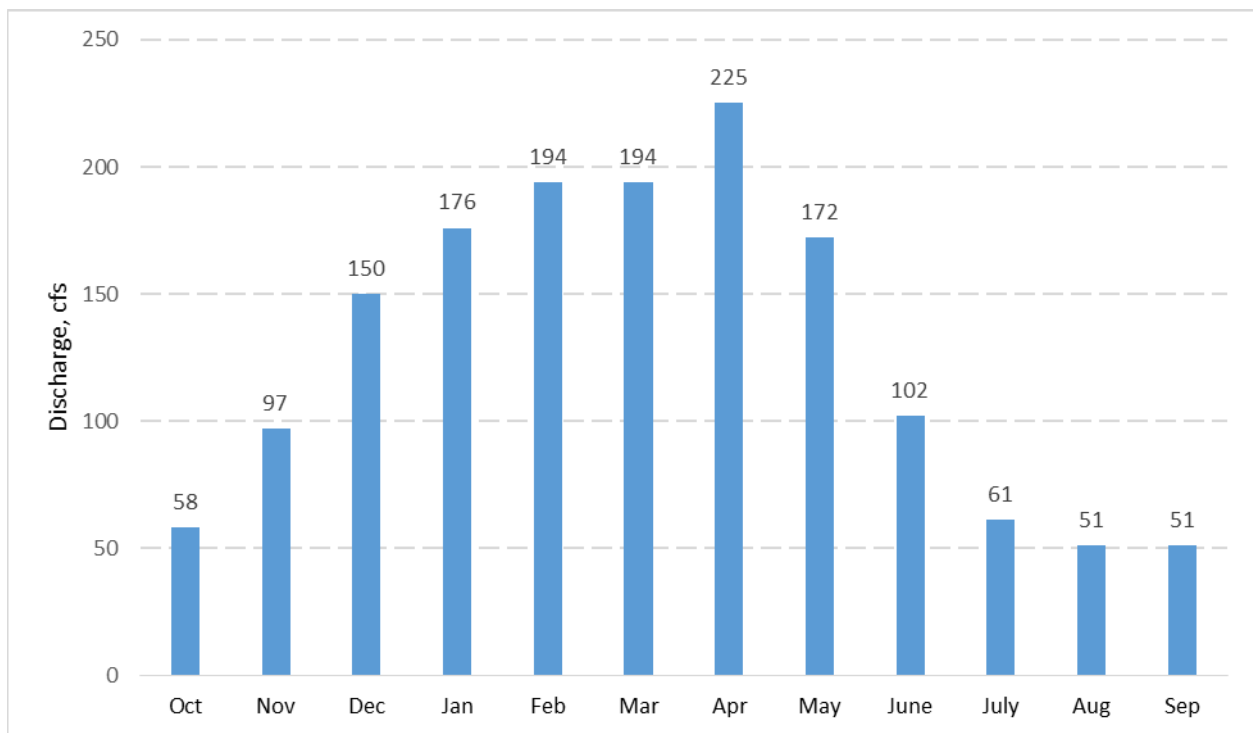
Figure 2.5-6. Recorded Peak Discharge of Mill Creek and Mill Creek below Bennington Diversion Dam (USACE 2005)

Figure 2.5-7 consists of two photographs of the Mill Creek Channel upstream of North Tausick Way. The photograph on the left is of a typical winter flow of 153 cfs. The photograph on the right is taken during the 1996 flood and flow is estimated to be at 3,500 cfs.



Figure 2.5-7. Mill Creek at 153 cfs (left) and Flooding at 3,500 cfs during the 1996 Flood (right)

Estimating historic flows requires data from gaged hydrologic inputs and outputs that simply did not exist prior to the nineteenth century. In addition, with flow measuring in place, data are discontinuous and even the earliest records are presumed to reflect at least some altered hydrology (Stillwater 2013). To estimate the historic flows that influence fish life stages, discharge data spanning 1940 to 1971 from the USGS Gage #14013000 near Kooskooskie, Washington, and City water supply diversion extraction data were used to calculate the mean monthly flow for each month. Blue Creek flow was added to the Mill Creek downstream of the confluence. The Mill Creek dataset is undiminished by diversions to Yellowhawk Creek. (Stillwater Sciences 2013). Figure 2.5-8 below summarizes the historic (describe as “representative” in the Stillwater report) monthly mean discharges within the Primary Focus Area.



Source: Stillwater Sciences (2013)

Figure 2.5-8. Mean Monthly Flows Calculated from Historic (representative) conditions Mill Creek (cfs)

2.5.3.2 Current

As stated above in Section 2.3, alteration of the flow regime of Mill Creek watershed began in the late 1800s to support agricultural production and community development. These impacts have altered the river system so that the hydrology is significantly different from historical conditions (Stillwater Sciences 2013).

Currently, within the Primary Focus Area, two USGS gages are located on Mill Creek. The most upstream, gage #14013700 (Calculation Period: 1997-11-01 to 2015-09-30), is next to the Five Mile Bridge (RM 12.8). The downstream gage, gage #14015000 (Calculation Period: 1941-04-01 to 2016-12-31), is located downstream of the Division Works Dam, which diverts water from Mill Creek to Yellowhawk and Garrison creeks. Monthly mean discharge data for both gages are presented in Figure 2.5-9.

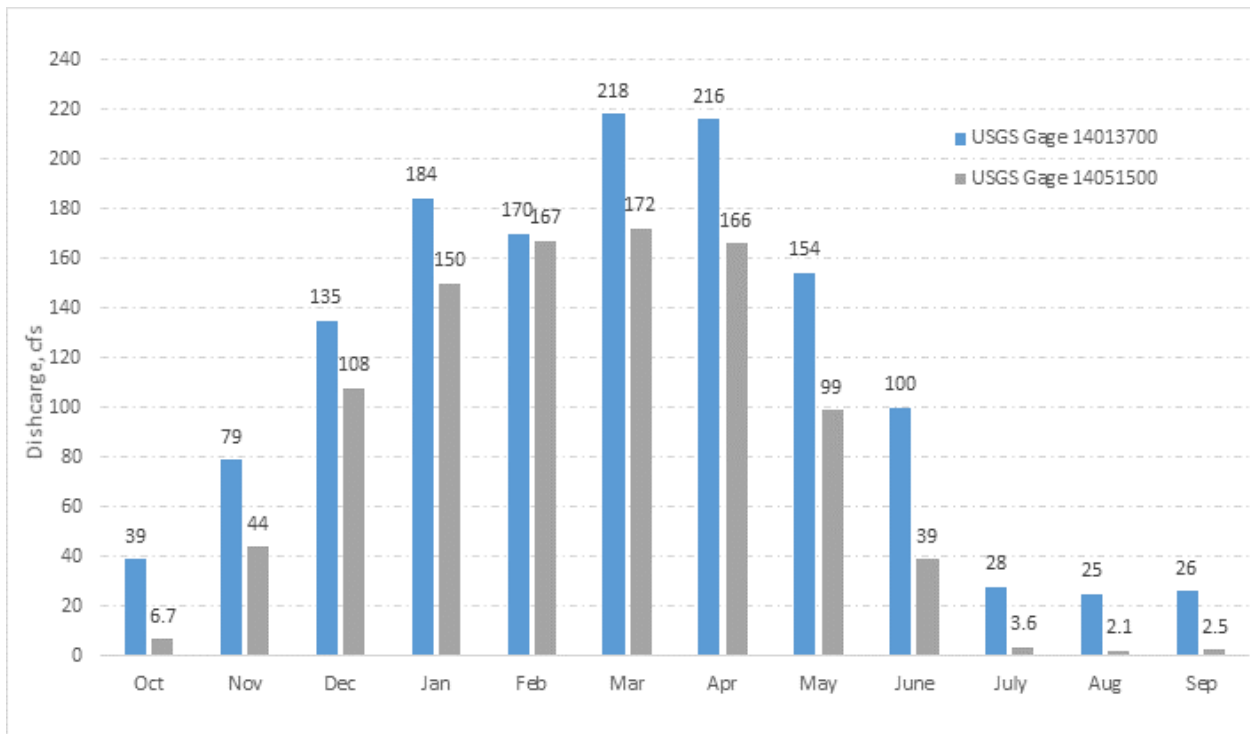


Figure 2.5-9. Current Mean Monthly Discharge (cfs) in Mill Creek

As can be seen from the mean monthly flows graphs above and from the recorded peak discharges in Figure 2.5-6, flows in Mill Creek are variable, averaging about 30 cfs above the Division Works Dam and 4 cfs below the Division Works Dam from July through October, with peaking in excess of 1,200 cfs during spring runoff. The largest floods have been recorded at 6,000 cfs or more (see Table 2.5-5 for flooding year). Annual peak discharge flow frequencies data are presented in Table 2.5-4 below (USACE 2011a).

Table 2.5-4. Peak Annual Discharge of Mill Creek above Bennington Diversion Dam

Recurrence Interval	Peak Annual Discharge
1.5 Year Bankfull Flow ^{1/}	642 cfs
2 Year	1,180 cfs
5 Year	2,000 cfs
10 Year	2,400 cfs
25 year	3,800 cfs
50 Year	5,400 cfs
100 year	7,050 cfs

^{1/} Bair et al. (2010)
Source: USACE (2011a)

Minimal and Optimal Flow

In the Primary Focus Area, different fish species at different life stages exist simultaneously at various flows and no single flow number will provide optimum habitat for all fish species and life stages under Mill Creek’s current channel configuration (Caldwell et al. 2002). Under any flow scenario, fish passage and habitat will also need to be addressed through consideration of other metrics such as channel characteristics, water quality, riparian conditions and sediment. For the purposes of this Assessment, one optimal and one minimal instream flow was identified to allow for a simplified approach of evaluating future conditions against project metrics. Existing instream flow studies (Caldwell et. al 2002 and Stillwater Sciences 2013) were reviewed in addition to a high level analysis of multiple flows under existing and conceptual channel conditions to identify the optimum flow and minimum flow number. The optimum flow has been designated at 100 cfs and the minimum flow at 45 cfs. A brief discussion on how the optimal and minimal flow numbers were selected is included below. Also note that detailed analysis of the effects on water temperatures under a range of flows in specific portions of the Primary Focus Area was not conducted as part of this Assessment. However, the results of Mendel et. al 2002¹ indicates increased flows could result in increased water temperatures in certain portions of Mill Creek where temperatures are influenced by the existing channel characteristics and cold water inputs. For this reason, the minimal and optimal flows identified in this Assessment are intended to be general guides for minimal and optimal flows for the

¹ Water temperature effects of increasing streamflow levels in lower Mill Creek below the Yellowhawk/Garrison diversion was documented in Mendel et. al 2002. The report notes that increasing flows by 3 to 12 cfs through the flood-control channel downstream of the Division Works Dam resulted in an increase in water temperature (10 to 12°F, 5.6 to 6.7°C) from the Division Works Dam to Roosevelt Street. Lethal temperatures over 90°F (32°C) were measured. Ecology 2007a concludes that lower flows benefiting from cold spring-water inputs are more beneficial to steelhead rearing than increasing the flows by 3 to 12 cfs through the flood-control channel where heat sink adds hot water to Mill Creek.

entire Primary Study Area and they should be further refined during more detailed design and planning of any proposed channel reconfiguration through the completion of more detailed analysis and temperature modeling.

WDFW and WDOE (Caldwell et al. 2002) conducted an instreamflow study using the Instream Flow Incremental Methodology (IFIM) to provide information on the relationship between stream flow and fish habitat by looking at four key variables (depth, flow velocity, substrate, and cover). This study shows that fish habitat in Mill Creek peaks at 75 cfs for Steelhead spawning, 60 cfs for juvenile Steelhead migration, and 35 cfs for Chinook juveniles (Caldwell et al. 2002). While this study alone will not set what the optimal or minimal instream flows should be, the data indicates a relationship between an increase and decrease in stream flow to an increase and decrease in fish habitat (Caldwell et al. 2002). According to the Stillwater Sciences (2013) report, the prescriptive flows to support the recovery and maintenance of all focal fish species in all life stages in the riverine ecosystem are in the range of 45 to 72 cfs during the summer months in Segment 1 of the Primary Focus Area. These identified prescriptive flows do not address fish passage issues or the altered nature of the channel in Segments 2, 3, and 4. As noted in the Burns et al. (2009) report, there is not a single flow that would allow all currently configured portions of Mill Creek from Gose Street to Bennington Diversion Dam to be passable. Therefore, fish passage barriers (further described in Section 2.8.5) will need to be resolved in addition to maintaining these prescriptive flows established by Stillwater Sciences for protection of fish habitat. For the purposes of this Assessment, the lowest flow in the Stillwater prescriptive range (45 cfs) is applied to the entire Primary Focus Area as the minimum flow.

The optimum flow number of 100 cfs approximates the 50 percent exceedance flow for the months of December through June in Mill Creek. The selected optimum flow number does not guarantee optimal fish habitat or fish passage in all of Lower Mill Creek's segments, but it does represent the seasonal mean monthly flow associated with winter and spring runoff for any given year and was selected to evaluate the multiple Project metrics and conditions at one flow number that represent a mean winter or spring flow.

Climate Change

As discussed in Section 2.1, climate change is projected to have substantial impact on Pacific Northwest water resources and ecosystems (Hamlet et al. 2010). To better understand the impacts for long range planning for water resources, the Climate Impacts Group at the University of Washington developed a comprehensive hydrologic database incorporating

climate change scenarios to support long-term water resource planning in the Columbia River Basin. The results of the assessment of the climate change scenario specific to the Walla Walla River basin indicate changes in spring snowpack and a shift from snow and mixed rain and snow events, to rain-dominant events (Hamlet et al. 2010). Associated shifts in streamflow timing from spring and summer to winter are also evident in basins with significant snow accumulation in winter for the current climate.

2.5.3.3 Control and Diversion of Flow

Water Rights Withdrawals and Diversions

Section 2.4.8.2 discussed the water right diversions and withdrawals for Mill Creek Primary Focus Area in detail. Figures 2.5-10 and 2.5-11 are schematics demonstrating water withdrawals from Mill Creek based on available instantaneous water rights flow data. The schematic is not a comprehensive representation of all water rights found in the Mill Creek watershed and is only intended to present graphically how water is being withdrawn from Mill Creek to serve water rights appropriations.

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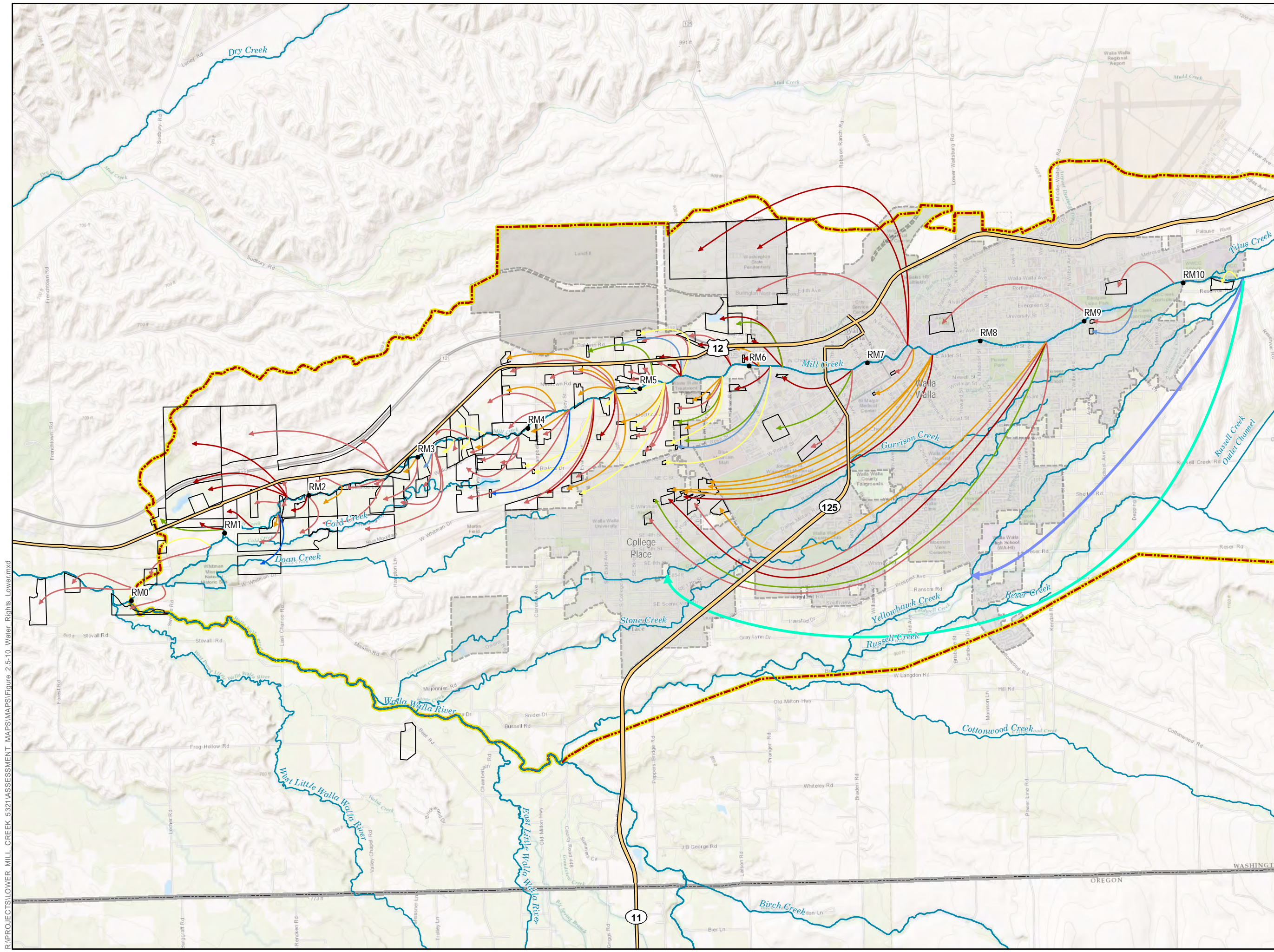
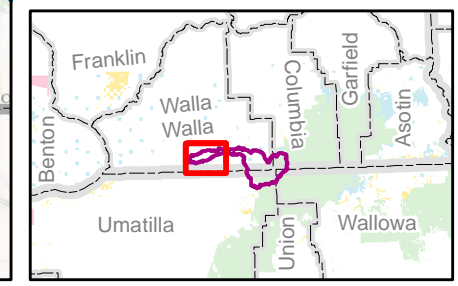
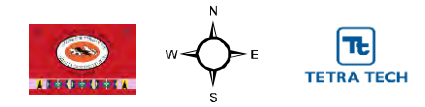
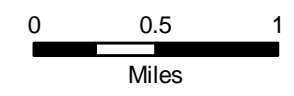
LOWER MILL CREEK HABITAT AND PASSAGE ASSESSMENT

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

FIGURE 2.5-10 WATER RIGHTS INSTANTANEOUS FLOW MAP LOWER MILL CREEK

- River Miles
- Major Stream
- Instantaneous Flow
 - ← 0.0 - 0.067 cfs.
 - ← 0.067 - 0.110 cfs.
 - ← 0.110 - 0.150 cfs.
 - ← 0.15 - 0.20 cfs.
 - ← 0.2 - 0.3 cfs.
 - ← 0.3 - 0.9 cfs.
 - ← 0.9 - 1.93 cfs.
 - ← 42 cfs in Garrison Creek
 - ← 67 cfs in Yellowhawk Creek
- ▭ Parcel
- ▭ Waterbody
- ▭ Project Area
- ▭ Primary Focus Area
- ▭ Secondary Focus Area
- ▭ Cities

Sources: CTUIR, Walla Walla County,
StreamNet

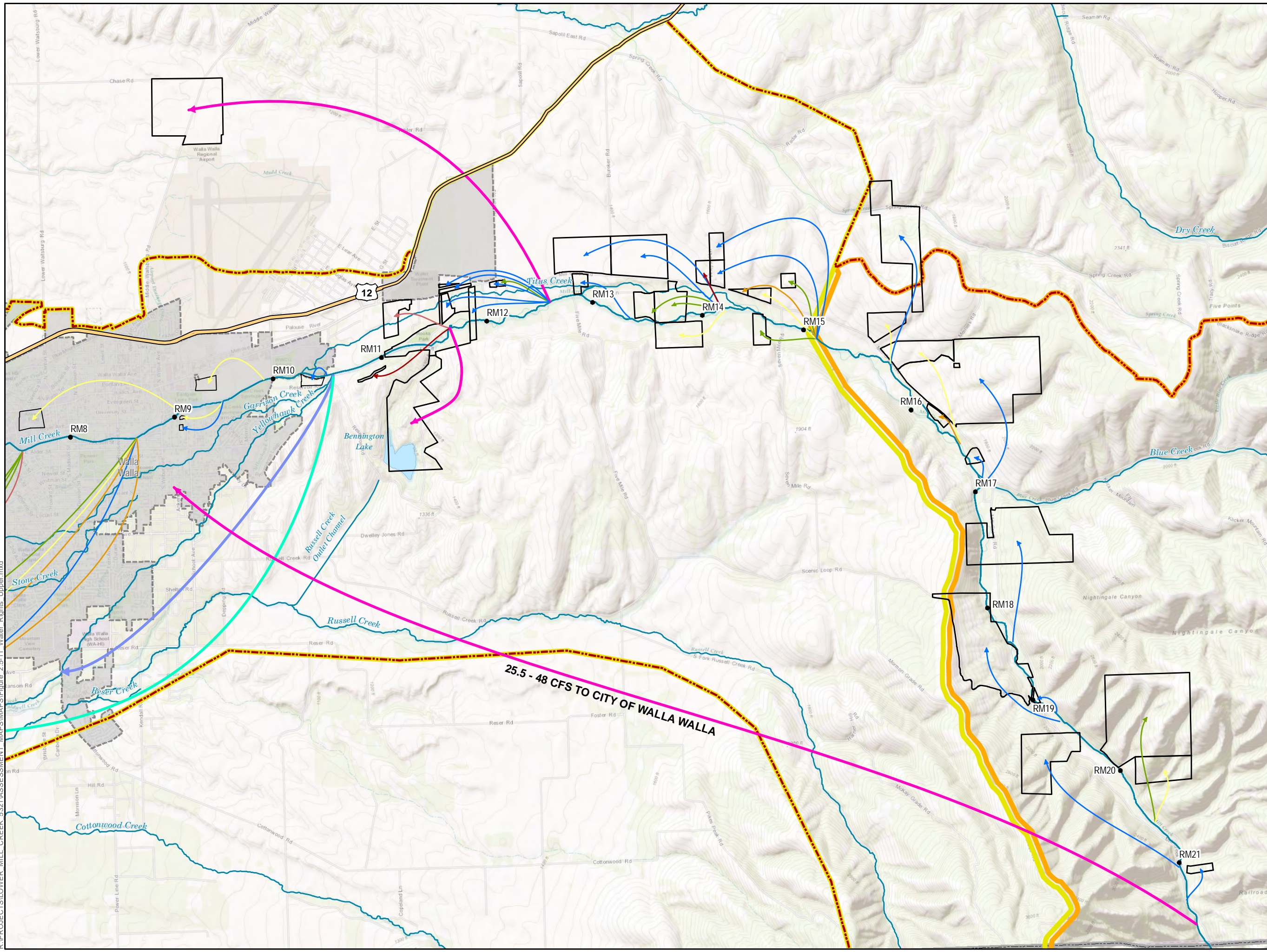


R:\PROJECTS\LOWER MILL CREEK_5321\ASSESSMENT_MAPS\MAPS\Figure 2.5-10_Water_Rights_Lower.mxd

LOWER MILL CREEK HABITAT AND PASSAGE ASSESSMENT

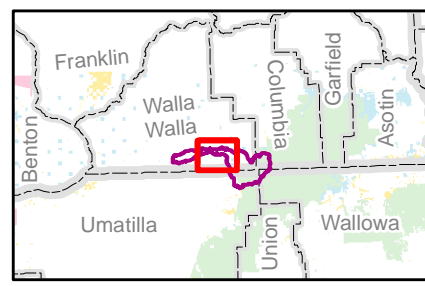
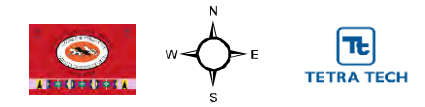
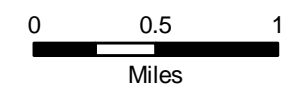
CONFEDERATED TRIBES OF THE UMATILLA INDIAN RESERVATION

FIGURE 2.5-11 WATER RIGHTS INSTANTANEOUS FLOW MAP UPPER MILL CREEK



- River Miles
- Major Stream
- Instantaneous Flow
 - ← 0.0 - 0.2 cfs
 - ← 0.2 - 0.4 cfs
 - ← 0.4 - 0.7 cfs
 - ← 0.7 - 1.4 cfs
 - ← 1.4 - 2.7 cfs
 - ← 2.7 - 8.6 cfs
 - ← 8.6 - +17 cfs
 - ← 42 cfs in Garrison Creek
 - ← 67 cfs in Yellowhawk Creek
- ▭ Parcel
- ▭ Waterbody
- ▭ Project Area
- ▭ Primary Focus Area
- ▭ Secondary Focus Area
- ▭ Cities

Sources: CTUIR, Walla Walla County, StreamNet



R:\PROJECTS\LOWER MILL CREEK\ASSESSMENT MAPS\MAPS\Figure 2.5-11 Water Rights Upper.mxd

In 1977 and updated in 2007, Ecology adopted Washington Administrative Code (WAC) 173-532, which establishes in-stream flow water rights for Mill Creek. In WAC 173-532, in-stream flows are measured at the Kooskooskie gage (USGS Gage No. 14013000) by the Management Point 1 designation and the Stream Management Reach description includes Mill Creek at the confluence with Walla Walla River to its headwaters, including tributaries. Figure 2.5-12 lists the in-stream flows in Mill Creek by month at Kooskooskie gage.

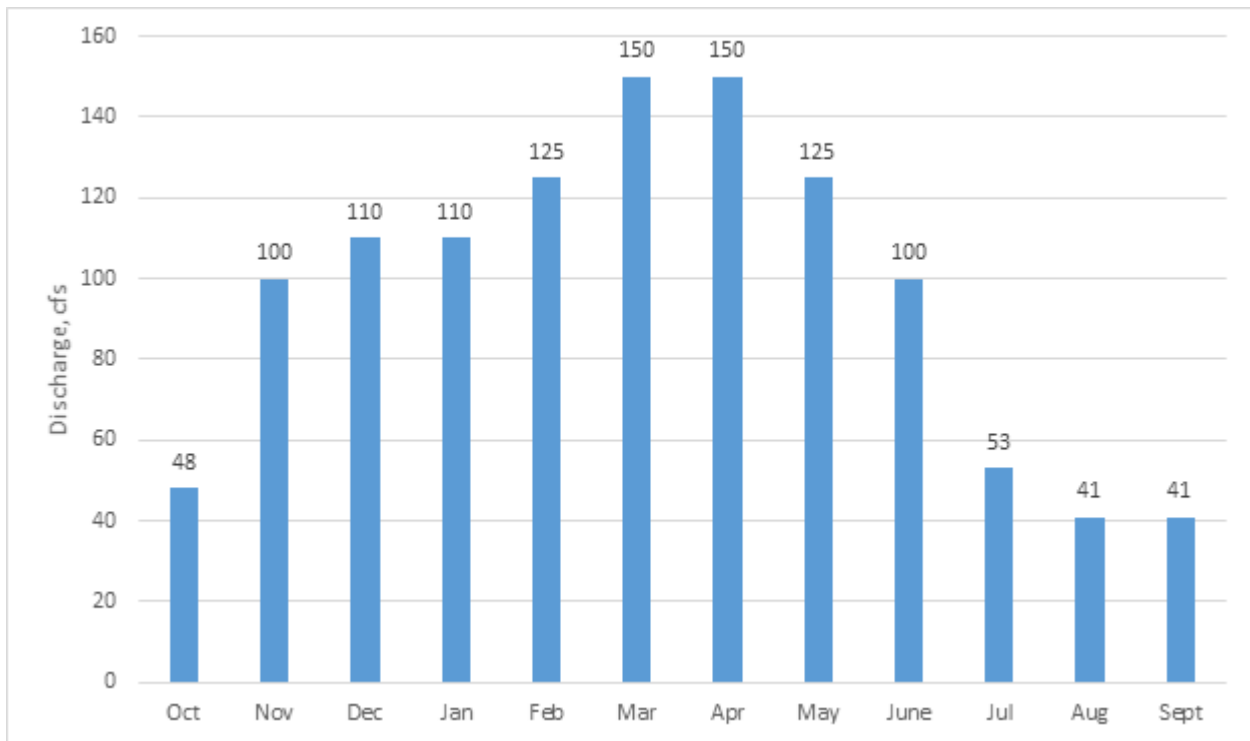


Figure 2.5-12. In-stream Flows in Mill Creek at Kooskooskie Gage, cfs (WAC 173-532 2007)

An in-stream flow is the level of stream flow required to preserve wildlife, fish, scenic/aesthetic, and other environmental and navigational values (WAC 173-532). In-stream flow is based, in part, on in-stream flow studies and stream gaging records. Establishing in-stream flow values do not put water back into Mill Creek nor does it guarantee flows will be found in the channel. This is demonstrated by comparing flows for the summer months in Figures 2.5-8 and 2.5-9, where flows downstream of the Division Works Dam average less than 5 cfs from July to October. In-stream flows do not negate any existing senior water rights, and Mill Creek is seasonally closed to new consumptive appropriations from June 1 to November 30 (WAC 173-532). During non-closure months, any new surface water withdrawals are limited to environmental enhancement projects as defined in WAC 173-532.

The City of Walla Walla municipal water system intake at Mill Creek RM 25.4 is 4.5 miles upstream from the Kooskooskie gage. Although there are no USGS gauges above the City's intake, the City of Walla Walla has collected flow data above their intake and this data was provided to CTUIR by Randal Son in March of 2016 (City of Walla Walla 2016b). The data covers daily mean flows from 2001 to 2015. According to this data, the City's average daily intake is approximately 17 cfs and accounts for approximately 32 percent of the daily average flow in Mill Creek upstream of the intake (City of Walla Walla 2016b). According to this data, the flow in Mill Creek immediately upstream of the City's water intake is 117 cfs with a 5-percent exceedance probability², 50 cfs with a 50-percent exceedance probability, and is 29 cfs with a 95-percent exceedance probability (City of Walla Walla 2016b). Details about the City of Walla Walla's drinking water systems are discussed in Section 2.4.8.

Control of Non-flood Flows at Bennington Diversion Dam

When flows are at 42 cfs or less, the majority of flow passes through the fish ladder (USACE 2015a). For flows greater than 42 cfs but less than 400 cfs, stream flow passes through the fish ladder and the low-flow outlet (USACE 2015a). Between October 15 and June 15, when flows are within this range, the USACE may divert up to 30 cfs through the drum fish screens to fill Bennington Lake for recreational use by exercising its junior water right. However, the USACE has adopted a policy to retain 100 cfs as the minimum flow in the Mill Creek Channel to accommodate adult steelhead passage through March; therefore, the USACE does not always divert the full 30 cfs allowed by its water right (USACE 2015a). Flows above 400 cfs are considered flood flows (see the following subsection for more discussion).

Control of Non-flood Flows at Division Works Dam

When Mill Creek is in non-flood flow conditions (less than 400 cfs), the USACE operates one gate at the Bennington Diversion Dam to regulate the forebay water surface elevation to maintain flow in the fish ladders. Ecology is charged with overseeing the allocation of non-flood water flows diverted from Mill Creek into the Yellowhawk/Garrison canal at the Division Works Dam for the purposes of satisfying water rights and maintaining adequate flows to sustain fish and fish habitat (Burns et al. 2009). Chapter 90.03 of the Revised Code of Washington sets forth Ecology's authority to regulate non-flood flow levels for such purposes (USACE 2012c). Ecology and USACE have a Memorandum of Understanding (MOU) for the

² A 5-percent exceedance probability represents a high flow that has been exceeded only 5-percent of all days of the flow record. Conversely, a 95-percent exceedance probability would characterize low-flow conditions in a stream, as 95 percent of all daily mean flows in the record are greater than the referenced flow.

operation of the Division Works Dam and flow allocation during non-flood periods (USACE 2012c). According to the MOU, when Mill Creek flows fall below 400 cfs, the USACE adjusts the Division Works Dam to allow 30 cfs into the Yellowhawk and Garrison creek channels, although it can be further adjusted to maintain a minimum flow of 25 cfs (USACE 2012c). WDFW staff has indicated that when more than 20 cfs is allowed down Yellowhawk, there have been complaints of localized flooding along the creek; however, no published evidence of this phenomena was provided (pers. com., Dave Karl and Mark Grandstaff, WDFW Habitat Program, Region 1, Walla Walla, WA, December 22, 2016). Gage data show that flows in Mill Creek average under 30 cfs, July through October, upstream of the Division Works Dam, and average under 10 cfs downstream. Virtually all flow is diverted from Mill Creek into Yellowhawk and Garrison creeks by late spring and early summer (Burns et al. 2009). Runoff from storm drains and local springs scattered throughout the city provide some low flow in Mill Creek below the Division Works Dam (USACE 2011a).

A general operation procedure coordinated between Ecology and USACE is “flow ramping,” which seeks to manage gradual seasonal changes of flow in Mill Creek without stranding fish between grade control structures and with consideration of the critical fish migration period of May 18 to June 15 (USACE 2012c). The flow ramping process is coordinated on an annual basis and subject to change. Historic Mill Creek hydrographs are used to assist the flow ramping process. Typically, historical hydrographs indicate a slow decrease from the last late spring peak to 70 cfs. At that flow rate, the ramping begins the first of two stages (USACE 2012c):

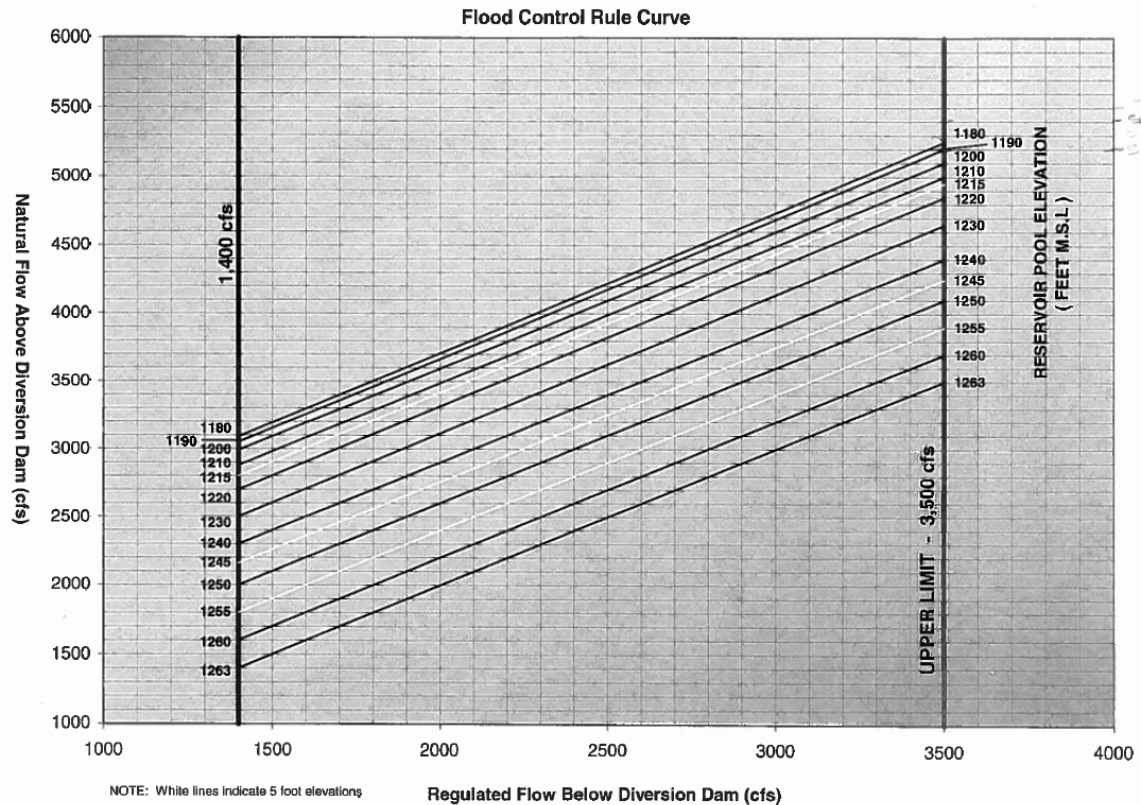
Stage one – Over a minimum period of 3 days (typically 7 days), flow will be adjusted so that the flow drops no more than 5 cfs over a 12-hour period.

Stage two – Once flow reaches 40 cfs in Mill Creek, a daily flow adjustment is made to create a “flow signal” in Yellowhawk Creek by increasing flow by approximately 5 cfs into Yellowhawk Creek in the morning and then back into Mill Creek in the afternoon. The flow adjustment continues until Mill Creek reaches 10 cfs; whereupon the ramping stops.

Control of Flood Flows at Bennington Diversion Dam and Division Works Dam

USACE begins flood control operations when flows on Mill Creek exceed 400 cfs (USACE 2012c). There are several stages to the flood control schedule implemented by USACE during flood control operations (these stages are outlined below). The original flood control operations manual for Bennington Diversion Dam was established by the USACE in 1948 and it set the threshold for diverting flow from Mill Creek at 1,400 cfs (USACE 1948). How much and how long the

Bennington Diversion Dam would divert flows depended on the elevation of Lake Bennington and the natural flow upstream of the Bennington Diversion Dam. Figure 2.5-13 is the Flood Control Rule curve nomographic chart that assisted dam operators in determining how much flow to divert to storage.



Source: USACE (1948)

Figure 2.5-13. Flood Control Rule Curve

A flooding event of 1996 was the result of two rainfall events that generated a significant amount of precipitation in quick succession and exhausted the storage capacity of Lake Bennington. This resulted in peak flows released downstream of the Bennington Diversion Dam above the designated 3,500 cfs flow. See Figure 2.5-7 for the year 1996. The probability and magnitude of flood damage increases rapidly as Mill Creek flows increase from 1,400 cfs to 3,500 cfs (USACE 2015a). As a result of the 1996 flood and an IRRM that resulted from a dam safety evaluation of Lake Bennington, the operating procedure for Bennington Diversion Dam was modified to further optimize the storage capacity of Bennington Lake (USACE 2015a). The IRRM revised the initial diversion flow level from 1,400 cfs to 2,500 cfs, followed by a rapid increase to 3,500 cfs (USACE 2015a). The following is a summary of the revised flood control action at specific flooding levels.

Stage 1 Flooding

When flow in Mill Creek is between 400 and 1000 cfs, USACE will open the two center arm gates at the Division Works Dam to maintain flows to Yellowhawk Creek at 0.9 feet (or approximately 25 cfs) (USACE 2012c). The Bennington Diversion Dam radial gates remain closed and water goes over the spillway and continues along the Mill Creek Channel. Coordination between various agencies begins at this stage (USACE 2015a). USGS gauge heights are monitored and recorded (USACE 2015a).

Stage 2 Flooding

When flow in Mill Creek is between 1,000 and 1,400 cfs, all four arm gates at the Division Works Dam are open and flows to Yellowhawk Creek are maintained at 0.9 feet (or approximately 25 cfs) (USACE 2012c). All Bennington Diversion Dam radial gates remain closed and the USACE continues agency coordination and monitors USGS gage heights (USACE 2015a). At this point, the fish ladder at the Bennington Diversion Dam is closed (USACE 2015a).

Stage 3 Flooding

When flow in Mill Creek is between 1,400 and 2,200 cfs, notifications and coordination continue. Staff continues a close monitoring of gages and maintains an updated estimated time of flooding event (USACE 2015a). The only physical operation at this stage is to set the Yellowhawk/Garrison Creek headworks to regulate flow (USACE 2015a). USACE will maintain flows to Yellowhawk Creek at 0.9 feet, unless USACE determines that different flows are necessary for flood control purposes (USACE 2012c).

Stage 4 Flooding

When flow in Mill Creek is above 2,200 cfs, stage 4 is declared, but action is not taken until flow reaches 2,500 cfs. At that point, the radial intake gates at Bennington Diversion Dam will be open, sending flow to Bennington Lake, at incremental flows for each gate until 3,000 cfs is reached in Mill Creek downstream of the dam (USACE 2015a). Once USACE officials give their approval, flow to downstream of the dam can be increased to 3,500 cfs but never to exceed that flow level (USACE 2015a). The gates are further adjusted to regulate flow in Mill Creek.

Release of Flows from Bennington Lake

Bennington Lake is drained by the Mill Creek Return Canal and Russell Creek Outlet Channel. If Bennington Lake elevation rises above 1,212 feet (the minimum elevation of the intake tower), water is evacuated through the intake tower to the Mill Creek Return Canal and, in critical situations, the Russell Creek Outlet Channel (See Figures 2.5-14 and 1.3-2). The Mill Creek Return Canal includes various section of shotcrete-lined open channel, corrugated metal pipe, and unlined open channel.

The design flow is 190 cfs and discharges into Mill Creek just upstream of the Division Works. The last time the canal was used was in 1997 after a flood event to return flood water to Mill Creek (USACE 2015a).

The Russell Creek Return Channel is used only for flood evacuation purposes and yearly maintenance requiring drawdown of Bennington Lake. It is a 7,300-foot-long, concrete-lined open channel that discharges into Russell Creek, a tributary to Yellowhawk Creek with a design discharge capacity of 250 cfs. The last time the Russell Creek Return Channel was used for flood diversion was in 1996. It is used every year for maintenance purposes (USACE 2015a).

If an event is forecasted to be less than 6 hours duration and with a peak flow in Mill Creek of less than 2,000 cfs, the flow diversion criterion may be held at the initial (pre-IRRM) diversion criterion (USACE 2015a). Table 2.5-5 lists past flood events that required flow regulation (diversion of flow) at Bennington Diversion Dam.

Table 2.5-5. Flood Events Requiring Regulation (USACE 2015a)

Date	Natural Peak Flow (upstream of dam), cfs	Regulated Peak Flow (Flows downstream to City of Walla Walla), cfs	Hours of Duration over 1,400 cfs
1906	5,200	–	–
1931	6,000	–	–
December 28, 1945	2,900	2,700	21
December 12, 1946	1,700	1,600	–
January 7, 1948	1,700	1,480	–
January 22, 1950	1,800	1,730	–
February 11, 1951	1,840	1,810	–
January 18, 1953	1,700	1,630	28
November 25, 1964	1,822	1,750	3
December 2, 1964	1,738	1,320	4
December 23, 1965	3,300	2,400	50
January 29, 1965	2,810	1,660	77
January 6, 1969	3,371	2,330	53
January 17, 1971	1,940	1,340	39
January 16, 1974	1,690	1,430	–
January 25, 1975	2,370	1,600	16
December 7, 1975	2,360	1,500	24
December 2, 1977	1,744	1,400	8
February 13, 1977	1,601	1,420	6
February 14, 1982	2,050	1,730	15
February 21, 1982	1,740	1,580	24
February 23, 1986	2,050	1,359	8

Table 2.5-5. Flood Events Requiring Regulation (USACE 2015a) (continued)

Date	Natural Peak Flow (upstream of dam), cfs	Regulated Peak Flow (Flows downstream to City of Walla Walla), cfs	Hours of Duration over 1,400 cfs
February 9, 1996	6,000	3,800	48
January 1, 1997	2,640	1,640	18
February 1, 1997	2,550	1,650	13
February 1, 2003	2,220	1,500	24
January 29, 2004	1,840	1,590	14

Source: USACE (2015a)

Figure 2.5-14 below visually represents the diversion of flooding discharges in relation to Bennington Diversion Dam and the amount of storage in Bennington Lake.

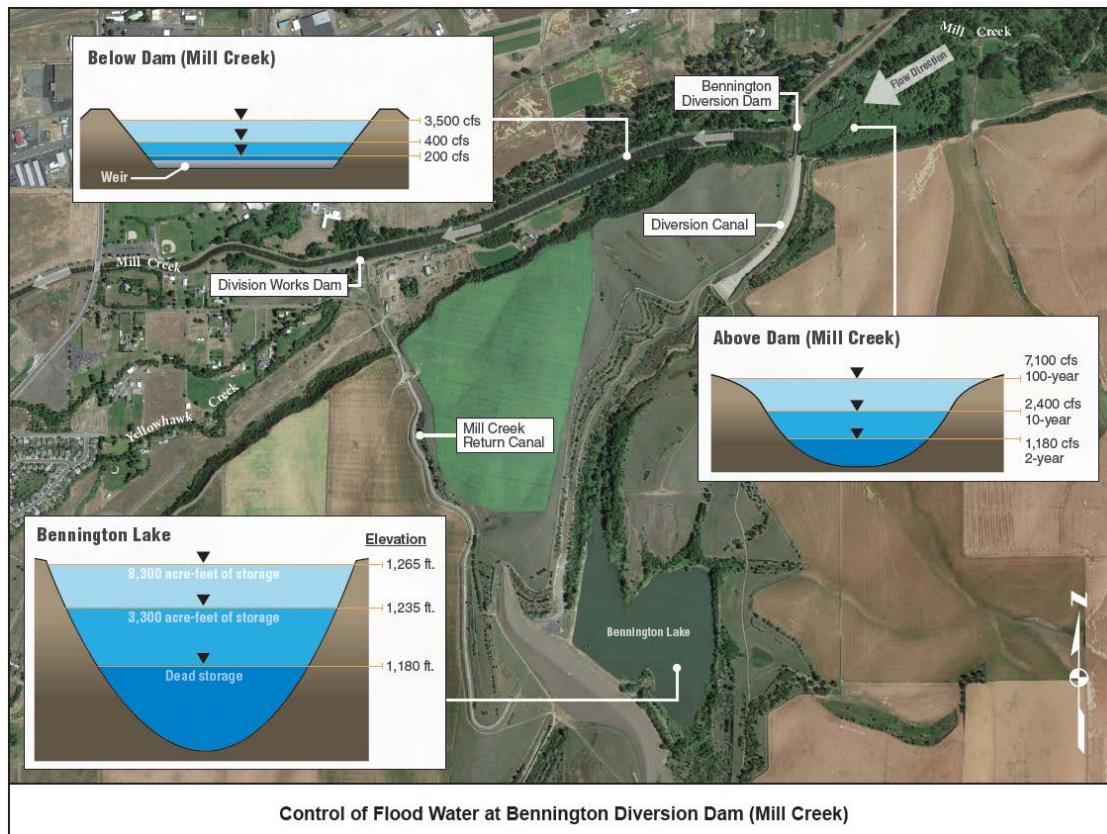


Figure 2.5-14. Control of Flooding Flow at Bennington Diversion Dam

As of March 2017, the USACE reverted to the previous 1948 threshold for diverting flow from Mill Creek at 1,400 cfs (USACE 1948); however, the flow curve diversion trigger is currently under review through the re-initiated Section 7 consultation with the USFWS and NMFS.

2.5.4 Hydraulics

2.5.4.1 Historic

There is a lack of detailed records of the hydraulic characteristics of Mill Creek before its main channel and floodplains were altered. Assumptions about the depths, bank widths, cross-section areas, and velocities can be made based on the geomorphic and hydraulic characteristics of Mill Creek within the Primary Focus Area.

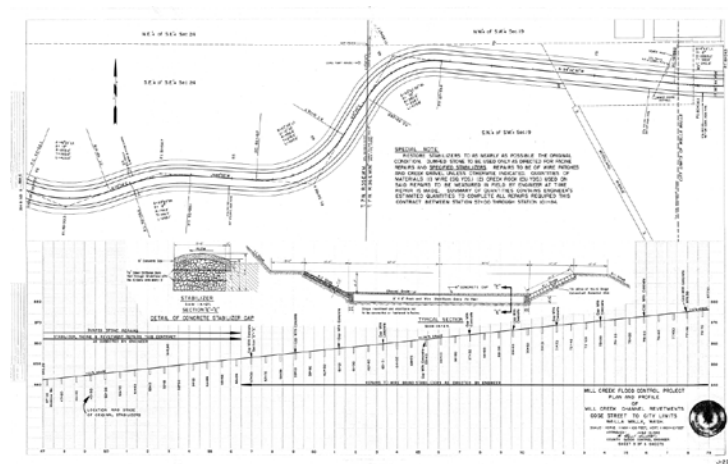
Upstream of the alluvial fan, Mill Creek historically flowed through a semi-confined river valley half a mile wide. The main channel was moderately sinuous and could freely migrate laterally within the valley floor. The historic main channel likely had a stable channel slope, similar to the current channel slope, ranging from 1.0 to 1.2 percent. Bankfull widths in Segment 5 were similar to the current, as the flow regime that defines the channel geometry has not been altered. However, during flooding events, the historic Mill Creek was more connected to its floodplain and side channels, generating smaller velocities.

As Mill Creek flowed onto the alluvial fan, flow in the main channel would spread out and the main channel pattern became braided with multiple distributaries branching off. The velocities were lower, bank widths wider, and bankfull width to depth ratios higher than those in the upstream single thread section. Yellowhawk Creek's and other distributaries' hydraulics would have been historically similar to those of Mill Creek, albeit at a reduced form relative to the amount of flow in the distributary's channel.

In Segment 1, the mainstem of Mill Creek returns to the sinuous single-channel pattern, creating a sinuosity similar to the reaches upstream of the Primary Focus Area. However, here Mill Creek has lost a significant amount of flow and sediment to the distributary river system and the gradient is not as steep as upstream. As a result, flows depths were relatively deeper and the bankfull widths smaller than what was found in Segments 2 through 4.

2.5.4.2 Current

As stated in the previous sections, within the Primary Focus Area, Mill Creek is a highly altered stream corridor with a controlled flow regime and a



Construction Drawing of Flood Control Project

hardened concrete channel or weir/sill geometry. The standard methods of measuring natural riverine processes and stream characteristics do not apply to an engineered system because the hydrologic and geomorphic processes are hindered and the channel geometry static.

For a natural riverine system, the bankfull flow is the flow that defines the geometry of the main channel and identifies opportunities for increasing focal fish species habitat. Current bankfull flow in Segment 5, which is a natural riverine system, has been identified by Bair et al. (2010) (Table 2.5-4) as 642 cfs at a 1.5-Year Recurrence Interval. However, for the segments with an altered flow regime (Segments 1, 2, 3, and 4), different methods for identifying current bankfull flow are required. One method, applied to Segment 1, involves reviewing the channel geometry at select flow rates and evaluating flow characteristics via hydraulic model. In Segments 2 through 4, the channel geometry is static, hardened, and not formed by the flow and sediment regimes. For the purposes of this assessment, the bankfull flow for current conditions is defined as the outer wall in the flume section and the bankfull flow as 3,500 cfs.

Three different computer or computational models were reviewed and applied to determine stream velocities, bankfull width, width-to-depth ratio, and several other Project metrics for the altered portion of the Mill Creek Channel. These three models have been developed to assess the hydraulic characteristics of Mill Creek and to understand how the Creek responds to specific flows and flooding conditions and as a guide to design fish passage elements, based on depths and velocities, in the various weirs or flume configurations. These three models include:

1. **2014 USACE Hydrologic Engineering Centers River Analysis System (HEC-RAS) Model.** This model was created by the USACE to model flooding events in Mill Creek in support of a Flood Impact Analysis (USACE 2014a). The Flood Impact Analysis took data from the HEC-RAS hydraulic model and GIS data to identify potential impacts to critical infrastructure. This model used the 1996 flood data to calibrate the model (USACE 2014a).
2. **2010 USACE HEC-RAS Model.** In 2010, the USACE created a HEC-RAS model of proposed fish passage elements upstream of the Bennington Diversion Dam. The analysis reviewed the water surface rise as the result of the improvements and compared the existing condition against the proposed alternatives. The focus area of the model included the Bennington Diversion Dam, the storage capacity of Bennington Lake and the Mill Creek mainstem upstream for 11,000 feet. This model used the 1996 flood data to calibrate the model (USACE 2011b).

3. **Burns et al. (2009) Model.** In a fish passage assessment report for Tri-State Steelheaders (Burns et al. 2009), a HEC-RAS model and spreadsheets were used to provide data for fish passability. Results from both hydraulic models were fed into a fish passage energetic model that quantified the fish passability of the reach at individual flows for individual fish species. Section 2.8 below summarizes the results of the two hydraulic models as they relate to fish passability calculations.

The following is a list of the bankfull flows selected, based on the sources noted above, for calculating the hydraulic characteristic metrics for each segment:

Segment 1 – The channel form is an incised single sinuous natural channel and is confined on both banks by agricultural and suburban development. Consistent with incised channels, the floodplain has been abandoned and flood flows are carried within the already down-cutting main channel. The usual physical characteristics that assist in determining bankfull flow generally do not apply and require a visual analysis of the incised channel that is out of the scope of this Assessment. For the purpose of this Assessment, a bankfull flow of 300 cfs has been selected as the current bankfull flow based on a review of the HEC-RAS cross sectional data and aerial photographs.

Segments 2 through 4 – As stated above, bankfull flow characteristics are difficult to apply to a hardened, engineered channel with a geometry that does not reflect the hydrologic or sediment regimes. For Segments 2 through 4, the banks are defined walls in the flume section and bankfull characteristic are calculated using 3,500 cfs as the bankfull flow. According to the fish passage assessment completed by Burns et al. (2009), during the months of fish migration in Mill Creek (May through June), the 50 percent exceedance flow (or median flow) is 92 cfs. A flow of 100 cfs was used in the hydraulic calculations of the 2009 assessment and is discussed above as the optimal flow set for the purposes of this Assessment (see Section 2.5.3). A flow of 45 cfs was determined to be the minimum flow required to support all life stages of focal fish in the Primary Focus Area (Stillwater Sciences 2013).

Segment 5 – This segment is a natural channel with a mostly unaltered flow regime. For this Assessment, the 1.5-year recurrence interval of 642 cfs (Bair et al. 2010) will be the bankfull flow.

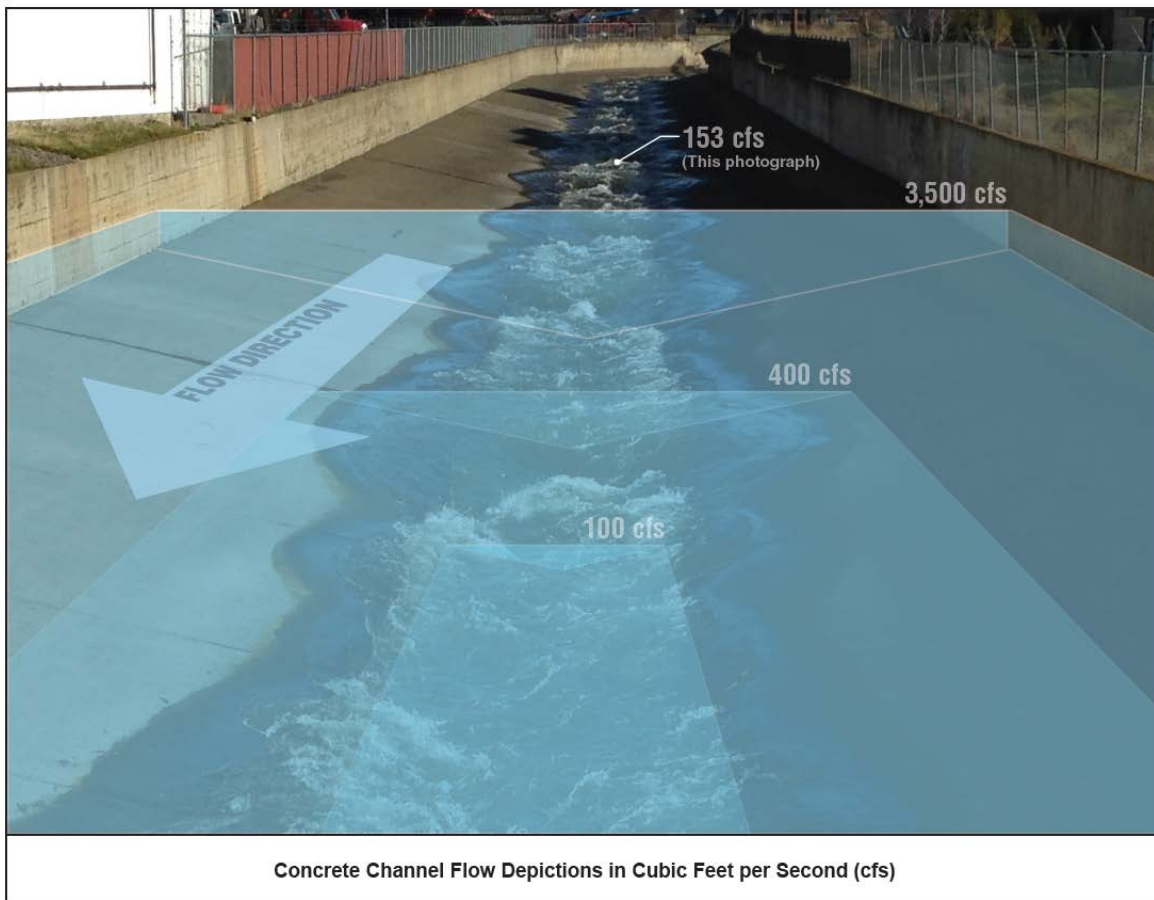
Table 2.5-6 below summarizes the current, minimal, and optimal hydraulic characteristics identified for each segment in the Primary Focus Area. Minimal and optimal hydraulic characteristics are identified assuming the current channel characteristics in Mill Creek.

Table 2.5-6. Existing Mill Creek Bankfull Flow Characteristics by Segment

Segment	Flow (ft ³ /s)	Bankfull Width (ft)	Bankfull Depth (ft)	Bankfull Area (ft ²)	Bankfull W/D	Average Velocity (ft ² /s)
1	<i>Current</i>					
	<i>Min</i>	300	48	2.5	115	19.7
	<i>Optimal</i>					
2, 3, and 4	<i>Current</i>	3,500	50	3.8	190	13.2
	<i>Min</i>	45	22	1.9	28	16.4
	<i>Optimal</i>	100	29	1.3	48	17.6
5	<i>Current</i>					
	<i>Min</i>	642	67	2.8	188	21.3
	<i>Optimal</i>					

ft – foot; ft²/s – square foot per second; ft³/s – cubic feet per second

Figure 2.5-15 represents conceptual water surfaces at various flows in the existing Mill Creek flume upstream of the North 9th Street Bridge.



Sources: Burns et al. (2009); USACE (2011b)

Figure 2.5-15. Overlay of Estimated Water Surface Elevations

2.5.4.3 Floodplain Connectivity

Historic

Upstream of Bennington Diversion Dam, Mill Creek historically flowed through a semi-confined river valley half a mile wide; the main channel was moderately sinuous and could freely migrate laterally within the valley floor. The valley gradient was approximately 2.0 percent slope and sinuosity of the main channel likely found a stable channel slope at a slightly lower gradient. Mill Creek was well connected to its floodplain and numerous side channels, providing stable flooding relief as well as lower velocities and depths in the main channel during high flows.

As Mill Creek flowed onto the alluvial fan, the main channel gradient was reduced to 1.0 to 1.2 percent slope. Distinct from the stable banks, defined bankfull widths, and side channels found in the upstream reaches, on the alluvial fan Mill Creek was transformed into a wide, multi-braided mainstem with a distributary system. During low flows, the multi-braided mainstem became a network of small channels separated by small and often temporary islands and bars. During flood flows, the mainstem would have fully contained water and the islands were submerged. In addition, during large flooding events, the mainstem and distributary system were subjected to erratic avulsion, often significantly re-working the mainstem, distributaries and floodplain layout.

As Mill Creek flowed toward the apron of the alluvial fan and became confined to the north by the valley side (Segment 1), the valley gradient dropped to less than 1.0 percent slope and Mill Creek transitioned back to a single thread sinuous channel form. In this reach, Mill Creek was well connected to its floodplain and side channels.

Current

Section 2.4.7 above discusses the history of the MCFCP. This project effectively disconnected Mill Creek from its floodplain in Segments 2 through 4. From upstream of the Bennington Diversion Dam to the end of Segment 5 at the 7 Mile Bridge (near RM 15), agricultural development alongside Mill Creek has limited channel migration and floodplain connectivity, the historical floodplain having been transformed into agricultural land by filling in the side channels and floodplains with ad hoc levees and rock barbs (Bair et al. 2010). In addition, to protect private property and public infrastructure, such as roads, much of Mill Creek's stream banks have been hardened by levees and various methods of bank protection (WWBWC 2010b).

Downstream of the Bennington Diversion Dam and through the City of Walla Walla (Segments 2, 3, and 4), Mill Creek is completely channelized into a configuration of either channel

spanning weir/sill grade stabilizers with a levee on both sides, or by a concrete flume with various configurations (Burns et al. 2009). Both configurations have completely disconnected the main channel of Mill Creek from the floodplain (USACE 2011a).

As Mill Creek flows through Segment 1, the channel returns to a more natural form; however, it is confined by agricultural development on both banks with limited floodplain connectivity.

The current percent of floodplain disconnected (PFD) metrics below are estimates of the impact of confining features (e.g., levees, flume channelization, stream bank projection, etc.) in the floodplain on river and floodplain connectivity. The minimal and optimal percent of floodplain disconnected (PFD) metrics below are estimates that reflect limited opportunities to reconnect the floodplain. The floodplain landform mapping and bankfull discharge by segment (see Table 2.5-6) is utilized to calculate the area of floodplain disconnected by confining features. The current, minimal, and optimal PFD is summarized in Table 2.5-7.

Table 2.5-7. Percentage of Floodplain Disconnected

Segment	Percentage of Floodplain Disconnected		
	Current	Minimal	Optimal
1	75	65	55
2	100	90	80
3	100	90	80
4	95	85	75
5	50	40	30

The highest amount of PFD occurs within Segments 2 through 4 as they are completely channelized by a weir/sill stabilizer with leveed banks or concrete flume with vertical walls. The channel through Segment 1 is incised and experiencing further down cutting and has been disconnected from its floodplain by agricultural development on its banks. It is estimated that 75 percent of its historic floodplain has been disconnected from the mainstem.

Reconnecting the floodplain in the highly urban Segments 2 through 4 will be challenging from a land availability standpoint. Segments 1 and 5 have opportunities for reconnecting the floodplain that would require willing landowners, excavation to reconnect floodplain channels, and riparian plantings. Because of the varied challenges, the minimal level of PFD has been identified as a reduction of 10 percent from the current PFD levels and the optimal PFD as a 20 percent reduction from current levels.

The inundation map series, Figures 2.5-16 through 2.5-22, show the flood inundation for the 1996 flood (3,500 cfs) for most of the Primary Focus Area. Floodplain inundation mapping is based on the readily available data found in the hydraulic models discussed in Section 2.5.4.2.

Inundation maps present the extent and depths of flooding at specific discharges and can assist in visualizing a wider range of flooding scenarios and in evaluating current conditions for the PFD. For example, a deeper inundation area could indicate the floodplain being activated at the smaller bankfull discharge rates. Conversely, a shallow depth could indicate a disconnected floodplain.

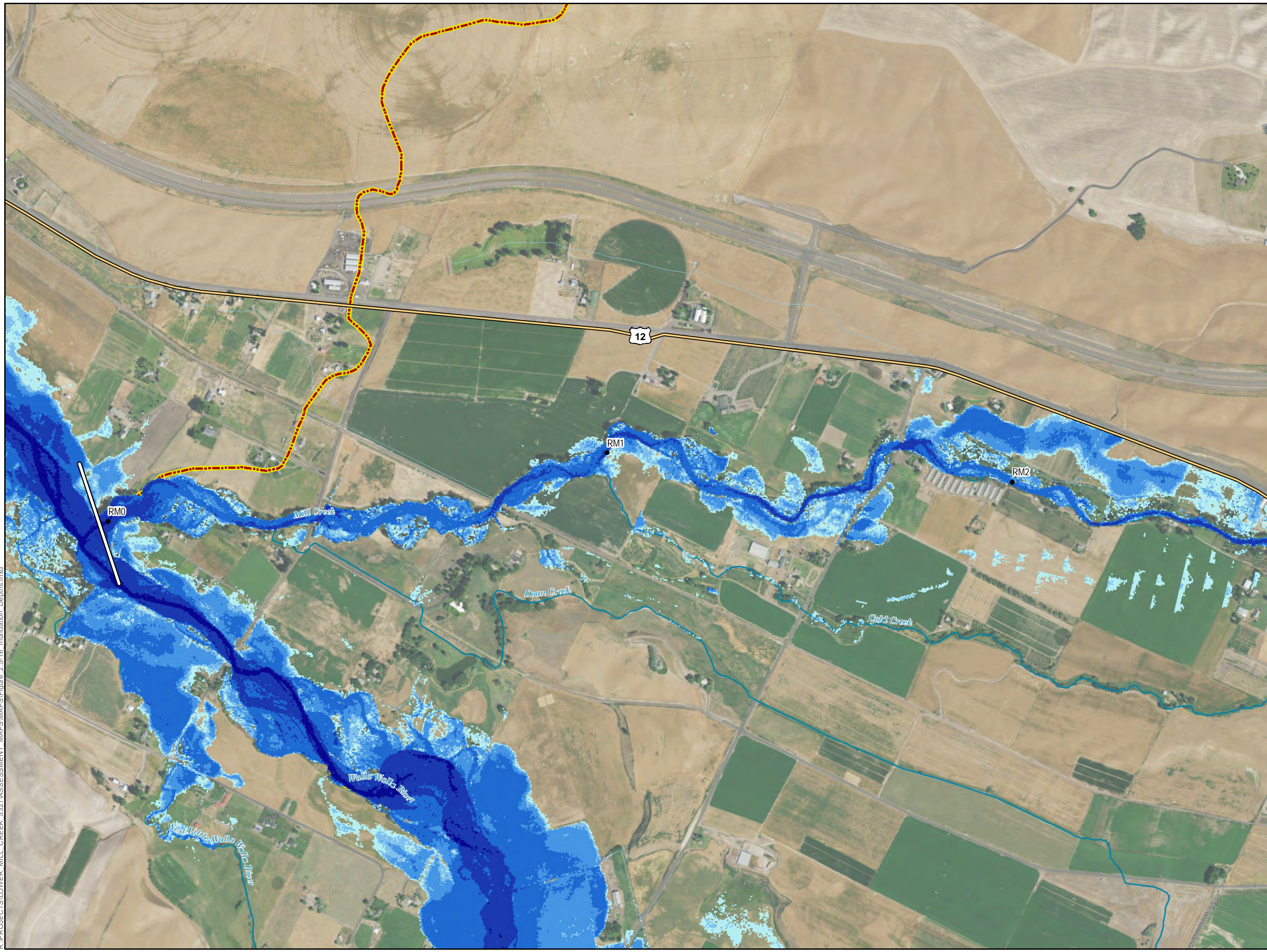
Data gaps in the inundation mapping include Titus Creek, all of the spring-fed channels, Garrison Creek, Yellowhawk Creek from the confluence with Russell Creek to the Division Works Dam, and Mill Creek from RM 12 to RM 15.

**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

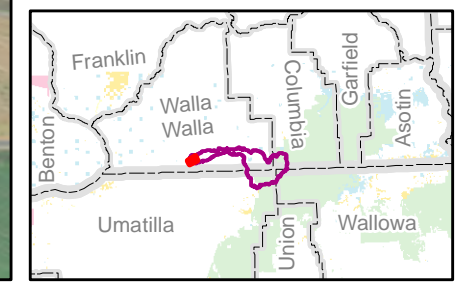
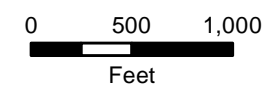
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**FIGURE 2.5-16
INUNDATION MAP OF
1996 MILL CREEK FLOOD
3,500 cfs
Segment 1**

- River Miles
 - Major Stream
 - Minor Stream
 - Reach Break
- Inundation Depths**
- 0 - 0.5 ft.
 - 0.5 - 1 ft.
 - 1 - 2 ft.
 - 2 - 5 ft.
 - 5 - 10 ft.
 - 10 - +30 ft.
- ▭ Primary Focus Area



Sources: CTUIR, Walla Walla County, StreamNet



R:\PROJECTS\LOWER MILL CREEK 5321\ASSESSMENT MAPS\MAPS\Figure 2.5-16 Inundation Depths.mxd

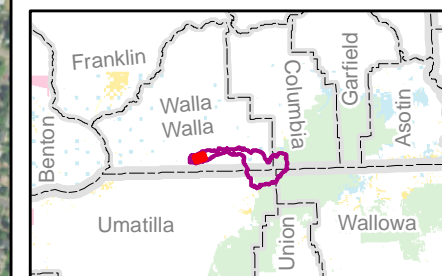
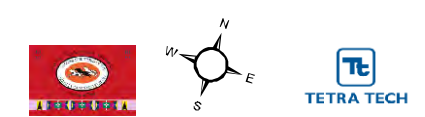
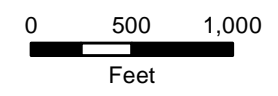
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**FIGURE 2.5-17
INUNDATION MAP OF
1996 MILL CREEK FLOOD
3,500 cfs
Segment 2**

- River Miles
 - Major Stream
 - Minor Stream
 - ▬ Reach Break
- Inundation Depths**
- 0 - 0.5 ft.
 - 0.5 - 1 ft.
 - 1 - 2 ft.
 - 2 - 5 ft.
 - 5 - 10 ft.
 - 10 - +30 ft.
 - ▭ Primary Focus Area

Sources: CTUIR, Walla Walla County,
StreamNet



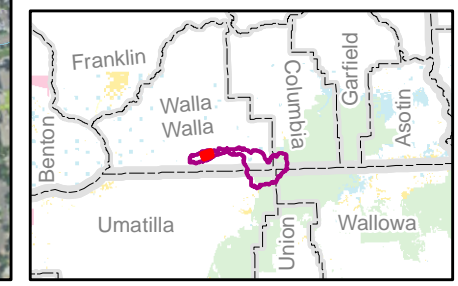
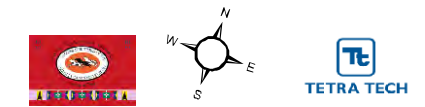
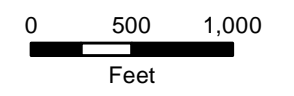
**LOWER MILL CREEK
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**FIGURE 2.5-18
INUNDATION MAP OF
1996 MILL CREEK FLOOD
3,500 cfs
Segment 3**

- River Miles
 - Major Stream
 - Minor Stream
 - Reach Break
- Inundation Depths**
- 0 - 0.5 ft.
 - 0.5 - 1 ft.
 - 1 - 2 ft.
 - 2 - 5 ft.
 - 5 - 10 ft.
 - 10 - +30 ft.
- Primary Focus Area

Sources: CTUIR, Walla Walla County,
StreamNet



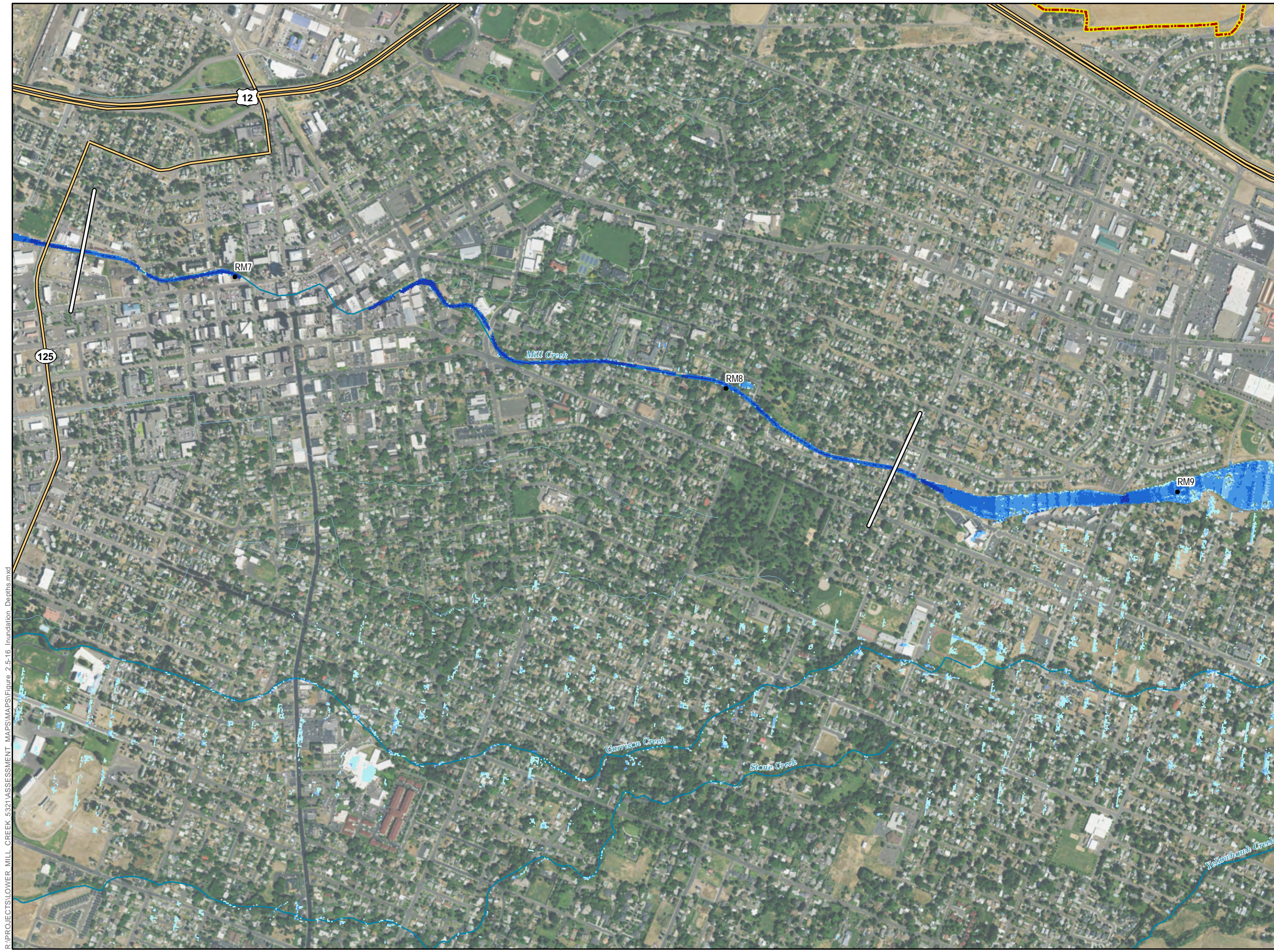
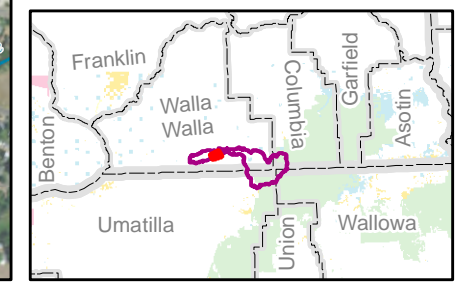
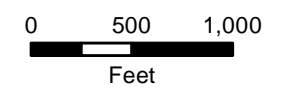
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**FIGURE 2.5-19
INUNDATION MAP OF
1996 MILL CREEK FLOOD
3,500 cfs
Segment 4**

- River Miles
 - Major Stream
 - Minor Stream
 - ▬ Reach Break
- Inundation Depths**
- 0 - 0.5 ft.
 - 0.5 - 1 ft.
 - 1 - 2 ft.
 - 2 - 5 ft.
 - 5 - 10 ft.
 - 10 - +30 ft.
- ▭ Primary Focus Area

Sources: CTUIR, Walla Walla County,
StreamNet



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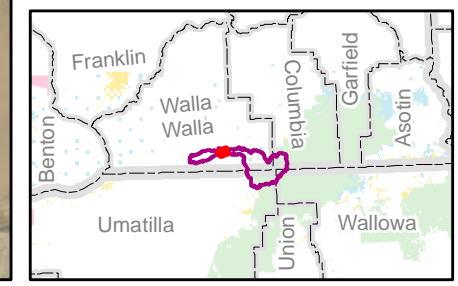
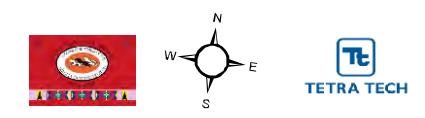
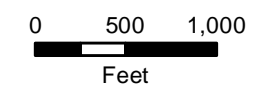
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**FIGURE 2.5-20
INUNDATION MAP OF
1996 MILL CREEK FLOOD
3,500 cfs
Segment 5**

- River Miles
 - Major Stream
 - Minor Stream
 - Reach Break
- Inundation Depths**
- 0 - 0.5 ft.
 - 0.5 - 1 ft.
 - 1 - 2 ft.
 - 2 - 5 ft.
 - 5 - 10 ft.
 - 10 - +30 ft.
- ▭ Primary Focus Area

Sources: CTUIR, Walla Walla County,
StreamNet



**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

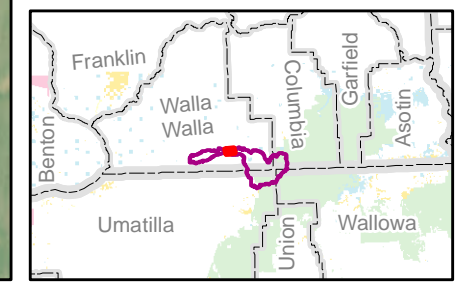
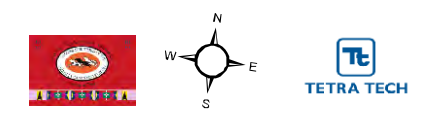
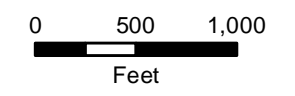
CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE 2.5-21
INUNDATION MAP OF
1996 MILL CREEK FLOOD
3,500 cfs
Bennington Diversion Dam**



- River Miles
 - Major Stream
 - Minor Stream
 - ▬ Reach Break
- Inundation Depths**
- 0 - 0.5 ft.
 - 0.5 - 1 ft.
 - 1 - 2 ft.
 - 2 - 5 ft.
 - 5 - 10 ft.
 - 10 - +30 ft.
 - ▭ Primary Focus Area

Sources: CTUIR, Walla Walla County,
StreamNet



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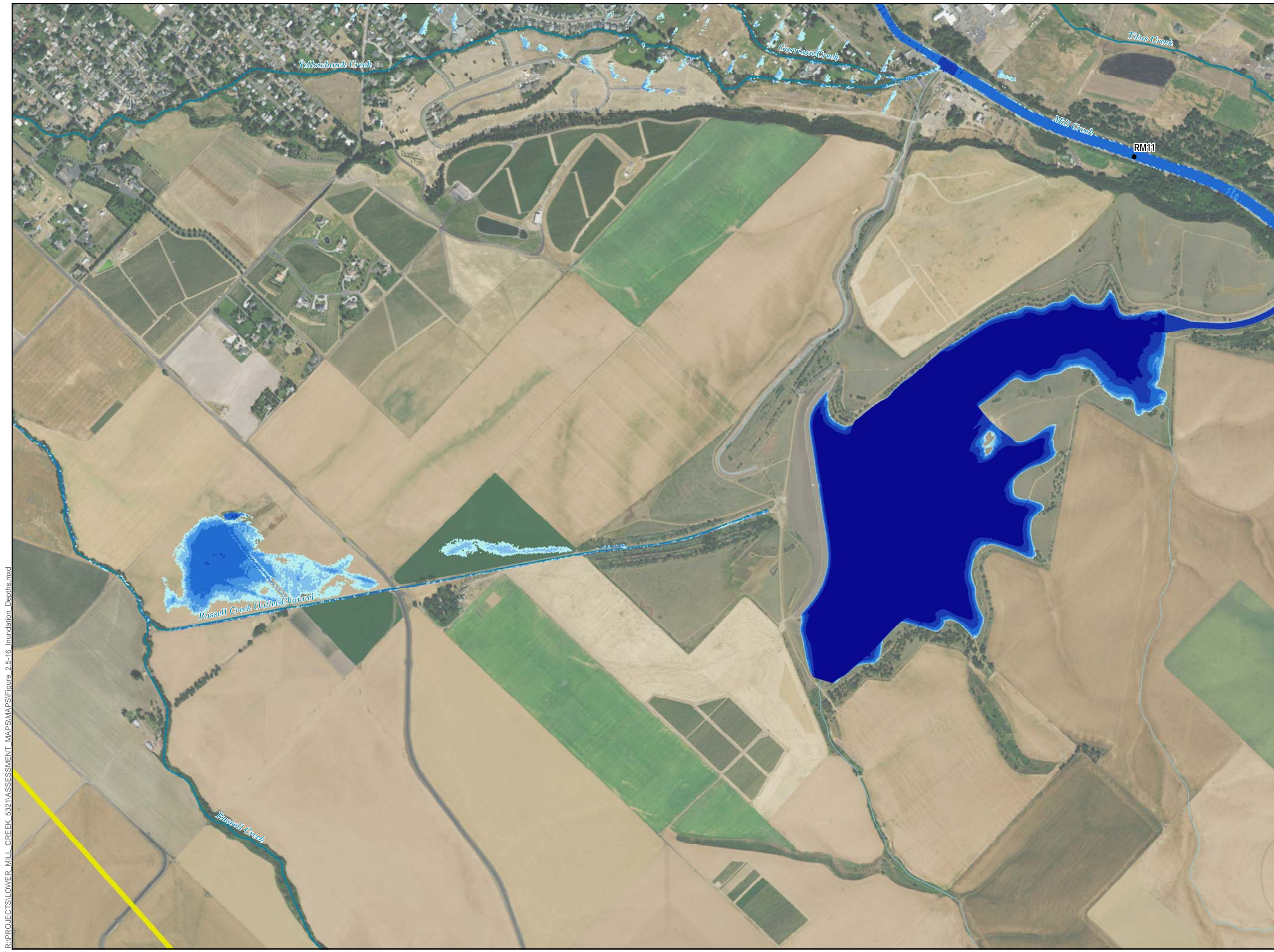
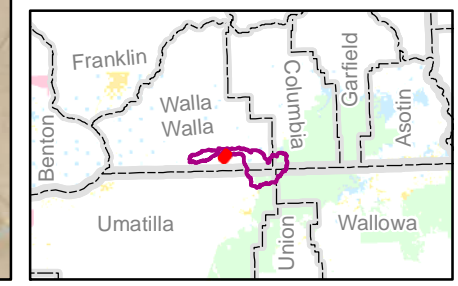
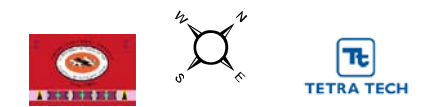
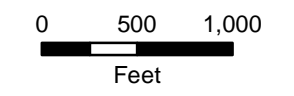
**LOWER MILL CREEK
HABITAT AND PASSAGE
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UMATILLA INDIAN RESERVATION

**FIGURE 2.5-22
INUNDATION MAP OF
1996 MILL CREEK FLOOD
3,500 cfs
Bennington Lake**

- River Miles
 - Major Stream
 - Minor Stream
 - Reach Break
- Inundation Depths**
- 0 - 0.5 ft.
 - 0.5 - 1 ft.
 - 1 - 2 ft.
 - 2 - 5 ft.
 - 5 - 10 ft.
 - 10 - +30 ft.
 - Primary Focus Area

Sources: CTUIR, Walla Walla County,
StreamNet



The relative abundance of floodplain habitat is quantified by the area of vegetation and wetlands and wetted areas with downed wood and/or aquatic vegetation in the floodplain. Floodplain habitats are digitized and calculated in ArcGIS utilizing high-resolution imagery along with site-specific field observations. The results of the habitat abundance area calculation are presented in Table 2.5-8 below. Segment 1 currently has 55 acres of floodplain habitat; however, as a degraded incised main channel, there are opportunities to reconnect the floodplain and increase the total area of floodplain habitat. The amount of floodplain available to reconnect is limited by agricultural development and private landowners. As a result of these constraints, the minimal abundance of floodplain habitat is set to 77 acres, a 40 percent increase from current conditions. The optimal abundance of floodplain habitat is set to 110 acres, a 200 percent increase from current conditions. For Segments 2, 3, and most of 4, Mill Creek is completely devoid of floodplain habitat. The minimal amount of relative abundance of floodplain habitat is set to 30 acres for Segments 2 and 3 and 90 acres for Segment 4. The optimal amount of relative floodplain habitat is set to 50 acres for Segments 2 and 3 and 120 acres for Segment 4. Segment 4 has higher minimal and optimal acreage amounts than Segments 2 and 3 because Segment 4 has more existing land use opportunities to increase floodplain habitat. Although Segment 5 is the most natural portion of the channel within the Primary Focus Area, it also has opportunities to increase floodplain habitat areas. The minimal amount of relative floodplain habitat is set to 25 acres and the optimal amount is set to 55 acres.

Table 2.5-8. Mill Creek Relative Abundance of Floodplain Habitat

Segment	Relative Abundance of Floodplain Habitat (Acres)		
	Current	Minimal	Optimal
1	55	77	110
2	0	30	50
3	0	30	50
4	68	90	120
5	175	200	230

Channel migration distances and migration rates were calculated using the historic channel alignments from 1919 and 1933 in Segments 3 and 4 where historic mapping of the main channel is clear and measurable. The maximum migration distance measured was 410 feet with a migration rate of 29 feet per year. Over time, migration has been limited in Segment 1 due to the downcutting of the Mill Creek channel and confinement from agriculture development on both banks. In Segments 2 through 4, the channel is completely confined by levees or concrete walls resulting in zero migration since the MCFCP was completed. In Segment 5, the channel has somewhat more room to migrate than in the other segments but is still confined by bank

protection, bridge openings, and roadway embankments. Due to the limitations on the ability of Mill Creek to migrate in all segments, a minimum and optimum migration rate metric was not identified.

2.5.4.4 Sediment Transport

A stream channel's geometry is maintained by its ability to transport water and sediment. The stream channel's shape will adjust to stream flow and sediment inputs, thus maintaining a dynamic equilibrium that reflects the prevailing flow and sediment regimes. Bankfull flows are the flows that fill the channel up to the stage where the stream just begins to overflow into its floodplains. Bankfull flows occur more frequently than larger flood flows, so over time they can move large amounts of stream sediments. Suspended sediment mainly consists of finer particles such as silts and clays, which are completely supported by the turbulence of flowing water. Bedload usually consists of particles of sand, gravel, cobbles, and boulders that are transported by traction—they roll, slide, and bounce along the streambed. Bedload builds the stream, while suspended load builds the floodplains (Bair et al. 2010).

Historic

Factors that affect the concentration of sediment in stream include the physical property of soil in the watershed, land use practices, climate conditions, and streamflow characteristics (USGS 1969). Surrounded by grassland in the valleys and thick timber in the steep mountain headwater, sources for sediment in Mill Creek remained stable and sediment concentration in Mill Creek were generally low. Pioneers reported that the water remained clear and carried little silt during high flows (USGS 1969).

When erosion did occur during high flows, the fine silt was deposited in the numerous floodplains upstream of the alluvial fan. The more coarse material was deposited onto the alluvial fan as Mill Creek's ability to transport the material diminished when its flow became spread out and distributed.

Current

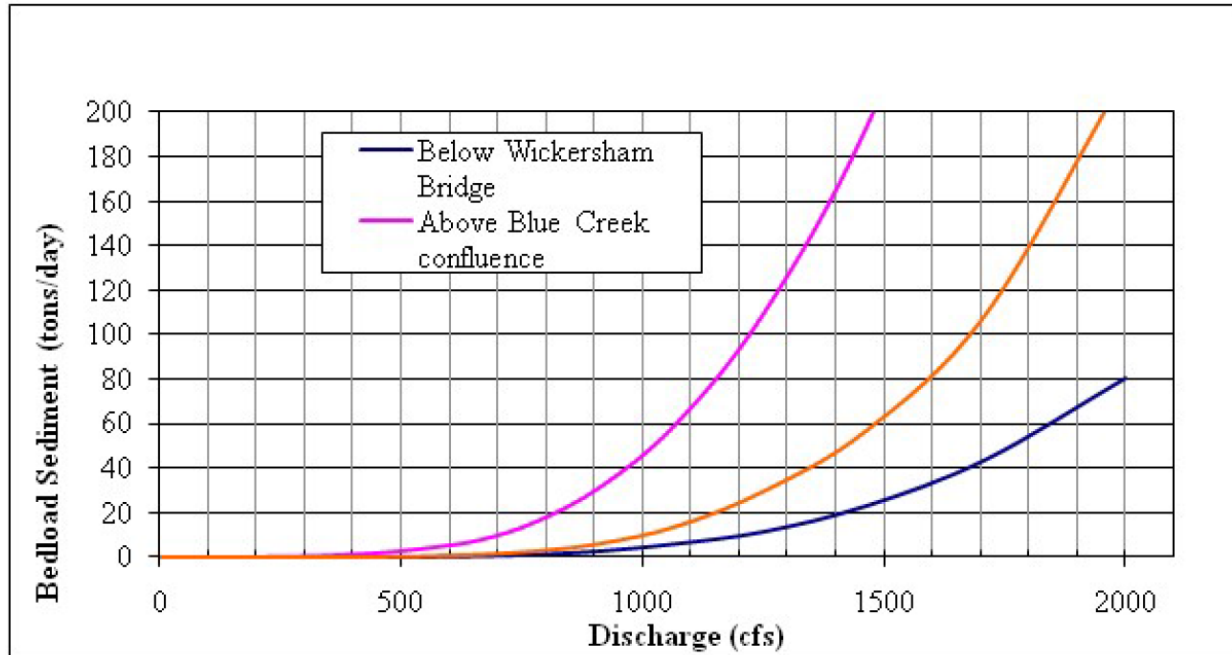
Mill Creek stream conditions changed as large areas of grassland were cultivated as cropland. The tilling of the silty loam soil allowed for transport of these soils into Mill Creek during heavy precipitation events. Most of the annual load discharge occurs between the months of November and April, corresponding to the winter high flows (USGS 1969).

Based on a sediment transport study conducted by the USGS in 1969, average sediment yields during the study period (July 1962 to 1965) ranged from 855 tons per square mile (1.3 tons per

acre) near the City of Walla Walla in the extensively cultivated parts of the basin to 420 tons per square mile (0.67 ton per acre) in the mountainous area above the Blue Creek confluence (USGS 1969). In addition, Yellowhawk Creek's average sediment yield during the study period was 1,600 tons per square mile (2.47 tons per acre). However, Yellowhawk Creek sediment samples were collected near the mouth of the creek at its confluence with the Walla Walla River and included runoff from Russell and Cottonwood creeks. The study did not determine if the sediment was from the Mill Creek diversion or from the other watersheds.

According to the USGS study, Mill Creek transported approximately 5 percent of the total sediment load discharged from the Walla Walla River subbasin. Silt predominates in the suspended sediment transported by all streams in the basin (USGS 1969). On average, sediment from streams draining in Mill Creek near the Walla Walla River was composed of 20 percent sand (particles 0.062 to 2.00 millimeters), 65 percent silt (0.004 to .062 millimeters), and 25 percent clay (particles less than 0.004 millimeters) (USGS 1969). The bedload in the mountain and upland streams of the Walla Walla watershed was estimated to be about 5 to 12 percent as much as the suspended load. For the Walla Walla River and its tributaries in the lower subbasin area, the bedload was estimated to be only about 2 to 8 percent as much as the suspended load.

A geomorphic assessment conducted by the WWCCD and U.S. Department of Agriculture, Forest Service estimated the bedload transport at three locations along Mill Creek (above Wickersham Bridge, above the Blue Creek confluence, and below the Blue Creek confluence) and generated a bedload rating curve (see Figure 2.5-23; Bair et al. 2010). Stream cross-sections were surveyed at these locations, along with data on stream slope, channel roughness, and the characteristics of the bed material, and were used as input parameters to the bedload estimate. The rating curve reflects how transport capacity can vary from reach to reach in the same creek. For example, the channel reach below Wickersham Bridge has a lower slope than the other two and transports bedload material at a lower rate (Bair et al. 2010).



Note: Orange curve represents location below the Blue Creek confluence.

Source: Bair et al. (2010)

Figure 2.5-23. Bedload Rating Curve, below Wickersham Bridge, Above and Below Blue Creek Confluence

As sediment is transported from the headwaters of Mill Creek toward lower Mill Creek, sediment accumulates over time in the forebay debris barrier area immediately upstream of the Bennington Diversion Dam (RM 11.4) and in the sediment trap within the levee weir/sill system upstream of the Roosevelt Street bridge crossing and downstream of Wilbur Avenue (RM 8.5) (City of Walla Walla 2014; USFWS 2011). The City of Walla Walla Floodplain Ordinance 2014-12 states that the schedule of sediment removal is relatively slow and could vary from 10 to 20 years (City of Walla Walla 2014). Walla Walla County staff can remember dredging Mill Creek in 1999, during which an estimated 8,000 cubic feet of sediment was removed, as a response to accelerated accumulation mostly due to the 1996 flooding event (Walla Walla County 2015b).

According to USACE maintenance logs, the last time sediment was removed from the forebay area of the Division Works Dams was in 2011 (USACE 2016c). The logs go on to indicate that sediment was removed to an elevation of 1,257 feet MSL but did not mention the volume of sediment removed. The only other date the maintenance logs mention regarding sediment removal was 1997 by a contractor with no details provided about the volume of sediment removed.

Altering the flow and sediment regime by diverting high flow and retaining sediment behind dams and weirs has caused Segment 1 to become sediment starved with an incised channel.

This downcutting of the channel has disconnected Mill Creek from its floodplain and dropped the groundwater level, impacting riparian vegetation.

Improvements to in-stream or floodplain habitat within the Primary Focus Area must demonstrate how any improvements would address sediment transport and supply, including conducting further evaluations of the current process and procedures associated with sediment removal. Sediment transport analyses ensures that design elements are process-driven and are suited for site-specific geomorphic conditions. Further characterization of the current type of sediment found in each segment will be necessary to the design of in-stream or floodplain habitat improvements. Along with the previous studies summarized above, characterizing bed material via grain size gradation data can be obtained via pebble counts. This information would assist, when combined with any improvements to in-stream or floodplain habitat, in determining minimal and optimal sediment budgets for lower Mill Creek. The minimal sediment budget would likely include sediment augmentation that would serve focal species habitat and not result in aggradation or degradation. The optimal sediment budget would be the natural occurrence of sediment transport under optimal hydraulic characteristics.

2.5.5 Groundwater

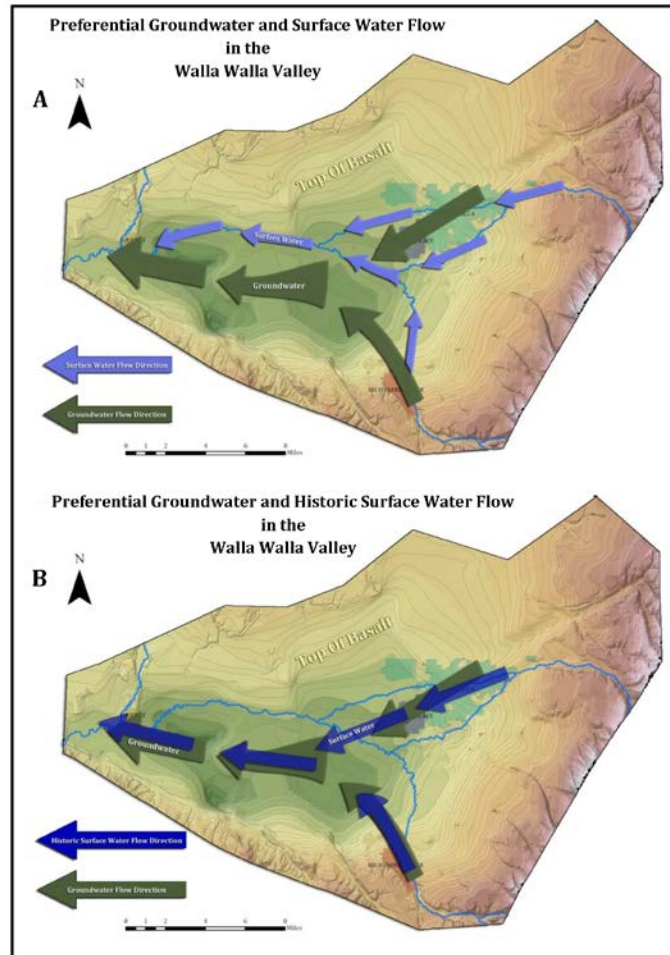
The Project Area contains two general aquifer types: a shallower, mostly unconfined alluvial aquifer that directly connects to surface water systems, and deeper, confined, basalt aquifers, with little or no direct connection to stream channels. The geology of the Mill Creek watershed comprises a layer of mixed fine- and coarse-grained alluvial sediments (or overburden) from prehistoric flood deposits above numerous fine-grained volcanic rock (basalt) layers (see Section 2.2, Geology and Soils). The overburden contains the alluvial aquifer and is generally thicker near the mouth of Mill Creek and its distributaries and becomes shallower and narrower towards the headwaters (Burns et al. 2011, USGS 2012).

2.5.5.1 Historic Aquifer Conditions

Groundwater flow in the Walla Walla Valley is assumed to follow flowpaths relative to the distribution of coarse sediments, and the predominant pattern is assumed to be relatively unchanged (Henry et al. 2013).

Surface flow has been altered from flood and alluvial deposits (in particular, Ice Age Missoula floods), resulting in an offset between modern-day stream flows, which follow topography, and groundwater flowpaths, which are inferred to follow the underlying geologic structure (Figure 2.5-24) (Henry et al. 2013).

The multiple basalt layers historically provided an abundance of artesian wells (i.e., wells that do not require a pump to bring water to the surface due to existing pressure in the aquifer) for this area of the Walla Walla subbasin (Molenaar 1961). In addition, the area had numerous springs and spring-fed channels. The distributary system at the mouth of Mill Creek provided numerous low-velocity channels for recharge of the alluvial aquifer (Patten 2015a) in the overburden and alluvial fan. The abundance of shallow wells and spring-fed channels are indicative of a historically high water table in the Mill Creek alluvial fan.



Source: Henry et al. (2013)

Figure 2.5-24. Groundwater Flow (Green) and Surface Water Flow (Blue) Post-Missoula (Ice Age) Floods (A) and Pre-Missoula Floods (B)

2.5.5.2 Current Aquifer Conditions

The Mill Creek watershed experienced some of the most intensive early groundwater development in the Walla Walla subbasin, and with new drilling technologies in the 1950s, the Walla Walla Valley experienced extensive expansion of groundwater resource development

(Vaccaro et al. 2015). Development of groundwater resources from the deeper basalt aquifer has continued and USGS recently indicated that this resource has been over-allocated (Ely et al. 2014).

While the basalt aquifer has been tapped extensively, the alluvial aquifer in the Project Area has not experienced the same level of groundwater withdrawals as in other parts of the Walla Walla subbasin (Henry et al. 2013). Elsewhere in the Walla Walla subbasin, extensive irrigation pumping of the alluvial aquifer for irrigation purposes contributed to parts of the mainstem Walla Walla River running dry during the summer (Patten 2015a). However, even within the Project Area, shallow wells, ditching, channel realignment, and diversions of springs and spring-fed channels have affected in-stream flow and groundwater distribution (Marti 2005).

The distributary network is still operating in both surface water and spring-fed channels, although flow regulation now determines how much surface water is allocated to each during certain times of the year, and various springs and spring fed channels have been modified and utilized for irrigation and other uses. The Walla Walla Basin Watershed Council (WWBWC) groundwater monitoring network within the Mill Creek drainage provides insight into the yearly and seasonal fluctuations of groundwater levels. Figure 2.5-25 shows the locations of the monitoring wells within the Project Area and immediately surrounding valley.

Figure 2.5-26 provides examples of well monitoring results from downstream and upstream near Mill Creek. Recent water levels range from approximately 6 to 14 feet below ground surface (bgs). Results from these wells demonstrate variation in the hydrologic connection to surface water. Well GW083, within the City of Walla Walla, shows seasonal water temperature fluctuation in opposing directions to groundwater levels, while well GW111 shows very little seasonal fluctuation in groundwater temperature even with the water level drawdown. Both wells appear to demonstrate consistent recharge and rebounding of groundwater levels annually; however, there is clear seasonal drawdown of the water table, which could affect stream flows and temperature during the summer months.

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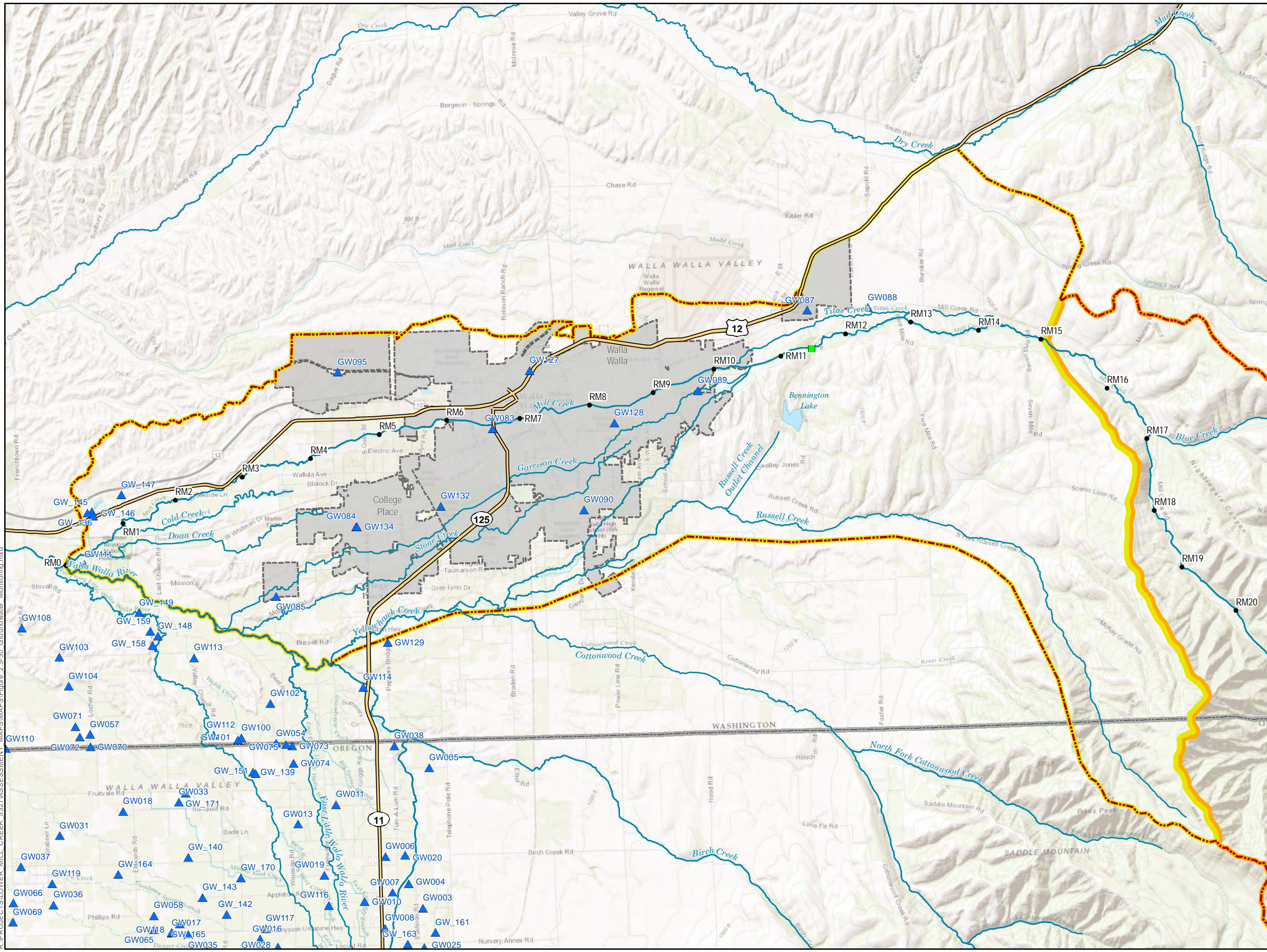
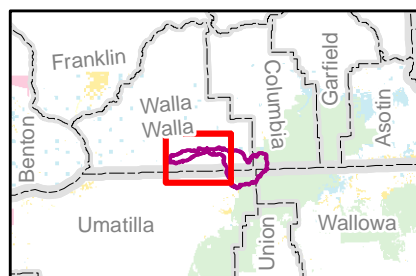
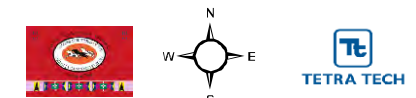
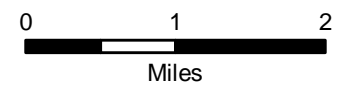
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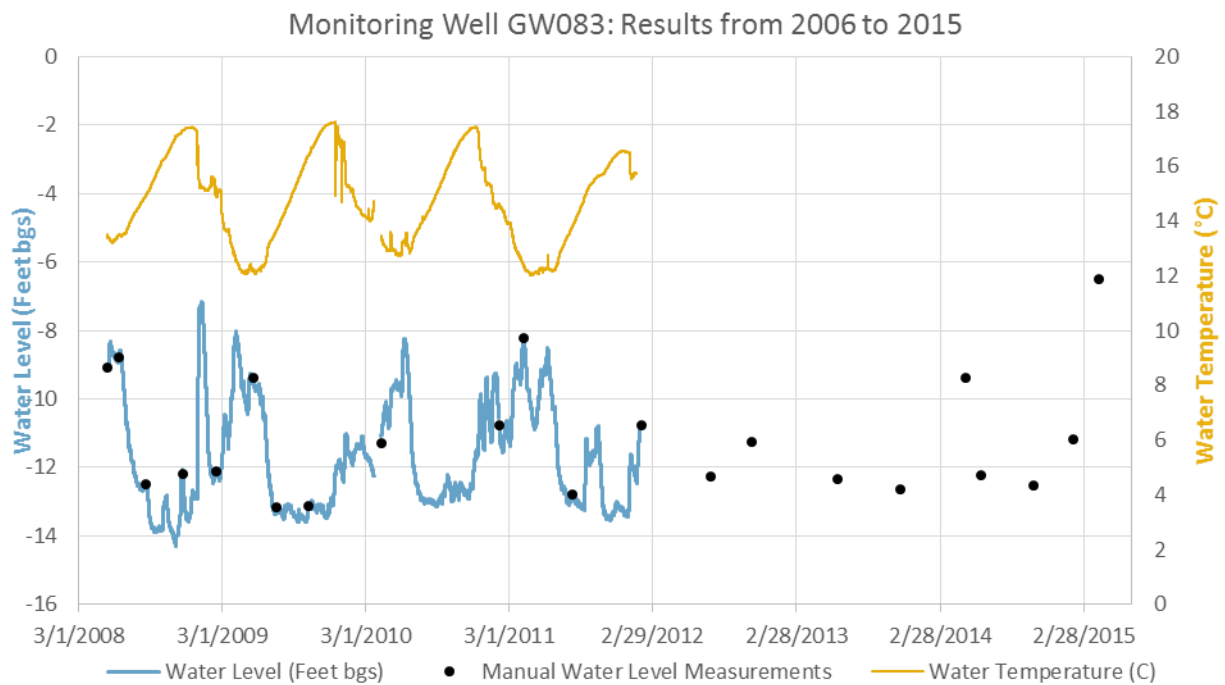
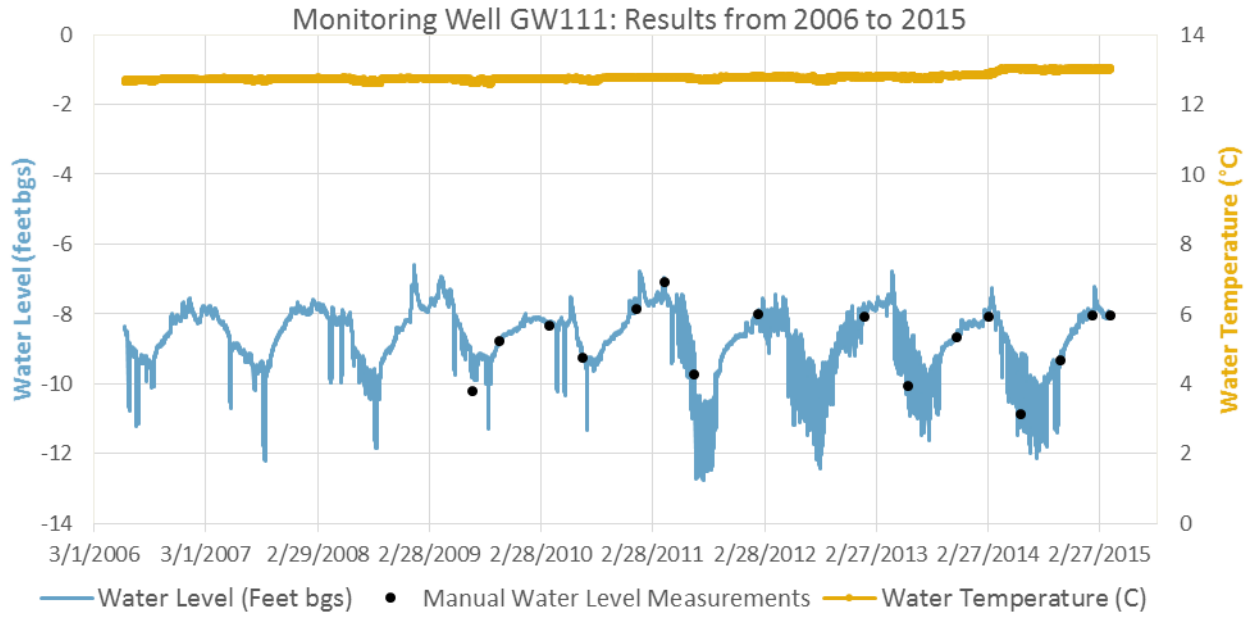
**FIGURE 2.5.-25
GROUNDWATER MONITORING**

- River Miles
- Bennington Diversion Dam
- ▲ Groundwater Monitoring Well
- Stream
- ▭ Waterbody
- ▭ Project Area
- ▭ Primary Focus Area
- ▭ Secondary Focus Area
- ▭ Cities

Sources: CTUIR, Walla Walla County, StreamNet



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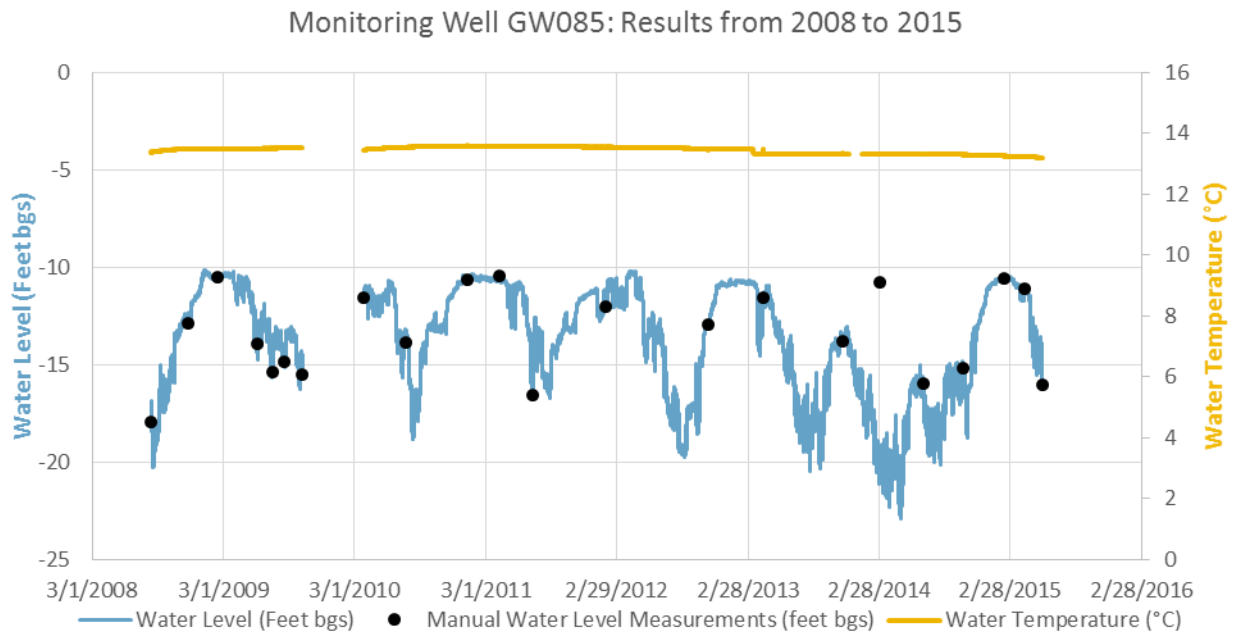
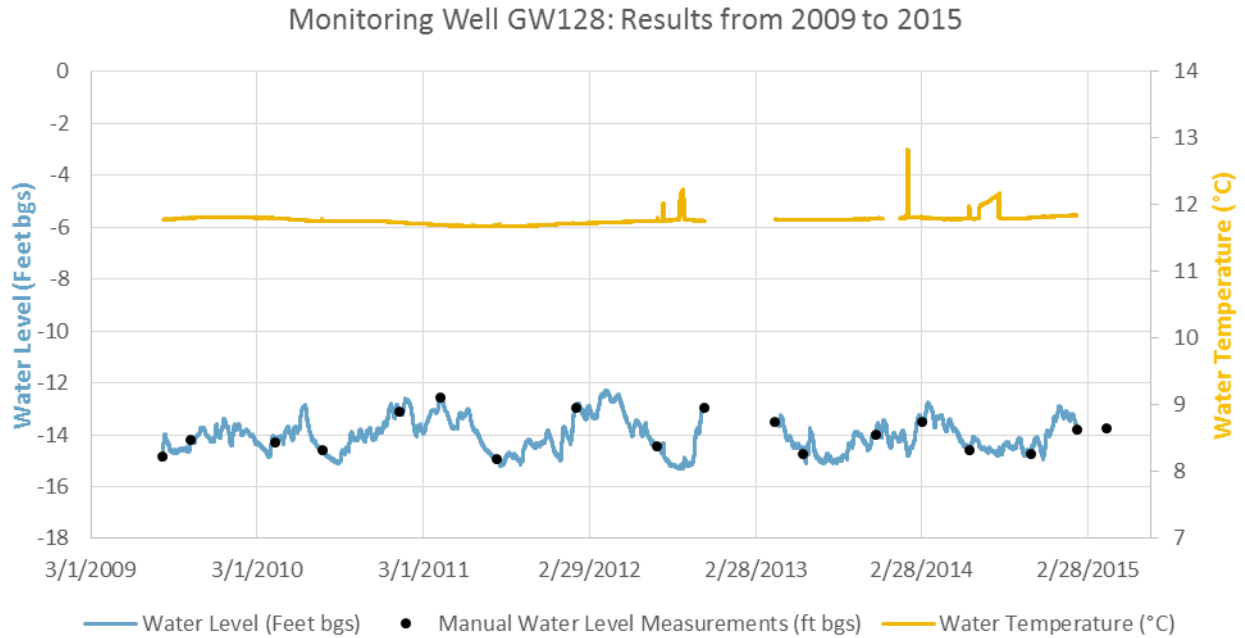


Source: WWBWC (2016)

Figure 2.5-26. Groundwater Levels and Water Temperature for Two Monitoring Wells in the Mill Creek Watershed along Mill Creek

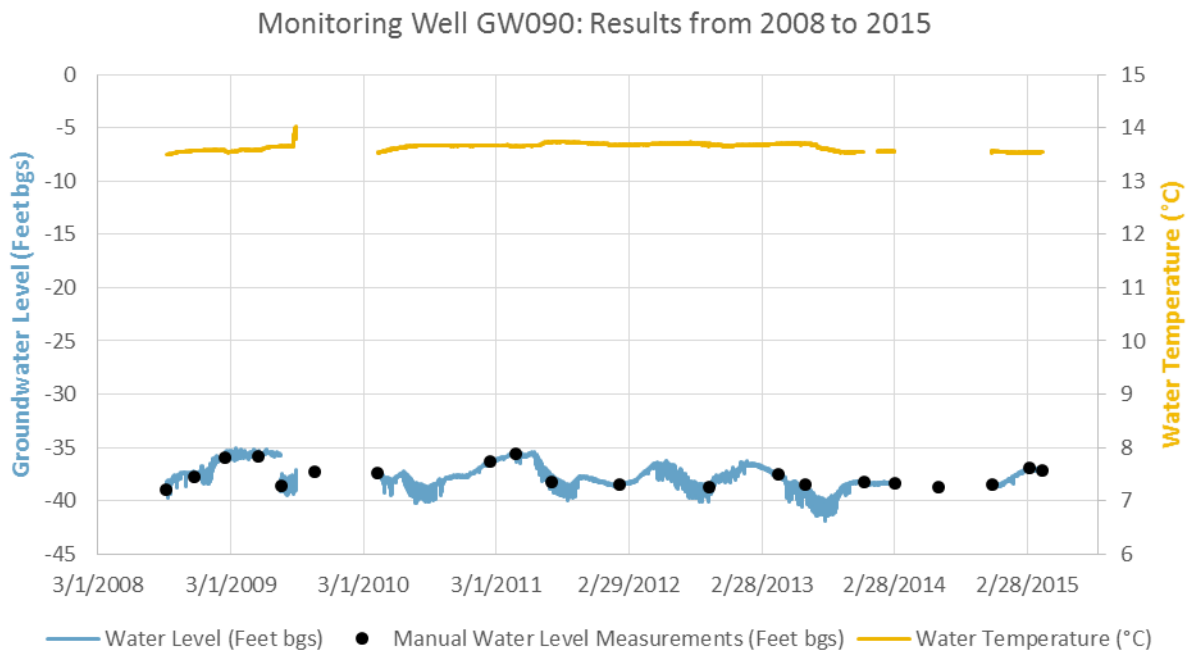
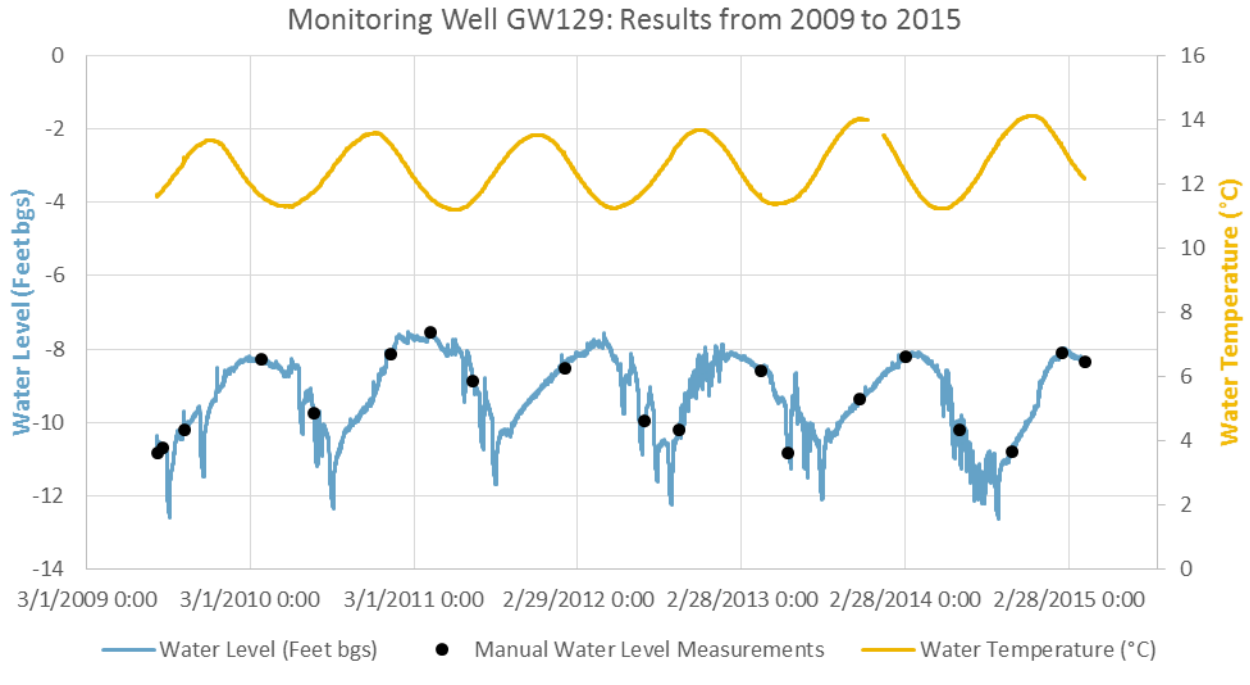
Water levels in the distributary system are also of interest as they help indicate existing subsurface flows and potential recharge opportunities (Figure 2.5-27). Yellowhawk Creek has been a focus of seepage studies (see Section 2.5.5.3) and, in addition to Mill Creek, is a key migration corridor for migrating salmonids (Figure 2.5-28).

