US Army Corps of Engineers
Walla Walla District

Walla Walla River Basin
No Action Report

January 2013

Walla Walla River Basin
No Action Report

For nearly a decade, the CTUIR and the Corps have partnered together on the Walla Walla River Ecosystem Restoration Feasibility Report (WWGI). There is noteworthy regional interest and support for this project, and it is a high priority for the CTUIR and the Corps. In recent years, we have forged ahead to complete the report and achieve a Chief's Report. However, the non-federal sponsor requirement to protect project flows has proven difficult due to the bi-state nature of the Walla Walla River and lack of an available legal mechanism to protect flows entering Washington from Oregon. The CTUIR is pursuing and making progress towards a negotiated water rights settlement for the WW Basin that can protect project flows but we are at a point where it is prudent to pause and work through the complex challenges encountered in the CTUIR's pursuit of instream flow protection through a water right settlement on the Walla Walla River.

Of the many challenges encountered during the life of this project, the most significant unresolved endeavor is the methodology to protect instream flows, which provide information to:

- Select a recommended alternative.
- Develop a financial plan to design, construct, operate, and maintain the recommended alternative.
- Generate letters of support and legal certification defending the stated requirements.
- Support completion of a Walla Walla River feasibility report/environmental impact statement (FR/EIS). Without an FR/EIS, we cannot move forward with pre-engineering and design (PED) or a Chief's Report.

Protection of instream flows is a complex issue. Water in the states of Washington and Oregon has been over appropriated for decades. The team anticipates it will take ten or more years to resolve these challenges. Because of this challenge, no action on this study will be taken at this time.

Because of this, the decade long effort to study the problems and opportunities on the Walla Walla River is summarized in a no action report. The report includes the authorization of the study, identification of problems and opportunities, formulation of alternatives and their evaluation. No conclusion or recommendation is made.

The no action report has been through multiple internal and external reviews. Based on feedback from headquarters USACE the team included information within the basin that

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describes and supports ongoing flood risk management and ecosystem restoration efforts. Based on feedback from district quality control (DQC) review and agency technical review (ATR) this information should be downscaled and the report should focus on restoration efforts on the Walla Walla River. These opposing points of view have not been resolved. The comments from these reviews have been captured and are available for future team members.

In summary, the *no action report* includes the following:

- Identification of the study authorization,
- Description of the problems and opportunities and the study objectives, and
- Description of all measures and alternatives and how they were evaluated. This includes information on the screening process as well as a detailed economic analysis on a handful of alternatives.

Along with the draft report the following has also been organized and packaged for future use.

- Detail on all analyses and investigations performed to date and
- Details on all reviews and outstanding comments for future resolution.

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List of Acronyms

µg/L	microns per liter
AF	acre-feet
AQI	Air Quality Index
BLM	Bureau of Land Management
BMP	Best Management Practice
BPA	Bonneville Power Administration
B-scat	visibility
CAA	Clean Air Act
CERCLA	Comprehensive Environmental Response, Compensation, And Liability Act
cfs	cubic feet per second
CHART	Critical Habitat Analytical Review Team
CIDMP	Comprehensive Irrigation District Management Plan
CIG	Climate Impacts Group
CO	carbon monoxide
Corps	US Army Corps of Engineers
CREP	Conservation Reserve Enhancement Program
CRP	Conservation Reserve Program
CRWE	Columbia River Water Exchange
CTUIR	Confederated Tribes of the Umatilla Indian Reservation
CWA	Clean Water Act
dB	decibels
dB(A)	hearing capability of the human ear
DDD	4, 4'- dichlorodiphenyldichloroethane
DDE	4,4'- dichlorodiphenyldichloroethylene
DO	Dissolved Oxygen
DPS	Distinct Population Segment
Ecology	Washington Department of Ecology
EDT	Ecosystem Diagnosis and Treatment
EOP	Environmental Operating Principles
EPA	US Environmental Protection Agency
EQ	Environmental Quality
ER	Engineer Regulation
ESU	Evolutionarily Significant Unit
FCSA	Feasibility Cost Share Agreement
ft^3	cubic feet
FY	fiscal year