As discussed above and in Section 2.4.8.2 (Water Rights) and Section 2.5.3.2 (Hydrology – Current), existing surface water diversions and groundwater wells reduce summer stream flows in lower Mill Creek well below minimum flow recommendations for fish passage and habitat. Demand for water continues to exceed the available supply, and development of new wells continues for both household and agricultural uses. The CTUIR is currently working collaboratively with basin partners address the over-appropriation of water to restore and protect adequate stream flows while trying to maintain current out-of-stream uses and values.



Source: WWBWC (2016)

Figure 2.5-27. Groundwater Levels and Water Temperature for Two Monitoring Wells in the Mill Creek Watershed along Garrison Creek



Source: WWBWC (2016)

Figure 2.5-28. Groundwater Monitoring Wells along Yellowhawk Creek

Springs

As discussed above, an alluvial fan distributary system has multiple spring fed channels and over time Mill Creek’s springs have been impacted by surface development and aquifer withdraws. Documentation on the location and amount of discharge from existing springs locations is limited. Golder and Associates, in a ground water flow model for the City of Walla Walla (City of Walla Walla 2007), incorporated six springs as drain nodes in the MODFLOW groundwater model. The location of each spring node is identified by Township, Range and Section number. The magnitude of flow is from observations by Golder and others and elevation associated with the each node is from USGS mapping (City of Walla Walla 2007). Table 2.5-9 reconstructs the information found in the Golder 2007 report (City of Walla Walla 2007). Also, see Section 2.8.6 Refugia for a discussion on Spring Creeks in and around the City of Walla Walla.

Table 2.5-9. Springs Represented in the Golder and Associates 2007 MODFLOW groundwater model (City of Walla Walla 2007)

Spring Name	Location ^{1/}	Elevation ⁴ (feet msl)	Observed Flow Rate ² (gpm)	Observed Flow Rate ³ (gpm)
Hospital Spring	T7N/R36E-20	970	No data	No data
Pioneer Park Springs	T7N/R36E-21	1,000	500	170
Stone Creek Springs (north branch)	T7N/R36E-28	1,005	225	170-450
Stone Creek Springs (south branch)	T7N/R36E-28	1,005	60	170-450
Veteran’s Hospital Spring	T7N/R36E-30	865	420	No data
Shelton’ Springs	T7N/R36E-34	1,005	200	No data

Notes:

1/ T=Township, R = Range, -30 = Section 30

2/ Data from Table 4, *Newcomb, R.C. 1961 Storage of Ground Water Behind Subsurface dam in the Columbia River Basalt, Washington, Oregon and Idaho, U.S. geological Survey Professional page 383-A*

3/ Measurements by Golder 2006

4/ Elevations estimate from USGS Walla Walla, WA 7.5 minute map

The groundwater levels in the Mill Creek alluvial aquifer are relatively close to the ground surface within the primary focus area, as can be seen in Figure 2.5-29. Depth to water throughout much of the City of Walla Walla and along Mill Creek, in Segments 1 through 3, is between 0 and 10 feet bgs. Groundwater levels are deeper between the distributaries of Stone Creek and Cold Creek, ranging from 0 to 175 feet bgs, largely due to topography (see Figure 2.5-29).

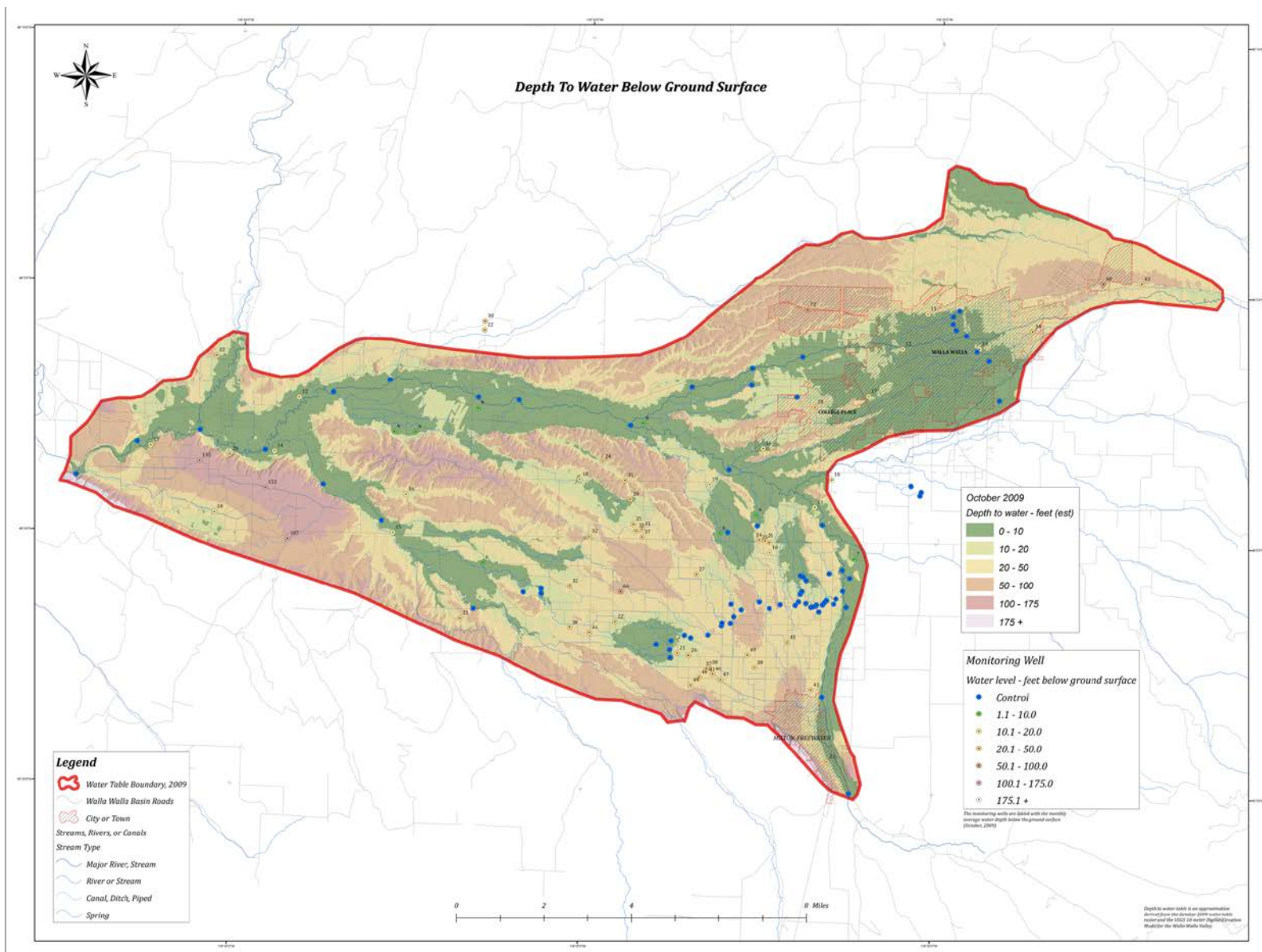


Figure 2.5-29. Existing Water Table Elevations in the Primary Focus Area (WWBWC 2010b)

2.5.5.3 Floodplain Storage and Hydrologic Connectivity

Recharge of the alluvial aquifer happens through precipitation, irrigation, hyporheic connection to the stream channel, and flooding. In an intact river system, the floodplain acts as an extension of the alluvial aquifer, attenuating stream flows as flood waters disperse onto the floodplain and discharging stored water during drier months. This connectivity supports basic floodplain and stream channel functions that regulate stream flows, temperature, and water quality. From a fisheries management perspective, groundwater input into streams provides cool water areas for fish rearing (Baker 2014). Floodplain water storage has also been shown to attenuate flows in river channels (Acreman et al. 2003).

Channel straightening and lining, as has been done in the flood control reach of Mill Creek, significantly reduces the groundwater exchange and effectively eliminates floodplain interaction. Seepage studies (evaluating water budgets and locations and amounts of water in gaining and losing reaches) have been conducted throughout the Walla Walla subbasin for over 100 years. These studies inform groundwater-surface water relationships, temperature changes, fish movement, spatial flow, and water distribution throughout the area.

The 2014 seepage study for Mill Creek identifies gaining and losing reaches, which indicate aquifer recharge areas (i.e., “losing reach”) and areas where groundwater is likely to be added to stream flow (i.e., “gaining reach”) (Baker 2014). Figure 2.5-30 depicts the August 2014 gaining and losing reaches along Mill Creek as well as the July 2013 gaining and losing reaches along Yellowhawk Creek (Baker 2014 and 2013). The results indicate gaining reach conditions directly upstream and downstream of the flood-control channel, bordered by losing reaches. The flood-control channel is essentially zero, due to the channel being lined and armored.

Seepage studies in Yellowhawk Creek identify substantial losing reaches in the upper half of the creek within Walla Walla city limits, as shown in Figure 2.5-30. This result is supported by reviewing data from monitoring wells near the losing reach portions of the creek, which show water levels between 25 and 40 feet bgs (WWBWC 2015, well GW089). These levels are lower than seen elsewhere in the aquifer, especially for being adjacent to a stream, and result in water levels being below the level that would be required for the aquifer to contribute groundwater into the stream. The reach just after the losing reaches at the southern edge of the city, by contrast, consistently has the highest gaining rates across monitoring years and seasons, being influenced by seepage from Russell and Cottonwood creeks, as well as a network of springs just upstream (Figure 2.5-30) (Baker 2013).

2.5.5.4 Current and Planned Management Actions

Many organizations have worked together within the Walla Walla subbasin to increase low summer flows and improve summer aquifer levels. Management actions, such as limiting new well permits and providing incentive programs for water conservation, have helped to increase the available water in the aquifers of the Walla Walla subbasin. Piping projects increase irrigation efficiency, reducing the amount of water that needs to be withdrawn from sources, but they also reduce the aquifer recharge rate across the landscape through unlined irrigation ditches (see Section 3 for additional discussion).

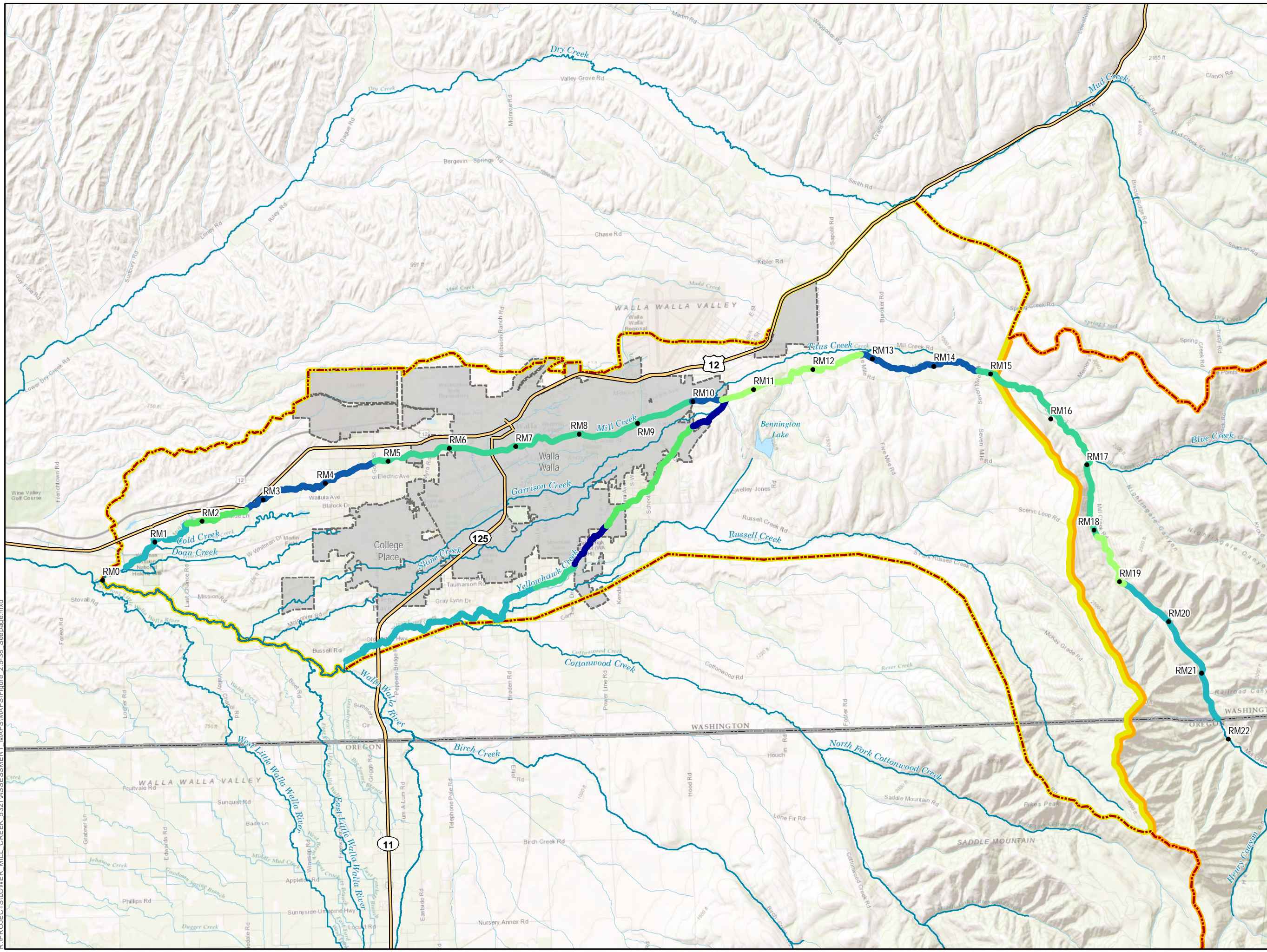
Direct aquifer recharge programs have been active in the Mill Creek watershed for over a decade. Both alluvial and basalt aquifer recharge actions are currently being undertaken.

While the basalt aquifer has limited connection to the streams, depletion of this resource is a concern. Water levels within the basalt aquifers have declined through much of the Columbia Basin (Burns et al. 2012). The City of Walla Walla has been utilizing the basalt aquifer as an aquifer storage and recovery facility since 1999 (City of Walla Walla 2015a, Ecology 2009). ASR is a method of aquifer recharge designed to allow recovery of a large portion of the water placed within a relatively hydrologically isolated geological unit. The City of Walla Walla uses the project to supplement water withdrawals from the Mill Creek diversion when flows are low or water quality is not within suitable parameters (Banton and Klisch 2007, City of Walla Walla 2015a). This project involves using surface water from the City's diversion supply and injecting it into wells within the Basalt aquifer. Faulting within the aquifer provides compartments that allow for recovery of the water at a later date (City of Walla Walla 2015a).

LOWER MILL CREEK HABITAT AND PASSAGE ASSESSMENT

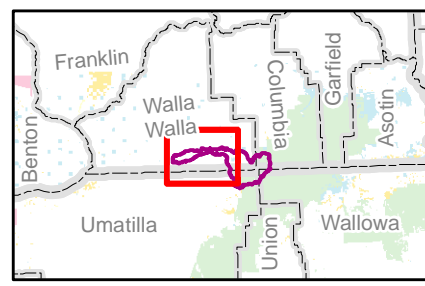
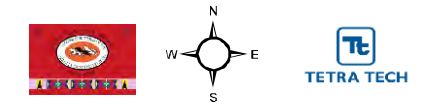
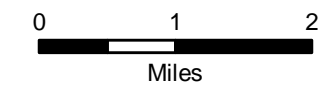
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**FIGURE 2.5-30
SEEPAGE ASSESSMENT AREAS**



- River Miles
- Major Stream
- Minor Stream
- Rate Per Mile (Gain/Loss) cfs
 - -3.09 - -2.00
 - -1.99 - -1.00
 - -0.99 - 0.00
 - 0.01 - 1.00
 - 1.01 - 1.50
 - 1.51 - 4.00
- Waterbody
- Project Area
- Primary Focus Area
- Secondary Focus Area
- Cities

Sources: CTUIR, Walla Walla County, StreamNet



Managed Aquifer Recharge (MAR) or Shallow Aquifer Recharge projects have been developed to improve water levels in the alluvial aquifer during low-flow periods. These projects include manmade infiltration basins, field flooding, infiltration galleries, and injection wells. There are currently 12 WWBWC-monitored MAR sites in the Walla Walla basin, one of which, Stiller Pond, is located near the mouth of Mill Creek away from the creek. Water for recharge activities at Stiller Pond is delivered by pipe from a private diversion downstream of Wallula Road (Patten 2015a). Recharge is authorized to occur between December 1 and May 31; however, it requires minimum instream flow to be met at two gages on Mill Creek and at the Ecology Walla Walla River gauging station at Detour Road (WWWMP 2011, Patten 2015a). According to the Washington Walla Walla Basin Aquifer Recharge Report (Patten 2015a), approximately 300 acre feet of water was recharged at Stiller Pond from October 1, 2013 to September 30, 2014 and approximately 214 acre feet of water was recharged from October 1, 2014 to September 30, 2015. Water quality monitoring results for 2015 (Patten 2015a) are provided in Table 2.6-3. Additional MAR sites include Stone and Yellowhawk creeks (Henry et al. 2013).

The *Walla Walla Basin Aquifer Recharge Strategic Plan* (Henry et al. 2013) also mentions development of Stone and Yellowhawk creek MAR sites. The Stone Creek site is a passive recharge site that does not require water rights but acts as floodplain enhancement, allowing water to flow into a shallow floodplain pool during high water events (Henry et al. 2013, WWCCD 2012) and the alluvial aquifer is recharged through the natural processes of seepage from temporary ponding during higher flow events. The Stone Creek project utilizes these functions on a small scale and allows for beneficial storage activities in the Mill Creek floodplain, where more active recharge methods of the alluvial aquifer, such as increasing the levels in Bennington Lake, have resulted in unwanted groundwater upwellings (Henry et al. 2013).

Most of the spring-fed channels still provide flow throughout the year, and restoration actions are proposed or ongoing on many of these systems (Johnson 2009, SRSRB 2014, Walla Walla County 2015c, HWS 2016). Protecting and enhancing these resources, in conjunction with habitat enhancement strategies, has the potential to improve floodplain storage as well as stream flow and habitat conditions.

2.6 WATER QUALITY

2.6.1 Surface Water Quality

2.6.1.1 Historical Conditions

Prior to the urbanization of Walla Walla and the construction of the MCFCP in 1948, Mill Creek likely had high water quality from the headwaters to the mouth. However, since the human modification to the channel and stream flow in lower Mill Creek, water quality conditions have degraded.

2.6.1.2 Current Conditions

Mill Creek's water quality conditions range from near pristine near the headwaters, due to the public access restrictions designed to protect the City of Walla Walla's municipal water supply, to highly degraded water quality below the USACE Division Works Dam, through the City of Walla Walla, to the mouth. The degraded water quality largely results from agricultural run-off and point-source pollution, water withdrawals, and highly modified channels and riparian areas due to urban development. Although Yellowhawk and Garrison creeks tend to have higher minimum flows during the low-flow months, these creeks also have water quality concerns.

Under Section 303(d) of the federal Clean Water Act of 1977, states must periodically prepare a list of all surface waterbodies that do not meet federal water quality standards and must conduct an analysis of the extent of the problem. Because the Walla Walla subbasin is within both Oregon and Washington, both Ecology and the ODEQ maintain 303(d) listings that include Mill Creek, and both agencies have developed TMDLs for Mill Creek and its distributaries. TMDLs are water cleanup plans that specify how much pollution needs to be reduced or eliminated in order to achieve water quality standards.

TMDLs in Mill Creek

Portions of Mill Creek are listed on Washington State's Water Quality Assessment and 303(d) list of impaired waterbodies for the following pollutants: ammonia-nitrogen (ammonia-n), chlorine, dissolved oxygen, pH, fecal coliform, and temperature (Ecology 2012a). These pollutants can affect the health of fish and quality of fish habitat. The portion of Mill Creek located within the state of Oregon is included on the ODEQ 303(d) for temperature. Table 2.6-1 lists the TMDLs and information associated with each in Washington.

Table 2.6-1. State of Washington TMDLs for Mill Creek, Yellowhawk Creek, and Garrison Creek

Waterbody	Parameter Name	Year TMDL Approved	River Mile (RM) on 303(d) List	Criterion
Mill Creek	Ammonia-n	1993	RM 6.4 to 0	October to April loading capacity controls resulting in concentrations below 16 micrograms per liter as nitrogen ($\mu\text{g/L-N}$). Wasteload allocation (WLA) of 0 pounds of ammonia-n per day was set for the period of May through November. (EPA 1993). ^{1/}
Mill Creek	Chlorine	1997	RM 6.4 to 0	0.011 milligram per liter (mg/L) residual chlorine (EPA 1997) ^{2/}
Garrison Creek	Chlorine	1997	RM 2.9 to 0	Acute exposure: 0.19 mg/L Chronic exposure: 0.011 mg/L (White et al. 1998)
Mill Creek	PCB	2006	N/A	Washington state water quality criteria for protection of aquatic life: 2,000 nanograms per liter (ng/L) (acute), 14 ng/L (chronic) For protection of human health: Water and fish consumption: 0.17 ng/L; parts per trillion (Gray et al. 2006) Waste load allocation for WWTP: 0.0062 gram (gm)/day Load allocation for nonpoint: 0.023 gm/day Loading capacity: 0.029 gm/day
Garrison Creek	PCB	2006	N/A	Washington state water quality criteria for protection of aquatic life: 2,000 ng/L (acute), 14 ng/L (chronic) For protection of human health: Water and fish consumption: 0.17 ng/L; parts per trillion (Gray et al. 2006) Waste load allocation for WWTP: 0.0011 gm/day Load allocation for nonpoint: 0.0017 gm/day Loading capacity: 0.0028 gm/day
Yellowhawk Creek	PCB	2006	N/A	Washington state water quality criteria for protection of aquatic life: 2,000 ng/L (acute), 14 ng/L (chronic) For protection of human health: Water and fish consumption: 0.17 ng/L; parts per trillion (Gray et al. 2006) Load allocation for nonpoint: 0.010 gm/day Loading capacity: 0.010 gm/day
Garrison Creek	4,4'-DDT	2006	RM 2.9 to 0.7	Criteria for water and fish consumption: 0.59 ng/L; parts per trillion (Gray et al. 2006)
Garrison Creek	4,4'-DDD	2006	RM 2.9 to 0.7	Criteria for water and fish consumption: 0.83 ng/L; parts per trillion (Gray et al. 2006)
Garrison Creek	4,4'-DDE	2006	RM 2.9 to 0.7	Criteria for water and fish consumption: 0.59 ng/L; parts per trillion (Gray et al. 2006)
Garrison Creek	Hexachlorobenzene	2006	RM 2.9 to 0.7	Criteria for water and fish consumption: 0.75 ng/L; parts per trillion (Gray et al. 2006)
Garrison Creek	Dissolved Oxygen	2007	RM 2.9 to 0.7	Ecology (2007b)

Table 2.6-1. State of Washington TMDLs for Mill Creek, Yellowhawk Creek, and Garrison Creek (continued)

Waterbody	Parameter Name	Year TMDL Approved	RM on 303(d) List	Criterion
Mill Creek	Dissolved Oxygen	2007	RM 0.5, 11.5, 12.8, 21.1	Depends on water quality classification. RM 0 to 6.4 minimum 5.0 mg/L RM 6.4 to 11.5 minimum 8.0 mg/L RM 11.5 to 21.6 minimum 9.5 mg/L and no waste discharge is permitted (Ecology 2007b)
Mill Creek	pH	2007	RM 0.5, 4.8, 6.7, 11.5	Minimum 6.5 units Maximum 8.5 units Human-caused variation 0.5 units ^{3/} (Ecology 2007b)
Garrison Creek	pH	2007		Minimum 6.5 units Maximum 8.5 units Human caused variation 0.5 units ^{3/} (Ecology 2007b)
Yellowhawk Creek	pH	2007		Minimum 6.5 units Maximum 8.5 units Human caused variation 0.5 units ^{3/} (Ecology 2007b)
Mill Creek	Fecal Coliform	2007	RM 0, 2.8, 4.8, 6.7 to 8.5	RM 6.4 to 25.2 (primary contact recreation use) not more than 10% of samples shall exceed 200 colony forming units (cfu)/100 milliliter (mL) RM 0 to 6.4 (secondary contact recreation use) not more than 10% of samples shall exceed 400 cfu/100 mL (Ecology 2014b)
Garrison Creek	Fecal Coliform	2006	RM 0 to 2.9	Primary Contact Criteria: not more than 10% of samples exceeding 200 cfu/100mL (Joy et al. 2006) In 2003, 40% of samples exceeded 200 cfu/200 mL (Ecology 2008).
Yellowhawk Creek	Fecal Coliform	2006	RM 8.2 to 6.3, RM 0.3 to 0	Primary Contact Criteria: not more than 10% of samples exceeding 200 cfu/100 mL (Joy et al. 2006) Greater than 25% and 62% of the samples exceeded the percentile criterion
Mill Creek and Tributaries	Temperature (Washington 303(d) listing)	2007	Entire length	Temperature standard not to exceed 16 °C for Class AA waters; 18 °C for Class A waters; 21 °C for Class B waters (Ecology 2002a) ^{4/}
Mill Creek	Temperature (Oregon 303(d) listing)	1998	RM 22.9 to 26	Bull Trout: summer maximum of 10.0 °C (50 °F) (ODEQ 2005)

1/ No WLA was set for ammonia-n during the period of discharge from the City's Wastewater Treatment Plant (WWTP). The WWTP discharges to Mill Creek from December 1 through April 30, and the WWTP effluent is available for irrigation use from April 15 through December 15 (Ecology 2002a).

2/ To address the residual chlorine issue, the Walla Walla WWTP plant installed ultraviolet disinfection equipment in 2005 and chlorine is only used for disinfection on an as needed basis (Ecology 2015b).

3/ Allowed when pH is between 6.5 and 8.5 units for Class A and B waters. Mill Creek RM 0 to 6.4 is a Class B water and RM 6.4 to 11.5 is a Class A water.

4/ Mill Creek RM 0 to 6.4 is a Class B water; RM 6.4 to 11.5 is a Class A water; RM 11.5 to 21.6 is Class AA water; Tributaries are all Class A waters

Sources of pollution to Mill Creek include residential, agricultural, stormwater, and wastewater. Polychlorinated biphenyl (PCB) concentrations have been evaluated as a result of prior effluent testing using the TMDL criteria developed in 2005. Ecology completed a study of PCB concentrations of the Walla Walla and College Place sewer networks and found effluent concentrations almost meeting EPA human health criteria with mean effluent values of 0.38 nanogram per liter (ng/L) and 0.30 ng/L for the Walla Walla and College Place WWTPs, respectively (Lubliner 2007). Low flows in the summer months resulting from diversions for municipal and agricultural uses can increase the concentration of pollutants as well as exacerbate high already high temperatures from lack of riparian vegetation and shading (Ecology 2002a).

Ecology issued a Water Quality Implementation Plan (WQIP) for all the TMDLs in the Walla Walla subbasin in 2008. The WQIP describes and prioritizes specific actions planned to improve water quality and outlines performance measures and targets for meeting allocations identified in the TMDLs. These performance measures and targets are evaluated through effectiveness monitoring which is conducted through technical studies described by Quality Assurance Project Plan that are developed for each TMDL. The Walla Walla Watershed Planning Unit's Water Quality Subcommittee prioritizes restoration projects in stream reaches that do not meet several water quality standards and have severe problems (such as highly erodible land). Stream reaches that only have one water quality problem are secondary restoration zones. The stretch of Mill Creek from RM 0 to 11 is considered a secondary restoration reach because the restoration challenges are so complex and unique that the solutions will probably be unlike any others in the watershed (Ecology 2014b).

Recommended Temperature Water Quality Standards

In addition to the statewide TMDL temperature standards listed in Table 2.6-1, EPA Region 10 issued guidance for states to set temperature water quality standards to protect cold water salmonids. EPA (2003) recommends a maximum seven day average of the daily maximum during the summer months of 12°C for bull trout juvenile rearing, 16°C for salmon³/trout⁴ "core"⁵ juvenile rearing, 18°C salmon/trout migration plus "non-core" juvenile rearing, 20°C salmon/trout migration (plus a provision to protect and, where feasible, restore the natural

³ Includes Chinook, Chum, Sockeye, Pink, and Chum salmon.

⁴ Includes Steelhead and coastal cutthroat trout.

⁵ Refers to areas where moderate to high density summertime salmon and trout juvenile rearing occurs.

thermal regime). The SRSRB Southeast Washington Recovery Plan (SRSRB 2011) lists a habitat restoration objective to achieve a condition in Mill Creek where water temperature does not rise above 22°C for more than four days per month.

These temperature standards reflect current scientific consensus for temperature maximums for the focal species, with preferred temperatures lower than the higher temperatures the fish are able to survive. Bell (1986) noted that preferred temperatures for Chinook migration and holding range from 7.2-14.5 °C; see Carter (2005) for a comprehensive literature review of the impacts of temperature on steelhead, coho, and Chinook lifestages.

Surface Water Quality Monitoring

Numerous water quality studies have been conducted throughout the Mill Creek watershed. Water quality monitoring has been conducted at the watershed scale, in smaller studies, and as part of the wastewater and stormwater monitoring and planning required by the Clean Water Act.

Watershed Monitoring

Water quality monitoring in the Walla Walla subbasin has been conducted by a number of groups over the years including the USACE, CTUIR, EPA, ODEQ, and Ecology. Ecology maintains a comprehensive database of environmental monitoring data in Washington, referred to as the Environmental Information Management (EIM) database. The EIM contains water quality monitoring data and analyses prepared by Ecology and also submitted by affiliated monitoring agencies (Ecology 2015c).

Ecology and its predecessor agency have operated the Statewide River and Stream Ambient Monitoring Program since 1959 (Ecology 2014c). This program has conducted long-term monthly monitoring of water quality at stations throughout Washington State. There is one long-term monitoring station on the Walla Walla River near Touchet (station number 32A070). The program has also included water quality monitoring at 12 additional sites in the Walla Walla subbasin including locations on the Walla Walla River, Touchet River, and Mill Creek for shorter time periods in support of the Clean Water Act (303(d)) listings. The data and reports for this station are available for download through the EIM database under study IDs AMS001, AMS001-2, AMS001B, AMS001C, AMS001D, and AMS001E.

In 2007, Ecology began a statewide trend monitoring program for persistent, bioaccumulative, and toxic chemicals in fish and surface water as a component of the Washington State Toxics Monitoring Program (Ecology 2012b). The purpose of the monitoring was to determine changes

in levels of chlorinated pesticides, PCBs, polycyclic aromatic hydrocarbons, and polybrominated diphenyl ethers. There is one site on the Walla Walla River located 5 miles east of Wallula Junction (ID SPMDTR-WALLA) included in this program that was monitored from 2007 to 2011. The data and reports from this location are available for download through the EIM database under study ID SPMDTR07 through SPMDTR11.

Ecology's Watershed Health Monitoring project has been collecting statewide water quality and habitat data, by region, since 2009. This project was formerly known as the Status and Trends Monitoring for Watershed Health and Salmon Recovery. The sample sites for this project were randomly selected from a list of potential sites to ensure unbiased surveys and statistical analysis at the statewide-, region-, or watershed-scale (Ecology 2006). The initial data collection for sites in the Walla Walla subbasin occurred in 2011 and the next survey is scheduled for 2016. The 2011 sampling effort included 23 sites throughout the subbasin, including a site on Reser Creek, and 2 sites on Yellowhawk Creek. Half of the sites were planned to be revisited in 2016 (Ecology 2016b). The data and reports from this location are available for download through the EIM database under study ID WHM_WAM0.

A basin-specific water quality monitoring plan has also been developed by Ecology for the Walla Walla subbasin associated with the TMDL. The *Walla Walla Watershed Bacteria, pH, and Dissolved Oxygen TMDL Effectiveness Monitoring Plan* (Ecology 2014b) is intended to evaluate whether TMDL project goals are being met. The purpose of the monitoring is to collect data on the effectiveness of implementation actions associated with TMDL recommendations. Field data collection for the monitoring study began in 2013 at 33 locations throughout the Walla Walla subbasin including Garrison Creek, Yellowhawk Creek, Russell Creek, Cottonwood Creek, and three sites on Mill Creek. The data and reports for these locations are available for download through the EIM database under study ID JROS0025.

A water temperature monitoring network has been established on streams flowing through the urban areas of Walla Walla and College Place through the Creating Urban Riparian Buffers (CURB) program. Beginning in 2013, water temperatures have been monitored at a total of 14 sites including locations on Butcher, Yellowhawk, Titus, Stone, Lincoln, Lassiter, Garrison, Doan, and Caldwell creeks. This program is funded by Ecology and implemented collaboratively by a number of organizations including the Tri-State Steelheaders, Kooskooskie Commons, and the WWCCD (WWBWC 2014). Specific locations and monitoring data for this project are available through the WWBWC. WDFW has also collected seasonal water temperatures at various sites within the Primary Focus Area over several years and has

provided the data to the CTUIR. However, this data would require additional processing and interpretation to be meaningfully reported in this Assessment.

Walla Walla Community College Monitoring

Walla Walla Community College and UNIBEST International LLC conducted a water quality study in 2013 and 2014 that included data monitoring for nitrogen and phosphorus at nine sites on Mill Creek, two sites on Titus Creek, and two sites on Yellowhawk Creek. Results show high nutrient change from Sites #7 to #9 in Mill Creek (where Mill Creek enters the USACE flood control channel).

According to the study, “out of the areas monitored in the Mill Creek watershed, the land adjacent to Sites #7 through #9 introduce the largest amounts of nitrogen” (WWCC 2014).

Wastewater and Stormwater

The federal Clean Water Act requires municipalities to obtain a National Pollutant Discharge Elimination System (NPDES) permit prior to discharging wastewater or stormwater into a water of the U.S. directly from a point source (e.g., a pipe, ditch, or channel). All permits take into account the TMDLs set for the receiving waters to ensure they meet their water quality standards.

In the Mill Creek watershed, point source discharges of wastewater come from the WWTPs for the Cities of Walla Walla and College Place. WWTPs typically obtain NPDES Individual Permits as these permits are written to address specific design and applicable water quality standards for an individual facility. Table 2.6-2 lists the NPDES Individual Permits issued to these two entities.

Table 2.6-2. NPDES Permits Issued to Municipalities within Mill Creek Watershed

Entity	Discharge to	Type of Permit	Permit Number	Permit Expiration
City of College Place	Garrison Creek ^{1/}	NPDES Individual Permit for WWTP	WA0020656	9/30/2016
City of Walla Walla	Mill Creek	NPDES Individual Permit for WWTP	WA0024627	6/30/2017
City of Walla Walla	Varies	Phase II Stormwater	WAR04-6508	7/31/2019
Walla Walla County ^{2/}	Varies	Phase II Stormwater	WAR04-6509	7/31/2019
Washington Dept. of Transportation	Varies	Phase II Stormwater	WAR04-3000	3/05/2019

1/ The City of College Place WWTP discharges into a wetland connected to Garrison Creek from May through October and is discharged directly to Garrison Creek November through April (Ecology 2002b).

2/ City of College Place is covered by WAR04-6509

Washington municipalities and the Washington State Department of Transportation (WSDOT) are required by the Clean Water Act to develop stormwater standards (i.e., Stormwater Management Plans) for mitigating and managing the impacts of stormwater runoff into surface waters of Washington State. Both the City of Walla Walla and Walla Walla County have Stormwater Management Plans. The purpose of these plans is to establish a strategy for reducing discharge of stormwater pollutants into surface waters from municipal storm drains.

To guide cities and counties in creating stormwater standards, Ecology created the Eastern Washington Phase II Municipal Stormwater Permit (Phase II Permit, effective February 16, 2007) under delegated authority by the EPA. Cities and counties as well as WSDOT are required to obtain NPDES permits under the Phase II Permit. Table 2.6-2 lists the current Phase II Permits issued in the Mill Creek watershed.

The City of College Place WWTP discharges into a wetland connected to Garrison Creek from May through October and is discharged directly to Garrison Creek from November through April (Ecology 2002b).

The City of Walla Walla's 2014 Phase II permit includes a comprehensive plan for reducing discharge of stormwater pollutants that includes on-site retention of stormwater, low impact development, and monitoring. The 2014 Phase II permit requires compliance with TMDLs. The City of Walla Walla is currently implementing the following actions as identified in the *Walla Walla Watershed PCBs, Chlorinated Pesticides, Fecal Coliform, Temperature, pH & Dissolved Oxygen Total Maximum Daily Load Water Quality Implementation Plan* (Ecology 2008): residential and arterial street sweeping; publishing articles, bill inserts, or TV spots regarding water quality; placement of no dumping placards on stormdrain inlets; and other measures (City of Walla Walla 2015a).

2.6.2 Groundwater Quality

Water quality in the alluvial aquifer is considered to be good (Henry et al. 2013). Monitoring has shown that water quality at aquifer recharge sites is also good and that the aquifer recharge water appears to dilute concentrations of contaminants within the alluvial aquifer systems (Henry et al. 2013). This research also indicated that alluvial aquifer water is geochemically very similar to the surface water, indicating a high degree of connectivity (Henry et al. 2013). As described in Section 2.5.5.4, MAR projects have been developed to improve water levels in the alluvial aquifer during low-flow periods. The Stiller Pond MAR site, located near the mouth of Mill Creek, is authorized to be recharged by Mill Creek surface flows December 1 through May 31 (WWWMP 2011). Water quality monitoring results at the Stiller Pond MAR site for 2014 and 2015 (Patten 2015a) are provided in Table 2.6-3.

Table 2.6-3. Water Quality Parameters for Managed Aquifer Recharge (MAR) at the Stiller Pond Site in the Lower Mill Creek

Location (source)	Date ^{1/}	Nitrate	Calcium (mg/L)	TDS (mg/L)	Chloride (mg/L)	PCBs (pg/L)
Mill Creek Surface Water for Recharge	2/26/2014	0.44	7	95	2.88	56.5
	3/25/2014	0.9	8.6	84	2.9	78.2
	6/5/2014	1.12	13.5	113	7.28	139
	12/11/2014	1.08	8.3	99	4.57	73.2
	3/2/2015	1.22	10.6	100	5.09	14.1
Up-gradient well (GW_147)	5/18/2015	1.07	12.8	115	6.5	106
	2/25/2014	6	44.2	315	32	634
	3/25/2014	5.94	45.1	300	32	703
	6/5/2014	5.5	43.7	293	30	1050
	12/11/2014	5.22	38.9	292	28	692
Mid-gradient well (GW_136)	3/2/2015	4.44	39.8	286	26	938
	5/18/2015	4.28	36.1	279	25.4	985
	2/25/2014	13	66.4	460	40	674
	3/25/2014	3.34	49.2	270	15	734
	6/5/2014	0.48	39.7	211	4.29	1050
Down-gradient well (GW_145)	12/11/2014	6.86	52.1	361	27	839
	3/2/2015	0.59	33.7	178	2.95	845
	5/18/2015	1.1	34.7	217	7.2	848
	2/25/2014	10	61.8	394	36	734
	3/25/2014	11.63	62.5	416	39	817
Down-gradient well (GW_146)	6/5/2014	6.77	56.7	372	28	1210
	12/11/2014	4.54	45.6	338	23	693
	3/2/2015	3.05	48.4	329	20	1190
	5/18/2015	2.98	51.1	378	29.4	938
	2/25/2014	18	70.5	560	47	858
Down-gradient well (GW_146)	3/25/2014	16.71	70.1	510	47	1100
	6/5/2014	10	57.8	456	34	1430
	12/11/2014	14	59.2	516	41	809
	3/2/2015	5.94	44.7	350	24	858
	5/18/2015	9.73	52.7	508	37.5	982

1/ Bold dates are when aquifer recharge is actively occurring. In 2014, recharge activities began near the first of March and ended near the end of May due to minimum instream flow requirements. In 2015, recharge activities began mid December and was shut down during periods of January and March.

Source: Patten 2015a

WWBWC concluded after two years of monitoring (2014 and 2015) that the aquifer recharge program operations do not appear to degrade water quality as much of the field parameters and major ion hydrochemical trends show reduced concentrations, indicating dilution of groundwater concentrations by aquifer recharge operations (Patten 2015a). The City of Walla Walla operates an ASR project to supplement water withdrawals from the Mill Creek diversion

when flows are low or water quality is not within suitable parameters (Banton and Klisch 2007, City of Walla Walla 2015a). This project involves using surface water from the City’s diversion supply and injecting it into wells within the Basalt aquifer. Faulting within the aquifer provides compartments that allow for recovery of the water later (City of Walla Walla 2015a). Table 2.6-4 provides values from monitoring of city groundwater wells before and after recharge actions.

While the groundwater quality is generally good, threats still exist to this resource. Stormwater management has the potential to introduce contaminants through improperly functioning or maintained UIC facilities (City of Walla Walla 2015a) in developed areas. Additionally, there is concern that nitrate contamination from agricultural practices could infiltrate the aquifers via impaired wells and improperly sealed wellheads (Cooms 2000). The Stormwater Management Plan (City of Walla Walla 2015a) details necessary actions and monitoring to address high-risk UIC areas as well as detailing the wellhead protection program. These actions are similar to recommendations made by Cooms (2000) regarding inspecting wells.

Table 2.6-4. Water Quality Parameters from the City of Walla Walla's Aquifer Storage and Recovery project (from Banton and Klisch 2007)

	Treated Surface Water from Mill Creek (mg/L)	Native Groundwater (mg/L)	Recovered Water from Recharged Aquifer (mg/L)
Calcium	5.6 – 6.4	17.5	9.9 – 15
Magnesium	1.9 – 2.5	7.3	3.8 – 5.8
Sodium	2	24	10 – 19
Silica	27 – 29	No data	46 – 59
Iron	< 0.1	< 0.05	< 0.1
Manganese	< 0.001 – 0.007	0.011	0.0041 – 0.0055
Chloride	1.3 – 1.5	2.3	1.5 – 1.6
Alkalinity as CaCO ³	25 – 30	120	56 – 110
Sulfate	1.0 – 1.2	5.5	2.1 – 4

CaCO³ – calcium carbonate; mg/L – milligram per liter

2.7 BIOLOGICAL COMMUNITIES

This section summarizes available information regarding fish, benthic macroinvertebrates, and wildlife in the Mill Creek Watershed. Many of these species are important indicators of watershed health because of their sensitivity to water quality, flow, connectivity, and riparian conditions. As discussed in detail in Section 2.3 and 2.5, the landscape and hydrology of lower Mill Creek have been significantly altered from their historical conditions, impacting environmental attributes such as water temperature, flow, and habitat.

The presence of fish, especially returning adult anadromous fish, can play an important ecological role in stream and riparian systems. Returning anadromous species that remain and die in streams (e.g. salmon carcasses) add direct food sources to juvenile fish, such as rearing salmonids (e.g. juvenile steelhead, bull trout) (Cederholm et al. 1999, Wipfli et al 2003, Denton et al. 2009, Lowery 2009). Additionally marine-derived nutrients in these carcasses add directly to stream nutrients, increasing primary and secondary production in these systems including enhancing riparian vegetation (Cederholm et al 1999, Edmonds and Mikkelsen 2006, Kohler et al 2012). These carcasses are also consumed by many terrestrial mammals and birds (Cederholm et al. 1999). So the overall role of anadromous fish to Mill Creek has importance to the overall stream and adjacent vegetation and wildlife communities.

2.7.1 Fish

This section consolidates and summarizes available information regarding important fish species for the region's residents. The focal fish species for this document include Middle Columbia River steelhead, spring Chinook salmon, Columbia Basin bull trout, and Pacific lamprey. These species were determined as the focus for this document due to their cultural importance to the CTUIR, associated socioeconomic and ecological benefits to the region, and protected status by federal and state agencies. The Primary Focus Area is broken into the five Mill Creek segments as discussed in Section 1.5. The Secondary Focus Area is Mill Creek and its tributaries upstream of the Segment 5 of the Primary Focus Area

The following subsections provide a summary of the basic history of the four focal species, focusing on information specific to activity in Mill Creek, including previous and current inventories. Other fish species, such as sculpins, resident lamprey, suckers, minnows, sunfish and other species found within the Walla Walla subbasin are not the focus of this document. Two native species of special concern in the subbasin include the mountain whitefish (*Prosopium williamsoni*) and the small endemic margined sculpin (*Cottus marginatus*); however these two species will not be discussed in detail as they are not included in the four focal species of this document. The mountain whitefish is a resident salmonid species that currently is not very common in this system, is occasionally a sport fish, and would have historically been a food source for the CTUIR. It is known to be in decline in this system and is a species of concern in the subbasin (Wydoski and Whitney 2003, NPCC 2005, CTUIR no date). The other is the small endemic margined sculpin which has very limited range in Washington State, is restricted to the headwaters of the Walla Walla, Touchet and Tucannon Rivers, and is considered a state sensitive species in both Washington and Oregon (Wydoski and Whitney

2003). Its habitat has been degraded through agriculture, grazing, logging and channelization. Actions that occur in the subbasin to enhance the four focal species' habitat conditions would be expected to result in some benefit to these two species as well.

The Subbasin Plan indicates some 30 species are present in the Walla Walla basin, only 17 of which are native (NPCC 2005). A total of 14 of the native species are present in Mill Creek and its distributaries (CTUIR no date). The distributaries such as Yellowhawk and Garrison creeks contain a variety of sculpins, minnows, and suckers, as well as anadromous stocks (Mendel et al. 2001). Bennington Lake contains a variety of game fish including stocked rainbow trout (*Oncorhynchus mykiss*), largemouth bass (*Micropterus salmoides*), black crappie (*Pomoxis nigromaculatus*), and bluegill (*Lepomis macrochirus*) (Phillips and Divens 2001). There are suggestions that steelhead, both juvenile and adult, may be diverted into Bennington Lake during spring flood flows when fish screens are removed (NMFS 2011). Estimates of numbers diverted are not available. During flood flows when water elevation reaches lake capacity (over 200 surface acres), water is diverted back to Mill Creek or Russell Creek, a tributary to Yellowhawk Creek. After flood season, an initial conservation pool is created at 1,205-foot elevation resulting in a lake size of about 52 acres. Other than when flows exceed Bennington Lake's capacity, water volume reductions occur from natural seepage and evaporation during the summer, often reaching lowest levels by December (lake size of about 20 acres and maximum 10 feet deep). Due to the annual fluctuation of Bennington Lake resulting in high temperatures and large late season volume reduction (reduced to about 20 percent of spring level), few salmonids are expected to survive the whole year in the lake and other species are limited in their abundance and production (Phillips and Divens 2001). For more information about non-focal species, please refer to regional fisheries and water resource reports (Knecht 1976, Wydoski and Whitney 2003, Mendel et al. 2007, StreamNet 2012, Watershed Company et al. 2014)).

2.7.1.1 Middle Columbia River Steelhead

The Mid-C steelhead Distinct Population Segment (DPS) is currently designated as Threatened under the federal ESA and a Candidate species by Washington State and includes the steelhead in the Walla Walla System. The Touchet system steelhead is genetically distinct from rest of the Walla Walla system including Mill Creek (Mendel et al. 2007, NMFS 2009). The 2009 recovery plan (NMFS 2009) lists significant factors in the Walla Walla system, including lower Mill Creek, that are restricting recovery of the Walla Walla population. These include impaired tributary habitat (including Mill Creek), fish passage concerns at the Bennington Diversion

Dam, and the Mill Creek Channel. Improvements in these areas are considered essential for the recovery of the whole Mid-C steelhead DPS, as delisting is likely not possible without significant improvements to the Mill Creek portion of the Walla Walla population (NMFS 2009).

Historic

Historical information on Mid-C steelhead is vague and imprecise, but the general consensus is that current distribution and numbers are far less than they were in the nineteenth century. WDFW estimates indicate historical steelhead runs between 4,000 and 5,000 adults. Ecosystem Diagnosis and Treatment (EDT) modeled estimates of historical spawner abundance was 16,451 (NPCC 2005). Data collected from 1998 to 2001 indicate that the Walla Walla subbasin average was 860 wild steelhead spawners (SRSRB 2011); however, adult abundance estimates can be difficult due to timing of adult return migration that often coincides with high flows and turbid conditions (Mendel et al. 2014).

Current

Mid-C steelhead are important to the local area and regionally from a social, economic, environmental and cultural standpoint. WDFW and the Lower Snake River Compensation Program of the USFWS have spent considerable time, money and effort to maintain and enhance adult returns and maintain steelhead fisheries to provide recreational and economic benefits to the Walla Walla subbasin over the past nearly 40 years. Mid-C steelhead are also the most populous anadromous salmonid found in the Mill Creek watershed. As stated above, the Mill Creek watershed is considered a key population component for recovery of the DPS. Steelhead are present in the Mill Creek watershed year-round. An extensive life-stage timing table can be found in Mahoney et al. (2012) that covers subbasin migration activity of life stages of Mid-C steelhead, as well as other focal salmonids, and is summarized as Figure 2.7-1. Maps indicating known Mid-C steelhead distribution and habitat usage by major life stage are presented in Figures 2.7-2 and 2.7-3.

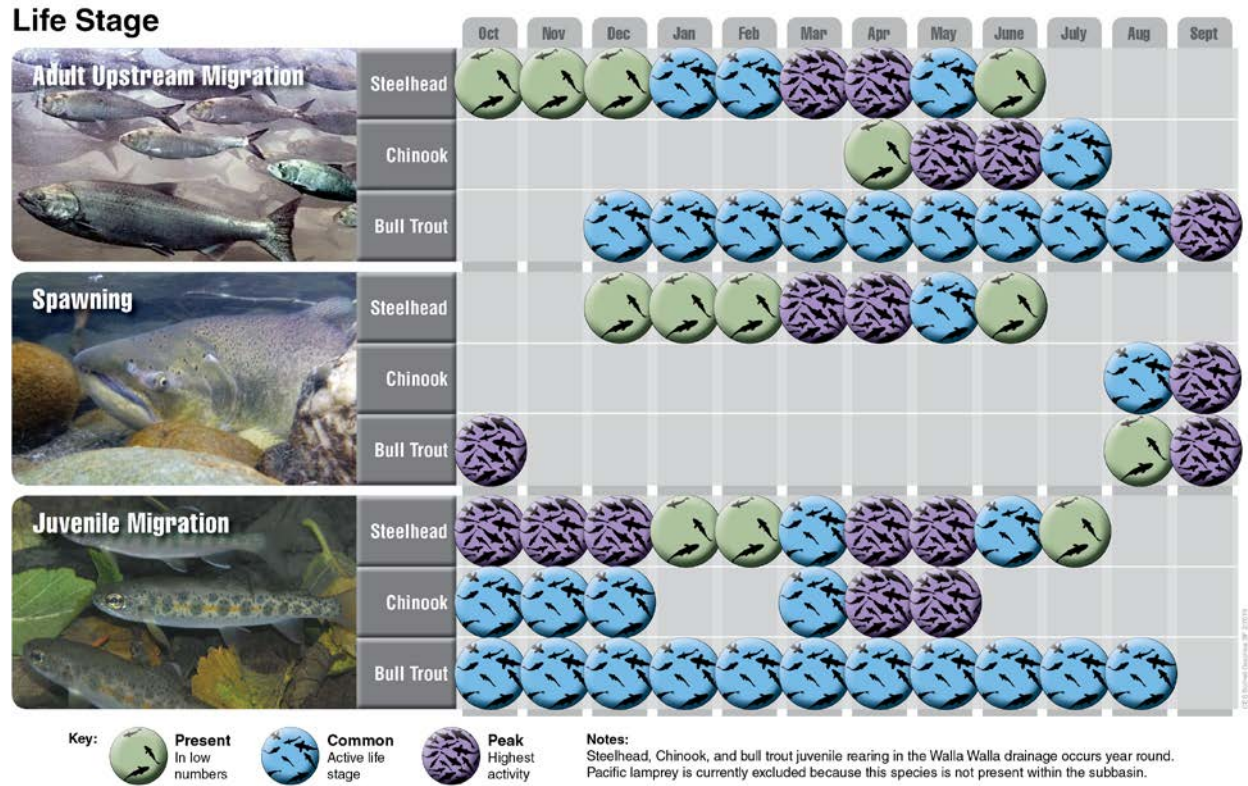


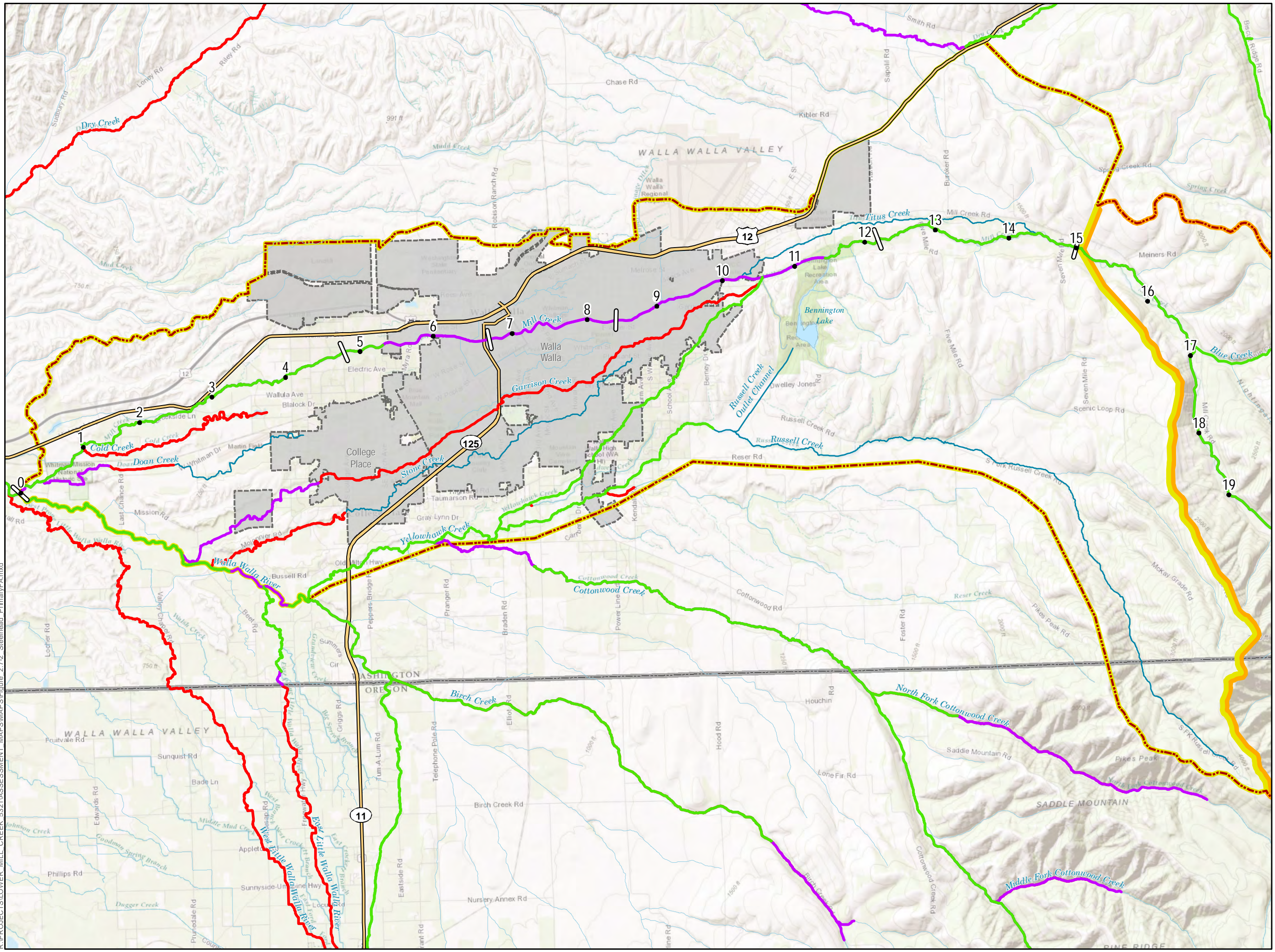
Figure 2.7-1. Run Timing for Focal Species in the Walla Walla Subbasin, Combined and Summarized from Mahoney et al. (2012)

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MILL CREEK - WALLA WALLA RIVER WATERSHED (MCWWR) STEELHEAD DISTRIBUTION

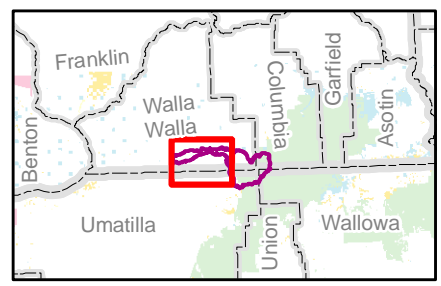
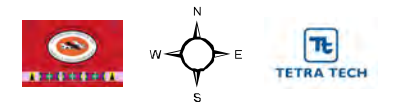
CTUIR MILL CREEK PROJECT

FIGURE 2.7-2 STEELHEAD DISTRIBUTION: PRIMARY FOCUS AREA



- River Miles
- Major Stream
- Minor Stream
- Use Type
 - Migration only
 - Rearing and migration
 - Spawning and rearing
- Reach Break
- Waterbody
- Project Area
- Primary Focus Area
- Secondary Focus Area
- Cities

Sources: CTUIR, Walla Walla County, StreamNet

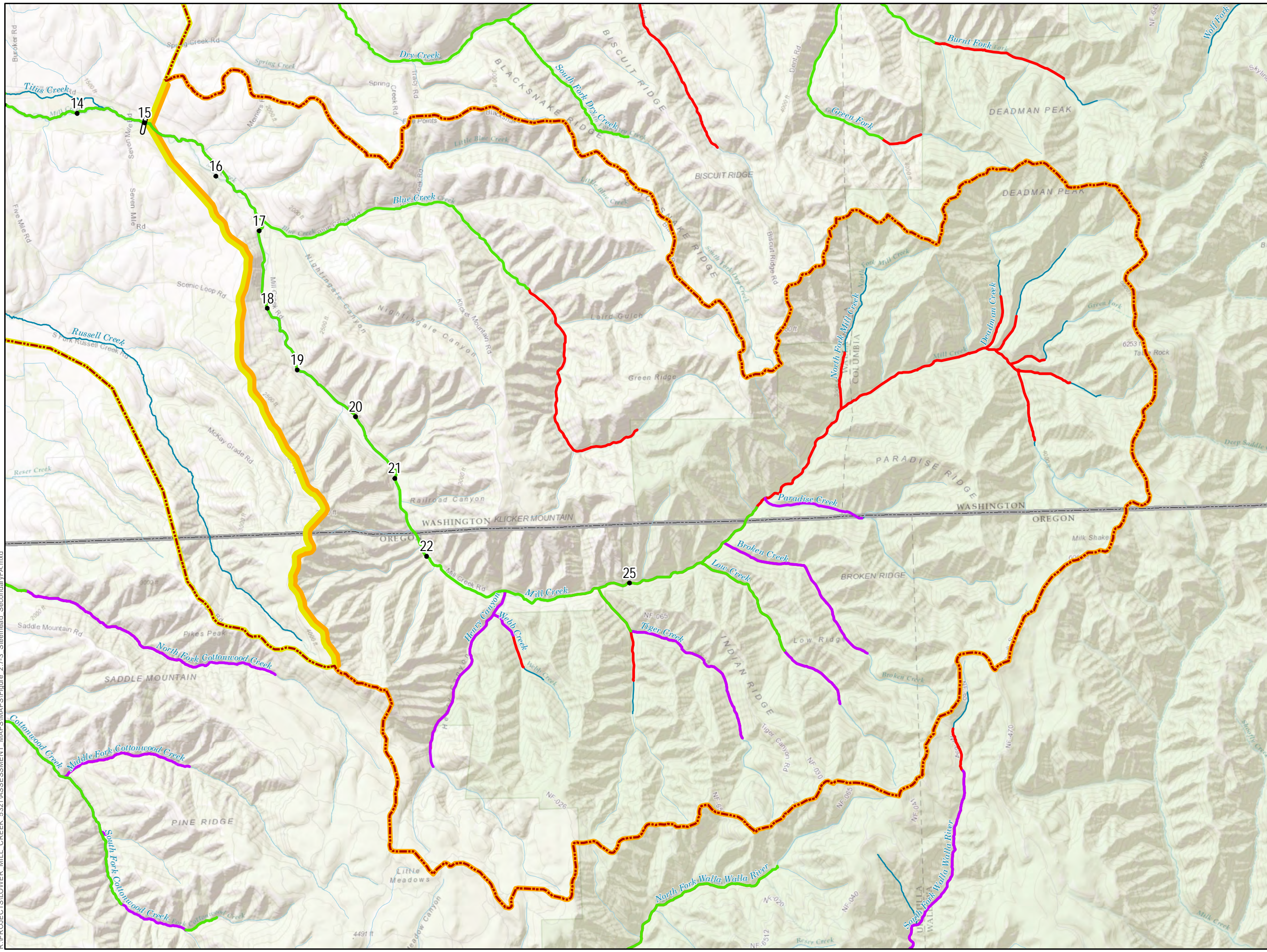


R:\PROJECTS\LOWER_MILL_CREEK_5321\ASSESSMENT_MAPS\MAPS\Figure 2.7.2_Steelhead_PrimaryFA.mxd

LOWER MILL CREEK HABITAT AND PASSAGE ASSESSMENT

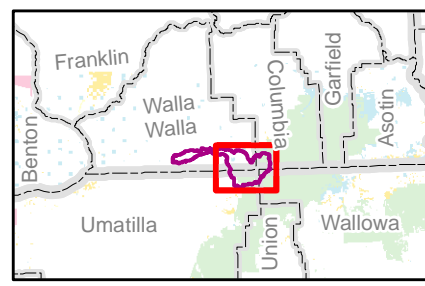
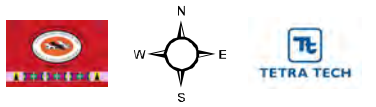
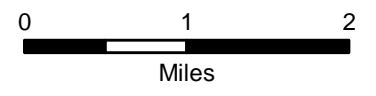
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UMATILLA INDIAN RESERVATION

**FIGURE 2.7-3
STEELHEAD DISTRIBUTION:
SECONDARY FOCUS AREA**



- River Miles
- Major Stream
- Minor Stream
- Use Type
 - Migration only
 - Rearing and migration
 - Spawning and rearing
- Reach Break
- Waterbody
- Project Area
- Primary Focus Area
- Secondary Focus Area
- Cities

Sources: CTUIR, Walla Walla County, StreamNet



R:\PROJECTS\LOWER MILL CREEK_5321\ASSESSMENT_MAPS\MAPS\Figure 2.7-3_Steelhead_SecondaryFA.mxd

Adult Abundance

The *Snake River Salmon Recovery Plan* (SRSRB 2011) currently indicates Mill Creek as a major spawning ground for the Mid-C steelhead DPS. Mendel et al. (2014), using a combined data set from the upper Walla Walla and the mouth of Mill Creek, indicates a combined summer steelhead production estimate of 38,800 steelhead smolts. Figure 2.7-4 shows the results of 22 years of adult salmonid monitoring on steelhead returns to Mill Creek upstream of Walla Walla (based on ladder passage count at Yellowhawk and Mill creek diversions at the Bennington Diversion and Division Works Dams) (Mendel et al. 2014). Accurate enumeration of adult abundance is considered a major data gap for Mill Creek (Mendel et al. 2007, 2014). Although counts are not of the complete run, the numbers provide some indication of adult returns although they do not necessarily correlate well with index redd counts (Mendel et al. 2014)

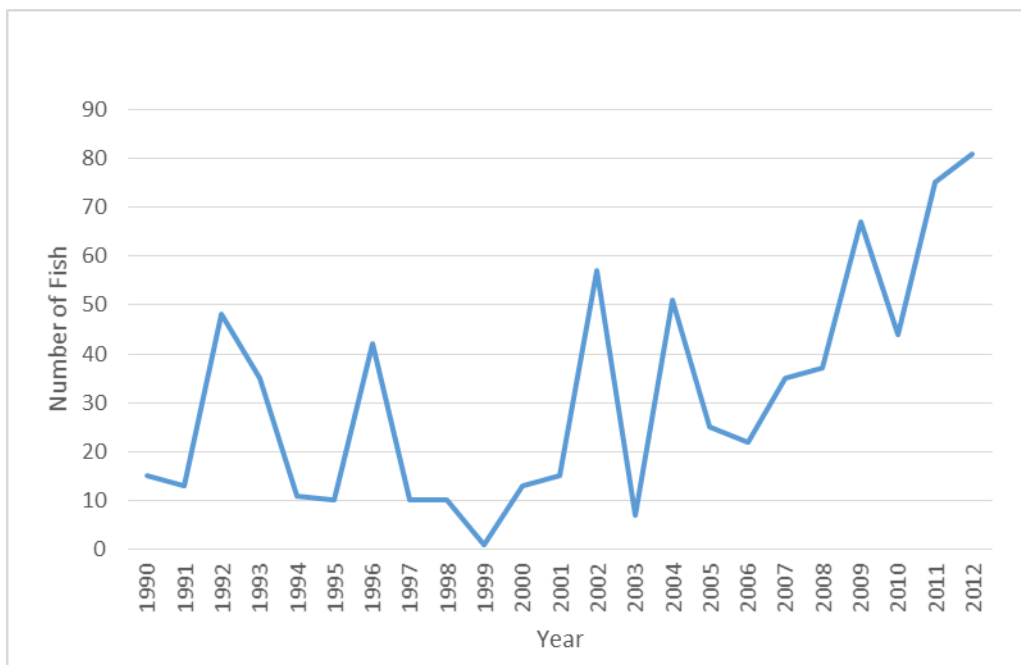
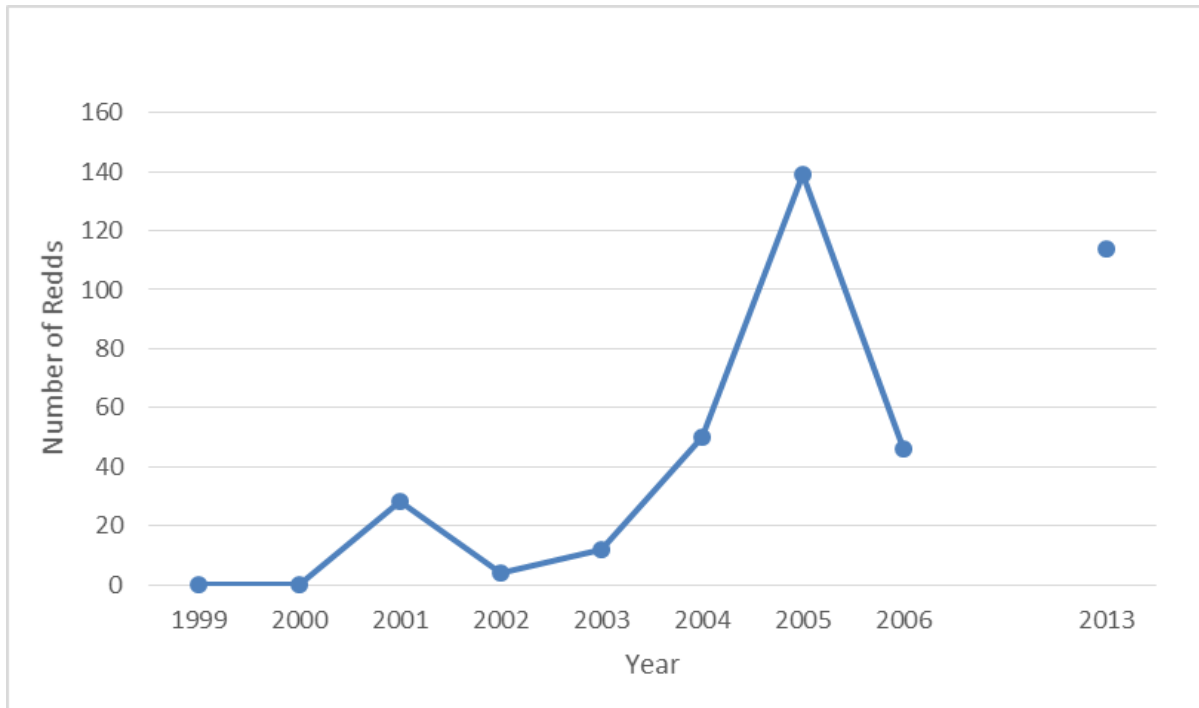


Figure 2.7-4. Partial Adult Steelhead Counts at the Passage Facilities on Mill and Upper Yellowhawk Creeks

Additionally, spawning surveys have been occurring since the 1990s (Mendel et al. 2007, 2014) and are summarized in Figure 2.7-5. This figure shows counts in index areas and are not extrapolated to estimate total redds above Bennington Diversion Dam. The results from the most recent spawner survey (2013) based on extrapolation of assumed number of spawners per redd, indicated an approximate abundance of 239 steelhead present in the region just upstream of Bennington Diversion Dam (diversion to Bennington Lake) upstream to Wickersham Bridge

in 2013 (Mendel et al. 2014), again this number is less than the total redds present above Bennington Diversion Dam.



Note: 2011 and 2012 surveys were canceled due to prolonged springs flows (Mendel et al. 2007, Mahoney et al. 2014)

Figure 2.7-5. Summer Steelhead Partial Redd Counts for Mill Creek

Juvenile Abundance

Consolidated data indicate that Mill Creek, particularly the portion above Bennington Diversion Dam (RM 11.4), contains some of the highest densities of 1-year and older steelhead in the Walla Walla subbasin. Table 2.7-1 presents juvenile steelhead/rainbow densities obtained by site sampling and then extrapolated by segment area to determine general population estimates (SRSRB 2006).

Local residents have observed steelhead and rainbow trout throughout Garrison Creek, especially in the spring (Ecology 1998). Yellowhawk Creek is primarily used by steelhead as a migration corridor with limited potential for rearing and spawning due to the creek's poor habitat qualities from channel and stream bank modifications, (Mendel et al. 2007, StreamNet 2012). On average, over 4,000 juveniles are estimated to use the Yellowhawk Creek channel (see Table 2.7-2 and SRSRB 2006). In July 2006, 230 meters (five sites) on Yellowhawk Creek were electroshocked, resulting in 32 young-of-year and three 1+-year-old steelhead/rainbow, which are low juvenile steelhead/rainbow numbers.

Table 2.7-1. Juvenile Steelhead/Rainbow Population Estimates for Mill Creek Generated from Average Juvenile Densities (SRSRB 2006)

Stream	Segment	Location	Total Area (100m ²)	Population estimate
Mill Creek	1	Mouth to Gose St	455	7,757
Tributaries	1	Lower tributaries (Doan and Cold)	195	1,800
Mill Creek	2-4	Gose St to Bennington Diversion Dam	1260	1,200
Mill Creek	5 & Above ^{1/}	Bennington Diversion Dam to Blue Creek	960	25,600
Tributaries	Above	Blue Creek	658	28,900
Mill Creek	Above	Blue Crk to water intake	1028	24,670
Tributaries	Above	Mid Tributaries (Henry Canyon, Webb, and Tiger)	50	N/A ^{2/}
Mill Creek	Above	Water intake to access limit	487	1,800
Tributaries	Above	Upper Tributaries (NF, Low, Broken, and Paradise)	1132	1,000

1/ "Above" indicates any Mill Creek area or tributary to Mill Creek upstream of Project Segment 5

2/This field is blank in the source material, Table 3-23 SRSRB 2006.

Table 2.7-2. Juvenile Steelhead/Rainbow Population Estimates for Yellowhawk Creek Generated from Average Juvenile Densities (SRSRB 2006)

Stream	Segment	Location	Total Area (100 m ²)	Population Estimate
Yellowhawk Creek	n/a	Mouth to source	665	3,800
Tributaries	n/a	Yellowhawk Creek tributaries (Lassater, Russell, Reser, and Caldwell)	261	548

2.7.1.2 Spring Chinook Salmon

Like steelhead, the Mid-Columbia spring Chinook salmon are a major cultural, economic and recreational resource both locally and for the Columbia River system in general. While this stock had been essentially extirpated from the Walla Walla subbasin in the last century, efforts by the CTUIR and other agencies and groups have worked over the last two decades to reestablish this stock in the Walla Walla system including Mill Creek. Many of the efforts in place to improve conditions in the Walla Walla basin for this stock have been in tandem with efforts to improve conditions for steelhead. This stock has increased over time and contributes to the local ecology and economy and is a culturally important species.

Mid-Columbia spring Chinook salmon are not currently listed by federal or Washington State agencies, because spring Chinook salmon were determined to be functionally extinct in the Walla Walla subbasin in the early 1920s although a few were observed in the 1950s (NPCC 2005). Spring Chinook salmon are currently present in the Mill Creek watershed year-round. An extensive life-stage timing table can be found in Mahoney et al. (2012) that covers subbasin

life stages of spring Chinook salmon and is summarized above in Figure 2.7-1. Maps indicating known Chinook salmon distribution and habitat usage are displayed in Figures 2.7-6 and 2.7-7.

Historic

The first major declines in run size in the Walla Walla subbasin started after construction of the Nine-Mile Dam in 1905. While the last sizeable return was recorded in 1925 (Mendel et al. 2014), spring/summer Chinook managed to persist in reduced numbers until the mid-1950s, at which point the species was considered extirpated from the subbasin (SRSRB 2011). Population decreases have been attributed to the mainstem Columbia hydroelectric dams and the growth in agriculture and irrigation in the Walla Walla basin and tributaries, such as Mill Creek (Mendel et al. 2014). A recent EDT analysis on the four southeast Washington subbasins (including Walla Walla) indicate that historic spring Chinook productivity was an order of magnitude greater than current productivity. EDT modeled estimates of historical spawner abundance was 17,929 (NPCC 2005). The Walla Walla subbasin was estimated historically at 13 to 25 adult returns per spawner, compared to the current estimate of 0 to 6.1 adult returns per spawner depending on basin tributary or channel (SRSRB 2006). To help restore runs to this system and to increase harvest, the CTUIR is in the process of developing a spring Chinook salmon hatchery on the South Fork Walla Walla River with the capability of producing 500,000 or more spring Chinook smolts.

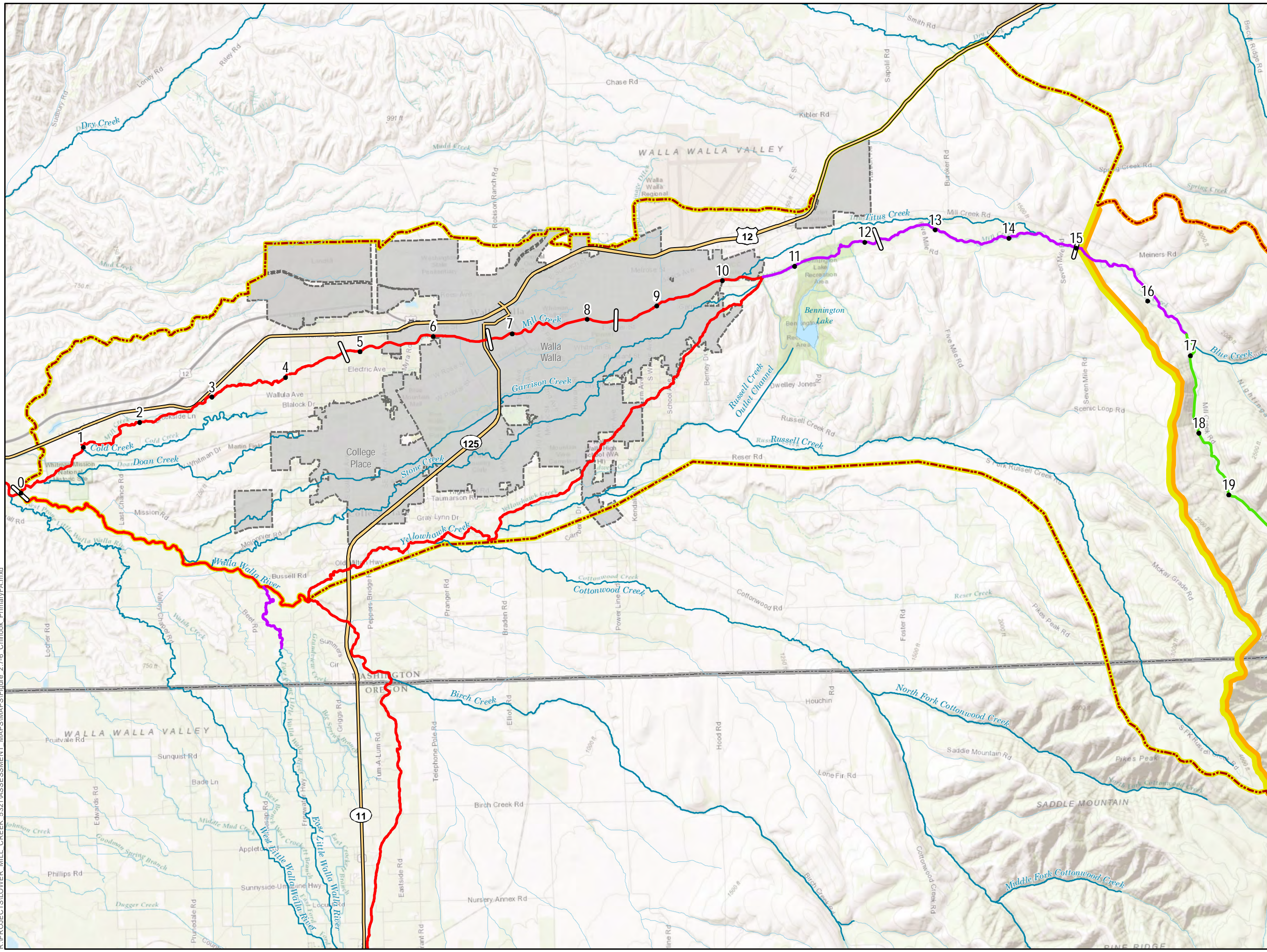
Current

Mid-Columbia spring Chinook are important to the region from a social, economic, environmental, and cultural standpoint. While the species was considered functionally extinct within the subbasin by the 1920s, fish were occasionally observed during fisheries monitoring efforts (Mahoney et al. 2013). To help restore spring Chinook in the subbasin, the CTUIR planted out-of-basin hatchery adult spring/summer Chinook into the South Fork Walla Walla River and Mill Creek beginning in 2000 (SRSRB 2011). Additionally, roughly 250,000 smolts from the Carson Hatchery were also released in the South Fork Walla Walla River (Mahoney et al. 2013). The first adult returns to Mill Creek occurred in 2004 from offspring of the adult plants into Mill Creek. Figure 2.7-8 shows the results of the spring Chinook planting of Mill Creek (Mendel et al. 2014). These adult return counts are considered partial counts and likely low as they are based on video counts at three different locations. Adult outplants were started in 2000, which resulted in redd construction the same year. Figure 2.7-9 summarizes adult spring Chinook upstream migration sightings at the passage facilities on Mill Creek and upper

**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

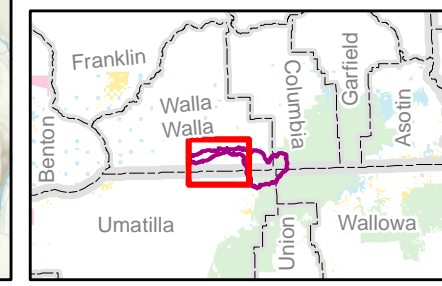
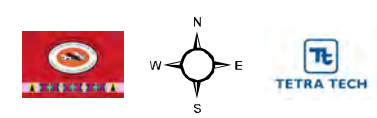
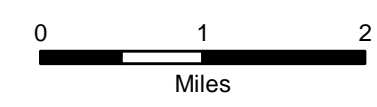
CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE 2.7-6
SPRING CHINOOK
DISTRIBUTION:
PRIMARY FOCUS AREA**



- River Miles
- Major Stream
- Minor Stream
- Use Type
- Migration only
- Rearing and migration
- Spawning and rearing
- Reach Break
- Waterbody
- Project Area
- Primary Focus Area
- Secondary Focus Area
- Cities

Sources: CTUIR, Walla Walla County, StreamNet

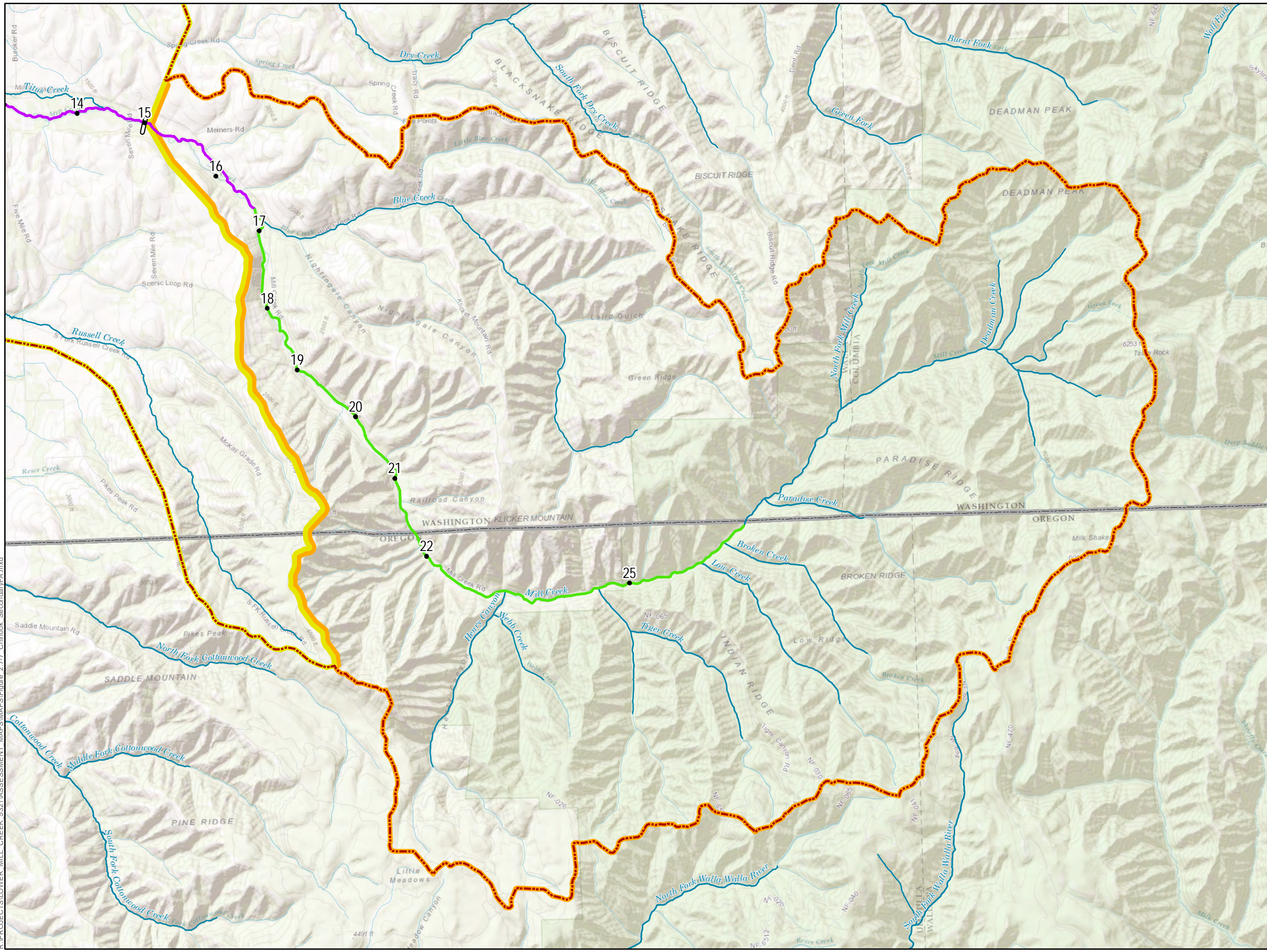


R:\PROJECTS\LOWER MILL CREEK 5321\ASSESSMENT MAPS\MAPS\Figure 2.7-6 Chinook Primary FA.mxd

**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

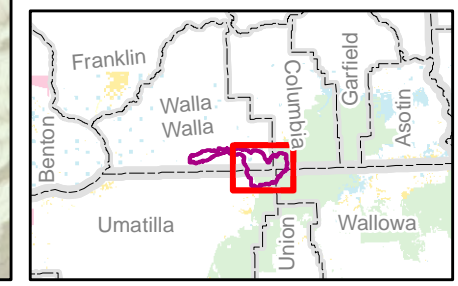
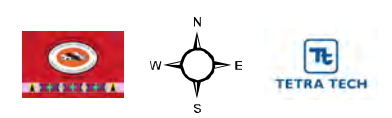
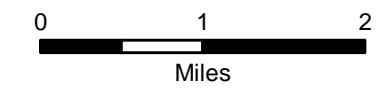
CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE 2.7-7
SPRING CHINOOK
DISTRIBUTION:
SECONDARY FOCUS AREA**



- River Miles
- Major Stream
- Minor Stream
- Use Type
- Rearing and migration
- Spawning and rearing
- Reach Break
- Waterbody
- Project Area
- Primary Focus Area
- Secondary Focus Area
- Cities

Sources: CTUIR, Walla Walla County, StreamNet



R:\PROJECTS\LOWER MILL CREEK_5321\ASSESSMENT_MAPS\MAPS\Figure 2.7.7_Chinook_SecondaryFA.mxd

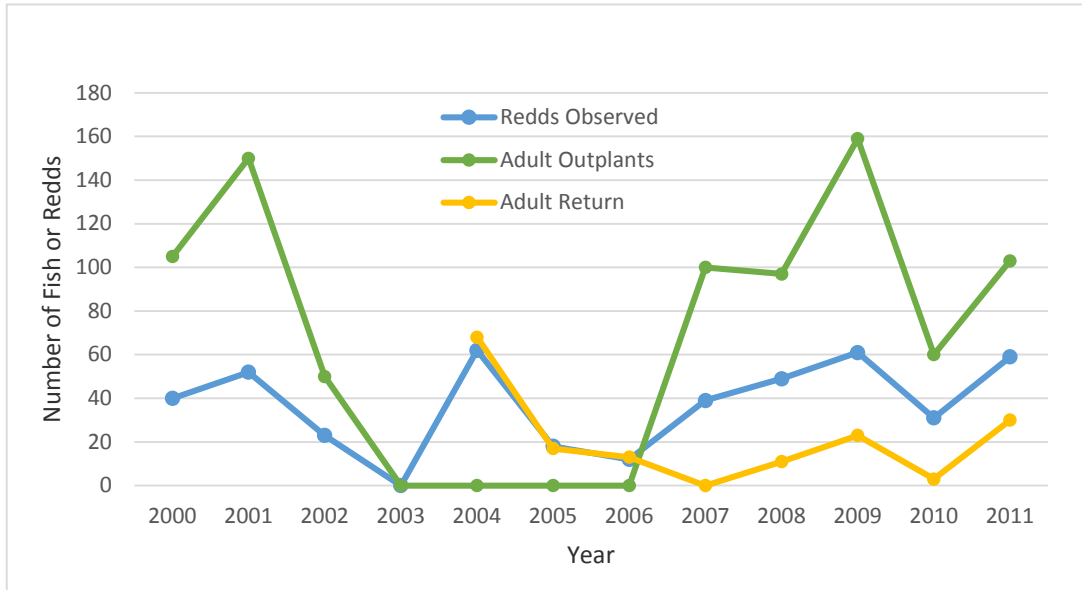


Figure 2.7-8. Adult Spring Chinook Salmon Outplanting and Adult Activity in Mill Creek (2000-2011) (Mendel et al. 2014)

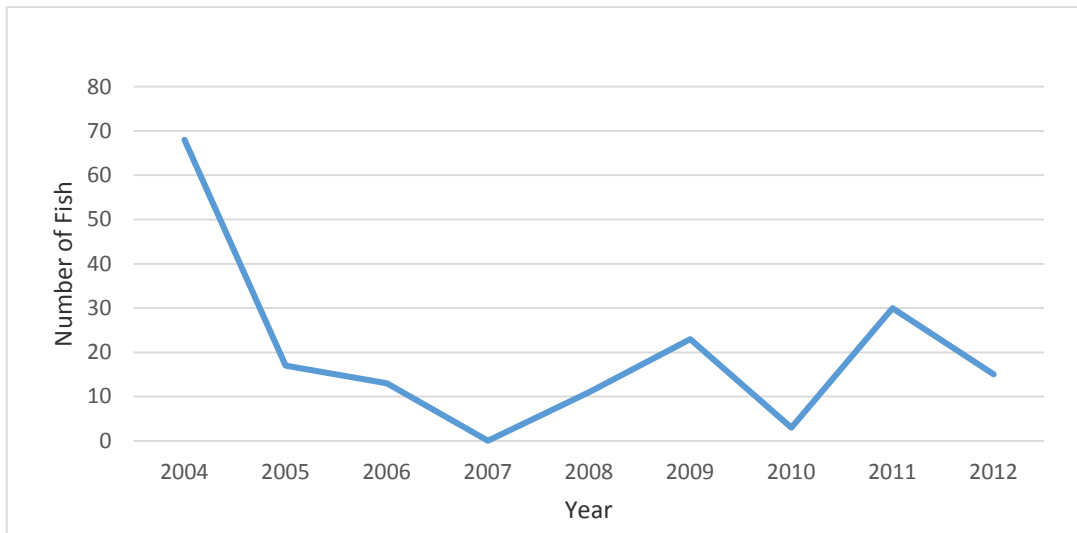


Figure 2.7-9. Partial Adult Spring Chinook Salmon Counts at Passage Facilities on Mill and Upper Yellowhawk Creeks (Mahoney et al. 2013)

Yellowhawk Creek and Bennington Diversion Dam. From 2003 through 2006, no adult outplants were placed, but the first adult returners arrived in 2004. Outplants were re-established in 2007 to bolster the natural returners. While improving adult returns from these releases remain insufficient to meet sustainable harvest goals (Mendel et al. 2014), spring returns to the upper Walla Walla and Mill Creek have increased from 200 (2004) to 1,135 (2009) (Mahoney et al. 2013) according to partial fish counts at Nursery Bridge and Mill and Yellowhawk creeks. However based on information from Mendel et al. 2014, Appendix A (Table 1 and 3), the spring Chinook adult returns are more recently trending downward.

The most recent adult survey from 2015 indicates multiple adult fish were sighted in Segment 4 with 10 adults seen in late May and 10 seen in mid-June, with the June sightings mostly at Bennington Diversion Dam (CTUIR 2015). From 1998 to 2006, over 600 juvenile Chinook were captured via electrofishing at 50 out of 302 sites sampled on Mill Creek; all but one of these sites were upstream of the Bennington Diversion Dam (Mendel et al. 2007).

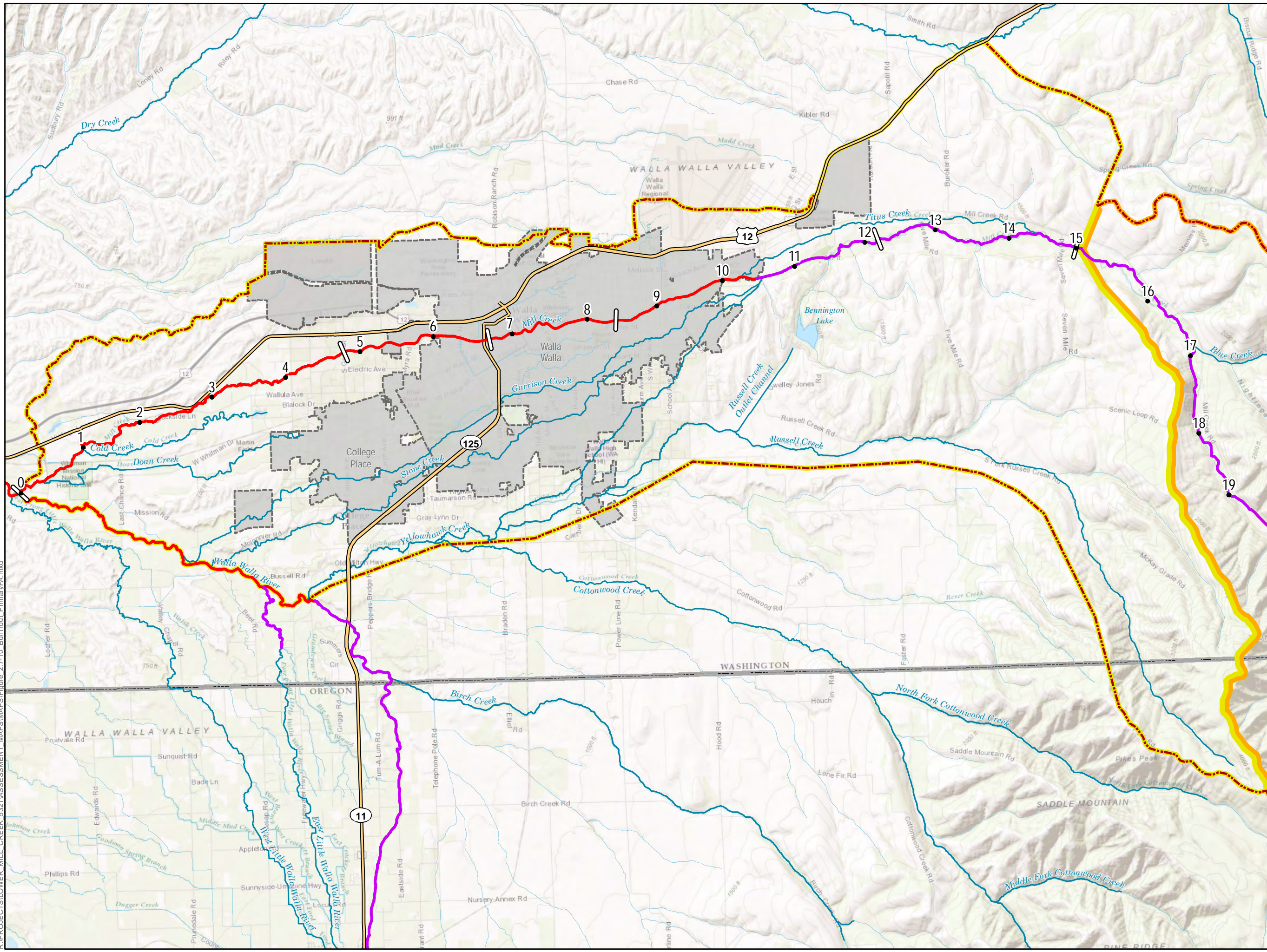
2.7.1.3 Columbia Basin Bull Trout

Bull trout are currently listed under the ESA as Threatened and a Candidate species by the State of Washington. The Walla Walla system is one of 24 currently occupied bull trout core areas in the Mid-Columbia recovery unit (USFWS 2015). Within this core area the Mill Creek bull trout population is genetically distinct from that of the Touchet (Mendel et al. 2007). Bull trout are present in the Mill Creek watershed year-round. An extensive run timing table can be found in Mahoney et al. (2012) that covers subbasin bull trout life stages and is summarized in Figure 2.7-1. Maps indicating known bull trout distribution, along with habitat usage, are displayed in Figures 2.7-10 and 2.7-11.

**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

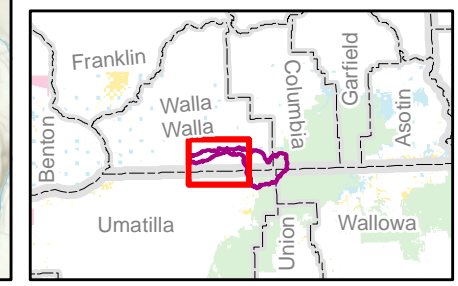
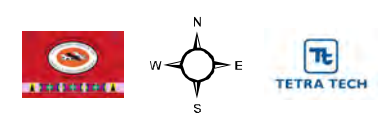
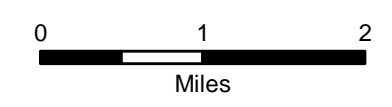
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**FIGURE 2.7-10
BULL TROUT DISTRIBUTION:
PRIMARY FOCUS AREA**



- River Miles
- Major Stream
- Minor Stream
- Use Type
 - Migration only
 - Rearing and migration
- Reach Break
- Waterbody
- Project Area
- Primary Focus Area
- Secondary Focus Area
- Cities

Sources: CTUIR, Walla Walla County, StreamNet

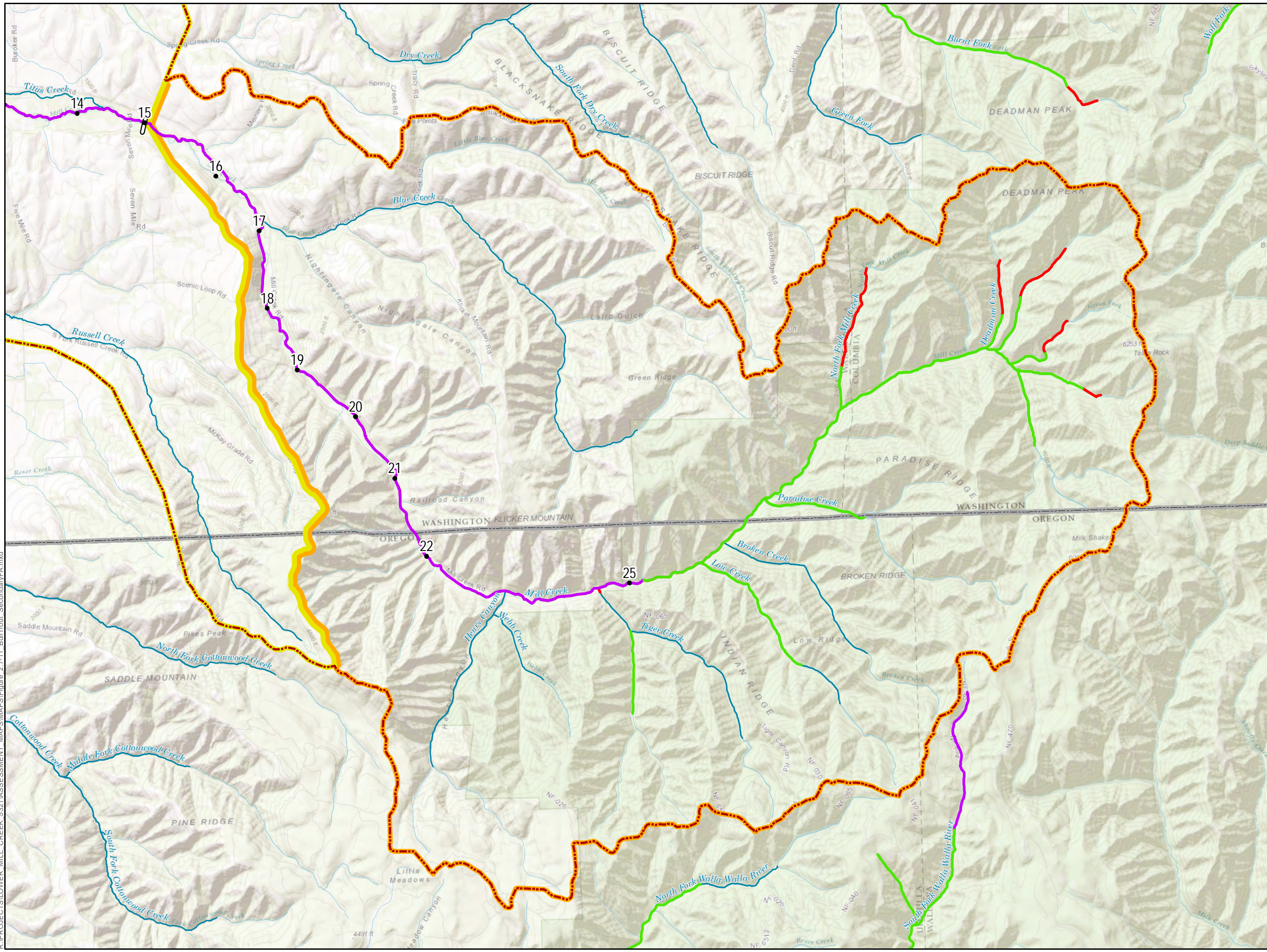


R:\PROJECTS\LOWER MILL CREEK\ASSESSMENT MAPS\MAPS\Figure 2.7-10_BullTrout_PrimaryFA.mxd

LOWER MILL CREEK HABITAT AND PASSAGE ASSESSMENT

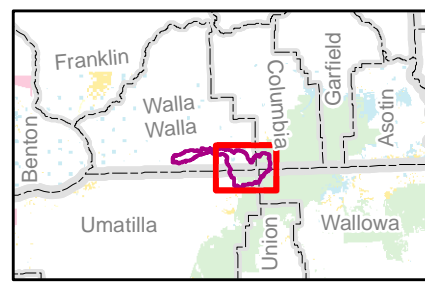
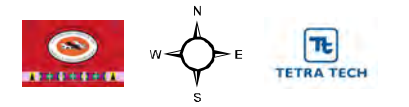
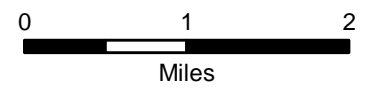
CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE 2.7-11
BULL TROUT DISTRIBUTION:
SECONDARY FOCUS AREA**



- River Miles
- Major Stream
- Minor Stream
- Use Type
- Migration only
- Rearing and migration
- Spawning and rearing
- Reach Break
- Waterbody
- Project Area
- Primary Focus Area
- Secondary Focus Area
- Cities

Sources: CTUIR, Walla Walla County, StreamNet



R:\PROJECTS\LOWER MILL CREEK_5321\ASSESSMENT_MAPS\MAPS\Figure 2.7-11_BullTrout_SecondaryFA.mxd

Historic

Historical data on bull trout are limited and anecdotal. The assumption is that prior to European settlement, bull trout had both resident and fluvial populations throughout the Columbia River and subbasins, including the Walla Walla River and Mill Creek.

Current

The Mill Creek bull trout population is in decline (, Howell and Sankovich 2012, USFWS 2015b, Howell et al. 2016, CTUIR No Date), and largely concentrated to the upper stream regions due to passage barriers and unsatisfactory habitat conditions downstream. However bull trout occupy habitat from the headwaters to the lower Walla Walla River into the Columbia River with some individuals moving out of and into this upper area from lower river areas (Howell et al. 2016). Walla Walla subbasin bull trout migratory, overwintering, foraging, and rearing habitat is considered to be a continuum requiring fish movement connectivity extending from the headwater areas into the Columbia River. Further details of this habitat use and connectivity, including migration timing including Mill Creek, is provided in many recently developed documents (Small et al. 2012, and Koch 2014, Schaller et al. 2014, USFWS 2015a, USFWS 2015b, Barrows et al. 2016). Bull trout benefit from limited human access to the upper stream reaches in the protected Mill Creek Watershed, as well as from regulations limiting fishing for bull trout in Oregon and Washington. Figure 2.7-12 summarizes the number of adult bull trout counts based on weir or video counts for Mill and Yellowhawk creeks (See Table 1 from Mendel et al. 2014).

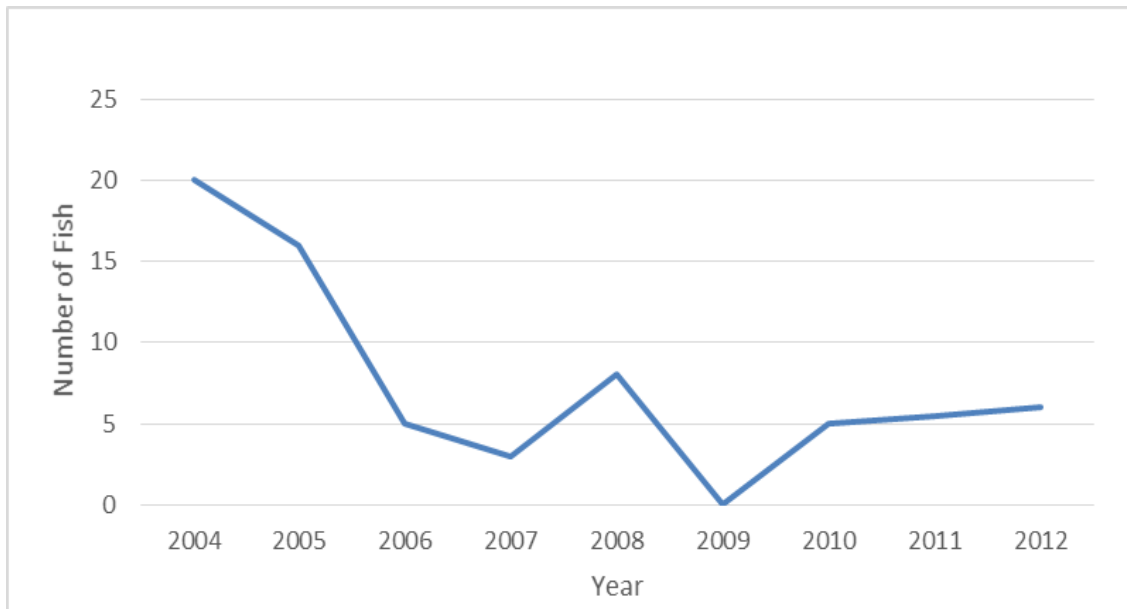


Figure 2.7-12. Partial Adult Bull Trout Counts for Mill and Yellowhawk Creeks (Mendel et al. 2014)

A rough estimate of recent adults in the upper Mill Creek watershed was 480 spawners (USFWS 2011). A total of 6,112 bull trout of varied life stages have been tagged in Mill Creek by co-managing agencies over 14 years between 1998 and 2012 (Koch 2014) (see Figure 2.7-13). Studies of seasonal movement and distribution found that fish ranged from a location 6 kilometer (km [3.7 miles]) upstream of the mouth up to 31 km (19.2 miles) away, and typically spawned along an 8-km (5 mile) reach above Bennington Diversion Dam. Wintering locations were primarily spread over a 21-km (13 mile) reach between Bennington Diversion Dam and the City of Walla Walla water intake structure with none of the radio tagged fish in the study moving downstream of the Bennington Diversion Dam (Starcevich et al. 2012). However some limited spring rearing and overwintering occurs in the region below the Bennington Diversion Dam based on known subadult and adult detections of upstream movement of Passive Integrated Transponder (PIT) tagged fish that were mostly originally tagged above Bennington Diversion Dam (Koch 2014). Overwintering PIT tagged bull trout subadults and adults below Bennington Diversion Dam was 25 and 35 percent, respectively (Howell et al. 2016). However of all the habitat areas evaluated in the Walla Walla subbasin, this area contained the worst habitat conditions for the summer months through December (Schaller et al. 2014). As a result, rearing is expected to be limited below Bennington Diversion Dam in Mill Creek. Bull trout also utilize this corridor for adult outmigration after upstream fall spawning (Howell et al. 2016).

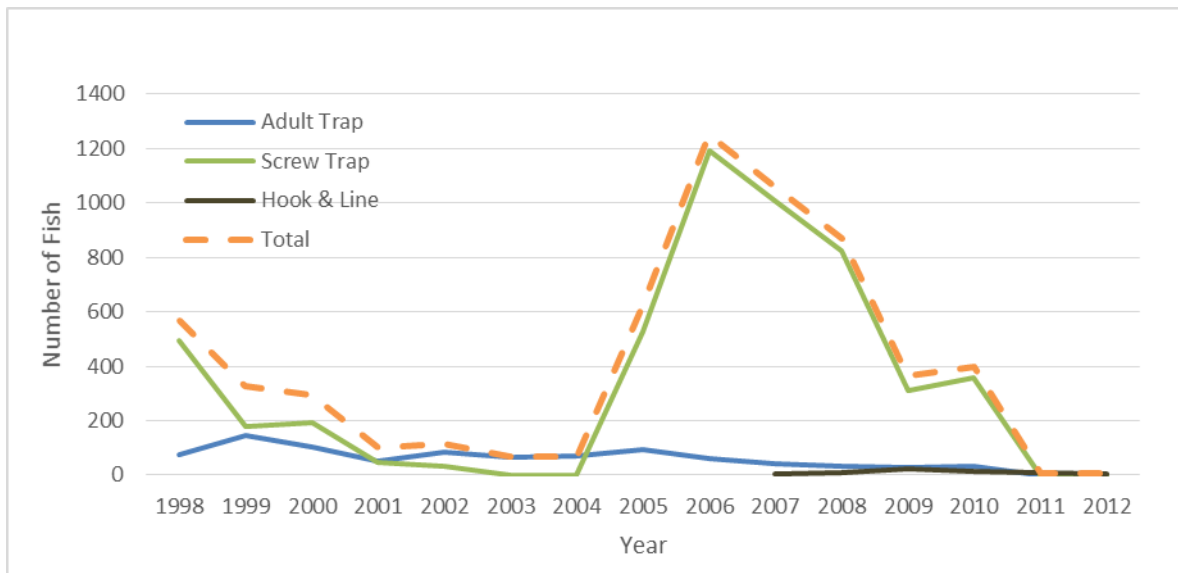
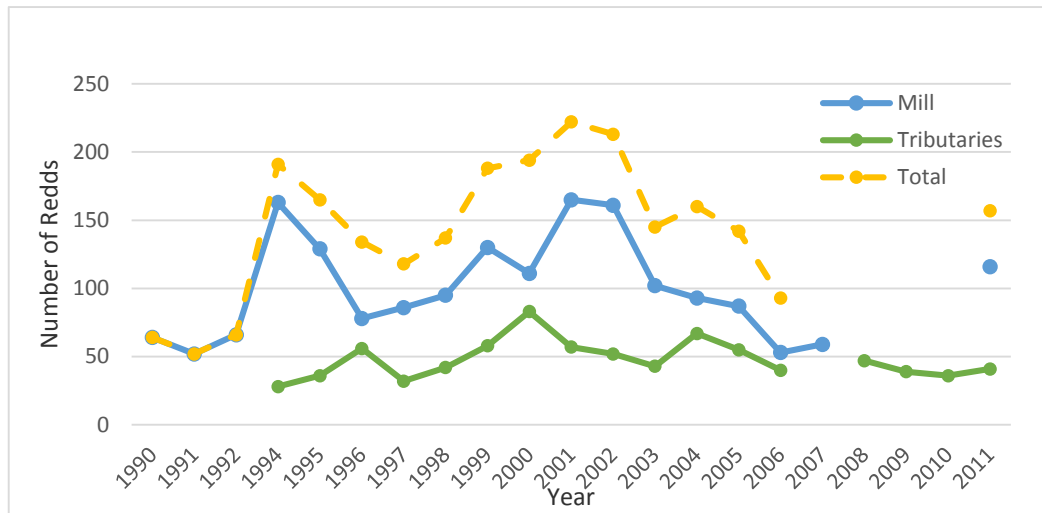


Figure 2.7-13. Adult and Sub-Adult (primarily screw trap) Bull Trout Tagged in Mill Creek by Collection Method (Koch 2014)

Bull trout spawning surveys have been occurring since the 1990s (Figure 2.7-14). The index redd counts in upper Mill Creek have averaged over 100 per year since the early 1990s, with a maximum count of 222 in 2001 (Mendel et al. 2014). A total of eight Mill Creek tributaries have been surveyed over this period showing a similar trend in abundance as the North Fork Mill Creek



Note: No surveys 2008-2011 on the mainstem Mill Creek due to lack of funding.

Figure 2.7-14. Surveyed Bull Trout Redds in Mill Creek and Mill Creek Tributaries (Mendel et al. 2014)

Upstream migration by adult bull trout to spawning areas is in April, with numbers peaking in May and June (Koch 2014) (Figure 2.7-1). Downstream return by adults is typically October through December, with a few lagging individuals showing up in January and February. Most adults successfully passed the Bennington Diversion Dam once the fish ladder was detected although delays are common. Subadults, while taking longer, also successfully navigated the fish ladder. However it has been documented through tagging that some bull trout, especially subadults, do not successfully pass upstream through the ladder and likely expired below the dam from water conditions (e.g. high temperature) and predation (e.g. avian) (Koch 2014, Schaller et al. 2014). Further details on migration timing and relative passage survival and temperature effects can be found in Howell et al. 2016, Schaller et al. 2014, USFWS 2015a, and USFWS 2015b.

Bull trout have routinely been seen in Yellowhawk Creek, but typically in much lower numbers than in Mill Creek. PIT tag arrays have detected subadult usage of Yellowhawk Creek, while a lone adult tagged in the Touchet River used Yellowhawk Creek as its migration corridor two years running. Current understanding is that Yellowhawk Creek, like lower Mill Creek, is

primarily a migration corridor for bull trout to reach the spawning grounds of upper Mill Creek (USACE 2011a), although as noted above some spring and fall rearing occurs (Koch 2014).

2.7.1.4 Pacific Lamprey

The 2015 Regional Implementation Plan (MCRMU 2015) indicates that the Walla Walla River and tributaries (including lower Mill Creek) were included in the historical distribution of Pacific lamprey; however, the species is currently considered extirpated with the nearest current distribution in the mainstem Columbia River.

Historic

The anadromous Pacific lamprey, like salmon, was an important anadromous fish tribal food resource in the systems where it was formerly present. Historically, there are specific mentions of lamprey fishing activities, such as tribal members harvesting lamprey near the mouth of the Walla Walla and near Skiphorton Creek in the South Fork Walla Walla (CTUIR 2004). There are also oral reference to lamprey being numerous in Mill Creek in the vicinity of the current Wilbur Street bridge in Walla Walla (Jackson et al. 1997). However, early assessments of Pacific lamprey populations were often inconsistent and only tangentially covered by salmonid assessment protocols (Moser and Close 2003). Additionally, in many occasions all lamprey were lumped together, with no way to differentiate Pacific lamprey numbers from brook or river lampreys.

Current

Pacific lamprey are not known to currently occupy the Mill Creek watershed. Between 1992 and 1995, WDFW collected 246 lampreys from Walla Walla screen trap boxes; however, there was no species determination and these could be Western brook lamprey. In 1999, no Pacific lamprey were caught during an electrofishing survey conducted by the CTUIR within the Walla Walla subbasin.

The CTUIR has sought to reintroduce Pacific lamprey into traditional fishing grounds, with plans to include the Walla Walla and Tucannon subbasin within the next few years (Columbia Basin Bulletin 2015). To this end, experimentation with artificial propagation continues at the William Grant Aquatics Lab at Walla Walla Community college (CUJ 2015).

2.7.2 Benthic Macroinvertebrates

Benthic macroinvertebrates are an important indicator of the general conditions of aquatic ecosystems. They help break down aquatic biomatter and are a food source for fish and avian species. Their relatively short lifecycles and quick response time to habitat conditions make them a useful indicator of stream health (Karr and Chu 1997). Surveys in the lower reaches of Mill Creek and Doan Creek indicate

depressed ecological function (Starkey 2015a). Table 2.7-3 summarizes the sample results; further discussion and explanation of the metrics can be found in Starkey (2015a).

Table 2.7-3. Summary of 2014 Macroinvertebrate Sampling in Segment 1 Near Whitman Mission (from Starkey 2015a)

Location		HBI ^{1/}	USFS Tolerance Quotient ^{2/}	Observed to Expected ^{3/}	# EPT ^{4/}	# Long Lived Species	Dominant Family
Mill Creek	Score	4.66	93	0.25	7	4	Chironomidae
	Result	Good	Impaired	Poor			
Doan Creek	Score	5.46	99	0.16	0	0	Chironomidae
	Result	Fair	Impaired	Poor			

1/ HBI: Hilsenhoff Biotic Index, summarizes the pollution tolerance of the macroinvertebrate taxa within the sample.

2/ USFS Tolerance Quotient: An assessment method used by USFS and BLM. Various taxa are assigned a rating (TQ) ranging from 2 only found in unpolluted waters up to 108 found in severely polluted waters.

3/ Observed to Expected: A ratio of actually Observed taxa vs the Expected to be Observed taxa

4/ EPT – Assesses the general species richness of three orders of aquatic insects which are typically intolerant of pollution; typically, a high value indicates low pollution conditions. These are Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies).

Macroinvertebrate samples have also been collected in Garrison and Yellowhawk creeks. Sampling at Garrison Creek indicates a depressed ecological system dominated by pollutant-tolerant species. Ecology sampling indicated a likely ecological effect of the WWTP outfall, with taxa numbers decreasing by half from the uppermost site (above the WWTP discharge) to lowest site (from 18 taxa to 9 taxa) (Ecology 1998). Sampling in 2011, from two sites about halfway up Yellowhawk Creek, indicated “fair” ecologic conditions (PSSB 2016).

2.7.3 Wildlife

This section identifies various known wildlife species that can be found around the Mill Creek watershed. More extensive information can be found through WDFW, as well as other regional reports and anecdotal sightings. The Walla Walla Shoreline Analysis Report noted that about 10 amphibian, 207 bird, 69 mammal, and 15 reptile species are present in the whole subbasin (The Watershed Company et al. 2014). Local birders often congregate around Bennington Lake, suggesting it is heavily utilized by a variety of avian species. A subset of these species are commonly found in the Mill Creek watershed (NPCC 2005, The Watershed Company et al. 2014), and are summarized along with their state status in Table 2.7-4.

Further details of the characteristics of the species, past effects of basin development on these species, wildlife focus species and their habitat needs can be found in various reports including the Walla Walla Subbasin Plan (NPCC 2005) and others such as The Watershed Company et al. 2014, and Washington State plans for wildlife in WDFW 2015 and WDFW 2005. Since the

emphasis of this report is evaluation of conditions related primarily to focal fish species within Mill Creek no further details of wildlife are presented in this assessment.

Table 2.7-4. Typical (Non-exhaustive) Wildlife Species Found Around Mill Creek and Walla Walla County^{1/}

Amphibian/Reptile			
Bull Frog (<i>Lithobates catesbeianus</i>)	Rocky Mountain Tailed Frog (<i>Ascaphus montanus</i>) (C)	Sagebrush Lizard (<i>Sceloporus graciosus</i>) (C)	Columbia Spotted Frog (<i>Rana luteiventris</i>) (C)
Western Toad (<i>Anaxyrus boreas</i>) (C)	Striped Whipsnake (<i>Masticophis taeniatus</i>) (C)	Northern leopard frog (<i>Rana pipiens</i>) (E)	Sagebrush lizard (<i>Sceloporus graciosus</i>) (S)
Striped whipsnake (<i>Masticophis taeniatus</i>) (C)	Tailed frog (<i>Ascaphus truei</i>) (S)	Western boreal toad (<i>Bufo boreas</i>) (C)	
Avian			
Great Blue Heron (<i>Ardea Herodias</i>)	Barrow Golden Eye (<i>Bucephala islandica</i>)	Hooded Merganser (<i>Lophodytes cucullatus</i>)	Tundra Swan (<i>Cygnus columbianus</i>)
American White Pelican (<i>Pelecanus erythrorhynchos</i>) (E)	Common Golden Eye (<i>Bucephala clangula</i>)	Ring Necked Pheasant (<i>Phasianus colchicus</i>)	Western grebe (<i>Aechmophorus occidentalis</i>)
Black-crowned Night Heron (<i>Nycticorax nycticorax</i>)	Bufflehead (<i>Bucephala albeola</i>)	Bald Eagle (<i>Haliaeetus leucocephalus</i>) (S)	Wood Duck (<i>Aix sponsa</i>)
Ferruginous Hawk (<i>Buteo regalis</i>) (E)	Golden Eagle (<i>Aquila chrysaetos</i>) (C)	Northern Goshawk (<i>Accipiter gentilis</i>) (C)	Prairie Falcon (<i>Falco mexicanus</i>)
Dusky Grouse (<i>Dendragapus obscurus</i>)	Mountain Quail (<i>Oreortyx pictus</i>)	Wild Turkey (<i>Meleagris gallopavo</i>)	Upland Sandpiper (<i>Bartramia longicauda</i>) (E)
Burrowing Owl (<i>Athene cunicularia</i>) (C)	Flammulated Owl (<i>Psilosops flammeolus</i>) (C)	Vaux Swift (<i>Chaetura vauxi</i>) (C)	Black-backed Woodpecker (<i>Picoides arcticus</i>) (C)
Lewis' Woodpecker (<i>Melanerpes lewis</i>) (C)	Pileated Woodpecker (<i>Dryocopus pileatus</i>) (C)	Loggerhead Shrike (<i>Lanius ludovicianus</i>) (C)	Sage Thrasher (<i>Oreoscoptes montanus</i>) (C)
Phalaropes (<i>Phalaropus spp</i>)	Avocets (<i>Recurvirostra spp</i>)	Stilts Family (<i>Recurvirostridae</i>)	Bank Swallow (<i>Riparia riparia</i>) (S)
Boreal owl (<i>Aegolius funereus</i>) (S)	Ferruginous hawk (<i>Buteo regalis</i>)	Grasshopper sparrow (<i>Ammodramus savannarum</i>) (S)	Great gray owl (<i>Strix nebulosi</i>) (S)
Long-billed curlew (<i>Numenius americanus</i>) (S)	Northern goshawk (<i>Accipiter gentilis</i>) (C)	Northern pygmy-owl (<i>Glaucidium gnoma</i>) (S)	Olive-sided flycatcher (<i>Contopus borealis</i>) (S)
Peregrine falcon (<i>Falco peregrinus</i>) (S)	Pygmy nuthatch (<i>Sitta pygmaea</i>) (S)	Sage thrasher (<i>Oreoscoptes montanus</i>) (C)	Swainson's hawk (<i>Buteo swainsoni</i>) (S)
Three-toed woodpecker (<i>Picoides tridactylus</i>) (S)	Vaux's swift (<i>Chaetura vauxi</i>) (C)	White-headed woodpecker (<i>Picoides albolarvatus</i>) (S)	
Mammal			
American Beaver (<i>Castor canadensis</i>)	Grey Wolf (<i>Canis lupus</i>) (E)	American Marten (<i>Martes americana</i>) (S)	Rocky Mountain Elk (<i>Cervus canadensis nelsoni</i>)
Black Bear (<i>Ursus americanus</i>)	Big Horned Sheep (<i>Ovis canadensis</i>)	Mule Deer (<i>Odocoileus hemionus</i>)	Washington Ground Squirrel (<i>Urocitellus washingtoni</i>) (C)
Black Tailed Deer (<i>Odocoileus hemionus</i>)	Blacktailed Jack Rabbit (<i>Lepus californicus</i>) (C)	Northwest White Tailed Deer (<i>Odocoileus virginianus</i>)	White Tailed Jackrabbit (<i>Lepus townsendii</i>) (C)
Merriam's Shrew (<i>Sorex merriami</i>) (C)	Preble's Shrew (<i>Sorex preblei</i>) (C)	Big Brown bat (<i>Eptesicus fuscus</i>)	Badger (<i>Taxidea taxus</i>)

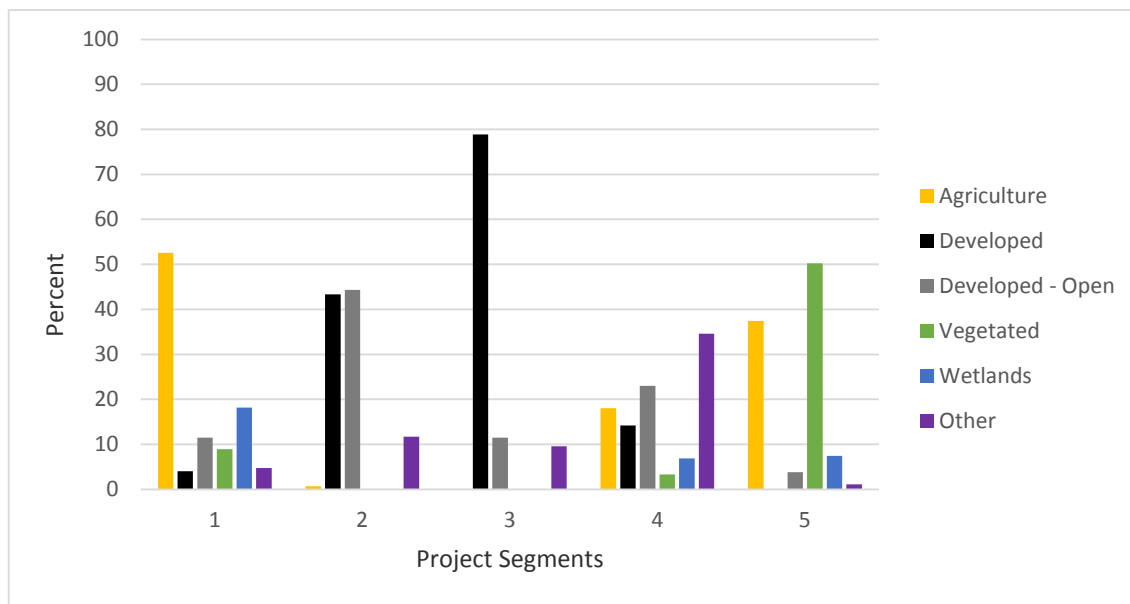
Table 2.7-4. Typical (Non-exhaustive) Wildlife Species Found Around Mill Creek and Walla Walla County^{1/} (continued)

Mammal (continued)			
Pallid Bat (<i>Antrozous pallidus</i>) (S)	Townsend Big-eared Bat (<i>Corynorhinus townsendii</i>) (C)	Lynx (<i>Lynx canadensis</i>)	Skunk Family (<i>Mephitidae</i>)
Fringed myotis (<i>Myotis thysanodes</i>) (S)	Long-eared myotis (<i>Myotis evotis</i>) (S)	Long-legged myotis (<i>Myotis volans</i>) (S)	Merriam's shrew (<i>Sorex merriami</i>) (C)
Silver-haired bat (<i>Lasionycteris noctivagans</i>) (S)	Washington ground squirrel (<i>Spermophilus washingtoni</i>) (C)	Western small-footed myotis (<i>Myotis ciliolabrum</i>) (S)	Wolverine (<i>Gulo gulo</i>) (C)

1/ State Status: E – Endangered, T – Threatened, C – Candidate, S – Sensitive

2.8 PHYSICAL HABITATS

This section describes the primary physical habitats of Mill Creek (and distributary channels) and surrounding areas including uplands, wetlands, riparian vegetation, and stream habitats (including fish passage barriers and refugia). Upland, wetland, and riparian vegetation physical habitats have been mapped in the Walla Walla Shoreline Plan (The Watershed Company et al. 2014) in the following six land cover classes: agriculture (crops and grazing), developed (light through heavy developed properties), developed – open (roads and parking lots), vegetated (forests and shrubs), wetlands, and other (totaling less than 1 percent of the total area assessed). A summary of land cover by Project segment along Mill Creek is shown in Figure 2.8-1. Overall, a majority of the Primary Focus Area consists of developed and agricultural land with limited vegetated land (forests and shrubs) in Segment 5.



Note: Summarized from the Walla Walla Shoreline Plan (The Watershed Company et al. 2014).

Figure 2.8-1. Summary of Land Cover (percent) of Mill Creek by Segment

2.8.1 Upland Habitat

The existing condition of upland habitat can affect the health of an adjacent stream. Upland habitat can provide important functions such as filtration and dispersal of runoff, which can improve stream health. Upland habitat in poor condition can lead to adverse impacts to stream health such as sedimentation, increased turbidity, and chemical loading that decrease water quality.

2.8.1.1 Historic

Historically, like most of the Walla Walla subbasin, upland habitat adjacent to lower Mill Creek consisted of predominantly steppe or shrub-steppe vegetation (typically consisting of a shrub overstory with a grass and herbaceous understory). The uppermost portion of the Project Area transitioning to the headwaters was dominated by dense conifer forests and meadows. During early European settlement, the upland habitat and foothills in the vicinity of lower Mill Creek were converted to a mixture of dryland agriculture and irrigated cropland near waterways (The Watershed Company et al. 2014). The upland habitat within the Primary Focus Area is within the southern portion of the Palouse Prairie Region (Bell and Hinson 2009). The historic grass species in this area included wild ryegrass, bluebunch wheatgrass (*Pseudoroegneria spicata*), and Sandberg bluegrass (*Poa secunda*).

2.8.1.2 Current

Currently, the upland areas of Segments 2 and 4 are urbanized and light industrial, while the uplands of Segment 3 are occupied by the Walla Walla city core. Outside of the developed areas of the City of Walla Walla, current upland habitat primarily consists of grazing land and irrigated cropland. Remaining upland habitat has also been degraded by a number of invasive plant species that are widespread in the Primary Focus Area. The National Park Service (NPS) identified six non-native invasive plant species that are present around the Whitman Mission Historical Site near the mouth of Mill Creek (Bell and Hinson 2009), and are likely present throughout the Primary Focus Area. Washington State University helps track county-wide noxious weeds (WSU 2016a).

While most of the upland areas within and near the Primary Focus Area have been converted into residential or ranching and agricultural use, some forested upland habitat exists at the upper portion of Segment 4 and Segment 5. However, parts of this upland located in Segment 4 reside on USACE property near the Bennington Diversion Dam and the USACE (2016c) has just completed a recent levee maintenance action that has cleared acres of forested vegetation along Mill Creek levees (see Section 2.8.3 for more details on this maintenance effort).

The upland areas around the distributary channels are similar to the rest of the Primary Focus Area. The upper portion of Yellowhawk Creek flows through residential areas then transitions to rural fields before discharging into the Walla Walla River. Garrison Creek is to the west and flows parallel to Yellowhawk Creek, but cuts closer to the urban center and dense neighborhoods of the City of Walla Walla, before flowing through rural fields to discharge in the Walla Walla River.

The uplands of the Secondary Focus Area can be generalized in two portions, with the demarcation about 2 miles upstream of where Blue Creek enters Mill Creek. The lower portion is similar to Segment 5 and predominantly rural fields used for grazing and agriculture. The upper portion transitions into the Blue Mountain foothills, where the uplands are moderately steep slopes that are a mixture of forest, bare ridges, and the occasional low meadow.



Figure 2.8-2. Upland Field, with Wetland Plants Evident in the Foreground

2.8.2 Wetlands

Wetlands play an important role in riverine ecological functions, such as decreasing peak flows, flood water storage, filtering of pollutants, and providing refugia and food sources for wildlife and macroinvertebrates. Even with the conversion of most of the Mill Creek area to agricultural, ranching, and developed land use, remnant wetlands still remain. Every segment of Mill Creek flows through some wetlands or has them nearby. Garrison Creek flows through a large wetland complex located roughly in the middle of its flow pathway. Yellowhawk Creek has a collection of small wetlands near where Russell Creek enters the larger stream.

Figure 2.8-3 summarizes wetland acreage adjacent to Mill Creek based on wetlands mapped by the National Wetland Inventory (NWI) for Walla Walla County by Segment. Figure 2.8-4 shows

wetland conditions within the bankfull extent of Mill Creek. Figures 2.8-5 to 2.8-8 are aerial maps that show the location and relative size of the NWI-mapped wetlands around Mill Creek. Figure 2.8-9 shows the location of the NWI-mapped wetlands around Yellowhawk and Garrison Creeks, and Figure 2.8-10 shows the Secondary Focus Area.

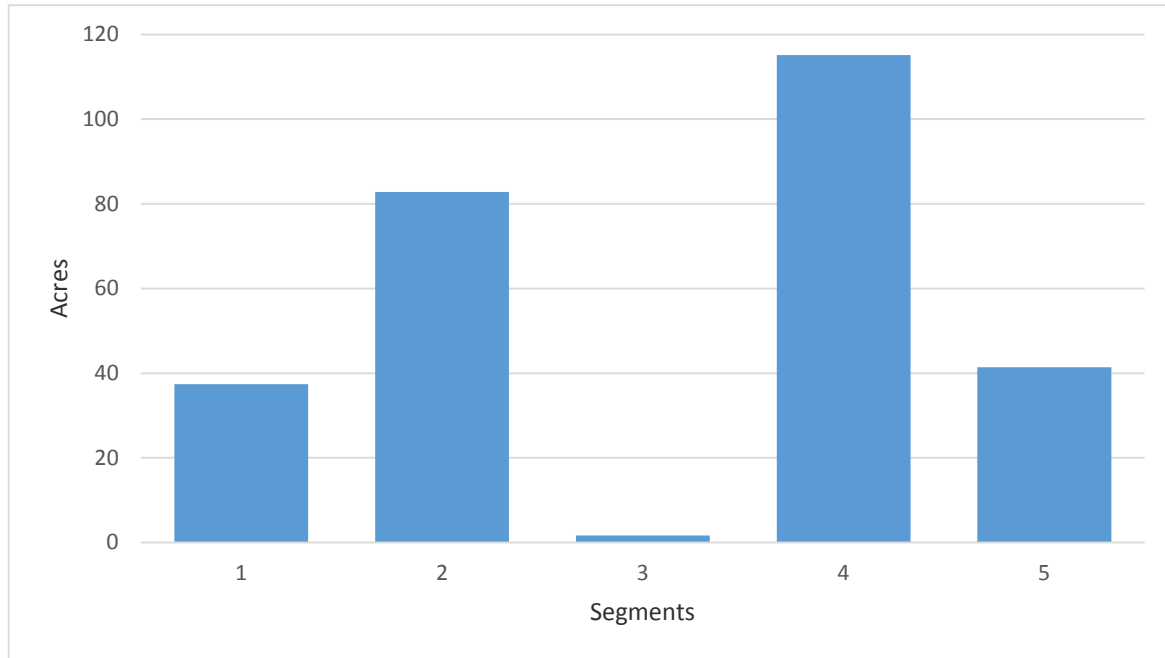


Figure 2.8-3. Wetland Area (acres) Adjacent to Lower Mill Creek by Project Segment



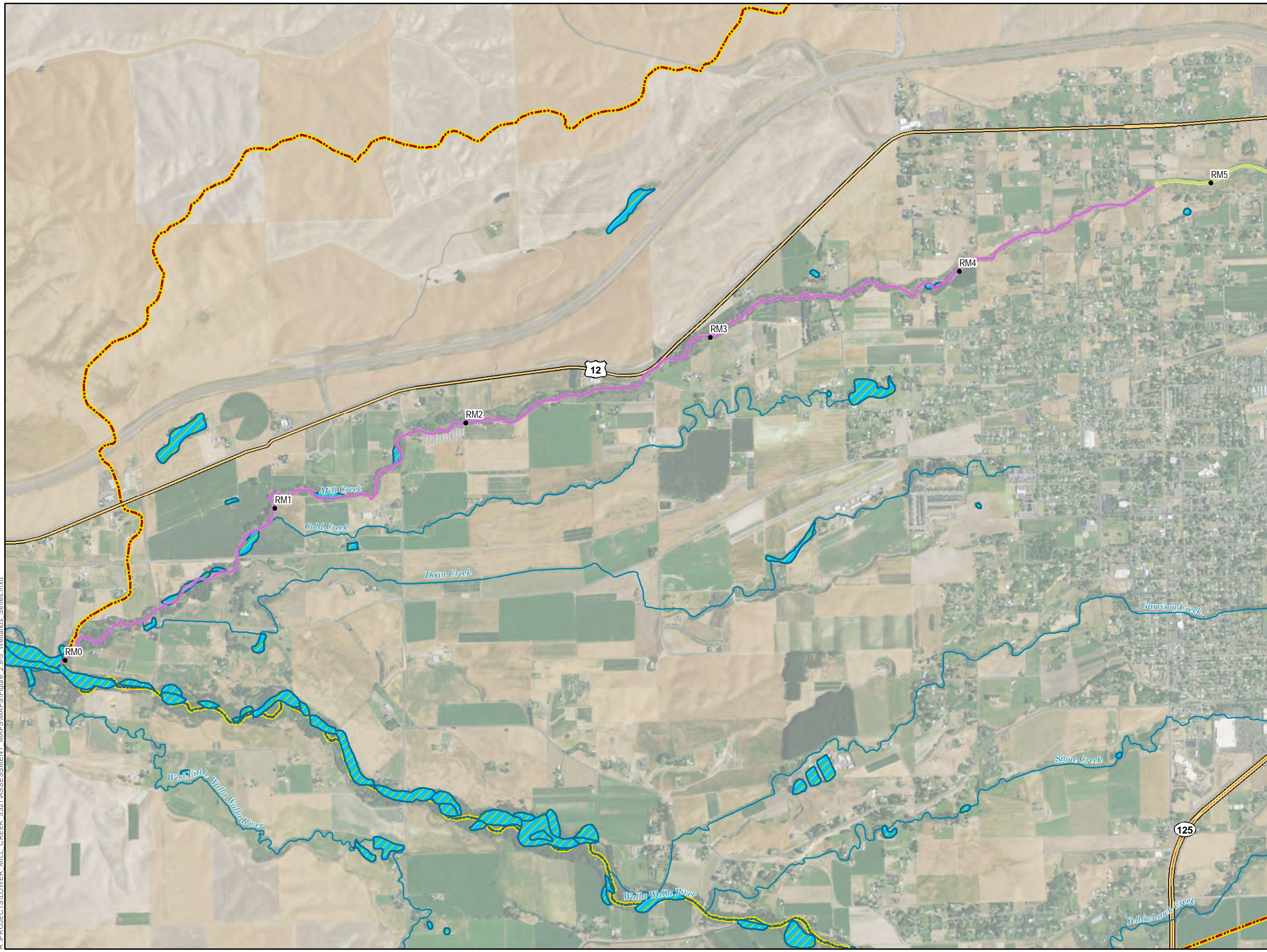
Figure 2.8-4. Wetland Adjacent to Lower Mill Creek

**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

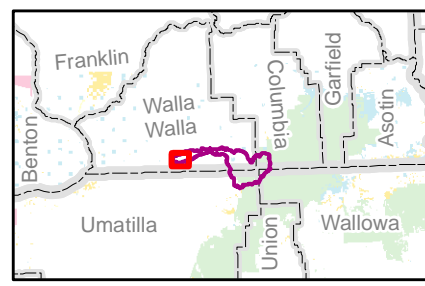
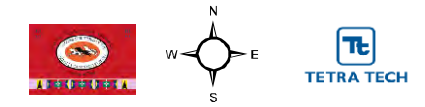
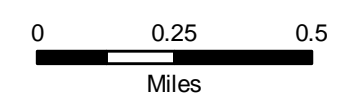
CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE 2.8-5
WETLANDS:
SEGMENT 1**

- River Miles
- Segment 1
- Segment 2
- Stream
- Waterbody
- NWI Wetland
- Project Area
- Primary Focus Area
- Secondary Focus Area



Sources: CTUIR, Walla Walla County, StreamNet, NWI



R:\PROJECTS\LOWER MILL CREEK 5321\ASSESSMENT MAPS\MAPS\Figure 2.8-5 Wetlands Series.mxd

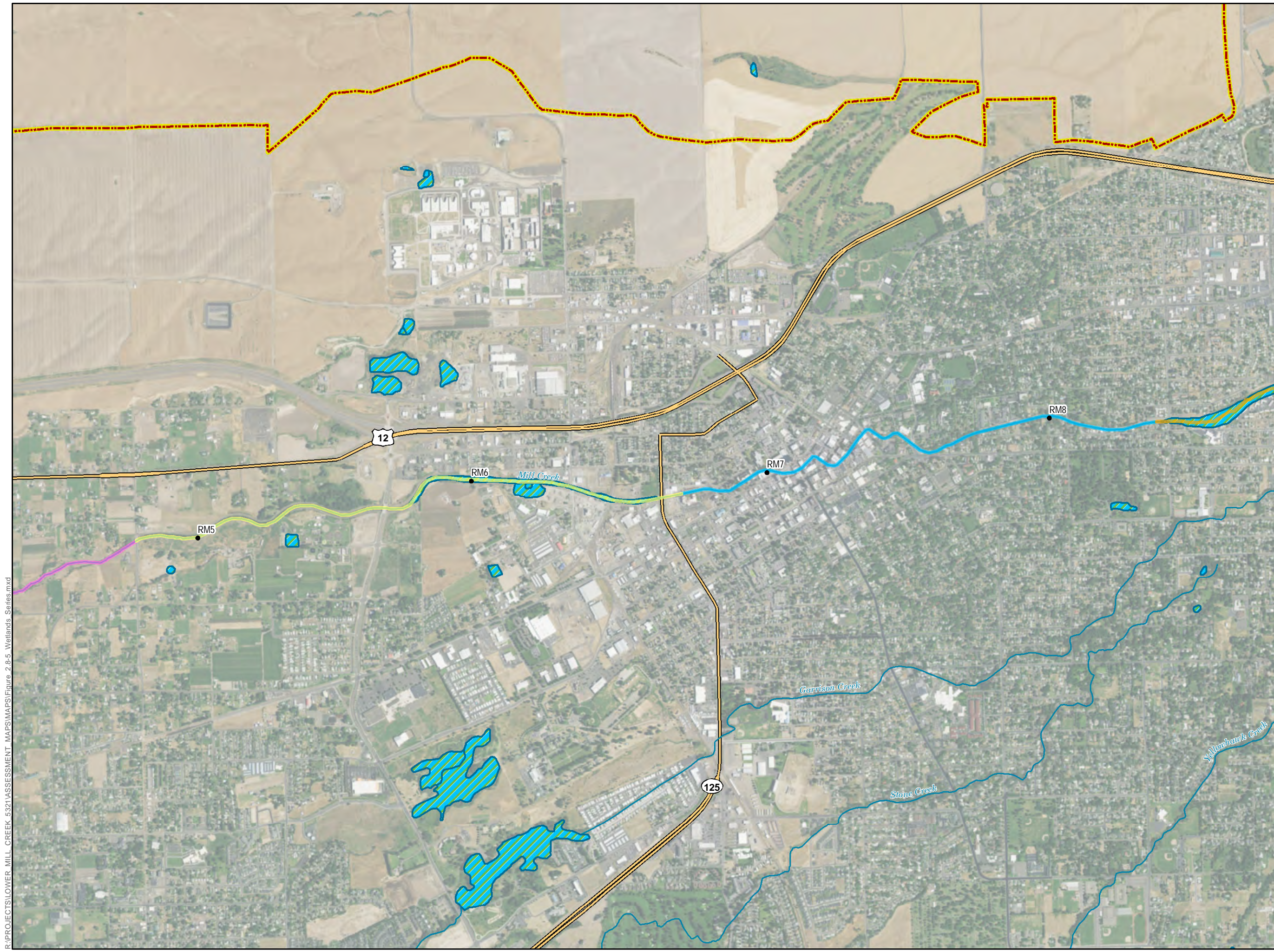
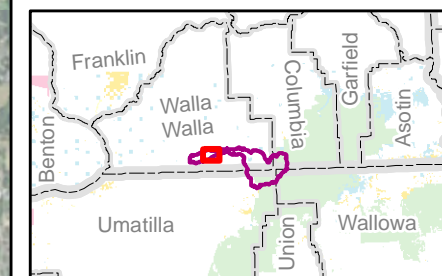
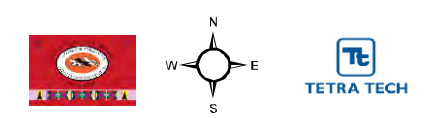
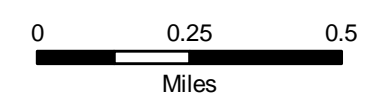
**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE 2.8-6
WETLANDS:
SEGMENTS 2 AND 3**

- River Miles
- Segment 1
- Segment 2
- Segment 3
- Segment 4
- Stream
- Waterbody
- NWI Wetland
- Project Area
- Primary Focus Area
- Secondary Focus Area

Sources: CTUIR, Walla Walla County, StreamNet, NWI



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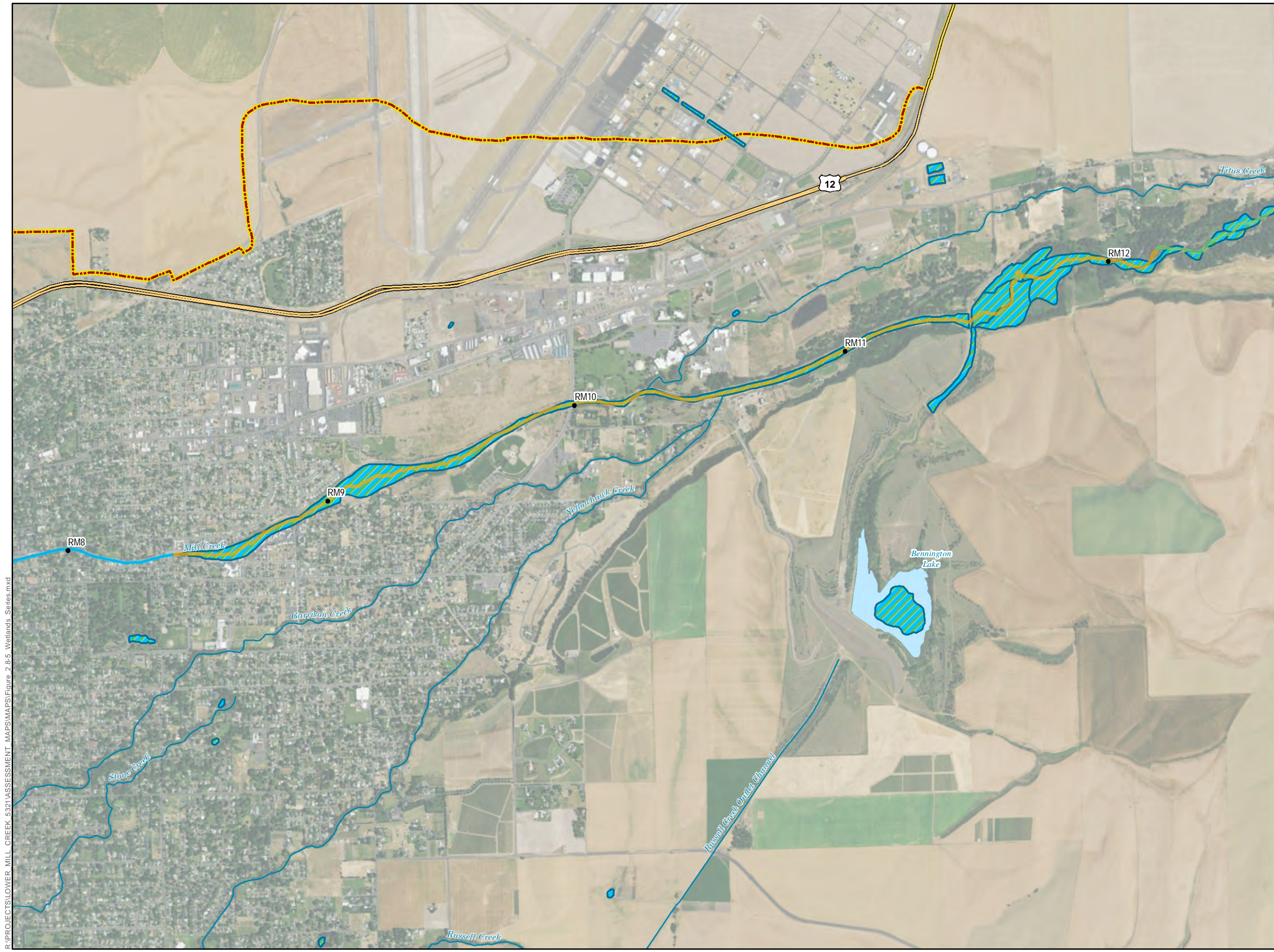
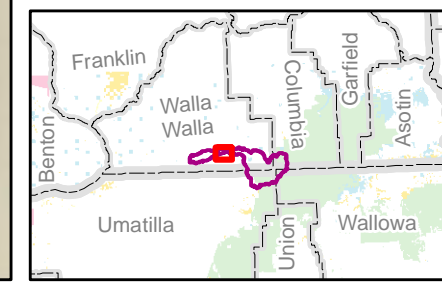
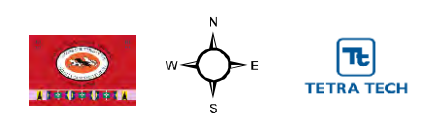
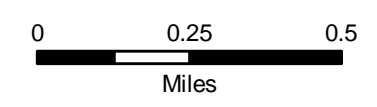
**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE 2.8-7
WETLANDS:
SEGMENT 4**

- River Miles
- Segment 3
- Segment 4
- Segment 5
- Stream
- Waterbody
- NWI Wetland
- Project Area
- Primary Focus Area
- Secondary Focus Area

Sources: CTUIR, Walla Walla County,
StreamNet, NWI



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**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

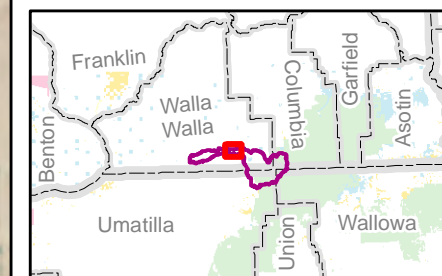
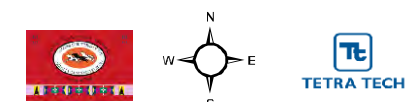
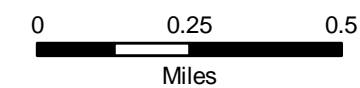
CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE 2.8-8
WETLANDS:
SEGMENT 5**

- River Miles
- Segment 4
- Segment 5
- Stream
- Waterbody
- NWI Wetland
- Project Area
- Primary Focus Area
- Secondary Focus Area



Sources: CTUIR, Walla Walla County, StreamNet, NWI



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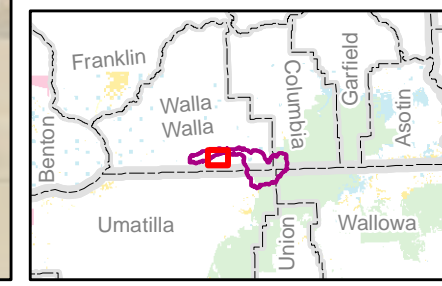
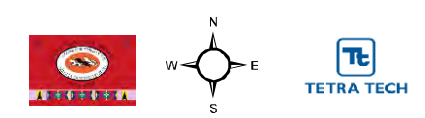
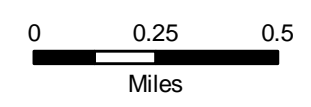
LOWER MILL CREEK HABITAT AND PASSAGE ASSESSMENT

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE 2.8-9
WETLANDS:
YELLOWHAWK/GARRISON**

- River Miles
- Segment 2
- Segment 3
- Segment 4
- Stream
- Waterbody
- NWI Wetland
- Project Area
- Primary Focus Area
- Secondary Focus Area

Sources: CTUIR, Walla Walla County,
StreamNet, NWI



R:\PROJECTS\LOWER_MILL_CREEK_5321\ASSESSMENT_MAPS\MAPS\Figure 2.8-9 Wetlands_Series.mxd

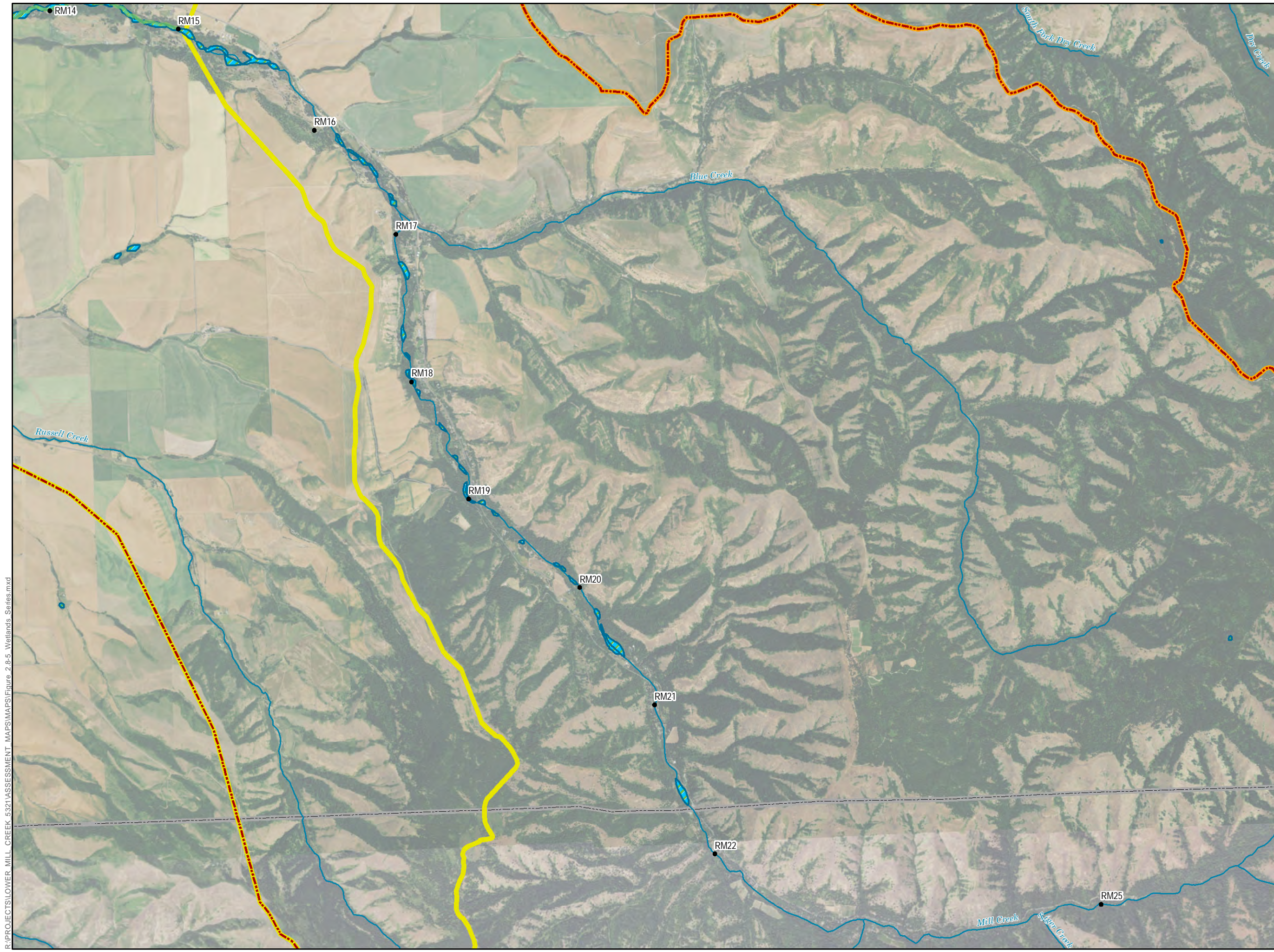
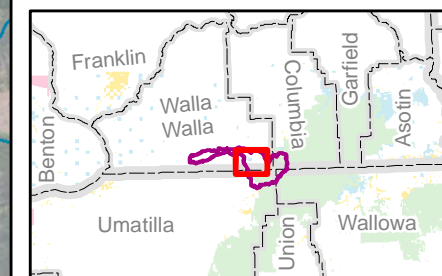
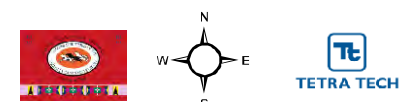
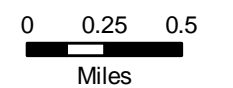
**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE 2.8-10
WETLANDS:
SECONDARY FOCUS AREA**

- River Miles
- Segment 5
- Stream
- Waterbody
- NWI Wetland
- Project Area
- Primary Focus Area
- Secondary Focus Area

Sources: CTUIR, Walla Walla County, StreamNet, NWI



R:\PROJECTS\LOWER MILL CREEK_5321\ASSESSMENT_MAPS\MAPS\Figure 2.8-5 Wetlands_Series.mxd

2.8.3 Riparian Vegetation

Riparian vegetation plays an important role in overall stream health and productivity (FEMAT 1993, Spence et al. 1996, Naiman et al 1998, Poff et al. 2011). Riparian tree cover provides shade, which reduces stream temperatures (FEMAT 1993). Additionally, riparian vegetation supplies organic input to streams, including insects and leaf matter, which provide direct and indirect food sources for fish (Murphy and Meehan 1991). Where trees are present, riparian areas are the main source of LWD to streams (Bisson et al. 1987). LWD helps create important stream habitat, such as pools, and moderates sediment storage and movement within a stream system. Riparian areas also help filter runoff, thereby reducing the delivery of fine sediments and potentially undesirable toxins or oversupply of nutrients to stream systems. Lastly, root systems of riparian vegetation stabilize stream banks, reducing erosion potential and increasing channel complexity (FEMAT 1993).

2.8.3.1 Historic

During Lewis and Clark's upstream journey along the Walla Walla River to the Touchet River in 1806, dense riparian corridors were noted within the Walla Walla subbasin. Other explorers (Fremont 1840 expedition and Mullan 1850 expedition) later noted the same conditions, with occasional clearings in the riparian vegetation (Parks et al. 2010). This suggests that much of the severe degradation of riparian habitat occurred during early settlement (mid-1800s to early 1900s) prior to the first aerial flight in 1939 (Parks et al. 2010).

2.8.3.2 Current

The Walla Walla County Shoreline Plan (The Watershed Company et al. 2014) ranks the riparian condition as "not properly functioning" for Mill Creek from its mouth to Bennington Diversion Dam. This is primarily due to the nearly complete lack of riparian vegetation, between of the start of urban development (approximately around Gose Street crossing) extending to just downstream of Bennington Diversion Dam where some limited riparian vegetation is beginning to establish.

A 2006 assessment of Mill Creek riparian conditions focused on the middle portion of the creek, starting at mid-Segment 4 (downstream of the Yellowhawk Creek bifurcation) and extending upstream beyond Segment 5 (to the Washington/Oregon state line) (Parks et al 2010). This review of aerial photography from 1939 to 2006 indicated that riparian conditions along Mill Creek have essentially remained consistent over the last 70 years since the original habitat degradation that occurred in the mid-1800s. Riparian habitat degradation came from

infrastructure development and land clearing for agriculture, while vegetation management and continued floodplain disconnection contribute to current riparian vegetation limitations. Current riparian vegetation (where existing) is dominated by 30- to 45-foot-tall stands of medium to mature black cottonwood (*Populus balsamifera* subsp. *trichocarpa*) and white alder (*Alnus rhombifolia*) stands, with intermittent black locust (*Robinia pseudoacacia*). The understory is dominated by herbaceous, nonnative, invasive species, such as reed canarygrass (*Phalaris arundinacea*), Himalayan blackberry (*Rubus armeniacus*), and sweetbriar rose (*Rosa rubiginosa*). Additionally, hounds tongue (*Cynoglossum officinale*), mullein (*Verbascum thapsus*), thistle, poison hemlock (*Conium maculatum*), and Japanese knotweed (*Polygonum cuspidatum*) are all present and could easily spread (Bell and Hinson 2009).

Existing riparian conditions in each segment were reviewed utilizing georeferenced aerial photography and site-specific photo-documentation. Table 2.8-1 summarizes the results of this assessment of existing riparian vegetation conditions of lower Mill Creek and distributaries.

Table 2.8-1. Summary of Riparian Vegetation Conditions of Lower Mill Creek and Distributaries^{1/}

Focus Area	Riparian Corridor Density	Percent of Segment with Canopy Cover
Segment 1	Moderate	25 < 50
Segment 2	Minimal	0 < 10
Segment 3	Minimal	0 < 10
Segment 4	Low	25 < 50
Segment 5	High	75
Yellowhawk Creek	Moderate	50 < 75
Garrison Creek	Low	25 < 50

^{1/}Based on aerial and photo review of the Focus Area.

The riparian vegetation conditions in Table 2.8-1 are briefly described for each segment in the subsections below, including a representative photograph of riparian conditions in each segment. Additional representative photographs for each segment can be found in Section 2.8.4, Stream Habitat.

Segment 1

The riparian zone in Segment 1 could best be described as a fragmented riparian corridor, but it is more intact overall than the majority (Segments 2, 3, and 4) of lower Mill Creek within the Primary Focus Area. It contains patchy stands of riparian vegetation along the entire length of the segment, interspersed with reed canarygrass and other invasive vegetation (Figure 2.8-11). The Upper Columbia Basin Network Stream Channel Characteristics and Riparian Condition



Source: Starkey (2015b)

Figure 2.8-11. Existing Riparian Vegetation Conditions in Segment 1 near the Whitman Mission Historical Site

report (Starkey 2015b) provides summary information for four test sites (two on Mill Creek, two on Doan Creek) in the Segment 1 area, with metric explanations in the appendices. The total cover for the Mill Creek samples averaged in the low 70s for percent cover (combination of greenline and cross section cover at above 1 meter and below 1 meter), whereas the greenline woody cover value averaged as 33.4 percent. The second value appears to be more in line with Segment 1 cover estimates, based on field photographs and aerial images.

Segment 2

Riparian vegetation is mostly non-existent in Segment 2 with little to none established along the banks of the levees. The levees are typically exposed gravel and riprap with the occasional patch of grass or aquatic vegetation. Where riparian vegetation is present, it is often separated from the creek by an access road or other manmade structure. The photograph in Figure 2.8-12 shows typical riparian conditions in Segment 2. In this example, the left bank is mostly barren;

however, there is some riparian vegetation present beyond the riprap and access road on the right bank. Figure 2.8-12 also shows development encroachment along the left bank of the levee. Development encroachment limits the opportunities for riparian vegetation along the stream corridor.



Figure 2.8-12. Existing Riparian Vegetation Conditions in Segment 2

Segment 3

There is little riparian vegetation in Segment 3. This segment is located within the urban area of Walla Walla and is essentially devoid of riparian vegetation; however, there are isolated mature trees. The majority of the stream shading in this segment comes from surrounding buildings. The photograph in Figure 2.8-13 shows a few isolated trees set in a maintained grassy yard next to the cement bank along lower Mill Creek.



Figure 2.8-13. Existing Riparian Vegetation Conditions in Segment 3 near Wildwood Park

Segment 4

The riparian vegetation conditions in Segment 4 are similar to those in Segment 2 except that isolated pockets of in-stream vegetation and limited riparian vegetation are established at the upstream extent of the segment. While existing riparian vegetation conditions are still constrained, they are improved relative to Segments 2 and 3, particularly in the upstream extent of the segment. The photograph in Figure 2.8-14 shows an example of existing conditions with no riparian vegetation on the right bank and a narrow band of riparian vegetation on the left bank. Despite a lack of a continuous riparian corridor, this segment has abundant aquatic vegetation, which is vulnerable to channel dredging operations.



Figure 2.8-14. Segment 4 Representative Photo of Riparian Conditions (facing upstream)

However, even though riparian conditions slowly improve when progressing upstream, it is important to note that the USACE has recently completed a levee maintenance project on their property, which cut down all standing woody vegetation on the levee and up to 15 feet away from the established toe line. This project was started in October 2015 and was finished in early 2016. This maintenance policy adversely affects existing riparian habitat conditions, removing an estimated 6 acres worth of riparian and upland vegetation (USACE 2016d). Figure 2.8-15 shows the area of removed vegetation, and Figure 2.8-16 outlines the portion of Mill Creek that was adversely affected by this action. The USACE vegetation management strategy uses goats for biological control in addition to mechanical vegetation removal.



Figure 2.8-15. Example of Vegetative Clearing in Segment 4.

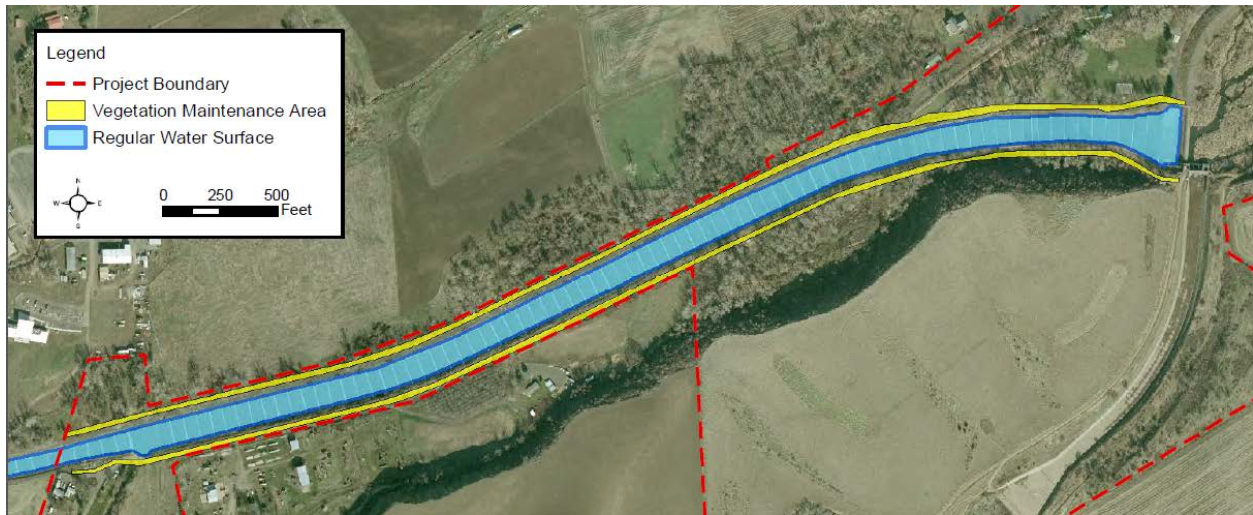


Figure 2.8-16. Map Illustrating the Extents of the 2015 USACE Vegetation Maintenance Project

Segment 5

Riparian conditions improve dramatically over the preceding segments, yet still are not as connected or dense as the riparian conditions in the headwaters. The riparian tree canopy and subcanopy provided by cottonwood and alders form a mostly consistent corridor. Much of Segment 5 ground cover is still dominated by reed canarygrass, which creates a dense mat that

makes it difficult for other plant species to get established. Figure 2.8-17 shows the continuous riparian corridor in the distance.



Figure 2.8-17. Riparian Conditions of Segment 5

Secondary Focus Area

The riparian conditions along the upper portions of Mill Creek appear to be functioning properly. The lower portion is quite similar to Segment 5, with a mostly intact riparian corridor on both banks of Mill Creek, backed with upland fields. The foothills and headwaters located upstream of Blue Creek are characterized by a dense, multi-story riparian corridor backed by valley slopes. Figure 2.8-18 shows robust riparian canopy cover with well-established shrubs on both sides of the creek.



Figure 2.8-18. Riparian Corridor of Upper Mill Creek

Distributaries

Yellowhawk Creek typically has a more robust riparian corridor than most of the Primary Focus Area. It is still intermittent, with back yards and other urban uses interrupting connectivity. Figure 2.8-19 shows conditions typical of the vegetated upper portion of Yellowhawk Creek, with a moderate riparian corridor that is routinely interrupted by residential properties. Garrison Creek had only limited riparian vegetation, consisting of reed canarygrass, willows, and cattails. Historically, the area below the sewage treatment plant had some of the most robust riparian area for Garrison Creek (Figure 2.8-20), most of which was later removed or otherwise severely curtailed. Titus Creek is almost completely lacking any tall canopy trees, except at the uppermost extent (WDFW 2011) and at the lower end on the WWCC campus. Assessing from aerial imagery, both Doan and Cold creeks have riparian conditions somewhat similar to Segment 1, but with more isolated patches of vegetation interrupted by agricultural fields.



Figure 2.8-19. Typical Conditions of Yellowhawk Creek with a Residential Yard Splitting the Riparian Corridor.

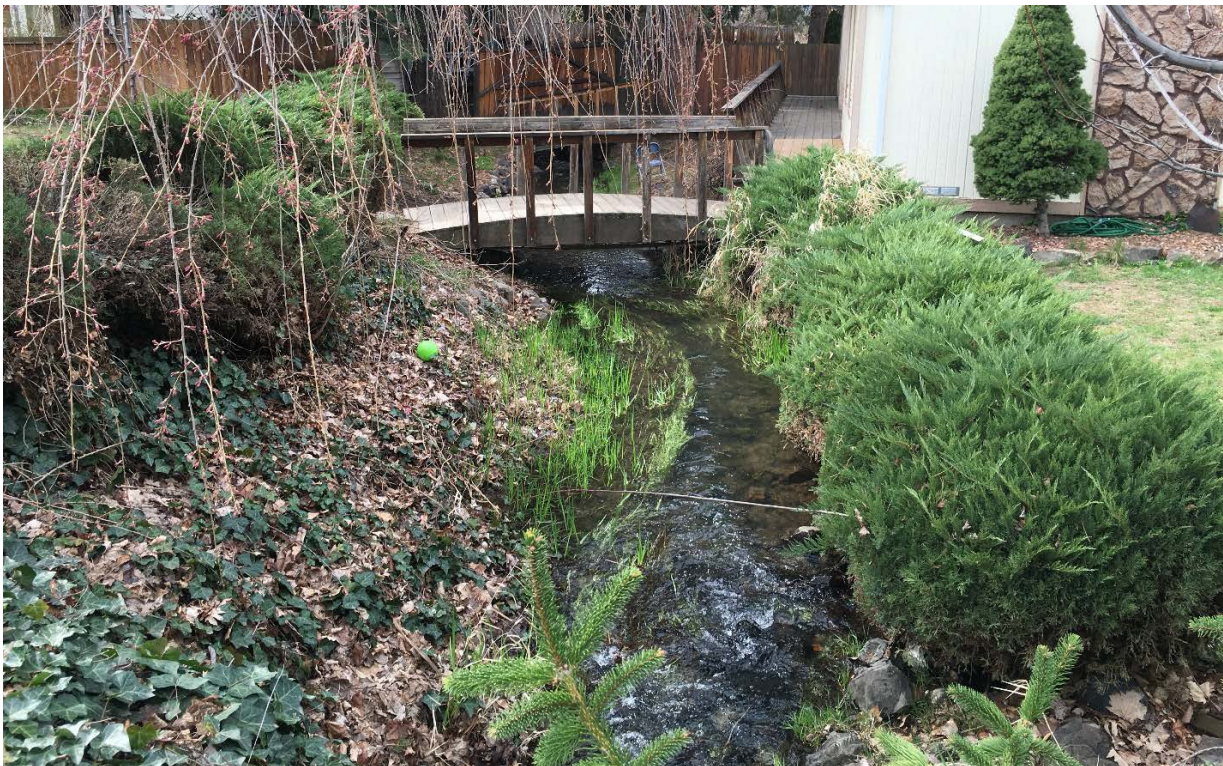


Figure 2.8-20. Typical Riparian Conditions of Garrison Creek, near Garden Drive

2.8.4 Stream Habitat

Properly functioning stream habitats are a result of physical factors (gradient, sinuosity, substrate composition), flows (wetted areas, pool depth, and frequency), water quality, and biological components (LWD, riparian vegetation, and canopy cover) that combine to create suitable conditions for a variety of life stages of aquatic species. When parts of this complex interaction are interrupted or degraded, aquatic species become restricted or prevented from occupying their historic ranges. Additionally, aquatic habitat conditions are considered to be a key factor needing improvement to aid in recovery of the ESA listed Mid-C steelhead and likely other focal species. The distribution figures in Section 2.7.1 also display known spawning, rearing, and migration habitat, for the focal species: steelhead (Figures 2.7-2 and 2.7-3), spring Chinook (Figures 2.7-6 and 2.7-7) and bull trout (Figures 2.7-10 and 2.7-11) (StreamNet 2012).

2.8.4.1 Historic

Prior to concentrated human settlement, the Mill Creek watershed was a free-flowing system, likely comprising pool riffle complexes with numerous off-channel habitats, springs, and streams in the lower watershed (NPCC 2005). The distributary system resulted from the alluvial fan created when Mill Creek exits the Blue Mountains, dropping sediment as it works its way to the confluence with the Walla Walla River. This system would naturally have flooded during high flows, distributing water and sediment across the alluvial fan, creating floodplain channels, backwaters, and elevated ponded areas (NPCC 2005) that could contribute delayed hyporheic return flow to the stream channels during lower flows.

As discussed earlier, historic accounts of the Walla Walla subbasin point to dense riparian vegetation along the stream banks, suggesting much of stream bank would have been vegetated and occupied by mature trees at higher elevations and flood-tolerant species in more dynamic areas (NPCC 2005). As shown in Section 2.3.1, by historical records there were multiple distributary channels that diverged from Mill Creek in the vicinity of Walla Walla (Figures 2.3-2a and 2.3-2b). Distributary channels that have low gradient typically supply good spawning habitat due to the presence of gravel substrate, and good rearing habitat often with cool water and natural accumulation of local and transported wood that would aid in development of good pool habitat (Paustian and Kelliher 2010). Typical alluvial fan channels have close connections to groundwater, which would moderate higher summer temperatures. The historical record of multiple artesian wells in the region indicates there was likely substantial groundwater coming near the surface, which would have helped feed these distributaries with cool water. As noted in Section 2.8.3, riparian vegetation would also have been greater than is

currently present, which would have supplied LWD, shade to maintain cooler temperatures, and allochthonous food sources for fish. Connectivity of distributaries to the mainstem would have allowed active movement of fish between the distributaries and Mill Creek.

The foothills of the upper watershed were likely forested with occasional open meadows in the valleys. These open meadows may have been maintained by the native tribes through the use of fire to manipulate the proper environmental conditions for subsistence hunting and gathering (WWBWC 2004). The headwaters were likely heavily forested and dominated by thick woodlands shading the stream (NPCC 2004).

2.8.4.2 Existing

The lower segments of Mill Creek have undergone moderate to extreme habitat modifications (NPCC 2005). The majority of the Primary Focus Area is well urbanized and heavily modified, and is an example of degraded habitat conditions. Loss of flow from water diversions in the system has also played a major role in limiting habitat in the portions of lower Mill Creek which includes full water rights allocation of flows passing through the City of Walla Walla (see hydrology section 2.5.3). Current flow below the Bennington Diversion Dam averages 2 to 4 cfs for three summer months, while one study recommends minimum flows in the range of 45 to 72 cfs in the summer for protection of fish species in the Primary Focus Area (Stillwater Sciences 2013) (see Section 2.5.3). Stillwater Sciences 2013 also recognizes that base flows may be less during summer months than the recommended 45 to 72 cfs. The City of Walla Walla's Federal Energy Regulatory Commission license agreement requires that they limit their upstream water diversion to meeting minimum flows at the Kooskooskie USGS gage (14013000) near the Oregon border. The Caldwell (et al. 2002) instream flow study uses the IFIM to provide information on the relationship between stream flow and fish habitat by looking at four key variables (depth, flow velocity, substrate, and cover). This study shows that fish habitat in Mill Creek peaks at 75 cfs for steelhead spawning, 60 cfs for juvenile steelhead migration, and 35 cfs for Chinook juveniles (Caldwell et al. 2002). There are also Washington State minimum flow recommendations at the Kooskooskie gage (WWWPU 2005); however, there are no minimum in-stream flow standards established for stream habitat protection through the remaining downstream portion of Mill Creek, resulting in near or at zero stream flows in some portions of the Primary Focus Area during certain times of the low-flow months (see Section 2.5.3.2 for additional details regarding in-stream flows). Figures 2.8-21 through 2.8-24 characterize habitat conditions for the mainstem of Mill Creek for the Primary Focus Area, along with additional supporting photographs.

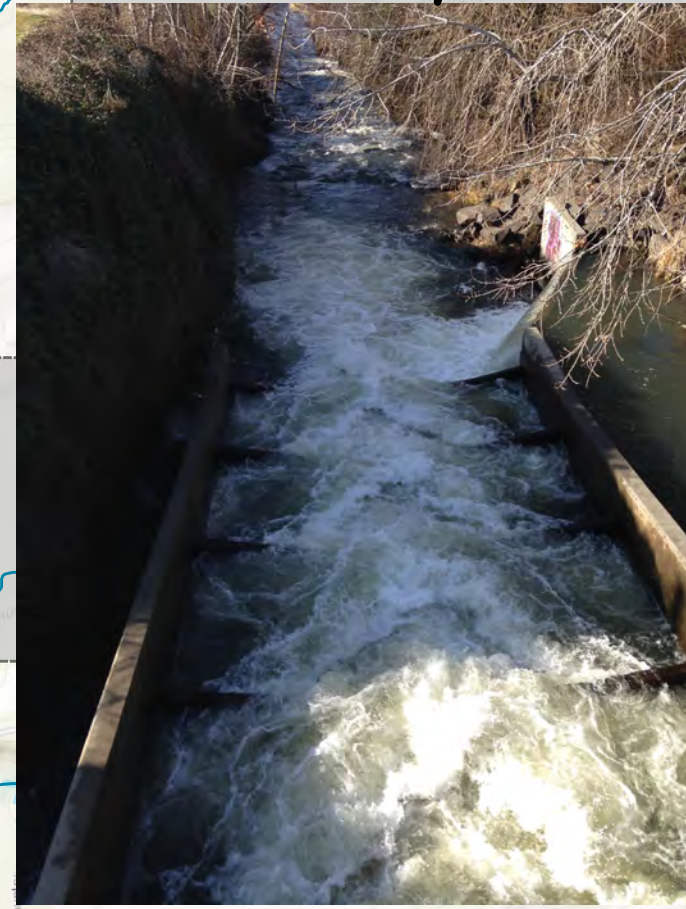
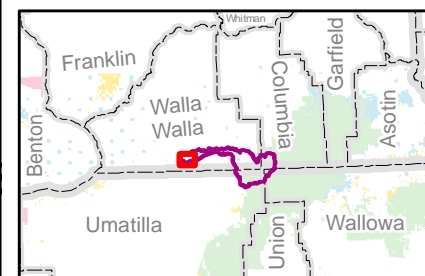
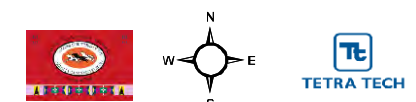
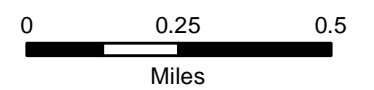
**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE 2.8-21
AERIAL HABITAT
ASSESSMENT
SEGMENT 1**

- River Miles
- ▲ Cold Water Spring Input
- Stream
- Aerial Habitat Assessment**
- Pool Riffle
- Step Pool
- Reach Break
- Waterbody
- Project Area
- Primary Focus Area
- Cities

Sources: CTUIR, Walla Walla County, StreamNet



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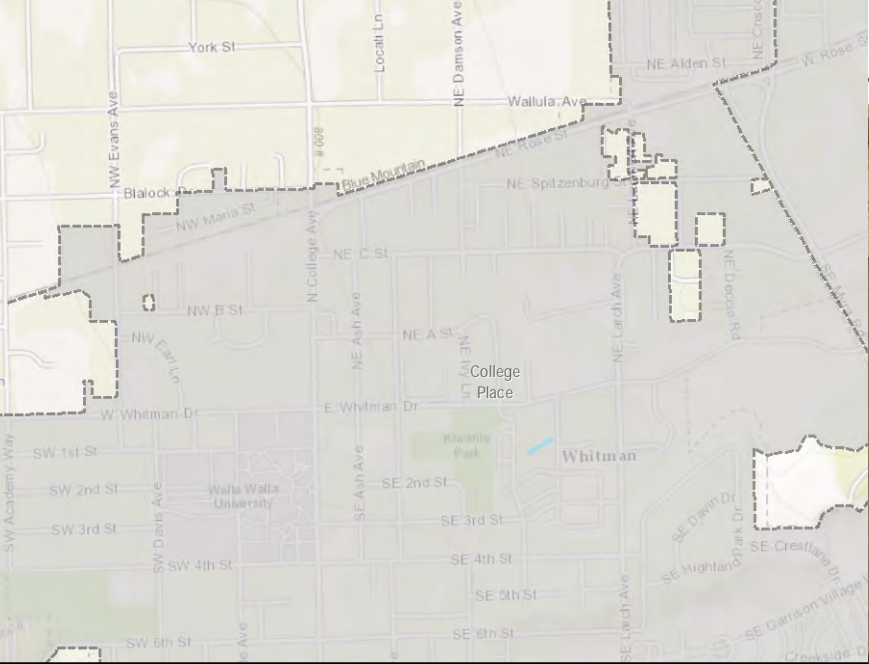
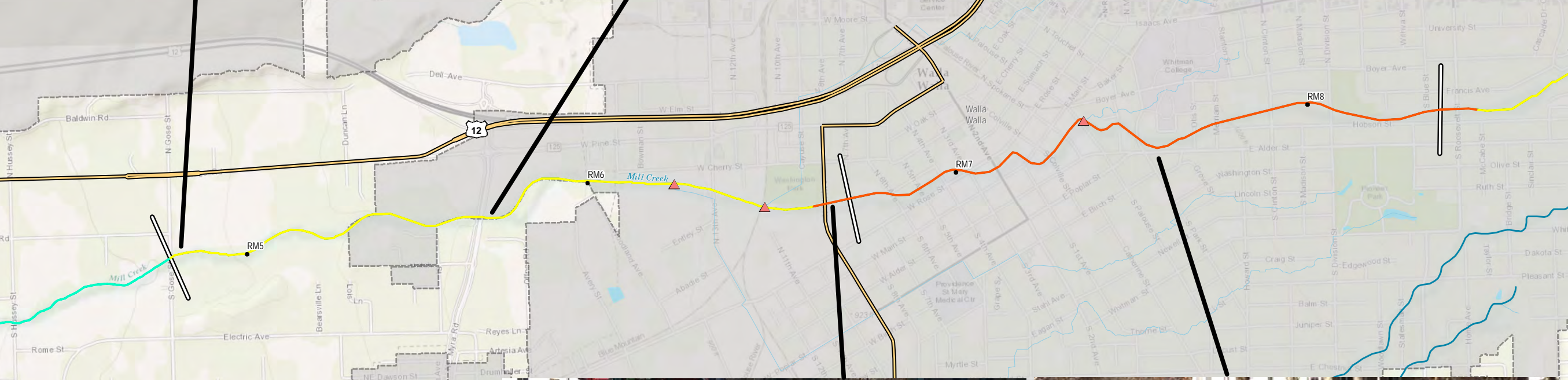
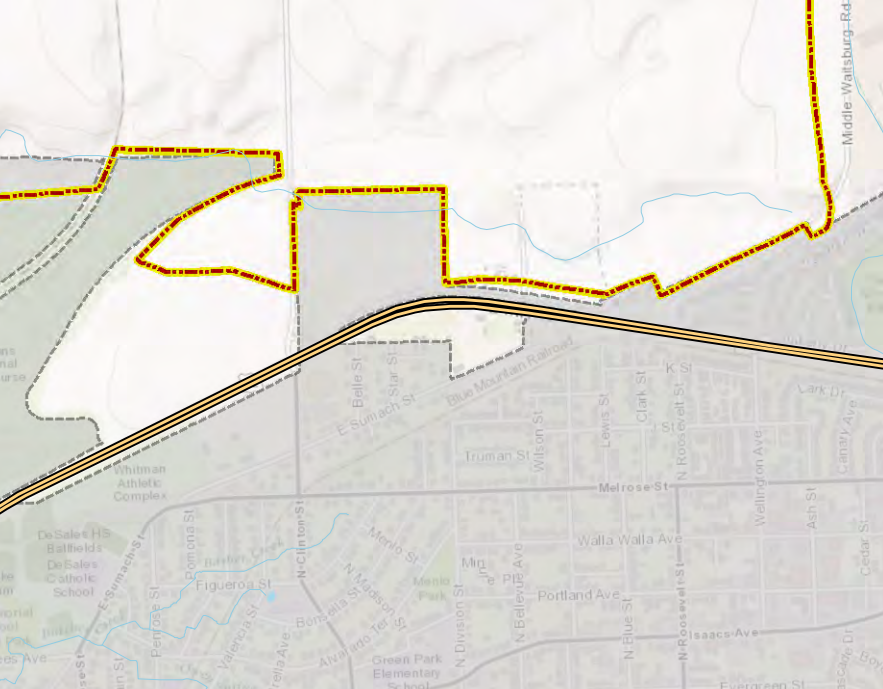
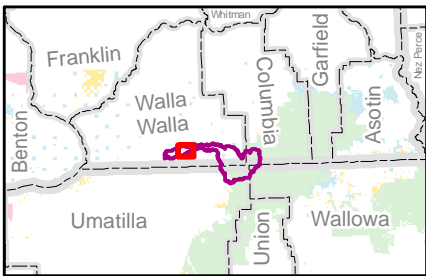
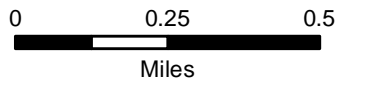
**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE 2.8-22
AERIAL HABITAT
ASSESSMENT
SEGMENTS 2 AND 3**

- River Miles
- ▲ Cold Water Spring Input
- Stream
- Aerial Habitat Assessment**
- Concrete
- Pool Riffle
- Step Pool
- Reach Break
- Waterbody
- Project Area
- Primary Focus Area
- Cities

Sources: CTUIR, Walla Walla County, StreamNet



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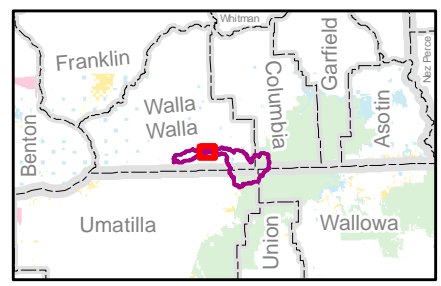
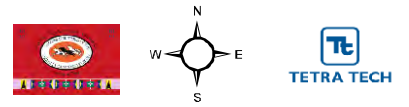
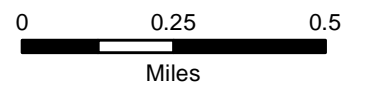
**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE 2.8-23
AERIAL HABITAT
ASSESSMENT
SEGMENT 4**

- River Miles
- Stream
- Aerial Habitat Assessment
- Concrete
- Pool Riffle
- Step Pool
- Reach Break
- Waterbody
- Project Area
- Primary Focus Area
- Cities

Sources: CTUIR, Walla Walla County, StreamNet



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**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE 2.8-24
AERIAL HABITAT
ASSESSMENT
SEGMENT 5**

- River Miles
- Stream
- Aerial Habitat Assessment
 - Pool Riffle
 - Step Pool
- Reach Break
- Waterbody
- Project Area
- Primary Focus Area
- Secondary Focus Area
- Cities

Sources: CTUIR, Walla Walla County, StreamNet

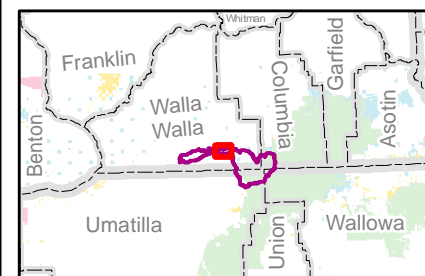
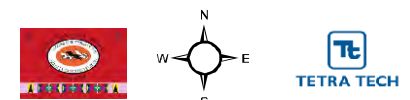
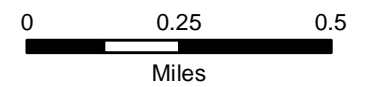


Table 2.8-2 defines the minimal and optimal habitat condition by habitat metric for the Primary Focus Area using the metrics from Table 1.2-1. The minimal and optimal habitat condition definitions for most metrics were modified from the pathways and indicators matrix from NMFS (1996) for salmon and steelhead which is similar to the bull trout pathways and indicators matrix (USFWS 1998). The habitat factors and objectives determined for Mill Creek by SRSRB (2011) were also considered. The values for existing conditions are compared to these values for each of the five Project Area segments and are presented in the discussion following the table.

Table 2.8-2. Defining Minimal and Optimal Habitat Conditions

Metrics	Minimal Conditions	Optimal Conditions
Pool Frequency (Based on Channel width)	5 feet wide requires 184 pools per mile	5 feet wide requires 184 pools per mile
	10 feet wide requires 96 pools per mile	10 feet wide requires 96 pools per mile
	15 feet wide requires 70 pools per mile	15 feet wide requires 70 pools per mile
	20 feet wide requires 56 pools per mile	20 feet wide requires 56 pools per mile
	25 feet wide requires 47 pools per mile	25 feet wide requires 47 pools per mile
	50 feet wide requires 26 pools per mile	50 feet wide requires 26 pools per mile
	75 feet wide requires 23 pools per mile	75 feet wide requires 23 pools per mile
	100 feet wide requires 18 pools per mile	100 feet wide requires 18 pools per mile
	and Inadequate structures to sustain pools over time	and Adequate structures to sustain pools over time
Percent Pool Area	10-90% pool area	30-60% pool area
Pool Quality	25% of pools are >1 meter deep; limited cover and warm water	50% of pools should be >1 meter deep with good cover and cool water.
Relative Habitat Abundance	10-90% Pool	30-60% Pool
	10-90% Riffle	30-60% Riffle
	10-90% Glide	30-60% Glide
Relative Feature Abundance	1 structure per pool	3 or more structures per pool
Relative abundance of spawning and rearing habitat	5-10% Spawning	>10% Spawning
	20-50% Rearing	>50% Rearing
LWD Counts	>20 pieces per mile; 12 inches diameter and >35 feet long	>20 pieces per mile; 12 inches diameter and >35 feet long
LWD Budget	Adequate source and transport of LWD into site	Adequate source and transport of LWD into site
Riparian Vegetation	>50% intact riparian corridor	>80% intact riparian corridor
Canopy Cover	>50% wetted channel coverage	>75% wetted channel coverage
Percent of Bank with Vegetation (within 5 meters)	>50% bank coverage	>75% bank coverage
Substrate	Gravel/Cobble subdominant	Gravel or Cobble dominant substrate
Embeddedness	20-30% embeddedness	<20% embeddedness

Note: See Tables 2.5-6 and 2.5-7 for current, minimal, and optimal flows and floodplain connectivity.

Segment 1 – Low Gradient, Semi-Natural Channel

This segment begins at the mouth and extends upstream to the start of the flood control zone. It is a semi-natural channel, providing limited rearing habitat and minimal spawning for Chinook and steelhead (Mahoney et al. 2012). WDFW has stated that restoration projects around the Whitman Mission National Historical property have enhanced available habitat and could support both Chinook and coho (Bell and Hinson 2009). Additionally, bull trout use this segment for migration during fall through spring.

Starkey (2015b) performed stream channel surveys at the Whitman Mission Historical Site, which is only a short distance upstream from the mouth. The results of these samples indicated an average of 19.8 meters bankfull width with 35.8 percent of the sampled area as pool habitat; the frequency was 15.2 pools per kilometer and a residual depth of 0.8 meter. LWD frequency was surprisingly high, estimated at 331.7 pieces per kilometer. Streambank conditions appear to be fairly stable, anchored with thick swaths of reed canarygrass. Table 2.8-3 summarizes existing versus minimal and optimal habitat conditions for Segment 1.

Table 2.8-3. Segment 1 Current, Minimal, and Optimal Habitat Conditions

Metrics	Current Conditions	Minimal Conditions	Optimal Conditions
Pool Frequency (Bankfull is 48 feet)	~26 pools per mile	26 pools per mile for channel width of 50 feet; inadequate structures to sustain pools	26 pools per mile for channel width of 50 feet; adequate structures to sustain pools
Percent Pool Area	40%	10-90% pool area	30-60% pool area
Pool Quality	Roughly 25% of pools are 1 meter deep with some cover and warm water	25% of pools are >1 meter deep; limited cover and warm water	50% of pools should be >1 meter deep with good cover and cool water.
Relative Habitat Abundance	40% Pool 20% Riffle 40% Glide	10-90% Pool 10-90% Riffle 10-90% Glide	30-60% Pool 30-60% Riffle 30-60% Glide
Relative Feature Abundance	On average 1 structure per pool	1 structure per pool	3 or more structures per pool
Relative abundance of spawning and rearing habitat	<10% Spawning <50% Rearing	5-10% Spawning 20-50% Rearing	>10% Spawning >50% Rearing
Large Woody Debris (LWD) Counts	>20 piece per LWD; likely not >35 feet long	>20 pieces per mile; 12 inches diameter and >35 feet long	>20 pieces per mile; 12 inches diameter and >35 feet long
LWD Budget	Limited in site source of LWD; LWD transport interrupted	Adequate source and transport of LWD into site	Adequate source and transport of LWD into site

Table 2.8-3. Segment 1 Current, Minimal, and Optimal Conditions (continued)

Metrics	Current Conditions	Minimal Conditions	Optimal Conditions
Riparian Vegetation	~50% intact riparian corridor	>50% intact riparian corridor	>80% intact riparian corridor
Canopy Cover	25-50% wetted channel coverage	>50% wetted channel coverage	>75% wetted channel coverage
Percent of Bank with Vegetation (within 5 meters)	<10% bank coverage	>50% bank coverage	>75% bank coverage
Substrate	Gravel subdominant	Gravel/Cobble subdominant	Gravel or Cobble dominant substrate
Embeddedness	20-30% embeddedness	20-30% embeddedness	<20% embeddedness

Note: See Tables 2.5-6 and 2.5-7 for current, minimal, and optimal flows and floodplain connectivity.

Segment 2 – Flood Control Reach – Lower Constructed Flood Sills

This segment is within the heavily modified flood control zone, containing infrequent isolated pockets of riparian vegetation that shade a fraction of the very wide wetted channel. Summer low flows with high seasonal temperature spikes, combined with poor shading and poor water quality, create poor habitat for salmonids and difficult migration conditions. Segment 2 is dominated by a series of constructed flood control sills, which act as a long series of step pools. While pool frequency is fairly high, the quality of these pools is not very good. Substrate for these areas are likely entirely sand and silt, and larger sediment transport to this section is affected by upstream dams thus no spawning potential is expected. There is little to no in-stream LWD and very limited in-stream vegetation (see Figure 2.8-25). Table 2.8-4 summarizes existing versus minimal and optimal habitat conditions for Segment 2.



Figure 2.8-25. Flood Control Sills in Segment 2

Table 2.8-4. Segment 2 Current, Minimal, and Optimal Habitat Conditions

Metrics	Current Conditions	Minimal Conditions	Optimal Conditions
Pool Frequency (Bankfull is 21 ft)	29.45 pools per mile	56 pools per mile for channel width of 20 feet; inadequate structures to sustain pools	56 pools per mile for channel width of 20 feet; adequate structures to sustain pools
Percent Pool Area	100 %	10-90% pool area	30-60% pool area
Pool Quality	Poor; <1 meter deep with no cover and warm water	25% of pools are >1 meter deep; limited cover and warm water	50% of pools should be >1 meter deep with good cover and cool water.
Relative Habitat Abundance	100% Pool 0% Riffle 0% Glide	10-90% Pool 10-90% Riffle 10-90% Glide	30-60% Pool 30-60% Riffle 30-60% Glide
Relative Feature Abundance	0 Features	1 structure per pool	3 or more structures per pool
Relative abundance of spawning and rearing habitat	0% Spawning <25% Rearing	5-10% Spawning 20-50% Rearing	>10% Spawning >50% Rearing
Large Woody Debris (LWD) Counts	0 LWD	>20 pieces per mile; 12 inches diameter and >35 feet long	>20 pieces per mile; 12 inches diameter and >35 feet long
LWD Budget	No site source of LWD; LWD transport interrupted	Adequate source and transport of LWD into site	Adequate source and transport of LWD into site
Riparian Vegetation	No vegetation	>50% intact riparian corridor	>80% intact riparian corridor
Canopy Cover	0% canopy cover	>50% wetted channel coverage	>75% wetted channel coverage
Percent of Bank with Vegetation (within 5 meters)	< 10 bank coverage	>50% bank coverage	>75% bank coverage
Substrate	Fines Dominant W/eroded riprap particles	Gravel/Cobble subdominant	Gravel or Cobble dominant substrate
Embeddedness	100%	20-30% embeddedness	<20% embeddedness

Note: See Tables 2.5-6 and 2.5-7 for current, minimal, and optimal flows and floodplain connectivity.

Segment 3 – Flood Control Reach – Concrete Flume

Segment 3 is entirely covered with several concrete flumes (Figure 2.8-26), with the mid part of the segment passing underground. As currently configured, the only habitat use for this segment by the focus fish species is as a difficult upstream and downstream migration corridor and limited summer rearing. Aside from the very stable stream banks due to being paved, Segment 3 is deficient in all typical habitat parameters. The lack of riparian or aquatic vegetation dramatically impacts benthic macroinvertebrates, which is an important food source for rearing juveniles. During the



Figure 2.8-26. Corrective Baffles Upstream of the Underground Portion of Mill Creek Channel, at Construction (9/2014) and at Winter Flows (2/2016)

summertime, this section often runs dry, with no off channel or pools to provide temporary refugia. Additionally, Glen Mendel indicates that sampling by WDFW in this segment only found juvenile steelhead/rainbow from Wildwood Park to 9th Avenue and not upstream of Wildwood park due to dry or nearly dry stream bed conditions (pers. com., Glen Mendel, private citizen, former WDFW manager, Walla Walla, WA, Aug. 22, 2016). Mendel further remarked that the highest densities of juvenile steelhead/rainbow were found in areas that offered cover and/or reduced velocities and adequate depths for rearing where water temperatures did not preclude rearing (pers. com., Glen Mendel, private citizen, former WDFW manager, Walla Walla, WA, Aug. 22, 2016).

During the rest of the year, the lack of complexity in the channel means most flow regimes present difficulty for juvenile salmonid migration (Burns et al. 2009). Even adults have

difficulty moving upstream during high water events. Efforts have recently been undertaken to address some of these issues. Parts of the flood water control flume have been modified to help adult steelhead, adult Chinook, and adult and subadult bull trout down to 6 inches long navigate the flow barrier. These modifications have also resulted in the presence of some pools, but pool area remains limited in Segment 3 overall. Table 2.8-5 summarizes existing versus minimal and optimal habitat conditions for Segment 3.

Table 2.8-5. Segment 3 Current, Minimal, and Optimal Habitat Conditions

Metrics	Current Conditions	Minimal Conditions	Optimal Conditions
Pool Frequency (Bankfull is 21 feet)	0 pools per mile	56 pools per mile for channel width of 20 feet; inadequate structures to sustain pools	56 pools per mile for channel width of 20 feet; adequate structures to sustain pools
Percent Pool Area	0 %	10-90% pool area	30-60% pool area
Pool Quality	Poor; <1 meter deep with no cover and warm water	25% of pools are >1 meter deep; limited cover and warm water	50% of pools should be >1 meter deep with good cover and cool water.
Relative Habitat Abundance	0% Pool 0% Riffle 100% Glide	10-90% Pool 10-90% Riffle 10-90% Glide	30-60% Pool 30-60% Riffle 30-60% Glide
Relative Feature Abundance	0 Features	1 structure per pool	3 or more structures per pool
Relative abundance of spawning and rearing habitat	0% Spawning 0% Rearing	5-10% Spawning 20-50% Rearing	>10% Spawning >50% Rearing
Large Woody Debris (LWD) Counts	0 LWD	>20 pieces per mile; 12 inches diameter and >35 feet long	>20 pieces per mile; 12 inches diameter and >35 feet long
LWD Budget	No site source of LWD; LWD transport interrupted	Adequate source and transport of LWD into site	Adequate source and transport of LWD into site
Riparian Vegetation	No vegetation	>50% intact riparian corridor	>80% intact riparian corridor
Canopy Cover	0% canopy cover (50% shaded) ^{1/}	>50% wetted channel coverage	>75% wetted channel coverage
Percent of Bank with Vegetation (within 5 meters)	<10% bank coverage	>50% bank coverage	>75% bank coverage
Substrate	No substrate (paved)	Gravel/Cobble subdominant	Gravel or Cobble dominant substrate
Embeddedness	100%	20-30% embeddedness	<20% embeddedness

^{1/} Part of Segment 3 is underground.

Note: See Tables 2.5-6 and 2.5-7 for current, minimal, and optimal flows and floodplain connectivity.

Segment 4 – Flood Control Reach – Upper Constructed Flood Sills and Diversion/Division Structures

This segment is within the heavily modified flood control zone, upstream of the concrete flume. The Bennington Diversion and Division Works Dam structures are all included within this segment. Similar to Segment 2, Segment 4 is dominated by a series of constructed flood control sills, which act as a long series of step pools. While pool frequency is fairly high, the quality of these pools is not very good and the section of wide weirs presents significant thermal and physical barriers at low flows. Substrate for these areas is mostly sand and silt with some large boulders placed for habitat by the USACE or contributed by the levees, and larger sediment transport to this section is affected by upstream dams; thus, no spawning potential is expected for these segments. There is little to no in-stream LWD because it is removed at Bennington Diversion Dam, and the USACE vegetation management strategy described in Section 2.8.3.2 removes trees growing on or adjacent to the levees. Within some areas, aquatic vegetation has been established within the channel, improving the quality of the sill pools (see Figure 2.8-27). Table 2.8-6 summarizes existing versus minimal and optimal habitat conditions for Segment 4.

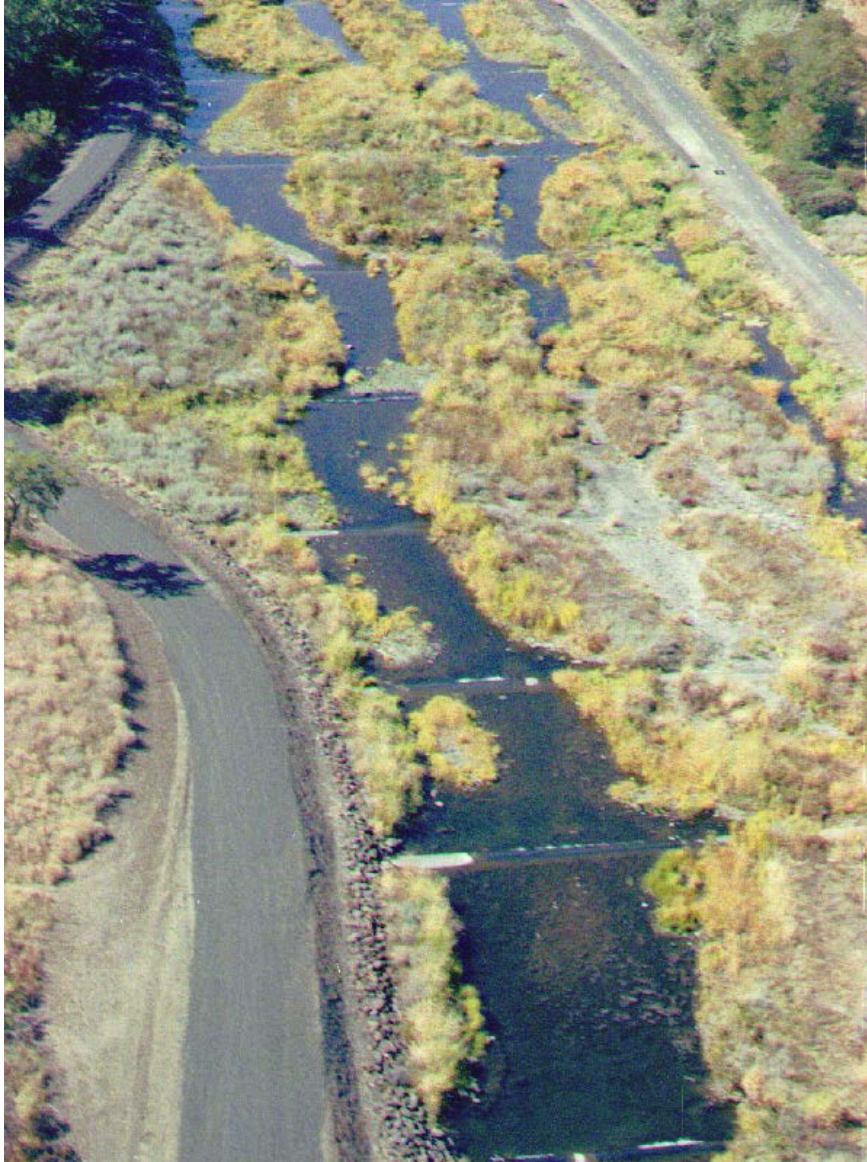


Figure 2.8-27. Aerial Photo of Flood Control Sills in Segment 4 at RM 8.5

Table 2.8-6. Segment 4 Current, Minimal, and Optimal Habitat Conditions

Metrics	Current Conditions	Minimal Conditions	Optimal Conditions
Pool Frequency (Bankfull is 21ft)	35.2 pools per mile	56 pools per mile for channel width of 20 feet; inadequate structures to sustain pools	56 pools per mile for channel width of 20 feet; adequate structures to sustain pools
Percent Pool Area	90 % ^{1/}	10-90% pool area	30-60% pool area
Pool Quality	Poor; <1 meter deep with no cover and warm water	25% of pools are >1 meter deep; limited cover and warm water	50% of pools should be >1 meter deep with good cover and cool water.

Table 2.8-6. Segment 4 Current, Minimal, and Optimal Habitat Conditions (continued)

Metrics	Current Conditions	Minimal Conditions	Optimal Conditions
Relative Habitat Abundance	90% Pool 0% Riffle 10% Glide	10-90% Pool 10-90% Riffle 10-90% Glide	30-60% Pool 30-60% Riffle 30-60% Glide
Relative Feature Abundance	0 Structure	1 structure per pool	3 or more structures per pool
Relative abundance of spawning and rearing habitat	<5% Spawning <50% Rearing ^{2/}	5-10% Spawning 20-50% Rearing	>10% Spawning >50% Rearing
Large Woody Debris (LWD) Counts	0 LWD	>20 pieces per mile; 12 inches diameter and >35 feet long	>20 pieces per mile; 12 inches diameter and >35 feet long
LWD Budget	No site source of LWD; LWD transport interrupted	Adequate source and transport of LWD into site	Adequate source and transport of LWD into site
Riparian Vegetation	<25% intact riparian corridor	>50% intact riparian corridor	>80% intact riparian corridor
Canopy Cover	<25% canopy cover	>50% wetted channel coverage	>75% wetted channel coverage
Percent of Bank with Vegetation (within 5 meters)	<25% bank coverage	>50% bank coverage	>75% bank coverage
Substrate	Fines Dominant ^{3/}	Gravel/Cobble subdominant	Gravel or Cobble dominant substrate
Embeddedness	100%	20-30% embeddedness	<20% embeddedness

1/ Under low flow conditions, this value would be lower because during low flow, pools in Segment 4 below the weirs do not extend the full distance downstream to the next weir, resulting in some riffle or glide near each weir.

2/ Rearing habitat could be less than 20 percent in Segment 4 because thermal problems restrict successful rearing to the very upper portion of this segment during the summer.

3/ Boulders and cobbles are common between the weirs.

Note: See Tables 2.5-6 and 2.5-7 for current, minimal, and optimal flows and floodplain connectivity.

Segment 5 – Low Gradient, Semi-Natural Channel

Segment 5 begins upstream from the Bennington Diversion Dam and man-made weir structures. At this segment, the stream returns to a semi-natural channel providing spawning and year-round rearing habitat for steelhead, as well as fall to spring rearing for bull trout and Chinook (Mahoney et al. 2012). This area remains affected by historical modifications for flood control and irrigation, and riparian ground cover is thoroughly dominated by reed canarygrass. Banks remain somewhat constrained by levees in most of this region, reducing access to any potential side channels. Unlike the previous three segments, however, in-stream channel conditions have had fewer direct modifications. Habitat conditions are still somewhat impacted with all but floodplain connectivity rated as “moderate.” This is a noticeable improvement over the conditions found in Segments 2 through 4. Channel sinuosity and pool-riffle conditions are

also improved. Table 2.8-7 summarizes existing versus minimal and optimal habitat conditions for Segment 5.

Table 2.8-7. Segment 5 Current, Minimal, and Optimal Habitat Conditions

Metrics	Current Conditions	Minimal Conditions	Optimal Conditions
Pool Frequency (Bankfull is 67 feet)	~23 pools per mile	23 pools per mile for channel width of 75 feet; inadequate structures to sustain pools	23 pools per mile for channel width of 75 feet; adequate structures to sustain pools
Percent Pool Area	33%	10-90% pool area	30-60% pool area
Pool Quality	Moderate; some pools are >1 meter deep with some cover	25% of pools are >1 meter deep; limited cover and warm water	50% of pools should be >1 meter deep with good cover and cool water.
Relative Habitat Abundance	40% Pool 40% Riffle 20% Glide	10-90% Pool 10-90% Riffle 10-90% Glide	30-60% Pool 30-60% Riffle 30-60% Glide
Relative Feature Abundance	Estimate is roughly 1 feature per pool	1 structure per pool	3 or more structures per pool
Relative abundance of spawning and rearing habitat	>10% Spawning >50% Rearing	5-10% Spawning 20-50% Rearing	>10% Spawning >50% Rearing
Large Woody Debris (LWD) Counts	> 20 pieces per mile	> 20 pieces per mile; 12 inches diameter and >35 feet long	> 20 pieces per mile; 12 inches diameter and >35 feet long
LWD Budget	Adequate source and transport of LWD into site	Adequate source and transport of LWD into site	Adequate source and transport of LWD into site
Riparian Vegetation	75% intact riparian corridor	> 50% intact riparian corridor	> 80% intact riparian corridor
Canopy Cover	50% to 75% canopy cover	> 50% wetted channel coverage	>75% wetted channel coverage
Percent of Bank with Vegetation (within 5 meters)	75% to 90% bank coverage	> 50% bank coverage	> 75% bank coverage
Substrate	Gravel Dominant	Gravel/Cobble subdominant	Gravel or Cobble dominant substrate
Embeddedness	10 to 25% embeddedness	20-30% embeddedness	<20% embeddedness

Note: See Tables 2.5-6 and 2.5-7 for current, minimal, and optimal flows and floodplain connectivity.

Distributary Channels

Yellowhawk and Garrison creeks are the largest of the distributary channels and, historically, likely had quite similar habitats, typical of alluvial fans. Up to 30 cfs and 10 cfs are diverted into Yellowhawk and Garrison creeks, respectively, from the lower diversion (Yellowhawk Dam) on Mill Creek (USACE 2012c, NMFS 2011). According to the MOU between Ecology and USACE,

when Mill Creek flows fall below 400 cfs, the USACE adjusts the Division Works Dam to allow 30 cfs into the Yellowhawk and Garrison creek channels, although it can be further adjusted to maintain a minimum flow of 25 cfs (USACE 2012c). WDFW staff has indicated that when more than 20 cfs is allowed down Yellowhawk, there have been complaints of localized flooding along the creek; however, no published evidence of this phenomena was provided (pers. com., Dave Karl and Mark Grandstaff, WDFW Habitat Program, Region 1, Walla Walla, WA, Dec. 22, 2016). Currently, both creeks flow through industrial parks and residential areas and have undergone modification, though not to the same degree as Segments 2 through 4.

Yellowhawk Creek is the larger of the two creeks and has higher quality habitat and focal species use (Mendel et al. 2007). Yellowhawk Creek is moderately better than most of the Primary Focus Area in terms of passage and habitat quality, being similar to Segment 1 on the mainstem (Figure 2.8-28). Yellowhawk Creek serves as an alternative migration corridor between the Walla Walla River and Mill Creek, allowing fish to bypass the difficult passage



Figure 2.8-28. Habitat Conditions of Lower Yellowhawk Creek

portion of middle Mill Creek segments, primarily for steelhead and some Chinook salmon (Mendel et al. 2007). Although Yellowhawk does function as a migration corridor, several partial fish passage barriers exist and are further described in Section 2.8.5.3. StreamNet (2012) claims that Yellowhawk Creek functions as a spawning and rearing reach for steelhead (Figure 2.7-2). However, a 2006 survey of Yellowhawk Creek found very few spawning areas containing only marginal quality spawning habitat (Mendel et al. 2007).

Garrison Creek is highly modified and has had chemical contamination issues, related to the College Place WWTP and non-point source pollution (Ecology 1998), and fish passage issues including five partial barriers and two complete barriers (see Table 2.8-9 in Section 2.8.5 for more detail). In 2009, a fish screen was installed at the Second Division Works Dam to prevent fish from entering Garrison Creek thereby eliminating chance for juvenile take in Garrison Creek (see Section 2.8.5.1 for details). While the creek is currently blocked at the Second Division Works Dam, StreamNet (2012) indicates that there is potential ESA-listed steelhead and bull trout rearing habitat in the lowest portion of Garrison Creek, and the whole channel could be potential rearing and spawning habitat and migration corridor if system flow issues were resolved and existing habitat enhanced.

The Garrison Creek Use-Based Receiving Water Study (Ecology 1998) examined three sample sites on Garrison Creek and rated the distributary channel as generally poor habitat (Figure 2.8-29). The plane bed channel had an average width of 1.8 meters wide and an average thalweg depth of approximately 0.5 meter. The dominant substrate was silt with little to no in-stream wood. Spawning may have happened in Garrison Creek historically but is currently regarded as unknown (Ecology 1998).

Lower Doan and Cold creeks have been utilized by summer steelhead and by juvenile spring Chinook for rearing (WDFW 2011). Parts of upper Titus Creek, specifically the small connector side channel that flows back into Mill Creek, have been documented as excellent spawning and rearing habitat for steelhead (WWCCD 2014). Lower Titus Creek is also utilized by all life stages of steelhead but has poor habitat quality and low flow due to irrigation diversions (WDFW 2011). Recently, a fish screen system was installed to prevent fish in Upper Titus from heading down into the Titus Creek Irrigation Ditch, a historic side-channel also used for irrigation withdrawals. The fish screen bypass diverts them back into a side channel of Mill Creek (WWCCD 2014, see Section 1.4.3.2 for more details on this project by WWCCD). This modification is considered an interim habitat improvement by eliminating take of ESA-listed fish down Titus Creek where fish stranding has been documented (NMFS 2015b). Titus Creek is also being considered as possible side-channel spawning and rearing habitat for anadromous stocks in the future (NMFS 2015b).