List of Acronyms (continued)

GFID	Gardena Farms Irrigation District
GIS	geographic information system
GCM	Global Climate Change model
HBDIC	Hudson Bay District Irrigation Company
HCP	Habitat Conservation Plan
HEC-RAS	Hydrologic Engineering Center's River Analysis System
HSRG	Hatchery Scientific Research Group
HTRW	Hazardous, Toxic, and Radioactive Waste
ICBTRT	Interior Columbia Basin Technical Recovery Team
IDC	Interest During Construction
IFIM	Instream Flow Incremental Methodology
ISAB	Independent Scientific Advisory Board
ISRP	Independent Scientific Review Panel
IWFM	Integrated Water Flow Model
IWR-Plan	Institute of Water Resources' Cost Effectiveness
km^2	square kilometers
kWh	kilowatt hours
lbs	pounds
LSRFWCP	Lower Snake River Fish and Wildlife Compensation Plan
LUST	leaking underground
MCFCP	Mill Creek Flood Control Project
MCL	maximum contaminant level
MCR	Middle Columbia River
MCWG	Mill Creek Work Group
mg/L	milligrams per liter
mi^2	square miles
mm	millimeters
MPG	Major Population Group
NAAQS	National Ambient Air Quality Standards
NAMS	National Air Monitoring Stations
NED	National Economic Development
NEPA	National Environmental Policy Act
NER	National Environmental Restoration
NMFS	National Marine Fisheries Service
NPDES	National Pollution Discharge elimination System
NO_2	nitrous oxide
NPCC	Northwest Power and Conservation Council

List of Acronyms (continued)

NRCS	National Resources Conservation Service
O&M	operation and maintenance
O_3	ozone
ODEQ	Oregon Department of Environmental Quality
ODF	Oregon Department of Forestry
ODFW	Oregon Department of Fish and Wildlife
OMRR&R	operation, maintenance, repair, rehabilitation, and replacement
OSE	Other Significant Effects
OWRD	Oregon Water Resources Department
OWT	Oregon Water Trust
Pb	lead
PCB	polychlorinated biphenyl
POD	point of delivery
PDT	Project Delivery Team
PED	preconstruction, engineering, and design
PHABSIM	Physical Habitat Simulation model
pHOS	proportion of effective hatchery-origin spawners
PHS	Priority Habitat Species
PIT	Passive Integrated Transponder
PL	Public Law
PM	particulate matter
PNI	Proportionate Natural Influence
PNW	Pacific Northwest
RCC	roller compacted concrete
RED	Regional Economic Development
RHABSIM	River Habitat Simulation model
RM	river mile
SIP	State Implementation Plan
SLAMS	State and Local Monitoring Stations
SO_2	sulfur dioxide
SPMS	Special Purpose Monitoring Stations
TMDL	total maximum daily load
TSP	total suspended particulates
USC	US Code
USFS	US Forest Service
USFWS	US Fish and Wildlife Service
USGS	US Geological Survey

List of Acronyms (continued)

UST	underground storage tank
UW	University of Washington
VSP	viable salmonid population
WAQA	Washington Air Quality Advisory
WDF	Washington Department of Forestry
WDFW	Washington Department of Fish and Wildlife
WDNR	Washington Department of Natural Resources
WNHP	Washington Natural Heritage Program
WQIP	Washington Quality Implementation Plan
WRDA	Water Resources Development Act
WRIA	Water Resource Inventory Area
WUA	weighted unit average
WWBWC	Walla Walla Basin Watershed Council
WWRB	Walla Walla River Basin
WWRBFR/EIS	Walla Walla River Basin Feasibility Report/Environmental Impact Statement
WWRID	Walla Walla River Irrigation District
WWT	Washington Water Trust
WWTP	waste water treatment plant

SECTION 1 – STUDY INFORMATION

1.1 Introduction

The US Army Corps of Engineers, Walla Walla District (Corps), in cooperation with the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) and other stakeholders, is conducting an ecosystem restoration study of the Walla Walla River Basin (WWRB). The study area encompasses the mainstem Walla Walla River from the Little Walla Walla Diversion, in Milton-Freewater, Oregon [River Mile (RM) 47] to its confluence with the Columbia River.