Figure 2.8-29. Habitat Conditions of Garrison Creek near Bridge Street

Limiting Factors

The identification and analysis of limiting factors (from Table 1.2-1), and the resulting development of a limiting factors matrix (Table 2.8-8), were accomplished based on analysis presented primarily above under the habitat description with consideration of fish passage issues noted in Section 2.8.5 and available subbasin documents. Major literatures sources used for the assessment of the factors noted in Table 2.8-8 are based on description provided in WSCC (2001), with relative level of limitation based primarily on WWVA (2004) and NPCC (2005). Overall, current limiting factors for both steelhead and spring Chinook salmon in the lower Mill Creek Primary Focus Area are primarily: fish passage obstructions, sediment load, habitat diversity, flow, temperature, and key habitat quantity (NPCC 2005). Specific data related to predation are limited and the overall importance of predation may be adjusted as new data are acquired. These limiting factors also likely apply to Mill Creek bull trout. Spring Chinook salmon had similar limiting factors, except that flow was considered a secondary factor. Channel stability and food availability were secondary limiting factors for steelhead. The high summer temperatures are adverse to egg incubation, fry development, and

Table 2.8-8. Matrix of Factors Limiting Productivity for Native Salmonids in the Lower Mill Creek Primary Focus Area

Mill Creek Segment/Distributary	Limiting Factors ^{1/}												
	Passage/Entrainment	In-Channel Characteristics				Riparian/Floodplain					Water Quality - Temperature	Water Quantity - Flows	
		Channel Substrate	LWD	Pool Frequency/Quality	Pool Depth	Riparian Condition	Streambank Condition ^{2/}	Floodplain Connectivity	Channel Stability ^{2/}	Off-Channel Habitat			Sediment
Segment 1	Red	Red	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Red		
Segment 2	Black	Black	Black	Black	Black	Black	Red	Black	Red	Black	Black	Black	Black
Segment 3	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black
Segment 4	Black	Black	Black	Black	Black	Black	Red	Black	Red	Black	Black	Black	Black
Segment 5	Red	Orange	Orange	Orange	Orange	Orange	Orange	Red	Orange	Orange	Orange	Red	Red
Yellowhawk/ Garrison Creeks	Black	Red	Red	Red	Orange	Red	Red	Black	Red	Red	Red	Black	Red

= Based on available information, conditions are adequately functioning
 = Based on available information, conditions may be limiting
 = Based on available information, conditions are limiting
 = Based on available information, conditions are highly limiting

1/ Limiting factors and ratings determined from the following reports and studies: WSCC (2001); NPCC (2005); WWWA (2004); NMFS (2009); and USFWS (2014).

2/ Under the NMFS (2009), these two limiting factors are only assessed via stability. However, the highly engineered streambanks and channel stability of Segments 2, 3, and 4, end up being limiting factors due to restricting the occurrence of natural riverine processes.

juvenile rearing. Very similar limiting conditions to lower Mill Creek occur in Yellowhawk and Garrison creeks. The primary limiting factors are upstream and downstream passage limitation, sediment load, habitat diversity, and temperature. Flows in Yellowhawk and Garrison creeks are currently not as limiting due to diversions of Mill Creek flow into the creeks during low flow in order to supply downstream irrigators, and there are more natural conditions relative to pool width to depth conditions than in Mill Creek.

Furthermore, the Walla Walla Subbasin Plan (NPCC 2005) outlines the EDT analysis that was performed for steelhead and spring Chinook. The analysis in this document indicates that Segments 2 through 4 are ranked first in terms of scaled Restoration Potential for steelhead. In contrast, Segment 1 and Segment 5 (and further up to Blue Creek) were only ranked at 41st and 43rd, respectively. For spring Chinook salmon, the ranking is somewhat similar, second for Segment 2 through 4 (the most human-developed area) while Segment 1 was ranked 7th and Segment 5 (up to Blue Creek) was ranked 21st.

Secondary Focus Area

General opinion and the results of the basin-wide EDT analysis indicates that higher quality salmonid habitat typically exists in headwater reaches (NPCC 2005). Upstream of the Primary Focus Area, and especially upstream of the Blue Creek confluence, habitat conditions improve rapidly. The Walla Walla Subbasin Plan (NPCC 2005) notes that upstream of Bennington Diversion Dam, up to the city water intake site, is fair to excellent steelhead habitat. Riparian conditions are improved, LWD is present and the substrate is the preferred cobble and gravel. Figure 2.8-30 shows the intact riparian conditions in the pumphouse for the City of Walla Walla water intake. The Walla Walla Watershed Alliance Reconnaissance Report (WWWA 2004) indicates that in the Mill Creek headwaters, most habitat and passage limiting factors would be rated good to fair (suggesting not limiting to possibly limiting), with some poor ratings (e.g., likely to highly likely limiting) related to flow and pool conditions.



Figure 2.8-30. Habitat Conditions in the Upper Watershed by the Pump House

2.8.5 Fish Passage Barriers

Fish passage in the Primary Focus Area is restricted by three factors: in-channel structures (e.g., dams, sills), flow (quantity, depth and velocity), and high water temperature. These three factors can have interactions that can result in partial or complete barriers to either upstream or downstream fish passage, or both. Some of these passage issues also occur in the Secondary Focus Area. Fish passage barriers in the Primary and Secondary Focus Area were assessed comprehensively for the salmonid focal fish species but not for Pacific lamprey. Pacific lamprey are not known to currently occupy the Mill Creek watershed and no data specific to Pacific lamprey passage through the Primary Study Area was found or reviewed. Additional future research is needed to fully assess passage issues for Pacific lamprey in Mill Creek.

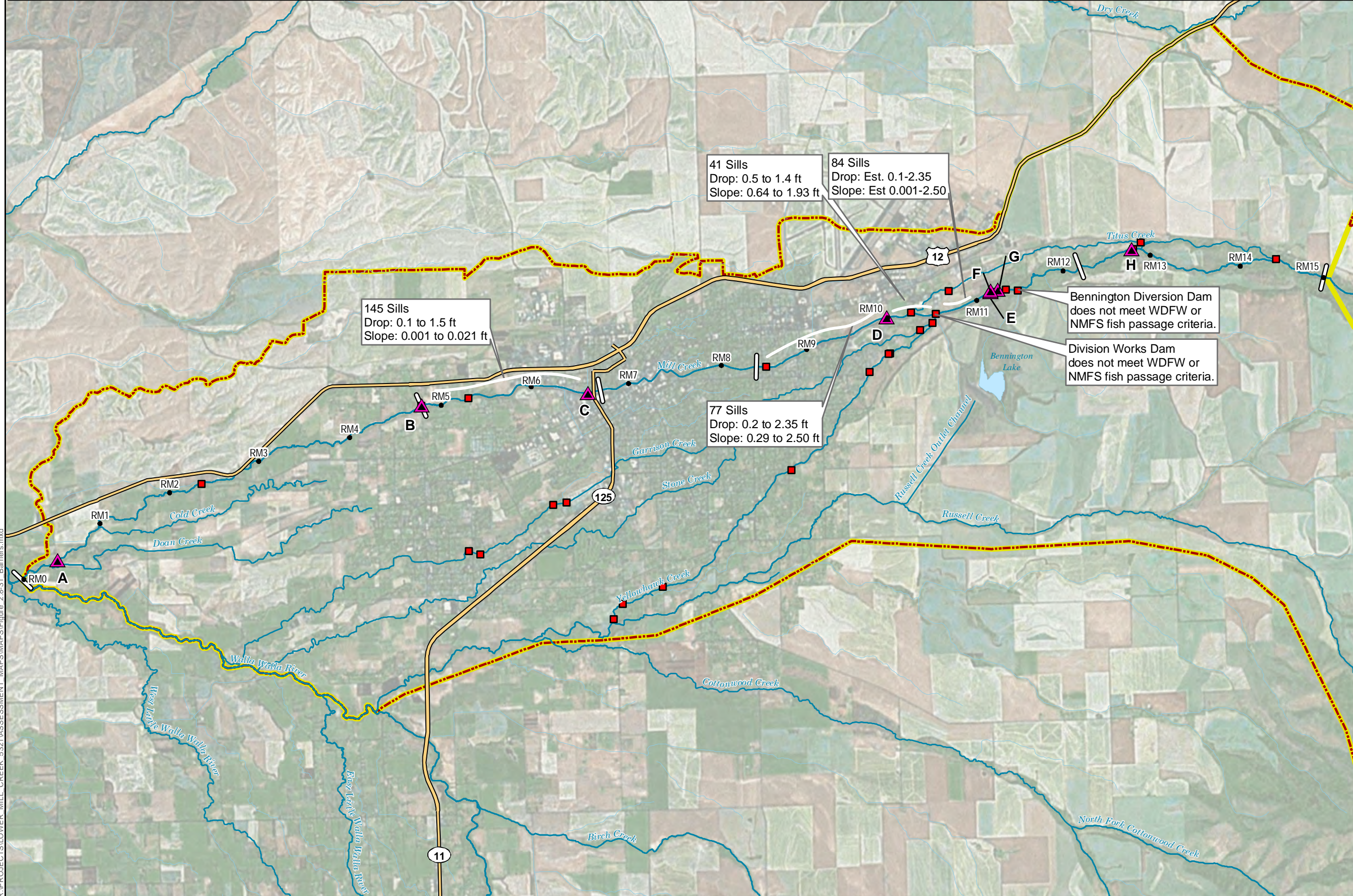
There are many fish passage barriers in the five project segments that are primarily the result of development actions in the stream channel (Figure 2.8-31) (Mendel et al. 2007, Burns 2009). Neither the Bennington Diversion Dam (RM 11.4) nor the Division Works Dam (RM 10.5) meet WDFW or NMFS fish passage criteria (NMFS 2011). Improving fish passage conditions at Bennington Diversion Dam and the flood control channel in Mill Creek are considered to be key restoration needs for the recovery of the ESA listed Mid-C steelhead. Fish passage issues, particularly at the Bennington Diversion Dam, are considered a significant obstruction to steelhead migration and production (NMFS 2009). The Division Works Dam, which controls

A) Swegle Rd % > 20C° Average May: 13% June: 57% July: 92% Sept: 18%	B) Gose Street % > 20C° Average May: 20% June: 74% July: 100% Sept: 39%	C) 9th Avenue % > 20C° Average May: 33% June: 88% July: 100% Sept: 20%	D) Tausick Way % > 20C° Average May: 0% June: 47% July: 100% Sept: 13%	E) Below Cold Return % > 20C° Average May: 0% June: 47% July: 67% Sept: 7%	F) In Cold Return % > 20C° Average May: 0% June: 17% July: 25% Sept: 0%	G) Above Cold Return % > 20C° Average May: 0% June: 47% July: 100% Sept: 13%	H) 5-Mile Road % > 20C° Average May: 0% June: 44% July: 100% Sept: 0%
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**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

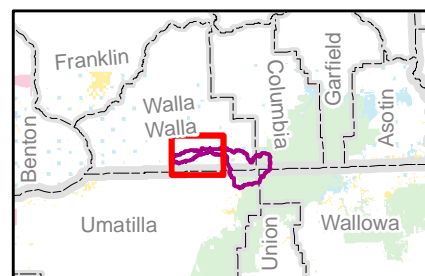
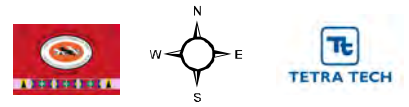
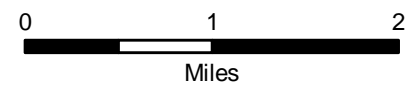
CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE 2.8-31
PHYSICAL/THERMAL
BARRIERS**



- River Miles
- ▲ Thermal Barrier
- Partial Barrier to Fish Passage
- Major Stream
- Minor Stream
- Reach Break
- Waterbody
- Project
- Primary Focus

Sources: CTUIR, Walla Walla County, StreamNet



R:\PROJECTS\LOWER MILL CREEK_5321\ASSESSMENT_MAPS\MAPS\Figure 2.8-31_Barriers.mxd

flood waters into the Yellowhawk/Garrison creeks canal, also has passage issues. Extensive channel and bank alterations begin at RM 4.8 (Gose St.), where Mill Creek enters the City of Walla Walla, and end at Bennington Diversion Dam (RM 11.4). Downstream conditions have been indirectly modified as a result of changes to flow patterns. There have been upstream modifications as well in the Secondary Focus Area, including the irrigation withdrawal networks and the Kooskooskie Dam, which was removed in 2005. There may also be upstream passage issues at the City of Walla Walla intake dam during certain flows (Schaller et. al. 2014).

Passage through the system for both up and downstream fish movement is considered important for all four focal species. For example the USFWS considers passage of bull trout to provide connectivity of habitat including dispersion and full expression of all life history phase of this species as important for the enhancement and preservation of this species (Small et al. 2012, Schaller et al. 2014, USFWS 2015a, USFWS 2015b, Barrows et al. 2016). This fish needs to be able to successfully pass adults upstream during spawning migration, allow downstream movement of adults to the lower Walla Walla and Columbia River systems post spawning and dispersion of juvenile and subadult stages within this system. The current system within Mill Creek has resulted in delays or blockages of bull trout movement within Mill Creek and its local tributaries, the details of which is provide in varied reports (Koch 2014, Schaller et al. 2014, USFWS 2015a, USFWS 2015b).

2.8.5.1 Bennington Diversion and Division Works Dams

The Division Works Dam (RM 10.5) is operated by Ecology and the USACE, and is typically closed under 400 cfs (extensive design and operation specifications can be found in Burns et al. 2009). The three-step fishway is on the right (north) bank (built in 1982) and high-flow design is described as 15 cfs but can operate at 3.8 to 20.7 cfs (USACE 2015a). This structure does not meet NMFS or WDFW upstream fish passage criteria. Also, at flows over 400 cfs additional reduction in passage may occur due to operating methods. The exit gate to the ladder may be closed during these periods to prevent debris accumulation stopping passage (USACE 2015a). During summer low flows, the slide gate at the exit of the fish ladder is sometimes used to close off the ladder (partially or entirely) to divert more water to the Yellowhawk/Garrison Creeks Canal, reducing flows in Mill Creek and restricting passage of fish moving downstream of the Division Works Dam in Mill Creek during the summer months (USACE 2015a). When this major irrigation diversion is occurring, some additional spill water may go over a likely impassible 2-foot-high sill into Mill Creek and may cause false attraction to fish and cause delay in fish finding the fishway on the right bank (pers. com., Glen Mendel, private citizen, former WDFW manager, Walla Walla, WA, August 22, 2016).

The Second Division Works, 500 feet downstream in the Canal, diverts water to the two creeks. It was agreed among managing agencies that there was not currently sufficient flow to maintain both Yellowhawk and Garrison creeks during low flow for fish habitat and passage. Because passage was not suitable in Garrison Creek during low flow, while conditions were better in Yellowhawk Creek for both passage and habitat, in 2009 a fish screen was installed to prevent fish from entering Garrison Creek and more low flow was directed to Yellowhawk Creek (USACE 2015a). When flows are low (less than 400 cfs in Mill Creek), per the MOU with Ecology, the USACE attempts to maintain a low flow of 25 cfs into Yellowhawk Creek. The fishway on Bennington Diversion Dam is noted as remaining a partial barrier to adult upstream migration. Additionally, during periods of high flows, juvenile salmonids have been diverted down to Bennington Lake and ultimately stranded (USACE 2011a).

Under the USACE operation, the Bennington Diversion Dam (RM 11.4) includes a fish ladder built in 1982. It is located at the south end of the dam and passes flows of 20 to 42 cfs, allowing fish to pass upstream. It is currently described as inadequate, and does not meet WDFW or NMFS fish passage criteria for velocity as well as physical obstruction. The low-flow outlet, located next to the fish ladder, creates attraction velocity that makes it difficult for fish to find the entrance to the fish ladder (USACE 2015a). Although USACE has added a series of ecology blocks on the north side of the fish ladder to minimize false attraction from the low-flow outlet (USACE 2015a), CTUIR fish monitoring crews have found that fish continue to be unable to find the fish ladder entrance (Weldert 2015). Additionally, there have been stranding issues at the stilling basin (USACE 2012a). When flows exceed 400 cfs in Mill Creek, there is partial closure of the ladder, completely blocking upstream passage (NMFS 2011). Plans to replace the ladder are ongoing, as well as regular planning meetings, including a request by USACE to USFWS and NMFS for re-initiation of ESA consultation in early summer of 2015 (pers. com., Glen Mendel, private citizen, former WDFW manager, Walla Walla, WA, February 23, 2016). See Section 1.4.3.5 for more information about ongoing activities by USACE including re-initiation of ESA consultations. Figure 2.8-32 shows the outflow of the existing fish ladder.



Figure 2.8-32. Bennington Diversion Dam low-flow outlet on left, fish ladder mouth on right.

Screened flow enters Bennington Lake (up to 30 cfs) during the spring, which typically prevents fish entrainment. However, when the fish screens are not functioning properly or are pulled during flood flow diversions, both upstream and downstream migrant fish can be diverted into Bennington Lake, such as when stream discharge exceeds 2,500 cfs and flows are diverted unscreened to Bennington Lake (NMFS 2011). There is not a specific number available on how many fish get past the screens during this time. Bennington Lake may be drawn back down to 5 to 10 percent of full pool volume following flood water addition by discharge through an intake tower primarily into a channel leading back to Mill Creek (NMFS 2011), although it may be retained at higher elevations in late spring for recreational uses in the spring (1,205-foot conservation pool elevation) (Phillips and Divens 2001). Fish diverted to Bennington Lake may leave with the water discharge into a canal leading back to Mill Creek, but NMFS (2011) does not consider this likely and fish passing through the tower outflow may not survive the passage.

2.8.5.2 Flood-Control Reach Passage Issues

Aside from the two dams within the Primary Focus Area, the downstream flood-control segments (Segments 2 through 4) present partial passage barriers, especially to juvenile salmonids but also for adult salmonids, which is a problem at both low and high flows (Burns et al. 2009). Burns et al. (2009) describes the heavily modified segments as the Mill Creek Channel (downstream of the Division Works Dam), and breaks the channel into two major sections: type one as channel spanning weirs (263 total), and type two as a concrete flume. The 1-mile reach between the two USACE dams contains an additional 84 channel-spanning concrete weirs (USACE 2011a). Burns et al. (2009) used hydraulic models to assess depth and flow at the barriers and fish energetic models, which used known fish swimming ability of typical Mill Creek spring Chinook salmon, steelhead, and bull trout to determine passability of the stream structures by species and flow. Winter and spring flood flows can be an obstacle to adult Chinook salmon and steelhead spawners as well as migratory adult and sub-adult bull trout, since the amount of resting zones in the channel is limited. Low flows can also cause barriers for bull trout and spring Chinook adults in early summer (June and July). Appendix C shows the segment barriers with known partial structural barriers at the flow regimes of 6, 20, 60, 100, 200, and 400 cfs on the mainstem of Mill Creek. Low flows and rising temperatures are a risk factor for juvenile stranding, to the point where a majority of the channel is dewatered during the summer and fall. As noted under the stream habitat discussion above, there are periods when little or no flow occurs in the channel, which would generally stop upstream and downstream fish movement when it occurs. There currently is no requirement to maintain flows to any recommended values for habitat or passage in most of the Mill Creek Primary Focus Area because senior water rights can extract all the water in the channel during low-flow periods.

Some of these barriers are a series of minor constructed obstacles, such as long reaches of grade control sills. Appendix A3 of Burns et al. (2009) lists the details of all 263 channel sills in detail. All these factors combined results in several locations along the Mill Creek Channel that present barriers to fish passability at a variety of flow regimes. Additionally, there are periods during the late spring and summer when temperatures present a thermal barrier to fish migration. The temperature barriers are described at site-specific sample locations that indicate the times of year at which water temperatures become a passage barrier (Figure 2.8-31).

2.8.5.3 Distributaries Passage Issues

As stated earlier, Yellowhawk Creek offers little spawning and rearing habitat but does act as a migration corridor to and from the Walla Walla River and Mill Creek, offering an alternative migration route to the mainstem of Mill Creek during low flow periods. However, there were nine partial fish passage barriers identified in Yellowhawk Creek and many obstructions identified in Garrison Creek in the WDFW 2006 assessment of salmonids (Mendel et. al 2007). Table 2.8-9 includes a list of physical barriers identified in Yellowhawk and Garrison Creeks by Mendel et. al 2007 but does not include dewatered reaches, temperature barriers, etc.

Table 2.8-9. Potential Physical Barriers in Yellowhawk and Garrison Creeks (Mendel et. al. 2007)

Spring/Location	River Mile	Barrier Type	Degree of Barrier
<i>Yellowhawk Creek</i>			
Garrison Creek/Yellowhawk Creek Diversion	9.0	Dam	Partial
Old Diversion at Top of Channel Split	8.3	Dam and Ladder	Partial
Pond and Culverts Above Bernie Road (Right Bank Channel)		Culvert and Pond	Partial
Old Irrigation Dam Above Bernie Road (Left Bank Channel)		Dam	Partial
Dam Above TSS Trap Site at Carl Street	7.7	Dam	Partial
Falbo Diversion	6.0	Irrigation Diversion	Partial
3 rd Street Culvert	4.4	Culvert	Partial
Weirs at Plaza Way	4.0	Weirs	Partial
Williams Diversion	3.8	Irrigation Diversion	Partial
<i>Garrison Creek</i>			
Top End Slide Gate at Certain Flows	10.1	Upper Control Gate	Partial
Hypothetical Barrier Representing Many Upstream Obstructions	4.9 to 10		Partial
Hypothetical Barrier Representing Many Upstream Obstructions	Garrison Creek 4.8		Partial
Larch Street	3.8	Culvert	Partial
Larch and Lyon's Ponds	3.7	Dams and Ponds	Complete
Hamada Ditch	3.7	Intake Screen	Partial

2.8.6 Refugia

Refugia are regions of streams where fish may avoid periods of adverse water quality conditions, such as high temperatures, occurring in most of the channel area. These areas, when present, allow fish to avoid potentially lethal conditions that may occur for only brief periods in the environment. After extensive review of existing surveys, data, and reports, no general source for an extensive inventory of known chemical or thermal refugia in the lower Mill Creek

system was found. However, locations with chemical input issues or temperature issues have been documented and indicate where adverse water quality conditions occur and refugia may be needed.

In regards to chemical input issues, there has been documentation of high chlorine levels in lower Mill Creek between Gose Street up to the city sewage treatment plant (WDFW 2011). In addition, numerous pollutants have been identified in Garrison Creek, including chlorine, ammonia, and herbicides, at concentrations that could adversely affect salmonids (Ecology 2014a). These chemical inputs are likely from stormwater runoff from the urbanized areas of College Place and have been suspected of resulting in fish kills (Ecology 2014a).

In regards to thermal issues, both lower Mill Creek and Doan Creek have been reported for having exceedances of acceptable salmonid water temperatures (Figure 2.8-31). NMFS (1996) indicated that the water temperature threshold (maximum daily temperature) for salmonid migration and rearing should not exceed 18°C. More recently EPA (2003) recommended a similar threshold of 18°C for migration and rearing for the average of 7 consecutive daily maximums (7DADM), and 20°C 7DADM for just migration. The current TMDL criteria for the main portion of Mill Creek assessed (RM 6.4 to 11.5) is 18°C daily maximum (Table 2.6-1) (Ecology 2012a). Washington State has revised the water quality standards, including the Walla Walla Basin, for migration and rearing, or just migration to 17.5 °C 7DADM (Ecology 2007a).

However, as noted by an NPS water quality report (Starkey 2015a), the representative site in Mill Creek (located near the Mission Historical Site) was in exceedance of currently applied acceptable salmonid temperatures (e.g. 18°C daily maximum) at least 59 percent of the time. Doan Creek was in exceedance 60 percent of the time in 2014 (June to November) and 85 percent of the time in 2013 (June to September).

Based on reported thermal barrier information and salmonid counts (only a few salmonids have been seen during the summer months between the mouth and 9th Avenue per Mendel et al. 2014), the locations of expected temperature refugia during hot summers would be the deepest portions of Segment 1 and Segment 5. The segments with the control weirs present a temperature hazard, as they can become isolated pools, approximately waist deep below some sills during low-flow periods, and the wide wetted area typical of the Mill Creek Channel has little to no available shading (Gallion et al. 2009). However, there are several spring-fed tributaries in the region that continuously add slightly colder flows to the larger streams and these spring inputs could contribute to spots of potential refugia. There are cold water springs that flow into the concrete channel near Wildwood Park location (Mendel et al. 2014, Figure 2.8-

22) and the document by Johnson (2009) covers in detail springs in the distributary system that could be critical locations of refugia during hot summer months (Table 2.8-10). The creeks with open flows (Doan/Cold, McEvoy, Stone, Lasater, and Caldwell) may add cold water input to the larger fish-bearing streams (Figure 2.8-21), which could help offset high summer temperatures. Other spring creeks such as Butcher, Lincoln, and College are diverted into pipes or storm drains before releasing into the Mill Creek flood control channel, lessening the potential for adding cold water to the mainstem versus the other spring inputs (Johnson 2009). At any of the discharge locations of these streams, local temperatures may be reduced, potentially supplying high temperature refuge sites for focal fish species.

Table 2.8-10 summarizes general information about the local spring stream networks, including outflow and source location.

Table 2.8-10. Spring Creeks In and Around the City of Walla Walla (Johnson 2009)

Spring Creeks	Tributary To	Flow into Segment/ Distributary	Transport	Ave Flow (cfs)	Source Location
Titus	Mill Creek (near Walla Walla Community College)	5 to 4	Channel/ Piped	–	Mill Creek Braid, diverges just downstream of Five Mile Bridge
Lincoln	Mill Creek	3	Piped	–	Pioneer Park near Division Street
College	Mill Creek (near Spokane Street)	3	Open Flow/ Piped	1.0	Isaacs Homestead, near Whitman College
Butcher (Owen & Barber)	Mill Creek (Near 11 th Street)	3	Piped/ Channel	0.18	Behind Whitman Dormitory
Doan/Cold	Mill Creek (at Whitman Mission)	1	Open Flow	–	Rodgers School.
Bryant	Garrison (near Jefferson Park)	Distributary	Culvert	0.94	Pioneer Park, forming 2 pools near Middle School
Caldwell	Yellowhawk Creek	Distributary	Open Flow	0.39	Near south Wilbur Street
Lasater	Yellowhawk Creek (near old Milton Highway)	Distributary	Open Flow	0.71	Near Braden School location
McEvoy	Walla Walla	NA	Open Flow	0.67	Near Beet Road
Stone	Walla Walla (above Burlingame Diversion)	NA	Open Flow	1.03	Behind the Blackberry Inn

Lower Yellowhawk Creek has several small spring-fed tributaries that help regulate overall water temperatures (NPCC 2005). The Mendel et al. 2007 temperature study from 2001 to 2006 indicates that the *cold return* sample location, a short distance downstream from Bennington Diversion Dam at RM 11.3 in Segment 4, functions as excellent temperature refugia for summertime salmonids. This *cold return* sample site refers to the location where the city

hydropower pipeline returns flow to Mill Creek. Figure 2.8-33 summarizes the three sample locations 45 meters upstream and 45 meters downstream of the cold return at RM 11.3, and how they relate to the 18°C threshold.

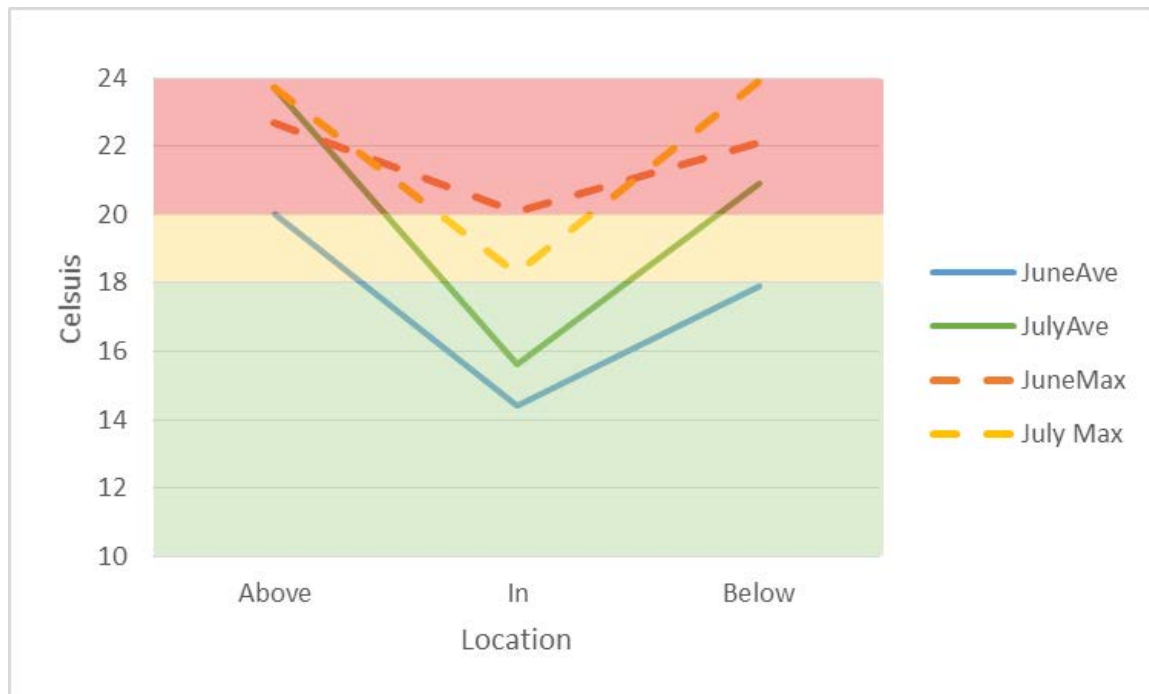


Figure 2.8-33. Temperature Differential at Sample Locations 45 m Above, In, and 45 m Below the RM 11.3 Cold Water Return During the Years 2002 to 2004 (Mendel et al. 2007).

2.9 SOCIOECONOMICS

2.9.1 Population Characteristics of Project Area

The Primary Focus Area largely overlaps with the City of Walla Walla, Washington, which had a total population of 31,731 residents as of the 2010 census (U.S. Census Bureau 2010b). Walla Walla is the largest city in Walla Walla County, a hub for the region’s agricultural economy—including a thriving wine industry—as well as home to Whitman College. The Primary Focus Area also extends by the neighboring City of College Place and census designated areas of Garrett and Walla Walla East, and into unincorporated Walla Walla County (Figure 1.3-1).

For the purposes of summarizing available socioeconomic data, the Primary Focus Area is represented by the 10 U.S. Census tracts intersected by lower Mill Creek that cover the Cities of Walla Walla and College Place and their immediate surroundings, with a total population of 51,742 (Figure 2.9-1; Table 2.9-1). Census tract 9201 is unique in that it extends farthest from the

Primary Focus Area in a horseshoe around the more populated center, including both the first and last river miles of the Primary Focus Area for Mill Creek.

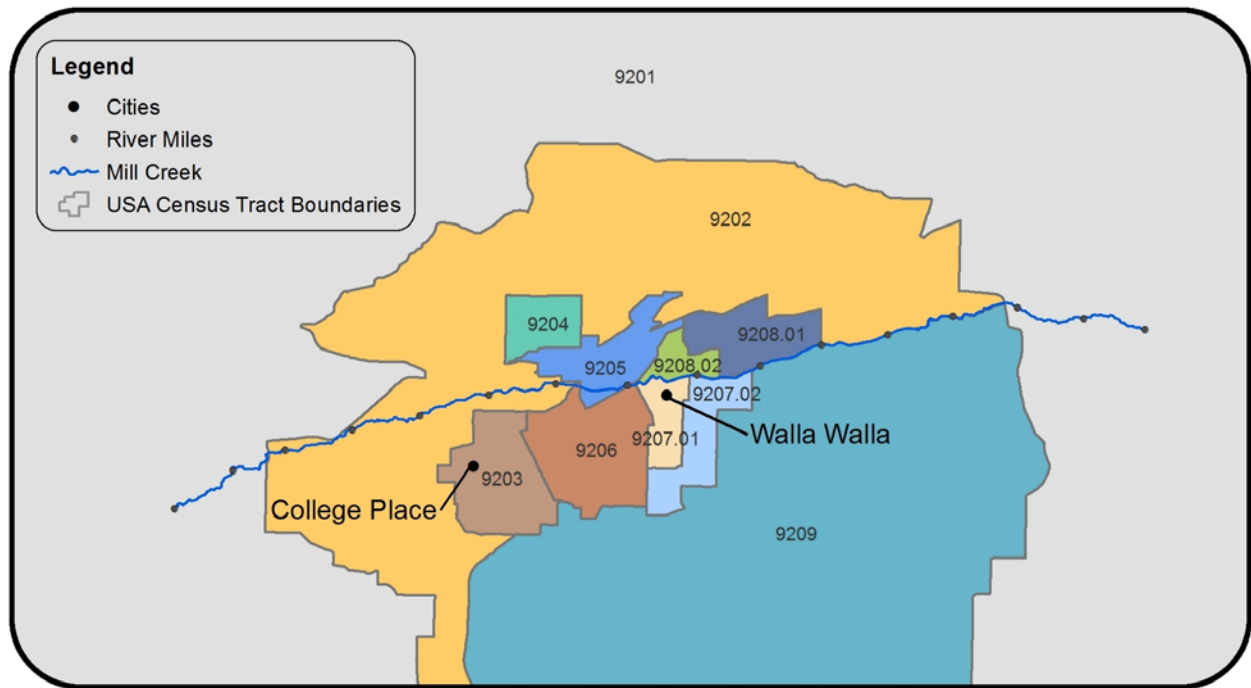


Figure 2.9-1. U.S. Census Tracts Intersected by Project Area

Table 2.9-1. Washington State, Walla Walla County, and Mill Creek Project Area Profile: ACS 5-Year Estimates (2010-2014)

Population Characteristic	Washington State	Walla Walla County	Census Tract 9201	Census Tract 9202	Census Tract 9203	Census Tract 9205	Census Tract 9206	Census Tract 9207.01	Census Tract 9207.02	Census Tract 9208.01	Census Tract 9208.02	Census Tract 9209
Total Population	6,899,123	59,476	4,652	4,300	8,635	3,014	5,553	3,981	4,473	5,238	3,528	8,368
Percent												
Male	49.9	51.1	48.0	53.7	45.8	49.2	50.9	46.6	52.7	53.7	44.7	47.6
Female	50.1	48.9	52.0	46.3	54.2	50.8	49.1	53.4	47.3	46.3	55.3	52.4
Birth to 19 years	25.7	26.4	24.6	34.5	25.0	36.4	23.1	22.1	22.2	30.7	31.7	26.2
65+ years	13.2	15.4	16.9	13.8	16.5	7.7	23.5	18.6	16.6	11.1	14.4	19.2
With a Disability	12.4	14.1	15.5	10.5	11.3	13.4	23.6	17.2	11.3	15.8	13.9	11.6
White	78.2	86.6	93.9	85.6	86.5	75.1	86.7	89.5	91.5	85.8	80.6	93.5
Native American	1.4	1.2	0.5	0.2	0.0	4.5	3.7	0.2	0.4	2.4	0.3	0.9
Two or more races	4.9	3.3	1.7	4.2	2.3	5.5	3.0	1.0	2.5	0.6	9.3	2.4
Hispanic or Latino (of any race)	11.7	20.6	9.8	34.5	18.6	58.1	34.6	17.0	11.7	13.2	15.2	6.6
Language Other than English Spoken at Home	18.8	19.8	7.9	29.7	17.1	52.7	33.1	18.6	13.6	17.9	19.1	5.3
Bachelor's Degree or Higher	32.3	26.5	27.4	31.5	27.7	9.6	16.9	31.1	34.5	18.5	35.0	43.8
Unemployed	8.8	6.9	3.5	8.2	4.6	12.5	9.4	8.7	10.2	6.0	6.7	4.5
Family Income Below Poverty Level, Past Year	9.1	11.8	10.3	13.3	14.2	30.9	20.1	12.6	9.3	13.6	10.6	4.2

Data Source: U.S. Census Bureau 2015a, 2015b, 2015c

Note: Census Tract 9204 is omitted from this analysis, as it consists entirely of the Washington State Penitentiary

Using the most recent American Community Survey (ACS) 5-year estimates for 2010 to 2014 (U.S. Census Bureau 2015a), Figure 2.9-2 presents the percentage of local employment by industry in the Primary Focus Area and Washington State. With multiple colleges and hospitals, the educational services and health care/social assistance sector is the largest source of employment in the Primary Focus Area at approximately 32 percent, exceeding the state total by 10 percentage points. Agriculture is also more prominent in the Project Area than the state as a whole, particularly in the more rural areas surrounding the City of Walla Walla. Indeed, agriculture is a major economic resource for Walla Walla County with the market value of production totaling over \$437 million dollars in 2012 (USDA 2012) and more than 100 wineries providing local employment and drawing visitors to the region (Visit Walla Walla 2016).

Table 2.9-1 summarizes ACS profile data for the Primary Focus Area, with Walla Walla County and Washington State included for comparison. Overall, the population in the Primary Focus Area is predominately white, with a large Hispanic/Latino community, including a majority Hispanic/Latino neighborhood in the central portion of the Primary Focus Area (census tract 9205). While not a strict urban-rural divide, there are clear differences between central Walla Walla-area communities and the surrounding countryside, with strikingly wide ranges in language spoken at home, educational attainment, unemployment, and poverty levels (Figure 2.9-3; Table 2.9-1).

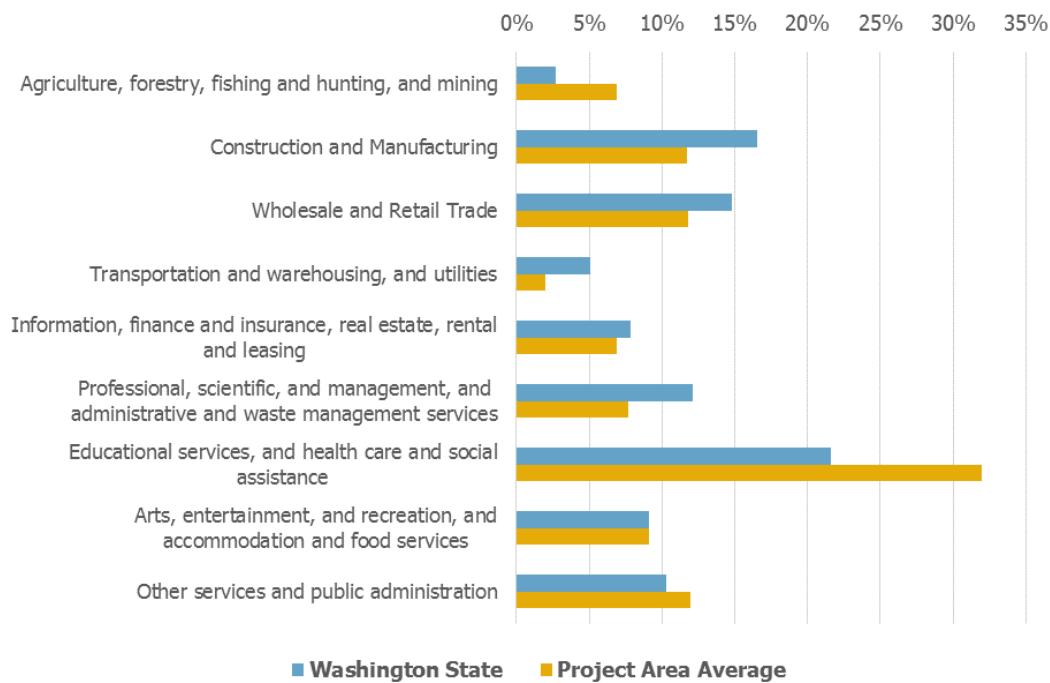


Figure 2.9-2. Percentage Employment by Industry, ACS 5-Year Estimate (2010–2014)

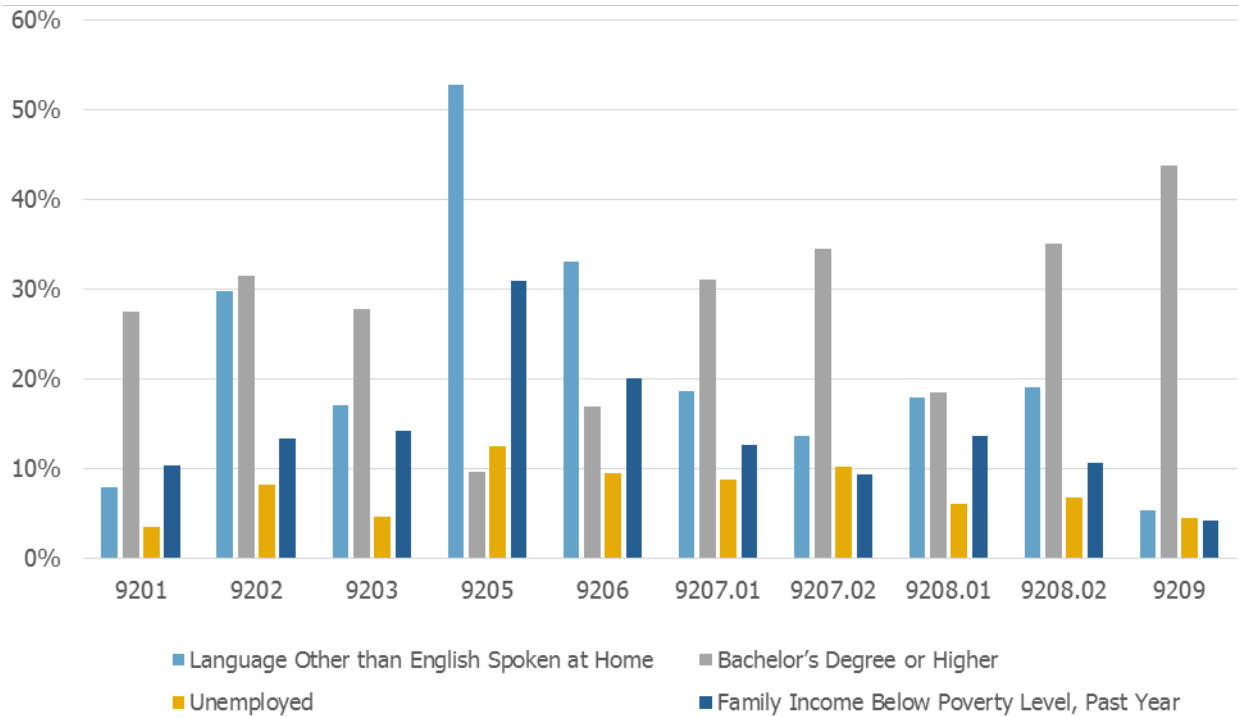


Figure 2.9-3. Key Characteristics within Primary Focus Area: ACS 5-Year Estimates (2010–2014)

The Secondary Focus Area for this assessment transitions from rural, lightly populated agricultural land into the sparsely populated Blue Mountains and Umatilla National Forest. Summary information for census tract 9201 above also covers the portion of the Secondary Focus Area with the largest population and closest geographic proximity to primary restoration activities. The three census block groups (the smallest geographic unit for which the U.S. Census Bureau publishes data) that include the outer extent have an estimated population ranging from 413 to 806 residents (U.S. Census Bureau 2015d), a fraction which may live within the Secondary Focus Area. For the CTUIR, the Umatilla National Forest is a longstanding resource and continues to be important for subsistence fishing and hunting as well as cultural activities (USDA Forest Service 1990).

2.10 CULTURAL RESOURCES

2.10.1 Cultural Setting

2.10.1.1 Cultural Significance to the CTUIR

Mill Creek is located in the Walla Walla Valley, which lies in the Plateau Culture area, and was seasonally occupied by the Weyiiletpu [Cayuse], Imatalamlama [Umatilla], and Waluulapam

[Walla Walla] tribes (Stem 1998), the earliest known inhabitants of the Walla Walla River basin. Originally, the Umatilla lived along both sides of the Columbia River downstream of the Walla Walla tribal area, with the Cayuse adjacent to the upper Umatilla, Walla Walla and Grande Ronde Rivers (Stem 1998). Several tribes often used some of the same territory, at the same time, for hunting, fishing, and gathering purposes (Dickson 2010). Principal food items in the diet of the Plateau people were fish, wild game, and roots. It was customary for tribes to meet at various places during their summer travels for the purpose of trading and socializing (Dickson 2010).

According to tribal legend, “before there were human beings on the Columbia Plateau, the Creator discussed their impending arrival with the animals. People would be like infants who would need to be taught how to live here. An animal council was held to determine how to proceed. Salmon volunteered to be the first to offer his body and knowledge to the people and the other plants and animals followed suit. The animal council's decisions reflect ‘tamanwit’, the traditional philosophy and law of the people, the foundation of a physical and spiritual way of life that would sustain Plateau peoples for thousands of years” (Conner and Lang 2006)

Tamanwit promotes the teaching that “all things of the earth were placed by the Creator for a purpose. The works of the Creator were given behaviors that were unchangeable, and until time's end, these laws are to be kept” (Morning Owl 2006). The people's purpose is to take care of all that was given them. The Creator decreed to the people that they have a reciprocal responsibility to respectfully care for, harvest, share, and consume traditional foods, or the foods may be lost. Neither can survive without the other. Since the beginning of time, tamanwit has taken care of the traditional foods and guided the CTUIR in preserving them (Sampson 2006). Hunting, fishing, and gathering are expressions of the covenant that tribal people have with the land and everything that lives on it. Often referred to as “Indian law,” this covenant requires the CTUIR to follow the seasonal round of hunting and gathering of their traditional subsistence foods. In their actions, they are giving back to the land that provides for them (Morning Owl 2006). This philosophy is reflected in the CTUIR’s “First Foods” policy (Jones et al. 2008), discussed earlier in Section 1.4.1.

One of the most important historic events to occur in the region was the negotiation and signing of the Treaty of 1855 between the Umatilla, Cayuse, and Walla Walla tribes and the United States government. Under this treaty, the three tribes ceded 6.4 million acres of ancestral lands to the federal government, while they would hold rights for fishing, hunting, gathering foods and medicines, and pasturing livestock throughout the territory, and retained 510,000 acres in

direct ownership (Dickson 2010). The treaty was signed on June 9, 1855 (Dickson 2010)⁶. Four years later in 1859, the Treaty was ratified by Congress (Payne and Schulz 2011).

Today, salmon and other fish species continue to be a significant part of the CTUIR's culture and traditional foods, as described in their "First Foods" policy noted earlier (Jones et al. 2008). Mill Creek and the Walla Walla Valley were part of the territory ceded in 1855, and as noted above, the Treaty of 1855 reserved the CTUIR's rights for fishing, hunting, and gathering foods and medicines. The CTUIR is thus continuing their historical and cultural legacy by taking an active role reestablishing and strengthening the fisheries in Mill Creek.

2.10.1.2 Cultural Significance to Non-Tribal Settlers and Immigrants

Mill Creek is also culturally important to early non-tribal settlers in the area. Fur traders established a post near the mouth of the Walla Walla River in 1818 (OHS 2016) and immigrants and missionaries followed soon after. The Whitman Mission was established in 1836 near the mouth of Mill Creek and was a stopping place for immigrants following the Oregon Trail. Marcus Whitman established irrigation methods and milling of grains in the valley and established a saw mill in upper Mill Creek (Lyman 1918). However, overexploitation of resources by the immigrants, the spread of disease, and encroachment on lands by settlers led to conflict, including the killings at the Whitman Mission and the "Cayuse War" of 1847 to 1850 (CUTIR 2016a). These conflicts ultimately resulted in the signing of the Treaty of 1855 between the Umatilla, Cayuse, and Walla Walla tribes and the United States government; an event which occurred on the banks of Mill Creek in present day City of Walla Walla.

The City of Walla Walla was established near Fort Walla Walla in 1862 along Mill Creek and its distributaries because it provided a readily available water supply that was necessary for a growing population and further development. By 1864, thousands of acres of land were being cultivated in the hills surrounding the City of Walla Walla (Paulus 2008) and many of Mill Creek's distributaries were turned into irrigation ditches and water was appropriated to agricultural users (WWBWC 2004). In 1878, Dr. Dorsey Baker constructed a flume down Mill Creek to access lumber harvesting from the upper Mill Creek drainages (Orchard 1982) and to help provide lumber for the growing town.

⁶ It is noted the Treaty of 1855 commenced in May of 1855 with the first Walla Walla Council gathering of Nez Perce, Walla Walla, Umatilla, Cayuse, and Yakama tribes, but Washington Territorial Governor Isaac I. Steven convened a second Treaty Council in 1856 for the purpose of ratifying the Treaty. Consequently, some scholars refer to it as the Treaty of 1856.

Historically and currently, Mill Creek is culturally important to the residents of Walla Walla County as it provides water for fish, wildlife, recreation, irrigation and domestic uses. Mill Creek and the Mill Creek watershed provides a critical water supply to the City of Walla Walla and Mill Creek and Bennington Lake are popular recreation resources that are viewed as major contributors to the quality of life of Walla Walla County residents and visitors.

2.10.2 Cultural Resource Identification

The locations of cultural resource sites are treated as confidential information in order to protect the resource from damage and exploitation (RCW 27.53.070), and are only available to persons obtaining advanced approval from the Washington State Department of Archeology and Historic Preservation (WISAARD 2016). Prior inquiries to the CTUIR have generally led to a statement that the entire Walla Walla Valley is considered culturally significant, and that cultural sites could exist anywhere in the valley (CTUIR 2007).

One of the few acknowledged cultural sites is the site of the 1855 Treaty Council Grounds. The grounds are believed to have been located near where the trail to Nez Perce crossed Mill Creek (currently near the center of downtown Walla Walla). It is said several thousand Indian people attended this Treaty Council, and their camps were distributed along miles of Mill Creek (Payne and Schulz 2011).

Therefore, the potential exists for individual cultural resource sites to exist along Mill Creek and its distributaries. Cultural resource investigations would need to be performed prior to any modification of the Mill Creek channel or other sites within the Project Area.

2.10.3 Historic Resource Identification

The National Historic Preservation Act of 1966, administered by the NPS, established the National Register of Historic Places to coordinate and support public and private efforts to identify, evaluate, and protect America's historic and archeological resources (36 CFR Part 60). The State of Washington and City of Walla Walla have adopted similar programs respectively known as the "Washington Heritage Register of Historic Places" and "Local Register of Historic Places". The state and local programs are authorized and overseen by the NPS (NPS 2016).

Listing of a property on the National, State, or Local Register is voluntary, and enables properties to be eligible for certain federal and local tax credits as an incentive to encourage preservation and restoration. In order to be eligible for listing, a property must be at least 50 years old and associated with events, activities, or developments that were important in the past. Once listed, properties should comply with the U.S. Secretary of Interior's Standards for

Historic Preservation. Properties listed on the National Register that have received federal funds may be subject to a Section 106 Consultation prior to significant alteration or demolition (36 CFR Part 60).

In 2009, the city received a grant from the Washington Department of Archaeology & Historic Preservation to conduct a Level 1 Inventory of Historic Properties within the downtown area. In addition to preliminary identification and characterization of historic properties, the inventory also identified properties potentially eligible for listing on the National, State, or Local Registers of historic places. Figure 2.10-1 shows the sites that were identified in the 2009 Inventory as listed or determined to be eligible for listing on the National Register of Historic Places, the Washington Heritage Register of Historic Places, and/or the Local Register of Historic Places (City of Walla Walla 2009b). The portion of the Mill Creek channel extending through downtown was determined to be eligible for listing.

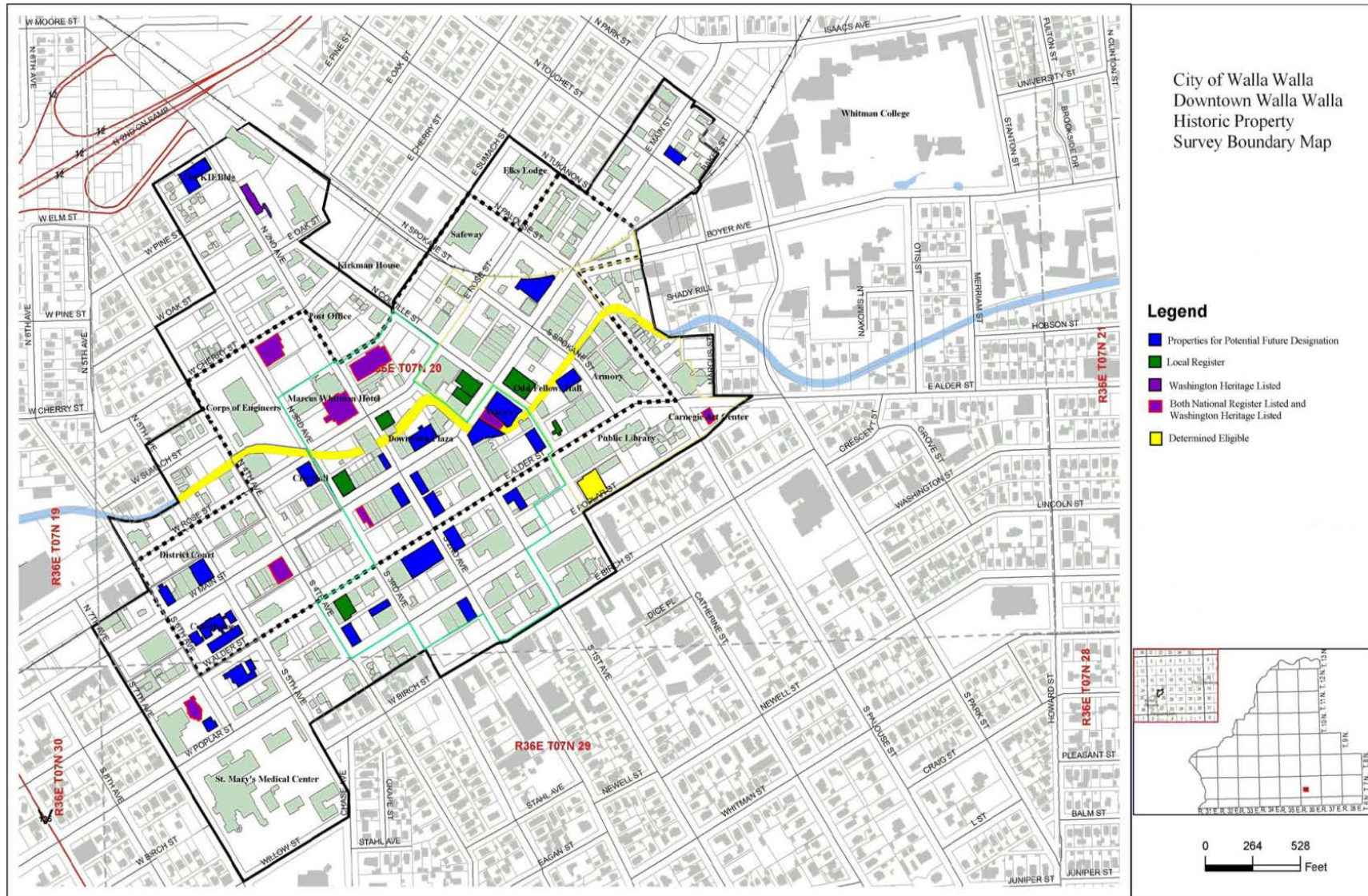


Figure 2.10-1. Downtown Historic Register Properties

Sites currently on the National, State, or Local Register and proximate to the existing Mill Creek channel and Garrison Creek are shown in Table 2.10-1. There are no listed properties adjacent to Yellowhawk Creek.

Table 2.10-1. Properties on Historic Property Registers

Name	Address	Year Built	Historic Property Register		
			National	State	Local
Walla Walla Gas & Electric Company Bldg.	111 6th Ave.	1911			X
Gardner Building	30 W. Main	1910			X
Marcus Whitman Hotel	107 N. 2nd Ave.	1906	X	X	
Pantorium Cleaners & Dye Works	18 – 30 N. 2nd Ave.	1922			X
Whiteside Bldg.	51 E. Main St.	1890			X
C.J. Breier Bldg.	57 - 61 E. Main St. & 5 N. Colville St.	1926			X
Liberty Theater	50 E. Main St.	1917	X	X	
Southerland Bldg.	102 E. Main St.	1913			X
Carnegie Library	109 S. Palouse St.	1905	X	X	
Union Gas Station (Marcy's)	33 S. Colville St.	1922			X
Whitman Mission National Historic Site	6 Miles West of Walla Walla off U.S. 410	1845	X	X	
Fort Walla Walla Historic District	77 Wainwright Drive	1856	X	X	

Source: Washington Information System for Architectural and Archeological Records Data (WISAARD 2016)

There are a number of other sites and building listed in the WISAARD database determined to be historically significant and potentially eligible for listing on a Register. Examples include bridges, the Walla Walla Treaty Site, and Council Grove (WISAARD 2016). Further review will be necessary if specific modifications or projects are proposed.

The MCFCP was evaluated for eligibility for listing on the National Register of Historic Places in 2009 by the USACE (McCroskey 2009). While not yet listed, the MCFCP was found to be eligible due to its age and unique features, and future alterations would require consultation under Section 106 of the National Historic Preservation Act (USACE 2016b).

Overall, as discussed above, there are a number of significant cultural and historic sites in the Project Area, as well as the potential for additional cultural resource discoveries. This will be an important consideration when developing conceptual alternatives to restore ecological and cultural functions along Mill Creek and its distributaries.

2.11 VISUAL AESTHETICS

2.11.1 Visibility of Mill Creek Corridor and Related Visual Aesthetics

As discussed earlier, most of lower Mill Creek flows through a highly developed landscape. Visibility varies widely, from stretches of open access to complete invisibility underground downtown Walla Walla (Figures 2.11-1 through 2.11-6). As most of the lower channel is bordered by private property, bridges and adjacent roadways and paths are the most common public viewpoints. Between RM 0 and 15, there are 27 bridge crossings, including 23 roads, 2 public footbridges, 1 private footbridge, and 1 railway crossing.

The aesthetics of lower Mill Creek itself are highly altered. Downstream from downtown Walla Walla, Mill Creek retains some more natural features, though flood control modifications are still plainly visible (Figure 2.11-1). Through downtown Walla Walla, 1,400 feet of the creek is underground (Burns et al. 2009), with small portions of the concrete-lined channel daylighted (Figure 2.11-2). However, even where daylighted, the creek is not easily visible from main pedestrian corridors (Figure 2.11-3).

East of downtown, Mill Creek continues in the concrete flume through residential areas and Whitman College campus. Views are obstructed by chainlink fencing and the concrete walls along the creek, the concrete giving the creek an appearance more similar to a drainage ditch (Figure 2.11-4).

Upstream of Roosevelt Street (approximately RM 8.5) the channel transitions back to the modified, but unlined channel, which continues through a residential area where views are limited to private backyards. Above RM 9, access to the creek opens up with adjacent recreational areas (see Section 2.12), including the Mill Creek Recreation Trail (Figure 2.11-5). The Bennington Diversion Dam (RM 11.4) is one of the most dramatic visual alterations in the Project Area (Figure 2.11-6) in the most heavily used recreational area of the creek (Section 2.12).



Figure 2.11-1. Mill Creek from Myra Road Crossing (RM 5.7), Facing Upstream



Figure 2.11-2. Daylighted Portion of Mill Creek (RM 7.2), Intersection of 1st and Main St.



Figure 2.11-3. Underground Portion of Mill Creek (RM 7.2), Intersection of 1st and Main St.



Figure 2.11-4. Mill Creek from Park Street Crossing (RM 7.5), Whitman College Campus/Residential



Figure 2.11-5. Mill Creek from Tausick Way Crossing (RM 10), Walla Walla Community College and Mill Creek Recreational Trail Facing Upstream



Figure 2.11-6. Mill Creek just below Bennington Diversion Dam (RM 11.4), Facing Upstream (Trail on Left)

Upstream of the Bennington Diversion Dam to RM 15, Mill Creek is far less altered, with a sinuous pattern and natural streambed, as well as more vegetated riparian areas, running through agricultural and rural residential properties (Figure 2.11-7). For local residents, access and views of the creek remain limited due to intervening vegetation. One exception is a short reach just downstream from RM 15 where residential backyards directly border the creek.



Figure 2.11-7. Mill Creek from Five-Mile Road Bridge (approx. RM 12.8)

2.11.2 Garrison Creek, Yellowhawk Creek, and Secondary Focus Area

As described earlier in this assessment (Section 2.4.3), both Garrison Creek and Yellowhawk Creek largely run through urbanized areas, though more so for Garrison Creek. Visibility of the creeks is primarily limited to road crossings and small openings in between private residential properties. Figure 2.11-8 is a representative view of Garrison Creek running in between residences with limited or no riparian vegetation and a reinforced streambank. As shown in Figure 2.11-9, the WWCCD has supported work on portions of Garrison Creek through the CURB program intended to reestablish a vegetated riparian zone between the stream and development (WWCCD 2016b). Such efforts may help to create a more natural appearance along Garrison Creek where implemented.

In addition to residential backyards and in between agricultural fields, Yellowhawk Creek is a prominent visual feature on the Walla Walla High School campus (Figure 2.11-10). Larger

riparian trees have been retained in this portion of the creek, and the bank is left unconstrained by riprap or other modification.

The Secondary Focus Area has only been minimally impacted by development and Mill Creek retains a natural visual aesthetic (Figure 2.11-11). Viewing access of Mill Creek in the upper watershed is limited due to public water supply protection of the watershed, as well as the absence of developed recreation facilities, as discussed below in Section 2.12.



Figure 2.11-8. Garrison Creek Near Fern Avenue



Figure 2.11-9. Garrison Creek Near School Ave. – CURB Project (WWCCD 2016b)



Figure 2.11-10. Yellowhawk Creek on Walla Walla High School Campus



Figure 2.11-11. Secondary Focus Area – Mill Creek Upper Watershed

2.12 RECREATION RESOURCES

2.12.1 Existing Recreational Uses Connected to Mill Creek

Running through a populated area, there are a number of developed recreational sites along lower Mill Creek (Figure 2.12-1). Within the City of Walla Walla, five parks border the creek, including Washington Park (no creek access), Wildwood Park, Eastgate Lions Park, the Mill Creek Sportsplex, and the Walla Walla Community College Recreation and Nature Area. The USACE manages a 612-acre

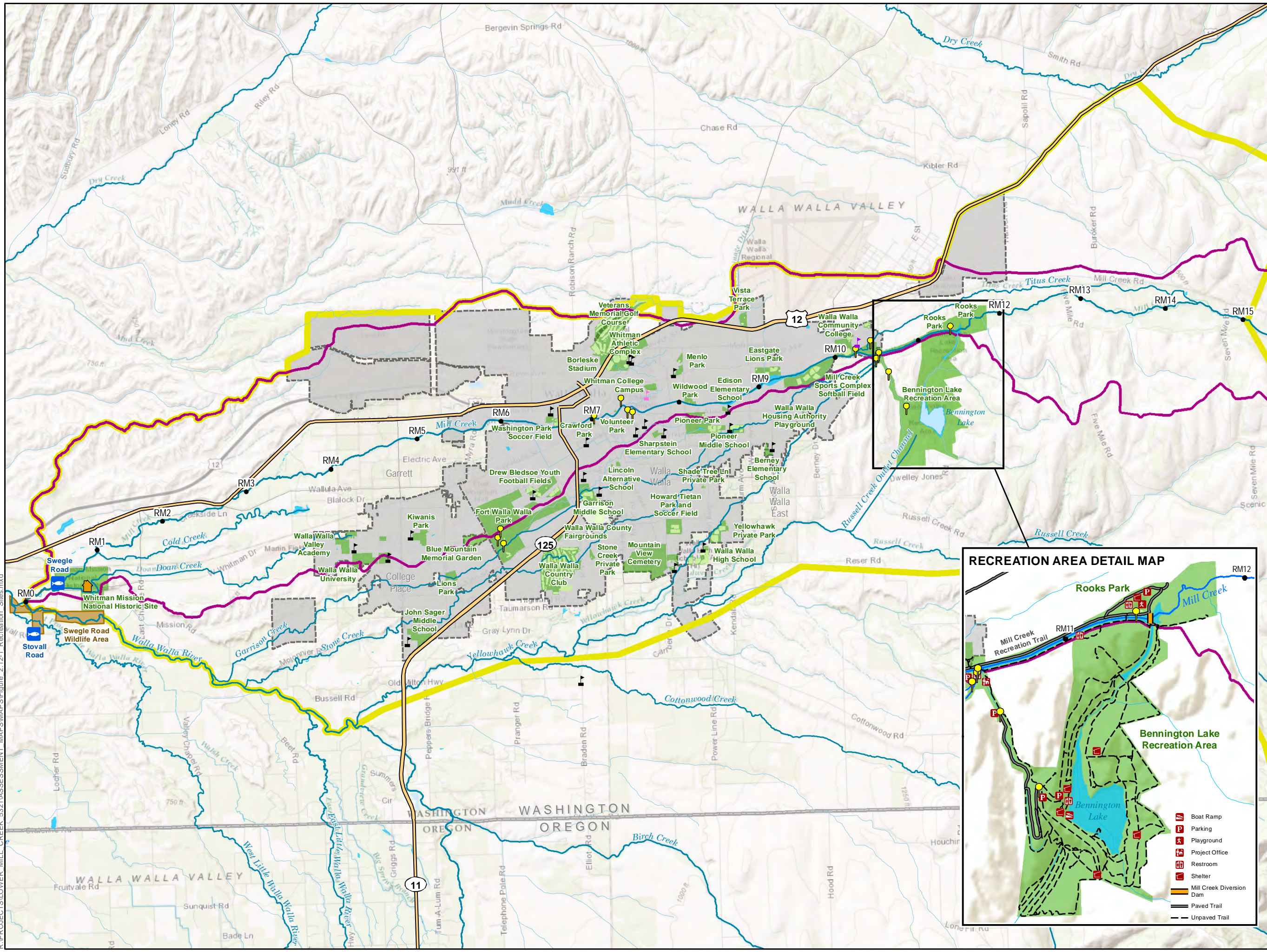


Bennington Lake - USACE Mill Creek Project Recreation Area

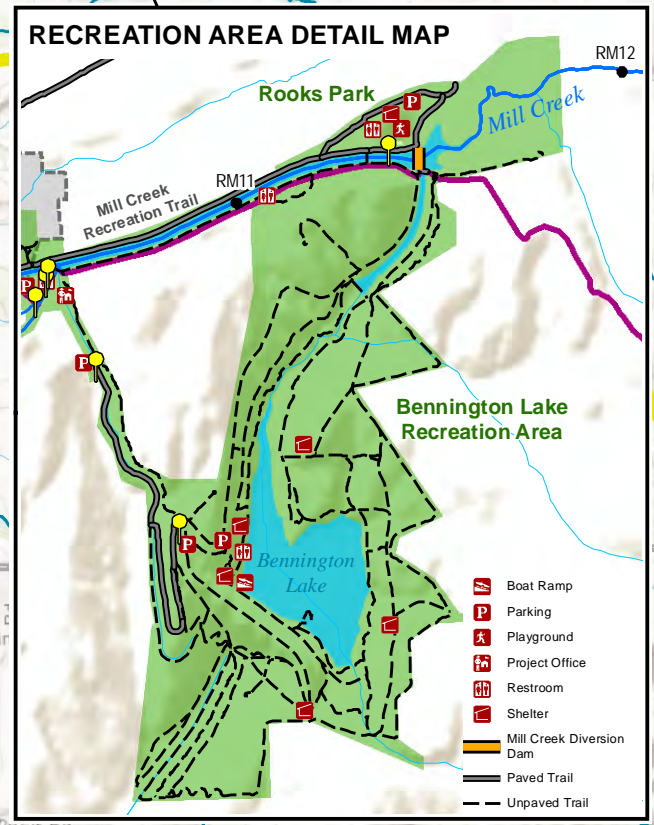
LOWER MILL CREEK HABITAT AND PASSAGE ASSESSMENT

CONFEDERATED TRIBES OF THE UMATILLA INDIAN RESERVATION

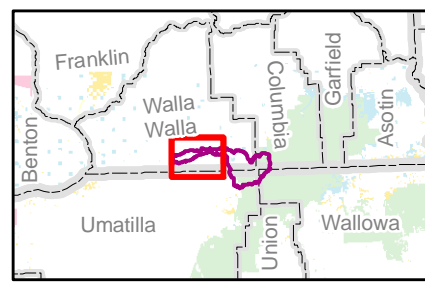
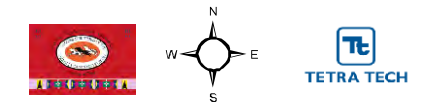
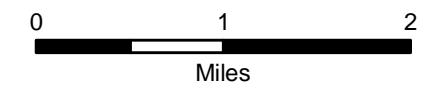
FIGURE 2.12-1 RECREATION SITES ALONG LOWER MILL CREEK



- River Miles
- Walla Walla Community College
- Whitman College
- School
- Whitman Mission National Historic Site
- Interpretive Sign/Educational Feature
- Public Fishing Site
- Major Stream
- Minor Stream
- Parks and Recreation
- Athletic Fields
- Wildlife Area
- Cities
- Mill Creek Watershed
- Primary Focus Area



Sources: CTUIR, City of Walla Walla, Walla Walla County, StreamNet



R:\PROJECTS\LOWER MILL CREEK\ASSESSMENT_MAPS\MAPS\Figure 2.12-1 Recreation Sites.mxd

recreation area at RM 11.5 as part of the Mill Creek Flood Control Project. This area includes Rooks Park, Bennington Lake, and more than 20 miles of trails, drawing over 300,000 visitors in 2012 (USACE 2012b, 2016a). The popular Mill Creek Recreation Trail runs 1.3 miles along the creek from Rooks Park to Eastgate Lions Park (City of Walla Walla 2008). Bennington Lake is the only public lake in the Walla Walla Valley, which WDFW stocks with rainbow trout in the spring for recreational fishing (Walla Walla County 2007, USACE 2012b). Hunting is also allowed in designated areas around Bennington Lake.

Near RM 1, the northwest corner of the 98-acre Whitman Mission National Historic Site overlaps Mill Creek and visitors are allowed to walk the full grounds; however, there are no designated trails or pathways to the creek (NPS 2015). Also near RM 1 is a public fishing access site on Mill Creek at Swegle Road and a WDFW Wildlife Area (Swegle Road Unit) which includes a 25-foot easement along both shorelines of Mill Creek and a WDFW-owned parcel along the south shore of the Walla Walla River, both of which provide public access for fishing, hunting, bird watching, and other recreation.

The Secondary Focus Area along the upper Mill Creek watershed extends into the Umatilla National Forest. The upper Mill Creek watershed area is protected as the primary public water supply source for the City of Walla Walla (supplying approximately 90 percent of the City's water needs), and is generally closed to the public (City of Walla Walla 2013b). The surrounding area of the Umatilla National Forest has no developed recreation sites, but dispersed and backcountry recreation is open to the public (USDA Forest Service 1990, 2014).

Mill Creek and its distributaries serve as a natural educational feature for area residents and visitors. A number of interpretive signs or educational features currently exist in the Primary Focus Area, though usually for nearby historical or recreational facilities and not directly associated with Mill Creek (Figure 2.12-2). One project on Garrison Creek



Figure 2.12-2. Project Sign for Living Classroom/Interpretive Walking Path along Garrison Creek; Collaborative Restoration Project by Sherwood Trust, Wildhorse Foundation, Kooskooskie Commons, and the City of Walla Walla Parks and Recreation Department

established a signed walking path as part of a group restoration project in 2011 (Figure 2.12-2).

A recent field survey by the CTUIR found that locations near Starbucks (by the daylighted portion of Mill Creek at 1st Avenue and Main Street), Indian Trail Road (near RM 0), and the Walla Walla Community College may be good potential candidates for additional interpretive signs (CTUIR 2016c).

2.12.2 Planned Recreation Use Associated with Mill Creek

The City of Walla Walla Comprehensive Plan notes plans for future development of a bridge to span Mill Creek from the Mill Creek Sportsplex on the south side to the Mill Creek Recreation



Figure 2.12-3. Pedestrian Bridge near Rooks Park

Trail and Eastgate Lions Park on the north side of the creek (City of Walla Walla 2008). Such a bridge may be similar to the existing crossing near Rooks Park (Figure 2.12-3). The Walla Walla County Comprehensive Plan does not set any specific goals related to Mill Creek; however, the plan makes general policy recommendations that would be applicable to Mill Creek, such as encouraging joint public-private ventures to provide park and other recreational opportunities (Walla Walla County 2007).

A Walla Walla-based non-profit organization, the Community Council, recently completed a study of opportunities for enhancing outdoor recreation opportunities in the region. One of their final recommendations was to connect the public to communities and landmarks via a network of trails, with the specific example of completing a river walk from Bennington Lake to the Whitman Mission along Mill Creek (Community Council 2015).

For the USACE Mill Creek Flood Control Project recreation area, the Final Master Plan currently sets out a number of potential changes to existing facilities. In addition to additional interpretive signs and programming, the USACE may add new facilities or other improvements at Bennington Lake and Rooks Park, such as picnic shelters/benches, a swimming beach, a fishing pier, Americans with Disabilities Act universal access, and restroom upgrades (USACE 2016b).

2.13 ECONOMIC VALUE

2.13.1 Value of Watershed

A healthy watershed provides a broad suite of ecosystem goods and services, from clean water and air to fishing and recreation opportunities. Because ecosystem services are primarily non-excludable, meaning one person's use of these services does not inhibit their use by another (e.g., water filtration and air quality), and where ecosystem marketplaces are nascent or nonexistent, watersheds have often been treated as having zero economic value (Earth Economics 2010). The services provided by healthy watersheds are, however, very expensive to engineer (if possible at all) and such solutions may only provide a fraction of the services provided by natural systems (EPA 2012).

Water quality is one of the most important and more readily quantifiable economic values of watersheds. As noted earlier, the protected Mill Creek watershed supplies up to 90 percent of the City of Walla Walla's water needs (City of Walla Walla 2013b). This saves money that would be required for more extensive filtration and/or treatment, and also generates revenue by running the same water through a hydropower generator that contributes to the local grid (City of Walla Walla 2013b). Though a comparable estimate for Walla Walla was not available, in the oft-cited example of New York City, an investment of \$1.5 billion in watershed conservation saved upwards of \$6.5 to 8.5 billion when compared to a new water filtration plant (EPA 2012).

In addition, there have been recent efforts to quantify the broader set of ecosystem goods and services provided by healthy watersheds. By one estimate, natural systems in western Washington's Snoqualmie Basin provide annual economic benefits of \$265 million to \$2.5 billion (Earth Economics 2010). Nationwide, outdoor recreation contributes over \$700 billion annually to the economy (EPA 2012).

Natural flood control is another high-value function of intact watersheds. Engineered flood control projects are generally very expensive to build and maintain, and can lead to even greater costs in the event of control failure and damages from unexpected flooding (Ecology 2010). In the United States, floods cause an average of \$8 billion in damage every year (EPA 2012). One assessment by Ecology estimated that, in western Washington, the value of existing wetlands for flood protection ranged from \$8,000 to \$51,000 per acre, depending on specific local circumstances (Ecology 1997). The USACE has at times followed a strategy of land acquisition and protection rather than to construct extensive flood control structures (Ecology 1997).

2.13.2 Value of Fishery Benefits to Individuals and Region

As described at the outset of this assessment, the Project’s central goal is to make ecologically and physically measurable progress towards fully resolving fish passage, improving fish habitat, and improving the conditions of River Vision touchstones (Jones et al. 2008). While there are a multitude of non-economic values to recovering threatened and endangered fish species, including inherent ecological value and Tribal cultural value, supporting habitat restoration in Mill Creek can also provide direct economic benefits to the community.

In 2011, the CTUIR commissioned a study to quantify the economic benefits of the Columbia River Water Exchange (CRWE) project to spring Chinook, steelhead, and other native fish species in the Walla Walla River Basin (IEC 2011). The CRWE project was proposed to restore summer river flows to benefit the fisheries. Tables 2.13-1 and 2.13-2 summarize the primary results of this economic analysis (see IEC 2011 for complete details of how these estimates were generated). Overall, improving the fisheries led to net economic benefits (social welfare value) estimated at \$353,000 to \$976,000 annually, totaling \$9.1 million to \$25.1 million over 50 years (Table 2.13-1). In the region, increased fish sales and expenditures associated with fishing activity were estimated to produce demand for 11 jobs, \$293,300 in employee compensation, \$423,000 in value added (gross state product), and \$810,000 in output (Table 2.13-2). While restoration along Mill Creek may have a different specific outcome, in terms of changes to fisheries, this analysis points to significant, tangible economic benefits of such activities.

Table 2.13-1. Summary of Quantified Annual Net Economic Benefits of Increased Spring Chinook and Summer Steelhead Populations Following Flow Restoration (IEC 2011)

Fishery	Increased Number of Fish Caught	Increased Net Economic Value
Spring Chinook		
Commercial	137	\$13,500
Treaty	962	\$95,000
Recreational	928	\$112,000
Total (Annual)	2,030	\$220,000
Total (50 years)^{1/}	101,000	\$5,670,000
Summer Steelhead		
Existence Value	800 to 5,2000 returning adults	\$66,200 to \$428,000
Recreational	1,911 fish caught	\$67,000 to \$328,000
Total (Annual)	--	\$133,000 to \$756,000
Total (50 Years)	--	\$3.4 to \$19.4 million

Note: Totals may not sum due to rounding

1/ Assumes a 3 percent discount rate

Table 2.13-2. Summary of Quantified Annual Regional Economic Benefits of Increased Spring Chinook and Summer Steelhead Populations Following Flow Restoration (IEC 2011)

Activity	Direct Sales/ Expenditures	Annual Regional Economic Contribution			
		Employment (Persons)	Employee Compensation	Value Added	Output
Spring Chinook					
Increases in Recreational Harvest	\$492,000	5	\$115,000	\$187,000	\$350,000
Increases in Non-Treaty Commercial Harvest	\$13,500	0	\$12,200	\$13,200	\$27,000
Increases in Treaty Commercial Harvest	\$95,000	3	\$85,600	\$93,100	\$190,000
Total	\$601,000	8	\$213,000	\$293,000	\$567,000
Summer Steelhead					
Increases in Recreational Harvest	\$218,000	3	\$80,300	\$130,000	\$243,000

2.13.3 Agricultural Value

The Walla Walla region is one of the most productive agricultural areas in the world (NPPC 2001 as cited in NPCC 2005) and agriculture is a major economic resource for Walla Walla County with the market value of production totaling over \$437 million dollars in 2012 (USDA 2012) and more than 100 wineries providing local employment and drawing visitors to the region (Visit Walla Walla 2016). The primary agricultural products in the subbasin are spring wheat, winter wheat, and barley; peas and lentils are also grown as well as apples, cherries, asparagus, potatoes, onions, alfalfa, and wine grapes (SRSRB 2011). Much of these crops are irrigated and irrigation represents the largest use of surface and groundwater in the Walla Walla subbasin (Ashley and Stovall 2004 as cited in NPCC 2005). The primary water sources for agricultural irrigation include the Touchet River, Walla Walla River, East-West Canal, Gardena Canal, Lowden Canals, gravel aquifers, and the basalt system (NPCC 2005). The Mill Creek watershed supplies water to approximately 10,000 acres of irrigated lands (pers. com. Brian Wolcott, Walla Walla Basin Watershed Council, Aug. 23, 2016) and therefore plays a large role in the agricultural economy of the county.

2.13.4 Real Estate Value

Currently, Mill Creek provides some localized real estate value benefits, primarily in portions where the creek retains a more natural appearance and is visible (see Section 2.11, Visual Aesthetics). In most areas along the intensely developed downtown corridor, however, the creek is either so highly modified, walled off by fences and concrete, or underground, that it fails to serve as a natural benefit to adjacent properties and in places may be considered an undesirable feature.

Revitalizing Mill Creek can serve to boost local real estate and other economic values. Recent studies from around the country have shown increased property values and tax revenues from proximity to open space, green space, walking/biking trails, or riparian areas (EPA 2012). Healthy waterfronts also increase real estate value for retail and commercial businesses (EPA 2012). In San Antonio, Texas, a feasibility assessment for the Westside Creeks Ecosystem Restoration Project found that the increased recreation opportunities provided by a restored waterfront would lead to annual net benefits of \$3.6 million (USACE and San Antonio River Authority 2013). Over 20 years ago, the town of Breckenridge, Colorado, completed a 5-year, \$6.5 million Riverwalk Restoration Project that transformed a degraded river corridor running through town into a thriving park that includes a performing arts center and outdoor event space (Figure 2.13-1) (City of Breckenridge 2009).

Naturalizing portions of Mill Creek through Walla Walla, including new public spaces, has the potential to provide similar economic benefits, increasing adjacent property values and contributing to the overall commercial and recreational sectors that benefit from increased use of the corridor. According to a study conducted by the Community Council, outdoor recreation could indirectly increase the demand for services in Walla Walla such as lodging, dining, and shopping (Community Council 2015). The Community Council also reported in its study that physical and mental health has been showed to be improved by spending time outdoors (Community Council 2015). Access to natural areas and fish and wildlife contribute to the quality of life for the residents of the City of Walla Walla and improvements to Mill Creek would increase the city's active and passive recreational opportunities and desirability to both residents and visitors.



Figure 2.13-1. Breckenridge Riverwalk Restoration Project

3. Problems and Opportunities

Mill Creek has a number of ecological degradation problems that were identified in Section 2 in the description of historic and current channel conditions and the identification of limiting factors. Section 3 extends the analysis by both identifying the major problems related to fish passage and habitat, floodplain storage and connectivity, and community connection to the stream corridor and then describing opportunities for addressing these problems and achieving the Project's goal and objectives.

3.1 HYDROLOGIC FLOWS

3.1.1 **Problem: Low flows in Mill Creek do not support multiple life stages of focal species**

During the hotter summer months (June through October), seasonal low flows in the Primary Focus Area of Mill Creek are subject to many withdrawals for municipal consumption, cropland irrigation and livestock, and water storage. These impacts have altered the hydrologic regime, severely reducing the amount of water flowing through Mill Creek leading to physical and temperature barriers to fish passage and increased concentrations of PCB levels and other toxins. At the Division Works Dam, most of the flows are diverted away from Mill Creek to Yellowhawk and Garrison Creeks. The flow is often so low below the Division Works Dam in Mill Creek during the summer (mean monthly discharge from July to October is 3.7 cfs) that it cannot sustain the minimum velocities and depths necessary to support any life stages for the focal fish species.

3.1.2 **Opportunity: Establish recommended target Mill Creek flows that support multiple life stages of focal fish species**

Minimal and optimal flows for the existing Mill Creek channel were discussed in Section 2.5.3 as a minimum of 45 cfs, and an optimal flows of 100 cfs for the Primary Focus Area. The minimum flows provide for adequate fish habitat but do not ensure that all fish passage barriers will be resolved. As noted in the Burns et al. (2009) report, there is currently not a single flow that would allow all portions of Mill Creek from Gose Street to Bennington Diversion Dam to be passable by fish. Therefore, fish passage barriers will need to be resolved through channel configuration work in addition to maintaining these minimum flows or achieving these optimal flows in Mill Creek. The potential for thermal impacts must also be considered as flow studies in the existing channel (Segments 1 through 4) have shown that certain flows can increase

temperatures in certain areas as they can dilute cold water inputs (Mendel et al. 2002, Ecology 2007a). The results from these flow studies indicate that reconfiguration of the channel (e.g., creating a narrower and deeper channel for low flows) and/or increased riparian cover/shading will be needed in addition to increased flows in order to provide high value fish habitat.

Under current conditions, options to increase flows in Mill Creek are limited because, as detailed in Section 2.5.3, demand for water exceeds Mill Creek's finite supply. As discussed in Section 2.4.8.2, the water rights necessary to sustain Treaty-reserved rights were not considered or adjudicated in the 1928 adjudication process for water rights in the Walla Walla River. The CTUIR is currently working collaboratively with basin partners to restore and protect adequate stream flows while trying to maintain current out-of-stream uses and values. Strategies and approaches to flow management have the potential to improve fish habitat. Conceptually, these approaches include:

- Control fish access to reaches where flow has been severely depleted by diversion or withdrawals. During the summer months, a significant amount of flow is diverted down Yellowhawk Creek, leaving Mill Creek dry. This concept would designate one flow path as the fish passage route and one as flood control. This would require fish screens at select locations that direct fish to the designated migration path and exclude them from the flood control path. In addition, this concept would require habitat improvements and flow control improvement to the habitat path.
- Store water during higher winter and spring flows and release it back to Mill Creek during summer months. This would utilize Bennington Lake and possibly an additional storage reservoir to capture water during the winter and spring to slowly release the stored water back to Mill Creek during critical low-flow periods.
- Purchase or transfer existing senior water right claims so that flows previously withdrawn for consumptive use remain in Mill Creek. This could include transferring a portion of an existing water right, sometimes referred to as abandoning or relinquishing, for non-consumptive use.
- Assist the City of Walla Walla with upgrading leaky delivery pipes in exchange for leaving a portion of the conserved water in Mill Creek. According to a City of Walla Walla's 2015 Water Use Efficiency Report, water loss was 33.6% in 2012, 31.4% 2013, 29.3% in 2014 and 25.3% in 2015 (City of Walla Walla 2015b). The water loss goal set by the Washington State Department of Health is <10% (City of Walla Walla 2015b).

Although the City of Walla Walla is currently implementing water saving measures and

decreasing its annual reported water loss due to leaky pipes, additional resources could be provided to the city to help achieve further water loss reductions.

Segment 1 would see the most benefit from meeting minimal or optimal flows, as it currently experiences seasonal low flows of less than 10 cfs. In addition, this segment has a semi-naturalized channel compared to the urban Mill Creek Channel and has more options for habitat restoration including opportunities for temperature refugia through integration of LWD, in-water structures such as boulders, and canopy shading from riparian connectivity along the banks.

Segments 2, 3, and 4 are currently highly altered by a concrete flume, tunnel, and vertical walls and/or a sill/weir with levee banks with no riparian vegetation. These segments have been identified as only serving as a migration corridor (i.e., no spawning, rearing, or migration habitat) when flows are sufficiently high to remove low-flow barriers and sufficiently cold to remove thermal barriers. Only recently have fish passage improvements through these segments been implemented, albeit to a small portion of the segments. These improvements include adding slots through the weir segments and installing baffles accompanied with resting pools and roughness panels in the flume segments. A low-flow channel has also been constructed in Segment 3. Figure 3.1-1 demonstrates the recent improvements to the flume segment shown at minimal flow. A flow of 100 cfs is simulated in Figure 3.1-2 and shows the roughened panels as well as the resting pools. However, while these improvements address physical passage issues, they may not fully address thermal barriers in Segments 2, 3, and 4 even when the minimal or optimal flows are met because of the potential dilution of cold water inputs (Mendel et al. 2002).



Figure 3.1-1. Segment 3 – Recent Fish Passage Improvements at Minimal Flow

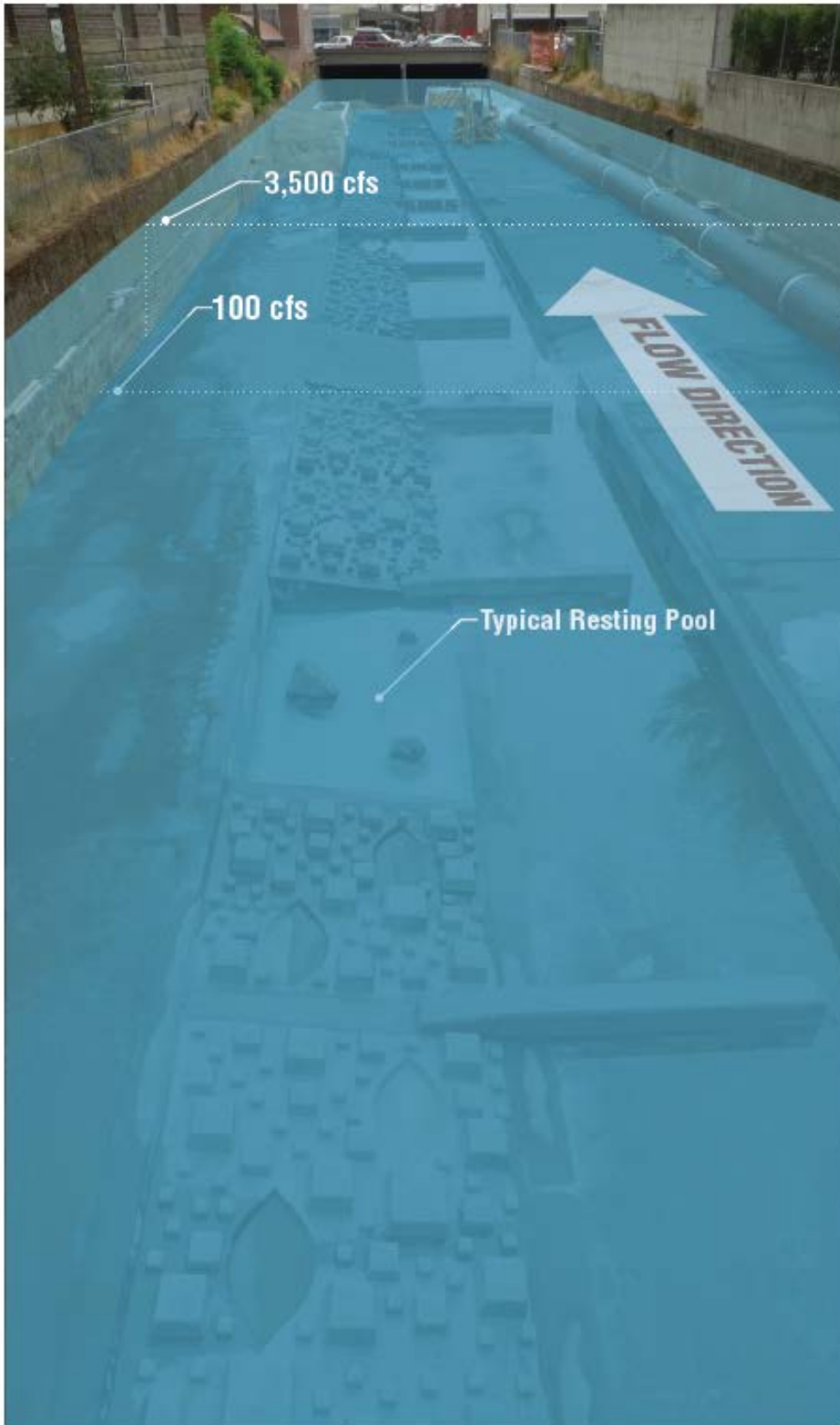


Figure 3.1-2. Segment 3 – Recent Fish Passage Improvements at Optimal Flow

In general, minimal improvement within these segments would include achieving the identified minimal flows along with the current plans to improve fish passage. However, as stated earlier, consideration of thermal impacts must be evaluated when adding flows to the existing channel configuration as increased flows could result in higher temperatures in certain areas where there are currently cold water inputs. Optimal improvement to these segments would involve achieving optimal flows, resolving fish passage, and converting the altered channel from a hard concrete channel to a naturalized channel. Figure 3.1-3 illustrates the concepts of minimal flow with minimal channel improvement and optimal flow with optimal channel improvements.

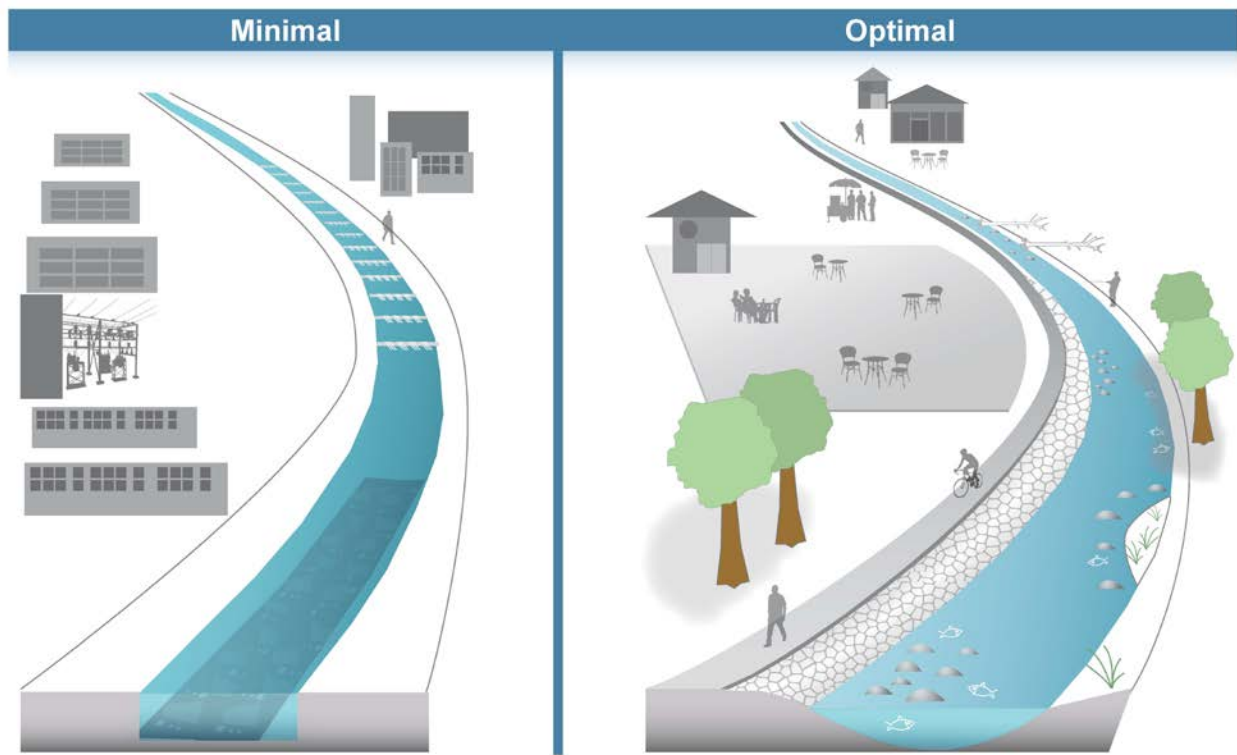


Figure 3.1-3. Minimal vs. Optimal Channel and Flow Improvements

Segment 5 is upstream of most flow control, though it is impacted by upstream diversions including the City of Walla Walla’s drinking water intake, and contains the highest quality aquatic habitat found within the Primary Focus Area. This segment has been identified as providing steelhead spawning and rearing habitat (see Sections 2.7 and 2.8 for details). In addition, the primary limiting factors for this reach have been identified as low minimum flows and high water temperature. However, monthly mean flow data for this segment indicate that it meets the minimum flow metric of 45 cfs for most of the year.

3.2 FLOODPLAIN CONNECTIVITY

3.2.1 Problem: Disconnected floodplain and encroaching land uses

The Mill Creek watershed has been transformed by development of roads, urbanization, agriculture and livestock grazing, and other human activities. Throughout the Primary Focus Area, Mill Creek's floodplains and side channels have been encroached for agricultural and urban use. The distributary channels were completely disconnected from Mill Creek when the MCFCP was constructed. Downstream of the MCFCP, Mill Creek's channel form is incised and continues to down-cut due to the alteration of the flow and sediment regime, further disconnecting Mill Creek from its floodplain during all but the highest of flood flows.

3.2.2 Opportunity: Increase floodplain connectivity and identify land use opportunities to increase floodplain area

Increasing Mill Creek's floodplain connectivity would re-establish natural processes that support multiple life stages for focal fish species. These natural processes include water retention (storage) in the floodplain, exchange between surface and subsurface (hyporheic) flow, fine sediment deposition in the overbank, and an increase in habitat diversity.

The following metrics, which are defined in Section 2.5, would be used to evaluate the increase of floodplain connectivity:

- Primary channel length;
- Secondary channel length;
- River complexity index;
- Percent of floodplain disconnected;
- Floodplain inundation; and
- Relative abundance of floodplain habitats.

In Segments 1 and 5, floodplain connectivity opportunities can be found at locations where high flows have previously overtopped Mill Creek's banks and flooded private agricultural land. A secondary channel alignment could then be developed by following the flood pattern, focusing on where water left the banks and on the pathway left by receding water back to Mill Creek. This side channel would be excavated to a depth and width that accommodates seasonal high and low flows to increase floodplain habitats.

Other opportunities to increase the number of side connections within Segments 1 and 5 include reconnecting relic channels via excavation at specific locations to allow for desired flow levels to contribute water back into the relic channel. In addition, re-introducing LWD into the system at key locations may initiate flow into existing side channels. These opportunities would increase the current levels of secondary channel length, floodplain inundation, and relative abundance of habitat by reconnecting side channels that have been disconnected due to downcutting in the main channel. These improvements would decrease the percent of floodplain disconnected.

In Segments 2 and 4, there are opportunities to eliminate channel confinements in the sill/flume sections to increase channel sinuosity or meandering. The change from an artificially straight concrete cross section to a naturalized meander pattern would increase the primary channel length in relation to the valley floor, and allow for the creation of secondary channels and floodplains. A confinement removal example would be setting back the levee and converting the concrete flume and adjacent land sections to a naturalized stream channel corridor. These opportunities would add secondary channel lengths that are currently at zero in these segments. Floodplain inundation and relative abundance habitat metrics would also improve, as the MCFCP has completely eliminated any floodplain features. These activities would introduce some modest connection points, decreasing the percent of floodplain disconnected from 100 percent.

In the highly urbanized Segment 3, which includes the downtown tunnel, the opportunities for eliminating channel confinement are very limited. The opportunity here is to transform the existing channel layout from the artificial trapezoidal shaped flume to a more naturalized shape that could include stream boulders, and irregular cross section shapes that mimic natural stream banks, pools, riffles, and glides. This transformation would include daylighting the downtown tunnel section. This type of stream corridor would be fish passable, provide stable low and high flow conveyance, and be connected to the urban environment in a way that engages human activity. Conceptual examples are presented in Figure 3.2-1.



Figure 3.2-1. Concepts of Naturalized Stream Corridor in an Urban Setting

Enhancing physical in-stream habitat, adding riparian plantings, and increasing stream flow capacity in Yellowhawk Creek present an opportunity to increase the side channel connectivity for Mill Creek. Currently, a significant portion of Mill Creek’s summer flows are diverted to Yellowhawk Creek for irrigation, transforming it into a migration reach for fish species during

that time period. The enhancements would allow Yellowhawk Creek to resemble a side channel that relieves the main channel of high flows, offers refugia to various fish species, and increases the total amount of side channel habitat in Mill Creek. In addition to physical enhancements to Yellowhawk Creek, stream flows would need to include managed high flows to flush or scour out sediment and maintain the channel's function.

Similar to Yellowhawk Creek, modifying Titus Creek from an irrigation ditch to a true side channel for Mill Creek would involve increasing in-stream habitat, riparian plantings, flow capacity, and channel sinuosity, as well as resolving fish passage. Historically, Titus Creek is thought to be a relic channel of Mill Creek.

Figure 3.2-2 shows a conceptual visualization of an expanded floodplain in Segment 4 just downstream of the Tausick Way bridge. This concept was developed by students in the Washington State University School of Design and Construction Landscape Architecture Studio. Students propose converting the old landfill into a community natural area that includes prairie, shrub, and wetland areas. They suggest the wetland could be sustained by stormwater runoff coming from the northern areas of Walla Walla and would function like a large rain garden.



Figure 3.2-2. Overview of WSU Visualization of Expanded Floodplain at Tausick Way (WSU 2016b).

Figure 3.2-2 presents a conceptual drawing of opportunities to increase floodplain connectivity and expand floodplain area within Segment 4 above the Division Works Dam. Elements shown on the figures are new side channels, new main channels, levee setbacks and riparian plantings to designate new riparian vegetation areas. Figure 3.2-3 presents one of many possible options for expanding the floodplain in Section 4. Setting back the south levee to open up opportunities for riparian habitat and new side channels could also be explored in this segment.

Document Path: C:\Users\jeremy.andrews\Documents\Local Working Folder\Mill Creek\Archive\OpportunitiesForConnectivity.mxd

LOWER MILL CREEK - HABITAT AND PASSAGE ASSESSMENT

CONFEDERATED TRIBES OF THE UMATILLA INDIAN RESERVATION

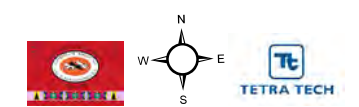
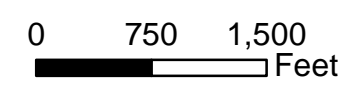
FIGURE 3.2-3 CONCEPTUAL FLOODPLAIN CONNECTIVITY MAP



- Existing Stream
- New Levee Setback
- New Main Channel
- Side Channel
- Segment 4
- Segment 5
- New Riparian Plantings

Note: Location and extents of floodplain improvements are conceptual and for planning purposes only. Further site, reach, and watershed level investigations are required to determine the appropriate floodplain reconnection methods and locations.

Sources: CTUIR, StreamNet



3.3 FLOODPLAIN STORAGE

3.3.1 Problem: Lack of hydrologic connectivity

Hydrologic connectivity includes groundwater contribution to surface channels as well as surface flows entering groundwater and other subsurface storage. This interaction has been altered throughout the Mill Creek watershed. As noted above and discussed in detail in Section 2, the Mill Creek channel within the Primary Focus Area has been cut off from its side-channels and floodplains, stopping the process of replenishing groundwater through infiltration of flood waters that would inundate the floodplain (see Section 2.5.5). In addition, there is substantial drawdown of the alluvial aquifer water levels near the downstream end of the watershed during the summer months (WWBWC 2015).

Overall, the water table may be depleted in some areas due to local water withdrawals, reduced stream flows, and lack of floodplain aquifer recharge. This can result in groundwater elevations being reduced to the point that the surface water streams lose a substantial portion of their remaining flows to aquifer recharge. This lack of two-way exchange results in a loss of beneficial groundwater inputs such as cooler water, chemical exchange, and flow contributions.

3.3.2 Opportunity: Increase floodplain storage and replenish aquifers through managed/small aquifer recharge

Within the Walla Walla Valley, the alluvial aquifer is directly connected to surface flows (through vertical exchange in the streambeds, as well as lateral contributions from the banks and spring-fed streams); therefore, pumping water from the aquifer can directly affect stream flows (Ecology 1995). Changes in surface water management for irrigation and flood control, as well as direct withdrawals from the aquifer, have dramatically reduced groundwater levels in some areas. To address depletion in groundwater levels in the broader Walla Walla Valley, management actions by numerous groups and agencies—such as Ecology, WWBWC, Walla Walla Watershed Management Partnership (WWWMP), WWCCD, Walla Walla River Irrigation District (WWRID), and the Cities of Walla Walla and Milton-Freewater—have included reductions in surface water withdrawal during the summer months, restrictions on new well development, and managed aquifer recharge (MAR) (WWBWC 2006; Ecology 2007; Henry et al. 2013; WWWWMP 2014; Patten 2015b).

The WWBWC has identified specific strategies to improve water resources and shallow aquifer conditions throughout the Walla Walla Valley, including the Mill Creek watershed. Five

different management scenarios were evaluated using their Integrated Water Flow Model (IWFM) calibrated to alluvial aquifer and surface water conditions within the primary urban and agricultural areas of the basin (GSA 2015a, 2015b):

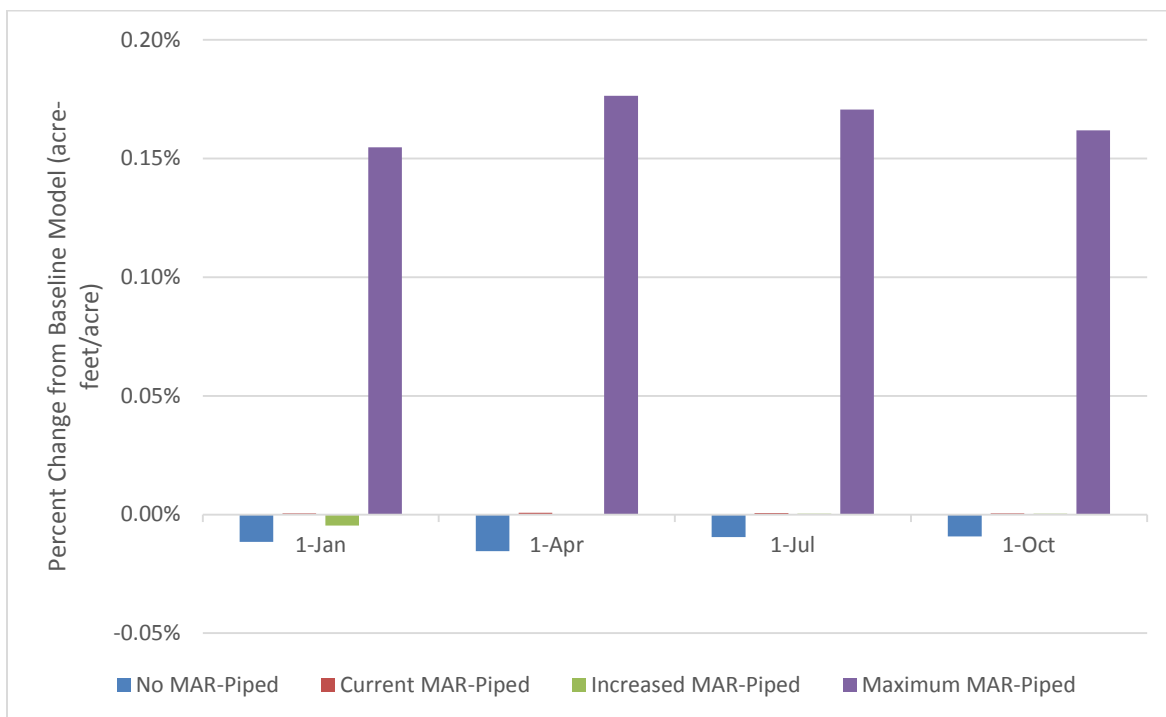
- 1) **Baseline Forward Model:** Continuation of current management practices. MAR is applied at current levels (9,014 acre-feet per year) at the seven currently active sites. No additional canals are converted to pipelines.
- 2) **No MAR-Piped:** Conversion of primary irrigation canals into pipelines while eliminating MAR.
- 3) **Current MAR-Piped:** Conversion of primary irrigation canals into pipelines, while maintaining MAR at current levels (9,014 acre-feet per year) at the seven currently active sites.
- 4) **Increased MAR-Piped:** Conversion of primary irrigation canals into pipelines, while MAR is increased from the seven current sites to 22 locations while increasing the total applied volume to 14,566 acre-feet per year.
- 5) **Maximum MAR-Piped:** Conversion of primary irrigation canals into pipelines, while MAR is increased from the seven current sites to 60 locations while increasing the total applied volume to 24,201 acre-feet per year.

There is currently one MAR site in the Primary Focus Area monitored by the WWBWC, the Stiller Pond site located approximately 0.5 mile north of Mill Creek near RM 1 (Patten 2015a). Additional sites are in development or planned, although it is acknowledged that aquifer recharge within the Mill Creek alluvial fan is likely most effective on a smaller scale, such as using off-channel infiltration methods (Henry et al. 2013). There would likely be a decrease in aquifer recharge in areas where irrigation ditches were converted to piping; however, some of the increased water available for irrigation might be usable for MAR (GSA 2015b). Relative to baseline conditions the Maximum MAR-Piped scenario had increases in groundwater elevation of 0.5 to 7.0 feet predicted within the Mill Creek watershed in an area adjacent to two locations identified as potential recharge sites within the urbanized area surrounding Walla Walla (GSA 2015b). Predicted groundwater elevation increases down-gradient of the recharge sites was less than 0.5 feet (GSA 2015b). No significant change in groundwater elevation for the Mill Creek watershed was predicted in the Current MAR-Piped and Increased MAR-Piped scenarios because these scenarios did not include active recharge sites in this area (GSA 2015b). Relative to baseline conditions, the No MAR-Piped scenario predicted a decline in groundwater elevation of one to four feet near the mouth of Mill Creek due to deactivation of the Stiller Pond

MAR site (GSA 2015b). During the initial IWFM development, Scherberg (2012) also assessed running the irrigation canal system through the winter, which increased the water table elevation throughout the modeled area.

Using the five modeled scenarios, Figure 3.3-1 presents the percent change in groundwater storage for the Mill Creek watershed relative to current management activities (Baseline Forward Model). As is acknowledged in the Alternatives Management Scenarios Report (GSA 2015b), piping will have a negligible effect (0.001%) on groundwater levels in the Mill Creek drainage due to the proposed pipe installation being outside of the Mill Creek drainage and south of the Walla Walla River. The benefit seen under piping scenarios is that it reduces the amount of water withdrawn for irrigation, which could result in more water left in the stream.

Across the entire model of the Walla Walla Valley, increasing MAR from its current levels is predicted to produce higher groundwater return flows to surface water in the vicinity of MAR sites, whereas eliminating MAR is predicted to decrease surface water flows (GSA 2015b). A decline in groundwater elevation is predicted in areas where canals are converted into pipelines because of the lost groundwater recharge from canal seepage (GSA 2015b). This effect is mitigated by increasing levels of MAR.



Source: GSA 2015b

Figure 3.3-1. Percent Change in Groundwater Storage Conditions Relative to Baseline Modeled Conditions for the Same Time Period

In general, very little overall effect on the Mill Creek watershed is predicted from WWBWC's proposed management scenarios, with less than 1 percent change in groundwater storage during any season and the least amount of change predicted during the drier months (Figure 3.3-1). These results are not surprising because, as discussed in Section 2.5.5, the Mill Creek alluvial aquifer water table is near the ground surface and winter precipitation and runoff effectively recharge the majority of the aquifer within the Mill Creek watershed every year. Additionally, piping is not applied in the Mill Creek watershed and, with the exception of the additional MAR sites added under the Maximum MAR-Piped scenario, MAR in the Mill Creek watershed is restricted to a single site in the lower Mill Creek watershed.

These modeling results are for the lower Mill Creek drainage area as a whole, and are not reflective of localized, smaller scale projects and impacts. In addition, while the Mill Creek alluvial aquifer is recharged during the winter months, localized depletions during summer low-flows are of concern, and therefore strategies that could provide cool return flows to the channels are of interest. Localized aquifer recharge sites may be able to act as localized elevated floodplain storage in the absence of more integrated floodplain connectivity opportunities. These smaller projects can provide localized aquifer recharge areas that result in "mounding" of the groundwater levels in the immediate vicinity (groundwater levels are higher where the recharge is happening and drop off farther from the recharge site, creating a mound in the water table).

Development of small MAR sites could create groundwater mounds near losing stream reaches and/or stream reaches that would benefit from cooler groundwater discharge into the streams during the summer months. This may be particularly useful where opportunities for floodplain connectivity improvements or direct increases in surface flow are limited, as it can provide increased flow and temperature mediation through indirect return flows that do not depend on conversion of an area of floodplain to more natural conditions. Another localized action that is currently being implemented by the City of Walla Walla is to update storm drains, urban drainage, and drywell systems to increase quality and quantity of water that is able to infiltrate into the alluvial aquifer within the urban environment. This action has the potential to both increase aquifer storage and allow for delayed groundwater return-flows in the dry season, as well as reducing runoff into the stream during high-flow events. Expansion of the MAR activities and incorporation of municipal stormwater practices (The Watershed Company 2015; WWBWC 2015) could be incorporated into strategies for addressing both surface and groundwater quantities within the Mill Creek watershed.

3.3.3 Opportunity: Increase floodplain storage and replenish aquifers through water exchange

Although MAR sites may be limited in larger-scale benefit to the alluvial aquifer system in the Mill Creek watershed, activities such as providing more surface water connection to remnant floodplains and the alluvial aquifer could correct lost functionality within the aquifer system. In the Primary Focus Area, connecting Mill Creek and its distributaries to the floodplain could provide improved hydrologic exchange between surface water and groundwater. During high flow events, surface water infiltrates into the floodplain soils and alluvial aquifer. Additionally, precipitation and runoff can recharge floodplain aquifers when surfaces are permeable. This provides additional water storage outside of the stream channels, and as water levels recede, the water eventually re-enters the channel. The delay between infiltration and discharge results in cool return flows that can provide temperature mediation as well as supplement water volumes to the surface streams. Depending on subsurface flow paths, floodplain recharge sites may be able to be located outside of the built area, and if the channel within the city has access to the soils and subsurface geology, the saturated sediments could discharge their stored groundwater via direct connection. Additional geotechnical and hydrological studies would be needed to confirm feasibility. In some areas, the water table may be such that just providing access to the streambank soils would allow groundwater discharge into the channel. Such areas are likely where seeps and springs are present. A number of opportunities for increasing hydrologic connectivity via floodplain connectivity are identified above in Section 3.2.2.

Additionally, the presence of the alluvial aquifer and its ability to recharge during the winter months provides a good potential resource for floodplain storage and exchange of water between the streams and the aquifer. Seepage studies within Mill Creek consistently show gains in stream discharge downstream of the concrete channel (Baker 2009, 2012, 2013). Additionally, groundwater levels from a monitoring well at the downstream end of the concrete flume are relatively high, being 7 to 14 feet bgs (see Section 2.5.5). Although additional studies are needed, this suggests that the portion of the channel currently confined in the Mill Creek Flume has the potential to be a gaining reach, if the channel could interact with the aquifer. Additionally, fisheries studies have observed at least one cold-water seep within the Mill Creek Flume that provides temperature refugia to fish under existing conditions (Section 2.8.6). This information suggests that increasing connection between the alluvial aquifer and the stream channel has the potential to improve streamflow conditions and benefit aquatic organisms.

The Walla Walla County Regional Shoreline Restoration Plan (The Watershed Company 2015; WWBWC 2015) lists floodplain projects in the conceptual stage for Doan Creek and Cold Creek,

which would provide additional flow and floodplain accessibility for the Mill Creek system by providing more interaction of the stream channels with the floodplain and alluvial aquifer. These actions include lengthening the straightened, ditched, and piped Doan Creek and providing a more natural stream design, and potentially reconnecting Cold Creek to Doan Creek. Adding additional small-scale projects that would open up areas of the floodplain would provide additional floodplain storage. Such projects may be included in the passive MAR sites, providing off-channel areas for flood waters to infiltrate, or more system-based approaches such as expanding riparian corridors and stream access to the banks. The lag time between water entry into the floodplain and discharge back into the stream provides opportunities for flow and temperature moderation to surface waters.

Larger scale opportunities may involve modifying heavily engineered sections of the main channel, such as modifying weirs and banks to provide more natural hydraulic gradients and groundwater-surface water exchange. Creating a more naturalized channel configuration through modifications to the existing Mill Creek Flume could allow exchange during non-flood-flow periods. Because the built environment of the MCFCZD prevents flows from being able to flow over a natural floodplain, the high winter flows would likely necessitate retaining a highly engineered transport channel, or directing flood flows elsewhere. However, a flood-transport channel could be separate from a channel, providing habitat and groundwater exchange with the alluvial aquifer. Splitting the flood flows between an infrastructure-based transport system (such as a pipe underneath the naturalized channel or via a system that redirects flood flows before entering the city of Walla Walla) and a naturalized surface water channel could allow the stream to maintain contact with the alluvial aquifer year-round, while providing flood protection within what is currently a heavily engineered system with minimal biological function. Benefits to aquatic species and groundwater resources would include:

- Cool water return flows during summer months,
- Year-round use of surface waters, and
- Metered aquifer recharge opportunities.

Furthermore, allowing groundwater return flow into a naturalized Mill Creek has the potential to generate sufficient flows, such that more water could be diverted to Yellowhawk Creek. This could in turn raise the water table in the losing reaches in Yellowhawk Creek and associated springs and distributaries to improve hydrologic connectivity, potentially increasing water levels and cooler groundwater return flows into the stream channels.

3.4 FISH PASSAGE CONDITIONS

3.4.1 Problem: Existing fish passage barriers

Three categories of fish passage barriers (to upstream migration) have been identified for Mill Creek: 1) structural, 2) flow (summertime lows and flashfloods), and 3) thermal. All three barrier categories affect the entire Primary Focus Area to different degrees, with Segments 2, 3, and 4 impacted more than the other segments. Table 3.4-1 outlines known problems, followed by additional details for each barrier category.

Table 3.4-1. Summary of Passage Problems by Barrier Category and Segment

Barrier Category	Segment Location	Problem
Structural	1,2,3,4, Distributaries	• Partial/Complete Barrier Structures
	4	• Bennington Diversion Fish Passage
	4	• Bennington Diversion Fish Screens
	4	• Division Works Dam
	2,4	• Sills
	3	• Paved Channel
Flow	All	• Low Summer Flows
	All	• High Winter Flows
Thermal	All	• High Summertime Water Temperatures
	All	• Lack of Temperature Refugia
	2,3,4	• Warm water inputs to Mill Creek

Structural – Fish passage barrier structures are present throughout the Primary Focus Area: six locations on Mill Creek, eight on Yellowhawk Creek, and four on lower Garrison Creek (Figure 2.8-31). Although a barrier has been repaired at upper Titus Creek, a temporary midstream diversion was installed on Titus Creek preventing fish from entering the portion of Titus Creek that is used as an irrigation delivery ditch, thereby eliminating fish access and rearing opportunity in the perennial flow sections of Titus Creek. Also, a complete fish barrier remains at lower Titus Creek’s downstream connection back to Mill Creek.

Two known partial barriers on Mill Creek are the fish passage structures attached to the Division Works Dam and Bennington Diversion Dam, which are both located in the upper half of Segment 4. The fish passage ladder at Bennington Diversion Dam has been noted specifically as problematic, failing to meet WDFW and NMFS passage criteria (NMFS 2011). Additionally, inadequate screening at the Bennington Diversion Dam can occasionally divert migrating adult and juvenile fish to Bennington Lake, especially during high-flow events.

The flood controlling sills in Segments 2 and 4 are a long series of shallow step pools and can inhibit migrating salmonids. Segment 2 was primarily impassable at the lower flows for steelhead and Chinook salmon, with bull trout only inhibited at minimal flow (6 cfs). Segment 4 was problematic at minimal flows and at high flows (200 and 400 cfs).

Flow – Flows, especially summertime low flows and spring flood events, are acutely problematic downstream of Segment 5. Segments 2, 3, and 4 are typically a fish passage barrier during these flow regimes (Appendix C shows the range of passable and impassable flows for steelhead, spring Chinook, and bull trout). There is not a single flow that would allow all portions of Mill Creek in Segments 2, 3, and 4 to be passable (Burns et al. 2009). Segment 1 and the distributary channels can become disconnected during periods of summertime low flow. Reduction of flows from irrigation withdrawal in distributaries, such as Titus and Garrison creeks, limits their use for rearing or passage. In addition to adult upstream passage issues, juvenile fish can be stranded in late spring in years when the hydrograph rapidly drops to low summer flow levels and smolts have trouble migrating downstream through the flood channel features. Also, when flow is increased, the possibility of diluting cold water inputs and increasing the overall water temperature in the stream exists especially in areas where there are currently temperature refugia.

Thermal – Thermal barriers are present throughout the Primary Focus Area (Figure 2.8-31). Water temperatures can become too hot for salmonids, starting as early as May and lasting through September, with temperature peaks in June and July. During these times, there are limited available refugia for salmonids to wait out the high temperatures. High water temperatures are due to low stream flows, channel characteristics, and warm water inputs from urban streams and stormwater outflows.

The cumulative effect of the known fish passage barriers in the Primary Focus Area restricts free access for migrating salmonids from reaching the quality habitats located in the upper Mill Creek Watershed (Secondary Focus Area).

3.4.2 Opportunity: Increase fish passage

Based on the fish passage problems outlined in the previous section, a series of corrective opportunities are presented in Table 3.4-2.

Table 3.4-2. Opportunities to Increase Fish Passage by Barrier Category and Segment

Barrier Category	Segment Location	Problem	Opportunities to Increase Passage
Structure	1,2,3,4, Distributaries	Partial/Complete Barrier Structures	<ul style="list-style-type: none"> • Repair existing structures to meet passage criteria • Remove existing structures
	4	Bennington Diversion Dam Fish Passage	<ul style="list-style-type: none"> • Improve existing fish ladder to current fish passage standards • Swim-through Channel • Roughened Channel • Pool and Weir Channel
	4	Bennington Diversion Fish Screens	<ul style="list-style-type: none"> • Improve screen function at multiple flows • Improve Bennington Lake outflow
	2,4	Sills	<ul style="list-style-type: none"> • Manage flows to prevent impassable conditions • Modification or removal of structures to improve passage at low flows
	3	Paved Channel	<ul style="list-style-type: none"> • Increase channel bed coarseness / complexity • Segment redesign
Flow	All	Low Summer Flows	<ul style="list-style-type: none"> • Establish target minimum flows
	All	High Winter Flows	<ul style="list-style-type: none"> • Additional off-channel flood storage • Improve floodplain connectivity • Additional holding areas
Thermal	All	High Summer Water Temperatures	<ul style="list-style-type: none"> • Increase summer flows to prevent water stagnation while considering potential thermal impacts of diluting cold water inputs with increased flows. • Add low flow channel to concentrate flows and avoid thermal loading in concrete portions of Mill Creek Channel.
	All	Lack of Temperature Refugia	<ul style="list-style-type: none"> • Improve pool quality (>1 meter deep) with cover • Add LWD to achieve 20 pieces per mile (>12 inch diameter, >35 feet long) • Add boulders as in-water structures • Improve ground water spring connectivity
	All	Lack of Canopy Shading	<ul style="list-style-type: none"> • Improve riparian connectivity to >80% intact • Improve canopy coverage to >75%

Applying these individual opportunities to improving existing fish passage conditions would require the following general restoration actions:

Reduce Structural Barriers – To increase fish passage through the Primary Focus Area, most of the identified partial fish passage structures need to be updated and modified to attain current fish passage standards (Figure 2.8-31). This would include:

- The installation of a new passable structure at the downstream connection of Titus and Mill creeks to allow access for and egress of anadromous stocks at this location.

- Updating the existing fish ladder at Bennington Diversion Dam to current fish passage standards. This fish ladder has been identified as a fish passage issue in need of resolution by both USFWS and NMFS, and several options have been proposed to resolve the passage issue (USACE 2012a). Updating the existing fish ladder would theoretically improve upstream migration at this site. However, repair of this particular fish ladder has been determined to be likely infeasible (USACE 2012a); options to fully resolve passage at this location are discussed in further detail in Section 3.4.3. Additionally, all new passage structure designs and improvements would need to accommodate passage of Pacific lamprey, which are likely to be returned to the subbasin in the future, in addition to passing all life stages of anadromous fish at all flows.
- Addressing the potential of salmonids making it past the Bennington Diversion Dam fish screens during flood events. One corrective action is to modify or reinforce the existing screening system so that the screens can handle more than 30 cfs. The capability to screen additional flows at the Bennington Diversion Dam would reduce the amount of salmonids that are accidentally passed and trapped in Bennington Lake. Furthermore, a secondary screening system could be built inside the canal that connects diverted flows from Mill Creek to Bennington Lake to further screen the water flowing into Bennington Lake, with a 10 percent flow return channel to allow salmonids a pathway back to Mill Creek.
- Modifying the grade control sills in Sections 2 and 4, creating a low flow channel, and/or increasing flows during low-flow periods to prevent the sills from becoming isolated pools. Modifications to the sills could include notching or the installation of holding or pool-forming structures (LWD/boulders) in combination with a low flow channel to allow for additional passage opportunities. A series of suggested modifications were developed in detail as a companion document (Burns 2010) to the Mill Creek Channel passage barrier report (Burns et al. 2009).

Reduce Flow Barriers – Fish passage barriers due to low flows would require modifying irrigation and water rights within the region to ensure sufficient summer flows to allow fish passage as well as channel reconfiguration to allow for a narrower and deeper channel that would maintain colder water temperatures (see Section 3.1.2 discussion). During high winter flows, migrating salmonids, particularly steelhead, could benefit from additional resting zones provided from the establishment of in-stream structures in the step pools located in Segment 2 and Segment 4. This would also include additional in-channel modifications (additional

constructed channel roughening structures or strategically placed boulders) to Segment 3, resulting in additional refugia and resting zones that would improve fish passage.

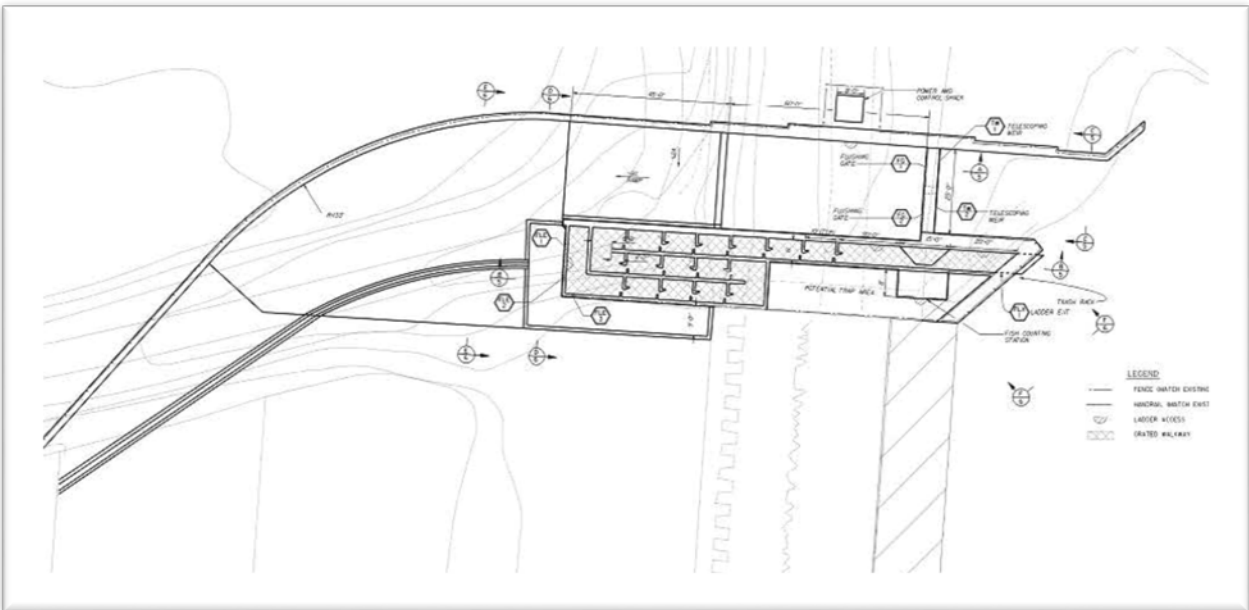
Reduce Thermal Barriers – For fish migration, the minimal goal would be to limit in-stream temperatures to no higher than the EPA 20°C 7DADM criteria for salmonid migration (EPA 2003). Improved management of flows would maintain a consistent minimum water flow during summer months, which would help limit the amount of heat build-up in the wetted channel. However, increasing flows will not necessarily decrease temperatures in areas where there are currently cold water inputs. Therefore, other strategies such as channel reconfiguration and natural or artificial canopy shading must be employed to provide cold water refugia in the channel. Adding in-stream structures (LWD, large individual boulders, and/or boulder clusters) to improve pool quantity and quality would also increase temperature refugia opportunities for present salmonids. Expansion and enhancement of riparian corridors (see Section 3.6) within available open space on either bank of Mill Creek would increase riparian shading, thus reducing solar input to the wetted surface of Mill Creek. Temporary shading structures (portable overhanging panels with shade cloth or solar cells) could be temporarily installed during summer months until the riparian corridors are established or in corridors where increasing riparian shading is not feasible (i.e., portions of Segment 3 where the channel ROW is constrained). In locations where cold water is currently being withdrawn from spring fed streams for irrigation purposes (such as irrigating lawns in the urbanized portion of Mill Creek), it may be possible to exchange the cold water irrigation source for a warm water irrigation source and direct the cold water spring inputs into Mill Creek.

3.4.3 Opportunity: Fully resolve fish passage

To fully resolve fish passage issues for all life cycles of salmonids would require extensive restoration actions that would expand on the scope of the general restoration opportunities discussed in Table 3.4-2 and would require a greater investment of time and funds to implement than what is described in Section 3.4.2.

Removing Structure Barriers – Complete removal of identified partial fish passage barriers would assist in resolving the overall cumulative impact to upstream fish passage; however, this is not likely feasible for Bennington Diversion Dam or the Division Works Dam. Retrofitting the existing fish ladder, which has been specifically identified as a fish passage issue, has been determined to be infeasible, and several options have been proposed to resolve the passage issue (USACE 2012a). One option is to shut down the existing ladder and build a new vertical

slot with an improved low flow outlet on the right bank, as illustrated in Figure 3.4-1 (USACE 2012a).

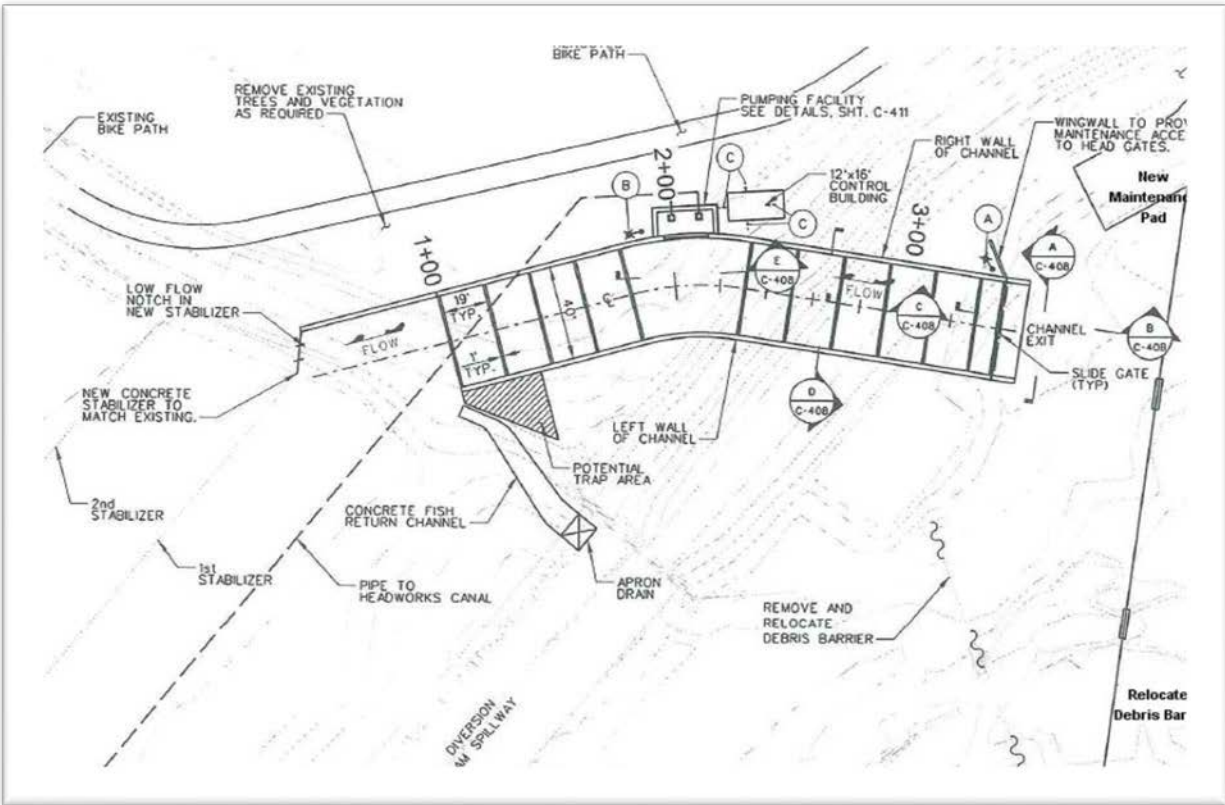


Source: USACE (2012a)

Figure 3.4-1. Proposed Vertical-Slot Fish Ladder and Low-Flow Outlet

Alternatively, a swim-through “natural channel” or “roughened channel” would create a long side channel to allow fish to bypass the structure entirely, and would require some redesign of the right bank levee structure. Similar to a swim-through channel, another option evaluated by USACE is a pool-and-chute fishway, which would include nine 20-foot-long pools with a 50-foot dissipation pool in the center (Figure 3.4-2) (USACE 2012a). Although four different methods of improving passage were fully considered by the USACE at this site, the vertical slot ladder design was the final recommended passage structure indicated in the passage evaluation document (USACE 2012a).

In addition to expanding the existing screening structures at Bennington Dam, another option would be to further incorporate Bennington Lake as off-channel flood water storage. The establishment of cold-water return channels back to Mill Creek would allow egress by any salmonids that made it past the screening structures.



Source: USACE (2012a)

Figure 3.4-2. Proposed Pool-and-Chute Fishway

To fully resolve fish passage problems (and several habitat problems) within the Mill Creek Channel would require an extensive redesign of Segment 3, including expansion of the downtown portion into a highly engineered “naturalized stream corridor” (Figure 3.2-1). This could include a combination of managed flow regimes along with a repurposed high-capacity cement channel into a sinuous terraced flow pathway, complete with pools, gravel cobble substrate, and riparian vegetation.

Resolution of Flow Issues – Resolving flow issues would require renegotiation and/or purchasing of existing water rights within the region to guarantee constant summer flows. It would also require enhancement of groundwater connections and adequate groundwater quantities similar to historical levels. Creation of additional off-channel flood storage sites or flood water bypass swales would ameliorate the effect of flood events on upstream fish passage.

Thermal – To fully achieve properly functioning thermal temperatures for migration purposes, average water temperatures should be maintained below 57°F (14°C) for a majority of the Primary Focus Area, thus providing optimal temperatures preferred by the focal species for migration (see Section 2.6.1). This temperature change would likely be achieved through a

combination of extensive riparian vegetation rehabilitation and expansion both within and upstream of the Primary Focus Area (see Section 3.6), increased summer flows (see Section 3.1), increased groundwater supplies, connections of this groundwater (hyporheic waters) to main and distributary channels, and channel reconfiguration to create for a narrower, deeper channel that maintains cooler water temperatures during low flows.

3.5 SPAWNING, REARING, AND MIGRATION HABITAT

3.5.1 Problem: Lack of existing spawning, rearing, and migration habitat needed to support survival of focal fish species

As discussed in Section 2.8, lower Mill Creek, especially Segment 3, has little to no spawning and rearing habitat for the focal fish species and functions mainly as a difficult migration corridor. However, the factors that adversely affect migration are flows (low flows and flooding) and passage barriers. Problems and opportunities to address and to remedy these issues are discussed above in Sections 3.1 and 3.4. Existing barriers to migration habitat limit salmonid access to the available spawning and rearing habitats in Segment 5 and the Secondary Focus Area. After addressing migration habitat, addressing rearing conditions may be the best option to benefit salmonids within the Primary Focus Area, although creation of spawning habitat may be eventually possible if substrate quality and temperatures were improved. Known problems with existing habitat conditions are identified in Table 3.5-1.

Table 3.5-1. Identified Habitat Problems and the Affected Segments

Issue Category	Segment Location	Problem
Substrate	All	• Quality
	All	• Embeddedness
Pool	3, Distributaries	• Pool Frequency
	All	• Pool Quality
Large woody debris (LWD)	All	• LWD per mile
	All	• LWD budget
Thermal	All	• High Summertime Water Temperatures
	All	• Lack of Temperature Refugia
	All	• Lack of Canopy Shading
	All	• Riparian connectivity

Substrate – Segment 1 substrate is dominated by fines and sand, with some patches of gravel, and has limited rearing habitat and minimal spawning habitat. Segment 1 has an incised channel and is cut off from bedload recruitment due to the altered flow and sediment regime from the MCFCP’s diversion of high flow and the retaining of sediment behind dams and weirs. Segments 2 and 4 include a series of constructed flood control sills that have substrate

predominantly composed of silt and sand with no spawning potential. Segment 3 is entirely a concrete channel, completely devoid of any substrate complexity that is useful for rearing or spawning salmonids. This segment would require a complete redesign and excavation of the existing concrete lining to provide substrate. Segment 5 has some select locations that are identified as having acceptable spawning substrate.

Pools – Segments 1, 5, and the distributary channels are predominantly shallow riffle pool complexes. Segments 2 and 4 include extensive series of shallow step pools, while Segment 3, even with some corrective modifications (created resting areas), is essentially a long featureless cement bed. For most of the Primary Focus Area, the quality of the existing pools is a more critical problem than the frequency of the pools. Existing pools could greatly benefit from in-water structures (LWD or boulders) to add complexity and increase pool scouring. Due to the current conditions of Segment 3, it is currently impossible for pools to develop without completely renovating the channel.

LWD – Segment 5 has some LWD and the potential to recruit additional pieces from the Secondary Focus Area. However, everything downstream from the Bennington Diversion Dam is essentially cut off from recruiting LWD from the forested headwaters of Mill Creek. The remainder of the segments are in need of supplemental LWD. Segment 1 and the distributary channel have some existing LWD, but could benefit from the placement of additional pieces.

Thermal Conditions – Currently, average water temperatures in lower Mill Creek routinely exceed the TMDL (Ecology 2002a) and EPA (2003) criteria of 64°F (18°C) 7DADM in the summertime, indicating that Mill Creek does not have functioning rearing and migration habitat during the summer months.

3.5.2 Opportunity: Increase habitat quantity/quality and improve habitat connectivity

Several opportunities to improve salmonid habitat within the Primary Focus Area are listed in Table 3.5-2. All segments would benefit from adjacent off-channel habitat and extensive in-channel structures to provide refuge areas during high flows. The entire Primary Focus Area could benefit from riparian enhancement actions to reduce summer temperatures (Section 3.6), which would overall improve spawning, rearing, and migration conditions.

Table 3.5-2. Opportunities to Resolve Identified Fish Habitat Problems

Issue Category	Segment Affected	Problem	Opportunities to Improve Habitat
Substrate	All	Quality	<ul style="list-style-type: none"> Supplementation of cobble and gravel spawning materials
	All	Embeddedness	<ul style="list-style-type: none"> Improve summertime flows to improve transport of fines Study upstream sediment inputs
Pool	1,3,5 Distributaries	Pool Frequency	<ul style="list-style-type: none"> Increase the number of pools, especially within the Mill Creek Channel
	All	Pool Quality	<ul style="list-style-type: none"> All sections could benefit from improvements to pool quality (>1 meter deep) with cover
	All	Refugia	<ul style="list-style-type: none"> Addition of LWD to provide hiding locations for juvenile salmonids
Large woody debris (LWD)	All	# LWD	<ul style="list-style-type: none"> Add LWD to achieve 20 pieces per mile (>12 inches diameter, >35 feet long)
	All	LWD budget	<ul style="list-style-type: none"> Improve riparian corridors for future recruitment
Thermal	All	High Summer Water Temperatures	<ul style="list-style-type: none"> Increase summer flows to prevent water stagnation while considering potential thermal impacts of diluting cold water inputs with increased flows. Add low flow channel to concentrate flows and avoid thermal loading in concrete portions of Mill Creek Channel.
	All	Lack of Temperature Refugia	<ul style="list-style-type: none"> Improve groundwater spring connectivity Improve pool quality (>1 meter deep) with cover
	All	Lack of Canopy Shading	<ul style="list-style-type: none"> Improve canopy coverage
	All	Riparian Connectivity	<ul style="list-style-type: none"> Improve riparian connectivity to >80% intact

Applying these individual opportunities to improving existing habitat conditions would require the following general restoration actions to enhance existing conditions:

Increase Substrate Quality – The minimum goal would be to have gravel and/or cobble as the subdominant substrate or less than 30 percent embeddedness if gravel and/or cobble is the dominant substrate. Improving flows would help transport fine substrate material, and prevent embeddedness. The selective addition of spawning cobbles and gravels may be an option if particular areas are suspected of having the potential of self-maintenance (e.g. Segment 1). Segment 3 would benefit from additional modifications such as having cobbles and boulders embedded into the cemented bed grade. However, any plan to improve rearing or spawning conditions in this segment would require a complete redesign of the stream channel and expansion of its ROW.

Increase Pool Frequency/Quality – Improve overall quality of existing pools, including depths (>1 meter deep) and available refugia. The addition of one structure (LWD/boulder) per pool would improve refugia conditions. The use of LWD would provide source material to help

Segments 2 and 4, where the presence of the flood control sills has essentially created a long series of shallow step pools. Additionally, alternating bank placement of the in-stream structures would help focus low flows into a more sinuous pattern that could encourage aquatic vegetation (currently existing in small patches of Segment 4) to grow on the margins of these step pools.

For most of the segments, pool frequency is near or at minimal conditions. Even though Segments 2 and 4 may have a pool frequency lower than minimal conditions, they are both mostly pool-type habitat, just of low quality. Increased pool frequency would result from the selective placement of pool-forming structures in the channel. This strategy would not work for Segment 3 due to the cemented channel bed. Establishing pools in Segment 3 would require a complete removal of existing cement armor in the channel.

Increase LWD – Ensure that each segment achieves 20 pieces of large LWD (12 inches diameter and more than 35 feet in length) per mile. Pool enhancement efforts would likely achieve this goal. Improve riparian conditions throughout the Primary Focus Area to establish future site-based LWD recruitment. Adding LWD structures to Mill Creek may not be permitted under current USACE management rules, however, a variance to those rules may be possible for engineered structures.

Improve Thermal Conditions – Most of the expected habitat use for the Primary Focus Area would be for rearing and migration. At a minimum, thermal conditions should be improved to keep temperatures below the TMDL (Ecology 2002a) and EPA (2003) criteria of 64°F (~18°C) 7DADM. This could be accomplished by a variety of measures: (a) increasing and/or maintaining summertime flows (see Section 3.1) to help keep water from standing still and receiving concentrating solar energy; (b) improving the connection of existing groundwater spring inputs into Mill Creek, which could establish cooler water pockets; (c) establishing riparian corridors on both sides of the channel to create shaded conditions (see Section 3.6); (d) reconfiguring the channel to create a narrower, deeper channel during low flows; and/or (e) alternating bank placement of in-stream structures (LWD and/or boulders) to help focus low flows into a more sinuous pattern that could encourage additional aquatic vegetation to grow on the margins of the step pools of Segment 2 and Segment 4 as well as benefit benthic macroinvertebrates.

3.5.3 Opportunity: Restore processes that sustainably maintain high quality habitat

To systematically restore sustainable fish habitat would require major restoration actions above and beyond those discussed in Section 3.5.2. These restoration actions are described below and include more aggressive goals for improved substrate, LWD recruitment, and minimum water temperatures.

Expansion of Substrate Function – Add suitable substrate (gravel and cobble) in all segments throughout the Primary Focus Area. The preferred goal would be to have gravel and/or cobble as the dominant substrate with less than 20 percent embeddedness in all segments. Extensive year-round flow management would aid the flushing of silts and fines from the Mill Creek system, along with the transport of desirable gravels and cobbles. Segment 3 would require a complete redesign of the bedform to achieve and retain high-quality rearing and spawning substrate.

Expand Pool Frequency/Quality – Improve overall quality of existing pools, including depths (more than 1 meter deep) and available refugia. Add three or more in-water structures (LWD/boulders) per pool to provide more complex refugia and source material to help support benthic macroinvertebrates, particularly in Segments 2 and 4. Additionally, alternate bank placement of the in-water structures to help focus low flows into a more sinuous pattern that could encourage aquatic vegetation (currently existing in small patches of Segment 4) to grow on the margins of these step pools. Improving both pool frequency and quality in Segment 3 would require an intensive redesign effort that would include removal of the cement substrate and construction of a pool frequency proper for the designed wetted channel.

Expand LWD– Ensure that each segment achieves 20 pieces of LWD (12 inches diameter and more than 35 feet in length) per mile. Pool enhancement efforts would likely achieve this goal. Also, improve riparian conditions throughout the Primary Focus Area to establish future site-based LWD recruitment.

Resolve Thermal Conditions – To fully achieve properly functioning thermal temperatures for rearing and migration purposes, thermal conditions should be improved to keep temperatures below 57°F (14°C) for a majority of the Primary Focus Area, as discussed above in Section 3.4.3. This would require a more extensive riparian vegetation corridor (see Section 3.6), increased summer flow (see Section 3.1), increased groundwater supply, increased connections to

groundwater-fed tributary streams, and channel reconfiguration to create for a narrower, deeper channel that maintains cooler water temperatures during low flows.

3.6 RIPARIAN VEGETATION

3.6.1 Problem: Lack of native riparian vegetation to shade Mill Creek and provide natural processes to support multiple life stages of focal species

Existing riparian conditions vary throughout the Project Area. While riparian vegetation is mostly functional in Segment 5 and the Secondary Focus Area, the rest of the Primary Focus Area has been extensively modified from historical conditions, including loss of large trees, reduced buffer width, and encroachment of invasive species. Table 3.6-1 identifies problems with the existing riparian conditions. Improvements to riparian conditions should focus on the most degraded portions of the Primary Focus Area (Segments 2, 3, and 4), illustrated by Figures 3.6-1 and 3.6-2.

Table 3.6-1. Identified Riparian Vegetation Problems and Affected Segments

Issue Category	Segment Location	Problem
Riparian Corridor	1,2,3,4,Distributaries	Corridor Connectivity
	1,2,3,4,Distributaries	Bank Coverage
	1,2,3,4,Distributaries	Canopy Shading
Invasive Species	All	Invasive Species
Management	All	Vegetation Removal
	All	Land Use



Figure 3.6-1. Barren Riparian Conditions



Figure 3.6-2. Urban Setting with Lack of Riparian Conditions within Segment 3

Riparian Corridors – Except for Segment 5 and the Secondary Focus Area, riparian conditions are deficient along Mill Creek and the distributary network. The resulting impact of a poor quality, incomplete riparian corridor with minimal shading of the wetted stream surface is the increase of water temperatures, which is a known limiting factor. Historic and ongoing clearing of riparian vegetation and adjacent urban and residential land uses has limited the amount of available space for the establishment of fully functioning riparian zones.

Invasive Species – There is a well-established community of non-native invasive shrub and grass species within the Primary Focus Area. These often are directly competitive to riparian vegetation, making it difficult for desirable species to establish, grow rapidly, and propagate. Reed canarygrass does well in wet environments, establishes easily, and spreads through an area quickly, choking out waterways, which results in accumulations of fine sediment materials.

Management – The levees along either bank of Mill Creek are heavily managed and cleared by either the USACE or adjacent landowners. Adjacent land to the channel is also heavily managed and includes range or agricultural fields, parks, or heavily developed urban zones. Constant grazing by livestock also degrades riparian establishment. Private and public landowners often maximize their property for personal or public use (parks, schools, sports fields); additionally, the USACE has a standard maintenance plan that regularly removes all vegetation from levees under their control.

3.6.2 Opportunity: Increase native riparian vegetation along Mill Creek

There are several potential actions to help resolve the known problems that adversely affect the riparian community of Mill Creek. Table 3.6-2 lists and summarizes these opportunities.

Table 3.6-2 Resolution Opportunities to Identified Riparian Problems

Issue category	Segments Affected	Problem	Opportunities to improve habitat
Riparian Corridor	1,2,3,4, Distributaries	Corridor Connectivity	<ul style="list-style-type: none"> Establish extensive riparian planting zone, >80% intact corridor
	1,2,3,4, Distributaries	Bank Coverage	<ul style="list-style-type: none"> Establishment of riparian vegetation in the margins and around the ordinary high water mark, >80% intact corridor
	1,2,3,4, Distributaries	Canopy Shading	<ul style="list-style-type: none"> Include a variety of tall tree species in riparian planting zone, >50% channel coverage
Invasive Species	All	Invasive Species	<ul style="list-style-type: none"> Regular maintenance actions to control invasive species.
Management	All	Removal Activities	<ul style="list-style-type: none"> Establishment of commonly accepted guidelines for any vegetation management within the riparian zone.
	All	Land Use	<ul style="list-style-type: none"> Modification of land use within a buffer zone along both banks

Applying these individual opportunities to improving existing riparian conditions would require implementing the following general riparian restoration strategies.

Riparian Corridor – The preferred goal would be to achieve greater than 80 percent intact riparian corridor on both banks that provides shading of at least 50 to 75 percent of the wetted stream area, if not 100 percent (Figure 3.6-3). Establishing extensive riparian corridors and restricting current vegetation clearing actions is important for self-regulating stream temperatures and introducing self-sustaining LWD recruitment.



Figure 3.6-3. Functioning Riparian Corridor in Upper Watershed

Planting available areas along Mill Creek would help shade and establish a continuous riparian corridor, as would the purchase/leasing of additional land for expansion of the riparian buffer zone. Shrubs should be planted on the banks near to the ordinary high water mark to allow interaction and maximum shading of the waterway. A mixture of tall tree species should be planted at a variety of distances, and in-water vegetation should be encouraged to grow along the margins of Mill Creek, specifically Segments 2 and 4, to help improve in-channel habitat

conditions. Coir rolls, with a mixture of soils and willow/red osier dogwood cuttings, could be placed and anchored within 1 meter of the banks of these sills to encourage in-channel and bankside vegetation growth.

Invasive Species – Implement an invasive nonnative vegetation control plan for the Primary Focus Area. A coordinated maintenance routine for both public employees and private landowners to control invasive nonnative plant species would help benefit desirable native species and promote their growth.

Management –Negotiate and develop memoranda of understanding with current and future landowners to improve, retain, or expand existing riparian buffer conditions. Specifically, this needs to be accomplished with the USACE, who typically removes all woody vegetation (canopy and subcanopy species) along their managed levees. The establishment of tall tree species on the far side of the USACE-controlled levee would eventually assist in providing shading to Mill Creek, while not actively infringing on the levee itself. Another possible solution would be to set back the USACE-controlled levee from the creek bank to allow space for a functioning riparian corridor adjacent to the banks while retaining the levee system.

3.7 COMMUNITY CONNECTION TO MILL CREEK

3.7.1 Problem: Community physically and visually disconnected from Mill Creek resulting in little to no interaction with the stream’s natural processes, qualities, and characteristics

Public views of Mill Creek are limited throughout the city of Walla Walla. As most of the lower channel is bordered by private property or hidden underground, bridges and adjacent roadways and paths are the most common public viewpoints. Although there are daylighted portions of Mill Creek through central downtown Walla Walla, these are not prominent features for typical pedestrians. Existing buildings adjacent to Mill Creek are largely oriented away from the waterway. Furthermore, public access to the water is illegal throughout the MCFCZD. As discussed in detail in Sections 3.4, 3.5, and 3.6, there are a very low number of fish present in lower Mill Creek due to existing fish barriers, lack of fish habitat, and lack of riparian vegetation, although Mill Creek once supported thriving fisheries. The trapezoidal concrete channel, the levees, and the concrete and sheetpile weirs of Segments 2, 3, and 4 present a hardened and artificial appearance, rather than the visual features associated with a more natural stream. The lack of access, lack of fish, lack of shade, and artificial appearance all

contribute to the community's disconnection from the stream's natural processes and characteristics.

3.7.2 Opportunity: Increase river identity with community

Throughout the Primary Focus Area, opportunities exist to create spaces for the public to view and interact with the channel. In locations where the flood channel may be widened, as described under Section 3.2 and illustrated in Figure 3.2-3, new land uses could include open, park-like settings along the channel with terraces that step down to the water (see example land use concepts from Washington State University in Figure 3.7-1). In more constrained areas such as through downtown Walla Walla, opportunity sites may include daylighting the underground portion of the channel and transforming the existing channel layout from the



Figure 3.7-1. Concepts of Naturalized Stream Corridor in Downtown Walla Walla (WSU 2015)

artificial trapezoidal shaped flume to a more naturalized shape that could include stream boulders and irregular cross-section shapes that mimic natural stream banks, pools, riffles, and glides. Through this constrained portion of the channel's ROW, a cantilevered walkway could be constructed over the channel to provide unique views and connections to the creek (see concept from the City Comp Plan shown in Figure 1.4-2). These opportunity sites could connect to existing and future pedestrian pathways and bicycle routes, making it easier for the public to access Mill Creek. Stakeholder input also revealed a community desire to provide recreational paddle boating access to Mill Creek possibly including a white water kayak or canoe course set up during the higher flow periods in the spring.

In any such new, more connected Mill Creek spaces, the potential exists for increasing public education about the historical values of the creek, current ecological functions, collaborative restoration efforts, and goals for ongoing stewardship and future conditions. Interpretive signs could provide a variety of easily understood information of interest to all ages. New art installations developed in cooperation with community members could add to the sense of identity and shared experience with Mill Creek. Playground-like interactive structures could double as mini-public recreation sites and educational features. Together, such additions to the Mill Creek corridor would help form appealing spaces to draw in residents and visitors.

Overall, by increasing river identity with the community, Mill Creek can better serve as an economic and social amenity while also raising the community's awareness of their impact to the watershed and stewardship of Mill Creek and its distributaries.

3.7.3 Problem: Existing aging channel infrastructure poses public safety hazard

Over the decades since the original flood control infrastructure was built, wear and tear on the system as well as new external stressors have led to potential risks to public safety. As described in more detail in Section 1.4.1.4, in 2010 the USACE's Periodic Assessment Report rated the Mill Creek Channel as minimally acceptable, and a USACE screening-level risk assessment in 2016 ranked the left bank at 2 and the right bank at 3 on a scale from 1 to 5, with 1 being the worst and 5 being the best (USACE 2013a; USACE 2016a). Walls are beginning to crack at a number of spots along the concrete-lined channel and, in some spots, they have buckled to an extent that would reduce efficacy in the event of a flood. Bridges across the channel are aging and may no longer provide their designed level of function (see Section 2.4.6). In downtown Walla Walla, nearby vacant parking lots are showing signs of failure, putting the channel and downstream properties at risk from potential collapse. The likely problem spots

along the channel become a greater public safety hazard in light of climate change and predicted increases in peak flows (USFWS 2011; Tetra Tech 2015) that could overwhelm the current system.

3.7.4 Opportunity: Improve public safety associated with Mill Creek Channel

A number of steps could be taken to improve public safety along Mill Creek. Where possible, naturalizing the channel could make access to and from the channel safer, reducing reliance on constructed access points that may fail as well as reducing the risk of falls (e.g., from bridges, walls, steep stairs/ladders). In addition, increasing the connection of Mill Creek to the floodplain and restoring natural floodplain functions (as discussed under Sections 3.2 and 3.3) could help mitigate effects from flood waters. This form of flood control would also require less future maintenance to ensure public safety. Where the channel ROW remains constrained by existing land uses, basic infrastructure repairs and improvements should be implemented to reassure the public that areas near Mill Creek are safe to live and work in, as well as enjoy.

4. Constraints to Restoring Mill Creek

The ability of the CTUIR and any other entities to undertake actions to address the problems and opportunities identified in Section 3 is constrained by a variety of physical, biological, social, economic, and legal/regulatory factors. These factors will influence the viability of any individual measure or set of measures that might be considered, and must be taken into account when developing alternatives intended to accomplish the Project goal and objectives. This section summarizes the key constraints that were considered in the process of developing the scenarios that are outlined in Section 5.

4.1 FLOOD PROTECTION REQUIREMENTS

As indicated in Section 1.2, the goal for this Project is to restore fish passage and improve habitat and River Vision touchstones (Jones et al. 2008) while maintaining or enhancing the existing flood control capacity. Stated in different terms, a firm constraint on any proposed alternative and associated strategic action plan is that it must not result in changes that would diminish the level of flood protection that currently exists in the Primary Focus Area. Responsibility for providing flood protection is shared among federal, state, and local government entities, as summarized below.

Flood protection within the Mill Creek watershed is provided primarily through the flood control capabilities of the MCFCP. As discussed in Section 1.4.3.5, the federal government owns, maintains, and operates the Bennington Diversion Dam, Bennington Lake and surrounding lands, the Division Works and Second Division Works, and the portion of the Mill Creek Channel from RM 10.6 (Division Works Dam) to RM 11.5 (including the dike structures and sediment traps just past Bennington Diversion Dam). The lands and facilities in federal ownership are under USACE jurisdiction. The lower 6 miles of the channel are in non-federal ownership and under the jurisdiction of Walla Walla County and are managed by the MCFCZD.

4.1.1 Federal Jurisdiction

Federal government entities with jurisdiction over flood protection within the Primary Focus Area are the USACE and the Federal Emergency Management Agency (FEMA). Authority and responsibilities for each agency as they relate to Mill Creek and the objectives of this study are summarized below.

4.1.1.1 USACE

The USACE has had flood protection responsibilities associated with Mill Creek since the Flood Control Act of 1938 authorized the MCFCP. The USACE designed and constructed Bennington Diversion Dam and associated works, and participated in the construction of the Mill Creek Channel (USACE 1993). The agency retains direct responsibility for the federally owned and maintained portion of the MCFCP (RM 10.6 to 11.5) and must review and provide permission under 33 U.S. Code Section 408 (Section 408) for any proposed alterations to modify the existing channel in the county controlled portion of the channel (RM 4.8 to RM 10.6).

Section 408 Permissions

The Section 408 permission ensures that any proposed alteration to the Mill Creek Channel will comply with the requirements and restrictions designed to protect the public interest and ensure the alternations would not diminish the channel's function as a flood protection system (USACE 2016e).

In March 2016, the USACE published a draft Environmental Assessment (EA) for Section 408 permissions for fish passage improvement alterations to the Mill Creek Channel proposed by the Mill Creek Working Group and Tri-State Steelheaders per the 2009 Mill Creek Fish Passage Assessment (Burns et al. 2009; see Section 1.4.3.1 for more information). Because these alterations would modify the Mill Creek Channel, they require Section 408 permission from the USACE; as part of the USACE's review, an EA was prepared. The public comment period on the EA ended on April 11, 2016, and a final Finding of No Significant Impact was signed on April 21, 2016, along with the USACE granting of Section 408 permissions (USACE 2016f). Appendix A of the USACE's Section 408 EA (USACE 2016e) includes a checklist of requirements for granting Section 408 permissions. This checklist includes demonstration that modifications to the channel will not:

Geotechnical:

- Increase erosion potential at the stabilizers.
- Increase erosion potential at the toes of the embankments.
- Increase water pressure beneath the slabs or behind the retaining walls.
- Restrict access for maintenance, inspection, and flood fight activities.
- Compromise the current level of concrete durability and serviceability.
- Fail to meet the requirements of USACE design and levee safety criteria.

Hydraulics:

- Reduce the design channel flood conveyance capacity.
- Increase the water surface elevation at the design flood discharge.
- Create hydraulic conditions that will lead to instability of either existing or proposed structural elements at any discharge.
- Create hydraulic conditions that will lead to channel instability, degradation, or aggradation in the reaches either upstream or downstream of the engineered channel reaches.

Structures:

- Reduce the factors of safety related to stability or sliding of existing channel retaining wall sections.
- Increase uplift pressures on channel floor slabs.
- Compromise reinforcing, waterstops, or other features of existing structures.
- Fail to meet applicable federal, state, municipal, and adopted standards for new design and construction.

These specific considerations may or may not apply to a proposed project alternative depending on the extent and nature of the alternative. However, Section 408 permissions would be needed from the USACE prior to any alteration of the county-owned portion of the channel. Per USACE Engineer Circular 1165-2-216 (USACE 2015c), if the proposed alteration to the channel would change how the USACE project meets its authorized purpose for flood control (i.e., reconfiguring a levee system for ecosystem restoration purposes), approval of Section 408 permissions would be required from the Director of Civil Works at Headquarter USACE (HQUSACE) as well as from the District Commander and Division Commander.

Operations and Maintenance Regulations for Flood Control Works

Accommodating Flood Flows

The regulations for operation and maintenance of flood control works constructed by the USACE for states, political subdivisions thereof, or other responsible local agencies are prescribed in 33 CFR 208.10. The USACE Walla Walla District manages the MCFCP under the general objective to “continue to safely and efficiently operate the project to provide flood risk management to the City of Walla Walla and surrounding areas as authorized in public law” (USACE 2015b). The project facilities were designed to protect Walla Walla from up to a 140-

year flood event (USACE 1993). Specific operation of the MCFCP is prescribed by the USACE's Mill Creek Water Control Manual. The flood control rule curve presented in the manual reflects a "sliding" regulation objective that is a function of the natural Mill Creek flow and the Bennington Lake elevation at a specific time. The USACE begins to divert water from Mill Creek to Bennington Lake when flows in the creek exceed 1,400 cfs (which is the capacity of the natural Mill Creek reach below the downstream end of the Mill Creek Channel at Gose Street). The rule curve is based on a regulation objective for a maximum flow of 3,500 cfs in the Mill Creek Channel, which represents the effective current design capacity of the riprapped channel sections (USACE 1993). Therefore, without the provision of additional flood water storage upstream from the Bennington Diversion Dam, maintaining the capacity to safely pass Mill Creek flows of up to 3,500 cfs should be regarded as a firm constraint on potential alternatives for restoration actions.

Vegetation Management to Maintain Flood Risk Reduction

The USACE manages vegetation along the federally owned portion of the channel, according to HQUSACE regulations and guidelines for managing levee vegetation, to maintain flood risk reduction for the City of Walla Walla and surrounding communities (USACE 2014b). The HQUSACE regulations and guidelines for managing levee vegetation apply to all USACE flood risk reduction projects, including those structures for which the USACE has certification authority. This latter authority applies to that portion of the channel owned and operated by the MCFCZD.

The USACE recently conducted a vegetation removal project on the federal portion of the channel because vegetation was overgrown to the point of obstructing visual inspections and access for maintenance. HQUSACE regulations and guidelines for managing levee vegetation would likely apply to any proposed Project alternative that retains existing or constructs new levees to ensure flood protection to the public. However, as lack of vegetation or vegetation removal along Mill Creek can increase stream temperatures and impact fish habitat and passage, alternatives will need to include riparian vegetation along the creek bank to meet the goals and objectives.

A variance from HQUSACE standard vegetation guidelines may be requested by the USACE district offices to further enhance environmental values or to meet state or federal laws and/or regulations. The variance process is contained in a USACE draft Policy Guidance Letter, *Process for Requesting a Variance from Vegetation Standards for Levees and Floodwalls* (77 Federal Register 9637–9650). For a variance to be approved, it must be shown to be necessary and the only

feasible means to (1) preserve, protect, and enhance natural resources, and/or (2) protect the rights of Native Americans, pursuant to treaty and statute. HQUSACE will evaluate variance requests in accordance with the draft guidance until final policy guidance is adopted.

4.1.1.2 Federal Emergency Management Agency

FEMA is the other federal agency with a significant degree of jurisdiction related to flood protection. Because it is the responsibility of local governments to implement floodplain management programs that meet or exceed federal and state flood risk management standards, FEMA's role with respect to regulation within specific local areas is indirect. Under the Disaster Relief Act of 1974 (Public Law 93-288), as amended in 1988, FEMA has responsibility for providing federal financial and physical assistance subsequent to a disaster declaration associated with floods and other natural disasters. In addition, the Floodplain Management Branch of FEMA (2016) administers the National Flood Insurance Program (NFIP), under which owners of property within identified floodplains can be eligible for insurance for flood-related damage to their properties.

Floodplain property owners are eligible for flood insurance if they live in a community (a county or municipality) that participates in the NFIP. Participation in the program is voluntary, but since 1973, flood insurance has been a required condition for receiving any flood-related federal assistance (Ecology 2004). Communities must adopt floodplain management standards that meet the minimum requirements established by FEMA to participate in the NFIP.

Walla Walla County, the City of Walla Walla, and the City of College Place are all participating communities in the NFIP; however, the majority of the City of Walla Walla is not within a mapped flood hazard area and these areas are therefore not eligible for flood insurance (Figure 4.1-1). According to a City of Walla Walla Planning Director's Memorandum from October 22, 1997, FEMA has determined there is "No Special Flood Hazard Area" or Zone C within the City of Walla Walla due to the MCFCP (City of Walla Walla 2014). Areas within the City of Walla Walla that are currently eligible for flood insurance are the identified floodplain areas along Caldwell, Yellowhawk, and Russell creeks. Areas within Walla Walla County that are eligible for flood insurance include areas along lower Mill Creek (Segment 1) and relatively small identified floodplain areas along Mill Creek just west and east of the Walla Walla city limits (see FEMA FIRM maps 530194 0430B, 530194 0435B, 530194 0440B, and 530194 0445B)

Lower Mill Creek Habitat and Passage Assessment and Strategic Action Plan

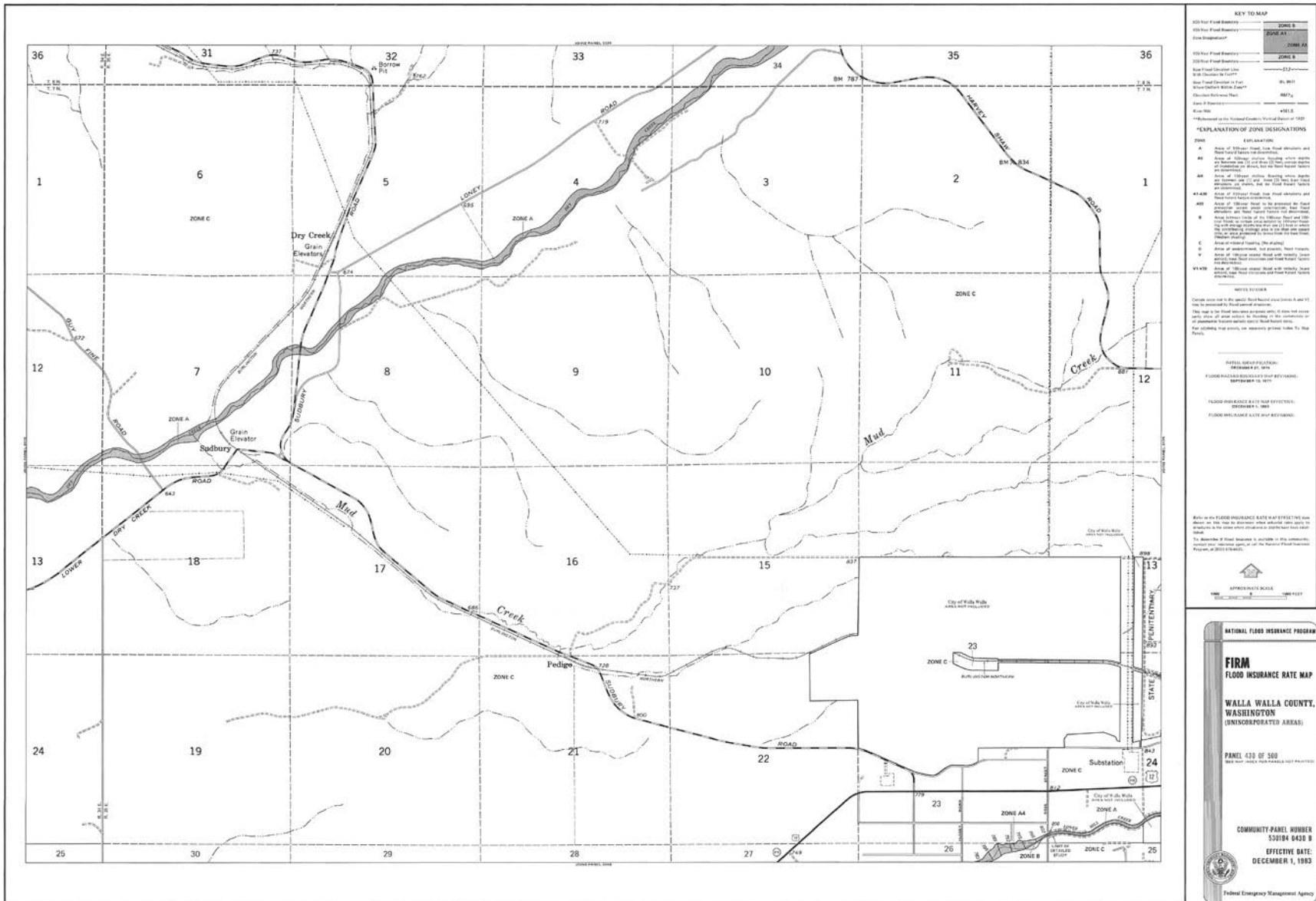


Figure 4.1-1a. FEMA Flood Insurance Rate Maps

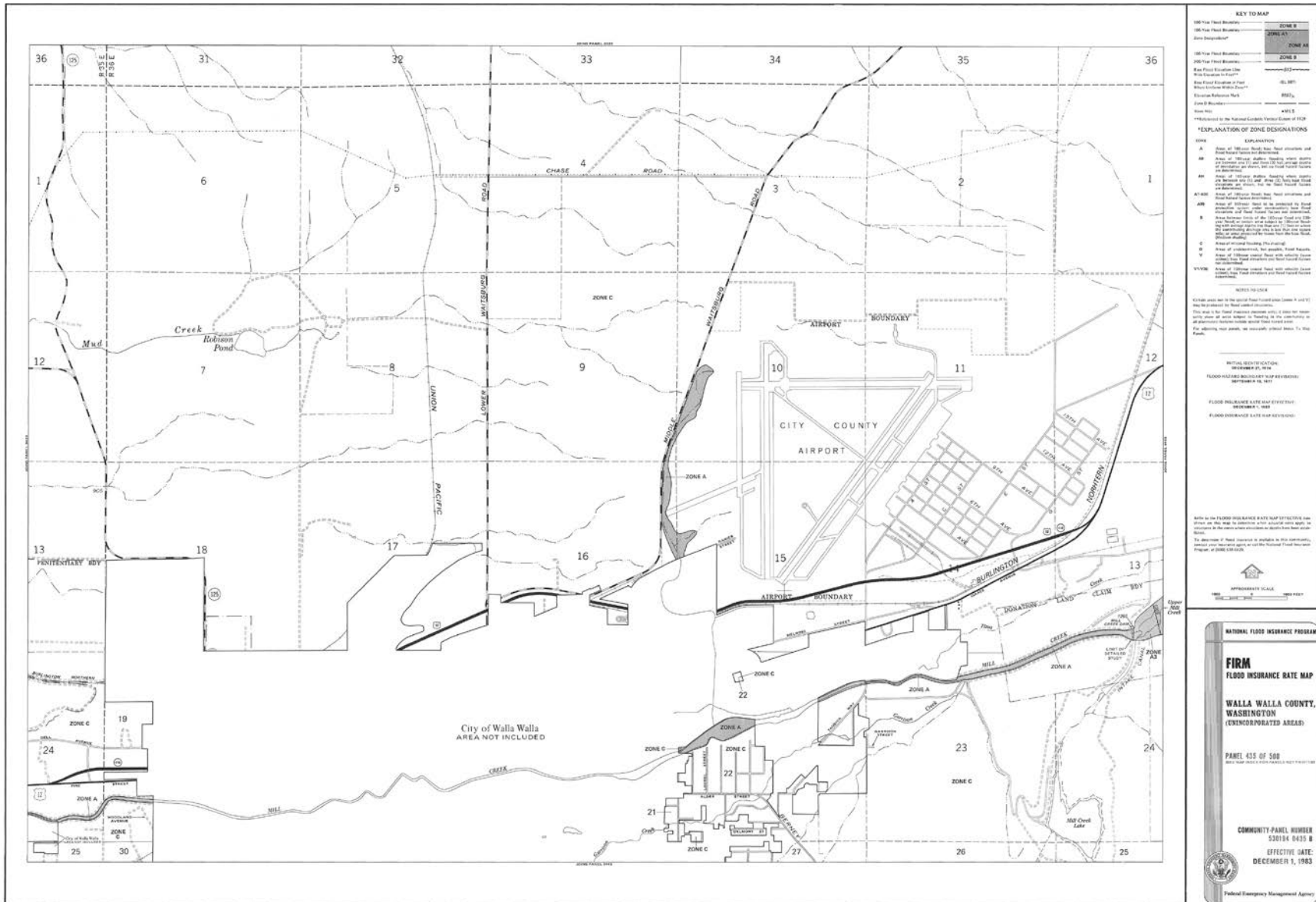


Figure 4.1-1b. FEMA Flood Insurance Rate Maps

Lower Mill Creek Habitat and Passage Assessment and Strategic Action Plan

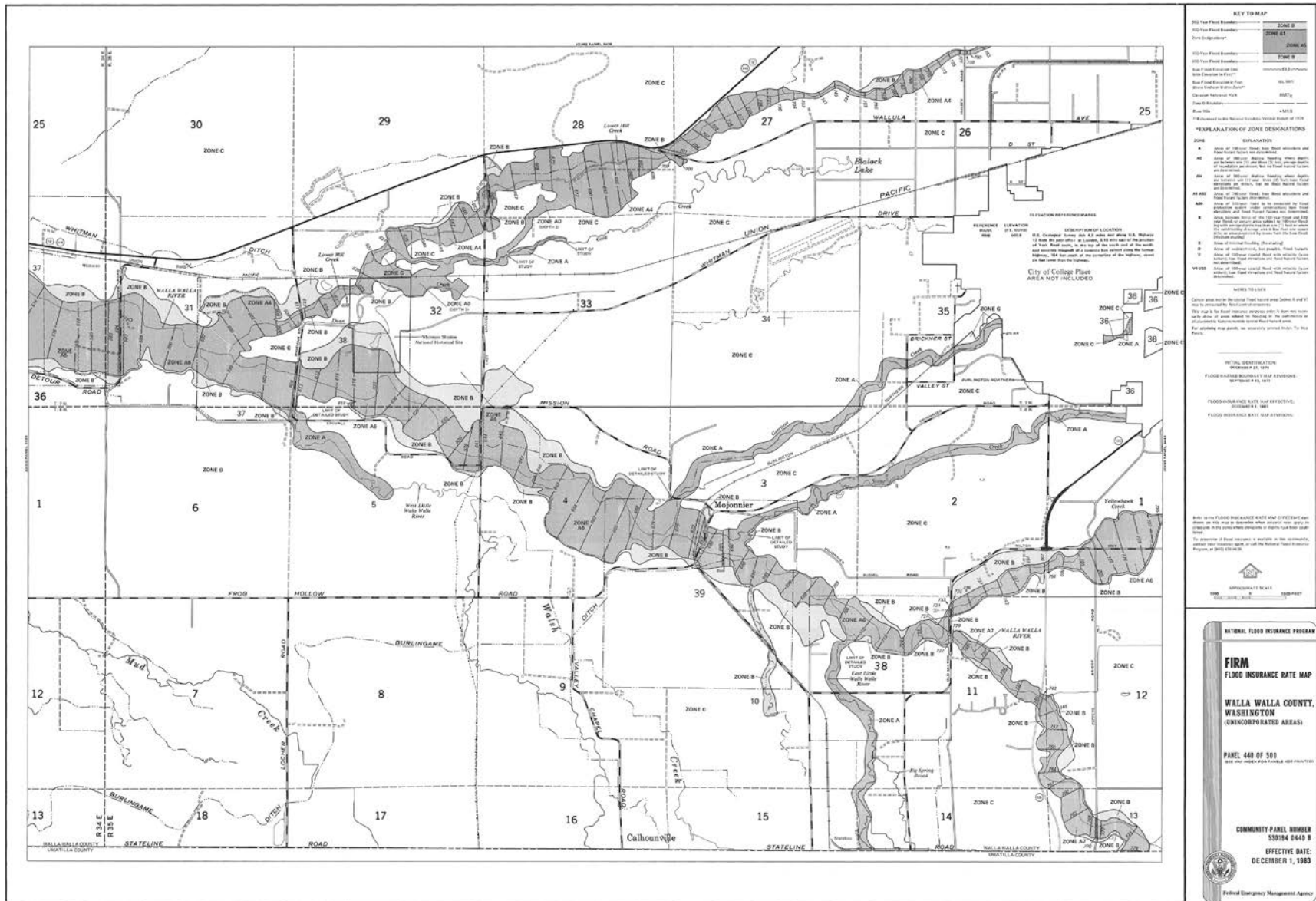


Figure 4.1-1c. FEMA Flood Insurance Rate Maps

Lower Mill Creek Habitat and Passage Assessment and Strategic Action Plan

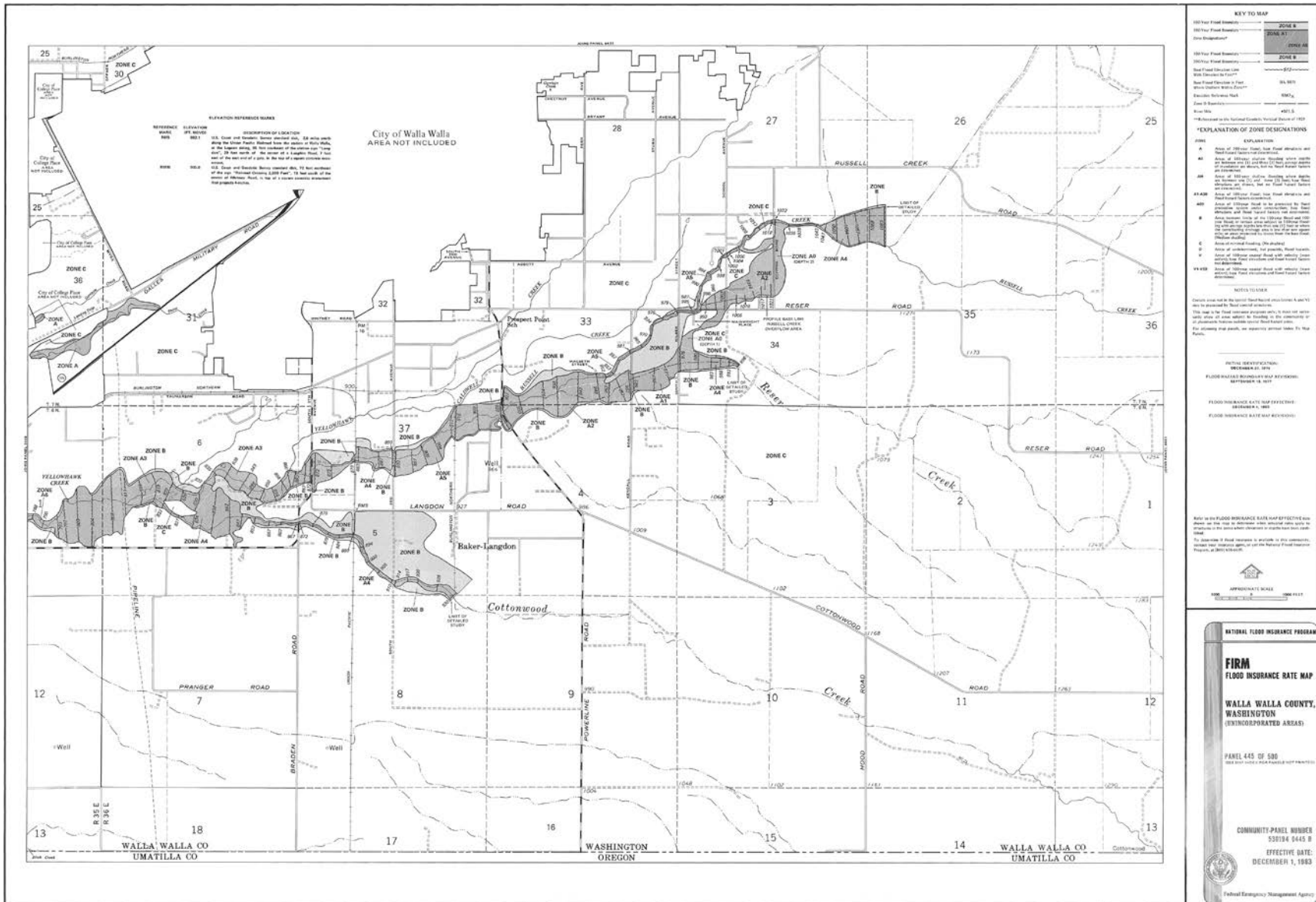


Figure 4.1-1d. FEMA Flood Insurance Rate Maps

Proposed alternatives to the current MCFCP should consider the potential effect on the current designation of FEMA flood zones (or lack thereof) and associated implications with the NFIP. There may be concern that the unmapped flood hazard areas of the City of Walla Walla that are currently not eligible for flood insurance under NFIP may be subject to increased risk for flood and would therefore need to be reevaluated by FEMA and potentially made eligible for coverage under NFIP.

4.1.2 Washington State

The Washington legislature adopted one of the first floodplain management laws in the nation in 1935, which established a program for permits for construction in designated flood control zones (Ecology 2004). Subsequent changes to the floodplain management law included a (temporary) state prohibition on construction of residential structures in floodways, and elimination of duplicate floodplain management programs through the state permit system and local floodplain ordinances developed for participation in the NFIP. As it currently stands, Washington floodplain management law (RCW Chapter 86.16) states that prevention of flood damage is a matter of statewide public concern, and places regulatory control within the Department of Ecology. The agency's current role primarily involves serving as the governor's designated state coordinating agency for the NFIP, providing technical assistance to local jurisdictions, and administering the Flood Control Assistance Account Program, under which Ecology provides grant funds to local governments for floodplain management planning and implementation. A 1995 memorandum of agreement between Ecology and the state Division of Emergency Management established a single planning requirement and a common review process for local flood hazard management plans (Ecology 2004). State flood protection requirements do not represent direct constraints on potential Mill Creek restoration actions.

4.1.3 Walla Walla County

Walla Walla County established the Walla Walla County Mill Creek Flood Control District on July 16, 1948, as a municipal corporation with responsibility for managing the non-federal portion of the Mill Creek Channel. Among the terms of the MCFCP agreement with the USACE, the Flood Control District agreed to provide the lands, easements, and ROWs necessary for construction of the MCFCP, and to maintain and operate the project in accordance with the prescribed regulations (USACE 1948). On February 25, 1974, the county dissolved the original district and established the Mill Creek Flood Control Zone District (MCFCZD), and assumed the operation and maintenance responsibilities for the non-federal portion of the

MCFCP. As discussed in Section 4.1.1 above, the MCFCZD cooperates with the USACE in management of Mill Creek flows under the guidance of the MCFCP Water Control Manual.

The USACE annually inspects this non-federal portion of the channel, looking for issues that need to be corrected (Walla Walla County 2016). Potential issues to be addressed by inspections include the physical condition of the structures, erosion, slope stability, encroachments within the project ROW, and the presence of vegetation on flood control structures. Vegetation restrictions similar to those defined for the federal portion of the channel (see Section 4.1.1.1) also apply to the non-federal portion (USACE 2013a).

Section 8 of the 2010 Hazard Identification and Vulnerability Analysis prepared by the Walla Walla County Emergency Management Department considers floodplains and flooding in Mill Creek and Yellowhawk, Cottonwood, Russell, Garrison, and Reser creeks (Walker 2014). The analysis states there are little flooding data available and that flows in Russell, Garrison, and Yellowhawk creeks are partially regulated by the Mill Creek Diversion and Reservoir Project. It concludes that the probability of flood occurrence along the subject creeks is low.

4.1.4 City of Walla Walla

As noted in Section 4.1.1.2 above, local governments must adopt floodplain management standards that meet the minimum requirements established by FEMA to participate in the NFIP. Until recently, the City of Walla Walla was not required to have a floodplain ordinance because the Mill Creek floodplain was the only floodplain within city limits and Mill Creek waters passing through the city are contained within the high-velocity flood control channel. However, recent annexations brought floodplain areas along Caldwell Creek, Yellowhawk Creek, and Russell Creek within the city limits, thus requiring the city to adopt an ordinance to regulate flood hazard within those areas. Through Ordinance 2014-12, the city adopted interim amendments to Title 21 of the Walla Walla Municipal Code regarding regulations of floodplains. This ordinance incorporates the provisions of 44 CFR 60.3 (Floodplain Management Criteria for Flood Prone Areas) and is consistent with the applicable policies, goals, and other provisions of the city's comprehensive plan. The Walla Walla floodplain management ordinance does not appear to constrain potential Mill Creek restoration actions.

The city has also adopted other land use regulatory provisions that aim to maintain or enhance current levels of flood protection, most notably the SMP adopted pursuant to the state Shoreline Management Act of 1971. The City's shoreline jurisdiction encompasses the Mill Creek waterbody and land within 200 feet of the OHWM of Mill Creek, as well as floodways, floodplain areas within 200 feet of a mapped floodway, and associated wetlands (City of Walla

Walla 2016). Actions undertaken within the shoreline zone would need to be consistent with the uses allowed under the corresponding shoreline environment designation, and would likely require a shoreline substantial development permit. The city is currently in the process of updating the original SMP adopted in 1977 (see Section 1.4.2.3 for more information on the SMP).

4.2 WATER RIGHTS VS. WATER SUPPLY

Section 2.4.8.2 discusses existing water rights on Mill Creek, and Section 2.5.3.2 discusses existing water right diversions and withdrawals. As stated in Section 2.5.3.2, the Walla Walla subbasin is over-appropriated from late spring to early fall during low-flow periods (Ecology 2007) and minimum in-stream flows set by WAC 173-532 are not met during these low-flow periods. As little as 2.1 and 2.5 cfs flows through Mill Creek in August and September at the USGS gage just downstream of the Division Works Dam while the minimal flow needed for fish habitat (in all months) is 45 cfs in Segments 1 through 4 (see Section 2.5.3.2).

Strategies for decreasing withdrawals from Mill Creek and increasing in-stream flows, especially during the low-flow months, must be identified as part of a proposed Project alternative in order to achieve the Project's goal and objectives.

4.3 MILL CREEK CHANNEL RIGHT-OF-WAY

Potential actions to address many of the problems and opportunities discussed in Section 3 would require making physical changes to the location and character of the Mill Creek Channel. For example, measures to make the channel more natural in appearance and restore floodplain connectivity could involve widening the floodplain in places where it is now confined to a constructed channel and changing the physical configuration of the waterway. Implementing such measures would require physical modifications (possibly including removal) of constructed facilities. Before any such physical modifications could be undertaken, however, the underlying definition of the ROW for the Mill Creek Channel would first need to be modified.

The original operation and maintenance manual for the Mill Creek Channel identified a number of restrictions recommended to protect the integrity of the project structures and functions, including the following (USACE 1948):

- No encroachment or trespass which will adversely affect the efficient operation and maintenance of the project works shall be permitted upon the ROWs for the protective facilities;

- No construction of buildings, bridge piers, or other structures which would reduce the section of the channel at any point shall be permitted;
- The construction of heavy structures on the banks adjacent to the channel which would increase the load on retaining walls shall be avoided;
- Installation of new utilities over, under or adjacent to the channel which would endanger the structures, including the toe drain, or interfere with the carrying capacity of the channel, either by reducing of clear area or by providing a place for snags and drift to accumulate, shall not be permitted;
- No excavation or construction shall be permitted within the limits of the project right-of-way, nor shall any change be made in any feature of the works without prior determination by the District Engineer of the War Department or his authorized representative that such improvement, excavation, construction, or alteration will not adversely affect the functioning of the protective facilities. Such improvements or alterations as may be found to be desirable and permissible under the above determination shall be constructed in accordance with standard engineering practice.

In summary, any actions that would involve modifications within the ROW would require prior approval by the USACE and real property transaction with the USACE or MCFCZD. If the action would occur outside the current limits of the ROW, it would also require transaction with the adjacent property owner(s).

In some sections of the Mill Creek Channel, particularly in Segments 2, 3, and 4, there are existing encroachments to the ROW. These encroachments include the underground section of Mill Creek where buildings and parking lots are constructed directly above the stream's ROW. Project alternatives should consider the removal of these encroachments to ensure adequate habitat and fish passage is provided. In addition to considerations of property ownership and real estate value, removal of encroaching properties that are listed on the National Register of Historic Places, such as the Liberty Theater (currently owned by Macy's Department Store) in downtown Walla Walla, may be subject to a Section 106 Consultation prior to the start of any significant alteration or demolition (36 CFR Part 60). As discussed in Section 2.10.3, the Mill Creek Channel itself is over 50 years old and may be eligible for listing on the National Register. Therefore, consultation with the State Historic Preservation Office would be required prior to conducting any significant modifications of the channel.

Figures 3.2-3 identifies possible opportunity sites to expand the floodplain in Segment 4 and thereby the ROW. These sites were selected because of the amount of open space and lack of

built structures. Further investigation will be needed regarding property ownership, real estate value, historic preservation, and prioritization of benefits vs. costs for expanding the ROW.

4.4 PHYSICAL CONSTRAINTS

As noted above, implementing many of the potential measures to improve fish passage and habitat associated with Mill Creek would require physical modifications to the existing channel. To varying degrees, the existing physical characteristics of the stream corridor and surrounding areas represent constraints on the degree of modification that can be accomplished. Key physical constraints on potential restoration actions are summarized as follows:

- **Stream gradient.** As discussed in Section 2.5.2.2, within the Primary Focus Area, Mill Creek drops from an elevation of 1,500 feet at Seven Mile Road (RM 15) to 590 feet at the Walla Walla River confluence (RM 0.0). The overall elevation change of 910 feet represents an average gradient of approximately 60 feet per mile, or 1.1 percent. Due to the highly altered nature of the Mill Creek Channel, there is little sediment transport downstream from the Bennington Diversion Dam and the sediment trap. This lack of sediment in the channel creates a need for artificial grade control such as stream bed protection and stream bank protection measures. Without these measures, the unprotected sections of the channel would be at risk for downcutting and erosion of the levees. Within localized stream reaches, it may be feasible to increase or decrease the stream gradient for fish passage and habitat restoration purposes; however, it is likely too costly and impracticable to change the stream gradient more extensively (over a longer reach or in many locations).
- **Hydrology.** The existing hydrologic characteristics of the Primary and Secondary Focus Areas, as described in Section 2.5.1, represent physical conditions that are essentially fixed with respect to potential stream restoration actions. Precipitation and runoff amounts and patterns will continue for the foreseeable future as determined by natural conditions. Based on the climate change predictions discussed in Section 2.1, peak flow timing may shift earlier and magnitude may increase over time, and reduced snow packs may further limit summer water supply. The potential for changes in stream flow volumes and timing is primarily limited to what could be accomplished through inter-basin transfers (such as diverting water from Mill Creek to Yellowhawk Creek), which is subject to limitations from a variety of legal, social, and physical constraints. Stream flow volumes and timing of peak flows in the Primary Focus Area could also be modified through flood water storage projects. Flood waters could be retained during

high-flow events and then released at an appropriate time to mimic smaller, more frequent storm events. Water from flood storage reservoirs could also be released slowly during the summer months to supplement low flows.

- **Infrastructure.** Infrastructure that is relevant to consideration of potential restoration actions includes the physical facilities comprising the Mill Creek Channel and constructed features in the vicinity of the channel, such as transportation facilities (streets, bridges, sidewalks, and trails), utility facilities (storm and sanitary sewers, water and gas supply lines, and electric and communications facilities), structures associated with other developed land uses (commercial, residential, institutional and industrial buildings, parking lots, and signage). Changes to existing infrastructure features would be subject to varying degrees of constraint. These constraints are primarily legal and economic in nature – making such changes would require obtaining the legal right to do so, and would entail associated economic costs that would vary with the value of the structures considered for modification.

5. Strategic Action Plan

5.1 INTRODUCTION TO THE STRATEGIC ACTION PLAN

Strategic planning is a systematic process of envisioning a desired future, and translating this vision into broadly defined goals or objectives and a sequence of steps to achieve them (Business Dictionary 2017). The strategic planning process helps define an organization's unique position in the context of stakeholder needs, societal trends, and relationships with cooperative and competitive organizations (EPA 1990). The CTUIR, in collaboration with stakeholders, began the strategic planning process for lower Mill Creek by envisioning a desired future based on the understanding of historic and current conditions and the identification of problems and opportunities and constraints detailed in the Assessment (Sections 1 through 4). The result of the strategic planning efforts are captured in this SAP.

Early in the strategic planning process, the CTUIR recognized that in order to achieve the Project goal and objectives (see Section 1.2), Mill Creek and its tributaries (i.e., the Mill Creek system) should to be viewed as a holistic system with multiple uses and purposes. System-wide concepts that only focus on a single use or purpose will not meet the multi-use, multi-purpose Project goal and objectives. Additionally, site-specific actions that are focused on only resolving segment-level issues may not integrate with the system-wide strategy to achieve the Project goal and objectives. Therefore, an initial set of system-wide management scenarios that address multiple uses and purposes were developed and evaluated. The CTUIR acknowledges that these are not the only possible approaches for achieving the Project's goal and objectives and that as part of this SAP, as well as through any other strategic planning process, additional scenarios have been and will need to be identified by stakeholders. The system-wide management scenarios presented in this SAP provide the basis for strategic planning only, and do not provide all potential system-wide management scenarios or the level of detail necessary for implementing or constructing solutions for lower Mill Creek. Further analysis of one or more system-wide management scenarios or the associated components will be needed during any future strategic planning or proposed feasibility study focused on addressing the problems associated with lower Mill Creek (see Section 3.0).

Using the lessons learned from identifying and evaluating an initial set of system-wide management scenarios, the CTUIR (in collaboration with the Executive Committee [EC], Technical Advisory Committee [TAC], and other stakeholders) has provided a strategic planning process that could ultimately result in a stakeholder identified and supported system-

wide management scenario that successfully balances the multiple uses and purposes of the Mill Creek system. The strategic planning process also provides stakeholder identified actions necessary to further advance any strategic planning or proposed feasibility study.

5.2 PURPOSE AND OVERVIEW OF THE SAP

The SAP documents ideas, develops processes, and identifies steps necessary to achieve the Project's goal and objectives (as defined in Section 1.2). The purpose of the SAP is to:

- 1) Identify possible approaches for achieving the Project's goal and objectives and to demonstrate that it is possible to fully resolve fish passage (as defined as meeting NMFS and WDFW fish passage criteria), improve fish habitat, and improve the conditions of River Vision touchstones (Jones et al. 2008), while maintaining or improving flood control, recreation, and economic values;
- 2) Document ideas for system-wide management of lower Mill Creek and the associated regulatory sideboards and funding opportunities;
- 3) Provide the Mill Creek stakeholder groups with a strategic planning process that results in a long-term system-wide vision for Mill Creek;
- 4) Identify immediate (within 6 months), urgent (within 1 year), and short-term (begin within 1 to 5 years) steps or actions for implementation while the long-term vision (begin within the next 5 years) for Mill Creek is further established and designed.

Provided below is an overview of each of the sections in the SAP:

- **Section 5.3 – Description of System-Wide Management Scenarios.** This section describes the four management scenarios initially identified by the CTUIR and reviewed by stakeholders. Stakeholder feedback on these scenarios has been incorporated into these descriptions. This section also includes an evaluation of these four scenarios (Section 5.3.2) against the Project's objectives and metrics, as well as a conceptual discussion of various considerations for each scenario (Section 5.3.3). A summary of each scenario's pros and cons is included in Section 5.3.4.
- **Section 5.4 – Alternative Management Scenarios Identified by Stakeholders.** This section documents alternative system-wide management scenarios, as well as potential segment-level conceptual alternatives and possible implementation tools suggested by stakeholders during review of the SAP.

- **Section 5.5 – Regulatory Sideboards and Funding Opportunities.** This section identifies the regulatory sideboards that will need to be considered when formulating more detailed actions and designs to support any future selected system-wide management scenario and when considering implementation and potential funding sources. Specific information regarding the USACE General Investigation Program is described in this section, including the process of developing a USACE Feasibility Study for which Walla Walla County is expected to be the non-federal sponsor. A USACE Feasibility Study must include the formulation of alternatives and typically takes up to 3 years to complete. Other federal and non-federal funding sources and regulatory sideboards are also discussed in this section.
- **Section 5.6 – Strategic Planning Process.** This section describes a strategic planning process that could ultimately result in the identification of a stakeholder supported system-wide management scenario that successfully balances the multiple uses and purposes of the Mill Creek system. This strategic planning process could be used when formulating and evaluating other possible management scenarios for lower Mill Creek.
- **Section 5.7 – Implementation Pathways.** This section includes a description of next steps, or actions, identified by stakeholders. These next steps include a description of actions that correlate with the following four levels of action:
 - Immediate actions that should be implemented within the next 6 months;
 - Urgent actions that should be implemented within the next year;
 - Short-term actions that should be implemented within the next 1 to 5 years; and
 - Long-term actions that should begin within the next 5 years.

The SAP facilitates the formulation and evaluation of system-wide management scenarios. It is critical that a system-wide management scenario for lower Mill Creek be identified and supported by stakeholders so that near-term actions can be integrated into a long-term vision. Therefore, a system-wide management scenario should be understood as a long-term approach for enhancing ecosystem benefits, recreation, and other objectives while maintaining or enhancing flood risk management. Although through this SAP, the CTUIR initially identified management scenarios that measurably address the Project’s goal and objectives, the SAP does not conclude with the selection of a preferred management scenario, as further investigation, evaluation, and stakeholder input is needed. Instead, Section 5.7 includes a description of next steps in the planning process to continue the work started in this SAP and facilitates the

selection and development of a future stakeholder-supported preferred management scenario that could be further developed as part of a future USACE Feasibility Study or other technical vehicle or authority for feasibility design.

5.3 SYSTEM-WIDE MANAGEMENT SCENARIOS

As stated earlier, the CTUIR developed an initial set of system-wide management scenarios using the information compiled in the Assessment, feedback provided by stakeholders during initial Project outreach (summarized in Appendix A), and consideration of this information within the context of the Project goal and objectives. From this analysis, four high-level, long-term system-wide management scenarios for the Mill Creek system were identified and are described in this section. The CTUIR recognizes that there are a number of possible variations to these four scenarios that could be evaluated as well as new scenarios not yet considered by the CTUIR or suggested by stakeholders. As such, the CTUIR provided the stakeholders opportunities to identify additional scenarios and/or segment-level alternatives during stakeholder meetings and reviews of the SAP. As noted above in the overview of the SAP (Section 5.2), these stakeholder suggested scenarios and segment-level alternatives are described and discussed in Section 5.4.

5.3.1 Description of System-Wide Management Scenarios

The four management scenarios described in this section were developed from the information provided by the historic and existing habitat, flood control, fish passage, and water flow studies referenced in Sections 1 and 2, the problems and opportunities identified in Section 3, and the constraints identified in Section 4. As previously stated, the conceptual scenarios developed in this section are not comprehensive of all possible management scenarios; rather, they are meant to serve as a starting point for evaluating possible system-wide approaches for addressing the identified challenges in lower Mill Creek. Each conceptual scenario offers a different balance of strategies for addressing flood control, fish passage and habitat, public amenities, and economic values. Other system-wide management scenarios can and should be considered and evaluated during future planning efforts (see Section 5.7).

The current flood control system was designed to use three methods to control flood flows: (1) diverting flood waters into off-channel storage at Bennington Lake; (2) conveying high flows through the armored and highly modified lower Mill Creek Channel; and (3) diverting a

managed portion of the flood flows through the distributary network.¹ As long as flood control for the urbanized area is required, any future management scenario will use one or more of these basic approaches: a) diverting water into storage facilities; b) conveying water through the city; and c) diverting water into the distributary network (i.e. divert water around urban center). The four scenarios presented here were selected to represent four general approaches to achieving the Project goal and objectives in lower Mill Creek.

The four conceptual system-wide management scenarios include:

- **Scenario 1: Current Management Approach.** This scenario would continue over the long-term the current approach to fish passage improvements and infrastructure repairs within the constraints of the existing flood control system, including other reasonably foreseeable projects. This scenario assumes that the current strategies being implemented to resolve fish passage and repair infrastructure in lower Mill Creek, such as construction and installation of weirs, baffles, and roughness panels through the concrete channel and the notching of sills, would be implemented as the primary approach over the long term and are evaluated accordingly.
- **Scenario 2: Yellowhawk Creek Fish Diversion.** This scenario would designate lower Mill Creek as the primary flood conveyance channel with all fish excluded, and would use Yellowhawk Creek as the primary fish migration channel, while incorporating additional habitat enhancement and protection efforts along Yellowhawk Creek.
- **Scenario 3: Naturalized Lower Mill Creek and Distributaries and Flood Water Storage.** This scenario would expand the concept of diversion and storage of flood waters currently employed through Bennington Lake by considering a range of upstream storage and gradual return options in order to reduce the need for flood control infrastructure below Bennington Diversion Dam and allow for a naturalized lower Mill Creek and distributaries with various ecological and social amenities through the urbanized area of Walla Walla.

¹ Note that during flood control operations when flows in Mill Creek exceed 400 cfs, the USACE maintains flows to Yellowhawk Creek at 0.9 foot (approximately 25 cfs) (USACE 2012c). The USACE has the authority to determine different flows for Yellowhawk and Garrison Creeks for flood control purposes when flows in Mill Creek are above 1,400 cfs (USACE 2012c). However, USACE staff indicated that generally these distributaries are not used as flood conveyance channels due to the potential for property damage along these distributaries (pers. com., Jeremy Nguyen, USACE, Walla Walla District, Walla Walla, WA, October 13, 2016).

- **Scenario 4: Underground Flood Channel.** This scenario would expand the concept of flood conveyance by incorporating an underground flood water conveyance tunnel, through which flood flows would be routed and fish species excluded, and a new “landscaped” channel would be constructed on the surface (above the underground flood water tunnel) through the urbanized area.

Each scenario is further described below, including key assumptions and the identification of characteristics necessary to evaluate each scenario against the Project goal, objectives, and metrics. These specific characteristics are only examples of the many potential components, approaches, and/or segment-level alternatives that could make up a given system-wide management scenario and, more specifically, segment-level solutions, and should not be taken as prescriptive or limiting the scope of possible opportunities.

Where minimum flows are prescribed that are above the current flow regime’s minimum flow, the intent is that this will be achieved through a multifaceted approach of acquiring water rights and implementing water efficiencies and/or water transfer or water storage programs. For example, a flow enhancement strategy (the Walla Walla Basin Integrated Flow Enhancement Study) is currently being discussed and planned by a steering committee and various technical work groups (pers. com., Gary James, Program Manager, CTUIR, Pendleton, Oregon, May 24, 2017). This study has been ongoing since 2014 with the goal of determining the best package of options for increasing streamflow in the Walla Walla Basin for native fish, while maintaining the long term viability and water availability for irrigated agriculture, residential, and urban use. Potential project components being evaluated include the Columbia River pump exchange, storage reservoirs, groundwater recharge (SAR and ASR) and irrigation efficiency. An initial report is expected in September of 2017 which will identify conceptual projects or a package of projects that the Steering Committee supports for further engineering and design studies. Studies are anticipated to continue in 2018 and 2019 with potential implementation to begin in 2020 or 2021. The primary outcome of the Walla Walla Basin Integrated Flow Enhancement Study is a water management plan that has broad support for implementation and will improve and protect stream flows across the Walla Walla Basin, including lower Mill Creek and its distributaries (pers. com., Gary James, Program Manager, CTUIR, Pendleton, Oregon, May 24, 2017).

5.3.1.1 Scenario 1: Current Management Approach

Scenario 1 was identified to test how only addressing fish passage in lower Mill Creek with limited habitat improvements, would perform as a long-term approach. This scenario is

constrained by current challenges such as lack of funding, lack of political and social will to alter the channel footprint, logistical challenges to setting back levees, increasing stream flows, or increasing shading, etc. Scenario 1 includes the fish passage projects that have been completed or that are currently being planned or undertaken in the Mill Creek Channel by the Mill Creek Working Group and the USACE, and includes other reasonably foreseeable projects discussed in Section 1. This scenario would also rely on projects continuing to be completed by a variety of public agencies, organizations, and other stakeholders to enhance or protect riparian and in-stream habitat along Segments 1 and 5 of Mill Creek and its distributaries (see Section 1), and to improve groundwater levels through aquifer recharge efforts (see Section 2.5.5).

Under this scenario, flow enhancement strategies would be implemented to achieve a minimal flow of 45 cfs in the summer (see Section 3.1.2 of the Assessment for example flow enhancement strategies). Existing flood control infrastructure would be maintained and/or improved to address flood control concerns. Although Scenario 1 would resolve physical fish passage issues in the Mill Creek Channel, no spawning and little to no rearing fish habitat improvements would occur in Segments 2 or 3 and only limited fish habitat improvements would occur in Segment 4 as this section will still be controlled by weirs and levees. Some thermal and physical passage barriers associated with managed low flow conditions will be resolved under Scenario 1 due to the achievement of a minimal flow of 45 cfs, construction of a low flow channel, and habitat improvements particularly above Roosevelt Street. This scenario would not address needed improvements to lower Mill Creek focused on meeting the Clean Water Act and other regulatory standards for water quality. Retrofitting the channel for fish passage would not decrease the functionality/capacity of flood control within the Segments 2, 3, and 4; however, further analysis of this scenario under a hydraulic model that incorporates changes to the hydrograph associated with climate change would be needed to evaluate whether this scenario would provide adequate flood control capacity and operations. Scenario 1 does provide near-term solutions for facilitating more upstream fish movement in the Mill Creek Channel which will help fish have access to cooler upstream water, thus providing some benefits against ecological impacts from climate change. Land use controls will need to be implemented in areas where channel improvements will require access or the ROW may need to be widened where fish passage structures are installed. Figure 5.3-1 provides a schematic of Scenario 1.

The general attributes of each channel segment under Scenario 1 are described below.

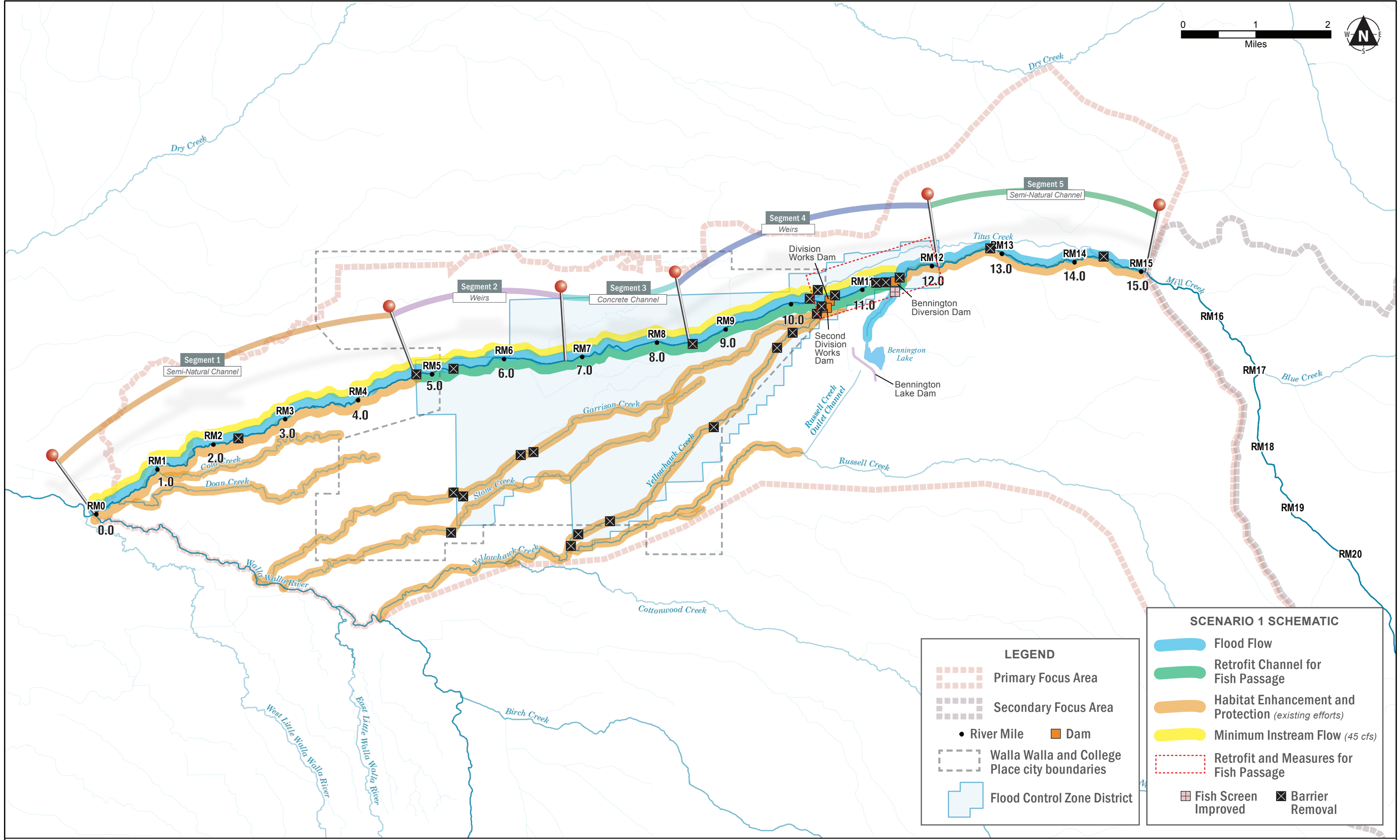
- **Segment 1.** This segment would remain in its current channel configuration with channel adjustment and floodplain formation processes allowed to continue where possible within existing landowner constraints. However, floodplain connectivity will continue to be limited due to channel incision from a reduction in bedload delivery because of the flood control channel and Bennington Diversion Dam. Based on landowner willingness, some restoration, enhancement, and protection projects may be implemented to improve conditions for fish passage and habitat, floodplain connectivity, and riparian characteristics.
- **Segment 2.** This segment would remain an artificial conveyance with horizontal tangents and curves, a consistent channel cross section, armored banks, and regularly spaced concrete and sheetpile weirs. Existing flood control infrastructure would be maintained and/or improved to address flood control concerns. Retrofitting of the existing channel would be implemented consistent with previous designs (i.e., the Mill Creek Working Group projects). The retrofits would improve the conditions for upstream fish passage but would not address the lack of spawning/rearing habitat.
- **Segment 3.** This segment would remain a concrete-lined channel threaded both above- and below-ground through downtown and central Walla Walla. Sections of the above-ground concrete channel have already been retrofitted to include a low-flow channel, small low-flow pools for resting, and roughened channel bottoms to improve hydraulics for upstream fish passage up to 400 cfs. Additional planned retrofits by the Tri-State Steelheaders would be implemented under this scenario with the intent to fully resolve upstream fish passage throughout this segment (these may or may not include daylighting the underground portion of the channel). The capacity of this channel to convey 100-year flood flows would be maintained and structural improvements may be made to strengthen existing infrastructure and eliminate the potential for failure and collapse.
- **Segment 4.** This segment would remain an artificial conveyance with a wide sediment trap comprising channel-spanning sill/weirs and the Division Works Dam and Bennington Diversion Dam, with the forebay consisting of wetland and stream channel features above the Bennington Diversion Dam. Existing flood control infrastructure would be maintained and/or improved to address flood control concerns. The sediment trap section would be periodically cleaned out to remove any sediment build up from flooding events, but otherwise would remain as currently configured. The Mill Creek Channel from the Division Works Dam up to the Bennington Diversion Dam would be

retrofitted to better support fish migration. Recent projects by the USACE and the Mill Creek Working Group that retrofitted seven weirs for fish passage would be expanded to cover all weirs in this segment. A selected measure², such as a new fish ladder on the right bank or a swim-through channel on the right bank, would be implemented to provide fish passage at the Bennington Diversion Dam. At the Division Works Dam, fish passage would be addressed through improvements to the existing fish ladder. The fish screens at Bennington Diversion Dam would also be improved to function properly at higher flows (see Section 2.8.5.1).

- **Segment 5.** This segment would remain in its current semi-natural channel configuration. Based on landowner willingness, some restoration, enhancement, and protection projects may be implemented to improve conditions for fish passage and habitat, floodplain connectivity, and riparian characteristics.
- **Distributaries.** Current restoration, enhancement, and protection efforts on the distributary channels would continue under Scenario 1. Generally, the distributaries would remain in their current channel configurations, with some improvements to habitat, floodplain connectivity, and riparian characteristics. In addition, any physical fish passage barriers not already being addressed would be removed or otherwise treated to improve chances of successful fish migration. This would include fish passage improvements between the Second Division Works Dam and the Division Works Dam.

² “Measure” is a term used by the USACE in the *Bennington Lake Diversion Dam Fish Passage, Walla Walla, Washington, Section 1135 (Project Modifications to Improve the Environment), Detailed Project Report and Environmental Assessment* (USACE 2012a) to mean “a feature or activity that can be implemented at a specific geographic site to address one or more planning objectives.”

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SCENARIO 1 SCHEMATIC

	Flood Flow
	Retrofit Channel for Fish Passage
	Habitat Enhancement and Protection (existing efforts)
	Minimum Instream Flow (45 cfs)
	Retrofit and Measures for Fish Passage
	Primary Focus Area
	Secondary Focus Area
	River Mile
	Dam
	Walla Walla and College Place city boundaries
	Flood Control Zone District
	Fish Screen Improved
	Barrier Removal

Figure 5.3-1.
Scenario 1: Current Management Approach

5.3.1.2 Scenario 2: Yellowhawk Creek Fish Diversion

Scenario 2 was identified by several stakeholders as an option for accommodating fish passage and habitat outside of the Mill Creek Channel, thereby avoiding any major changes to the flood control infrastructure in the mainstem. Under this stakeholder-suggested scenario, fish would be excluded from lower Mill Creek from the mouth to the Division Works and fish would be bypassed through Yellowhawk and Garrison creeks. Lower Mill Creek would function as the primary flood conveyance channel, Yellowhawk Creek as the primary fish migration channel, and Garrison Creek as the secondary fish migration channel. Habitat enhancement, barrier removal, and protection efforts would be implemented along Yellowhawk and Garrison creeks, and other distributaries. Channel widening and deepening and the expansion of riparian and floodplain areas along Yellowhawk and Garrison Creeks would be needed in order to provide minimal or optimal fish passage and habitat and to accommodate the recommended minimal flows in Yellowhawk. Land use controls will need to be implemented along Yellowhawk and Garrison creeks such as adequate buffer widths and setbacks to provide space for restored streams.

This scenario would require detailed consideration at the junctions between Yellowhawk, Garrison, and Mill creeks to eliminate the possibility of fish using lower Mill Creek, as well as solutions for potential attraction flow and potential straying issues at the junctions with the Walla Walla River during upstream migration. Similar to Scenario 1, projects would continue to be completed by a variety of public agencies, organizations, and other stakeholders to enhance or protect riparian and in-stream habitat along Segments 1 and 5 of Mill Creek and its distributaries (see Section 1), and to improve groundwater levels through aquifer recharge efforts (see Section 2.5.5). Since fish would be excluded from lower Mill Creek below the Division Works, actions to address issues related to water quality or fish passage or rearing benefits would not be included in RM 0 to RM 10.5. This scenario would not address needed improvements to lower Mill Creek focused on meeting the Clean Water Act and other regulatory standards for water quality. The actions included in this scenario do not include increased flood water storage or conveyance from what is currently provided and therefore does not include considerations for climate change, which may impact future flood control capacity and operations. Figure 5.3-2 provides a schematic of Scenario 2.

The general attributes of each channel segment under Scenario 2 are described below.

- **Segment 1.** This segment would remain in its current channel configuration with channel adjustment and floodplain formation allowed to continue where possible within existing landowner constraints. Any channel alterations made in this segment would be

to improve flood conveyance and control because lower Mill Creek would not be used for fish migration under this scenario. Precautions to eliminate upstream fish passage into lower Mill Creek from the Walla Walla River would be taken by installing a channel-spanning fish exclusion sill at or near the mouth of Mill Creek. Installation of this fish exclusion sill may result in impacts to salmonids traveling upstream due to false attraction. Impacts from false attraction at the sill may include delay in fish migration, failure to move upstream, or fish straying into other drainages.

- **Segment 2.** This segment would remain an artificial conveyance with horizontal tangents and curves, a consistent channel cross section, armored banks, and regularly spaced concrete and sheetpile weirs. Existing flood control infrastructure would be maintained or improved to address flood control concerns, and other improvements may be necessary to improve flood water conveyance. None of the Mill Creek Working Group's planned retrofits would be constructed, and no habitat upgrades would be implemented and no fish barriers would be removed unless necessary for improving channel hydraulics for flood conveyance.
- **Segment 3.** This segment would remain a concrete-lined channel threaded both above- and below-ground through downtown and central Walla Walla. It would be upgraded for improved flood control and public safety. None of the Mill Creek Working Group's planned retrofits would be constructed, and no habitat upgrades would be implemented and no fish barriers removed unless necessary for improving channel hydraulics for flood conveyance. All improvements would be for maintaining (or increasing) channel capacity to ensure that it could carry the 100-year flood flows. Sections of the channel may be daylighted, or may have structural improvements made to strengthen the existing infrastructure and eliminate the potential for failure and collapse.
- **Segment 4.** This segment would remain an artificial conveyance with a wide sediment trap comprising channel-spanning sill/weirs upstream of the Roosevelt Street Bridge. The sediment trap section would be periodically cleaned out as sediment builds up from flooding events, but otherwise would remain as currently configured. Fish would be excluded from lower Mill Creek downstream of the Division Works Dam, and existing flood control infrastructure would be maintained or improved to address flood control concerns.

A fish screen, spanning the entire channel width, would be installed at the Division Works Dam to exclude fish movement to the lower segments of Mill Creek. Fish would be diverted to Yellowhawk Creek, which would be used as the primary fish migration channel. The Division Works fish screen



Example Hydrolox™ Traveling Water Screen.

would be designed to meet all fish screen regulations and guidelines for fish protection through the use of a polymer mesh with small screen openings (see figure above) that would convey water while completely excluding fish from moving downstream in lower Mill Creek. Although the intent would be to design the fish screen to meet all regulations and guidelines, it may have functional challenges dealing with debris, sediment accumulation, and high flows, while being able to screen fish of various sizes and species, without causing high fish mortality and increasing risks of flooding and safety. Therefore, further investigation of risks and functionality of this channel-spanning fish screen will be needed as part of any future feasibility studies.

Fish passage for upstream and downstream movement from Yellowhawk and Garrison creeks into Mill Creek at the Division Works Dam would be addressed through improvements to the existing fish ladder. The Mill Creek Channel, from the Division Works Dam up to the Bennington Diversion Dam, would be retrofitted to better support fish migration. A selected measure, such as a new fish ladder on the right bank or a swim-through channel on the right bank, would be implemented to provide fish passage at the Bennington Diversion Dam. The fish screen at Bennington Diversion Dam would also be improved to function properly at higher flows and to prevent fish stranding in Bennington Lake (see Section 2.8.5.1).

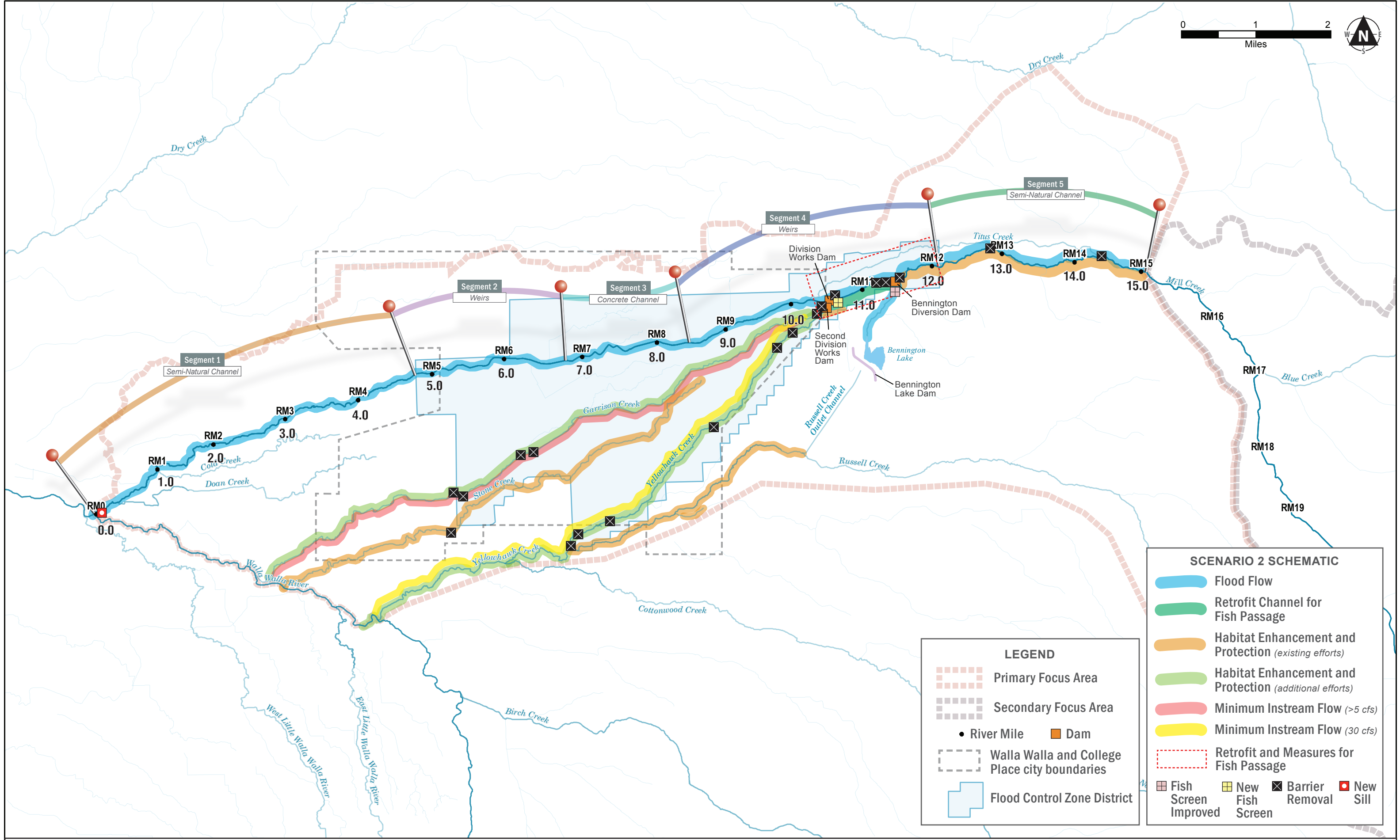
- **Segment 5.** This segment would remain in its current semi-natural channel configuration and would resolve all existing fish passage barriers. Based on landowner willingness, some restoration, enhancement, and protection projects could be implemented to improve conditions for fish passage and habitat, floodplain connectivity, and riparian characteristics.

- **Yellowhawk Creek.** The primary actions for fish passage and habitat would occur on Yellowhawk Creek, as fish would be excluded from entering lower Mill Creek and compelled to rely primarily on Yellowhawk Creek for migration. These primary actions would include specific fish passage improvement between the Second Division Works Dam and the Division Works Dam, as well as additional enhancement and protection projects along Yellowhawk Creek. Under this conceptual scenario, a minimum in-stream flow of 30 cfs (this flow component was selected to assist in evaluating the scenario) would be established for Yellowhawk Creek to support the channel as the primary fish migratory corridor. However, instream construction (including channel widening and deepening) and the expansion of riparian and floodplain areas along Yellowhawk Creek would be needed in some areas where development has encroached on the stream in order to provide minimal or optimal fish passage and habitat and to alleviate reported flooding issues when flows exceed 20 cfs (see Section 2.5.3 for more information). In-stream habitat, floodplain connectivity, and riparian planting projects, as well as protection or acquisition of lands adjacent to the channel beyond existing efforts, would be implemented to the extent that local property owners allow; this scenario assumes that voluntary compliance would be sufficient to ensure fish passage and habitat improvements are made throughout the creek. This scenario would include new interpretive signs where public access near an improvement project is possible. All fish passage barriers not already being addressed would be removed or otherwise treated (e.g., thermal barriers) to improve chances of successful fish migration.
- **Garrison Creek.** The secondary actions for fish passage and habitat would occur on Garrison Creek, as fish would be excluded from entering lower Mill Creek and be compelled to rely primarily on Yellowhawk Creek for migration, with Garrison Creek serving as a secondary migration channel. A minimum in-stream flow of greater than 5 cfs (this flow component was selected to assist in evaluating the scenario) in Garrison Creek would assist in providing conditions for upstream fish migration. However, Garrison Creek's current condition is an urbanized stream with multiple fish barriers and screened diversion and irrigation withdrawals, poor riparian and in-stream habitat, and floodplain connectivity issues. Therefore, before Garrison Creek can be utilized as a secondary migration channel, the stream would need to undergo extensive restoration including the completion of in-stream habitat, floodplain connectivity, and riparian planting projects, as well as protection or acquisition of lands adjacent to the channel beyond existing efforts. A specific issue includes the installation of a fish screen in 2008

upstream of the headgate of Garrison Creek at the Second Division Works to exclude salmonids (especially juvenile salmonid out migrants) from migrating down Garrison due to Garrison Creek's poor passage and habitat conditions that resulted in stranding and fish mortality at the Garrison/Yellowhawk division works (USACE 2016b, WWCCD 2009). Under this scenario, the fish screen would be removed and all fish passage barriers not already being addressed would be removed or otherwise treated (e.g., thermal barriers) to improve chances of successful fish migration in Garrison Creek. In addition, instream construction and expansion of riparian and floodplain areas may be required where development has encroached on Garrison Creek. This scenario would also include new interpretive signs where public access near an improvement project is possible.