The CTUIR, a tribe Federally-recognized under the Treaty of 1855, is the local sponsor. With such local sponsorship, the Corps may use its Congressional authorities to participate in restoring function and high value habitat throughout this reach of the Walla Walla River.

1.2 Authority

The Walla Walla River Basin Feasibility Report/Environmental Impact Statement (WWRBFR/EIS) was prepared as an interim response to a Resolution by the Committee on Public Works of the United States Senate, adopted July 27, 1962, which reads:

> "Resolved by the Committee on Public Works of the United States Senate, That the Board of Engineers for Rivers and Harbors, created under Section 3 of the Rivers and Harbors Act of 1902, be, and is hereby, requested to review the Reports on the Columbia River and Tributaries, published as House Document numbered 403, Eighty-Seventh Congress, and other pertinent reports, with a view to determining any modifications of the recommendations contained therein are advisable at this time, with particular reference to further development of land and water resources to meet anticipated regional requirements.
>
> The investigation will be coordinated with the Department of the Interior, Department of Health, Education and Welfare, the Department of Agriculture, and other interested Federal agencies and the States concerned."

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In 2007, language was also included in a Water Resource Development Act (WRDA), further describing changes to previous cost share requirements.

> "SEC. 4074. WALLA WALLA RIVER BASIN, OREGON.
>
> In conducting the study of determine the feasibility of carrying out a project for ecosystem restoration, Walla Walla River basin,
>
> Oregon, the Secretary shall—
>
> (1) credit toward the non-Federal share of the cost of the study the cost of work carried out by the non-Federal interest before the date of the partnership agreement for the project if the Secretary determines that the work is integral to the project; and
>
> (2) allow the non-Federal interest to provide the non-Federal share of the cost of the study in the form of in-kind services and materials."

The WRDA 2007 language specific to this study was not utilized. The sponsor did not pursue cost share for previous work completed and the feasbility cost share agreement was authorized to allow the sponsor credit for work in-kind services during the study phase.

In addition to authorities granted to the Corps for ecosystem restoration, and specific legislation provided for continuation of this study, the project provides for the letter or intent of several Federal laws, directives, and Executive Orders concerning restoration and conservation efforts. As a Federal agency, the Corps is responsible for executing the intent of these laws, which include:

- Anadromous Fish Conservation Act of 1965, as Amended
- Endangered Species Act (ESA) of 1973, as Amended
- Farmland Protection Policy Act
- Fish and Wildlife Coordination Act of 1958, as Amended
- Historic and Archeological Data Preservation
- National Environmental Policy Act of 1969, as Amended

1.3 Study Area Location and Description

The WWRB is located in southeastern Washington and northeastern Oregon. It is a fan-shaped basin that encompasses 4,553 square kilometers (km^2) [1,758 square miles (mi^2)]. Of this, 73% (3,309 km^2 or 1,278 mi^2) is located in the State of Washington. The majority of the basin is moderately sloped, with fairly even terrain; although the easternmost one-fifth is part of Umatilla National Forest, and is steeply sloped and lightly timbered (Figure 1-1).

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The Walla Walla River and its tributaries originate in the Blue Mountains of southeastern Washington and northeastern Oregon and flow north and west to enter the Columbia River into Lake Wallula upstream of McNary Lock and Dam. Elevations in the subbasin range from about 5,900 feet mean sea level (msl) at mountain peaks to approximately 260 feet msl at the Columbia River (Figure 1-2).