- **Other Tributaries.** Additional enhancement and protection efforts would be implemented on Russell Creek and existing efforts would continue on Stone Creek under Scenario 2. As with Yellowhawk and Garrison creeks, instream construction and the expansion of riparian and floodplain areas where development has encroached on the creeks may be required. In addition, any fish passage barriers not already being addressed would be removed or otherwise treated (e.g., thermal barriers) to improve chances of successful fish migration.

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SCENARIO 2 SCHEMATIC

- Flood Flow
- Retrofit Channel for Fish Passage
- Habitat Enhancement and Protection (*existing efforts*)
- Habitat Enhancement and Protection (*additional efforts*)
- Minimum Instream Flow (>5 cfs)
- Minimum Instream Flow (30 cfs)
- Retrofit and Measures for Fish Passage

LEGEND

- Primary Focus Area
- Secondary Focus Area
- River Mile
- Dam
- Walla Walla and College Place city boundaries
- Flood Control Zone District
- Fish Screen Improved
- New Fish Screen
- Barrier Removal
- New Sill

Figure 5.3-2.
Scenario 2: Yellowhawk Creek Fish Diversion

5.3.1.3 Scenario 3: Naturalized Lower Mill Creek and New Flood Water Diversion and Storage

Scenario 3 identifies the concept of restoring habitat and resolving fish passage in lower Mill Creek by naturalizing the channel below the Bennington Diversion Dam. The naturalized channel would be viable by reducing lower Mill Creek's flood water conveyance capacity requirements through a range of storage and gradual return options prior to flows passing the Bennington Diversion Dam. Flows would also be controlled through the distributary channels and would include habitat improvements and resolution of fish passage barriers in the distributaries. This scenario was identified as a possible solution given the problems and opportunities identified in Section 3, constraints identified in Section 4, and desire to restore the mainstem of lower Mill Creek to meet the optimal Project metrics. Given that lower Mill Creek is highly constrained by adjacent land uses through the City of Walla Walla, and given the current reliance on the Mill Creek Channel to convey 3,500 cfs or more of flows during peak flood events, opportunities for a natural creek channel, complete fish passage, and habitat restoration are limited under these existing conditions. Land use controls will need to be implemented along lower Mill Creek such as adequate buffer widths and setbacks to provide space for a restored stream.

Reducing peak flows in the Mill Creek Channel below the Bennington Diversion Dam would provide more opportunity to implement habitat improvements in the channel without being constrained by flood conveyance requirements. A naturalized lower Mill Creek would also be a community asset for the City of Walla Walla. Potential actions to create a more naturalized channel would include the removal of the concrete armored channel bed, addition of in-channel habitat features, and introduction of native riparian vegetation. In addition, reduction of peak flows would facilitate in considering areas where the current channel ROW could be expanded outside of the existing levee system to provide increased community interactions and beautification of the waterfront along lower Mill Creek. These enhanced community interactions with lower Mill Creek would include both visual and physical access points to the stream, and could include actions such as the daylighting of the existing underground portions of the channel and integration of passive and active open spaces with the restored lower Mill Creek. Opportunities to educate the community about the natural processes, qualities, and characteristics of the historic and restored channel would occur through the reconnection of lower Mill Creek to the community. Furthermore, by reducing the peak flows running through the Mill Creek Channel there would be the potential to decrease the safety concerns associated with the creek. Under this scenario, lower Mill Creek would no longer be considered a safety

hazard and would instead serve as a community asset and have the potential to stimulate economic benefits to the downtown Walla Walla business community.

Under this proposed scenario, the reduction in peak flows would result from increased flood water diversion and storage upstream of the Bennington Diversion Dam. As a result of the reduced peak flows downstream of the Bennington Diversion Dam, Segments 2 through 4 would be restored to a naturalized channel and would operate between a minimum in-stream flow of 45 cfs (see Section 2.5.3) and peak flood flows no greater than 1,000 cfs (these flow components were selected to assist in evaluating the scenario), therefore establishing a range of flows capable of supporting multiple life stages for the focal fish species. Spawning, rearing, and migration habitat for the focal fish species would be improved by increasing habitat quantity and quality, improving habitat connectivity, and restoring processes that sustainably maintain a diversity of high-quality habitat. Floodplain connectivity would be increased to the extent possible to support the re-establishment of natural processes, while considering flood control and public safety needs. Figure 5.3-3 provides some visualizations created by Washington State University landscape architecture students envisioning what a naturalized channel could look like under Scenario 3.

The specific flow and capacity components used in this scenario were developed to evaluate the conceptual feasibility of this scenario, but do not serve as specific recommendations or guidelines. Furthermore, this scenario would require a more detailed design-level study to determine the possible flow ranges and flood management operations for a naturalized channel, the volume and locations of potential storage sites, and the capacity and water management implications of alluvial and deep aquifer recharge options. In addition, due to this scenario requiring more time for feasibility studies to be completed, it assumed that in the near-term fish passage and habitat restoration actions would continue to be planned and implemented based on how the proposed actions align with the long-term system-wide scenario of a naturalized lower Mill Creek (see Section 5.7.3, Short-Term Actions).

Figure 5.3-4 provides a schematic of Scenario 3, including the five potential flood water diversion and storage options identified and described in Table 5.3-1. As previously stated, the configuration of any flood water diversion and storage option would be based on detailed feasibility studies conducted as part of future planning efforts (see Section 5.7), and would include the consideration of both alluvial and deep aquifer recharge options. Although detailed feasibility studies would be necessary to develop robust engineering configurations for any of the storage options, key features listed in Table 5.3-1 were used to evaluate each option at a conceptual level. Under each storage option, water would be diverted into storage during peak

flows and cold water would be returned from the lower portion of the reservoir resulting in lower water temperature returns. However, possible thermal impacts from return water would need to be studied in greater detail during a more detailed analysis or feasibility study. In addition, further evaluation of potential adverse impacts to fish habitat, passage, and survival in Segment 5 due to the storage options and return flows will need to be completed. For Option 1, the enhancement of Bennington Lake storage capacity assumed that, due to physical site limitations, this option would have to be implemented in combination with a proposed new storage facility to manage the total anticipated flood flow volume.³ For Options 2 through 5, associated estimates for new storage capacity were based on an initial assumption that any of these options could have sufficient capacity as they include status quo storage at Bennington Lake to manage the highest anticipated flow volumes (derived from the 1996 events in the watershed).⁴

In addition to Options 2 through 5, the USACE previously investigated the design of a proposed Mill Creek-Blue Creek Reservoir located at the confluence of Blue Creek with Mill Creek (Mill Creek RM 17). This study was undertaken in 1962 to 1965 with the purpose of the proposed dam and reservoir to provide additional water supply and flood risk protection, as well as recreational benefits to the City of Walla Walla and its surrounding communities. Preliminary engineering drawings were provided by the USACE (see Figure 5.3-5 below). Although the location of this proposed Blue Creek reservoir is not in the same location as the proposed reservoir under Option 3, this preliminary design from USACE does show that additional flood control dams have been considered upstream from the Bennington Diversion Dam. Each of these components, or potential options, for flood storage are presented here

³ Increasing storage capacity of Bennington Lake will require excavation of material along the north and east shoreline of the lake. Along the north shore, next to the east bank of the diversion canal, the local topography offers an opportunity to maximize the amount of storage while minimizing the volume of total removed material. An estimated 1,700 acre-feet of additional storage, between elevations 1,210 and 1,250 MLS, can be gained by excavating 4.7 million cubic yards of material. Further storage volume can be obtained along the eastern shoreline, but at a less efficient material removal rate.

⁴ The February 1996 storm produced 26,225 acre-feet of total flow volume. Bennington Lake, assuming its full storage capacity is available, can retain 8,300 acre-feet. Allowing some of the flood flow to bypass through Segments 2 through 4 will help sediment transport through the Primary Focus Area, reduce the total required water storage volume, and reconnect floodplains. This bypass flow down the Mill Creek Channel will be a maximum of 1,000 cfs and the total bypassed volume will be 9,771 acre-feet. In order to limit the bypass flow to 1,000 cfs, 8,200 acre-feet of volume will have to be retained in a new storage reservoir upstream of the Bennington Diversion Dam.

solely as examples to demonstrate the various opportunities that have been and could be considered under this scenario.

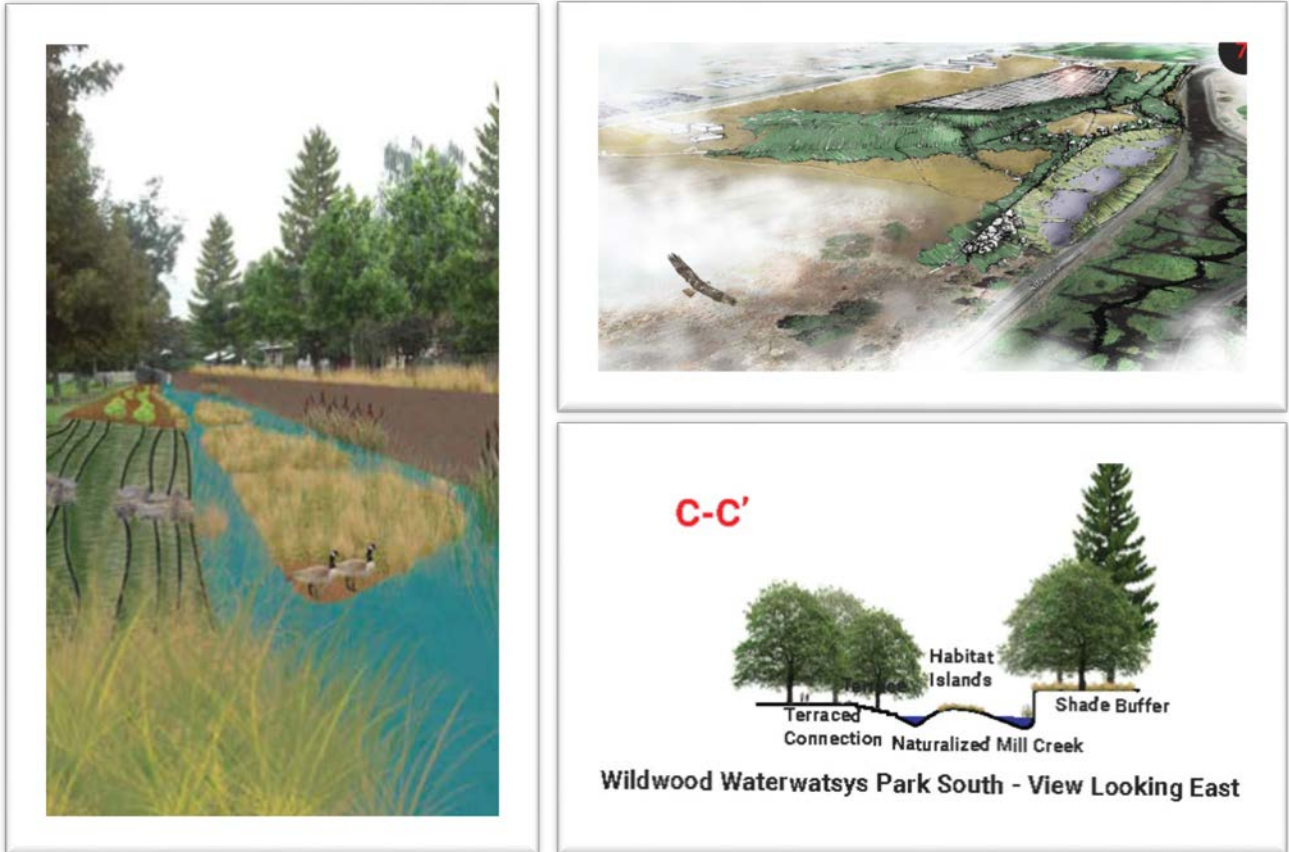


Figure 5.3-3. Possible Visualizations of a Restored Mill Creek (WSU 2016b)

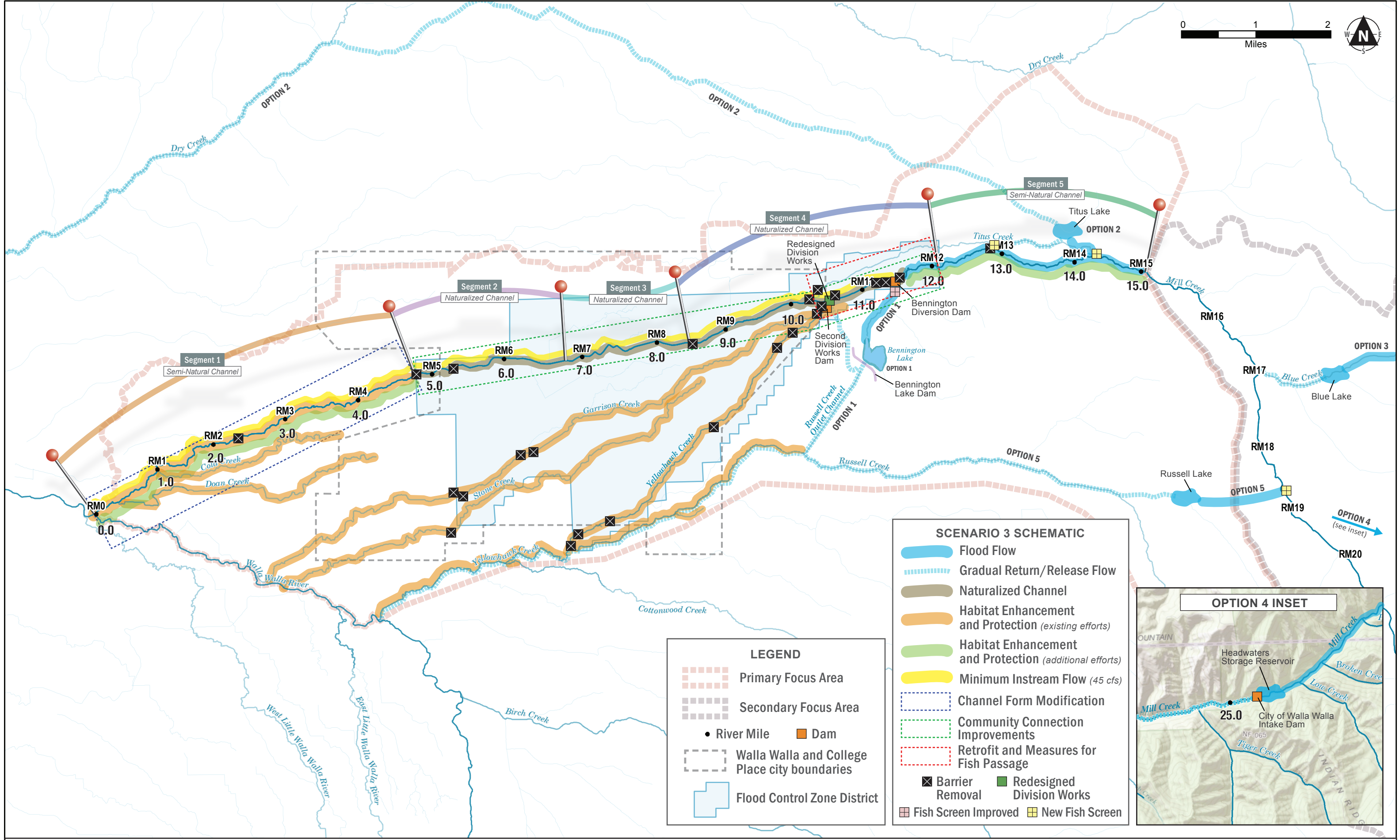


Figure 5.3-4.
Scenario 3: Naturalized Lower Mill Creek and Tributaries and Flood Water Storage

Table 5.3-1. Scenario 3 Flood Conveyance/Storage Options

Flood Conveyance/Storage Option ^{1/}	Key Features
Option 1 – Enhanced Bennington Lake	<ul style="list-style-type: none"> • Improve conveyance into Bennington Lake from Bennington Diversion Dam. • Increase storage capacity of Bennington Lake from 8,300 acre-feet to 10,000 acre-feet. • Improve controlled return flow to lower Mill Creek and outflow to Russell Creek. • Upgrade Bennington Diversion Dam fish screens.
Option 2 – Titus Lake and Dry Creek Release ^{2/}	<ul style="list-style-type: none"> • Construct new storage lake with 8,200 acre-feet of storage north of Titus Creek (called Titus Lake). • Controlled return flows to lower Mill Creek via Titus Creek • Alternate outflow of 100 cfs north to Dry Creek, eventually discharging into the Walla Walla River. • Continue status quo functions of Bennington Diversion Dam and Lake.
Option 3 – Blue Lake and Blue Creek Release	<ul style="list-style-type: none"> • Construct new storage reservoir with 8,200 acre-feet of storage on Blue Creek. • Controlled outflow to lower Mill Creek. • Continue status quo functions of Bennington Diversion Dam and Lake.
Option 4 – Headwater City Intake Reservoir	<ul style="list-style-type: none"> • Construct new storage reservoir with 8,200 acre-feet of storage on upper Mill Creek in the headwaters at the City of Walla Walla intake, replacing the existing dam with new infrastructure to accommodate greater storage capacity and maintain intake function. • Controlled return flows to Mill Creek. • Continue status quo functions of Bennington Diversion Dam and Lake.
Option 5 – Russell Creek Diversion and Russell Lake ^{3/}	<ul style="list-style-type: none"> • Construct gravity flow diversion tunnel into tributary of Russell Creek. • Construct reservoir with 8,200 acre-feet of storage on Russell Creek tributary. • Controlled outflow to Russell Creek, continuing downstream to Yellowhawk Creek and then the Walla Walla River • Continue status quo functions of Bennington Diversion Dam and Lake

1/ Estimates of storage capacity are based on addressing a total flow volume of 26,225 acre-feet from the 1996 flood, while allowing a maximum 1,000 cfs through lower Mill Creek below the Bennington Diversion Dam. Option 1 will have to be combined with some amount of new storage elsewhere to provide this level of flood control. Options 2 through 5 include the status quo storage amount at Bennington lake as well as new storage, allowing any of these options to meet the volume demand.

2/ Option 2 includes two possible release routes from the proposed "Titus Lake": 1) a short release route via Titus Creek back to Mill Creek, 2) a longer release route via open ag-land and drainage features that include open channel flow, some ponds and ditches that eventually release into Dry Creek. A desktop analysis concluded that conceptually at least 50-100 cfs can be released downstream via the open ag-land/Dry Creek route. This assumes no major changes in capacity and a grass lined channel with a manning's n of 0.045, with 10-foot bottom width, 4 to 1 side slopes, average velocity of 2.7 feet per second, 2.0 feet of flow depth and an average slope of 0.00450 ft/ft. For the Dry Creek channel to convey 1,000 and 2,000 cfs, it would require substantial improvements (i.e., a modern version of Mill Creek Channel) for erosion control and conveyance which is why the water storage option (i.e. "Titus Lake") is included in this option. To release any amount of water to either Dry Creek or Titus Creek would require a comprehensive understanding of capacity of these features and identification of what infrastructure improvements are required to safely convey the water.

3/ Option 5 will require an 8,500-foot-long, 16-foot-diameter diversion tunnel with an inlet invert at 1,780 feet mean sea level in upper Mill Creek and outlet invert at 1,760 MSL in a tributary of Russell Creek.

Lower Mill Creek Habitat and Passage Assessment and Strategic Action Plan

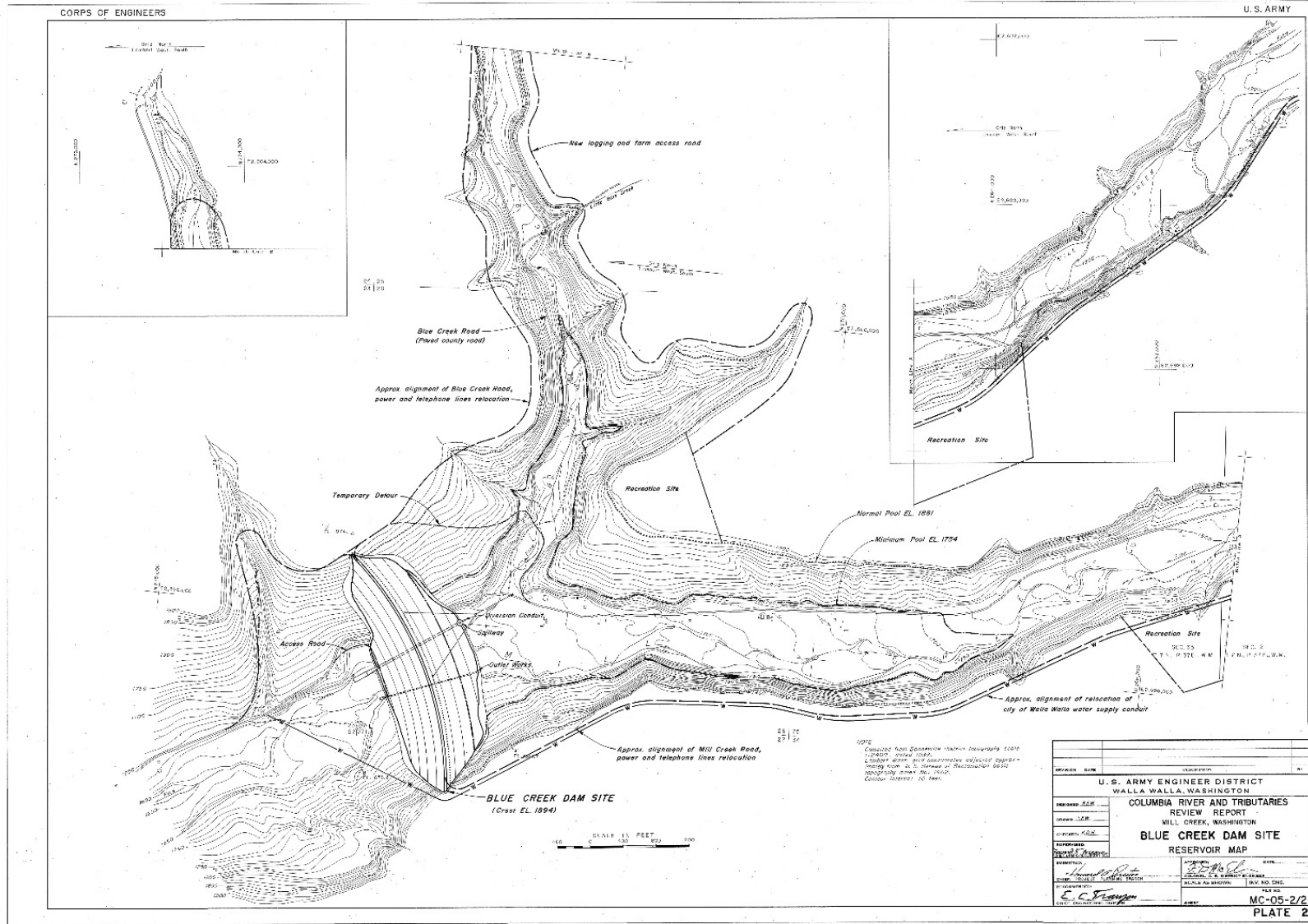


Figure 5.3-5. Blue Creek Reservoir Design (USACE 1963)

The general attributes of each channel segment under Scenario 3 are described below.

- **Segment 1.** This segment would require additional enhancement and protection projects because the flows in lower Mill Creek would be managed through upstream storage (i.e., no greater than 1,000 cfs) in comparison to the current range of controlled flows (i.e., no greater than 3,500 cfs). Enhancement and protection projects would be necessary because of the altered flow and sediment regime that would contribute towards changes in channel dimensions and patterns in Segment 1. The goal of these enhancement and protection projects would be to increase floodplain connectivity and accommodate the altered flow and sediment regime through modified channel dimensions and the addition of in-stream features. In addition, channel alterations would be made to improve conditions both for fish passage (including thermal barriers) and habitat. Overall habitat enhancement and protection actions, including riparian plantings, would be implemented beyond existing efforts. Under this scenario, it will be necessary to acquire land through easement agreements or acquisition with willing land owners to provide adequate opportunities for channel reconfiguration and floodplain connectivity.
- **Segment 2.** This segment would become a naturalized channel through the removal of the weirs, channel armoring, levees, and other flood control infrastructure. The channel would be reconfigured to have a more natural appearance and function and would be designed to accommodate a 45 cfs low-flow channel as well as floodplain inundation at 1,000 cfs (these flow components were selected to assist in evaluating the scenario). Due to the removal of the flood control features, there may be more channel movement through natural processes; however, it would still be constrained by the ROW corridor. Channel and floodplain configurations would promote floodplain connectivity and water storage. Barriers to fish migration would be removed and fish habitat improved. Riparian and within channel vegetation would be restored where local property owners allow such changes. Opportunities for increasing recreational and other community uses of the channel and floodplain would be realized where allowed by local property owners.
- **Segment 3.** This segment would also become a naturalized channel through the removal of the concrete channel. By removing the concrete channel, this naturalized form would be functionally connected to the hyporheic zone and alluvial aquifer. Similar to Segment 2, the channel would be reconfigured to have a more natural appearance and function and designed to accommodate a 45 cfs low-flow channel as

well as floodplain inundation at 1,000 cfs. Due to the removal of the flood control features, there may be more channel movement through natural processes; however, it would still be constrained by the ROW corridor. Channel and floodplain configurations would promote floodplain connectivity and water storage. Within the restrictions of available (or obtainable) properties, more natural channel function would be restored and, potentially, floodplains and wider riparian areas would be created. Opportunities for increasing recreational and other community uses of the channel and floodplain would be realized where allowed by local property owners. The restricted range of flows expected through this segment would make designing and implementing channel improvements less difficult than under the current flow regime.

- **Segment 4.** This segment would also become a naturalized channel through the removal of the weirs, channel armoring, levees, and other flood control infrastructure. Similar to Segments 2 and 3, the channel would be reconfigured to have a more natural appearance and function and designed to accommodate a 45 cfs low flow channel as well as floodplain inundation at 1,000 cfs. Due to the removal of the flood control features, there may be more channel movement through natural processes; however, it would still be constrained by the ROW corridor. Channel and floodplain configurations would promote floodplain connectivity and water storage. Within the restrictions of available (or obtainable) properties, more natural channel function would be restored and, potentially, floodplains and wider riparian areas would be created. Opportunities for increasing recreational and other community uses of the channel and floodplain would be realized where allowed by local property owners.

The Division Works Dam would be removed, the channel regraded, in-stream features added, and an in-stream diversion adequate for the existing water rights on Yellowhawk and Garrison creeks would be constructed.⁵ Upstream of the removed Division Works Dam, the channel would be naturalized through the removal of the weirs, channel armoring, levees, and other flood control infrastructure. Fish passage would be resolved at the Bennington Diversion Dam through a selected measure, such as a new fish ladder on the right bank or a swim-through channel on the right bank. Under Option 1 (see Table 5.3-1), the controlled return flow to lower Mill Creek and outflow to Russell Creek

⁵ According to Ecology's Water Rights Database, there are currently 233 existing water rights tied to Garrison and Yellowhawk creeks (Ecology 2011). However, the actual status of each water right is not clear as some may no longer be active. See Section 2.5.3.2 for more information about current water right withdrawals and diversions.

from Bennington Lake would be improved. Gradual return/release flows would be used to assist in meeting minimum instream flow of 45 cfs for lower Mill Creek and would provide conditions to release cooler water in the summer months, alleviating thermal barriers. The fish screens at Bennington Diversion Dam would also be improved to function properly at higher flows (see Section 2.8.5.1). In addition, because the Mill Creek Channel downstream of the Bennington Diversion Dam would be naturalized, sediment balance would be achieved either through transport or sediment augmentation based on the measure selected for fish passage at the dam.

- **Segment 5.** This segment would require additional enhancement and protection projects because the flows in lower Mill Creek would be managed through storage (i.e., no greater than 1,000 cfs) in comparison to the natural range of flows (i.e., 100-year flow of 7,050 cfs). Enhancement and protection projects would be necessary because of the altered sediment regime that would now contribute sediment downstream of the Bennington Diversion Dam. Any storage option selected (see Table 5.3-1) would be required to incorporate new fish screens. Under Option 2 (see Table 5.3-1), a controlled return flow to lower Mill Creek via Titus Creek would be constructed. Gradual return/release flows would be used to assist in meeting a minimum in-stream flow of 45 cfs for lower Mill Creek and would provide conditions to release cooler water in the summer months. The goal of these enhancement and protection projects would be to increase floodplain connectivity and accommodate the altered flow and sediment regime through modified channel dimensions and addition of instream features. Fish passage barriers in this segment would be addressed and overall habitat enhancement and protection actions, including riparian plantings, would be implemented beyond existing efforts.
- **Distributaries.** Current restoration, enhancement, and protection efforts on the distributary channel would continue under Scenario 3. In general, the distributaries would remain in their current channel configurations. Any fish passage barriers not already being addressed would be removed or otherwise treated (e.g., thermal barriers) to improve chances of successful fish migration. This would include fish passage improvements between the Second Division Works Dam and the Division Works Dam. The possible expansion of alluvial aquifer recharge or Managed Aquifer Recharge (MAR) sites is included in Section 3.3.3 as part of the storage options that may have benefits to base flow and temperatures in the distributaries, as delay between infiltration and discharge results in cool return flows that can provide temperature mediation as

well as supplement water volumes to the surface streams. Cooler temperatures and additional water volumes in the distributaries would help improve fish habitat and resolve passage and may potentially reduce the low flow diversions from Mill Creek into the distributaries to meet irrigation needs.

5.3.1.4 Scenario 4: Underground Flood Channel

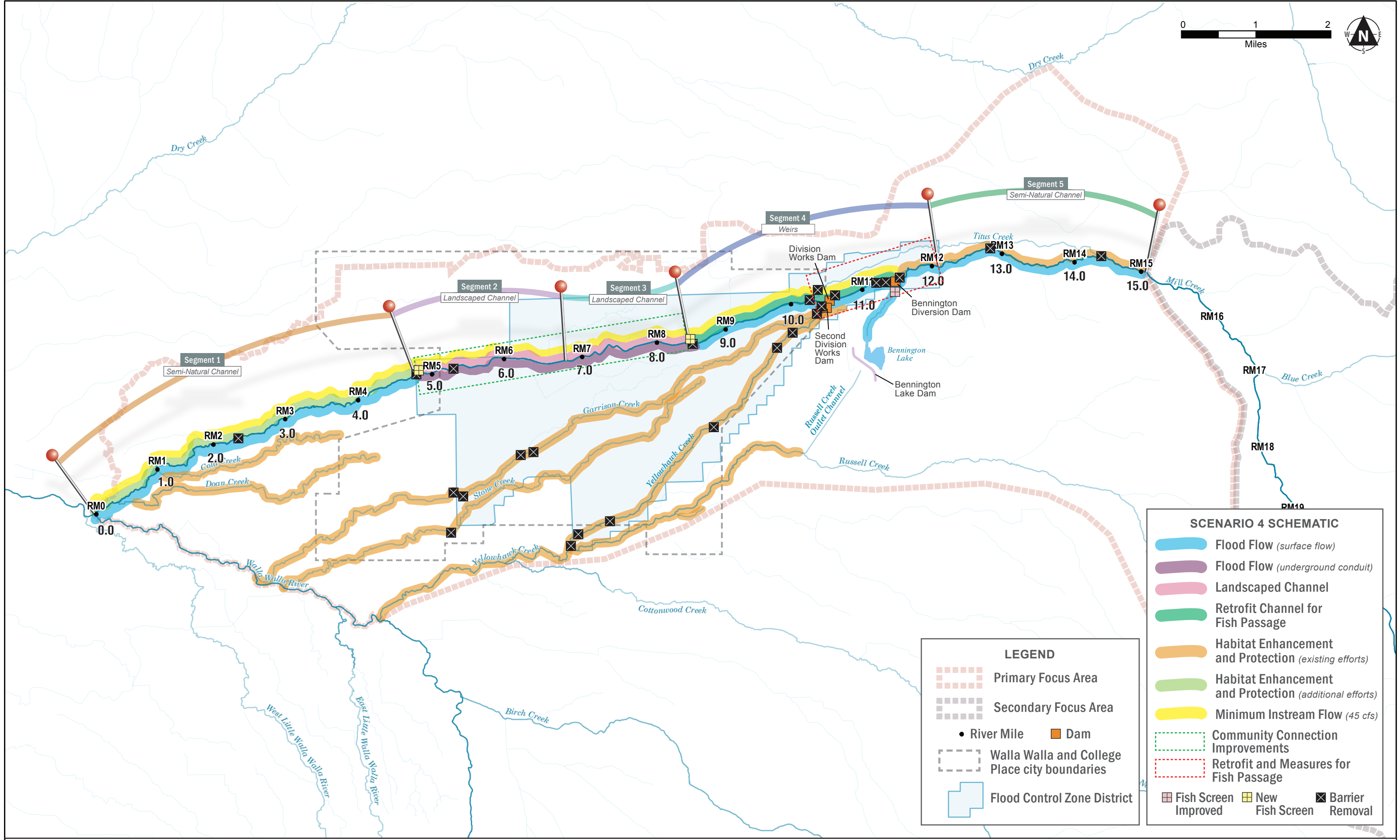
Scenario 4 identifies the stakeholder-suggested concept of creating an underground flood conveyance “conduit” to replace the capacity of the current Mill Creek Channel, allowing for the construction of a new “landscaped” channel on the surface (above the underground flood water tunnel) through the urbanized area. Scenario 4 would route all flood flows through the underground flood conveyance conduit, from which fish would be excluded, and would provide fish passage and improved habitat in the landscaped channel constructed on the surface. A minimum in-stream flow of 45 cfs (this flow component was selected to assist in evaluating the scenario) would be maintained downstream of the Bennington Diversion Dam to provide fish passage and to create fish habitat in the landscaped channel. The underground flood water conduit would be designed to accommodate a 100-year storm event. In Segment 1, additional habitat enhancement and protection projects would be completed to provide improved conditions for the focal fish species and to accommodate any potential downstream channel geometry changes resulting from flow surfacing out of the underground conduit. In Segments 2 and 3, the open landscaped channel would be sized to provide optimal fish passage and habitat characteristics associated with the minimum in-stream flow of 45 cfs. The specific components used in this scenario were developed to evaluate the conceptual feasibility of this scenario, but do not serve as specific recommendations or guidelines.

In addition, the landscaped channel would enhance community interaction and understanding of lower Mill Creek and its natural processes, qualities, and characteristics through the creation of visual and physical access points throughout these two segments. In a similar fashion as under Scenario 1, the channel in Segments 4 and 5 would be retrofitted for fish passage. Measures to provide fish passage at Bennington Diversion Dam would be implemented and existing habitat and protection efforts currently being conducted or planned along lower Mill Creek and its distributaries would be completed. Figure 5.3-6 provides a visualization created by Washington State University landscape architecture students of a possible underground flood conveyance conduit. Land use controls will need to be implemented in areas where channel improvements require access. For example, the ROW may need to be widened where fish passage structures or fish screens are installed. Figure 5.3-7 provides a schematic of Scenario 4.



Figure 5.3-6. Visualization of Underground Flood Conveyance Conduit (WSU 2016b)

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SCENARIO 4 SCHEMATIC

- Flood Flow (surface flow)
- Flood Flow (underground conduit)
- Landscaped Channel
- Retrofit Channel for Fish Passage
- Habitat Enhancement and Protection (existing efforts)
- Habitat Enhancement and Protection (additional efforts)
- Minimum Instream Flow (45 cfs)
- Community Connection Improvements
- Retrofit and Measures for Fish Passage

LEGEND

- Primary Focus Area
- Secondary Focus Area
- River Mile
- Dam
- Walla Walla and College Place city boundaries
- Flood Control Zone District
- Fish Screen Improved
- New Fish Screen
- Barrier Removal

Figure 5.3-7.
Scenario 4: Underground Flood Channel

The general attributes of each channel segment under Scenario 4 are described below.

- **Segment 1.** This segment would require additional enhancement and protection projects to improve conditions for the focal fish species and to accommodate any potential downstream channel geometry changes resulting from flow surfacing out of the underground conduit. Because the underground conduit would release flood waters directly into Segment 1, there would be the potential for localized changes in channel geometry that would require enhancement projects to address the resulting conditions. The goal of these enhancement and protection projects would be to increase floodplain connectivity and accommodate the altered flow and sediment regime/release of flood waters through modified channel dimensions and the addition of in-stream features. In addition, channel alterations would be made to improve conditions for fish passage (including thermal barriers) and habitat. Overall habitat enhancement and protection actions, including riparian plantings, would be implemented beyond existing efforts. Under this scenario, it will be necessary to acquire land through easement agreements or acquisition with willing land owners to provide adequate opportunities for channel reconfiguration and floodplain connectivity.
- **Segment 2.** This segment would incorporate an underground flood water conduit, which all flood flows would be routed through and fish species excluded from, with an overlying new landscaped channel (see Figure 5.3-8 for an example concept). The combined profile of the underground conduit and the aboveground landscaped channel would fit within the existing channel dimensions, although the channel may need to be excavated 1 to 4 feet deeper depending on the specific location within the existing channel. A new fish screen or sill would be required for the downstream end of Segment 2 to prevent fish from entering the underground flood water conduit and instead move upstream through the landscaped channel. Note that there would be the potential for false attraction of fish at the confluence of the underground flood water conduit and the landscaped channel. False attraction may delay fish in their migration, or may keep fish from finding access upstream and stray into another watershed. The landscaped channel would be sized to provide optimal fish passage and habitat characteristics associated with the minimum in-stream flow of 45 cfs and optimal flow of 100 cfs (these flow components were selected to assist in evaluating the scenario). The landscaped channel would be designed to provide naturally appearing aesthetics; however, it would provide limited improvement in floodplain connectivity or floodplain storage. Riparian vegetation would be incorporated where local property owners allow

such changes. Opportunities for increasing recreational and other community uses of the landscaped channel would be realized where allowed by local property owners.

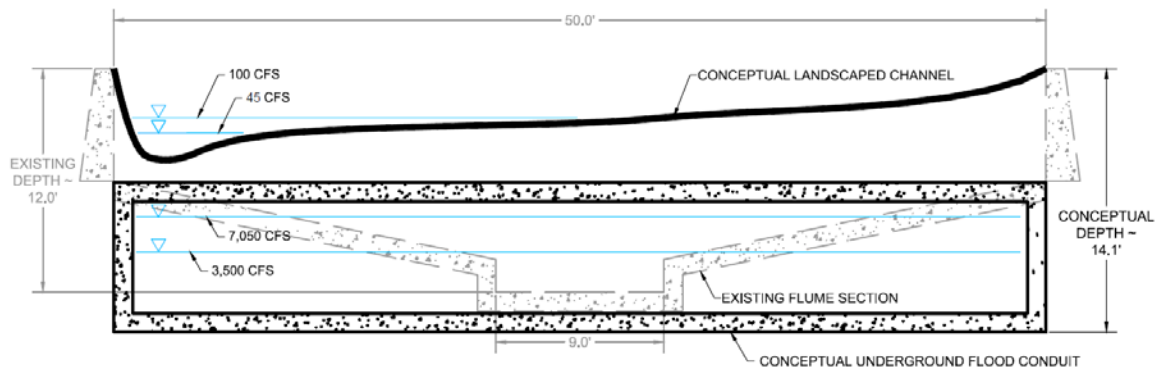


Figure 5.3-8. Scenario 4 Conceptual Channel and Flow Levels

- **Segment 3.** This segment would incorporate a flow diversion system (mechanical or passive) with an underground flood water conduit, which all flood flows would be routed through and fish species excluded from, with an overlying new landscaped channel (see Figure 5.3-8). The combined profile of the underground conduit and the aboveground landscaped channel would fit within the existing channel dimensions, although it may be necessary to excavate the channel 1 to 4 feet deeper depending on the specific location within the existing channel. As described for Segment 2, the landscaped channel would be sized to provide optimal fish passage and habitat characteristics associated with the minimum in-stream flow of 45 cfs and optimal flow of 100 cfs. The landscaped channel would be designed to provide naturally appearing aesthetics; however, it would provide limited improvement in floodplain connectivity or floodplain storage. A new fish screen would be installed at the upstream end of the underground flood water conduit to prevent fish from entering the conduit at any flow rate. The diversion system would govern the flow rate in the landscaped channel. During the low-flow months, no water would be diverted into the underground flood water conduit; instead, flow would be allowed to rise to the aboveground landscaped channel to meet the minimum in-stream flow of 45 cfs. Conversely, during high flows no more than 100 cfs would flow to the landscaped channel. The underground conduit would be designed to accommodate a 100-year storm event. Riparian vegetation would be incorporated where local property owners allow such changes. Opportunities for increasing recreational and other community uses of the landscaped channel would be realized where allowed by local property owners.

- **Segment 4.** This segment would remain an artificial conveyance that includes a wide sediment trap comprising channel-spanning sill/weirs, the Division Works Dam, and the Bennington Diversion Dam, with the forebay consisting of wetland and stream channel features above the Bennington Diversion Dam. Upstream of the underground flood water conduit, the Mill Creek Channel would be retrofitted, in part with a low-flow channel, to better support fish migration, and the sediment trap section would be periodically cleaned out as sediment builds up from flooding events. At the Division Works Dam, fish passage would be addressed through improvements to the existing fish ladder. A selected measure, such as a new fish ladder on the right bank or a swim-through channel on the right bank, would be implemented to provide fish passage at the Bennington Diversion Dam. The fish screens at Bennington Diversion Dam would also be improved to function properly at higher flows (see Section 2.8.5.1).
- **Segment 5.** This segment would remain in its current semi-natural channel configuration and would have all existing fish passage barriers removed. Based on landowner willingness, some restoration, enhancement, and protection projects would be implemented to improve conditions for fish passage and habitat, floodplain connectivity, and riparian characteristics.
- **Distributaries.** Current restoration, enhancement, and protection efforts on the distributary channel would continue under Scenario 4. In general, the distributaries would remain in their current channel configurations. Any fish passage barriers not already being addressed would be removed or otherwise treated (e.g., thermal barriers) to improve chances of successful fish migration. This would include fish passage improvements between the Second Division Works Dam and the Division Works Dam.

5.3.2 Scenario Evaluation

This subsection provides an evaluation and comparison of how each of the system-wide management scenarios described in Section 5.3.1 make measurable progress towards achieving the Project goal and objectives. This includes an evaluation of each scenario's achievement of the desired Project objectives based on the metrics (Table 1.2-1 in Assessment). Specific cost estimates associated with each scenario are not provided in this evaluation as the estimation of costs and timing of design and construction would be evaluated during future planning phases (see Section 5.7 for more information).

In order to evaluate the management scenarios, specific components (e.g., descriptive enhanced physical and ecological conditions, regulated flow amounts, storage volumes, and

infrastructure improvements) were assumed for each scenario. These components are not intended to serve as specific recommendations or guidelines, but rather as characteristics of the described scenario for evaluation purposes only.

The evaluations highlight that certain system-wide management scenarios make more progress toward achieving the Project goal and objectives than others. Under each management scenario, the evaluation shows if the Scenario has a low, moderate, or high potential at addressing the limiting factor/Project objective grouping (see Table 5.3-2). Although Table 5.3-2 provides this relative comparison, no management scenario is selected as the preferred scenario as additional scenarios, or variations on the four scenarios presented in 5.3.1, should be further evaluated through a USACE Feasibility Study (Section 5.5.1) or separately through other planning processes to select a preferred Project management scenario in cooperation with the Project stakeholders. Also, further evaluation of adverse impacts, public safety risks, and costs (as discussed in Section 5.3.3) should be conducted as part of further evaluation of scenarios.

The following comparisons were made from the evaluation of each scenario against the Project's limiting factors/Project objectives:

- *Scenario 1: Current Management Approach* received moderate to low potential at addressing each of the limiting factor/Project objective grouping due to the more limited scope of addressing fish habitat and aesthetics as compared to the other three scenarios. The Scenario does not completely address many of the Project metrics related to in-channel characteristics, sediment, river identity/open space and recreation/water quality, and education and culture/economic amenity.
- *Scenario 2: Yellowhawk Creek Diversion* received moderate to low potential at addressing each of the limiting factor/Project objective grouping due to its lack of addressing restoration in the mainstem of lower Mill Creek, but had slightly more “moderate” potential than Scenario 1 due to the strength of improvements in Yellowhawk Creek for fish passage, fish habitat, and riparian vegetation.
- *Scenario 3: Naturalized Lower Mill Creek and New Flood Water Diversion and Storage* and *Scenario 4: Underground Flood Channel* received moderate to high potential for each of the limiting factor/Project objective grouping due to the more extensive restoration of the mainstem of lower Mill Creek as compared to either Scenario 1 or 2; however, Scenario 3 had greater potential than Scenario 4 in four key limiting factor categories: in-channel characteristics, floodplain/riparian, water quality – temperature, and water quantity – flow. This is due to the scenario's proposed full channel restoration, removal of flood

control infrastructure below Bennington Diversion Dam, and promotion of natural form, function, and aesthetics to the greatest extent feasible.

The results of this evaluation of system-wide Scenarios 1 through 4 shows that Scenario 1 (Current Management Approach) and Scenario 2 (Yellowhawk Creek Fish Diversion) achieve low to moderate improvements for limiting factors, while Scenario 3 (Naturalized Mill Creek and New Flood Water Diversion and Storage) and Scenario 4 (Underground Flood Channel) demonstrate potential opportunities to meet the necessary ecological and community benefits, as well as address key stakeholder needs and concerns. Although Scenario 3 was evaluated as achieving the highest potential to address each of the limiting factor/Project objective grouping, specific approaches and/or alternative components developed during a feasibility analysis could come from any of the other scenarios or suggestions from stakeholders. For example, the lower peak flows in a naturalized mainstem channel that allow for more extensive restoration opportunities described in Scenario 3 could come from increased flood water storage capacity, alternative conveyance strategies, or a combination of both, providing a range of conceptual approaches that fully meet the Project objectives. In addition, some of the possible alternative components could have multiple functions such as the use of MAR to increase flood storage while benefiting fish habitat and passage through increased base flow and reduced temperatures in the distributaries and reduced low flow withdrawals in Mill Creek.

As stated earlier, the potential for adverse impacts, public safety risk, and comparison of costs would need to be evaluated for all of these scenarios or any scenario identified by stakeholders. See Section 5.3.3 for a discussion of these considerations.

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Table 5.3-2. System-Wide Management Scenario Evaluation

Limiting Factor ^{1/} (Project Objective)	Project Metrics ^{2/}	System-Wide Scenario Evaluation				Potential to Address Limiting Factors/Project Objectives		
		1	2	3	4	Low	Moderate	High
Passage/Entrainment ^{4/} (Objective 3)	Fish passage conditions; flows and barriers	Moderate	Moderate	High	High	All site-specific fish barriers are removed. Some site-specific thermal barriers are treated. Alterations made to flood control infrastructure to improve fish passage, but no increase in natural conditions. Lower Mill Creek continues to serve flood control function.	All site-specific fish barriers are removed. Some site-specific thermal barriers are treated. Minimum flows maintained year-round in primary fish pathway. Optimal flows maintained some of the time.	All site-specific barriers are removed and/or treated (thermal). Naturalized channel configuration restores natural fish movement patterns. Minimum flows maintained year-round in primary and secondary fish pathways. Optimal flows maintained most of the time. Fish passage maintained year-round for both upstream and downstream movement in primary and secondary fish pathways.
In-channel Characteristics ^{5/} (Objective 3)	Primary channel length; bankfull width; bankfull depth; bankfull cross-sectional area; bankfull width/depth ratio; wetted width; wetted depth; cross-sectional area; stream velocities; gradient; sinuosity; average meander pattern; braided-channel ratio; pool frequency or spacing; percent pool area; relative habitat abundance; relative feature abundance; relative abundance of spawning and rearing habitat; LWD counts; and LWD budget	Low	Moderate	High	Moderate	Limited channel alterations or habitat changes in lower Mill Creek or distributaries. Existing habitat enhancement and protection efforts continued. Overall, the stream channels remain similar to current conditions.	Channel modifications generally focused on improving flood conveyance and habitat conditions provide moderate improvements to in-channel characteristics. Natural processes restored in some locations. Some in-channel characteristics remain at less than optimal values.	Complete transformation to a naturalized channel improves in-channel characteristics to optimal values where possible. Most or all weirs, levees, and channel armoring removed and underground portions of lower Mill Creek daylighted. Channels reconfigured to restore natural geomorphic processes to the extent possible.
Floodplain/Riparian ^{6/} (Objective 4)	Secondary channel length; riparian vegetation; canopy cover; river complexity index; percent of floodplain disconnected; floodplain inundation; relative abundance of floodplain habitats; channel migration rate; flood control and public safety; current adjacent land use; land management areas; floodplain storage; and percent of bank with vegetation	Low	Low	High	Moderate	Limited improvement in the quantity and quality of available floodplain habitat. Existing riparian planting efforts improve conditions locally but overall riparian characteristics similar to the current condition.	Modified channels provide moderately increased floodplain connectivity and accessible floodplain habitat. Natural channel and floodplain processes restored in some locations, but constraints remain in other areas. Some additional riparian planting efforts. Overall floodplain and riparian metrics remain at less than optimal conditions.	Naturalized channel will be functionally connected to the hyporheic zone and alluvial aquifer to provide increased floodplain connectivity and restore natural channel and floodplain processes to the greatest extent possible. Accessible floodplain habitat quantity and quality substantially increased. Floodplain and riparian metrics achieve optimal values.
Sediment ^{7/} (Objective 3)	Substrate quality and quantity; sediment budget; and relative abundance of spawning habitat	Low	Low	Moderate	Moderate	Limited channel and flow alterations result in sediment characteristics remaining similar to current conditions.	Modified channels and hydrology provide some sediment sorting, and some increase in quality and quantity of spawning substrate. Natural sediment transport patterns and processes not fully restored. Optimal sediment metric values may not persist over time due to factors related to the lack of natural sediment transport processes (e.g., siltation) and remaining lateral channel constraints.	Naturalized channels and expanded lateral floodplain area provide effective sediment sorting and increase the quality and quantity of spawning substrate. Natural sediment transport patterns and processes restored; erosion and deposition volumes balanced. Sediment metrics achieve optimal values.

Table 5.3-2. System-Wide Management Scenario Evaluation (continued)

Limiting Factor ^{1/} (Project Objective)	Project Metrics ^{2/}	System-Wide Scenario Evaluation				Potential to Address Limiting Factors/Project Objectives		
		1	2	3	4	Low	Moderate	High
Water Quality – Temperature ^{8/} (Objectives 5 and 6)	Hydrology; temperature regime; focal fish species timing; focal fish species distribution; and floodplain storage	Moderate	Moderate	High	Moderate	Limited channel alterations or habitat changes in lower Mill Creek or distributaries resulting in water quality and temperature similar to current conditions. Continuing to implement existing habitat enhancement and protection efforts provides limited improvements to water quality and stream temperature.	Modified channels along lower Mill Creek or major distributaries provide some water quality and temperature improvements through increased mixing of cool groundwater and surface water. Riparian planting provides some stream shading reducing temperatures to a moderate degree. Optimal temperatures may not be maintained year round. Intermittent thermal barriers may persist.	Restoration of natural hydrologic and hydraulic processes provides highest water quality and temperature improvements in lower Mill Creek or major distributaries through greatest increase in cool groundwater surface water exchange. Riparian planting provides most stream shading and greatest reduction in temperatures. Optimal temperatures are maintained year round. Thermal barriers are addressed.
Water Quantity – Flow ^{9/} (Objectives 5 and 6)	Flows and Barriers, hydrology; floodplain storage	Moderate	Moderate	High	Moderate	Lower Mill Creek continues to serve flood control function and passes high flood flows. Minimum 45 cfs flows not maintained.	Lower Mill Creek flood flows routed through underground flood water conduit. Minimum 45 cfs flows maintained year-round in primary fish pathway, optimal 100 cfs flows maintained some of the time.	Alternate flood water conveyance and storage options divert flood flows from the most populated portions along lower Mill Creek. Range of flows in lower Mill Creek provide optimal fish passage and habitat characteristics. Minimum 45 cfs flows maintained year-round in primary fish pathway, optimal 100 cfs flows maintained most of the time.
River Identity/Open Space and Recreation/Water Quality/Education and Culture/Economic Amenity ^{10/} (Objective 7)	Visibility of Mill Creek Corridor; amount of open space throughout Mill Creek Corridor; connectivity of Mill Creek Corridor to system of open space and recreation; stormwater, streetscape, and landscape BMPs; water quality treatment; vegetation along bank and adjacent open space; access to Mill Creek Corridor; educational features; visibility of Mill Creek Corridor; development orientation to Mill Creek Corridor; value of watershed; and fishery benefits to individuals and the region	Low	Moderate	High	High	Social and economic amenities along lower Mill Creek remain largely unrealized similar to current conditions. Limited benefits occur related to fish passage improvements and continuing to implement planned habitat enhancement and protection efforts.	Social and economic amenities along lower Mill Creek and/or major distributaries moderately improved by more natural aesthetics and allowing for increased recreational/community use opportunities. Some new economic benefits realized due to additional habitat enhancement and protection efforts and resulting increase in fisheries/watershed value.	Social and economic amenities along lower Mill Creek and/or major distributaries are substantially improved by most natural aesthetics, daylighting of Mill Creek Channel, and most recreational, educational, community, and open space opportunities. Highest economic benefits due to additional habitat enhancement and protection efforts and resulting increase in fisheries/watershed value.
Key Stakeholder Engagement/Regulatory Pathway/Funding Pathway ^{11/} (Objective 8)	Opportunities for involvement; identify regulatory sideboards and constraints; identify regulatory pathways and opportunities; and funding opportunities for implementation	Moderate	Moderate	High	High	Opportunities for stakeholder engagement and pursuing Project regulatory/funding pathways are limited.	Opportunities for stakeholder engagement and pursuing Project regulatory/funding pathways are moderate.	Opportunities for stakeholder engagement and pursuing Project regulatory/funding pathways are high.

5.3.3 Scenario Considerations

In addition to assessing each scenario for its ability to achieve the Project's goal and objectives, the feasibility and potential risks involved with each scenario must also be considered. At a minimum, the feasibility and potential risks that must be considered include flood protection, ROW availability, fish exclusion structures, water quantity, and physical system characteristics (see Section 4 for a discussion of possible constraints for restoring lower Mill Creek). This section provides an assessment for each of these feasibility and potential risk considerations. As stated earlier, costs associated with each scenario were not investigated in this SAP, but must be evaluated during future planning phases (see Sections 5.6 and 5.7 for more information). Additional studies and investigations needed to further evaluate feasibility and risks are identified in Section 5.6

5.3.3.1 Flood Protection

In terms of flood protection, all of the system-wide management scenarios would satisfy existing requirements for controlling flood-flow volumes and would keep flood risks within established or required limits. Of greatest importance to flood control design is the peak flow rate within the channel for different return periods. These rates have been established for Mill Creek from a robust set of historical flow records (see Section 2.5.3). The records provide a good understanding of expected peak flow rates for the near future; however, given recent research into altered hydrologic conditions and estimated changes under future climate change scenarios (see Section 2.1), the expected flow rates are likely to change over time.

Scenario 1

Scenario 1 does not include specific considerations for climate change. Therefore, there is a risk for flood control failure under flows higher than what is currently accommodated for in the MCFCP. Scenario 1 would need to be further studied and modeled using hydrology that is adjusted for climate change considerations.

Scenario 2

Scenario 2 does not include specific considerations for climate change. Therefore, there is a risk for flood control failure under flows higher than what is currently accommodated for in the MCFCP. Scenario 2 would need to be further studied and modeled using hydrology that is adjusted for climate change considerations.

The installation of the channel-spanning fish screen at Division Works Dam may have functional challenges dealing with debris and sediment accumulation on the fish screen which

could decrease the rate flood waters can enter the Mill Creek flood conveyance channel and increase risk for flooding and safety in the City of Walla Walla. In addition, there may be risk for localized flooding along Yellowhawk and Garrison creeks due to increased flows.

Scenario 3

Scenario 3 proposes a flood control system that could provide additional storage capacity compared to what is currently provided. Scenario 3 may be more resilient to climate change than Scenarios 1 and 2; however, this scenario would also need to be further studied and modeled using hydrology that is adjusted for climate change considerations. In addition, this scenario, like all scenarios, would have to be evaluated for public acceptance and support as it proposes additional flood water storage uphill of the City of Walla Walla.

Scenario 4

Scenario 4 proposes a flood control system that could provide additional conveyance capacity compared to what is currently provided. Scenario 4 may be more resilient to climate change than Scenarios 1 and 2; however, this scenario would also need to be further studied and modeled by using hydrology that is adjusted for climate change considerations.

The installation of the channel-spanning fish screen at the upstream end of the underground flood conveyance channel may have functional challenges dealing with debris and sediment accumulation on the fish screen which could decrease the rate flood waters can enter the underground flood conveyance channel and increase risk for flooding and safety in the City of Walla Walla.

5.3.3.2 ROW

For all four scenarios obtaining 100 percent landownership and therefore control over all properties along the existing channel is not expected to be possible nor would it be required to successfully implement any of the scenarios. Implementation of any of the four management scenarios will require landowner collaboration and permission for access to the channel in Segments 2 through 4. All four scenarios would have challenges with access to Segments 2 and 3 for implementation of modifications to the flood control channel. Scenarios 2, 3, and 4 would require acquisition of property and ROW to maximize floodplain restoration with levee setbacks and to construct a greater bankfull channel and/or natural channel. Scenario 1 would have challenges with access to Segments 2 and 3 for implementation of modifications to the flood control channel. The difficulty in obtaining additional ROW would depend on the specific location of improvements and the extent of ROW needed.

A number of surface and underground channel features are covered by existing infrastructure (e.g., bridges, buildings, roads) that could require relocation, reconfiguration, or even removal to accommodate specific components of any of these scenarios. Section 2.4.6 of the Assessment describes the existing transportation infrastructure which includes 27 bridge crossings over Mill Creek within the Primary Focus Area, including 23 roads, two public footbridges, one private footbridge, and one railway crossing. At this conceptual level planning stage of system-wide management scenarios, an inventory and identification of all infrastructure features that could require change under a given scenario was not completed. During the proposed USACE Feasibility Study or other technical planning/design vehicle or authority, these constraints will need to be further evaluated based on any given management scenario or segment level alternative(s). Each scenario evaluated in this subsection is expected to be implementable within the existing infrastructure constraints or through modification to or removal of existing infrastructure; therefore, existing infrastructure is not expected to make any of the scenarios infeasible.

Scenario 1

Scenario 1 would continue to have similar ROW requirements as the existing channel; however, based on the inspection recently completed of the city-owned non-bridge structures that cross over the channel in the downtown area (Olson 2016), 3 of the 11 structures inspected were rated in poor condition (see Section 2.4.6). At a minimum, Scenario 1 will need to either remove or rebuild the three structures rated as poor condition. Also, access to Segment 2 for the purposes of making improvements to the flood control channel would be a challenge because it is constrained by adjacent properties. In general, ROW concerns would be less of an issue for Scenario 1 than Scenario 2 because the majority of planned improvements will occur within the existing ROW.

Scenario 2

Scenario 2 may require a widened ROW along Yellowhawk and Garrison Creeks in order to accommodate increased flows and habitat restoration sites. Obtaining adequate ROW control to implement the proposed changes for Scenario 2 would be challenging, but workable. Also the design and dimensions of the proposed fish sill and fish screen would need to be further investigated to understand whether they could be accommodated within the current ROW. As Scenario 2 relies on the existing Mill Creek Channel to convey flood waters, Scenario 2 would also need to either remove or rebuild the three structures rated as poor condition in the City of

Walla Walla non-bridge structure inventory (Olson 2016) as these aging structures are at risk for failure during a flood event.

Scenario 3

Scenarios 3 could remain within the existing ROW in Segments 1, 2, 3, and 4; however, this is contingent on the flood-flow volumes identified during subsequent feasibility studies. Segment 5 would require additional ROW for areas where more flood water storage would be constructed.

Scenario 4

Scenario 4 could remain within the existing ROW; however, this is contingent on the flood-flow volumes identified during subsequent feasibility studies. Also the design and dimensions of the proposed fish screens would need to be further investigated to understand whether these fish screens could be accommodated within the current ROW. If the alternative flood control channel or buried flood water conveyance pipe north of Yellowhawk Creek was evaluated (see Section 5.4, Table 5.4-2), consideration for an identified new ROW would be necessary.

5.3.3.3 Fish Exclusion Structure

Fish exclusion structures would be necessary under all four scenarios (i.e., fish screens at Bennington Diversion Dam); however, the ones required under Scenarios 2 and 4 will require further investigation as they will be more difficult to design, construct, and operate. According to discussions with the fish screen manufacturer Hydrolox™, fish exclusion structures for Scenarios 2 and 4 would be feasible; however, the cost of the design, manufacturing, and installation would likely be high and could potentially make these two scenarios cost-prohibitive to construct. The size of the fish screens and whether or not they could be accommodated within the current ROW would also need to be further evaluated. The fish screens required under all four scenarios at Bennington Diversion Dam would be an improvement over the existing fish screen intended to prevent fish stranding in Bennington Lake.

Scenario 1

In 2001, fish screens were installed at the intake on the Bennington diversion structure to prevent trapping fish in Bennington Lake (USACE 2016b). Scenario 1 assumes the fish screen will be upgraded to prevent fish from entering Bennington Lake during flood events or during USACE managed water diversions from Mill Creek to Bennington Lake. This scenario further assumes that the work completed under the USACE Section 1135 program will be leveraged to

accomplish these necessary improvements. Also, Scenario 1 assumes the Bennington Diversion Dam will be modified to meet WDFW or NMFS fish passage criteria (NMFS 2011).

Scenario 2

Under Scenario 2, a fish exclusion structure would be installed at the Division Works Dam that would prevent fish (as small as fry) from migrating down lower Mill Creek and instead diverting them into Yellowhawk Creek while accommodating flood flows under a 100-year event. As previously noted in Section 5.3.1, the installation of this channel-spanning fish screen at the Division Works Dam may have functional challenges dealing with debris, sediment accumulation, and high flows, while being able to screen fish of various sizes and species, without causing high mortality for fish and increasing risks for flooding and safety. Additional investigation regarding risks and functionality of this proposed channel-spanning screen will be needed.

In addition, the installation of a channel-spanning fish exclusion sill at or near the mouth of Mill Creek could result in mortality of fish due to false attraction and delay in fish migration or fish straying into other drainages. To mitigate for this, stakeholders suggested a trap and haul program that would reduce the risk of fish mortality from false attraction at the exclusion sill.

Scenario 3

Under Scenario 3, the fish screens at Bennington Diversion Dam would be improved to function properly at higher flows (see Section 2.8.5.1). New fish screens would need to be installed at the intake point for any storage option selected under Scenario 3 (see Table 5.3-1 for storage options).

Scenario 4

Under Scenario 4, a fish exclusion structure would be installed at the start of the underground flood conveyance channel. This structure would also need to prevent fish (as small as fry) from migrating down the underground flood conveyance channel (and instead diverting them to the aboveground landscaped channel) while accommodating flood flows under a 100-year event. The installation of this channel-spanning fish screen at the start of the underground flood conveyance channel may have functional challenges dealing with debris, sediment accumulation, and high flows, while being able to screen fish of various sizes and species, without causing high mortality for fish and increasing risks for flooding and safety. Additional investigation regarding risks and functionality of this proposed channel-spanning screen will be needed.

5.3.3.4 Water Quantity

All four scenarios recommend a minimum flow be maintained in the lower Mill Creek system (either in mainstem or distributaries depending on the scenario) in order to meet minimal fish passage and habitat metrics. However, consideration of thermal impacts must be evaluated when adding flows to the existing channel configuration as increased flows could result in higher temperatures in certain areas where there are currently cold water inputs. Addressing limited low flow water quantity and severe thermal problems is critical for all scenarios to be successful. Existing and future conditions temperature modeling will need to be performed along lower Mill Creek and its primary distributaries under any management scenario to understand where stream temperatures are most problematic, where stormwater influences water temperature, and how cold water inputs at specific points along the channel influence temperature. Based on this information, alternatives flow regimes and channel configurations should be modeled and evaluated for the most successful scenario for reducing high temperatures during the summer months.

5.3.3.5 Physical System Characteristics

One of the physical system characteristics to consider is stream gradient. As noted in Section 4.2, the measured gradients of Mill and Yellowhawk creeks in the Primary Focus Area range from 0.7 percent to 1.4 percent. These gradients would allow for some localized adjustment for the naturalized channel features proposed under Scenarios 3 and 4, as well as the inlet and outlet for the underground flood conveyance in Scenario 4. Therefore, gradient issues should not make any of these scenarios infeasible.

Scenario 1

Ongoing operations continue to block sediment and debris from Lower Mill Creek which has hydraulic and geomorphic impacts on Mill Creek and the mainstem Walla Walla by altering channel dimensions and habitat complexity.

Scenario 2

The installation of the channel-spanning fish screen at the Division Works Dam may have functional challenges dealing with debris, sediment accumulation, and high flows that could result in catastrophic failure of the fish screen and increased risk for flooding and safety in the City of Walla Walla and along Yellowhawk Creek. Additionally, the blocking of sediment and debris may have hydraulic and geomorphic impacts on Mill Creek and/or its main distributaries (Yellowhawk and Garrison creeks) by altering channel dimensions and sediment transport. Furthermore, as fish will be diverted up and down Yellowhawk and Garrison Creeks

(rather than lower Mill Creek), these creeks will need to be assessed for increased flow capacity and habitat restoration sites and whether these changes would cause impacts to neighboring properties.

Scenario 3

Due to the proposed water storage options and channel reconfigurations in Scenario 3, there may be impacts to Segment 5 or upper Mill Creek and/or its tributaries such as altered hydrologic (e.g., decreased flows), geomorphic (e.g., altered sediment transport), and aquatic habitat (e.g., decreased pools) characteristics. This scenario should be further evaluated for any potential adverse impacts at proposed diversion or storage areas, as well as at new discharge areas. Potential adverse impacts to Segment 5 from proposed screening and diversions should also be evaluated.

Scenario 4

Under Scenario 4, the conceptual landscaped channel located above the underground flood conduit could potentially be at risk for sediment scour that could degrade the landscaped habitat over time. This could lead to a high level of maintenance activity and costs. If this scenario were to be further investigated through a proposed feasibility study, this scenario should analyze flows greater than 100 cfs (e.g., up to 200 cfs) to ensure sediment scour and channel-forming flows while maintaining maintenance access in the naturalized channel.

5.3.4 Scenario Pros and Cons

As discussed in Sections 5.3.2 and 5.3.3, if any of the four scenarios presented in Section 5.3.1 are further studied, the costs for construction and operation and maintenance (O&M) would need to be evaluated. In addition, any selected scenario, or components of scenarios, would have to be evaluated for public acceptance and support and overall feasibility through public outreach. As a starting point to these potential future evaluations, Table 5.3-3 provides a summary of the pros and cons associated with each of the scenarios described and evaluated in Section 5.3.

Table 5.3-3. System-wide Scenario Pros and Cons

Scenario	Pro	Con
Scenario 1: Current Management Approach	<ul style="list-style-type: none"> • Costs would likely be less than other scenarios due to utilizing existing flood control infrastructure and no new revisions to the ROW. • Some potential for improvements and changes to aging flood control infrastructure and existing public/private infrastructure such as bridges, buildings, and roads that are within the existing ROW that would benefit the City of Walla Walla. • Similar ROW requirements as the existing channel, thus lowering impacts to adjacent properties and costs for acquiring additional ROW. • Achieves optimal conditions for upstream fish passage and some minimum conditions for in-channel characteristics, river identity/open space and recreation/water quality, education and culture/economic amenity. • Existing modeling, designing, permitting, and constructing process and experience in place, as well as examples to demonstrate to the public. • Segment-level actions would be completed in incremental steps instead of through a longer-term process requiring detailed planning within the ROW. 	<ul style="list-style-type: none"> • Improvements to aging flood control infrastructure and existing public/private infrastructure such as bridges, buildings, and roads that are within the existing ROW would have the potential to result in similar characteristics as what is currently present in the City of Walla Walla. • Costs associated with obtaining water rights to maintain minimum instream flow of 45 cfs. • Risk for flood control failure under flows higher than what is currently accommodated for in the MCFCP. • Would not achieve optimal conditions for in-channel characteristics, sediment, river identity/open space and recreation/water quality, education and culture/economic amenity. • Continued investment of funds focused on fish passage and flood control infrastructure over time limits stakeholders' ability to accomplish longer-term actions that support accomplishing Project goal and objectives. • Limited community connection to Mill Creek.

Table 5.3-3. System-wide Scenario Pros and Cons (cont.)

Scenario	Pro	Con
<p>Scenario 2: Yellowhawk Creek Fish Diversion</p>	<ul style="list-style-type: none"> • Improvements and some potential changes to aging flood control infrastructure and existing public/private infrastructure such as bridges, buildings, and roads that are within the existing ROW that would benefit the City of Walla Walla. • Dedicated corridor focused on fish passage, fish habitat, and riparian vegetation. • Achieves some optimal improvements in Yellowhawk Creek for fish passage, fish habitat, and riparian vegetation. • Little to no fish related concerns in downtown Walla Walla. • No ROW acquisitions required in downtown Walla Walla. 	<ul style="list-style-type: none"> • Costs would need to include acquisition of additional ROW along Yellowhawk and Garrison creeks in order to accommodate increased flows and habitat restoration and enhancement locations. • Costs would need to include implementation of fish passage improvements on Garrison and Yellowhawk creeks. • Costs associated with obtaining water rights and ensuring the flows are maintained at a minimum instream flow of 30 cfs in Yellowhawk and 5 cfs in Garrison creeks. • Costs associated channel spanning fish screen at Division Works Dam. • Risk for flood control failure under flows higher than what is currently accommodated for in the MCFCP. • Risk for localized flooding along Yellowhawk and Garrison creeks due to increased flows. • Functional challenges of maintenance by the County. • Functional challenges associated with channel spanning fish screen at Division Works Dam at dealing with debris, sediment accumulation, and high flows, while being able to screen fish of various sizes and species, without causing high mortality for fish and increasing risks for flooding and safety. • Functional challenges associated with fish mortality, false attraction, and delay in fish migration at channel-spanning fish exclusion sill at or near the mouth of Mill Creek. • Would not achieve optimal conditions for in-channel characteristics, sediment, river identity/open space and recreation/water quality, education and culture/economic amenity. • Lack of community connection to Mill Creek. • Lack or community or residential support for changes in ROW along Yellowhawk and Garrison creeks.

Table 5.3-3. System-wide Scenario Pros and Cons (cont.)

Scenario	Pro	Con
<p>Scenario 3: Naturalized Lower Mill Creek and Tributaries and Flood Water Storage</p>	<ul style="list-style-type: none"> • Improvements and changes to aging flood control infrastructure and existing public/private infrastructure such as bridges, buildings, and roads that are within the existing ROW that would benefit the City of Walla Walla. • Reduced flood control failure risk in the MFCFP. • Similar ROW requirements as the existing channel, thus lowering impacts to adjacent properties and costs for acquiring additional ROW. • Additional storage capacity that would potentially assist in resiliency to climate change. • Potential to provide cold water releases during summer months from flood water storage sites. • Potential recreational opportunities associated with mainstem channel in Segments 2 through 4 and storage options in Segments 4 and 5. • Extensive restoration of the mainstem of lower Mill Creek including full channel restoration, removal of flood control infrastructure below Bennington Diversion Dam, and promotion of natural form, function, and aesthetics to the greatest extent feasible. • Achieves optimal conditions for fish passage, in-channel characteristics, sediment, river identity/open space and recreation/water quality, education and culture/economic amenity. 	<ul style="list-style-type: none"> • Costs associated with constructing new flood water storage facilities in Segments 4 and 5 and constructing the newly naturalized stream channel in Segments 2 through 4. • Costs associated with channel restoration and enhancement in Segments 1 and 5 due to altered hydrologic and geomorphic processes from flood water storage. • Costs associated with obtaining water rights to maintain minimum instream flow of 45 cfs. • Costs associated with operation and maintenance. • Functional challenges of maintenance by the County. • Impacts to hydrologic, geomorphic, and aquatic habitat conditions in Segment 5 due to water storage options. • Public risk and potential adverse impacts to environment from implementing additional flood storage infrastructure.

Table 5.3-3. System-wide Scenario Pros and Cons (cont.)

Scenario	Pro	Con
<p>Scenario 4: Underground Flood Channel</p>	<ul style="list-style-type: none"> • Improvements and changes to aging flood control infrastructure and existing public/private infrastructure such as bridges, buildings, and roads that are within the existing ROW that would benefit the City of Walla Walla. • Similar ROW requirements as the existing channel, thus lowering impacts to adjacent properties and costs for acquiring additional ROW. • Potential for additional flood conveyance capacity compared to what is currently provided and therefore, has the potential to be more resilient to climate change. • Potential recreational opportunities associated with mainstem channel in Segments 2 through 4. • Extensive restoration of the mainstem of lower Mill Creek including partial channel restoration and promotion of natural aesthetics to the greatest extent feasible. • Achieves some optimal conditions for fish passage, in-channel characteristics, sediment, river identity/open space and recreation/water quality, education and culture/economic amenity. 	<ul style="list-style-type: none"> • Costs associated with constructing new flood conveyance conduit in Segments 2 and 3, constructing the newly landscaped channel in Segments 2 and 3, and improving the channel in Segment 4. • Costs associated with operation and maintenance of both the underground flood conveyance conduit and the landscaped channel. • Costs associated with obtaining water rights to maintain minimum instream flow of 45 cfs. • Costs associated channel spanning fish screen and fish barrier. • Functional challenges of maintenance by the County. • Functional challenges, flood and fish survival risks, and costs associated with channel spanning fish screen at dealing with debris, sediment accumulation, and high flows, while being able to screen fish of various sizes and species, without causing high mortality for fish and increasing risks for flooding and safety. • Functional challenges associated with fish mortality, false attraction, and delay in fish migration at channel-spanning fish exclusion sill at or near the outlet of the flood conveyance conduit. • Would not completely achieve optimal conditions for in-channel characteristics, sediment, river identity/open space and recreation/water quality, education and culture/economic amenity. • Lack of hydrologic connectivity between the Mill Creek landscaped channel and ground water.

5.4 ALTERNATIVE MANAGEMENT SCENARIOS IDENTIFIED BY STAKEHOLDERS

This section describes alternative management scenarios as well as potential segment-level concept alternatives and possible implementation tools suggested by stakeholders during their review of the draft management scenarios. Meetings were held with the TAC jointly with the Mill Creek Working Group on November 11, 2016, and March 20, 2017. Written comments were provided by stakeholders on the draft management scenarios in the months following these meetings. Tables 5.4-1 and 5.4-2 lists the stakeholder suggestions provided in their comments/feedback on the Assessment and Draft SAP and compare them to the management scenarios identified in Section 5.3. The stakeholder suggested management scenarios and segment-level concept alternatives are a combination of standalone “new scenarios” or variations on the existing management scenarios described in Section 5.3 where suggested changes could modify specific sections of a given scenario or combines elements from a number of scenarios to results in a new hybrid scenario. Also, stakeholders suggested that within a given system-wide management scenario, short-term and long-term approaches can be applied in specific segments and these approaches may be different. For example, in segment 1, flood plain expansion projects should be implemented at sites where land owners are willing in the short-term, while more extensive naturalization of the channel can be achieved over the longer term once flood management strategies under Scenarios 2 or 4 are implemented. However, consideration should be made regarding the implementation of short-term strategies that could potentially conflict or prevent the implementation of longer-term, system-wide management scenarios.

Table 5.4-1. Stakeholder-Suggested Management Scenarios

Suggested Scenario	Comparison to Scenarios Identified Under Section 5.3	Evaluation of Scenario
<p>Scenario 1B. This stakeholder-suggested system-wide management scenario is similar to Scenario 1 in that it assumes flood flows would continue to be managed through conveyance in Mill Creek, and storage in Bennington Lake. Scenario 1B does not assume that all stream segments would be substantially altered to meet all life stage needs and habitat metrics (e.g., the concrete channel in Segment 3 may not be altered to try to provide spawning and ideal rearing conditions), but it does include the following additional management strategies:</p> <ul style="list-style-type: none"> Expand channel and floodplain in Segments 1, 2 (portion), 4 (portion), and 5 by setting back levees. Supplement bedload recruitment in Segment 1 to reduce incision of the channel and provide suitable substrate for fish habitat. Increase spring and summer water flows in stream Segments 1 through 5 while addressing the thermal issues in all 5 segments of lower Mill Creek, especially downstream of Bennington Dam, but also below Blue Creek, so that all those areas meet WDOE and EPA temperature standards for rearing and migration. Resolve all fish passage constraints, including thermal issues. Realign channel upstream and downstream of Mill Creek flume (concrete portion) to include a low flow channel and notched weirs and habitat features and shading (riparian or artificial), plus improved water quantity and quality to improve rearing conditions and fish survival. In Segment 3, reduce velocity barriers and provide depth and cover to increase passage and provide more rearing to increase passage and survival of migrants, and survival during spring and summer rearing of salmonids. Daylight the tunnel section to improve migration and for increased rearing. Segments 3 and 4 will also need infrastructure maintenance and improvements to address existing safety and flood control concerns. This segment could also incorporate parks, trails and other recreational and aesthetic enhancements (e.g., see WSU student presentations). However, the general footprint and configuration of this stream segment may not change appreciably, except possibly in a few locations. 	<p>This stakeholder-suggested scenario builds on Scenario 1 by expanding the floodplain, resolving thermal barriers, and implementing additional channel improvements, while assuming flood waters will continue to be conveyed through Mill Creek under the existing general operation procedure coordinated between Ecology and USACE (USACE 2012c).</p>	<p>Although this scenario builds on the concepts of Scenario 1, its additional passage and habitat enhancements would result in better meeting the Project goal and objectives. Although Scenario 1B would more effectively address the Project goal and objectives, and associated limiting factors than Scenario 1, it would not address the Project goal and objectives as well as Scenario 4; this is because Scenario 4 accommodates complete up and downstream fish movement and also provides more opportunity for community interactions with Mill Creek.</p>
<p>Re-route Yellowhawk Creek. This stakeholder-suggested system-wide management scenario would exclude fish from lower Mill Creek from the mouth to the Division Works and fish would be bypassed through Yellowhawk Creek. Under this scenario, upper Yellowhawk Creek would be re-routed around the urbanized portions of the City of Walla Walla to provide greater opportunity for stream restoration and floodplain connection. Lower Mill Creek would function as the primary flood conveyance channel, Yellowhawk Creek as the primary fish migration channel, and Garrison Creek as the secondary fish migration channel.</p>	<p>This stakeholder-suggested scenario is a variation of Scenario 2. The only difference would be the location of upper Yellowhawk Creek, which would be moved farther south/southeast to avoid the urbanized portions of the City of Walla Walla.</p>	<p>This scenario correlates with the description of Scenario 2 and would therefore address the Project goal and objectives, and associated limiting factors, the same as Scenario 2 when evaluated against the project metrics. See the results of Scenario 2's evaluation in Table 5.3-2 for an indication of how this stakeholder-suggested scenario would address the limiting factors per the Project metrics.</p>
<p>Trap and Haul at Mouth of Mill Creek with Scenario 2 Yellowhawk Creek Fish Diversion. This is a variation of Scenario 2 where a fish trap and haul program would be implemented just upstream of the mouth of Mill Creek where the fish screen would be constructed.</p>	<p>This scenario modifies Scenario 2 by adding a trap and haul program to move fish that are attracted to Mill Creek's flows at the fish screen near the mouth to above the Bennington Diversion Dam in Segment 4.</p>	<p>This scenario correlates with the description of Scenario 2 and would therefore address the Project goal and objectives, and associated limiting factors, similar to Scenario 2, but would address the Passage/Entrainment limiting factor more effectively because fish mortality would likely be reduced that is associated with false attraction and delay in fish migration or fish straying into other drainages.</p>
<p>Trap and Haul with Scenario 2 Yellowhawk Creek Fish Diversion. This is a variation of Scenario 2 where a fish trap and haul program would be implemented at the diversion structure located at the Gose Street Bridge.</p>	<p>This scenario modifies Scenario 2 only in that it moves the fish screen from the mouth of Mill Creek to Gose Street Bridge. At the Gose Street Bridge, a trap and haul program would be implemented to move fish from Segment 1 to above the Bennington Diversion Dam in Segment 4. Under this scenario, fish would be able to utilize the portion of lower Mill Creek downstream of Gose Street, but may impact the effectiveness of attracting fish to Yellowhawk which is a key element of Scenario 2.</p>	<p>This scenario correlates with the description of Scenario 2 and would therefore address the Project goal and objectives, and associated limiting factors, the same as Scenario 2, but would address the Passage/Entrainment limiting factor more effectively because fish mortality would likely be reduced that is associated with false attraction and delay in fish migration or fish straying into other drainages. However, this scenario may address the Passage/Entrainment limiting factor less effectively than the Trap and Haul at the Mouth of Mill Creek scenario due to the potential that less fish may use Yellowhawk as the primary migratory corridor versus the lower portion of Mill Creek and encountering the barrier at the Gose Street Bridge.</p>

Table 5.4-1. Stakeholder-Suggested Management Scenarios (cont.)

Suggested Scenario	Comparison to Scenarios Identified Under Section 5.3	Evaluation of Scenario
<p>Hybrid of Scenarios 1 and 3. This stakeholder-suggested system-wide management scenario would include a hybrid of Scenarios 1 and 3 that would be implemented at the segment-level through an urgent/short term time frame and a long-term time frame.</p> <p>Segment 1: Short-term/urgent strategy is to work towards Scenario 3 by opportunistically connecting floodplain and natural process based on landowner willingness. Long-term strategy is to work towards a naturalized channel to provide benefits for flood storage/risk, restore natural processes, floodplain connecting, and sediment dynamics. Strategically identify key areas for restoration based on future conditions under Scenario 3.</p> <p>Segments 2 and 3: Short-term/urgent strategy is to incorporate elements of Scenario 1 and 3 working to address fish passage and opportunistically connect floodplain based on landowner willingness. Long-term strategy is to work towards a naturalized channel to provide benefits for flood storage/risk, restore natural processes, floodplain connecting, and sediment dynamics. Strategically identify key areas for restoration based on future conditions under Scenario 3.</p> <p>Segment 4: similar strategy as for Segment 2 – although incorporate elements of Scenario 3 to improve conveyance and connectivity with Yellowhawk and Garrison.</p> <p>Segment 5: similar strategy as Segment 1.</p>	<p>This scenario ultimately results in Scenario 3.</p>	<p>As this scenario ultimately results in Scenario 3, it would address the Project goal and objectives, and associated limiting factors, the same as Scenario 3.</p>
<p>No Action Scenario. This scenario was suggested by stakeholders as a "do nothing" where not even the current channel improvements being implemented by the Tri-State Steelheaders would be implemented. The purpose of this scenario would be to show the impacts to the focal species, the heightened flood risks to the community, and the costs of these impacts and risks under a No Action Scenario.</p>	<p>Does not compare to scenarios identified under Section 5.2.</p>	<p>The No Action Scenario does not meet the goal and objectives of this Project and would likely would address the limiting factors less than management scenarios 1-4. In addition, considering the current conditions of increased development, degradation of infrastructure, decreased floodplain function, and existing impacts to fish and fish habitat (as described in Section 2 of Assessment), a No Action Scenario would result in high risk for flood damage, loss of aquatic resources, and poor water quality.</p>

Table 5.4-2. Stakeholder-Suggested Segment Level Alternatives

Suggested Segment Level Alternative	Associated Management Scenario	Comments
<p>Provide permanent protection of shoreline areas through conservation easements. Blue Mountain Land Trust suggested that it would be interested in partnering on future work by holding conservation easements on restoration/public access sites. Permanent protection through an easement or similar arrangement with a willing landowner could enhance the effectiveness of restoration work by ensuring that future landowners cannot undo any of the restoration improvements that have been made. Additionally, purchasing easements may be an avenue to incentivize landowner cooperation by compensating for any lost economic value, such as for land removed from production for restoration work.</p>	<p>This specific strategy for protecting shoreline areas would apply to all the identified management scenarios in Section 5.3 and stakeholder suggested management scenarios listed in Table 5.3-1.</p>	
<p>Restore Titus Creek, Jones Ditch, and Garrison Creek to natural creeks and distributaries. Specifically related to Titus and Garrison creeks, restoration of these distributary systems is important because both creeks are listed as critical habitat. Specific actions for restoring Titus Creek should include the following actions;</p> <ul style="list-style-type: none"> • Pipe irrigation water withdrawals through irrigation pipe(s) rather than Titus Creek functioning as an irrigation canal. • Restore the natural Titus Creek stream channel. • Modify the existing 12-inch culvert under the MCFCP levee where Titus Creek flows into Mill Creek. This will eliminate the existing fish passage barrier, thereby providing opportunity for fish to use the portion of lower Titus Creek on the Walla Walla Community College campus including the spring ponds that provide cold water inputs to flow. • Restore Titus Creek fish habitat and riparian areas and eliminate potential stranding locations through physical channel improvements and flow management. • Once the irrigation pipe(s) are in place and restoration is complete, remove fish screens from Titus Creek to allow access by focal species. 	<p>This specific restoration segment-level alternative would fit within the following identified management scenarios: Scenario 1, Scenario 3 (including New Flood Control Channel Routed Around City of Walla Walla Scenario described above), and Scenario 4. Restoration of Titus Creek does not fit within Scenario 2 as fish will not have access to Mill Creek below the Division Works Dam and Titus flows back into Mill Creek below the Dam.</p>	<p>This segment-level alternative for restoring critical habitat in Mill Creek's distributaries would be applied to the extent practicable under all of the examined scenarios.</p>

Table 5.4-2. Stakeholder-Suggested Segment Level Alternatives (cont.)

Suggested Segment Level Alternative	Associated Management Scenario	Comments
<p>Create a wider floodplain for Mill Creek in Segments 2, 3, and 4 by setting back the levees and implementing small-scale projects that add habitat components such as adding concrete rocks and allowing/promoting vegetation on levees. This will create a more naturalized channel in these sections.</p>	<p>This specific restoration project would fit within the following identified management scenarios: Scenario 1, Scenario 3 (including New Flood Control Channel Routed Around City of Walla Walla Scenario described above), and Scenario 4.</p>	
<p>Build an underground flood delivery pipe or flume north of Yellowhawk Creek above the urbanized portion of the City of Walla Walla in place of the Segment 3 underground flood channel in Scenario 4. In addition to this being a segment-level alternative to Scenario 4, this could be incorporated in Scenario 3 as it would eliminate the need for some upland flood water storage in Scenario 3. An easement could be attained for such underground pipe and non-structural land use above ground could continue.</p>	<p>This specific segment-level alternative would apply to Scenarios 3 and 4 and would be similar in concept to underground conveyance "conduit" in Scenario 4.</p>	<p>This would provide for easier maintenance (i.e., access and overall maintenance) of the underground pipe. A piped system of this nature could be much easier to screen and transport sediment in the main channel of Mill Creek. This segment-level alternative would eliminate the need for the Segment 3 concrete flume and cross-sectional weirs and provides opportunities for a natural river channel. This could be designed to address future impacts of climate change and balance water needs in Mill Creek. Although this segment-level alternative would likely be expensive, it could be more feasible than some of the currently proposed segment-level alternatives in other scenarios.</p>
<p>Construct a new flood control channel capable of conveying 3,500 cfs or more around the City of Walla Walla via either Russell Creek or Dry Creek.</p> <ul style="list-style-type: none"> The Russell Creek option would include construction of an armored flood control channel from Bennington Lake, down Russell Creek, eventually merging with Yellowhawk Creek and discharging into the Walla Walla River. The Dry Creek option would include construction of a diversion dam near river mile 14 and construction of an armored conveyance channel north to Dry Creek, merging with Dry Creek. Opportunities for creation of wetlands or water storage project along Dry Creek could also be considered. <p>Under both options, substantial improvements for erosion control and conveyance would be needed to accommodate flood flows. This specific segment-level alternative assumes that peak flows down Mill Creek below the Bennington Diversion Dam would be reduced and Mill Creek would be restored to a naturalized channel and would operate between a minimum in-stream flow of 45 cfs and peak flood flows no greater than 1,000 cfs, thereby establishing a range of flows capable of supporting multiple life stages for the focal fish species.</p>	<p>This stakeholder-suggested segment-level alternative is a variation of Segment 3 under Scenario 3. The Russell Creek conveyance option is similar to Option 1 of Scenario 3 (see Table 5.3-1) and the Dry Creek conveyance option is similar to Option 2 of Scenario 3 (see Table 5.3-1).</p>	<p>Under this segment-level alternative, a modernized version of the Mill Creek Channel would need to be constructed to accommodate flood flows down either Russell or Dry creeks. An examination of multiple options of flood water storage and conveyance is recommended under this segment-level alternative in order to effectively manage existing peak flows and intensified flows that may occur in the future due to climate change.</p>
<p>Gravel and sediment augmentation for replacement of material currently removed by the USACE above the MCFCP. Improved channel stability and floodplain function.</p>	<p>This specific segment-level alternative would apply to all Scenarios.</p>	<p>This segment-level alternative would need to be evaluated in context with potential impacts to channel hydraulics and sediment transport.</p>
<p>Enhance flows in Yellowhawk Creek and lower Mill Creek through implementation of water exchange strategies described in the Walla Walla Basin Integrated Flow Enhancement Study (pers. com., Gary James, Program Manager, CTUIR, Pendleton, Oregon, May 24, 2017). Water exchange strategies include the exchange of Columbia water with major irrigation districts such as Gardena Farms Irrigation District (GFID) to meet instream flow targets. With GFID receiving their water from a new exchanged source, it is anticipated that diversion of Mill Creek water into Yellowhawk Creek would be reduced. A base flow for steelhead usage would remain in Yellowhawk Creek, but water to supply GFID would no longer be necessary therefore increased instream flow would be expected below the Division Works Dam.</p>	<p>This specific segment-level alternative would apply to all Scenarios.</p>	
<p>Build screened irrigation intakes in Mill Creek mainstem rather than use distributaries for irrigation diversions thus allowing distributaries to be accessed by fish and have habitat restored.</p>	<p>This specific strategy for increasing fish access and habitat to distributaries would apply to all the identified management scenarios in Section 5.3 and stakeholder suggested management scenarios listed in Table 5.3-1.</p>	
<p>Construct a hydroelectric generating plant at appropriate locations under Scenarios 2 and 4 along the Mill Creek mainstem where flood waters are conveyed into the flood control channel. In addition, it might be a possible opportunity to capture hydroelectricity at output locations from storage facilities in Scenario 3. Production of hydroelectric energy could produce funding for implementation of management scenarios, as the money would directly go towards restoring Mill Creek as proposed in SAP or planning process such as a feasibility study.</p>	<p>This would apply to Scenarios 2 and 4 and possibly to Scenario 3.</p>	

5.5 REGULATORY SIDEBOARDS AND FUNDING OPPORTUNITIES

This section identifies the regulatory sideboards that will need to be considered when formulating more detailed designs to support a selected management scenario and when considering implementation and potential funding sources. In assessing the Mill Creek regulatory framework, the following key questions relating to jurisdiction must be considered:

- Which entities own or control land within the Project Area that would be impacted by the selected concept alternative for each segment or by a proposed flood water diversion and storage facility?
- Which entities can undertake and/or fund Mill Creek restoration actions?
- Which entities can or must approve such actions, and what are the corresponding approval processes?

As discussed in Section 1, the USACE and MCFCZD own or control easements that make up the MCFCP. As a property owner and operator of the MCFCP, the USACE would be a central agency involved in implementing any Mill Creek restoration project. The MCFCZD is the holder of the perpetual easements that collectively define the ROW for the MCFCP, and would need to be involved in property-related transactions required to permit future actions within the ROW. Because the MCFCZD is a corporation established by Walla Walla County, the county would also need to be a key partner in a restoration program. Other lands within the Project Area are owned by a multitude of public and private entities. Specific landowners would be identified during the more detailed segment-level design phase, and impacts to and necessary approvals from all landowners would be identified and evaluated.

The primary entities that could undertake restoration actions or provide project funding would include the USACE, CTUIR, BPA, WWCCD, WWWMP, the Salmon Recovery Funding Board, SRSRB, Ecology, MCFCZD, and City of Walla Walla. However, collaboration with a number of stakeholders and funding from multiple sources will be needed to accomplish the system-level improvements proposed for Mill Creek and its distributaries.

The following subsections discuss USACE regulatory sideboards and funding mechanisms as well as identify other federal and non-federal regulatory issues and funding opportunities. Once a preferred management strategy is selected, a plan should be developed that includes a strategy for navigating the applicable regulations and securing funding for the further development of the preferred management strategy.

5.5.1 USACE Regulatory Sideboards and Funding Mechanisms

5.5.1.1 USACE Regulations Applicable to the Current MCFCP

Section 4.1.1.1 of this Assessment describes USACE regulations that apply to the current MCFCP. Some of these regulations would need to be complied with and some may require modification to be compatible with the restored Mill Creek under system-wide management Scenario 3. For example, a Section 408 authorization would be needed from USACE prior to making alterations to the portion of the Mill Creek Channel within the MCFCZD. However, the operations and maintenance regulations prescribed by the Mill Creek Water Control Manual and current vegetation management policies would likely need to be revised if a concept under Scenario 3 were designed and constructed. As discussed in Section 4.1.1.1, a variance from USACE standard vegetation guidelines may be requested by the USACE district offices to further enhance environmental values or to meet state or federal laws and/or regulations. Close coordination with the USACE would be required to appropriately revise existing operation and management regulations.

5.5.1.2 USACE Civil Works Program – Authorizations and Appropriations

The USACE delivers flood risk management services through the agency's civil works program. Project studies and project construction are typically authorized through a Water Resources Development Act (WRDA). The most recent WRDA was passed December 9, 2016 under the Water Infrastructure Improvements for the Nation Act. The WRDA do not appropriate funds for projects authorized under this act.

General Investigation Program

A proposed Mill Creek restoration project would likely cost more than \$10 million, which would require an individual authorization by Congress through the General Investigations (GI) program. Under the GI program, two separate congressional authorizations (and appropriations) would be needed: 1) authorization to study the project; and 2) authorization to construct the project recommended by the study.

Funding for USACE activities are typically appropriated through the annual Energy and Water Development Appropriations Act (E&W Act). Every year, the President proposes a budget to Congress that includes budget appropriations for the USACE under this bill. Congress reviews and amends the budget and ultimately has the authority to approve it. More USACE projects receive authorization than funding is available for, resulting in competition among authorized projects for funds during the annual budget and appropriations processes (Carter and Stern

2016). Currently, there is a backlog of more than 1,000 authorized studies and construction projects and recently there have been few new studies or construction projects in either the President's budget request or enacted appropriations (Carter and Stern 2016).

For most projects, the USACE needs a non-federal sponsor to be responsible for a share of the study and construction costs. Non-federal sponsors include tribal, state, county, or local agencies or governments and can also include nonprofits or other entities. Since the passing of the WRDA in 1986, the non-federal sponsors have taken on a significant portion of the financing of studies, construction, and operations and maintenance costs for most USACE projects (Carter and Stern 2016). WRRDA 2014 expanded the authority for non-federal sponsors to perform studies and construct projects that previously would have been undertaken by the USACE, while still allowing for federal cost sharing as though the USACE had performed these studies or constructed the project (Carter and Stern 2016).

The following is the typical planning process for individually authorized projects (that have received funding through an appropriation) where the USACE is the manager of the study and the project:

1. Feasibility Study – once a feasibility study is authorized by Congress, appropriations are sought through the annual E&W Act. Within the USACE, projects are planned at the district level and approved at the division level and headquarters in Washington, D.C. (Carter and Stern 2016). A non-federal sponsor must also be secured prior to the start of a feasibility study, and the cost of the study is split equally between the USACE and the non-federal sponsor. The study involves the completion of a feasibility report, which includes a comprehensive review of a proposed project including the formulation of alternatives, investigation of engineering feasibility, completion of a cost-benefit analysis, and assessment of impacts under the National Environmental Policy Act (Carter and Stern 2016). The analysis leads to a determination of whether the project warrants further federal investment and the selection of a recommended plan by the Chief of Engineers (known as the Chief's Report). A feasibility report typically takes up to 3 years to complete, but can take much longer. As a rule of thumb, the USACE seeks to complete approximately 80 percent of the engineering design in the feasibility report (i.e., the amount that the agency deems necessary to prepare a meaningful cost estimate).
2. Preconstruction, Engineering, and Design (PED) – this involves the preparation of detailed technical designs and specifications and a clear identification of the lands,

easements, ROWs, relocations, and disposal areas that are needed for the project (Samet 2009). The PED can begin after the Chief's Report is issued but prior to receiving congressional authorization for project construction (Carter and Stern 2016). The amount of work the USACE can complete on the PED is subject to the availability of funds through appropriations. Funding of the PED is shared between the USACE and the non-federal sponsor in the same proportion as the cost-share agreement for the construction phase. The PED typically takes about 2 years to complete and the USACE expects to carry out the final 20 percent of its engineering design during the PED phase, with the first 80 percent carried out during the feasibility phase (Samet 2009).

3. Construction – once the project is authorized for construction, the USACE must seek funding to carry out the project. Per 33 U.S. Code (U.S.C.) §§ 2211-2215, the maximum federal cost share of construction for inland flood control projects and for aquatic ecosystem restoration projects is 65 percent. Once funding is in place, the USACE will typically contract out the actual construction work but will function as the project manager (vs the non-federal sponsor).
4. Operations and Maintenance Phase – the extent and funding of this phase depends on the nature of the project. Typically, ownership and operation and management responsibilities of a flood control project is transferred to the non-federal sponsor. Per 33 U.S.C. §§ 2211-2215, the maximum federal cost share of operation and maintenance for inland flood control projects and for aquatic ecosystem restoration projects is zero percent, meaning it falls to the non-federal sponsor to fund operations and maintenance.

In May of 2015, the Mill Creek Coalition submitted a Letter of Interest to the USACE regarding a proposed Mill Creek Feasibility Study (as discussed in Section 1.3). The USACE Walla Walla District has requested funding for a Mill Creek Feasibility Study for the last several years. Although it has not yet received any funding, it may be funded in the near future. Walla Walla County is anticipated to be the non-federal sponsor of a proposed feasibility study.

Continuing Authority Programs

Projects carried out under one of the USACE continuing authority programs (CAP) follow a similar, but typically less detailed, planning process than do individually authorized projects under the GI program. CAP projects are completed in two phases: 1) feasibility phase and 2) design and implementation phase. CAP projects do not require project-specific appropriations from Congress and are completed at the discretion of the USACE. However, they compete for

both study and construction funding from a very limited pool of federal funds, which has severely limited the number of CAP projects constructed.

Three of the CAPs that may be applicable to a Mill Creek restoration program are summarized as follows:

- *Section 1135 – Project Modifications for Improvement of the Environment:* Section 1135 of the WRDA of 1986 provides the USACE authority to modify existing USACE projects to restore the environment and to construct new projects to restore areas degraded by a USACE project.⁶ The Section 1135 program has an authorized yearly funding ceiling of \$40 million for the entire country. The federal share of an individual project carried out under this program cannot exceed \$10 million, and the federal cost share is 75 percent (33 U.S.C. 2309a). In FY 2016, only \$3 million was appropriated under this authority (Carter and Stern 2016).
- *Section 206 – Aquatic Ecosystem Restoration:* Section 206 of the WRDA of 1996 gives the USACE authority to plan and carry out projects to restore degraded aquatic ecosystems. These projects do not have to be related to an existing USACE project. The Section 206 program has an authorized yearly funding ceiling of \$50 million for the entire country. The federal share of an individual project cannot exceed \$10 million, and the federal cost share is 65 percent (33 U.S.C. 2330). In FY 2016, only \$8 million was appropriated under this authority (Carter and Stern 2016).
- *Section 205 – Flood Damage Reduction:* Section 205 of the 1948 Flood Control Act authorizes the USACE to study, design, and construct small flood control projects in partnership with nonfederal sponsors. The Section 205 program has an authorized yearly funding ceiling of \$55 million for the entire country. The federal share of an individual project cannot exceed \$10 million, and the federal cost share is 65 percent (33 U.S.C. 701s). In FY 2016, only \$8 million was appropriated under this authority (Carter and Stern 2016).

⁶ Under the Section 1135 program, the USACE prepared a Detailed Project Report and Environmental Assessment to present analysis and recommendations for a fish passage improvement project at Bennington Diversion Dam (USACE 2012a). See Section 1.4.3.5 for more information on this project including its current status as incomplete and unfunded.

5.5.1.3 Technical Assistance

The USACE also has general authority to provide technical assistance to states and communities without project-specific authority or appropriations. These technical assistance authorities include the following programs:

- *Planning Assistance to States*. This PAS program authorizes the USACE to provide technical assistance to states and communities for regional water resources planning, and eligible levee system evaluations of federally authorized levees (42 U.S.C. 1962d-16).⁷ This program has an authorized yearly funding ceiling of \$30 million for assisting states and \$15 for other technical assistance. The federal cost share varies depending on the project and an individual project carried out under this program cannot exceed \$5 million per state for state assistance. In FY 2016, \$6 million was appropriated under this authority (Carter and Stern 2016).
- *Floodplain Management Services*. This program authorizes the USACE to provide technical assistance on flood and floodplain issues (33 U.S.C. 709a). This program has an authorized yearly funding ceiling of \$50 million for the entire program and can be 100 percent funded by the USACE. In FY 2016, \$15 million was appropriated under this authority (Carter and Stern 2016).
- *Tribal Partnership Program*. This program authorizes the USACE to study water projects located on tribal lands that benefit Indian tribes (33 U.S.C. 2269). This program does not have an authorized yearly funding ceiling but does have a maximum 50 percent federal cost share requirement. An individual project carried out under this program cannot exceed \$1 million. In FY 2016, \$1.5 million was appropriated under this authority (Carter and Stern 2016).

5.5.2 Other (Non-USACE) Regulatory Sideboards

This subsection outlines the likely or potential permits and approvals that will be needed in addition to the USACE planning process described in Section 5.5.1. A permit matrix identifying potential requirements of federal, state, and local government agencies is included in Table 5.5-1. More detail regarding many of these requirements was provided in Sections 1, 2, and 4.

⁷ Under the PAS program, USACE completed a study in March 2013 on behalf of the MCFCZD to evaluate the Mill Creek Flood Control Channel's capability of providing its intended level of flood risk reduction to the city of Walla Walla and surrounding areas. See Section 1.4.3.5 for more information on this study.

Table 5.5-1. Overview of Regulatory Framework

Federal	State	Walla Walla County	City of Walla Walla
<p><i>Environmental Review</i></p> <ul style="list-style-type: none"> National Environmental Policy Act 	<p><i>Environmental Review</i></p> <ul style="list-style-type: none"> State Environmental Policy Act – RCW 43.21C 	<p><i>Environmental Review</i></p> <ul style="list-style-type: none"> State Environmental Policy Act – WWCC 18.04 	<p><i>Environmental Review</i></p> <ul style="list-style-type: none"> State Environmental Policy Act – WWMC 21.08
<p><i>Fish, Wildlife, and Habitat</i></p> <ul style="list-style-type: none"> Endangered Species Act Magnuson-Stevens Fishery Conservation & Management Act of 1996 Fish and Wildlife Conservation Act of 1980 Fish and Wildlife Coordination Act of 1934 Pacific Northwest Electric Power Planning & Conservation Act of 1980 	<p><i>Waters/Wetlands/Floodplains</i></p> <ul style="list-style-type: none"> Shoreline Management Act of 1971 – RCW 90.58 Hydraulic Code – RCW 77.55 Section 401 Water Quality Certification Section 404 Certification WA. Dept. of Natural Resources Jurisdiction Determination Watershed Planning Act of 1988 – RCW 90.82 Water Pollution Control Act – RCW 90.48 	<p><i>Waters/Wetlands/Floodplains</i></p> <ul style="list-style-type: none"> Shoreline Master Plan Flood Damage Prevention – WWCC 18.12 Walla Walla Watershed Plan (WRIA 32) Walla Walla Subbasin Plan (prepared by Walla Walla County and the Walla Walla Basin Watershed Council for the Northwest Power and Conservation Council, 2004). Stormwater – WWCC Title 11 	<p><i>Waters/Wetlands/Floodplains</i></p> <ul style="list-style-type: none"> Shoreline Master Plan Walla Walla Watershed Plan (WRIA 32) Stormwater Management – WWMC 13.06 Pollution of Streams – WWMC 13.15 Mill Creek – Pollution – WWMC 13.28 Mill Creek – Obstruction or Diversion – WWMC 13.32
<p><i>Waters/Wetlands/Floodplains</i></p> <ul style="list-style-type: none"> Clean Water Act – Section 401, Section 404 and NPDES Floodplain/Wetlands Environmental Review Requirements (10DFR 1022.12) 	<p><i>Heritage Conservation and Cultural Protection</i></p> <ul style="list-style-type: none"> Archeological & Cultural Resources – Executive Order 05-05 Archeological Sites & Resources – RCW 27.53 	<p><i>Land Use and Local Permitting</i></p> <ul style="list-style-type: none"> County Comprehensive Plan County Critical Areas Ord. – WWCC 18.08 	<p><i>Heritage Conservation and Cultural Protection</i></p> <ul style="list-style-type: none"> Historic Preservation Commission – WWMC 2.28
<p><i>Heritage Conservation and Cultural Protection</i></p> <ul style="list-style-type: none"> Antiquities Act of 1906 Historic Sites Act of 1935 National Historic Preservation Act of 1966 (NHPA) Archaeological Resource Protection Act of 1979 Archaeological and Historic Preservation Act of 1974 Native American Graves Protection and Repatriation Act 	<p><i>Land Use and Local Permitting</i></p> <ul style="list-style-type: none"> Critical Areas Ord. – RCW 36.70A.030(5), RCW 36.70A.040(3)(b), 36.70A.060(2), and RCW 36.70A.170 		<p><i>Land Use and Local Permitting</i></p> <ul style="list-style-type: none"> Downtown Master Plan Walla Walla Urban Area Comprehensive Plan City Critical Areas Ord. – WWMC 21.04
<p><i>Other Potentially Applicable Regulations</i></p> <p>Farmland Protection Policy Act (7 U.S.C. 4201)</p>			

NPDES – National Pollutant Discharge Elimination System; RCW – Revised Code of Washington; U.S.C. – U.S. Code; WRIA – Water Resource Inventory Area; WWCC – Walla Walla County Code; WWMC – Walla Walla Municipal Code

5.5.3 Other Federal Funding Opportunities

Grants and cost sharing agreements to help fund stream restoration and habitat protection projects are available from federal, state, and private entities. Some of these funding opportunities are listed below. Also see Section 5.2 of the Walla Walla County Shoreline Restoration Plan (The Watershed Company, the Walla Walla Basin Watershed Council, and Ecology 2015) for a list of funding mechanisms available for the restoration and protection of shoreline ecological functions.

5.5.3.1 BPA

BPA, under its Fish and Wildlife Program, funds fish and wildlife mitigation projects throughout the Columbia Basin to address impacts of federal dams. Activities include supporting better fish passage and protecting and restoring land and water habitat. BPA has implemented hundreds of these types of projects working with federal agencies, Northwest tribes, states, local governments, land conservancies and other partners, with a focus on species listed under the ESA. This work is fully funded by BPA's electric ratepayers and guided by the four-state Northwest Power and Conservation Council's (Council) Fish and Wildlife Program. This council and the program were established in 1980 by the Pacific Northwest Electric Power Planning and Conservation Act. The Accords agreement (Three Treaty Tribes-Action Agencies 2008) is also under the fish and wildlife program and works to protect and support a broad range of aquatic and terrestrial species. In addition to addressing the survival of ESA-listed species, projects to enhance Pacific lamprey survival are moving forward under the Accords. Fish and wildlife investments proposed for BPA funding are reviewed by the Council's Independent Science Review Panel to ensure projects address the factors that affect fish health and that their results are scientifically valid. Evaluation results are used to continually improve the program as part of an adaptive management approach.

BPA's Fish and Wildlife Program FY 2016 planning budget includes \$310 million for expenses and \$60 million for capital improvements. This budget represents the parent fund for the entire program. Within this parent fund, \$117.1 million expense budget is planned under the FCRPS 2008 BiOp (non-Accord) Program, which is used to fund projects responsive to the FCRPS 2008 BiOp that are not covered under the Accord agreements; and a \$21.5 million expense budget and \$13.9 million capital budget is planned for the CTUIR Fish Accords Program (BPA 2016).

5.5.3.2 NRCS Regional Conservation Partnership Program

The Regional Conservation Partnership Program (RCPP) was authorized in the Agricultural Act of 2014 (also known as the 2014 Farm Bill) and is a program that promotes coordination between the NRCS and its partners (landowners and agricultural producers) to multiply conservation investments (typically the RCPP seeks to match partner investments at a 1 to 1 ratio) and reach conservation goals on a regional or watershed scale. The NRCS provides assistance to producers through partnership agreements and through program contracts or easement agreements.

In FY 2017, the RCPP had \$263 million available for project funding. This funding is divided between three funding pools: 40 percent is allocated to national, multi-state projects; 25 percent is allocated to state projects; and 35 percent is allocated to projects in critical conservation areas⁸ (USDA 2016). Future projects identified by stakeholders or during feasibility analysis may qualify for funds under all three funding pools. To qualify for RCPP funds, projects would need to focus on improvements to water quality and quantity to restore critical components of salmon habitat, aid in the recovery of Pacific salmon, and protect public health and the environment while maintaining a strong agricultural sector (USDA 2016).

RCPP contracts and easement agreements are implemented through the following NRCS programs: Agricultural Conservation Easement Program, Environmental Quality Incentives Program, Conservation Stewardship Program, or the Healthy Forests Reserve Program. In the designated critical conservation areas, the NRCS may also utilize the authorities under the Watershed and Flood Prevention Program, other than the Watershed Rehabilitation Program. The Watershed and Flood Prevention Program was authorized by the Flood Control Act of 1944 (Public Law 78-534) and provides technical and financial assistance to states, local governments, and tribes (project sponsors) to plan and implement authorized watershed project plans for the purpose of:

- Watershed protection
- Flood mitigation
- Water quality improvements
- Soil erosion reduction
- Rural, municipal, and industrial water supply
- Irrigation

⁸ The Project Area is located within the Columbia River Basin designated critical conservation area.

- Water management
- Sediment control
- Fish and wildlife enhancement
- Hydropower

A project that is eligible for funding under the Watershed and Flood Prevention Program must be publically sponsored (by a taxing authority), have a project area of 250,000 acre or less, and have benefits that are directly related to agriculture, including rural communities, that are at least 20 percent of the total benefits of the project (NRCS 2016b).

Eligible partners for the RCPP include agricultural or silvicultural producer associations, farmer cooperatives or other groups of producers, state or local governments, American Indian tribes, municipal water treatment entities, water and irrigation districts, conservation-driven nongovernmental organizations, and institutions of higher education. Eligible participants that may enter into conservation program contracts or easement agreements under the framework of a partnership agreement include eligible producers and landowners of agricultural land and non-industrial private forestland (USDA 2016).

5.5.3.3 EPA

The United States Congress established the Section 319 program (Section 319) as part of the Clean Water Act amendments of 1987. The EPA provides Section 319 grant funds to states, administered in Washington by Ecology, which are required to provide a 40 percent funding match. This program provides grants to eligible nonpoint source pollution control projects similar to Washington's Centennial program (see Section 5.5.4.7 below). Eligible projects include riparian and wetland habitat restoration and enhancement projects and stream restoration projects. Similar to the Centennial program, project sponsors must provide a 25 percent match to Section 319 grant funding (Ecology 2016c).

5.5.3.4 USFWS

Tribal Wildlife Grants

The USFWS has administered competitive Tribal Wildlife Grants since 2003 to provide technical and financial assistance to tribes for the development and implementation of programs that benefit fish and wildlife resources and their habitat (USFWS 2016). Activities may include, but are not limited to, planning for wildlife and habitat conservation, fish and wildlife conservation and management actions, fish and wildlife related laboratory and field research, natural history studies, habitat mapping, field surveys and population monitoring, habitat preservation,

conservation easements, and public education that is relevant to the project (USFWS 2016). Grant monies may be used for salaries, equipment, consultant services, subcontracts, acquisitions and travel (USFWS 2016).

“Traditional” Section 6 Conservation Grant Program

The “traditional” Section 6 Grant Program was established in 2001 and is administered by the USFWS to provide funding to states to implement conservation projects for the recovery of federally listed species and species at risk (WDFW 2016b). This program was established under the federal Cooperative Endangered Species Conservation Fund and states must have a cooperative agreement with the USFWS under Section 6 of the ESA to be eligible to receive funds under this program. In Washington State, the “traditional” Section 6 grants are administered by the USFWS in conjunction with the WDFW and Washington Department of Natural Resources (WDFW 2016b).

5.5.4 Non-federal Funding Sources

5.5.4.1 Snake River Salmon Recovery Board

The SRSRB, located in southeast Washington, convened in 2002 for the purpose of developing a locally supported, technically sound plan to recover ESA-listed salmon and steelhead. The SRSRB is represented by five counties and the CTUIR. The board advises, recommends, and approves funding for habitat projects, monitoring programs and administrative functions necessary to implement their locally-produced salmon recovery plan. The board offers grants through its Snake River Lead Entity, represented by the board and is the only lead entity in the Snake River Salmon Recovery Region. The Lead Entity is supported by a regional technical team and a committee composed of technical and citizen members. The committee produces a project list for consideration and final prioritization by the board.

5.5.4.2 Salmon Recovery Funding Board

In 1999, the Washington Legislature created the Salmon Recovery Funding Board. The board provides grants to protect or restore salmon habitat and assist related activities. Composed of five citizens, appointed by the governor, and five state agency directors, the board brings together the experiences and viewpoints of citizens and the major state natural resource agencies.

5.5.4.3 Recreation and Conservation Funding Board

Established by citizen Initiative 215 in 1964, the Recreation and Conservation Funding Board helps finance recreation and conservation projects throughout the state (RCO 2016). The eight-member board consists of five citizens appointed by the Governor, and three state agency directors. The board administers several grant programs including the Land and Water Conservation Fund and the Aquatic Lands Enhancement Account. Although the Land and Water Conservation Fund is mainly used to preserve and develop outdoor recreation resources, it can also be used to protect wildlife habitat. Projects under this fund require a 50 percent match and at least 10 percent of the total project cost must be from a non-state, non-federal contribution. The Aquatic Lands Enhancement Account can fund the acquisition, improvement, or protection of aquatic lands for public purposes and to target the re-establishment of natural ecological functions. Eligible projects include the purchase of aquatic or upland lands, restoration of damaged or altered aquatic or upland lands, or development projects that improve public access to aquatic lands and waters such (RCO 2016).

5.5.4.4 Walla Walla Watershed Management Partnership

The WWWMP was legislatively authorized in 2009 as a unique local water management pilot program for the State of Washington. The partnership's program was developed by local stakeholders in cooperation with Ecology. Its board and committees collectively provide a unique local governance structure including participants from water users, environmental interests, tribes, citizens, governments, conservation districts, bi-state (Oregon) entities, and higher education. The partnership works with water users to develop mutually beneficial outcomes for farms, fish, and communities in the watershed. Among its primary authorities and duties are to: administer and oversee the Local Water Plan process and implementation; manage banked water; acquire water rights by donation, purchase or lease; participate in local, state, tribal, federal, and multistate basin water planning initiatives and programs, and; enter into agreements with water rights holders to not divert water that becomes available as a result of Local Water Plans, water bank activities, or other programs and projects endorsed by the WWWMP and Ecology. The partnership was given the unique authorization to process and approve local water rights changes previously delegated to Ecology. Local Water Plans are the vehicle through which the partnership administers water right changes that provide flexibility sought by water right holders in exchange for net benefit to in-stream flows.

5.5.4.5 Office of Columbia River

In 2006, Washington State created the Columbia River Basin Development Account, authorized \$200 million to fund it, and tasked Ecology to aggressively seek out new water supplies for both in-stream and out-of-stream uses (Ecology 2016d). Ecology created the Office of Columbia River to administer these funds to develop new water supplies using storage, conservation, and voluntary regional water management agreements.

5.5.4.6 Walla Walla County Conservation District

The WWCCD works with local land managers to coordinate technical, financial, and educational resources needed for the conservation of soil, water, and related natural resources. Together with the Farm Service Agency, the WWCCD administers Walla Walla County's Conservation Reserve Enhancement Program. The WWCCD also offers technical expertise to help homeowners plant a riparian buffer along their backyard streams. Other programs and projects address irrigation efficiency and piping, upland erosion control, wetland restoration and enhancement, fish-friendly stream bank stabilization, and installation of fish screens and water meters for irrigators (The Watershed Company et al. 2014).

5.5.4.7 Ecology

Centennial Grants

Ecology administers the state-funded Centennial Program that provides grants to local governments, special purpose districts, conservation districts, and federally recognized tribes for water quality infrastructure and nonpoint source pollution projects (including stream restoration projects) to improve and protect water quality. Non-point source pollution projects require a 25 percent match from the applicant (Ecology 2016e).

Floodplains by Design

Ecology's Floods and Floodplain Management Division administers the Floodplains by Design grant program which focuses on coordinating investment in and strengthening the integrated management of floodplain areas through Washington State (Ecology 2015d). Ecology awards grants on a competitive basis to eligible applicants for projects that support the integration of flood hazard reduction with ecological preservation and restoration. Ideal projects under this grant program are part of a strategy tailored to the specific reach of a river that reduces flood risk to affected communities, restores ecological function and is a net gain for other community interests. In areas where agriculture is a dominant land use, projects need to be part of a strategy that provides a net gain for agriculture as well as enhances ecological function (Ecology

2015d). For the FY 2015-17 funding round, the Washington State Legislature provided \$35,560,000 to fund seven top-priority projects under this program.

5.5.4.8 Blue Mountain Land Trust

The Blue Mountain Land Trust is a non-profit organization that works with landowners to voluntarily preserve the natural, scenic, and agricultural value of privately-owned land for future generations. The Blue Mountain Land Trust currently holds two easements along Mill Creek, totaling 75 acres. Additional conservation easements could be held with a willing landowner to protect shoreline areas along Mill Creek and its distributaries. In addition to working with land owners to donate land for conservation easements, The Blue Mountain Land Trust can work with a number of funding sources to purchase easements and remove land from urban, agricultural or timber harvesting uses in favor of stream restoration work.

5.5.4.9 Sherwood Trust

The Sherwood Trust was founded by Donald and Virginia Sherwood in 1991 to build sustainable capacity in the Walla Walla region (Sherwood Trust 2016a). Community Capital Project Grants may be available from the Sherwood Trust if proposed projects provide a positive contribution to the economic development of the Walla Walla area or provide a meaningful contribution to enhance development of the Walla Walla area or provide a meaningful contribution to enhance the quality of the environment (Sherwood Trust 2016b).

5.6 STRATEGIC PLANNING PROCESS

Building on the lessons learned from Sections 5.2, 5.3, and 5.4, this section describes a strategic planning process that could be utilized during future planning efforts. This strategic planning process will help stakeholders identify/refine the system-wide management scenarios that will be further evaluated during the next stage of planning. While Section 5.7 describes the specific actions for implementing this strategic planning process, Section 5.6 describes the planning tools.

The strategic planning process involves four parts: identify/refine system-wide management scenarios through a step-wise decision framework; evaluate each management scenario using the evaluation framework in Section 5.3.2; define future conditions that can be achieved under each management scenario; and evaluate each management scenario's constructability and costs while identifying possible funding and regulatory pathways. The strategic planning process could ultimately result in a selected stakeholder preferred scenario that could be carried into a

proposed USACE Feasibility Study as the locally preferred option or could be further designed through other technical vehicles or authorities.

5.6.1 Process for Identifying System-wide Management Scenarios

The process of identifying system-wide management scenarios is an iterative one as it requires the balancing of priorities and the evaluation of options for flow and fish given the lower Mill Creek flood control constraints. From this process, the CTUIR identified a stepwise decision framework that provides a logical decision path for determining the components of a management scenario that adequately manages flood waters and achieves the Project's minimal and optimal metrics. The stepwise decision process is illustrated in Figure 5.6-1. This process should be utilized when formulating other possible management scenarios for lower Mill Creek, as well as developing strategies for resolving specific segment-level issues.

The first step in the decision framework shown in Figure 5.6-1 is to decide how a given scenario would potentially address fish passage and habitat (i.e., whether fish passage and habitat are provided in the mainstem of lower Mill Creek, the distributary system, or a combination of both). The second step is to look at the distributary channels and consider how much flood water capacity they could provide while still maintaining fish habitat and while considering ROW and land use constraints. The third step is to evaluate how much flood water storage capacity could be provided under a given scenario and identify options to meet these storage needs, such as enlarging Bennington Lake, building another reservoir, and/or using aquifer recharge for storage. Adverse impacts from implementing additional flood storage infrastructure should also be considered as part of this step. The fourth step is to determine the amount of flood channel capacity that would be needed in lower Mill Creek to convey flood waters that would not be stored under the various flood water storage options or conveyed down the distributary system determined in steps 2 and 3 of the framework. Step four will also identify how to move flood waters through, under, or around the urbanized area. Each step in the decision framework is iterative, with each decision being considered in the full context of the management scenario.

This stepwise decision framework will be utilized by stakeholders when formulating possible management scenarios or when refining one of the management scenarios described in Section 5.2 or 5.3. This framework can also be utilized to help identify segment-level conceptual alternatives once a preferred management scenario is selected. The USACE may also find this decision framework useful when developing alternatives for any proposed USACE led Feasibility Study (see General Investigation Program under Section 5.4.1.2)

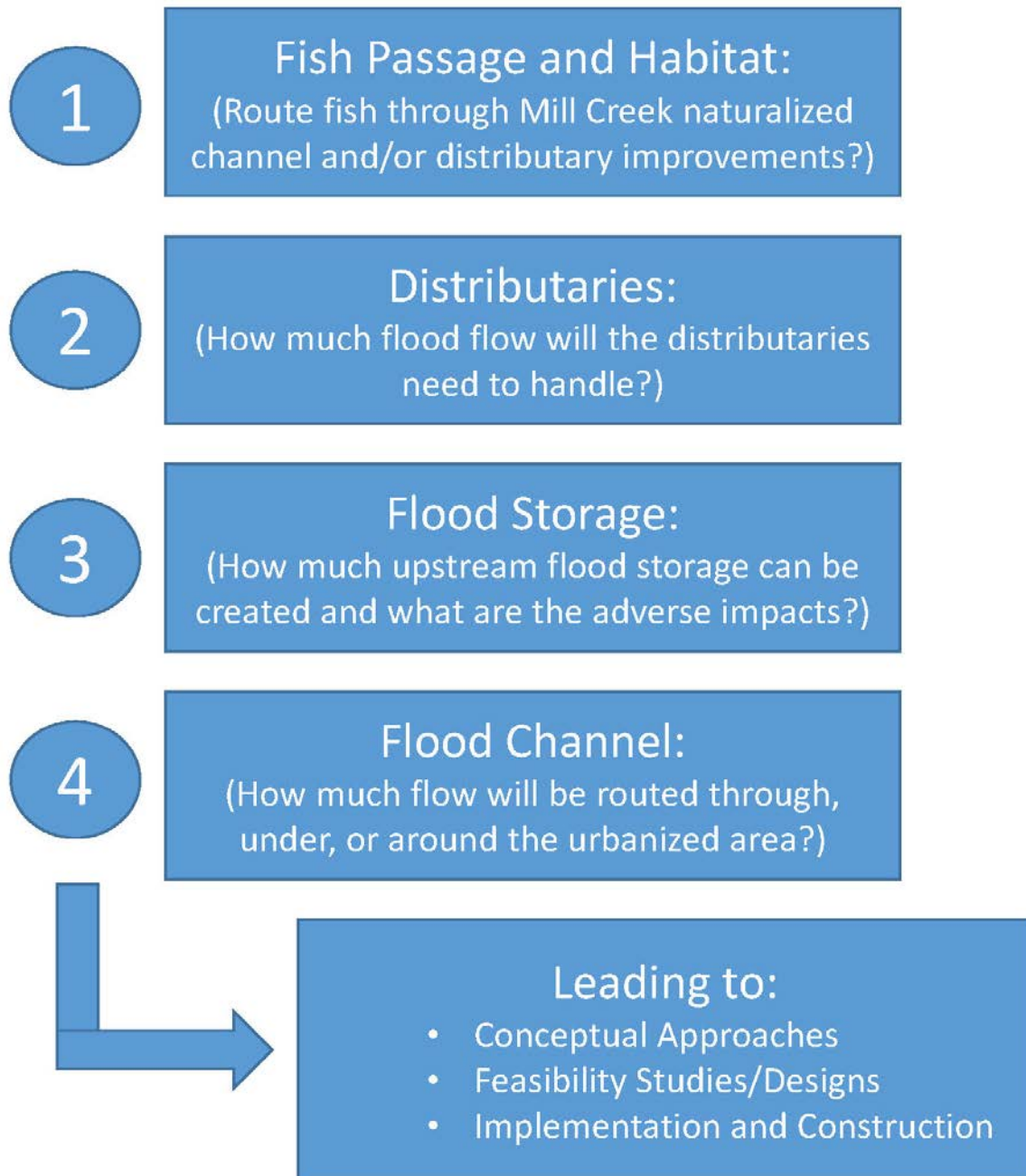


Figure 5.6-1. Stepwise Decision Framework

5.6.2 Evaluation of Scenarios Against Project Goal and Objectives

See Section 5.3.2 for an evaluation framework that can be used to evaluate identified system-wide management scenario for its ability to make measurable progress towards achieving the Project goal and objectives. The evaluation of the four management scenarios presented in Section 5.3.2 serves as an example of how other suggested management scenarios, such as the stakeholder suggested scenarios described in Section 5.3.3, could be evaluated as part of future planning efforts.

5.6.3 Defining Future Conditions of a System-wide Management Scenario

To help inform further investigation of system-wide scenarios and segment-level alternatives, this section provides an example of how to determine future conditions under a given scenario. This includes the identification of quantitative estimates (minimal and optimal) for each Project metric which further assists in considering a given scenario as it relates to risks, pros and cons, and eventual constructability and costs. For this section Scenario 3 was selected as the example scenario as it achieved several optimal metrics under the scenario evaluation against the Project's goal and objectives (see Section 5.2). In particular, Scenario 3 components such as improving flows, removing the concrete armoring, and restoring riparian and in-stream habitat in the channel have the most value for achieving the desired future conditions, improving limiting factors, and meeting Project objectives out of the four initially identified scenario in Section 5.3. Figure 5.6-2 demonstrates the conceptual feasibility of the naturalized channel within the existing ROW with the minimal, optimal, and flood flow water levels.

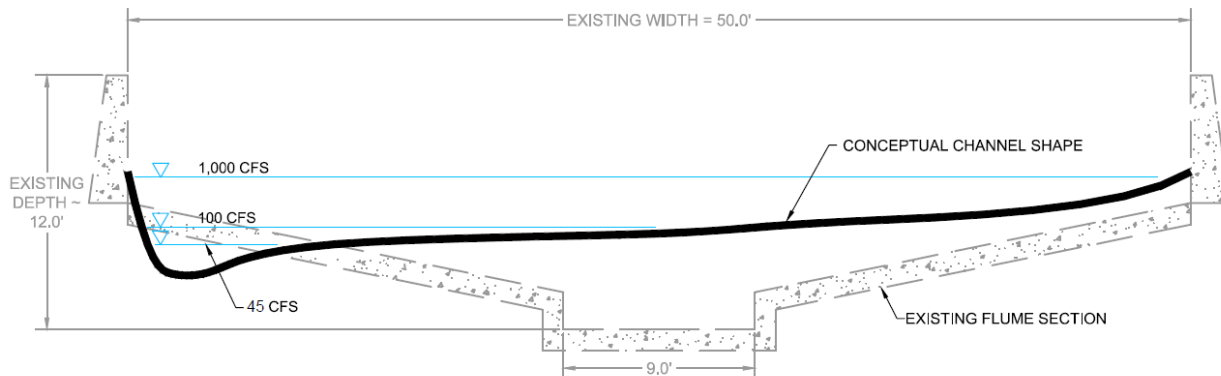


Figure 5.6-2. Scenario 3 Conceptual Channel and Flow Levels

In order to provide an improved understanding of the potential benefits of Scenario 3 and how some or all of the components of Scenario 3 might be used in a proposed feasibility study, each of the Project metrics (see Tables 1.2-1 and 1.2-2) were evaluated under this scenario to determine minimal and optimal future conditions as shown in Table 5.6-1 and Table 5.6-2. For the purposes of this analysis, the Project metric evaluation was focused on Segments 1 through 5 and does not account for changes that will also occur along distributaries or at new flood water conveyance/storage option locations. These would need to be incorporated as necessary into any proposed feasibility studies. A range of minimal and optimal metrics are provided in Table 5.6-1 and Table 5.6-2 to demonstrate the potential improved conditions anticipated in lower Mill Creek under Scenario 3.

Table 5.6-1. System Scenario 3 Current, Minimal, and Optimal Future Conditions - Project Metrics Associated with Project Objectives 1 through 6

Project Metrics	Mill Creek Current Conditions	System-wide Scenario 3 - Mill Creek Potential Future Conditions ^{1/}	
		Minimal	Optimal
Fish Passage Conditions	see Figure 2.8-31 and Appendix C	all site-specific fish barriers removed and/or treated (thermal)	all site-specific fish barriers removed and/or treated (thermal)
Flows and Barriers	80 cfs = average of the mean monthly flows	minimum 45 cfs for all segments	100 cfs for all segments
Primary Channel Length	85,600 feet	up to 10% increase	greater than 10% increase
Secondary Channel Length	Low	reconnect existing side channels	reconnect existing side channels and create new side channels
Bankfull Width ^{2/}	12 feet	44 to 54 feet	49 feet
Bankfull Depth ^{2/}	1.2 feet	2.3 to 2.9 feet	2.6 feet
Bankfull Cross-Sectional Area ^{2/}	12 square feet	114 to 140 square feet	127 square feet
Bankfull Width/Depth Ratio ^{2/}	10	23 – 25	19
Wetted Width	10 ft ^{3/}	15.7 feet ^{4/}	28.4 feet ^{5/}
Wetted Depth	0.2 ft ^{3/}	0.6 feet ^{4/}	0.8 feet ^{5/}
Cross-Sectional Area	2.2 square feet ^{3/}	9.1 square feet ^{4/}	23.5 square feet ^{5/}
Stream Velocities	1.8 to 3.0 feet/second	1.8 to 3.0 feet/second	2.1 to 3.0 feet/second
Gradient	1.10%	1.10%	1.10%
Sinuosity ^{2/}	1.06–1.17	increase from current where land use allows	increase from current where land use allows
Average Meander Pattern	sinuous	naturalized pattern	historic pattern
Braided-Channel Ratio ^{2/}	1.00 to 1.11	1.15	>1.15
River Complexity Index ^{2/}	0.0003 to 0.0014	0.0004 to 0.0019	0.0005 to 0.0022
Pool Frequency or Spacing ^{2/}	23 to 35 pools/mile (none in Segment 3)	23 to 35 pools/mile	23 to 48 pools/mile depending on width ^{6/} , adequate structures to sustain pools over time
Percent Pool Area ^{2/}	highly variable (none in Segment 3; > 90% in Segments 2 and 4; and 30 to 40% in Segments 1 and 5)	10 to 90% pool area	30 to 60% pool area
Relative Habitat Abundance	low habitat diversity	naturalized channel with increased pool and riffle habitat	mixed pools, riffles, and glides (30 to 60% each)
Relative Feature Abundance	low feature abundance (no structures in Segments 2 to 4)	1 structure per pool	3 or more structures per pool
Relative Abundance of Spawning and Rearing Habitat	low spawning and rearing habitat abundance (no spawning habitat in Segments 2 and 3) except in Segment 4 (>10% spawning and greater than 50% rearing)	naturalized channel designed specifically to increase the abundance of habitat spawning and rearing habitat	spawning and rearing habitat at or near historic abundance
LWD Counts ^{2/}	low existing LWD quantities (none in Segments 2 to 4)	15 pieces/mile (>12-inch diameter and > 35-foot length)	>20 pieces/mile (>12 inch diameter and > 35-foot length ^{6/})
LWD Budget	limited in site source of LWD and transport interrupted	adequate source and abundance of LWD	adequate source, abundance, and transport of LWD
Substrate Quality and Quantity	highly varied (concrete in Segment 3, fines dominate segments 2 and 4, gravel dominates Segments 1 and 5)	gravel/cobble substrate, <17% fines in gravel, embeddedness 20 to 30%	gravel/cobble substrate, <12% fines in gravel, embeddedness <20% ^{6/}
Sediment Budget	sediment transport processes are interrupted	Gravel augmentation; sediment transport occurs without a trend of aggradation or degradation	adequate supply of sediment and restored sediment transport processes
Temperature Regime ^{2/}	see Figure 2.8-31	limit in-stream temperature to no higher than 64°F (~18°C).	average water temperatures should be maintained below 57°F (14°C)
Hydrology ^{2/}	flows managed for flood control and public safety	flow depths and velocities suitable for spawning and rearing habitat and passage for focal species at all life history stages	flows levels that provide abundant, high quality spawning and rearing habitat and passage for focal species at all life history stages
Riparian Vegetation ^{2/}	little to no vegetation (<25% intact riparian corridor) except Segment 4 (75% intact riparian corridor)	>50% intact riparian corridor	>80% intact riparian corridor
Canopy Cover ^{2/}	low canopy cover (<25%) except in Segment 4 (50% to 75% canopy cover)	>50% wetted channel surface area covered	>75% wetted channel surface area covered
Percent of Floodplain Disconnected ^{2/}	50–100%	40–90%	30–80%
Floodplain Inundation ^{2/}	low	low	low

Table 5.6-1. System Scenario 3 Current, Minimal, and Optimal Future Conditions - Project Metrics Associated with Project Objectives 1 through 6 (cont.)

Project Metrics	Mill Creek Current Conditions	System-wide Scenario 3 - Mill Creek Potential Future Conditions ^{1/}	
		Minimal	Optimal
Relative Abundance of Floodplain Habitats	varied (none in Segments 2 and 3; 55 to 68 acres in Segments 1 and 4; and 175 acres in Segment 5)	30 to 200 acres	50 to 230 acres
Channel Migration Rate ^{2/}	low	naturalized channel designed specifically to increase floodplain inundation	floodplain inundation area at maximum given constraints
Flood Control and Public Safety	see Section 4.1	See Section 4.1	See Section 4.1
Current Adjacent Land Use	see Section 2.4 and 3.2	See Figures 3.2-2 through 3.2-8	See Figures 3.2-2 through 3.2-8
Focal Fish Species Timing	see Section 2.7	focal species timing not impeded by water quality, water quantity, or passage limitations most of the time	focal species timing not impeded by water quality, water quantity or passage limitations except in extreme circumstances
Focal Fish Species Distribution	see Section 2.7	focal species distribution at or near historic range most of the time	focal species distribution at or near historic range except in extreme circumstances
Focal Fish Species Habitat Use	see Section 2.8	naturalized channel designed specifically to provide habitat for focal species	focal species habitat use at or near historic levels
Land Management Areas	see Section 2.8.3 and 4.1	See Section 4.1	See Section 4.1
Floodplain Storage	limited floodplain storage	naturalized channel designed specifically to increase floodplain storage	increase floodplain storage and replenish aquifers through water exchange at or near historic levels
Percent of Bank with Vegetation	highly varied (<10% Segments 1 to 3; 25 to 90% Segments 4 and 5)	>50% bank vegetated	>75% bank vegetated

1/ Estimated target values to inform future design criteria and/or be compared against future monitoring results.

2/ The metric and evaluation method were developed in collaboration with the Physical Habitat Monitoring Strategy (Jones et al. 2015).

3/ Wetted dimensions modeled with HEC-RAS for average summer low flows (4 cfs).

4/ Wetted dimensions modeled with HEC-RAS for 45 cfs.

5/ Wetted dimensions modeled with HEC-RAS for 100 cfs.

6/ USFWS matrix of diagnostics, pathways and indicators (USFWS 1998).

Table 5.6-2. System Scenario 3 Current, Minimal, and Optimal Future Conditions – Project Metrics Associated with Project Objectives 7 and 8

Project Metrics or Topics	Mill Creek Current Conditions	System-wide Scenario 3 - Mill Creek Potential Future Conditions ^{1/}	
		Minimal	Optimal
Visibility of Mill Creek Corridor	Ranges from no visibility (underground portion) to highly visible. Most of corridor has moderate to low visibility from public and private observation points.	Daylight downtown corridor; remove chain-link fence along corridor; add some pedestrian access points to corridor through creation of parks and public spaces along stream channel; provide direct access to stream bank in some areas where ROW is widened. Seek to secure 25 percent of widened ROW sites identified in Figures 3.2-2 through 3.2-8.	Daylight downtown corridor; remove chain-link fence along corridor; add as many pedestrian access points to corridor as possible through creation of parks and public spaces along the stream channel; provide direct access to stream bank in most areas where ROW is widened. Seek to secure at least 50 percent of widened ROW sites identified in Figures 3.2-2 through 3.2-8.
Amount of Open Space throughout Mill Creek Corridor	Ranges from no open space adjacent to existing corridor to 100 percent open space adjacent (e.g., Rooks Park).	Seek to secure 25 percent of widened ROW sites identified in Figures 3.2-2 through 3.2-8.	Seek to secure at least 50 percent of widened ROW sites identified in Figures 3.2-2 through 3.2-8.
Connectivity of Mill Creek Corridor to System of Open Space and Recreation	Limited bicycle and pedestrian access to lower Mill Creek, especially in urbanized portions of Primary Focus Area. Multi-use recreation path extends along north and south levee of lower Mill Creek from Eastgate Lions Park east to Rook's Park (see Section 2.12). Pedestrian connections primarily sidewalks along streets that cross the channel (Figure 2.4-15), providing limited physical and visual access.	Increase pedestrian access points by 25 percent through creation of parks/public spaces along stream channel and integrate access to new parks/public spaces with existing network of sidewalks, pedestrian paths, bicycle routes, and multi-use recreation paths.	Increase pedestrian access points by at least 50 percent through creation of parks/public spaces along stream channel and integrate access to new parks/public spaces with existing network of sidewalks, pedestrian paths, bicycle routes, and multi-use recreation paths.
Stormwater, Streetscape, and Landscape Best Management Practices (BMPs)	City of Walla Walla working to retrofit existing network of direct inlets and short segments of storm pipe that convey stormwater to surface waters with compliant underground injection control facilities, surface infiltration facilities, or low impact design (LID) stormwater management features (City of Walla Walla 2015).	Retrofit 100 percent of existing stormwater outfall structures along lower Mill Creek within City of Walla Walla to address water quality and water temperature.	Retrofit 100 percent of existing stormwater outfall structures along lower Mill Creek within City of Walla Walla to address water quality and water temperature. Implement LID design and surface irrigation facilities at all new parks/open spaces created by lower Mill Creek restoration efforts.
Water Quality Treatment	City of Walla Walla owns 2,111 catch basins and 50 percent require replacement to address water quality (City of Walla Walla 2015).	Replace/upgrade existing catch basins that are impacted by restoration activities and install new standard catch basins where needed.	Replace/upgrade existing catch basins that are impacted by restoration activities and install new standard catch basins where needed.
Vegetation Along Bank and Adjacent Open Space	Nearly complete lack of riparian vegetation between of the start of urban core (near Gose Street crossing) and just downstream of Bennington Diversion Dam where limited riparian vegetation beginning to establish.	Increase vegetation along bank to a >50 percent intact riparian corridor and focus riparian plantings in widened ROW sites identified in Figures 3.2-2 through 3.2-8.	Increase vegetation along bank to a >80 percent intact riparian corridor and focus riparian plantings in widened ROW sites identified in Figures 3.2-2 through 3.2-8.
Access to Mill Creek Corridor	Bridges and adjacent roadways and paths most common public viewpoints. Between RM 0 and 15: 27 bridge crossings, including 23 roads, 2 public footbridges, 1 private footbridge, and 1 railway crossing. No physical access allowed in Segments 2, 3, and 4 for public safety protection.	Increase pedestrian access points by 25 percent through creation of parks/public spaces along stream channel. Allow direct access to stream bank through removal of chain-link fences and creation of at-grade access points to water.	Increase pedestrian access points by at least 50 percent through creation of parks/public spaces along stream channel. Allow direct access to stream bank through removal of chain-link fences and creation of at-grade access points to water.
Educational Features	Some interpretive signs/educational features exist in the Primary Focus Area, usually for historical or recreational facilities and not specifically Mill Creek (Figure 2.12-2). Signed walking path established on Garrison Creek for group restoration project in 2011 (Figure 2.12-3).	Include an average 1 interpretive sign per RM in Primary Focus Area about rehabilitation efforts, ecosystem, or fish passage/habitat.	Include a minimum of 2 interpretive signs per RM in Primary Focus Area about rehabilitation efforts, ecosystem, or fish passage/habitat.
Development Orientation to Mill Creek Corridor	Few existing land uses oriented to Mill Creek.	Create opportunities for public open space oriented along lower Mill Creek and for private development (e.g., hotels, cafes, shopping) to orient towards lower Mill Creek within Downtown Walla Walla.	Create opportunities for public open space oriented along lower Mill Creek and for private development (e.g., hotels, cafes, shopping) to orient towards lower Mill Creek throughout the Primary Focus Area.
Value of Watershed	See Sections 1 and 2.13	Increase economic value by restoring natural flood plain functions in some places. Seek to secure 25 percent of widened ROW sites identified in Figures 3.2-2 through 3.2-8 to widen the floodplain and create wetlands.	Increase economic value by restoring natural flood plain functions to greatest extent practicable. Seek to secure at least 50 percent of widened ROW sites identified in Figures 3.2-2 through 3.2-8 to widen the floodplain and create wetlands.
Fishery Benefits to Individuals and the Region	See Sections 1 and 2.13	Restore sustainable fishery to Mill Creek to support tribal fish harvests.	Restore sustainable fishery to Mill Creek to support tribal and non-tribal (recreational) fish harvests.
Opportunities for Involvement	See Appendix A	Stakeholder involvement process will continue throughout development of SAP, but will focus on distribution of work products for stakeholder review and presentation of these materials at the EC/TAC stakeholder meetings.	Stakeholder involvement process will continue throughout development of SAP, but will focus on distribution of work products for stakeholder review and presentation of these materials at the EC/TAC stakeholder meetings. Future design- and implementation-phase involvement to be determined.
Identify Regulatory Sideboards and Constraints	See Sections 4 and 5.5	See Sections 4 and 5.5	See Sections 4 and 5.5
Identify Regulatory Pathways and Opportunities	See Sections 4 and 5.5	See Sections 4 and 5.5	See Sections 4 and 5.5
Funding Opportunities for Implementation	See Section 5.5	See Section 5.5	See Section 5.5

^{1/} Estimated target values to inform future design criteria and/or be compared against future monitoring results.

5.6.4 Evaluate Constructability and Costs of a System-wide Management Scenario

Once one or more management scenario are identified and further refined through the process identified in Sections 5.6.1 through 5.6.3, the available information should be used to begin evaluating the constructability and costs associated with a given scenario. Operations and maintenance costs should also be evaluated and considered when selecting a preferred management scenario. For the four scenarios initially identified in this SAP, some of the constructability and cost considerations that should be further investigated are outlined in Section 5.3.3. These same considerations should be evaluated for any new system-wide management scenario identified through the strategic planning process.

5.7 IMPLEMENTATION PATHWAYS

Throughout the Assessment and strategic planning process, the CTUIR has collaborated with stakeholders to envision a system-wide approach that makes measurable progress toward achieving the Project goal and multi-use, multi-purpose objectives of fully resolving fish passage and improving floodplain function and in-stream habitat, and does so while maintaining or improving flood control, recreation, and economic values. To this end, the SAP portion of this Project (Section 5) has presented system-wide management scenarios identified by CTUIR and stakeholders, has provided a process for identifying other system-wide management scenarios, and provided a framework that can be used to evaluate how a given system-wide management scenario meets the Project goal and multi-use, multi-purpose objectives. Through ongoing collaboration with the stakeholders, it is the CTUIR's intent that this Assessment and SAP will inform future decision-making processes in any proposed USACE Feasibility Study or other technical planning/design vehicle or authority prepared with or independently of USACE, as well as to demonstrate that through an objective driven evaluation process, certain management scenarios meet multi-use, multi-purpose objectives better than others. The Assessment and SAP provide a solid foundation of information and strategy for stakeholders to advocate more effective ways to manage the Mill Creek system that meets desired conditions and multiple use and purpose objectives.

This section of the SAP provides the implementation pathways, as identified by stakeholders, which will be used to continue the strategic planning process that has been initiated in this SAP. It provides the stepping-stones that comprise the pathways needed to move towards a set of actions that will address multi-use, multi-purpose objectives for lower Mill Creek and are

necessary and interrelated for the achievement of the Project's goal and objectives. Because there are many planning-level steps needed before actions can be executed, the Project stakeholders identified four levels of action that provide the pathway toward making substantial progress at achieving multi-use, multi-purpose objectives. The four levels of action are comprised of immediate, urgent, short-term, and long-term actions. The sections below define the four levels of action and the associated actions that are necessary to accomplish regardless of the timing of a proposed USACE Feasibility Study or other technical planning/design vehicle or authority associated with lower Mill Creek. These four levels of action provide the basis for stakeholder engagement going forward and provide the actions needed to move towards achieving a multi-use, multi-purpose system where fish passage has been resolved, floodplain function and in-stream habitat improved, and flood control, recreation, and economic values have been maintained or improved.

5.7.1 Immediate Actions

Immediate actions are those that will be addressed by the stakeholders within six months following the completion of this Assessment and SAP. The immediate actions identified by the stakeholders include:

1. The CTUIR and WDFW developing a presentation for the next Mill Creek Working Group meeting that will be focused on identifying the stakeholders responsible for the urgent, short-, and long-term actions identified in this SAP.
2. The CTUIR and WDFW coordinating and conducting the next Mill Creek Working Group meeting during which individual stakeholders will be identified as members of a Mill Creek Management Implementation Team (MCMIT). The MCMIT will build upon this Project (i.e., Assessment and SAP) and be responsible for implementing and overseeing, measuring, and informing the Mill Creek Working Group on the progress of each of the urgent, short-, and long-term actions. The MCMIT will be in addition to or inclusive of the Mill Creek Working Group. This team will be led by co-managers with integration of the Mill Creek Coalition and other current EC members. The intent will be to integrate municipal, county, public use and safety (including flood control), and fish managers into a decision making process with a focus on resolving multi-use, multi-purpose objectives on lower Mill Creek. A lead position to support the MCMIT could be funded and supported by multiple agencies and partners with a focus on urgent actions as a primary responsibility.

5.7.2 Urgent Actions

Urgent actions are critical issues that will be substantially addressed by the MCMIT within 1 year following the completion of this Assessment and SAP. The urgent actions identified by the stakeholders include the MCMIT undertaking the following:

- 1) Developing a work plan to carry out the urgent actions and a proposed USACE Feasibility Study or other technical planning/design vehicle or authority associated with lower Mill Creek.
- 2) Developing and supporting an MOU or agreement amongst the stakeholders that supports the advancement of multi-use, multi-purpose objectives that meet ESA and Clean Water Act requirements in the work plan identified above (urgent action number 1) while recognizing that a proposed USACE Feasibility Study or other technical planning/design vehicle or authority may initially be flood control centric.
- 3) Identifying and obtaining sustainable funding that will be used to dedicate staff for guiding, organizing, and coordinating each of the urgent actions.
- 4) Addressing and promoting the urgent actions through consultation with the Mill Creek Working Group (if MCMIT established separately from the Mill Creek Working Group) and other stakeholder groups associated with Mill Creek.
- 5) Increasing stakeholder involvement, participation, and consensus on urgent, short-, and long-term actions through the following:
 - a) Facilitating, reviewing, and overseeing the development and management of the strategic planning process described in Section 5.6 of the SAP.
 - b) Developing a communication plan that will include:
 - (1) Identifying a strategy for obtaining public input on urgent, short-, and long-term actions (e.g., public meetings, online surveys, etc.).
 - (2) Developing presentations and materials for stakeholder and public meetings.
 - (3) Facilitating opportunities for land owners and stakeholders to coordinate through direct outreach.
 - (4) Developing and managing fact sheets of on-going and future restoration projects and available funds to implement those projects.
 - c) Developing a decision making plan that will include:

- (1) Establishing goals, purpose, and need of the objective for which decisions are evaluated against.
 - (2) Determining which type of decisions require stakeholder approval.
 - (3) Defining the decision making process.
 - (4) Providing a decision making tree or process diagram so all stakeholders understand and adhere to decisions and know what should be considered in making decisions.
- 6) Reviewing, revising, and addressing measurable multi-use, multi-purpose objectives that incorporate the following:
- a) Resolve fish passage, improve floodplain function and in-stream habitat, and maintain or improve flood control, recreation, and economic values.
 - b) Eliminate loss of floodplain connection and habitat and preventing future extinction of species (e.g., bull trout).
 - c) Define quantifiable approaches and progress tracking mechanisms (e.g., stakeholder involvement, committees) to ensure the multi-use, multi-purpose objectives will be addressed in all future proposed actions (i.e., management scenarios, alternatives, or concepts for long-term vision).
 - d) Determine approaches and methods for identifying and evaluating proposed actions (i.e., management scenarios, alternatives, or concepts for long-term vision) that address the multi-use, multi-purpose objectives.
 - e) Ensure consideration for adverse impacts on all species and habitats from a proposed action, especially actions involving the rerouting of flows or flood water storage, is evaluated as well as the likely public acceptance and support of the proposed action through the strategic planning process identified in Section 5.6 of this SAP.
 - f) Ensure proposed actions (i.e., management scenarios, alternatives, or concepts for long-term vision) adequately plan for and budget operations and maintenance of the proposed built and natural infrastructure.
 - g) Refined the evaluation criteria for selecting a preferred system-wide management scenario and short-term actions and use this criteria to inform future decision-making processes in a proposed USACE Feasibility Study or other technical

- planning/design vehicle or authority associated with lower Mill Creek, and ensure the evaluation criteria also meets the requirements of NEPA compliance.
- 7) Develop approaches and processes to track the integration of complimentary planning and management efforts (e.g., Walla Walla Basin Integrated Flow Enhancement Study, City of Walla Walla ASR Water Permit Plan, in-stream flow acquisitions, fish passage, park development).
 - 8) Identify and evaluate regulatory constraints and identify opportunities to improve regulatory processes and identify funding mechanism that may benefit the implementation of urgent, short-, and long-term actions.
 - 9) Make progress on the following short-term actions:
 - a) Implement fish passage projects in Segments 2, 3, and 4 by:
 - (1) Identifying and prioritizing fish passage projects throughout Mill Creek and its distributaries and tributaries.
 - (2) Identifying and protecting project access points for fish passage projects.
 - (3) Obtaining sustainable funding for implementing fish passage projects.
 - (4) Continuing the work lead by the Tri-State Steelheaders including the construction of low-flow channels and installation of weirs, baffles, and roughness panels in Segment 3; however, further evaluation and prioritization is necessary in Segments 2 and 4 to meet long-term actions and comprehensive objectives of the Project.
 - (5) Resolving fish passage at Bennington Diversion Dam and Division Works Dam and leveraging the work already completed by the USACE under the Section 1135 program (see Section 1.4.3.5).
 - (6) Addressing fish entrapment issues in Mill Creek's distributaries by installing fish screens where appropriate. This includes ongoing work by WWCCD and WDFW in Cold Creek, Doan Creek, and Schulke Ditch (see Table 1.4-2 in Section 1 of Assessment).
 - b) Identifying, prioritizing, and implementing land acquisition and protection, in-stream flow acquisition, floodplain protection and restoration, and habitat enhancement (ongoing) opportunities on lower Mill Creek, including enhancing its distributaries and tributaries.

- c) Continuing to implement shallow aquifer recharge projects.
- d) Addressing land-use planning and infrastructure improvement projects through ordinances, building codes, planning guidelines, etc. including the following specific actions:
 - (1) Identify and develop mechanism(s) to halt new floodplain development with a multi-level approach that includes acquisitions, public education and outreach, FEMA maps, regulations, voluntary agreements with landowners, land-use plans, park development (e.g., green space corridor along Mill Creek), and trail corridor (e.g., along levee system).
 - (2) Engage and advise on amendments to the County Comp Plan (Walla Walla County 2009) and on the major update to the City Comp Plan (City of Walla Walla 2008), Walla Walla 2040, with a focus on advocating for stronger shoreline setbacks (especially in downtown Walla Walla where the current minimum shoreline buffer width is 0 feet from N. 3rd Ave. to S. Colville Street) and prevention of new development within the floodplain.
 - (3) Review Walla Walla County and City of Walla Walla Critical Area designations and make recommendations as appropriate to further protect areas within the floodplain or along shorelines.
 - (4) Review Walla Walla County Code Chapter 18.08.085 allowed activities within designated critical areas and make recommendations to further restrict uses within the critical areas, if appropriate.
 - (5) Consult with City of Walla Walla on adopting a special district for the restoration of Mill Creek. This special district would have a specific plan that encapsulates the long-term management strategy for lower Mill Creek and its' distributaries within the City limits. The areas targeted for restoration/infrastructure improvements will be identified within the special district map and all proposed new development or proposed renovation or repair of existing buildings and infrastructure will be required to comply with the special district's plans for stream restoration and ROW expansion.
 - (6) Encourage the city and county to adopt more protective restrictions than currently required by their respective Comp Plans for new construction within

proximity of Mill Creek, Yellowhawk Creek, or Garrison Creek, thereby preserving opportunities for floodplain expansion and connectivity.

- (7) Protect existing open space adjacent to Mill Creek and its distributaries by placing lands into a land trust or conservation easement.
 - (8) Further investigate and address flood control infrastructure concerns and risks, including how to manage old buildings and condemned structures within or adjacent to the lower Mill Creek ROW.
- e) Construct/plant urban riparian buffers along lower Mill Creek and its distributaries. This includes continued implementation of the restoration of native riparian vegetation through partnerships with the Tri-State Steelheaders, Kooskooskie Commons, Walla Walla Basin Watershed Council, WWCCD, and participating land owners.
- 10) Reviewing and updating the urgent actions.

5.7.3 Short-Term Actions

Short-term actions are those that will be substantially addressed by the MCMIT within the next 1 to 5 years following the completion of this Assessment and SAP. The short-term actions identified by the stakeholders include:

- 1) Continuing to address and complete the short-term actions identified above under number nine of the urgent actions until a proposed USACE Feasibility Study or other technical planning/design vehicle or authority associated with lower Mill Creek is funded.
- 2) Providing technical support and coordination to the Mill Creek Coalition and others stakeholders on obtaining funds for a proposed USACE Feasibility Study or other technical planning/design vehicle or authority associated with lower Mill Creek that incorporates multi-use, multi-purpose objectives.
- 3) Continuing to identify other funding mechanisms that work in coordination or independent from a proposed USACE Feasibility Study or other technical planning/design vehicle or authority.
- 4) Developing a matrix that tracks short-term actions and the relationship to long-term actions (e.g., screening off distributaries in the short-term, with the understanding of

reconnecting in the long-term) that includes a cost/benefit approach to evaluating the connections.

- 5) Making progress on long-term “must haves” that include:
 - a) Addressing multi-use, multi-purpose objectives and all associated action items identified above under number six of the urgent actions.
 - b) Continuing to manage and implement all associated actions items identified above under number five of the urgent actions.
 - c) Improving methods for maintenance of City and County infrastructure.
 - d) Resolving fish passage throughout Mill Creek and its distributaries, including all life-history stages, up- and downstream movement, and thermal barriers.
 - e) Maximizing floodplain function (i.e., inundation and storage), in-stream habitat, and thermal benefits in Mill Creek and its distributaries and tributaries, including reconnecting of lost habitat where appropriate.
 - f) Maintaining or improving flood control, recreation, and social and economic amenities.
 - g) Increasing opportunities for people in Walla Walla to have wildlife interactions.
 - h) Decreasing flood risk throughout the Mill Creek drainage.
 - i) Improving infrastructure and safety for the community along Mill Creek, while increasing opportunities for the community to engage with the stream.
 - j) Addressing in-stream flows throughout the Mill Creek drainage through:
 - (1) Ongoing CTUIR efforts such as the Walla Walla Basin Integrated Flow Enhancement Study (pers. com., Gary James, Program Manager, CTUIR, Pendleton, Oregon, May 24, 2017) and in-stream flow acquisitions.
 - (2) Developing an approach for acquiring additional water rights to increase instream flows during low-flow periods of the year.
 - (3) Encouraging the adoption of consumptive use goals, primarily for the City of Walla Walla, but for all Mill Creek surface water and ground water users.
 - k) Increasing spring Chinook salmon reintroductions through the CTUIR fisheries staff.

- l) Developing an integrated approach to storm water runoff as part of both the short- and long-term actions.

5.7.4 Long-Term Actions

Long-term actions are those priorities that will be completed by the MCMIT as part of the short-term actions or begin within the next 5 years following the completion of this Assessment and SAP. The long-term actions identified by the stakeholders include:

- 1) Continuing to work in coordination or independent from a proposed USACE Feasibility Study or other technical planning/design vehicle or authority to identify a stakeholder preferred management strategy for lower Mill Creek.
- 2) Continuing to coordinate with the County and City to address land-use planning and infrastructure improvement projects through ordinances, building codes, planning guidelines, etc. including the specific actions described under urgent actions item 9(d) to facilitate the implementation of short- and long-term actions and to protect existing open spaces.
- 3) Making measurable progress on addressing the long-term “must haves” and all associated action items identified above under number five of the short-term actions.
- 4) Receiving sustainable funding to complete the short- and long-term actions.
- 5) Implementing an integrated approach to storm water runoff developed as part of both the short- and long-term actions.
- 6) Completing technical studies and investigations that will be needed to inform short- and long-term actions and feasibility of any proposed actions that include:
 - a) Conducting PCB source (major impact on aquifer recharge) identification, including increasing the City efforts associated with the waste water treatment plant.
 - b) Analyzing stormwater and wastewater management and its effects on surface and ground water quality based on water samples collected near locations of the former dump site downstream of Tausick Way and downstream of the Stubblefield cleanup site near Myra Road.
 - c) Conducting water temperature data collection and modeling along lower Mill Creek and its primary tributaries (i.e., Yellowhawk and Garrison Creeks) to understand where water temperatures are most problematic, where stormwater influences water

- temperature, and how cold water inputs at specific points along the channel influence water temperature.
- d) Analyzing water temperature data collected by WDFW and other available water temperature information to perform modeling of various channel configuration combinations and in-stream flows described under a particular proposed action.
 - e) Utilizing the water temperature modeling results, evaluate proposed action(s) in terms of flow regimes and channel configurations to determine the most successful action(s) for reducing high water temperatures during the summer months.
 - f) Conducting a tracer dye study, or equivalent, on Yellowhawk Creek to determine the in-stream flows the channel can accommodate currently without localized flooding and how increased flows may affect adjacent property owners.
 - g) Conducting a study of fish movement to increase the understanding of fish species' distribution, timing, and use of Mill Creek, distributaries, and Bennington Lake.
 - h) Performing a ground-based aquatic habitat assessment to fully recognize impacts to floodplain/channel function, understand the magnitude of habitat and habitat complexity lost from encroachment of riverine channel floodways, and document the potential for restoring lower Mill Creek.
 - i) Incorporating the USACE dam break analysis and identified areas outside levees that should be protected from development.
 - j) Completing a geotechnical investigation of the existing Mill Creek flood control channel, as well as necessary locations associated with proposed actions.
 - k) Conducting a structural stability assessment and hydraulic modeling to evaluate proposed infrastructure improvements and removals.
 - l) Performing additional sediment characterization and transport study in each Project segment to ensure proposed actions are process-driven, suited for site-specific geomorphic conditions, and adequately evaluated in terms of the amount of sediment that can aggregate before channel capacity is compromised.
 - m) Investigating floodplain aquifer recharge sites as feasible proposed actions, including through geotechnical and hydrological feasibility, as well as investigating small reservoirs north of Titus and off the main channel of Blue Creek and groundwater recharge up-gradient from and below Bennington Lake.

- n) Modeling floodplain storage potential under proposed action(s) to evaluate the potential changes in storage, groundwater levels, and vertical stream-aquifer hydrologic connectivity.
- o) Conducting detailed modeling of climate change and its potential effect on future flood events, flows, and flood storage needs.
- p) Investigating the feasibility and preliminary designs of large fish screen(s) at the Bennington Diversion Dam, Division Works Dam, and locations where channel-spanning screens would be required (e.g., see Scenario 4 under Section 5.3.3.3) adequate to address high discharge, debris, and bedload movement that can be expected under different proposed actions for managing flood waters while protecting fish and without increased risk of flooding or jeopardizing public safety.
- q) Developing engineering designs of proposed actions that addresses the multi-use, multi-purpose objectives for selection of locally preferred proposed action(s).
- r) Evaluating costs associated with the locally preferred proposed action(s).
- s) Continuing to identify and evaluate regulatory constraints and opportunities to improve regulatory processes that benefit the long-term actions and mechanism that provide funding towards lower Mill Creek.

6. Conclusion

Lower Mill Creek is in urgent need of restoration and infrastructure investment both from a natural resource and a flood risk mitigation perspective. Although upper Mill Creek offers excellent aquatic habitat and pristine water quality, lower Mill Creek has lost significant channel and floodplain function and no longer provides adequate fish passage or habitat. This is due to decreased flows, physical and thermal barriers, and highly managed creek channels resulting from agricultural development, urbanization, and flood control activities. The inaccessibility of the high-quality habitat upstream combined with lost rearing and spawning habitat in lower Mill Creek have made the current condition of lower Mill Creek a significant factor limiting the recovery of populations of ESA-listed fish species. At the same time, issues related to lower Mill Creek's aging flood control infrastructure and the expectation that climate change may alter the timing and magnitude of peak flows (USFWS 2011) amplify the potential risks for safety and flood protection. The Walla Walla community considers the study of flood risk presented in lower Mill Creek a high priority (Dozier et al. 2015). Together, the concerns for improved flood risk mitigation and recovery of fish species through passage improvements and increased rearing and spawning habitat compound the urgency for restoration and infrastructure investments throughout lower Mill Creek.

The Mill Creek watershed is considered a key population component for the recovery of the Mid-Columbia steelhead DPS, currently designated as Threatened under the federal ESA and a Candidate species by Washington State. Mid-Columbia spring Chinook salmon were extirpated in the Walla Walla subbasin in the 1920s; however, the CTUIR and other stakeholders are working to reestablish this stock in the Walla Walla system including Mill Creek. Mid-Columbia steelhead and Mid-Columbia spring Chinook are important locally and regionally for social, economic, environmental, and cultural reasons. The focal fish species discussed in the Assessment and SAP will continue to be under threat, with the eventual extinctions of these fish species, as long as lower Mill Creek's issues of low summer flows, physical/thermal barriers, lack of fish and riparian habitat, high water temperatures, and encroaching urbanization continue.

The CTUIR and the lower Mill Creek stakeholders understand the urgency of addressing not only the problems related to flood control and safety, but also the need to address fish passage and habitat. This is why Mill Creek and its tributaries should be viewed as a holistic system

with multiple uses and purposes and why a system-wide management plan must be created for lower Mill Creek.

The SAP provides a strategic planning process that could ultimately result in a stakeholder-identified and -supported system-wide management scenario that successfully balances the multiple uses and purposes of the Mill Creek system. The CTUIR, in collaboration with stakeholders, identified an initial set of system-wide management scenarios in the SAP; however, this is only a start to the future planning work that must continue if lower Mill Creek is to be restored to fully resolve fish passage (defined as meeting NMFS and WDFW fish passage criteria), improve fish habitat, and improve the conditions of River Vision touchstones (Jones et al. 2008), while maintaining or improving flood control, recreation, and economic values – a goal which was agreed upon by all stakeholders involved with this Project.

The work completed in the Assessment and SAP is the start of a larger strategic planning process. A critical next step is to form the MCMIT to facilitate, oversee, and implement the development and management of the strategic planning process described in the SAP. A coalition of stakeholders should participate in the MCMIT and collaborate on providing funding to hire staff or experts to continue this planning process. Ultimately, the MCMIT should provide technical support and coordination to the Mill Creek Coalition and other stakeholders on obtaining funds for a proposed USACE Feasibility Study or other technical planning/design vehicle or authority associated with lower Mill Creek that incorporates multi-use, multi-purpose objectives. Over the next 5 years, beginning with the immediate actions within 6 months of the completion of this document, a stakeholder-supported system-wide management plan should be selected, designed, and funded so that the long-term vision for Mill Creek can be realized and supported by the immediate and short-term restoration and flood control investments implemented in the near future.

As stated in the Assessment and SAP, the USACE Walla Walla District is working to get a Feasibility Study (under the General Investigation Program) included in the agency's budget request. Walla Walla County would likely be the non-federal sponsor. If a USACE Feasibility Study were funded, the CTUIR and stakeholders would advocate for the SAP to be integrated into the study resulting in the inclusion of a locally preferred alternative that has multi-purpose, multi-beneficial solutions. If the Feasibility Study does not incorporate such solutions, then the CTUIR and stakeholders will pursue planning and design of a multi-purpose, multi-beneficial management scenario through other technical vehicles or authorities, including legal approaches if necessary. Figure 6-1 provides an illustration of these possible paths forward.

Lower Mill Creek Restoration - Possible Paths Forward

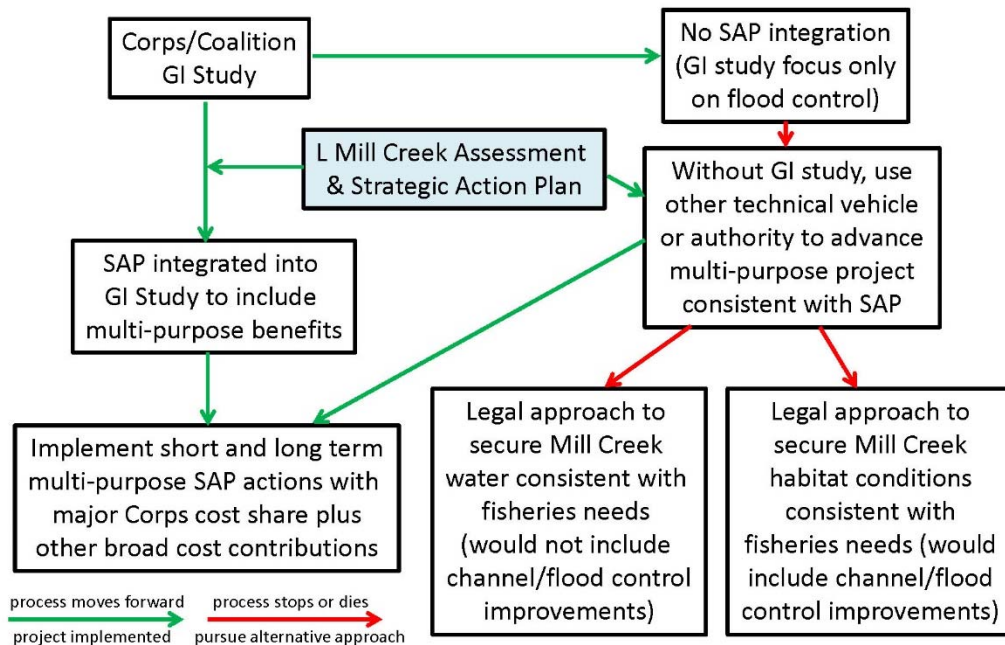


Figure 6-1. Possible Paths Forward for Implementation

While the long-term, holistic strategy for improving fish passage, fish habitat, and flood control infrastructure is still being refined, planned, and eventually designed, the urgent actions identified in Section 5.7.2 should be implemented. The following actions are the most critical for decreasing take and supporting the survival of ESA-listed fish, as well as increasing the safety and flood protection and community connection for the Walla Walla community along lower Mill Creek. These actions should be implemented within the next 5 years:

- Construct fish passage structures at Bennington Diversion Dam and Division Works Dam that function at all flows.
- Identify and protect open spaces along the existing lower Mill Creek and the Yellowhawk and Garrison creek ROWs.
- Acquire additional water rights and/or implement water management strategies to increase minimal in-stream flows of lower Mill Creek to 45 cfs.
- Continue to implement shallow aquifer recharge projects.

- Further investigate and address flood control infrastructure concerns and risks, including how to manage old buildings and condemned structures within or adjacent to the lower Mill Creek ROW.
- Engage with and advise the City of Walla Walla and Walla Walla County on implementing more strict land use control on new construction within the floodplain or within proximity of the shoreline of lower Mill Creek or its distributaries.
- Conduct public outreach with the community to educate the public on the ecological and cultural importance of lower Mill Creek and the potential restoration opportunities that will bring economic and natural resource amenities to the community.
- Complete technical studies and investigations that will be needed to inform short- and long-term actions and evaluate the feasibility of any proposed actions (see Section 5.7.4 for a detailed list of technical studies needed).

In conclusion, the community of Walla Walla and the broad group of Mill Creek's stakeholders have no time to waste. A number of focal species in the Mill Creek watershed are at risk for extirpation and the safety of property and life in Walla Walla County may be at risk from flood damage. Every year, these issues escalate due to continued urban encroachment along the stream corridors and within the floodplain, rising summer temperatures, and increased demands for water. The entire Mill Creek drainage holds ecological and cultural significance to the CTUIR because this creek system is integral to the CTUIR's First Foods and River Vision, and improvements to fish passage and habitat are necessary to address ESA-listed salmonids and Tribal treaty rights. In addition, given the urban context of the lower portions of the Mill Creek drainage, opportunities to create economic and community amenities and to reconnect the urban community to the water and its natural ecosystem must be explored. The work completed by the CTUIR and stakeholders through this Project is only the beginning of the work that must continue as the stakeholders and community near lower Mill Creek continue to engage and envision a restored Mill Creek system that benefits both fish and the community of Walla Walla.

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APPENDIX A
STAKEHOLDER INVOLVEMENT SUMMARY

Lower Mill Creek Habitat and Passage Assessment and Strategic Action Plan

Stakeholder Involvement Summary

Submitted to:



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Walla Walla Community College
Water and Environmental Center, Office 485
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May 2016

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1. Introduction

The Lower Mill Creek Habitat and Passage Assessment and Strategic Action Plan (the Project) is being undertaken by the Confederated Tribes of the Umatilla Indian Reservation (CTUIR), with work expected to occur throughout 2015 and 2016. The CTUIR has subcontracted the development of an Assessment and Strategic Action Plan to the firm Tetra Tech, Inc. As part of this planning process, extensive coordination between numerous agencies, organizations, and stakeholders with vested interests in the welfare of Mill Creek has been conducted and will continue to be conducted throughout the Project. The Project goal is to make ecologically and physically measurable progress toward fully resolving fish passage, improving fish habitat, and improving the conditions of River Vision touchstones (Jones et al. 2008) while maintaining or improving flood control, recreation, and economic values, and facilitating support among key stakeholders. The CTUIR understands that in order to develop a strong base of support for implementing any necessary changes to Mill Creek, it is critical to engage with the various stakeholder interests. To accomplish this, the CTUIR has developed a stakeholder involvement process that consists of meetings, questionnaires, interviews, and targeted outreach. The stakeholder involvement process is intended to identify, assess, and address the wide range of interests within the framework of the CTUIR goal and objectives for Mill Creek. This document provides a description of the Project's stakeholder involvement process and a summary of the feedback received.

2. Stakeholder Involvement Process

The CTUIR recognizes that there are varying levels of interests, responsibilities, and concerns for lower Mill Creek. A comprehensive list of stakeholders was developed representing a range of stakeholder interests related to natural resources, flood protection, water supply, economic development, property rights, public access, and urban amenities.

Based on the varying levels of stakeholder interests, four levels of stakeholder groups were identified: Executive Committee (EC), Technical Advisory Committee (TAC), and Other Stakeholders and Contributors. Each group was assigned different roles, tasks, and level of stakeholder involvement as described below:

- EC – Provides project guidance and direction on the broad issues of policy, jurisdictional constraints, and implementation at major milestones throughout the Project.

- **TAC** – Provides technical support, evaluation, assessment and peer review of documentation; and
- **Other Stakeholders & Contributors (Others)** – Provides input regarding areas of special interest influencing Lower Mill Creek.

A list of stakeholders within each category is included the Table 1 below.

Table 1. Stakeholder List and Tiers

Organization/Entity	EC	TAC	Others
CTUIR	X	X	
Tetra Tech (CTUIR Contractor)	X	X	
<i>Federal</i>			
USACE	X	X	
Bonneville Power Administration (BPA)			X
National Oceanic and Atmospheric Administration (NOAA)	X	X	
National Marine Fisheries Service (NMFS)			
U.S. Fish and Wildlife Service (USFWS)		X	
U.S. Environmental Protection Agency (EPA)		X	
U.S. Forest Service		X	
<i>State</i>			
Washington Department of Fish and Wildlife (WDFW)	X	X	
Washington Department of Ecology (Ecology)		X	
Washington Department of Natural Resources		X	
Washington Department of Transportation		X	
<i>Regional/Local</i>			
Walla Walla County Flood Control District	X	X	
Walla Walla County Conservation District	X	X	X
Walla Walla County			
City of Walla Walla	X	X	
Port of Walla Walla		X	
Walla Walla Valley Metropolitan Planning Organization		X	
<i>NGOs</i>			
Downtown Walla Wall Foundation			
Walla Walla Watershed Council	X	X	
Walla Walla Watershed Management Partnership	X	X	
Snake River Salmon Recovery Board (SRSRB)	X	X	
Tri-State Steelheaders		X	
Blue Mountain Land Trust			X
Blue Mountain Audubon Society			
National Fish and Wildlife Foundation			X
Kooskooskie Commons			X
Walla Walla 2020			X
Community Council			X
Citizens for Good Governance			X
Walla Walla Wine Alliance			X
Walla Walla Valley Chamber of Commerce			X
Tourism Walla Walla			X
<i>Others</i>			
Members of Mill Creek Working Group	X	X	
Members of Mill Creek Coalition (Silent Member)	X	X	
Private citizens with technical knowledge of Mill Creek		X	

Table 1. Stakeholder List and Tiers (continued)

Organization/Entity	EC	TAC	Others
Concerned citizens with a vested or personal interest			X
Walla Walla Community College (WWCC) – William A. Grant Water & Environmental Center		X	
Washington State University – School of Engineering and Architecture; School of Design & Construction			X
Whitman College			X
Walla Walla School District			X
Irrigation Districts (Gose, Hydro, Bialock, Bialock Orchards, Orchard, Gardena, etc.)			X
Whitman Mission Water District			X
Downtown business owners			X
Property owners (adjacent, downtown, commercial, private)			X

A stakeholder outreach effort was initiated with each of the stakeholder groups to identify key individuals and solicit their input using e-mail, phone calls, meetings, questionnaires, and interviews. The CTUIR initiated the effort by sending out e-mails to the stakeholders requesting their involvement in the process, and asking them to complete and return a distributed questionnaire. The CTUIR and Tetra Tech followed up with individual e-mails and phone calls to further encourage stakeholders to participate and respond.

Two key stakeholder groups actively working on the development of plans for Mill Creek include the Mill Creek Coalition and the Mill Creek Working Group. The CTUIR made extensive efforts to reach out to those groups through meetings, presentations, and interviews.

The Mill Creek Coalition consists of representatives from the City of Walla Walla, Walla Walla County, Port of Walla Walla, the Downtown Walla Walla Foundation, and the U.S. Army Corps of Engineers. Their combined interests broadly represent flood protection, economic development, and urban amenities. Their focus is to secure funding to develop a feasibility study and action plan, and ultimately, construct long-term improvements to Mill Creek. The CTUIR coordinated with all interested members of the Mill Creek Coalition on an individual basis. At this time, the Mill Creek Coalition has indicated that they will not formally participate in the Project as an organization, but will have one member of the Coalition sit on the EC in order to keep the Coalition updated on the Project’s progress. This Coalition member will not speak on behalf of the Coalition during the EC meetings. Individual members of the Coalition may participate in the Project as individuals, but will not represent the Coalition.

The Mill Creek Working Group consists of a broad range of agency and nongovernmental organizations that have an interest in Mill Creek’s natural resources. The CTUIR provided questionnaires to 79 members of the Mill Creek Working Group and interviewed several

members. Similar to the Mill Creek Coalition, the Mill Creek Working Group has elected not to have a designated representative serve on the EC or TAC. Each individual Working Group member who has completed a questionnaire or participated in interviews chose to respond as representatives of their own organizations and not the Working Group. Presentations by the CTUIR to the Mill Creek Working Group will continue throughout the Project, as will the continued involvement of individual members participating in this Project.

Overall, the CTUIR will provide updates and presentations on the Project at the request of the Working Group and Coalition and intends to be as inclusive as possible with both entities.

Table 2 includes a list of stakeholders who have agreed to participate on the EC or TAC. Footnotes indicate which of these stakeholders also participate on the Mill Creek Coalition and/or the Mill Creek Working Group.

Table 2. EC and TAC Members

Key Stakeholders (Ec)		Organization
Dean Holecek, Tribal Liaison		USACE
Diane Driscoll, Fisheries Biologist, Columbia Basin Branch ^{2/}		NOAA NMFS
Paul Wemhoener ^{1/} (silent member)		Mill Creek Coalition
Steve Pozzanghera, Regional Director		WDFW
Mark Wachtel, Regional Habitat Program Manager, R1-Eastern Region ^{2/}		
Steve Martin, Director ^{2/}		Snake River Salmon Recovery Board
Wayne John, Chief of Road Operations & Maintenance ^{1/2/}		Walla Walla County Flood Control District
Nabiel Shawa, City Manager ^{1/2/}		City of Walla Walla
Rick Jones, District Manager		Walla Walla County Conservation District
Chris Hyland, Executive Director		Walla Walla Watershed Management Partnership
Brian Wolcott, Executive Director ^{2/}		Walla Walla Basin Watershed Council
Key Stakeholders (TAC)		Organization
Cindy Boen, Chief, Plan Formulation Section ^{1/2/}		USACE
Michelle Eames, Eastern Washington Field Office ^{2/}		USFWS
Dave Karl, WDFW Habitat Program ^{2/}		WDFW
Bruce Heiner, P.E. ^{2/}		WDFW
Brian Burns, Executive Director and Project Manager ^{2/}		Tri-State Steelheaders
John Foltz, Lead Entity Coordinator ^{2/}		Snake River Salmon Recovery Board
William Dowdy, District Fish Biologist		U.S. Forest Service, Walla Walla Ranger District, Umatilla National Forest
Ki Bealey, Public Works Director		City of Walla Walla (Public Infrastructure)

Table 2. EC and TAC Members (continued)

Key Stakeholders (TAC)	Organization
Elizabeth F. Chamberlain, Development Services Director	City of Walla Walla (Shoreline Management)
Jim Kuntz, Executive Director ^{1/}	Port of Walla Walla
Victoria Leuba, Supervisor in Water Resources ^{2/}	Ecology
Eric Hartwig, ERO Walla Walla ^{2/}	Ecology
Elio Agostini, Executive Director ^{1/2/}	Downtown Walla Walla Foundation
Dave Stockdale, Director William A. Grant Water & Environmental Center	Walla Walla Community College
Gerald J. Anhorn, Dean, Ag, Energy, and Water Programs ^{2/}	Walla Walla Community College
Andrea Weckmueller-Behringer, Executive Director	Walla Walla Valley Metropolitan Planning Organization
Scott Anfinson, Regional Maintenance Environmental Coordinator	Washington Department of Transportation
Barbara Clark, President	Walla Walla 2020
Glen Mendel ^{2/}	Private Citizen; Retired WDFW; Technical knowledge of Mill Creek
Sean Taylor, WDFW Fish Passage & Screening Biologist ^{2/}	WDFW
Mike Denny	Blue Mountain Audubon Society - Walla Walla Chapter
Cathy Schaeffer, Deputy District Director ^{1/}	Congresswoman Cathy McMorris Rodgers, Fifth District, Washington
Tom Glover, AICP, Director Community Development Department	Walla Walla County
Mike Kuttel Jr.	Ecology
Judith Johnson, Program Coordinator ^{2/}	Kooskooskie Commons
Amy Molitor, President	Kooskooskie Commons
Randy Glaeser, Director/County Engineer ^{2/}	Walla Walla County Public Works

1/ Members of the Mill Creek Working Group

2/ Members of the Mill Creek Coalition

Representatives from the Bonneville Power Administration and the City of College Place declined an invitation to participate on the TAC, but will be kept updated on the Project’s progress throughout the process. The stakeholder process does not consist of a statistically correct sampling of the general population, but rather a targeted outreach to stakeholders whose organizational missions or primary responsibilities directly or indirectly involve or relate to Mill Creek. It is anticipated there will be future opportunities for general public involvement during refinement, feasibility studies, design, and implementation of the recommendations contained in the Strategic Plan.

A more in-depth discussion of the outreach effort and corresponding results is provided below.

2.1 MEETINGS

A meeting was held with the EC at the Walla Walla Community College Water & Environmental Center on October 22, 2015. All of the EC members were in attendance. The purpose of the meeting was to introduce the Project, Primary and Secondary Focus Areas, Project goal, objectives and metrics, the stakeholder process, and Project schedule, and to solicit feedback regarding the Project and data needs.

The CTUIR also presented an update on the Project to the Mill Creek Working Group on April 13, 2016. Presentations by the CTUIR to the Mill Creek Working Group will continue throughout the Project as requested.

A series of three meetings are planned with the EC and TAC members during future Project phases to: 1) present the draft Assessment and future conditions for each break; 2) present the Concept Alternatives; and 3) present the final Concept for each break and draft Strategic Action Plan.

2.2 QUESTIONNAIRES AND INTERVIEWS

2.2.1 Distribution, Participation and Response

The CTUIR sent out a total of 51 questionnaires by e-mail to the EC, TAC, and Other Stakeholders (in addition to the 79 questionnaires sent to the Mill Creek Working Group, making a total of 130 distributed questionnaires, although some of the Working Group members also serve on the EC or TAC and therefore received the questionnaire twice). Follow-up e-mails were sent and/or phone calls made to encourage completion and return of the questionnaires. A total of 30 completed questionnaires were returned with a response rate of 78 percent EC, 54 percent TAC, and 57 percent Other Stakeholders.

In addition to the questionnaires, the CTUIR and Tetra Tech extended an invitation to all the key stakeholder an opportunity to be interviewed. The CTUIR and Tetra Tech also identified certain stakeholders for interview outside of the EC and TAC based on their involvement and expertise or background knowledge related to Mill Creek. In some instances, group interviews were arranged with multiple stakeholders at their request, as in the case of the Walla Walla Community College Water and Environmental Center and the City of Walla Walla.

A total of 16 stakeholders were interviewed in-person. Five of these stakeholders not only participated in interviews, but also completed and returned completed questionnaires. Written

interview summaries were prepared following each interview and included in the outreach documentation. The results of the interviews have been combined with the completed questionnaire responses, and have been incorporated into the summaries of stakeholder concerns and comments.

Table 3. Stakeholder Outreach Response Results

Stakeholders	Questionnaires		Persons Interviewed
	Sent	Returned	
Executive Committee (EC)	9	7	4
Technical Advisory Committee (TAC)	28	15	9
Other Stakeholders	14	8	3
TOTAL	51	30	16

Tetra Tech and the CTUIR received feedback through the form of interviews or completed questionnaires from a total of 46 stakeholders. Note that the information contained in the 30 completed and returned questionnaires is considered representative of the 51 stakeholders who were sent questionnaires. It is also anticipated some additional interviews will be conducted throughout the process to obtain additional input and clarification.

2.2.2 Summary of Questionnaire Priorities

Through the questionnaire, the CTUIR asked stakeholders to assign a priority rating to 18 different resources or issues relative to Mill Creek. The level of importance ranged from 1 being the lowest to 5 being the highest priority. Of the 30 completed questionnaires received, only 24 contained completed priority rating tables, and only 5 respondents assigned a value to every resource or issue while the rest assigned values to some but not all resources or issues. Table 4 reflects the total number of responses provided from the 24 completed priority rating tables for each ranking of each resource or issue. For example, under the resource “Habitat,” two respondents ranked it as a “1” priority (lowest priority) while 11 respondents ranked it as a “5” (highest priority). By multiplying the number of responses by the corresponding weighted priority value, it is possible to establish a composite value by resource or issue. EXAMPLE: Habitat = (2)x(1)+(0)x(2)+(5)x(3)+(4)x(4)+(11)x(5) = 80.5. Review of the composite value resulted in the rankings shown in the far right column of Table 4.

Table 4. Summary of Priority Rating for Completed Questionnaires

Resource or Issue	Responses by Priority					Composite Weighted Value	Total Average (total/ # of subcategories)	Rank
	1	2	3	4	5			
Natural Resource							80.5	1
Habitat	2	0	5	4	11	88		
Fisheries	2	0	5	4	10	83		
Water Quality	2	0	3	7	9	84		
Land Conservation	2	4	7	4	4	67		
Flood Protection							78	2
Public Safety	3	0	3	4	12	88		
Infrastructure	4	2	3	4	7	68		
Water Supply							58	5
Rural	5	1	3	7	2	54		
Municipal	3	4	2	2	7	60		
Manufacturing & Industrial	4	5	4	3	2	48		
Irrigation	4	1	7	5	2	57		
In-stream Uses	4	3	2	5	7	71		
Economic Development							59.3	4
Commercial/Industrial	5	4	5	3	2	50		
Agriculture	5	2	3	5	4	58		
Tourism	2	3	6	1	8	70		
Public Access							61.5	3
Business	4	5	2	5	2	50		
Recreation	3	3	4	3	8	73		
Property Rights	6	2	5	3	4	57	57	7
Urban Amenity	2	3	5	5	3	58	58	5

Figure 1 reflects the ranking by Priority Resource/Issue.

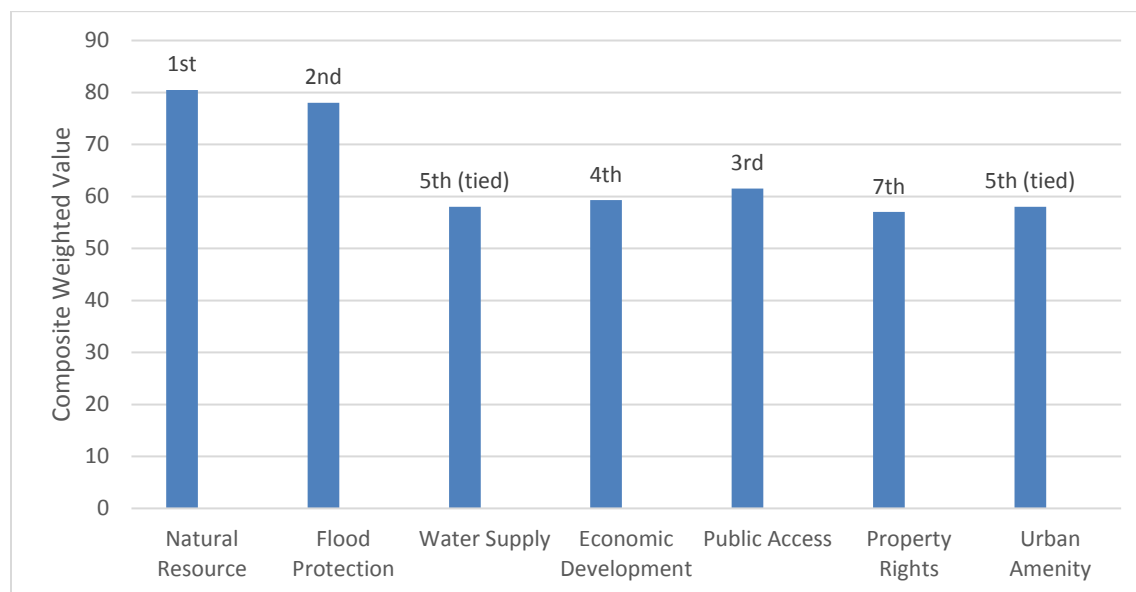


Figure 1. Summary of Responses from Priority Rating Table in Completed Questionnaires

The numeric values reflected in Table 4 and Figure 1 are based solely on the responses contained in the 24 submitted questionnaires that included a completed priority ranking table, and do not reflect input received during interviews, or necessarily encompass the priorities for all 51 stakeholders who were sent questionnaires.

Natural resources ranked slightly higher than flood protection as the top priority among stakeholders. The other five categories had similar composite weighted values, indicating that the 24 stakeholders contributing to this data are almost all concerned with natural resources and flood protection but in regards to other resources or issues, they have varied interests and priorities.

2.3 SUMMARY OF STAKEHOLDER COMMENTS

2.3.1 Summary of Issues or Resources Mentioned in Stakeholder Comments

In an effort to reflect the feedback received in the interviews as well as the questionnaires (including questionnaires where the resource/issues table was not completed), Figure 2 provides a summary of the total number of submitted questionnaires and in-person interviews that mentioned the resource or issue listed in the bar graph. In order to not over represent the opinions of the five stakeholders who were interviewed and submitted completed questionnaires, the feedback from their interview and completed questionnaire was combined. Therefore, for the purposes of this analysis, there were 41 total responses analyzed. Figure 2 reflects the number of respondents (of 41 total) that mentioned a particular resource or issue in either their interview or submitted questionnaire. For example, statements concerning natural resources were mentioned at least once in 26 of the 41 responses. In some instances, a stakeholder response may have discussed an issue in detail, but for purposes of Figure 2, the issue/resource is only counted once per questionnaire/interview. These results do not necessarily represent the priorities for all 41 respondents; they simply show the number of stakeholders who expressed interest in these topics.

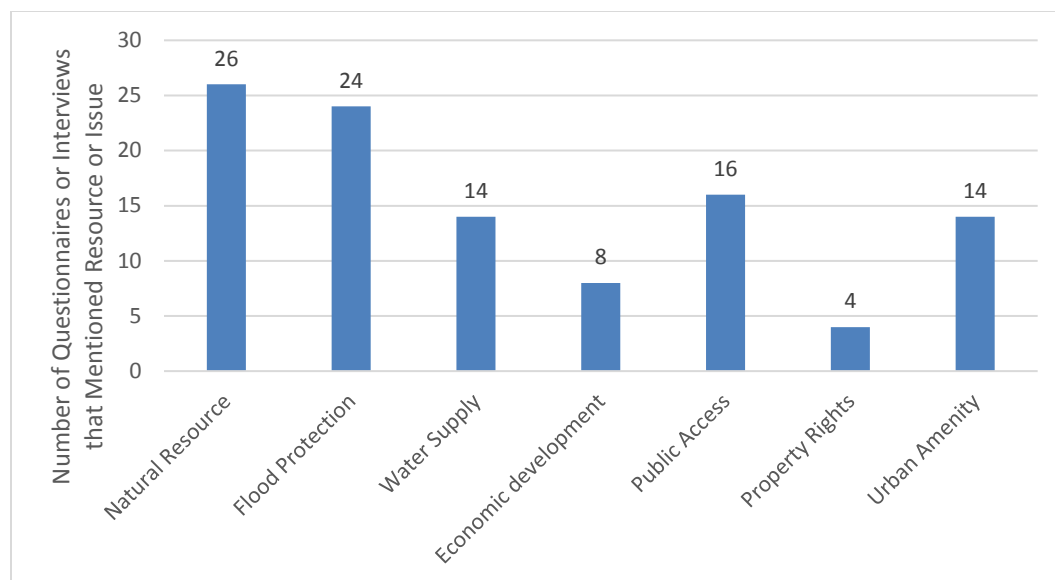


Figure 2. Summary of Resources/Issues Mentioned in Questionnaires and Interviews

Based on Figure 2, natural resources and flood protection appear to be the primary concerns, but are closely followed by public access, urban amenity, and water supply concerns. After reviewing the written or verbal comments received in the questionnaires and/or interviews, Tetra Tech found that many stakeholders expressed a desire to “naturalize” Mill Creek not only to increase habitat and resolve fish passage, but also to enhance the channel for public access and create an urban amenity. Comments regarding water supply related primarily to minimum in-stream flows for fisheries and irrigation. Tourism was the primary focus of comments regarding economic development and was also a factor in the concerns about public access and urban amenities.

Figure 3 reflects the number of stakeholders who specifically mentioned the natural resource issues of habitat, fisheries, water quality, and land conservation at least once in their completed and returned questionnaires or in their interview. In some instances, a particular issue may have been mentioned multiple times but it was only counted once per questionnaire or interview for purposes of the Figure 3 chart. These results do not necessarily represent the priorities for all 41 respondents.

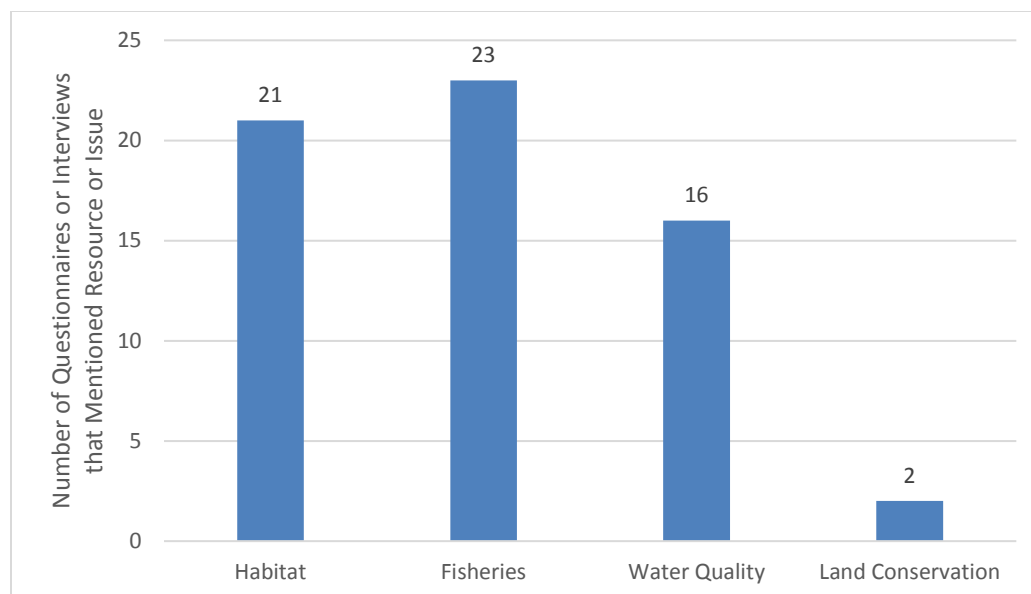


Figure 3. Number of Questionnaires and Interviews Containing Comments Regarding Natural Resources

Fisheries rank as the primary natural resource concern followed closely by habitat and water quality, upon which fisheries are dependent. Polychlorinated biphenyl (PCB) contamination downstream of downtown Walla Walla was noted in several stakeholder responses. A number of the respondents listing water quality as a concern also mentioned stream flow as a concern. It was noted in one interview the only thing that is stopping de-listing of the Mid-Columbia summer steelhead in this basin is the Mill Creek Channel, which could have regional implications. It is interesting to note the low response regarding land conservation, which would seem to be closely tied to the provision of habitat.

2.3.2 Summary of Recommended Documents

The questionnaire and interview process generated an expansive list of recommended documents, many of which have been identified and obtained through the data collection phase of this Project. The CTUIR and Tetra Tech will be reviewing the list to identify any gaps and determine which additional documents to obtain.

2.3.3 Summary of Funding Suggestions

An extensive list of potential federal, state, and local funding sources was identified through the questionnaire and interview process, captured in individual stakeholder comments. Without more thorough review and vetting, and identification of a specific proposal, it is difficult to determine relevant funding sources at this time. Suggestions regarding potential funding sources will be identified in the Assessment and during development of conceptual alternatives.

2.3.4 Summary of Recommendations

Review of the stakeholder comments from the completed questionnaires and interview summaries resulted in identification of four primary areas of recommendation:

- Preserve and maintain upper Mill Creek and its headwater conditions.
- Maintain the flood control function and capacity.
- Retain and enhance natural resources and functions, including habitat, fisheries, water supply, water quality, in-stream flows, and an open channel.
- Retain and enhance public access, channel visibility, and outdoor recreation opportunities including paths for pedestrians and bicyclists.

Other specific areas identified and recommended for “change” include:

- Improve fish passage through the flood channel, including the Bennington Lake diversion.
- Implement stormwater management and treatment, particularly within upland urban areas, to maintain acceptable water quality standards for Mill Creek and assist in shallow aquifer recharge.
- Make an informed and collective decision whether Mill Creek or Yellowhawk Creek should be the primary passage corridor.

The long-term vision for Mill Creek can generally be summarized as follows:

- A flood protection strategy and system that recognizes, addresses, and complements other Mill Creek functions including fish passage, water supply, public access, and urban amenity functions.
- A functioning/passable stream channel that provides a variety of habitats for all life stages of anadromous fish, which ultimately results in both Mid-Columbia steelhead and bull trout being removed from their current listing under ESA, and implementation of the CTUIR’s River Vision.
- A resource that the public values, respects, and enjoys in multiple ways.

2.3.5 Potential Concepts/Future Conditions

Stakeholders were encouraged to think “outside the box” during the questionnaire and interview process, which resulted in some of the following suggestions regarding potential concept and future conditions. Some of the main ideas include:

- Establishment of a second storage reservoir and/or additional floodplain capacity to help moderate and increase in-stream flows.
- Reconfiguration of Titus Creek to serve as a bypass corridor around the USACE flood control works.
- Reestablishment of the natural area on the Walla Walla Community College Campus, between Titus Creek and Mill Creek, as an active and functioning outdoor laboratory for education programs in conjunction with the Water and Environmental Center.
- Construction of a peak flow bypass to accommodate excess flows during flood events.
- Enhancement of the Mill Creek corridor through downtown with urban amenities similar to those recently presented by students from the Washington State University Landscape Architecture program.

3. Conclusion

The information gathered through the stakeholder involvement process will be used to identify opportunities for collaboration and will help develop conceptual alternatives that address the various stakeholder interests. The broader outreach efforts conducted through interviews and the distribution of the stakeholder questionnaires was completed early in the assessment process to use key stakeholder input for identifying existing data, identifying regulatory constraints, and helping draft and refine a range of potential future conditions for Mill Creek. The stakeholder involvement process will continue throughout the development of the assessment, conceptual alternatives, and strategic plan, but will focus on the distribution of work products for stakeholder review and the presentation of these materials at the three EC/TAC stakeholder meetings.

Based upon the review of the 30 completed questionnaires and 16 interviews conducted to date, key issues, concerns, and visions for Mill Creek identified include:

- Preserve and maintain upper Mill Creek and its headwater conditions.
- Maintain flood control function and capacity.

- Retain and enhance Mill Creek’s natural resources and functions, including habitat, fisheries, water supply, water quality, in-stream flows, and creation of an open channel.
- Retain and enhance public access, channel visibility, and outdoor recreation opportunities including paths for pedestrians and bicyclists.

4. References

Jones, K.L., G.C. Poole, S. O’Daniel, and E. Quaempts. 2008. The Umatilla River Vision. Tucker, Georgia, Ecometrics, Inc. and the Confederated Tribes of the Umatilla Indian Reservation.

APPENDIX B
SUMMARY OF MILL CREEK FISH PASSAGE/SURVIVAL/HABITAT ISSUES AND
RELATED EFFORTS (FROM 1931 TO 2017)

Summary of Mill Creek Fish Passage/Survival/Habitat Issues and Related Efforts

(compiled by Glen Mendel, December 2016)

12/31/2016

1931 – Major flood in the town of Walla Walla caused substantial property damage

1938 – Congress approved a flood control project, (completed in 1941) that included construction of a concrete channel, Bennington Dam and off channel flood water storage (Bennington Lake). Later channel spanning weirs/stabilizers downstream and upstream of concrete channel were added

1982 – US Army Corps of Engineers (USACE) retrofitted a fish ladder into left bank of Bennington Dam in a low flow slot, in response to Washington Department of Game (now Washington Department of Fish and Wildlife – WDFW) requests, and set spill threshold for flows over 400 cfs without ladder passage

1992 – USACE completed the Walla Walla River Basin Reconnaissance Report – that report ignored discussion regarding the issues or plans for improving fish passage and survival in Mill Creek Flood Channel

1995 (May) – USACE Mill Creek Master Plan finalized

1997 (October) – USACE Walla Walla River Watershed Reconnaissance Report sponsored by Confederated Tribes of the Umatilla Indian Reservation (CTUIR) – the primary purpose was mainstem Walla Walla River flow and habitat enhancement. The Mill Creek Flood Control Project area was again generally ignored

1998 (May) – Washington Department of Fish and Wildlife (WDFW) sent a letter to USACE about unscreened diversion concerns into Bennington Lake and potential impacts on ESA listed steelhead and bull trout. In addition, a **Mill Creek Fish Passage and Screening Meeting** was held with WDFW, USACE, and other agencies and tribes

1998 (September) – WDFW sent USACE a comment letter regarding the 1997 Reconnaissance Report and pointed out the omission of Mill Creek and no emphasis for improving fish passage or survival in the flood channel through Walla Walla

1998 (October to October 1999) – Oregon Dept. of Fish and Wildlife (ODFW) staff recovered 15 PIT tags from bull trout in the debris pile from the screens at the City of Walla Walla Water Intake Dam in upper Mill Creek. One radio tagged bull trout was found alive in the debris pile and returned to the water in Oct. 1999.

1999 – The US Fish and Wildlife (USFWS) Service Biological Opinion was released for operations and construction of modifications at the City of Walla Walla Intake Dam

1999 (March) – WDFW sent USACE a letter to begin discussions about improving habitat conditions in Mill Creek, plus WDFW’s willingness to consider sponsoring an 1135 project for 3 areas:

1. Screening the diversion of water into Bennington Lake
2. Improving salmonid rearing habitat between the Diversion (Bennington Dam) and Division (at Yellowhawk) dams with a low flow channel
3. Improving fish passage at Bennington Diversion Dam

1999 (July) – WDFW secured a grant (from WA Interagency Committee - IAC) to assist USACE screen Bennington Dam diversions for low and moderate flows, however funds had to be spent by end of May 2000

1999 (September) – WDFW sent a letter to USACE to emphasize the need to accelerate the screening of Bennington Lake diversions before the grant (IAC) expires

2000 (January) – Walla Walla Basin Watershed Council (WWBWC) submitted a final application for fish passage improvements and improved screening at the City of Walla Walla Water Intake Dam

2000 (February) – USACE email to WDFW offering temporary plate screens for diversions into Bennington Lake so the lake could be filled and stocked with trout for spring/summer recreation

2000 (March) – WDFW sent request for extension of grant (to IAC) contract for screens at Bennington Diversion.

2000 – USFWS and irrigation districts reach a court settlement agreement for minimum water flows in the Walla Walla River - incremental increases from 2000 to 2003 for maintaining minimum flows. Irrigators continue to maintain targeted minimum flows.

2000 (March) – WDFW letter to USACE to reiterate the desire to work together to improve fish habitat/survival conditions and fish passage in Mill Creek

2000 (July) – WDFW letter to USACE to provide funds and screens for annual refill flows into Bennington Lake for recreation (excluding flood flows)

2000 (Summer) – USACE constructed the infrastructure for screens to be installed

2000 (summer) – WWBWC and ODFW completed a fish screening bypass project at City of Walla Walla Water Intake to protect bull trout and other species

2000 (December) – WDFW delivered new screens to USACE for diversions from Mill Creek into Bennington Lake for recreational use

2001 (Spring) – WDFW, Washington Department of Ecology (WDOE), USACE and others conducted a test of increased water flows in Mill Creek below Yellowhawk Creek, plus sandbagging at Mill Creek weirs to concentrate flows for improved passage of fish as stream discharge declined. The additional water below Yellowhawk created unsuitable water temperatures for salmonids in Mill Creek downstream of Wilbur Avenue and swamped the benefits of cold spring inflows into the channel

2002 (April) – 16 steelhead adults stranded and died, reported to USACE and removed from the Bennington spillway stilling basin by visiting biologists, and USACE staff. A follow-up conference call occurred with USACE, CTUIR, WDFW and other agencies to discuss the issues and concerns along with possible solutions

2002 (May) – meeting and tour with agencies and non-profits to discuss the fish kill and passage/habitat issues and the need for ESA consultation for the flood channel

2002 (July) – WDFW letter to USACE to initiate review of passage issues and design interim passage improvements as well as to initiate the longer term 1135 process (as recommended by USACE as the most appropriate and expeditious approach) for Bennington Dam fish passage improvement – construction projected to occur in 2004

2002 (August-October) – WDFW, the Walla Walla Watershed Alliance & WDOE, initiated the formation, organization and coordination of the Mill Creek Workgroup. Meetings have been held 2-4 times per year. WDFW became the sole lead after several years and continues to coordinate and lead this workgroup

2002 (Fall) – WDFW, CTUIR and USACE met several times for a short term effort to improve fish access into and past the fishway at Bennington Dam (e.g. short term actions included the addition of ecology blocks below ladder entrance, change of slide gate operation, etc.)

2002 (Oct) – USACE provided a preliminary cost estimate for the 1135 Project with WDFW as local sponsor

- Feasibility study cost was estimated to be \$394,000-428,000, with a timeline of 4-5 months to 1 year.
- Plans and Specifications were expected to cost \$360,000-390,000 and take 6 months

2002-2007 – Multiple meetings and coordination occurred between USACE, WDFW, CTUIR and other agencies to evaluate options and issues to improve fish passage at Bennington Dam. Designs (30% plans) were completed for passage Alternative 1 by USACE before funding was exhausted.

2003 (March) – USACE completes the draft Biological Assessment of their operations on Mill Creek. Later supplements were required by NMFS

2003 (October) – WDFW sent letter to USACE with comments on the draft Biological Assessment (BA)

2004 (April) – response from USACE to WDFW BA comments

2005 (summer) – Kooskooskie Dam, a 9 ft high dam built as a water diversion by the City of Walla Walla in 1907 in upper Mill Creek (within Washington), was removed by the Tri-State Steelheaders (TSS) using grants

2006 – Draft Snake River Salmon Recovery Plan for Southeast Washington was released by the Snake River Salmon Recovery Board - emphasizes passage problems in Mill Creek

2006 (Summer) – Gose Street fish passage improvement project was completed at the lower end of the flood control channel by Walla Walla Conservation District (WWCD) and CTUIR, with assistance by WDFW

2007 – USACE provided a memorandum for the record at WDFW's request that summarized 1135 Feasibility Study funding expenditures to date by USACE (total ~\$365k). USACE was on Continuing Resolution from Congress, so no current funding available

2007 – WDFW secured a grant from Salmon Recovery Funding Board to conduct a study to evaluate fish passage conditions in the non-Federal flood channel in Mill Creek - Tri State Steelheaders agreed to lead that process, with assistance from WDFW

2007 (November) – A bull trout was found wedged in the ecology blocks downstream of fish ladder (below the low flow outlet) at Bennington Dam

2007 (November) – USFWS issued the Mill Creek Biological Opinion (BiOp) regarding the effects of USACE operations on bull trout – it required improved fish passage at Bennington Dam by October 2012

2007 (December) – USACE released the Fish Passage Plan for Mill Creek Project

2008 (January/February) – USACE, the National Marine Fisheries Service (NMFS) and USFWS revised ESA consultation measures to avoid adverse effects on ESA listed fish

2008 (February) – WDFW and USACE held a conference call regarding status of the 1135 Feasibility Study - project on hold until USACE can secure funding

2008 (February) – USFWS email to USACE reminding them of the need to meet BiOp terms, and to do a passage assessment at Bennington Dam (condition 3d) and elsewhere by August 2008

2008 – TSS, with a smaller technical committee of the Mill Creek Work Group, lead the effort to hire a consulting engineering firm to complete a fish passage assessment and preliminary designs for improving passage in the flood channel downstream of Yellowhawk diversion. Project scoping meeting was in March and the draft assessment was sent out for review by agencies and CTUIR in November 2008.

2008 (April) – Levee vegetation variance request released by USACE with input from a workgroup of agencies

2008 (April) – Conference call between USACE, USFWS and NMFS regarding Mill Creek priority actions

2008 (Summer/fall) – Conducted planning and implementation of screening off upper Garrison Creek by WWCD, WDFW, and USACE to eliminate ESA take of ESA listed steelhead and bull trout, and other fish that would enter upper Garrison Creek.

2008 (September) – USACE response letter to USFWS and NMFS regarding compliance with terms and conditions of the USFWS BiOp for Mill Creek.

2009 (January) – USACE conference call with agencies shows the planned 1135 schedule with construction of new fish passage at Bennington in 2011, to be completed by 2012.

2009 (June) – WDFW called and hosted a meeting with the USACE Lt. Colonel and staff, NMFS, USFWS and CTUIR to try and emphasize the need to make passage and habitat changes in Mill Creek on USACE lands and how to move forward after many delays. **Meeting summary – At that time the incomplete 1135 Feasibility Study had taken over 6 years of meetings and effort, plus substantial funding.** The Watershed Alliance was the non-federal sponsor who secured funding for the USACE through Congressional earmarks. Approximately \$365,000 has been expended by the USACE for the 1135 Project at Bennington Dam, plus substantial time and costs for the involved agencies and CTUIR.

Current Status: 30% Designs exist for three alternatives, and one alternative (R. Bank Fish Ladder) is 100% designed at the feasibility level: the documents and process have been shelved since November 2007 and a summary memo was submitted for the record.

The Project is on hold until USACE secures funding to complete the Feasibility Study (complete designs, cost estimates, environmental evaluation for NEPA document, select preferred alternative, and write the feasibility report).

2009 (October) – Mill Creek Passage Assessment – Final Report to TSS - by Burns, Powers and 2 other authors.

2009 (November) – NMFS released the Mid-Columbia Steelhead Recovery Plan and noted that Bennington Dam is a significant passage obstruction for steelhead trying to reach important production areas upstream of the flood channel. It also noted that viability criteria for steelhead can't be met for this Distinct Population Segment (DPS) as long as the Mill Creek portion of the population is at risk.

2009 (fall/winter) – USACE installed screens on the water diversion at Rooks Park (north side short distance below Bennington Dam)

2010 (May) - USACE held meetings with WDFW and others, plus consulting engineers (Anderson Perry) for completion of the 1135 Feasibility Report, and a second meeting with USACE, WDFW and BPA regarding funding availability considering the recently identified perpetual maintenance obligations of the sponsor

2010 (December) – Completed 30% full channel fish passage design

2011 (January) - USACE Completed Mill Creek Floodplain Report

2011 (March) – USACE, WDFW and others met regarding 1135 alternative funding or congressional exemption to recently identified sponsor maintenance requirement

2011 (June) – USFWS consultation response sent to USACE re: Mill Creek Flood Control maintenance activities not previously covered in BiOp

2011 (June) – Walla Walla Conservation District submitted a passage and habitat proposal to the Snake River Salmon Recovery Board for Jones Ditch on the south shore of Mill Creek below Bennington Dam

2011 (June) – Selection process for the preferred alternative for improving passage at Bennington Dam (among passage workgroup, WDFW, and USACE)

2011 (September and October) – TSS completed pilot fish passage projects at 9th Ave (lower end of concrete channel), Roosevelt Ave (top end of concrete channel) and at four channel spanning weirs at Tausick Way using Salmon Recovery funds. Design work, including physical model evaluation, was completed from December 2009-July 2011.

2011 – Snake River Salmon Recovery Plan (draft) updated and released. It emphasized the importance of improving fish passage at Bennington Dam, and elsewhere in Mill Creek.

2011 (June) – USACE responded to USFWS and NMFS with summary of compliance with USFWS BiOp requirements

2011 (June) – USACE provided draft plans and Environmental Assessment for the low flow channel in the section with weirs between Bennington Dam and Division Dam (0.5 ft. deep).

2011 (September) - NMFS completed ESA consultation on Mill Creek with release of the final BiOp - and declared that the USACE operations constitute a “jeopardy” to ESA listed mid-Columbia River steelhead (DPS) persistence

2012 (February) – USACE sent a letter to NMFS and rejected the NMFS BiOP and requested re-initiation of consultation because the BiOp covered areas and actions the USACE claimed are beyond their authority. **USACE emphasized the lack of certainty of funding from US Congress to implement the proposed actions**

2012 (February) – NMFS sent a letter to USACE regarding review and status of priority mid-Columbia steelhead recovery proposed actions, plus the Steering Committee of the Mid-Columbia Steelhead Forum met with the USACE to review proposed actions and priorities

2012 (April) – USACE sent out draft Feasibility (1135) Report for review with two week review. WDFW requested more time to review.

2012 (May) – USACE summarized the 1135 situation and the two options to try and move forward (either continue with 1135 and request congressional waiver for sponsor maintenance requirement, or construct the project using USACE O&M funding)

2012 (September) – USACE released the partially completed 1135 Feasibility Report (without complete NEPA & FONSI, or final designs), for the preferred alternative of a new fish ladder on right bank (for 20-42 cfs flows to remain open up to 400 cfs), but the project is shelved because of the recently identified requirement for the sponsor (WDFW) to provide perpetual maintenance funding. WDFW withdrew as local sponsor because of the perpetual maintenance requirement, and funding available for the 1135 process became unavailable because that money could not be used outside 1135 process. Also, potential cost-share funding by the CTUIR (Bonneville Power Administration mitigation funding) was no longer available for Bennington fish passage without the 1135 project.

2012 (October) – NMFS sent a letter to USACE regarding an updated review of priority mid-Columbia steelhead recovery proposed actions

2012 (October) – NMFS hosted a meeting with USACE Walla Walla District commander and USACE staff, relevant agencies, and CTUIR regarding progress status and priorities to improve fish passage and survival in Mill Creek – USACE committed to request \$5-6 million from Congress for implementing Bennington Dam fish passage improvements. USACE sent out follow up email to confirm diversion trigger at 3,500 cfs, but that diversion might begin at 2,400 cfs because of rapid flow increases

2012 (December) – TSS and consultants sent out revised roughness panel designs for fish passage improvement in the non-federal concrete flood channel reach

2013 (February) – WDFW sent a letter to USACE to formally withdraw as 1135 sponsor

2013 (Summer) – USACE constructed pilot low flow passage structures (ladders) at three weirs in Mill Cr and completed preliminary designs for improving fish passage at the Division Dam ladder. Although an excavated channel between four weirs with the new fish passage structures was proposed, the low flow channel was not constructed, only three 1-2 step fish ladders at weirs were completed.

2013 (July-September) – TSS completed a fish passage project from Spokane to Colville streets in downtown Walla Walla after final designs were completed from December 2011 to May 2013.

2014 (May) – USACE, NMFS, USFWS and CTUIR met to discuss fish passage and habitat priorities in Mill Creek and how to further engage USACE and secure funding

2014 (July) – USACE notified USFWS and NMFS of plans for modifying up to 10 weirs to improve passage, including a low flow channel in between weirs (of 0.5 ft deep and approximately 22 ft upstream of each weir to connect to bottom of plunge pool from upstream weir)

2014 (September) – TSS completed the Yellowhawk fish passage project (planted the following spring)

2014 (October) – USFWS provided a summary study report of bull trout movement in Walla Walla Basin and highlighted that fish passage issues and delays are substantial for bull trout and reintroduced spring Chinook salmon. They presented results to the public at the Southeast Washington Salmon Recovery Monitoring Workshop. Bull trout adults had an average 53 hr passage delay and subadults had an average delay of 76 hrs (3+ days). About 28% of subyearling bull trout never passed upstream, with little evidence of long term survival below Bennington Dam. Spring Chinook took an average of over 18 days to pass upstream. These delays occurred as stream flows decreased, water temperatures became intolerable, and predator abundance increased.

2014 (November) – USACE staff noted that their efforts to improve fish passage at both ladders and the low flow channel were on hold due to lack of funding when they presented the status of their activities in Mill Creek and concluded that the designs for the Bennington Dam ladder, Division Dam ladder and low flow channel were complete or nearly complete, and would be wrapped up and shelved until further funding. A few low flow weirs in Mill Creek would be modified each year as USACE operations funding is made available (they noted that at current rate it would take more than 20 years to do all of the weirs within the USACE footprint over about one mile).

2015 (April) – USACE updated Mill Creek Workgroup on their projects – they noted that funding was requested from Congress for fish passage at Bennington Dam, but not received for 2015 or 2016. USACE noted that they would be making another funding request for 2017. Since the 1135 process was terminated the USACE policy changed to allow them to use cost share from others, but BPA withdrew from funding USACE fish mitigation actions

2015 (May) – The Mill Creek Coalition submitted a Letter of Interest to USACE regarding their intent to sign on for a General Investigation Cost Share Agreement of rebuilding/restoring the flood channel

2015 (June) – Draft Bull Trout Recovery Plan was released for public comment

2015 (June) – USACE requested re-initiation of ESA consultation by the USFWS and NMFS and submitted a new Biological Assessment for Mill Creek operations. The intent of the re-initiation of consultation was because the USACE had rejected the NMFS BiOp and the USFWS BiOp was to have been for five years, and that had passed. Also, any revision to the BA must be submitted to both federal services for review.

2015 (July) – Draft Bull Trout Recovery Plan closed for public comment

2015 (August 12) – public meeting regarding the USACE plans to do levee vegetation maintenance (clearing). They received funding for this activity because of the USACE assessment of high risk of flood damage to the community.

2015 (September) – USACE completed their NEPA process for levee clearing

2016 (January) – USACE releases update of the Mill Creek Master Plan

2016 (February) – USACE Walla Walla District submitted a budget proposal to Congress requesting funding for a Mill Creek General Investigation Study that would be primarily for flood control

2016 (August) – CTUIR provided a draft of their Mill Creek Assessment for review and comment with a September response deadline date.

2016 (June-September) – TSS contractors completed the fish passage project for nearly 1000 ft of channel upstream of 9th Ave. after design work was completed from December 2012-June 2014.

2016 (November) – Mill Creek Workgroup meeting and update on 2016 TSS passage project upstream of 9th Ave. and discussion of the next steps for the General Investigation Study funding effort and the CTUIR Mill Creek Planning effort.

2016 (November-December) – USACE contractors removing roots as continuation of the levee tree removal project

2016 (December) – TSS contractor continues work to complete final design for fish passage project from upstream of Roosevelt St. downstream to Wildwood Park (has been in design from December 2015 and expected to be completed in June 2017).

2017 (December) – USACE notified NMFS and USFWS that they will begin a Supplemental Environmental Impact Statement (EIS) for operations of the Mill Creek Flood Control Project to update the original EIS completed in the 1970s as compliance with the National Environmental Policy Act.