The WWRB encompasses five counties: Umatilla, Union, and Wallowa Counties in Oregon; and Columbia and Walla Walla Counties in Washington. Two Congressional Districts are at least partially located within the Basin: Oregon District 2 and Washington District 5. The three main fish-producing subdrainages are Mill Creek, the Touchet River, and the Walla Walla River. These three drainages account for 92% of the WWRB—54% in Washington and 38% in Oregon.

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Figure 1-1. Walla Walla River Basin (Walla Walla Subbasin Plan, Northwest Power and Conservation Council, 2004)

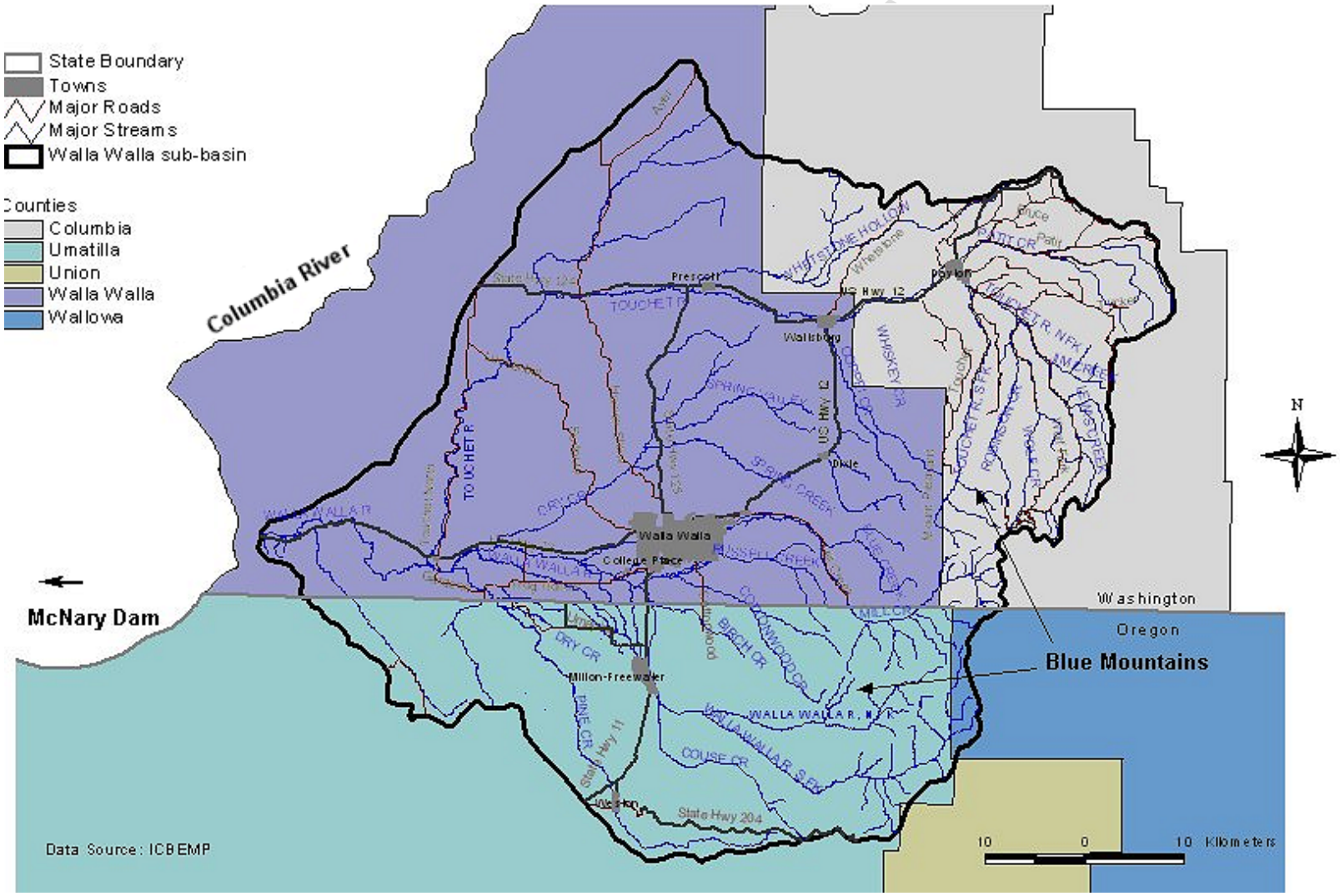
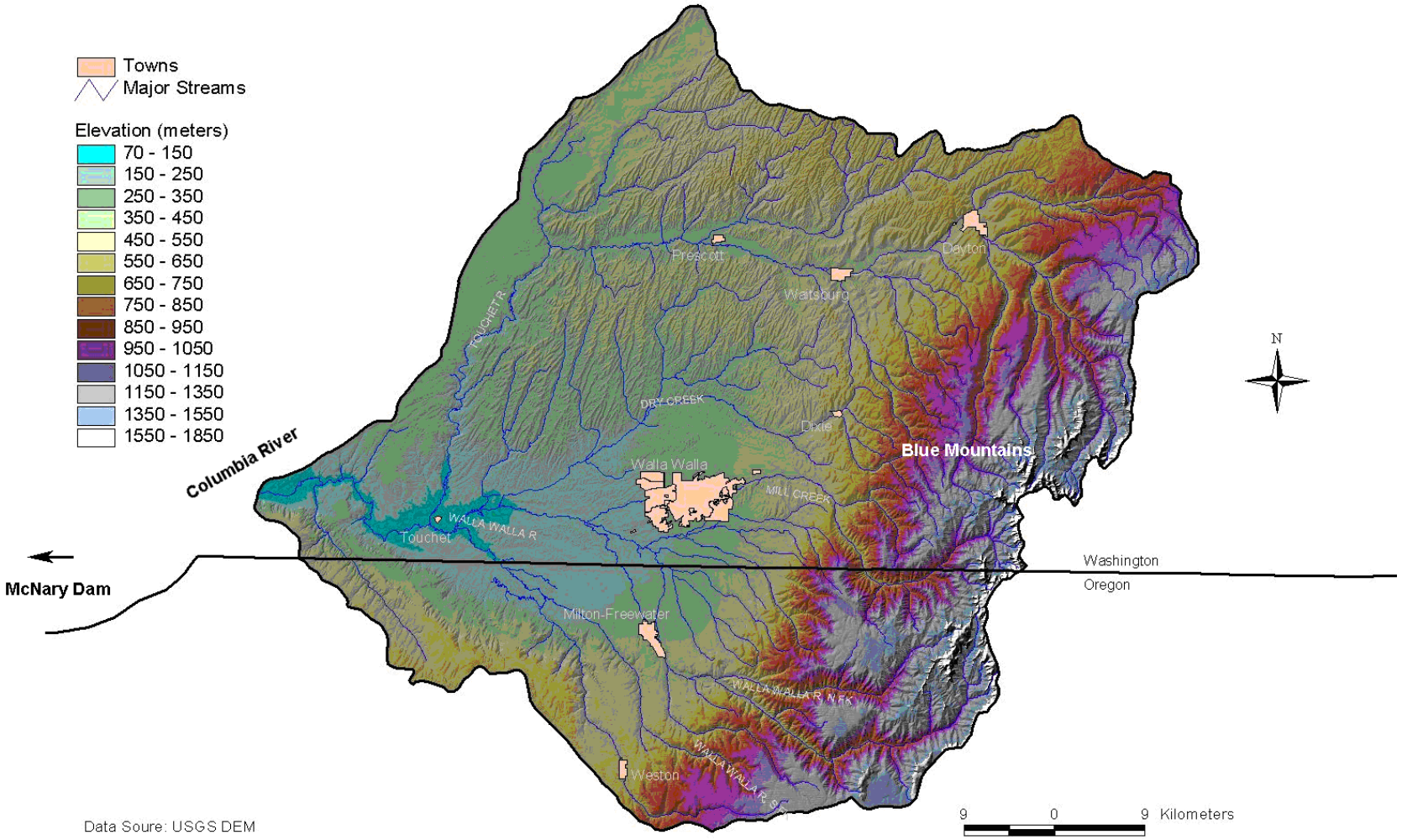
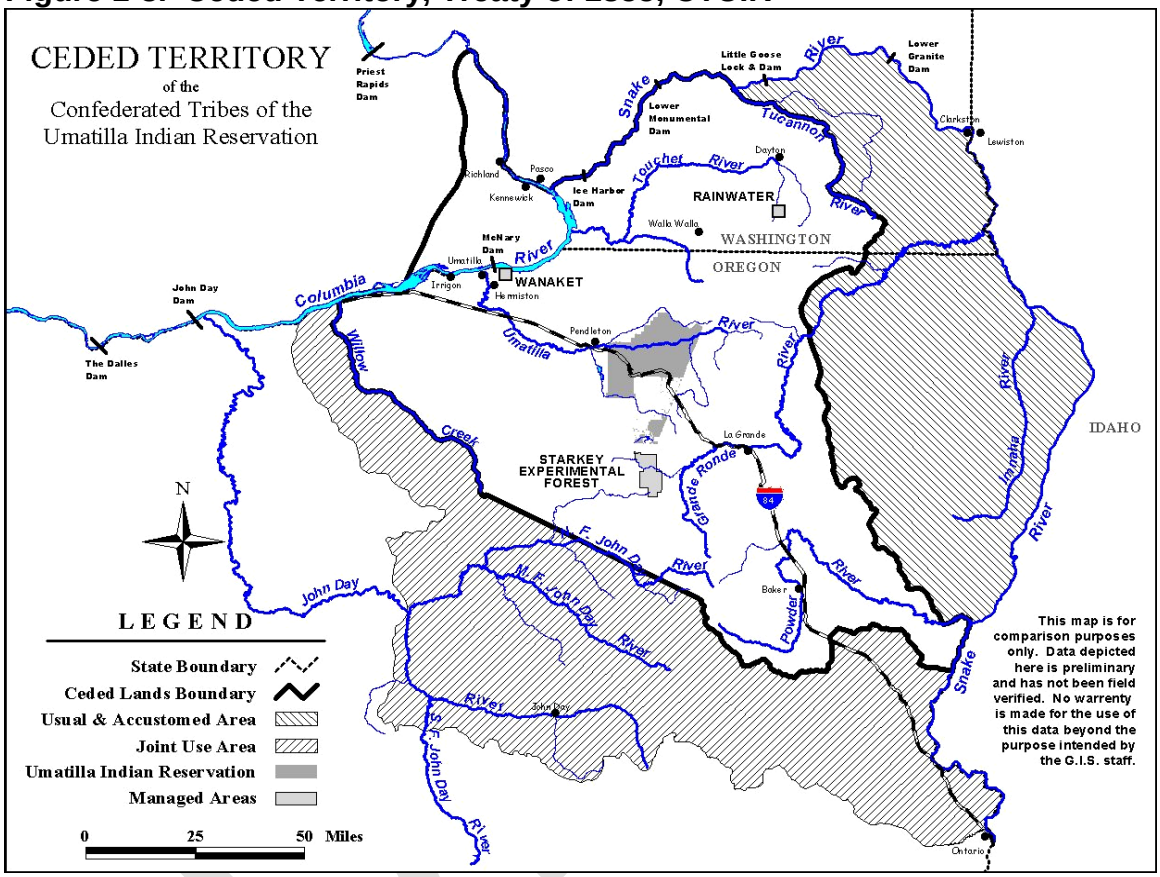