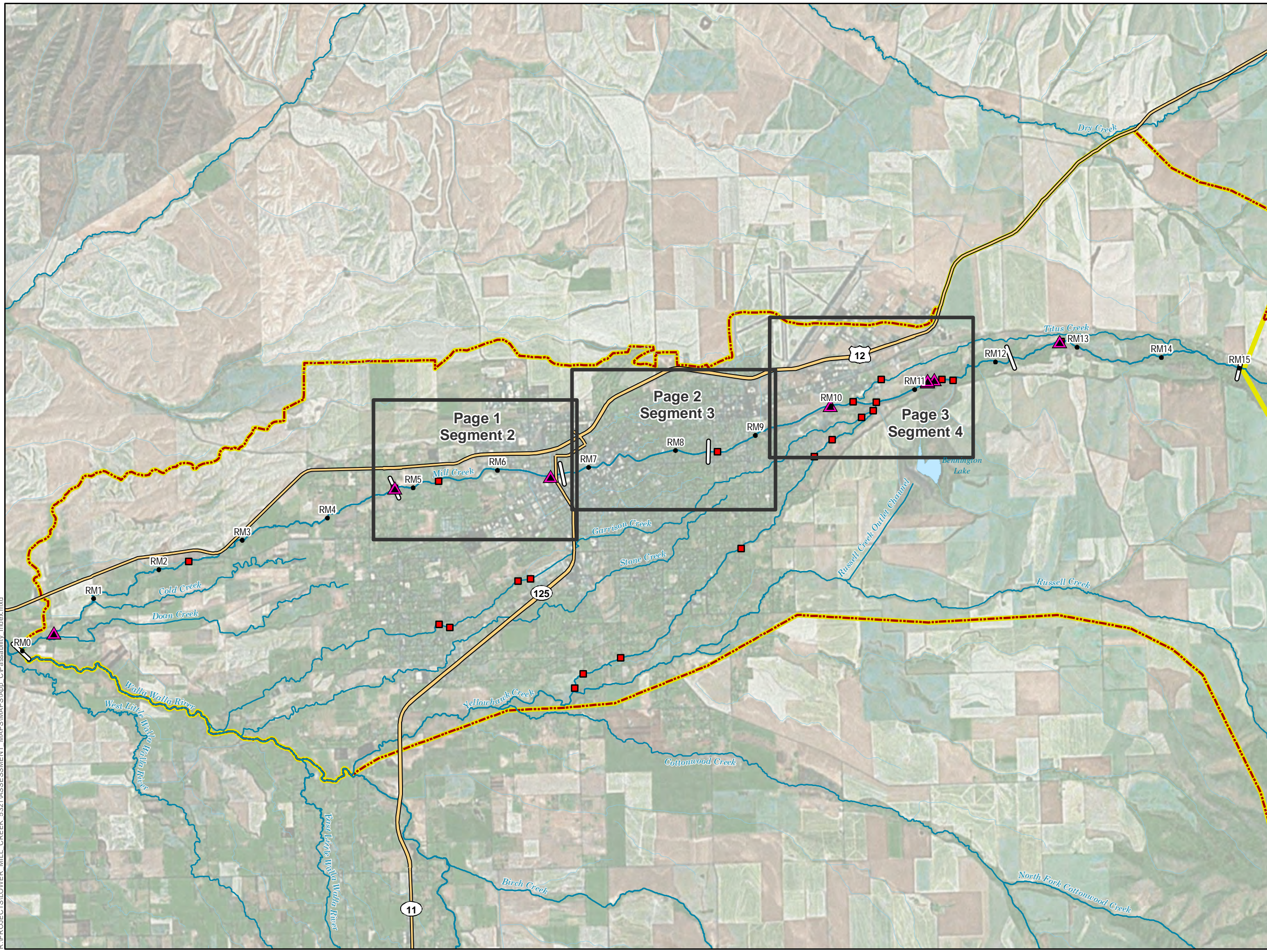
APPENDIX C
FISH PASSAGE ASSESSMENT MAPS BY SPECIES AND STREAM FLOW

LOWER MILL CREEK HABITAT AND PASSAGE ASSESSMENT

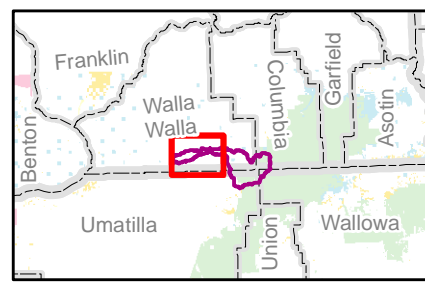
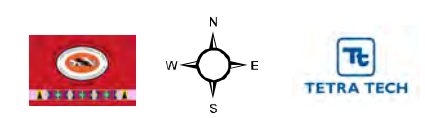
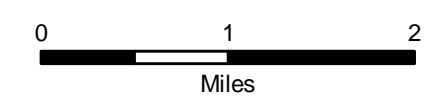
CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

APPENDIX C INDEX MAP

- River Miles
- ▲ Thermal Barrier
- Partial Barrier to Fish Passage
- Major Stream
- Minor Stream
- Reach Break
- Waterbody
- Project
- Primary Focus
- Passability Maps Sheet Index



Source: StreamNet



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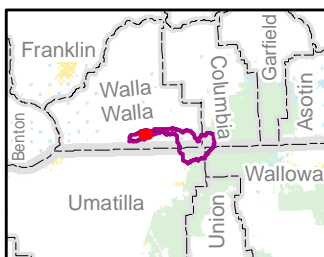
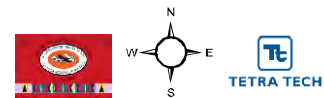
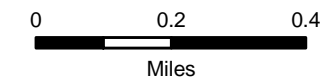
**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE C-1
PASSABILITY OF BULL TROUT
BY MILL CREEK FLOW
AND PROJECT SEGMENTS
6 CFS
Segment 2**

- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



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**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

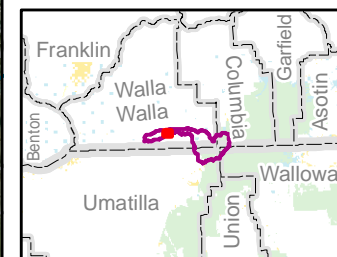
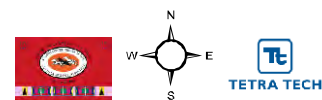
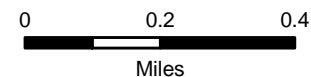
CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE C-2
PASSABILITY OF BULL TROUT
BY MILL CREEK FLOW
AND PROJECT SEGMENTS
6 CFS
Segment 3**



- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



LOWER MILL CREEK HABITAT AND PASSAGE ASSESSMENT

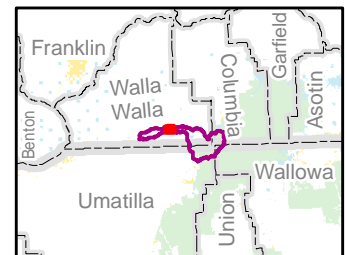
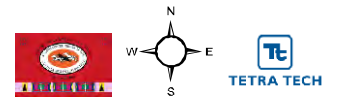
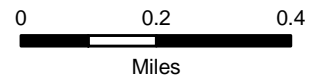
CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

FIGURE C-3 PASSABILITY OF BULL TROUT BY MILL CREEK FLOW AND PROJECT SEGMENTS 6 CFS Segment 4



- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



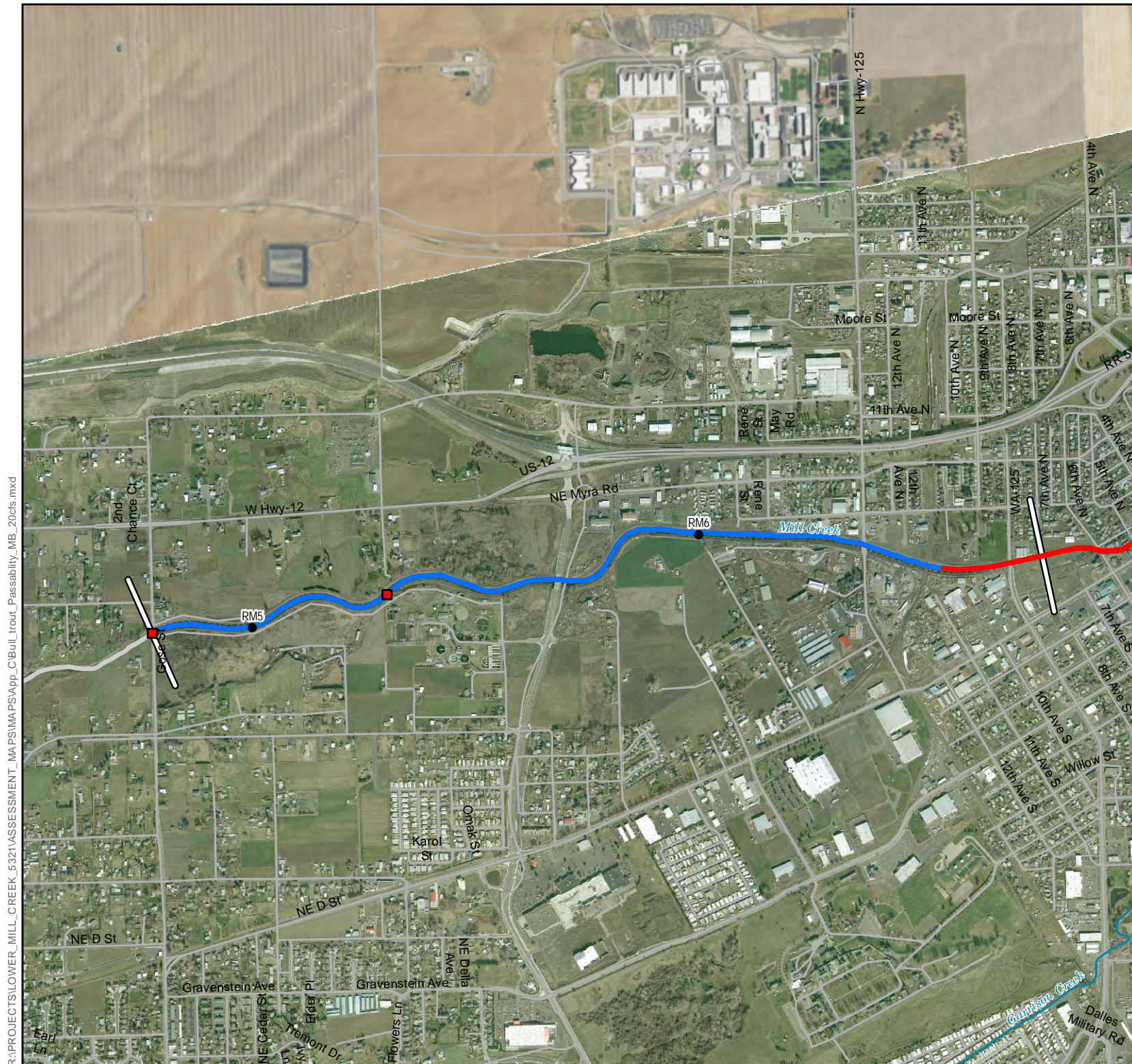
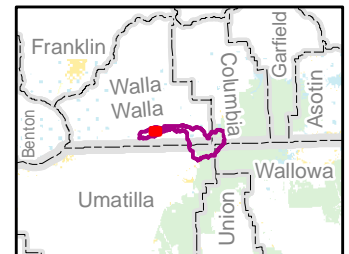
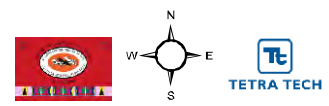
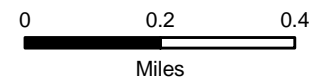
**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE C-4
PASSABILITY OF BULL TROUT
BY MILL CREEK FLOW
AND PROJECT SEGMENTS
20 CFS
Segment 2**

- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



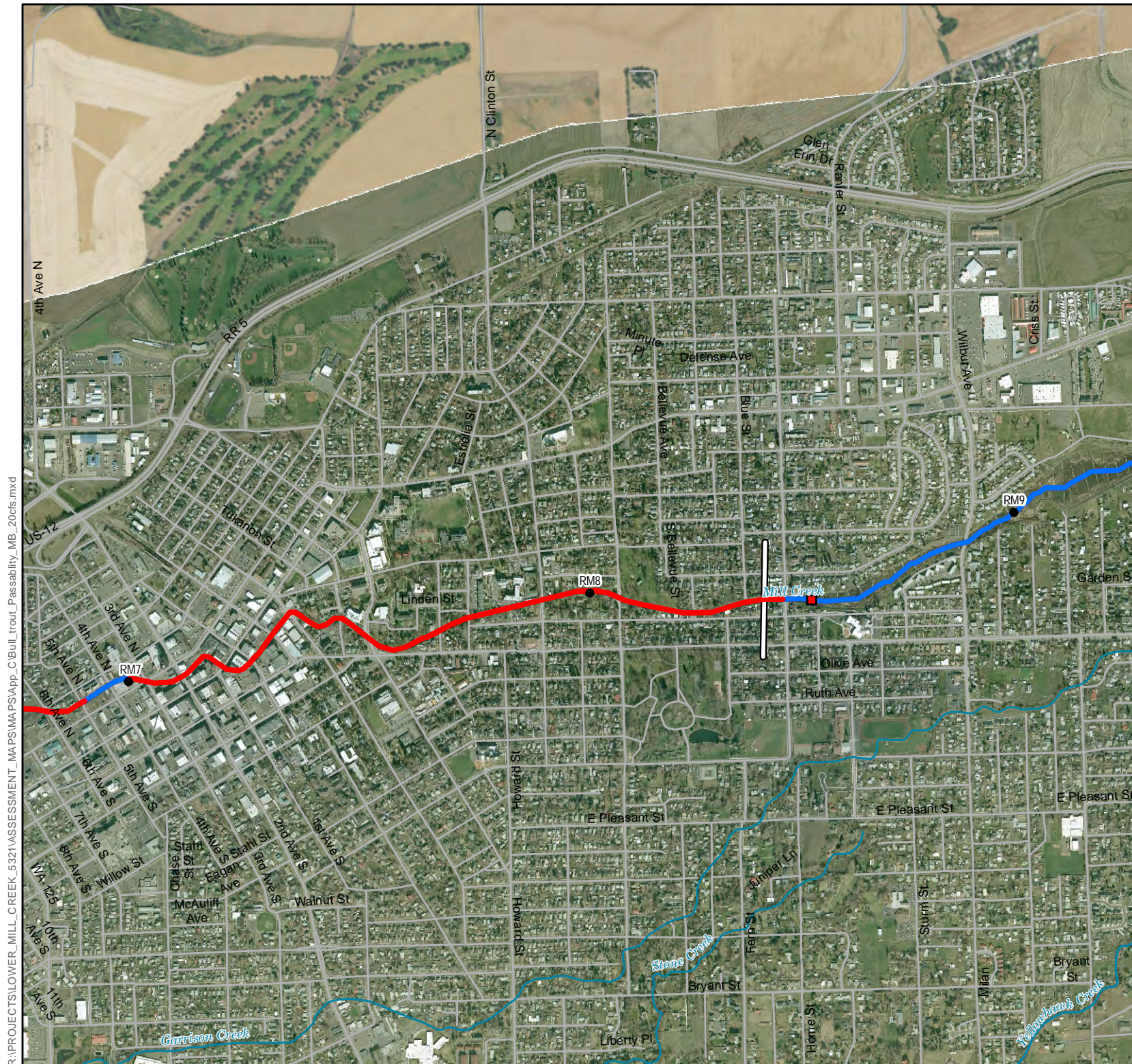
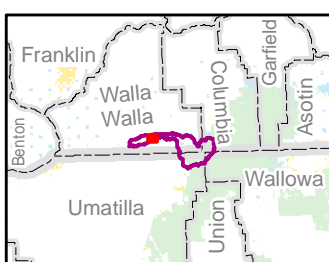
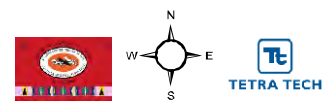
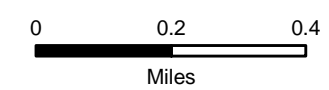
**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE C-5
PASSABILITY OF BULL TROUT
BY MILL CREEK FLOW
AND PROJECT SEGMENTS
20 CFS
Segment 3**

- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



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LOWER MILL CREEK HABITAT AND PASSAGE ASSESSMENT

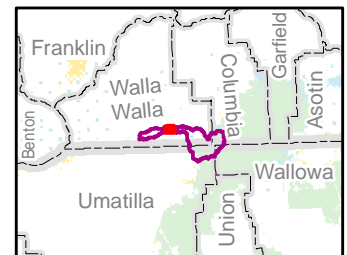
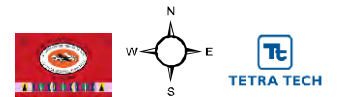
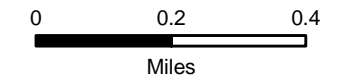
CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

FIGURE C-6 PASSABILITY OF BULL TROUT BY MILL CREEK FLOW AND PROJECT SEGMENTS 20 CFS Segment 4



- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



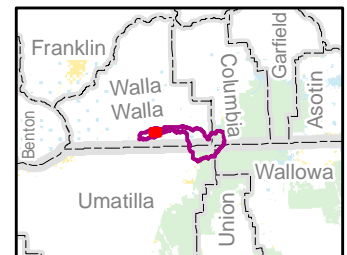
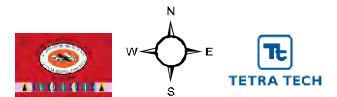
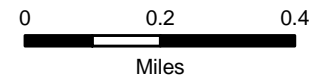
**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE C-7
PASSABILITY OF BULL TROUT
BY MILL CREEK FLOW
AND PROJECT SEGMENTS
60 CFS
Segment 2**

- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



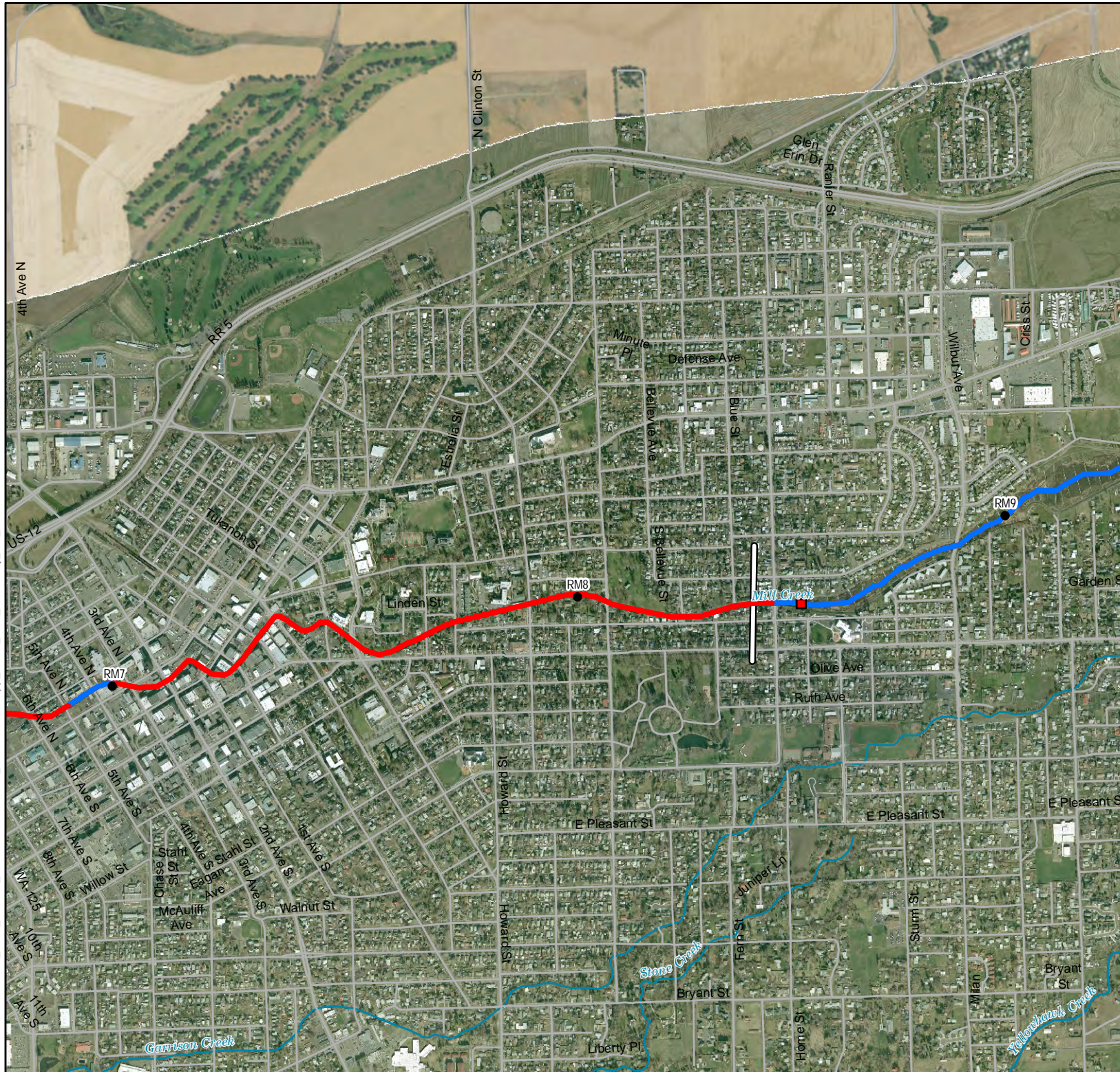
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**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

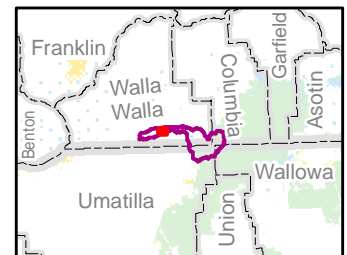
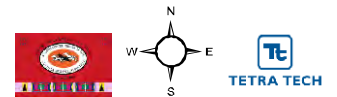
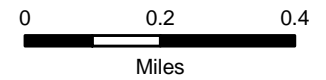
CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE C-8
PASSABILITY OF BULL TROUT
BY MILL CREEK FLOW
AND PROJECT SEGMENTS
60 CFS
Segment 3**



- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



LOWER MILL CREEK HABITAT AND PASSAGE ASSESSMENT

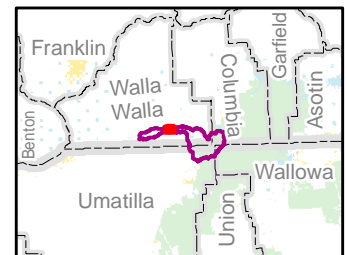
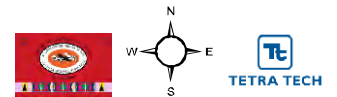
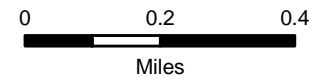
CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

FIGURE C-9 PASSABILITY OF BULL TROUT BY MILL CREEK FLOW AND PROJECT SEGMENTS 60 CFS Segment 4



- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



LOWER MILL CREEK HABITAT AND PASSAGE ASSESSMENT

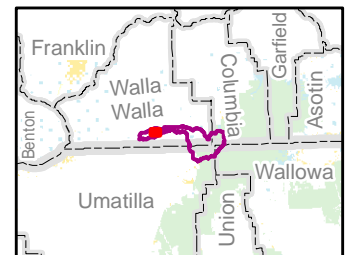
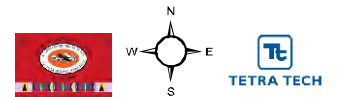
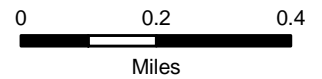
CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

FIGURE C-10 PASSABILITY OF BULL TROUT BY MILL CREEK FLOW AND PROJECT SEGMENTS 100 CFS Segment 2



- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



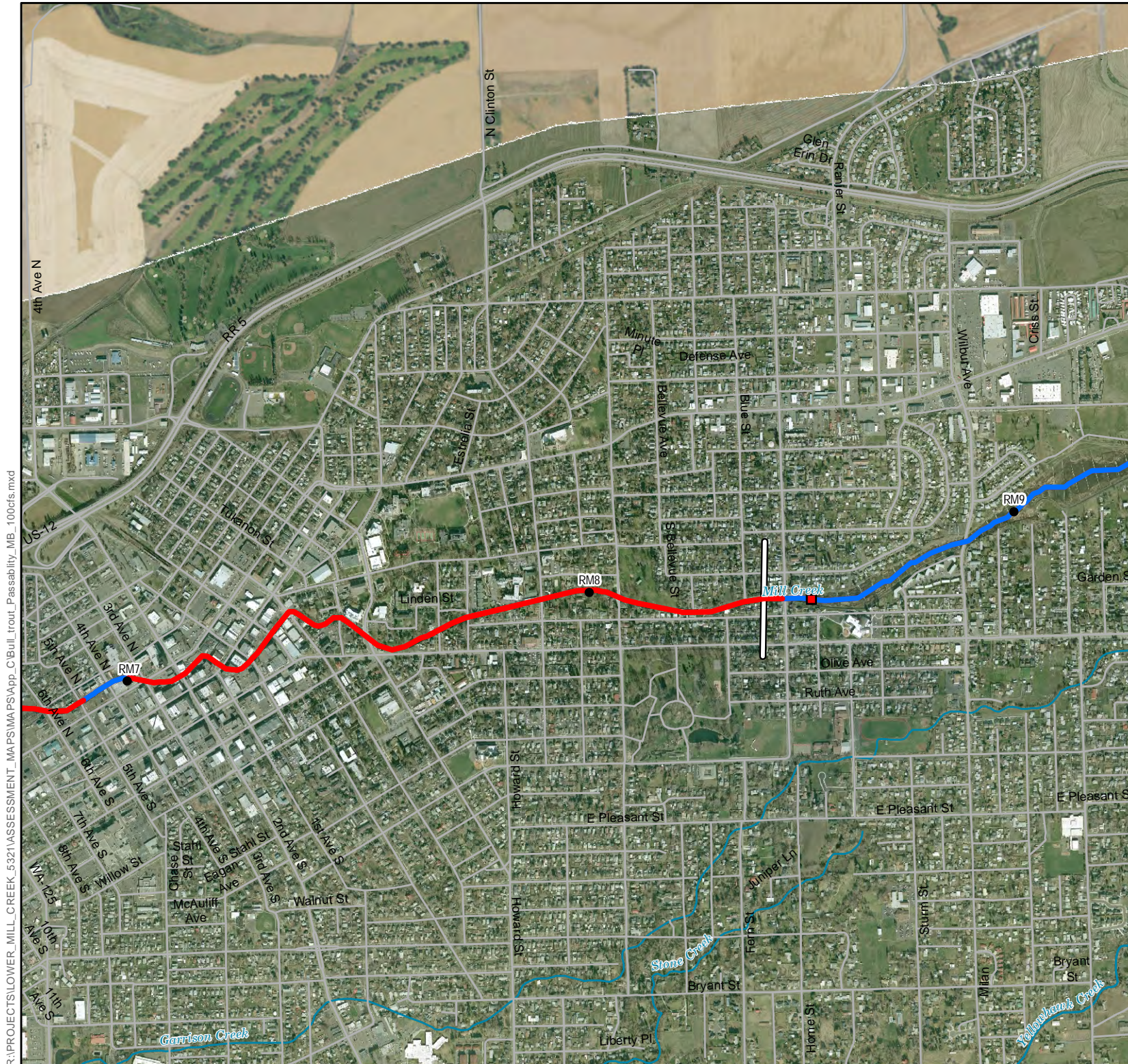
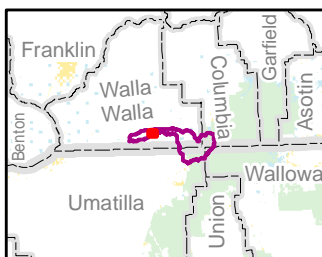
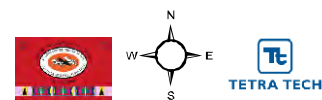
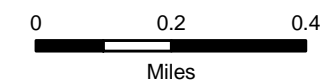
LOWER MILL CREEK HABITAT AND PASSAGE ASSESSMENT

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

FIGURE C-11
PASSABILITY OF BULL TROUT
BY MILL CREEK FLOW
AND PROJECT SEGMENTS
100 CFS
Segment 3

- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



LOWER MILL CREEK HABITAT AND PASSAGE ASSESSMENT

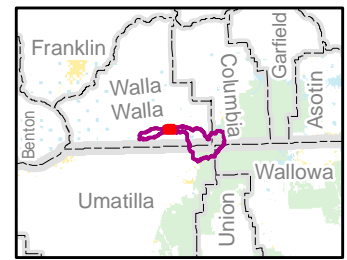
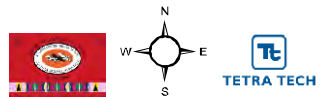
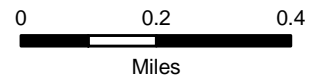
CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

FIGURE C-12 PASSABILITY OF BULL TROUT BY MILL CREEK FLOW AND PROJECT SEGMENTS 100 CFS Segment 4



- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



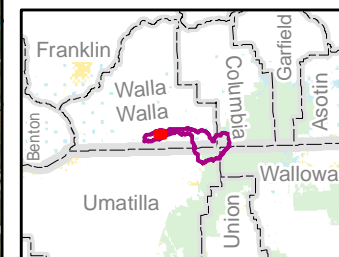
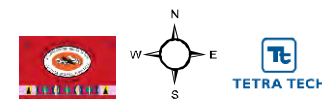
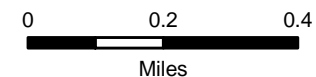
**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

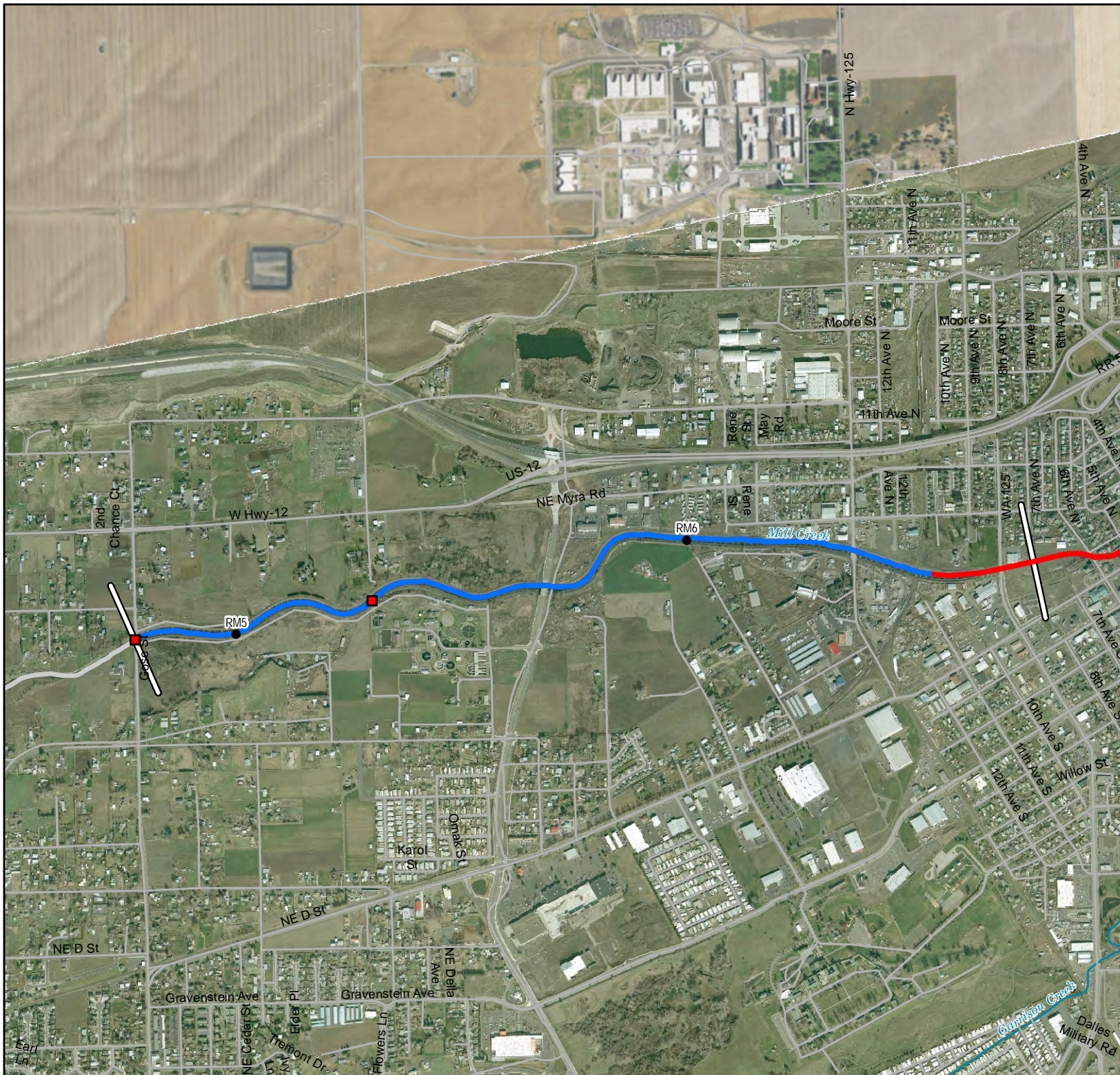
**FIGURE C-13
PASSABILITY OF BULL TROUT
BY MILL CREEK FLOW
AND PROJECT SEGMENTS
200 CFS
Segment 2**

- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



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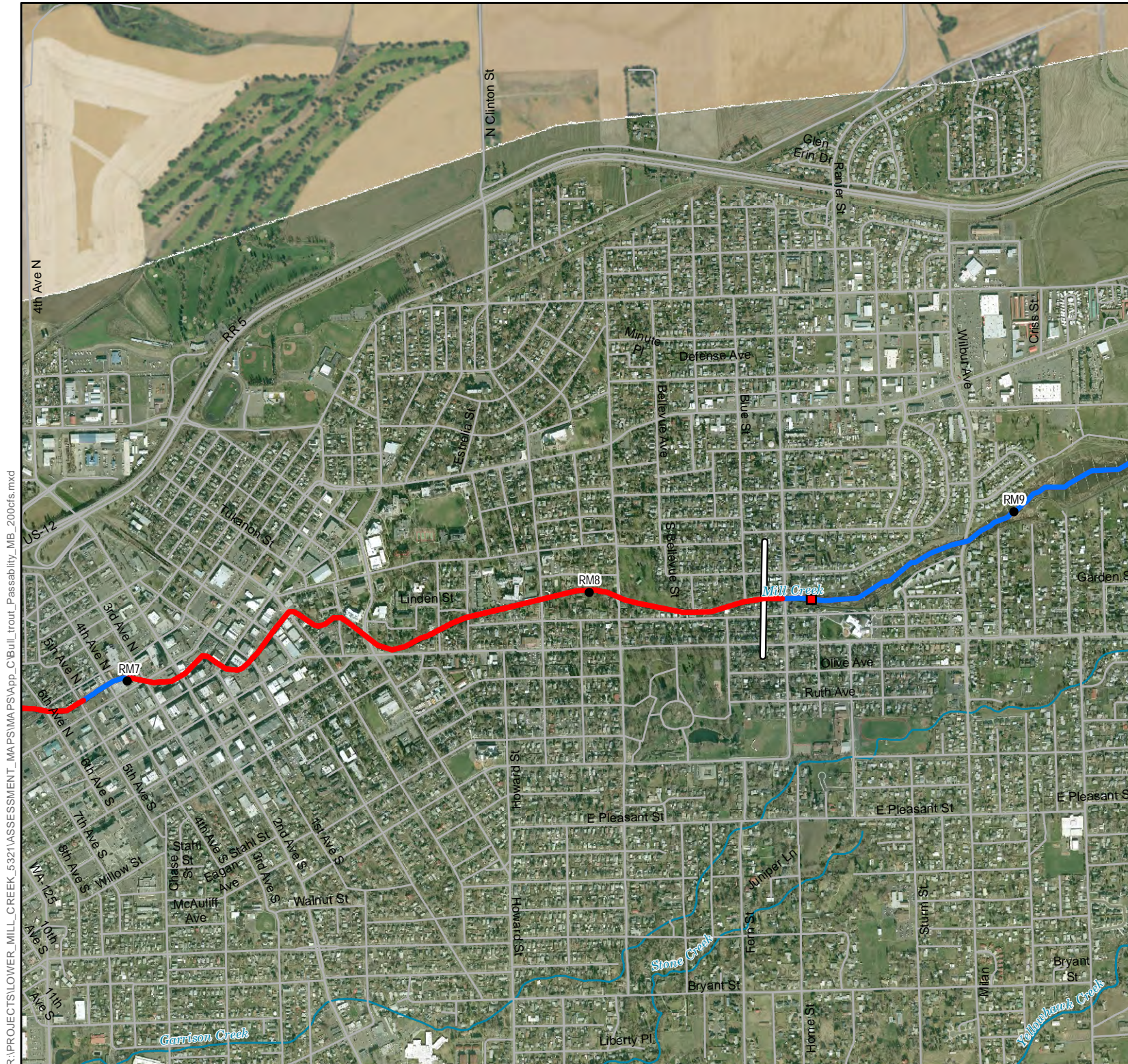
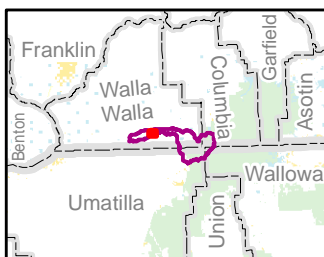
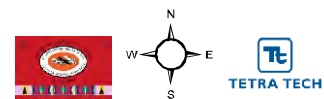
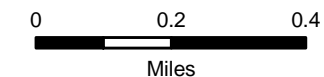
**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE C-14
PASSABILITY OF BULL TROUT
BY MILL CREEK FLOW
AND PROJECT SEGMENTS
200 CFS
Segment 3**

- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



LOWER MILL CREEK HABITAT AND PASSAGE ASSESSMENT

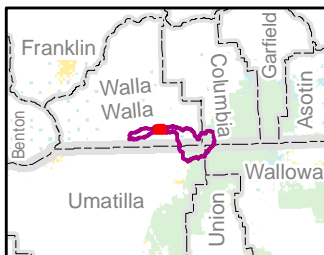
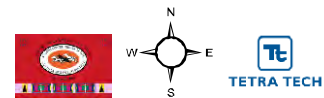
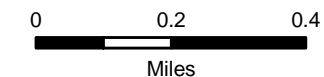
CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

FIGURE C-15 PASSABILITY OF BULL TROUT BY MILL CREEK FLOW AND PROJECT SEGMENTS 200 CFS Segment 4



- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



LOWER MILL CREEK HABITAT AND PASSAGE ASSESSMENT

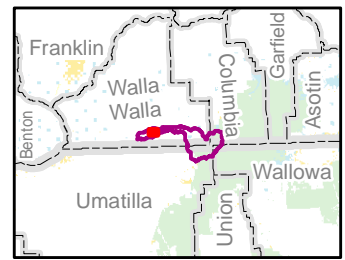
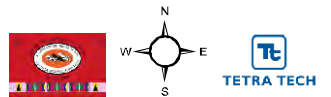
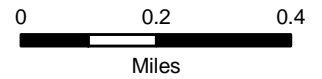
CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

FIGURE C-16 PASSABILITY OF BULL TROUT BY MILL CREEK FLOW AND PROJECT SEGMENTS 400 CFS Segment 2



- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



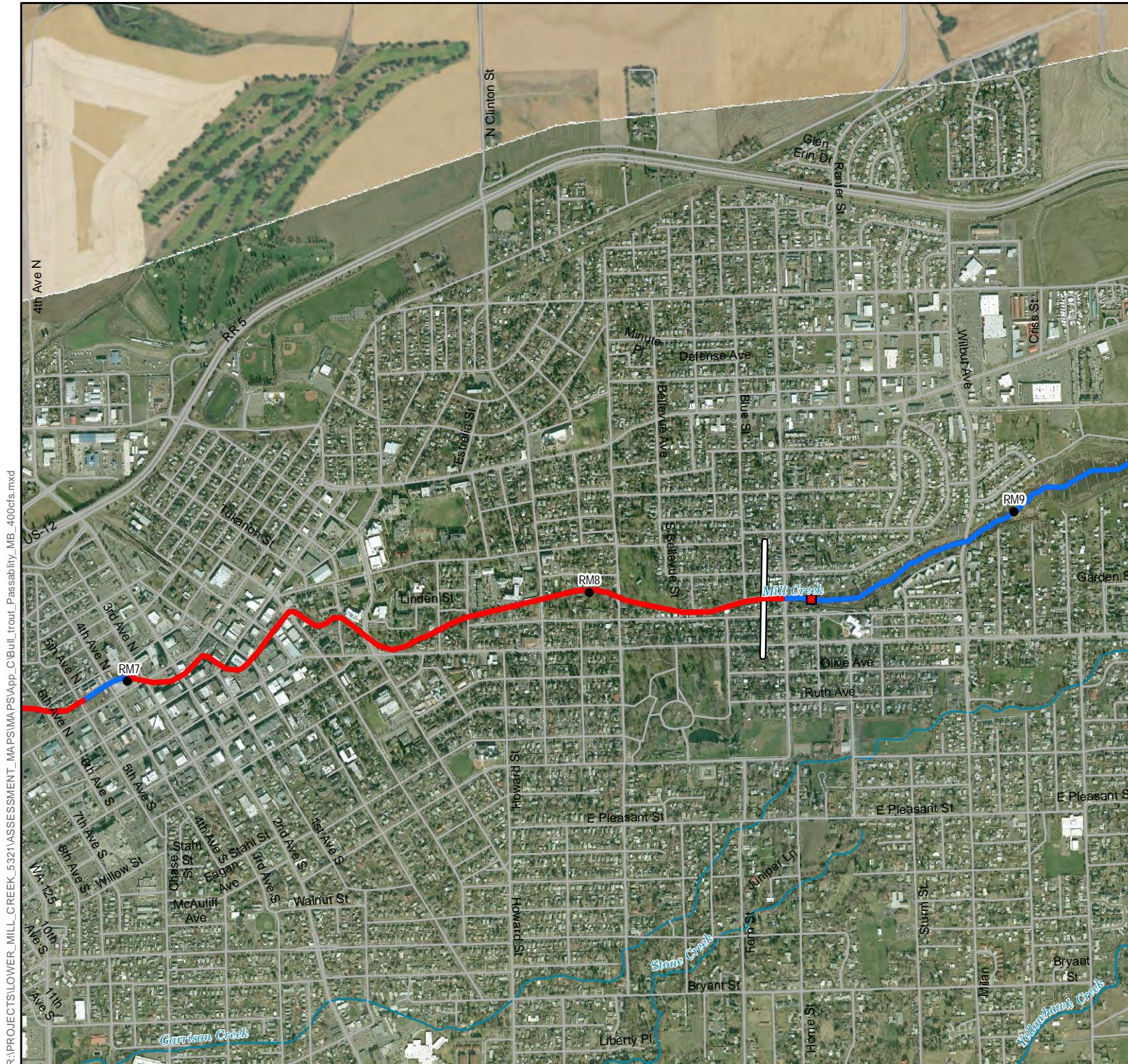
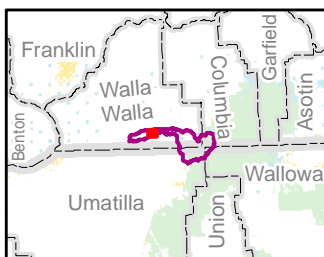
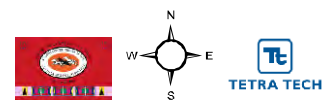
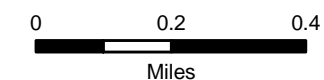
**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE C-17
PASSABILITY OF BULL TROUT
BY MILL CREEK FLOW
AND PROJECT SEGMENTS
400 CFS
Segment 3**

- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



LOWER MILL CREEK HABITAT AND PASSAGE ASSESSMENT

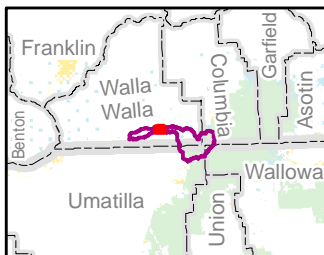
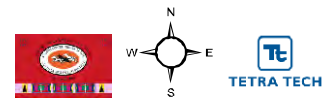
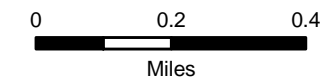
CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

FIGURE C-18 PASSABILITY OF BULL TROUT BY MILL CREEK FLOW AND PROJECT SEGMENTS 400 CFS Segment 4



- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



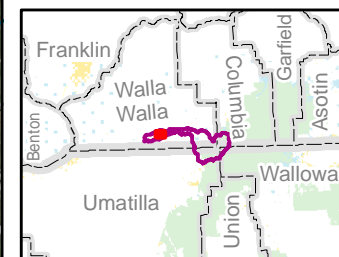
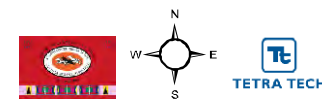
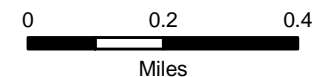
**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE C-19
PASSABILITY OF STEELHEAD
BY MILL CREEK FLOW
AND PROJECT SEGMENTS
6 CFS
Segment 2**

- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



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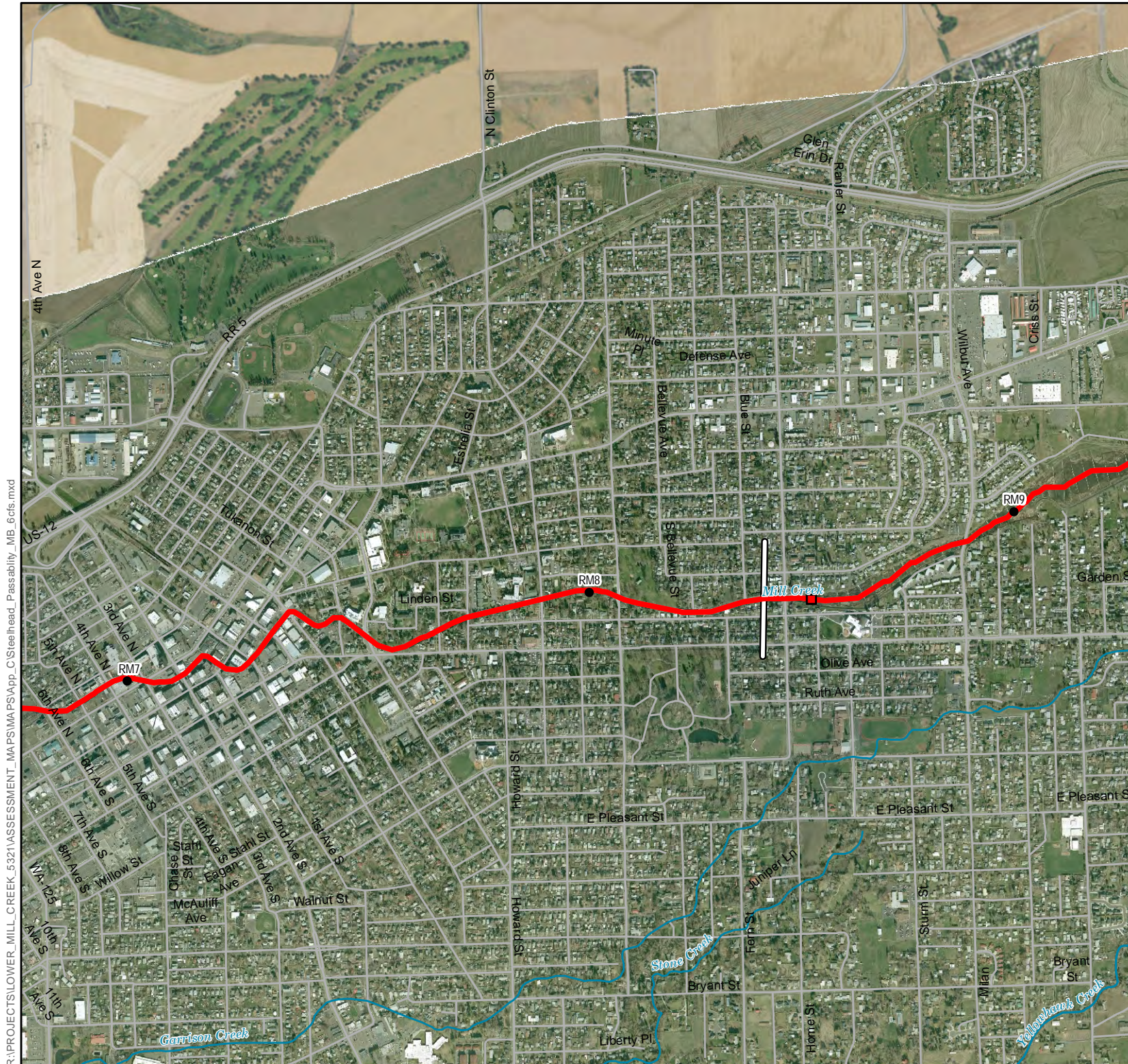
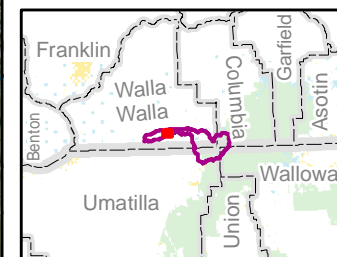
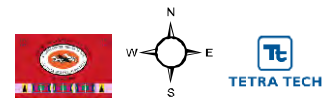
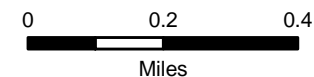
**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE C-20
PASSABILITY OF STEELHEAD
BY MILL CREEK FLOW
AND PROJECT SEGMENTS
6 CFS
Segment 3**

- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



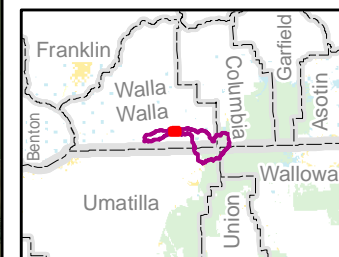
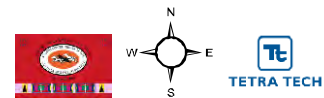
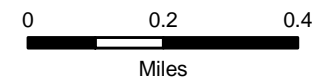
**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE C-21
PASSABILITY OF STEELHEAD
BY MILL CREEK FLOW
AND PROJECT SEGMENTS
6 CFS
Segment 4**

- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



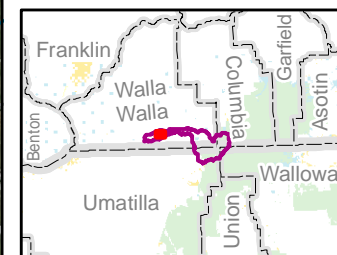
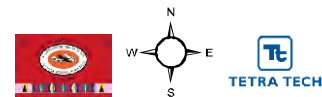
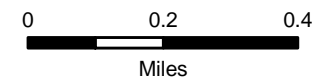
**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE C-22
PASSABILITY OF STEELHEAD
BY MILL CREEK FLOW
AND PROJECT SEGMENTS
20 CFS
Segment 2**

- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



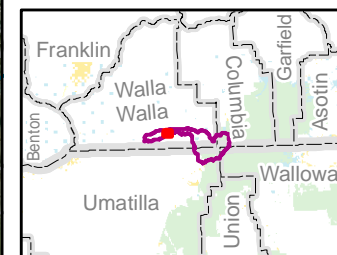
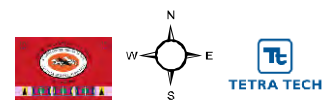
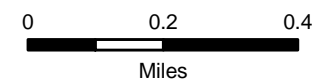
**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE C-23
PASSABILITY OF STEELHEAD
BY MILL CREEK FLOW
AND PROJECT SEGMENTS
20 CFS
Segment 3**

- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



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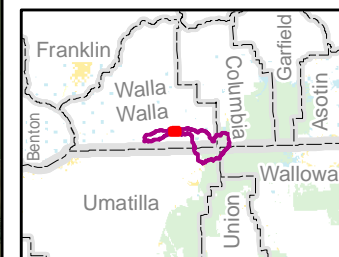
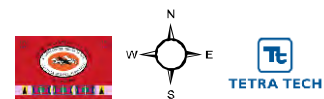
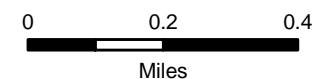
**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE C-24
PASSABILITY OF STEELHEAD
BY MILL CREEK FLOW
AND PROJECT SEGMENTS
20 CFS
Segment 4**

- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



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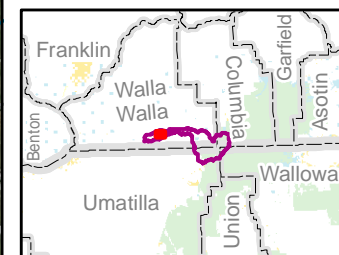
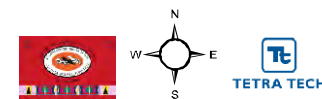
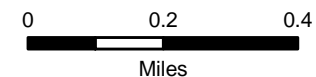
**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE C-25
PASSABILITY OF STEELHEAD
BY MILL CREEK FLOW
AND PROJECT SEGMENTS
60 CFS
Segment 2**

- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



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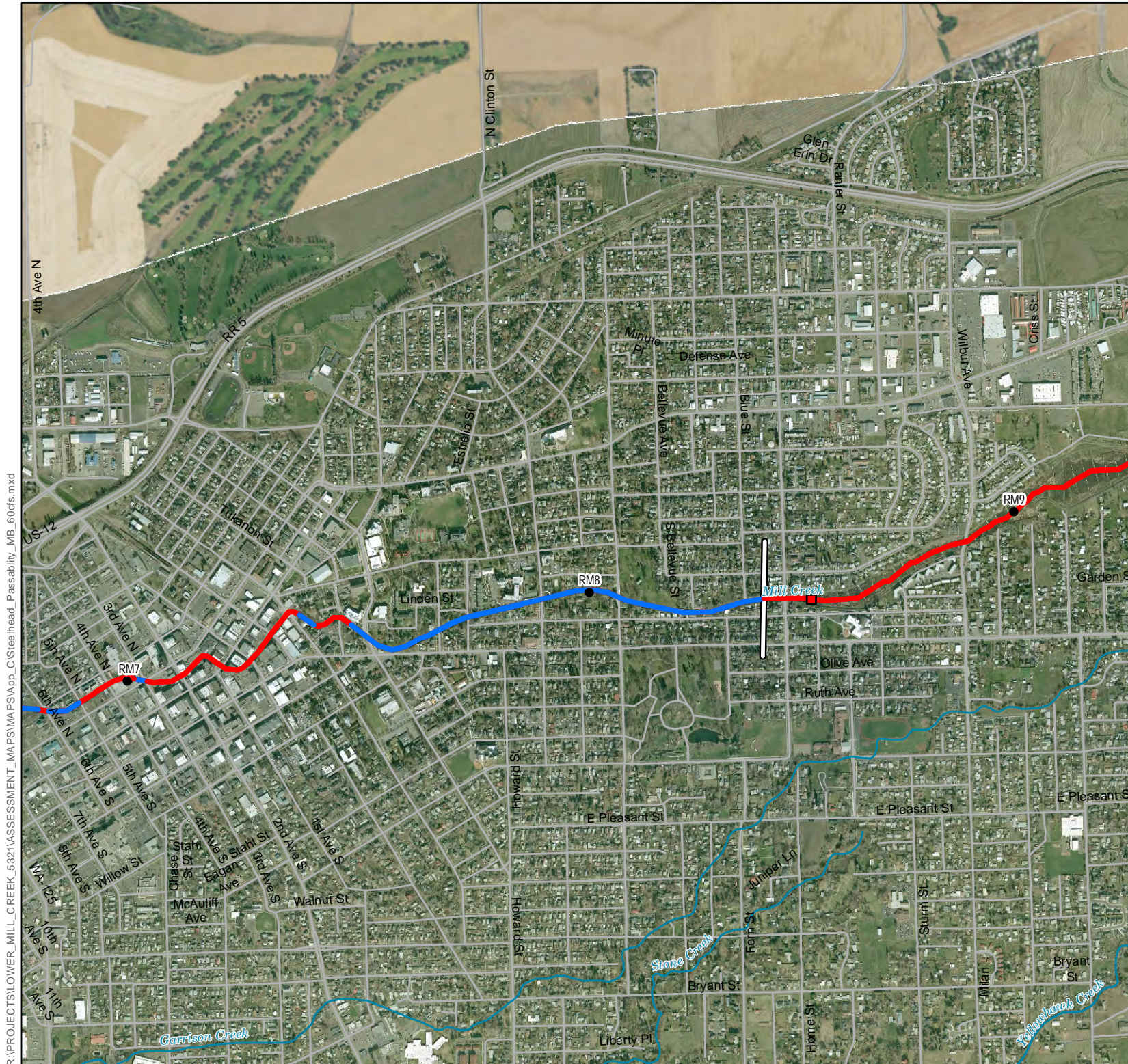
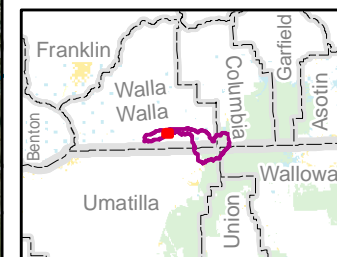
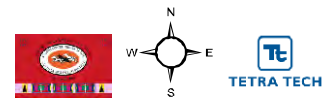
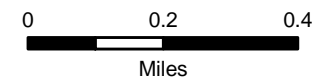
**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE C-26
PASSABILITY OF STEELHEAD
BY MILL CREEK FLOW
AND PROJECT SEGMENTS
60 CFS
Segment 3**

- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



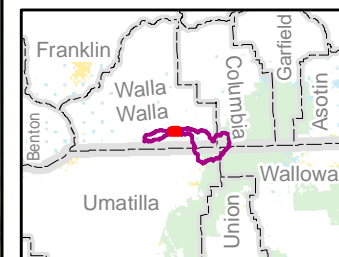
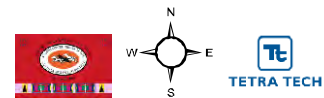
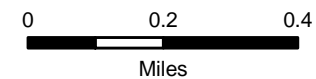
**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE C-27
PASSABILITY OF STEELHEAD
BY MILL CREEK FLOW
AND PROJECT SEGMENTS
60 CFS
Segment 4**

- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



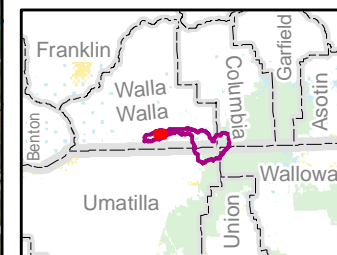
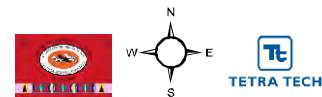
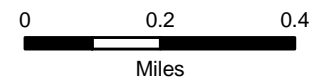
**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE C-28
PASSABILITY OF STEELHEAD
BY MILL CREEK FLOW
AND PROJECT SEGMENTS
100 CFS
Segment 2**

- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



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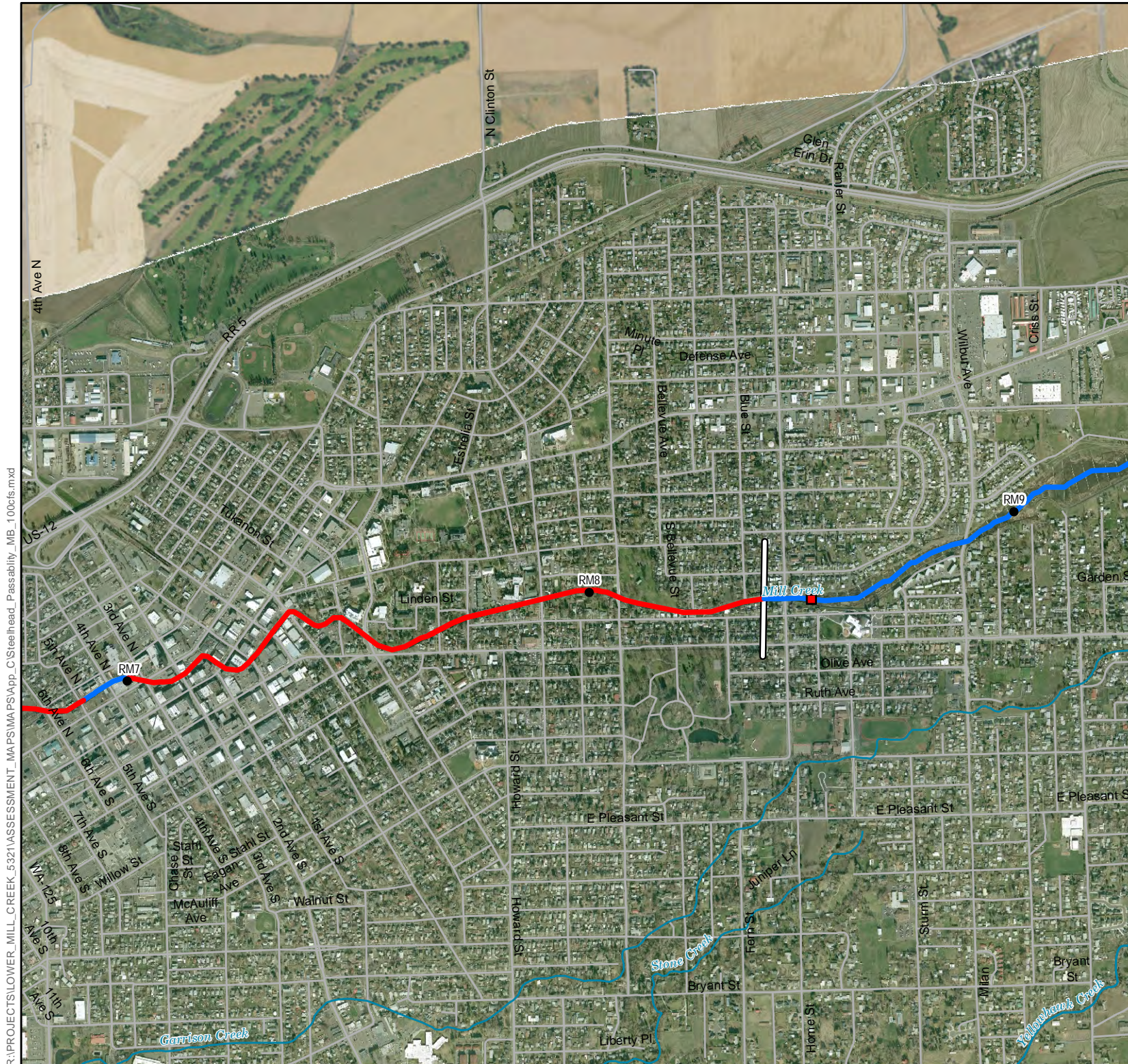
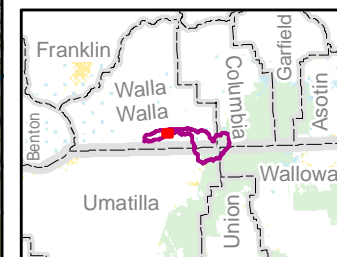
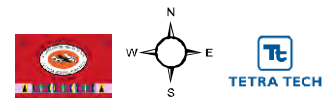
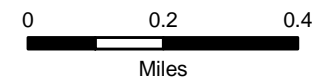
**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE C-29
PASSABILITY OF STEELHEAD
BY MILL CREEK FLOW
AND PROJECT SEGMENTS
100 CFS
Segment 3**

- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



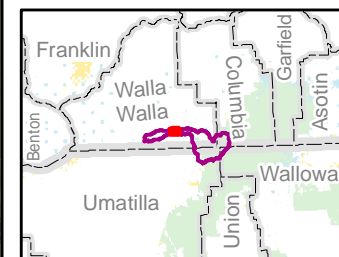
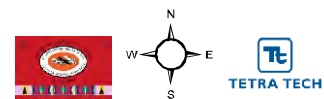
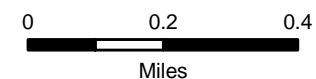
**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE C-30
PASSABILITY OF STEELHEAD
BY MILL CREEK FLOW
AND PROJECT SEGMENTS
100 CFS
Segment 4**

- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



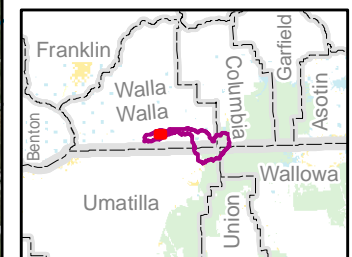
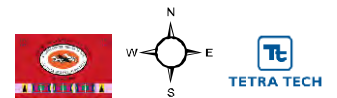
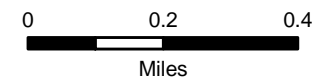
**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

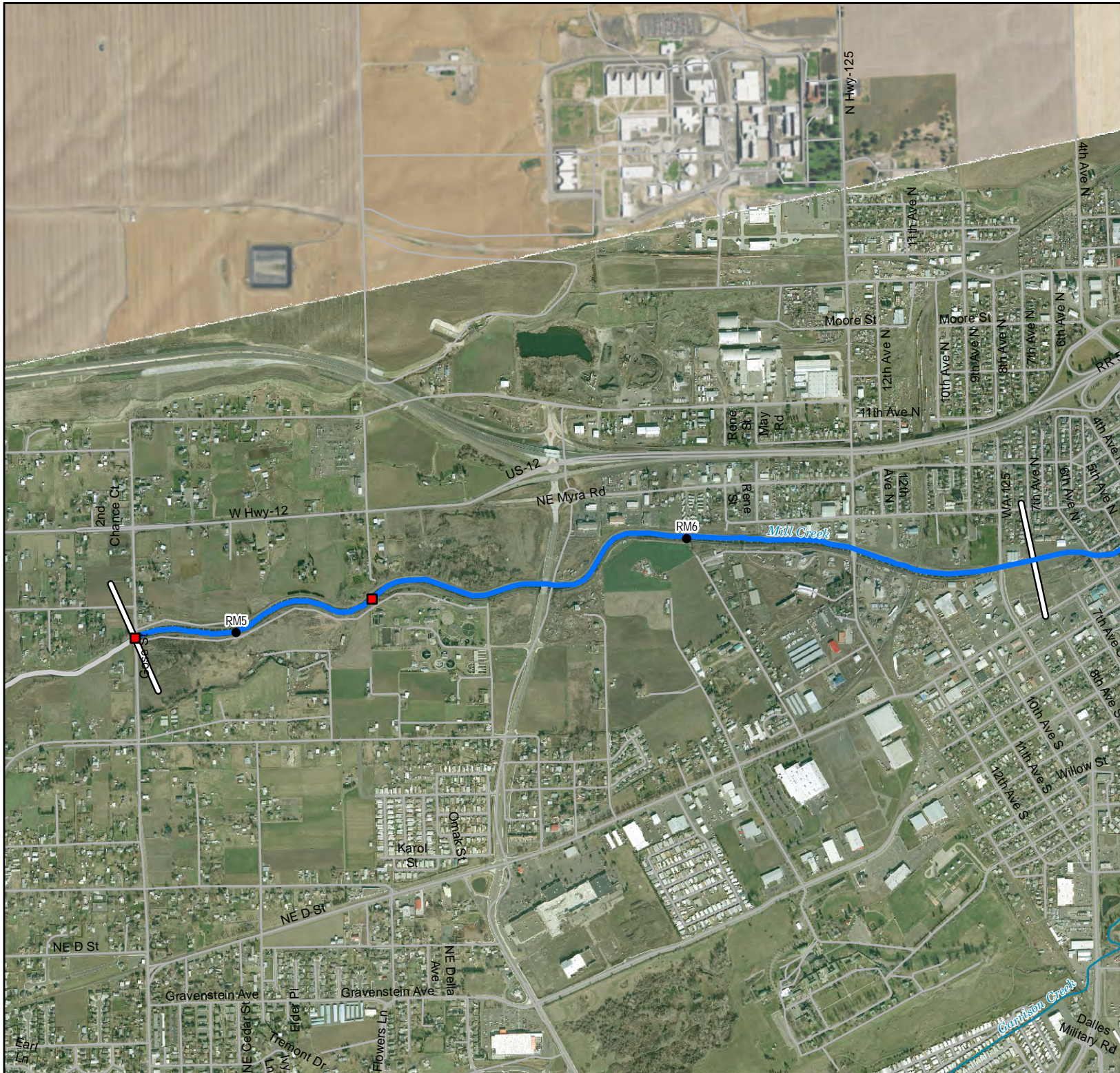
**FIGURE C-31
PASSABILITY OF STEELHEAD
BY MILL CREEK FLOW
AND PROJECT SEGMENTS
200 CFS
Segment 2**

- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



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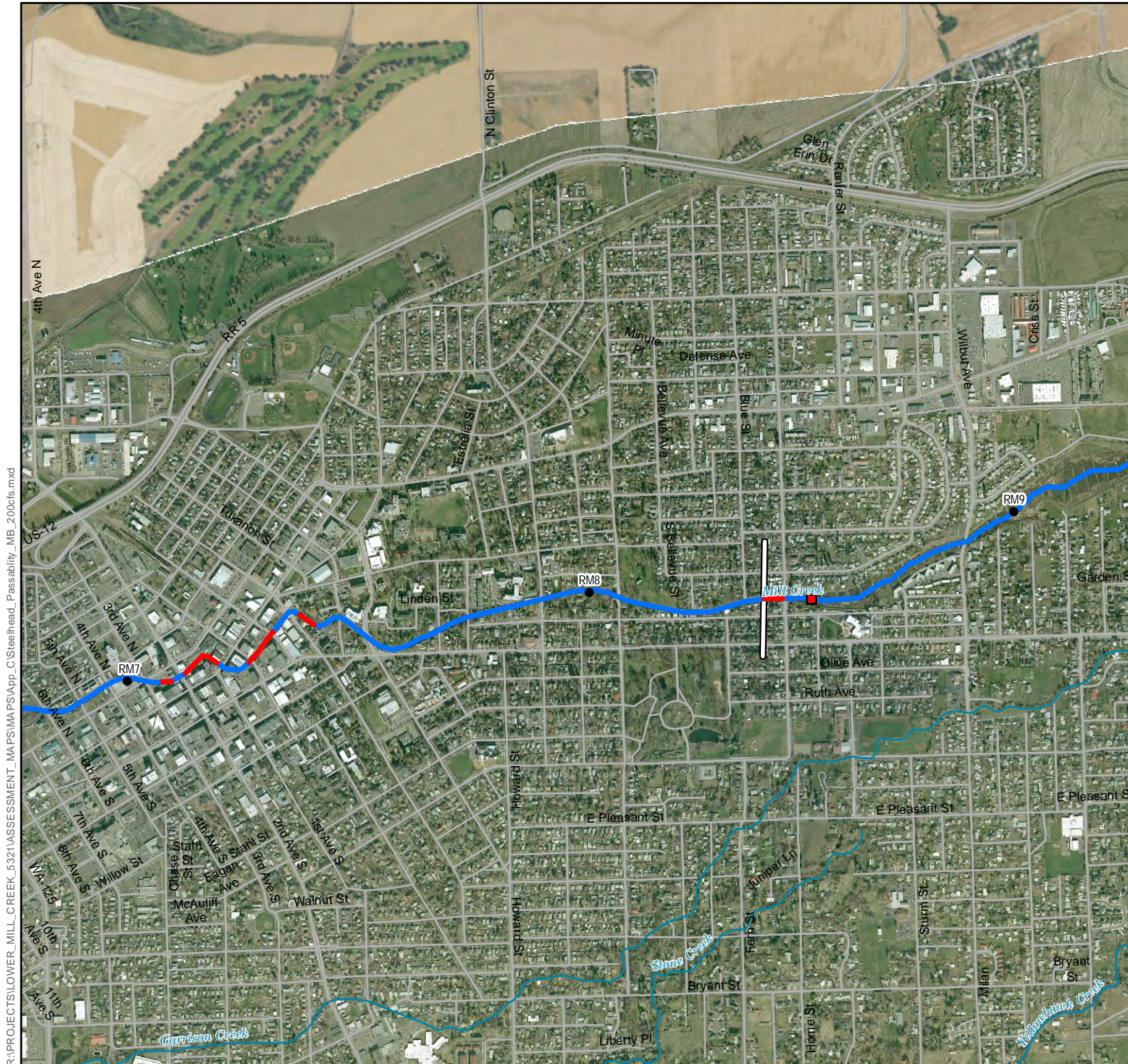
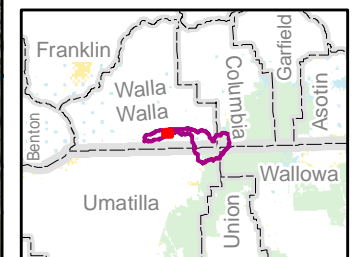
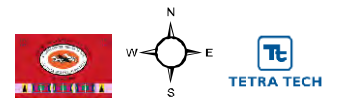
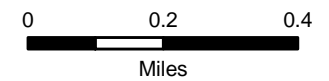
**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE C-32
PASSABILITY OF STEELHEAD
BY MILL CREEK FLOW
AND PROJECT SEGMENTS
200 CFS
Segment 3**

- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



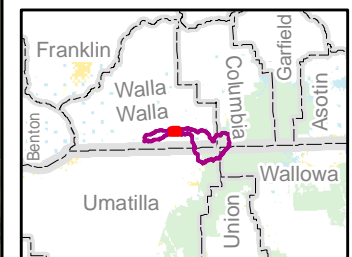
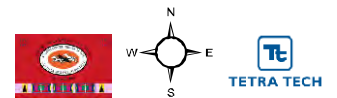
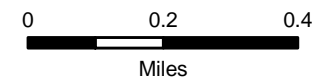
**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE C-33
PASSABILITY OF STEELHEAD
BY MILL CREEK FLOW
AND PROJECT SEGMENTS
200 CFS
Segment 4**

- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



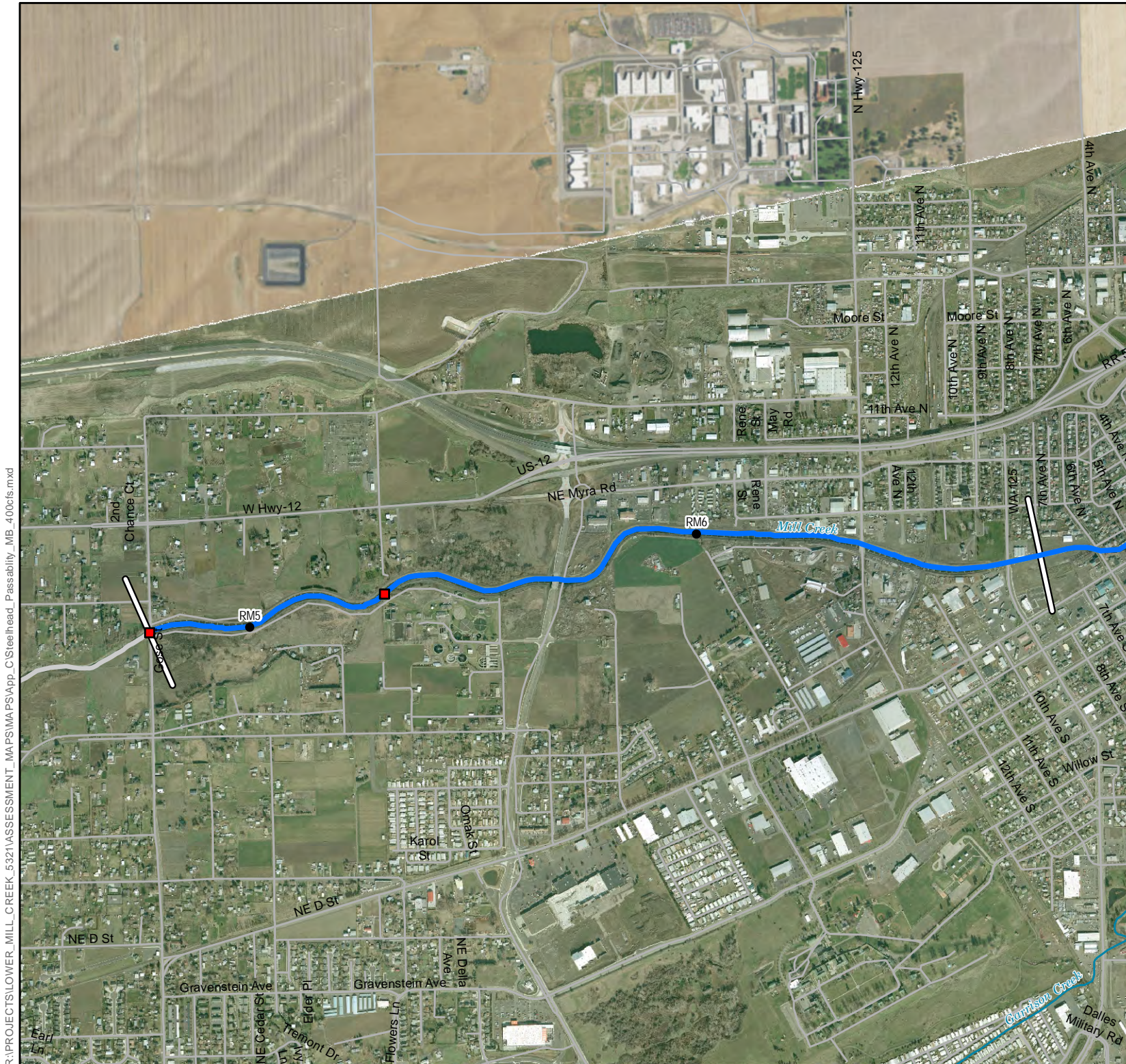
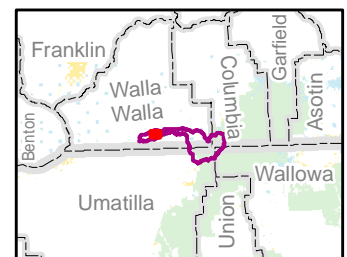
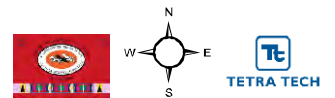
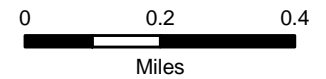
**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE C-34
PASSABILITY OF STEELHEAD
BY MILL CREEK FLOW
AND PROJECT SEGMENTS
400 CFS
Segment 2**

- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



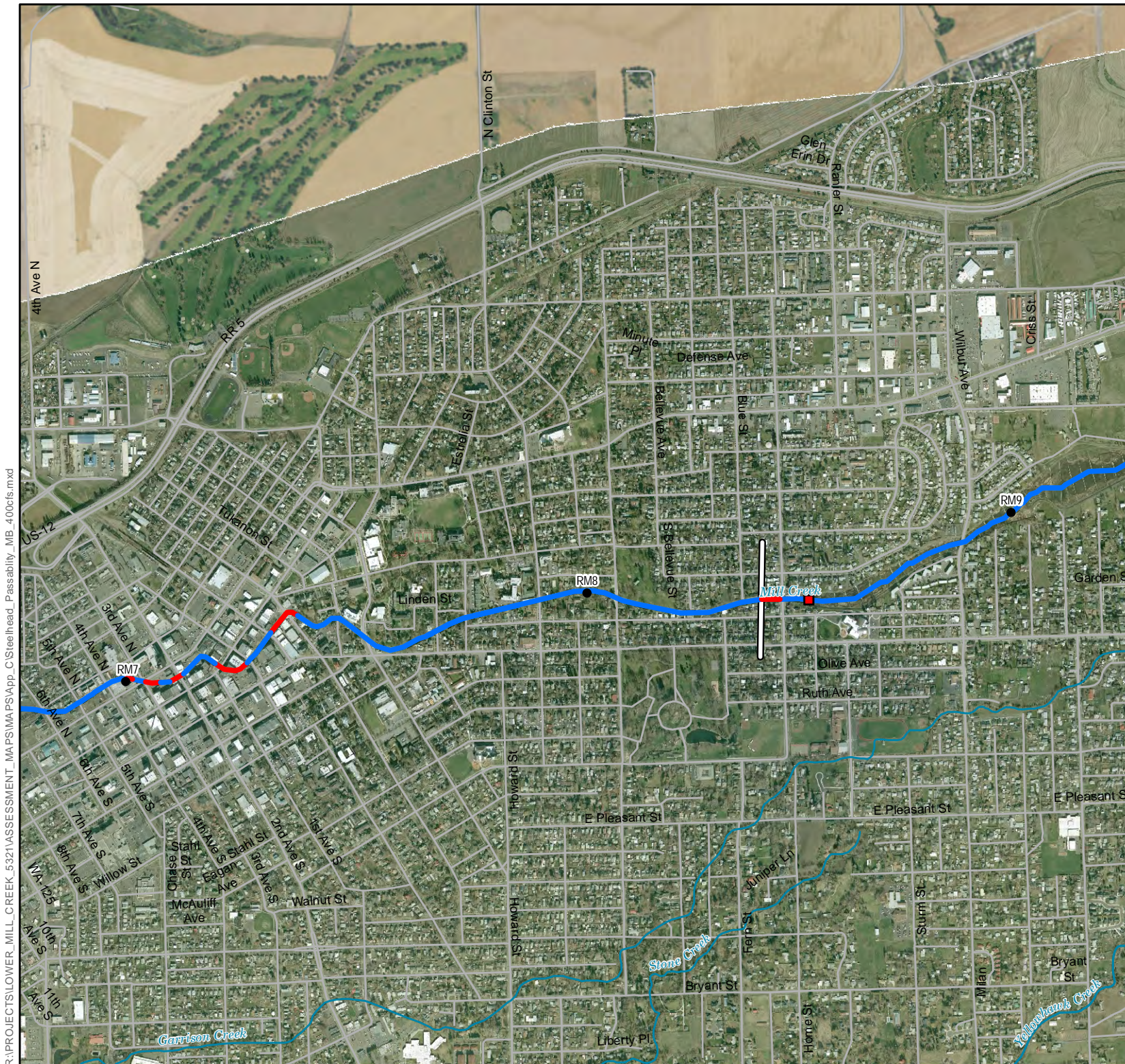
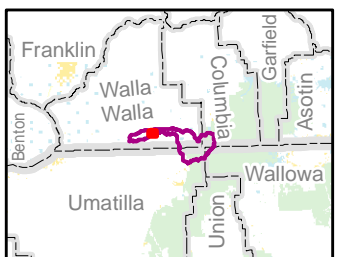
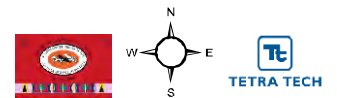
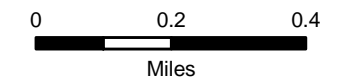
**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE C-35
PASSABILITY OF STEELHEAD
BY MILL CREEK FLOW
AND PROJECT SEGMENTS
400 CFS
Segment 3**

- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



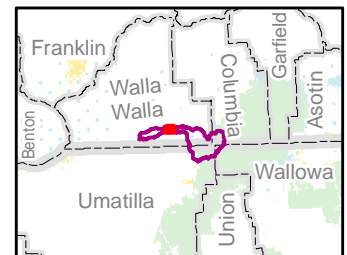
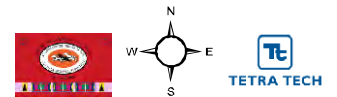
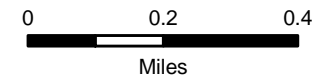
**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE C-36
PASSABILITY OF STEELHEAD
BY MILL CREEK FLOW
AND PROJECT SEGMENTS
400 CFS
Segment 4**

- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



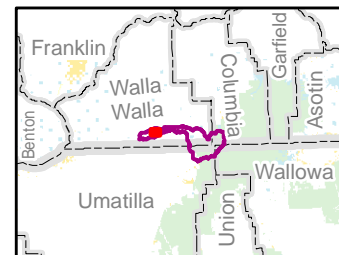
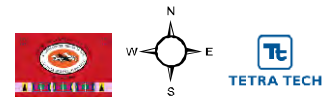
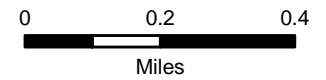
**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE C-37
PASSABILITY OF SPRING
CHINOOK BY MILL CREEK FLOW
AND PROJECT SEGMENTS
6 CFS
Segment 2**

- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



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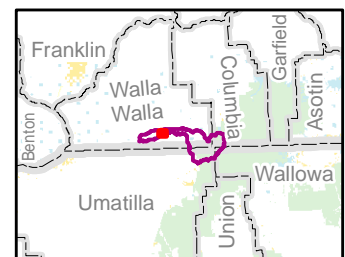
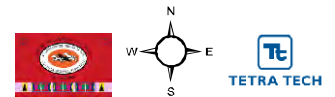
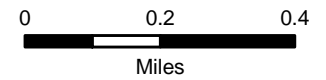
LOWER MILL CREEK HABITAT AND PASSAGE ASSESSMENT

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

FIGURE C-38
PASSABILITY OF SPRING
CHINOOK BY MILL CREEK FLOW
AND PROJECT SEGMENTS
6 CFS
Segment 3

- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



LOWER MILL CREEK HABITAT AND PASSAGE ASSESSMENT

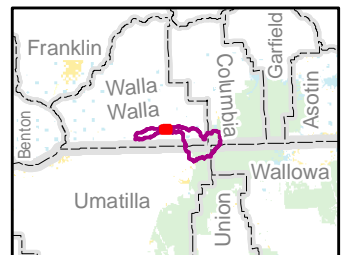
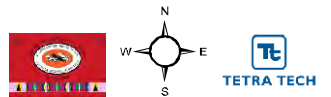
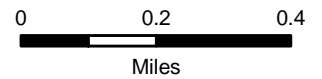
CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

FIGURE C-39
PASSABILITY OF SPRING
CHINOOK BY MILL CREEK FLOW
AND PROJECT SEGMENTS
6 CFS
Segment 4



- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



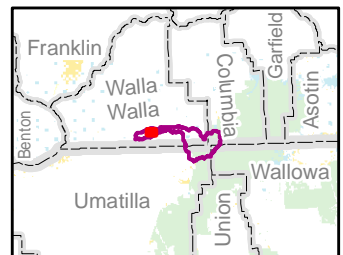
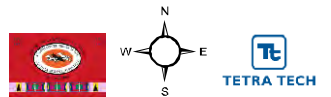
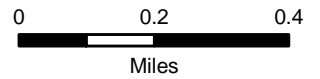
**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE C-40
PASSABILITY OF SPRING
CHINOOK BY MILL CREEK FLOW
AND PROJECT SEGMENTS
20 CFS
Segment 2**

- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



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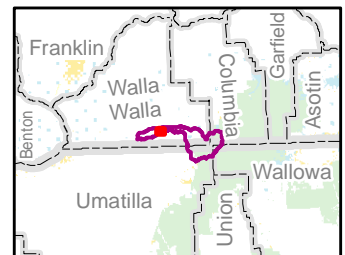
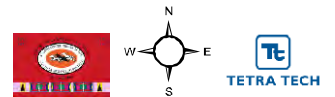
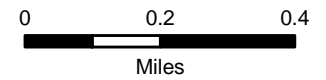
**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE C-41
PASSABILITY OF SPRING
CHINOOK BY MILL CREEK FLOW
AND PROJECT SEGMENTS
20 CFS
Segment 3**

- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



LOWER MILL CREEK HABITAT AND PASSAGE ASSESSMENT

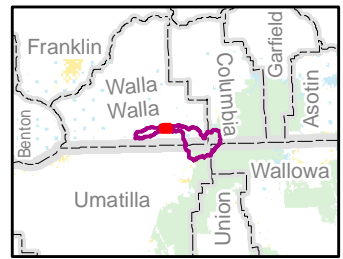
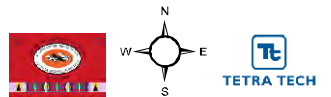
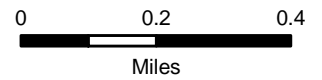
CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

FIGURE C-42 PASSABILITY OF SPRING CHINOOK BY MILL CREEK FLOW AND PROJECT SEGMENTS 20 CFS Segment 4



- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



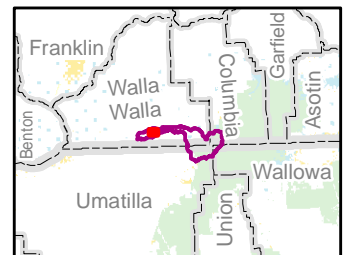
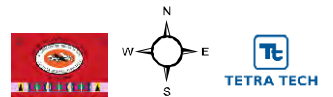
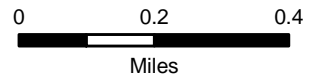
**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE C-43
PASSABILITY OF SPRING
CHINOOK BY MILL CREEK FLOW
AND PROJECT SEGMENTS
60 CFS
Segment 2**

- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



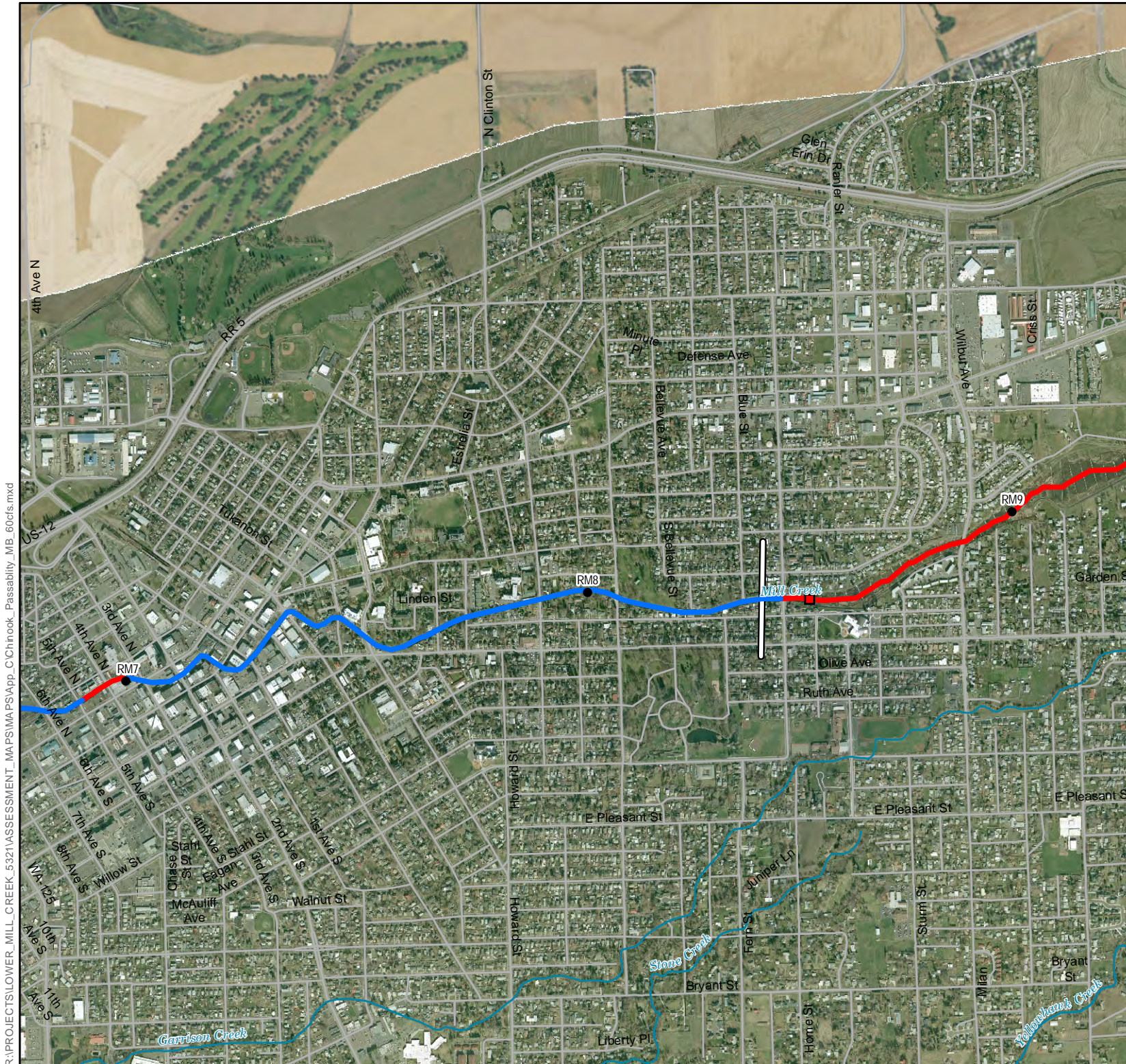
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**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

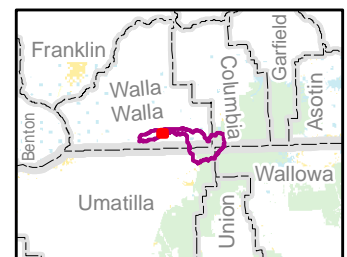
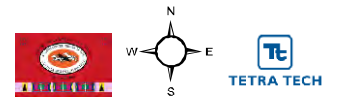
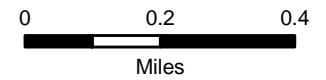
CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE C-44
PASSABILITY OF SPRING
CHINOOK BY MILL CREEK FLOW
AND PROJECT SEGMENTS
60 CFS
Segment 3**



- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



LOWER MILL CREEK HABITAT AND PASSAGE ASSESSMENT

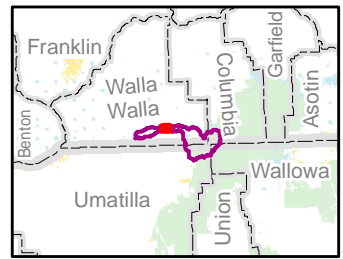
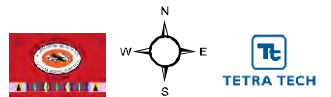
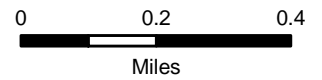
CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

FIGURE C-45
PASSABILITY OF SPRING
CHINOOK BY MILL CREEK FLOW
AND PROJECT SEGMENTS
60 CFS
Segment 4



- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



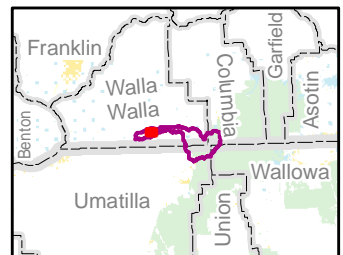
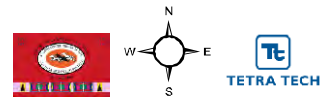
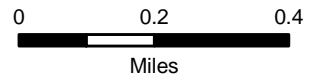
**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE C-46
PASSABILITY OF SPRING
CHINOOK BY MILL CREEK FLOW
AND PROJECT SEGMENTS
100 CFS
Segment 2**

- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



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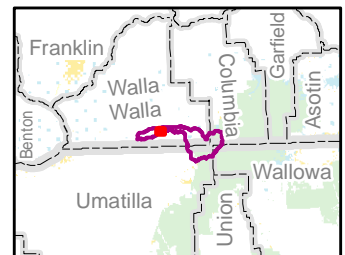
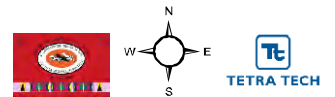
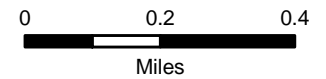
**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

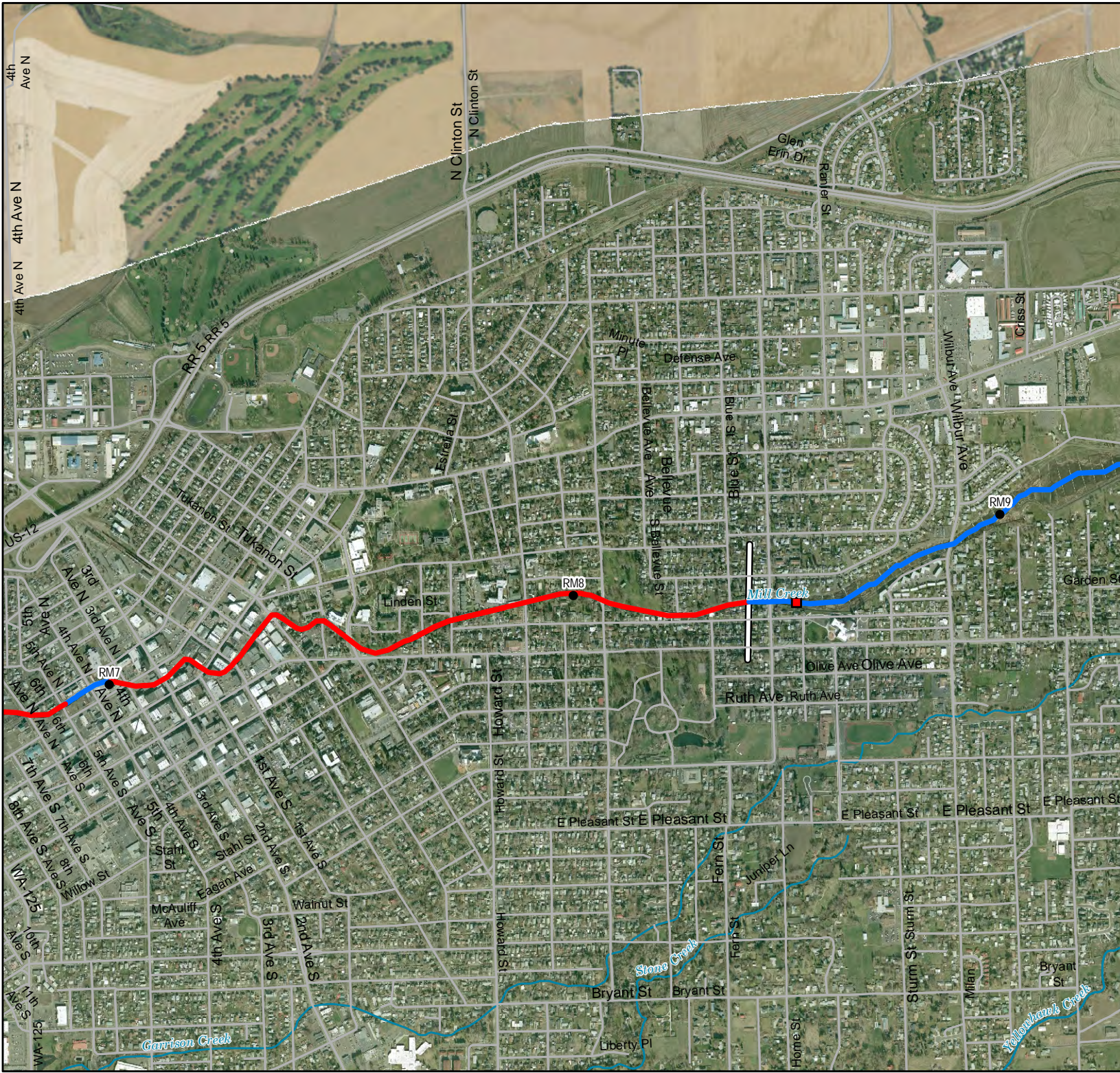
**FIGURE C-47
PASSABILITY OF SPRING
CHINOOK BY MILL CREEK FLOW
AND PROJECT SEGMENTS
100 CFS
Segment 3**

- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



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LOWER MILL CREEK HABITAT AND PASSAGE ASSESSMENT

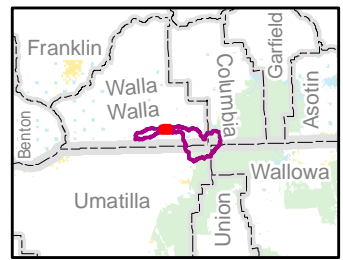
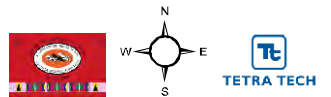
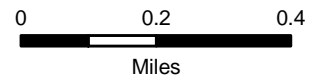
CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

FIGURE C-48
PASSABILITY OF SPRING
CHINOOK BY MILL CREEK FLOW
AND PROJECT SEGMENTS
100 CFS
Segment 4



- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



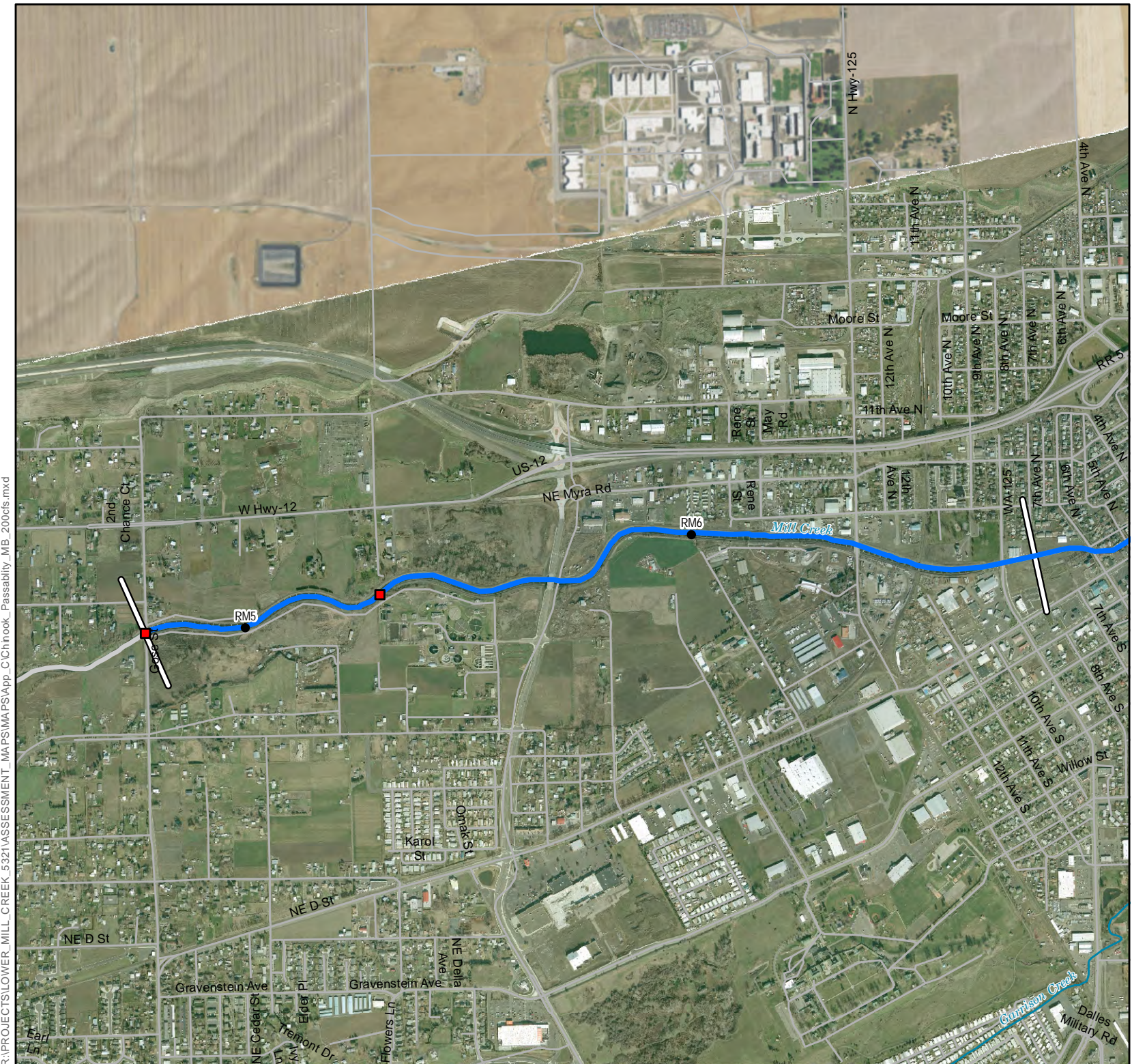
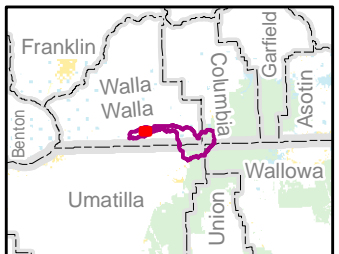
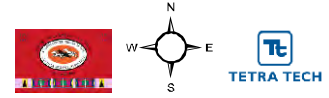
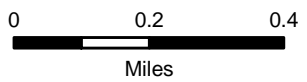
**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE C-49
PASSABILITY OF SPRING
CHINOOK BY MILL CREEK FLOW
AND PROJECT SEGMENTS
200 CFS
Segment 2**

- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



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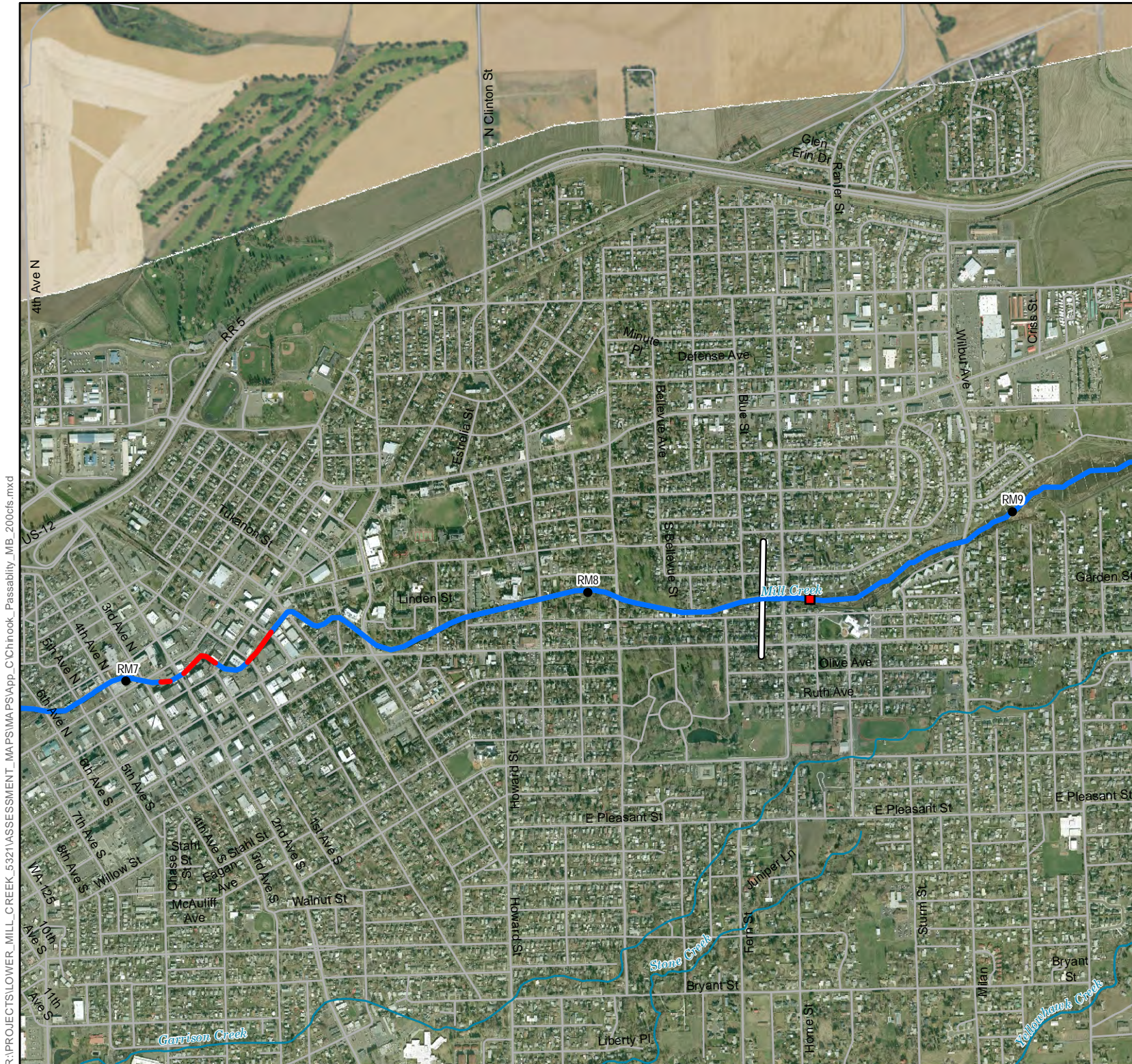
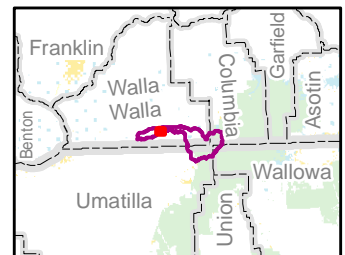
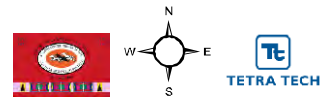
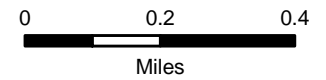
**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE C-50
PASSABILITY OF SPRING
CHINOOK BY MILL CREEK FLOW
AND PROJECT SEGMENTS
200 CFS
Segment 3**

- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



LOWER MILL CREEK HABITAT AND PASSAGE ASSESSMENT

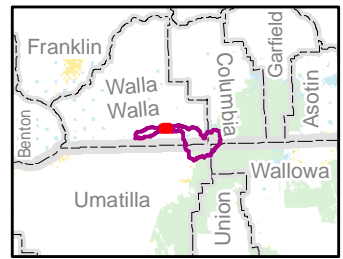
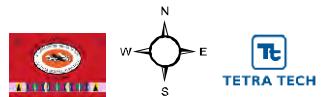
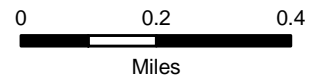
CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

FIGURE C-51 PASSABILITY OF SPRING CHINOOK BY MILL CREEK FLOW AND PROJECT SEGMENTS 200 CFS Segment 4



- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



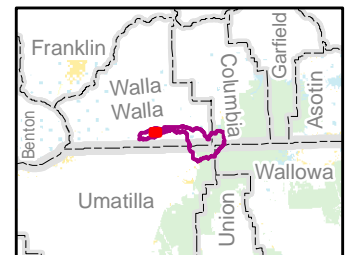
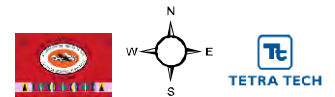
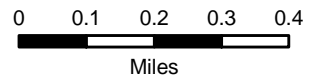
**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE C-52
PASSABILITY OF SPRING
CHINOOK BY MILL CREEK FLOW
AND PROJECT SEGMENTS
400 CFS
Segment 2**

- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



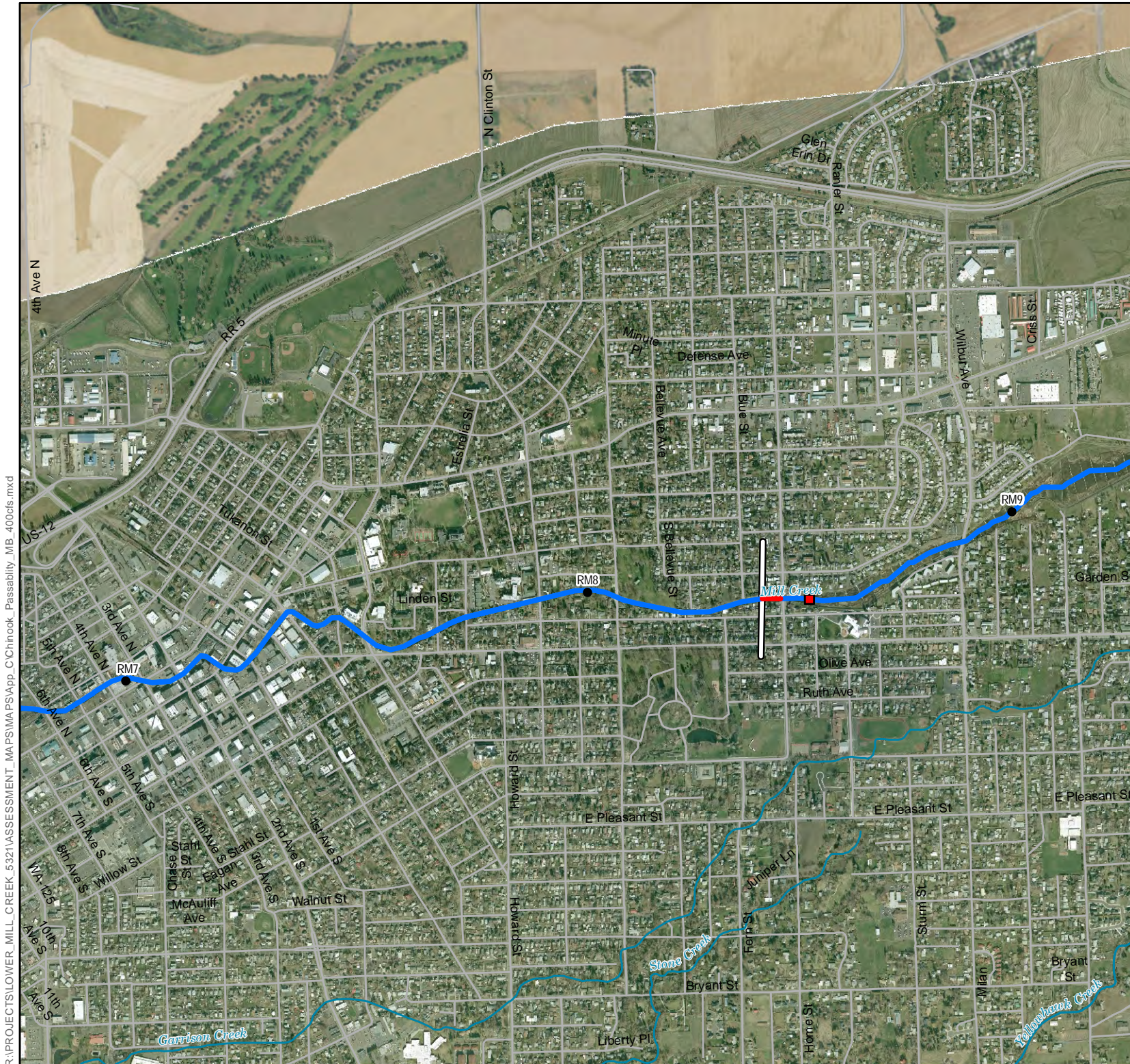
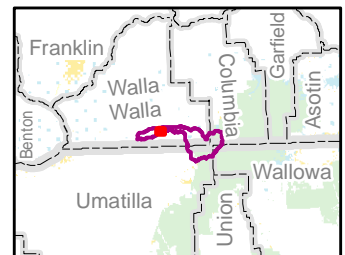
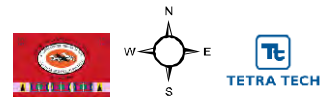
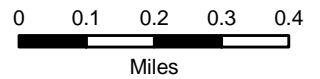
**LOWER MILL CREEK
HABITAT AND PASSAGE
ASSESSMENT**

CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

**FIGURE C-53
PASSABILITY OF SPRING
CHINOOK BY MILL CREEK FLOW
AND PROJECT SEGMENTS
400 CFS
Segment 3**

- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet



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LOWER MILL CREEK HABITAT AND PASSAGE ASSESSMENT

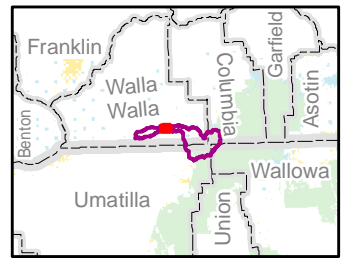
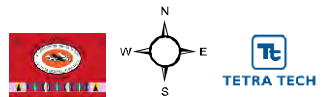
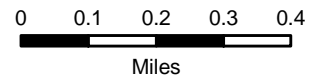
CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION

FIGURE C-54 PASSABILITY OF SPRING CHINOOK BY MILL CREEK FLOW AND PROJECT SEGMENTS 400 CFS Segment 4



- River Miles
- Fish Passage Barriers
- ▭ Project Area Breaks
- Stream
- Impassable
- Passable
- No Determination

Source: StreamNet





TETRA TECH

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