Figure 1-2. Walla Walla River Basin (Walla Walla Subbasin Plan, Northwest Power and Conservation Council, 2004)



The WWRB is part of the historical territory of the Walla Walla, Cayuse, and Umatilla Indian Tribes. More than 6.4 million acres in what is now northeastern Oregon and southeastern Washington were ceded to the United States in the Treaty of 1855 (Figure 1-3). In exchange, a parcel of land was designated as the Umatilla Indian Reservation for the tribes to retain as a permanent homeland. The tribes also reserved and were granted the right to fish, hunt, and gather traditional foods and medicines throughout the ceded lands. The CTUIR still protect and exercise those rights throughout Treaty lands.

Figure 1-3. Ceded Territory, Treaty of 1855, CTUIR



1.4 Scope Limitations

As with all planning-level work, the results of hydrologic, hydraulic, design, economic, and environmental evaluations given in this report quite often differ slightly from those presented in prior reports. The results presented in this report were subjected to a higher degree of refinement, but are subject to change as detailed design and cost estimation take place. Information presented in this report is based on Corps criteria for determining Federal interest in developing and implementing solutions to ecosystem restoration problems, which may differ from the criteria of other agencies. The information in this report does not supersede, or in any way affect, the results of other studies conducted for other purposes.

1.5 History of Investigations

The Corps completed the first phase (reconnaissance) of the General Investigation in 1997. The Reconnaissance Study evaluated ecosystem problems and opportunities within the WWRB. The recommendation from that report was to proceed to a feasibility phase of the General Investigation. The Corps' Headquarters certified the reconnaissance report, giving the Walla Walla District authority to move into the feasibility phase. In May 2002, the Corps entered into a Feasibility Cost Sharing Agreement (FCSA) with the CTUIR.

1.6 Prior Studies, Reports, and Existing Water Projects

The following reports/projects have been reviewed, as directed in the 1962 authorization:

- Columbia River Treaty, 1964, was ratified in 1961 and effected in 1964. The Treaty is an agreement between the United States and Canada to provide flood control and power benefits within regions of both countries. As a direct result of the Treaty, four storage dams were built: Mica, Arrow, and Duncan Dams in British Columbia, Canada; and Libby Dam in Montana. These four projects more than doubled the storage capacity of the entire Columbia River system, increased control of the river flow, thereby decreasing the risk of major flooding events downstream, and provided an abundance of water for power generation. The Columbia River is a shared resource, providing power and revenues to both the Pacific Northwest and British Columbia. While its headwaters are situated in British Columbia, only about 15 percent of the total Columbia River Drainage Basin is actually in Canada. Under the Treaty, Canada is entitled to half of the downstream power benefits calculated based upon treaty procedures (referred to as the Canadian Entitlement).

- McNary Lock and Dam, 1954, authorized by Section 2 of the River and Harbor Act of 1945 [Public Law (PL) 79-14, 79th Congress, 1st Session], and approved 2 March 1945 in accordance with House Document 704, 75th Congress, 3d Session. The dam is serves multiple purposes that include navigation, hydropower, irrigation and recreation. McNary is located on the Columbia River in Washington and Oregon at river mile 292.0. It is the fourth dam upstream of the mouth of the Columbia River. Lake Wallula lies directly behind McNary Dam. It extends 64 miles upstream to the U.S. Department of Energy's Hanford Site (about 27 miles above Pasco, Washington), on the Columbia River.

- Reports on the Columbia River and Tributaries, 1963, published as House Document Number 403, Eighty-Seventh Congress. The need for a well-balanced multipurpose development of water resources in the Columbia River Basin was recognized. The uses of water resources were identified as hydropower, navigation, recreation, flood control, and wildlife habitat. This

report is concerned with an analysis of all these uses, an objective appraisal of conflicts that arise, and the drafting of proposals for further economic water resource utilization.

- Touchet River, Columbia County, Washington, 1969. This snagging and clearing project was authorized by the Flood Control Act of 1937, as amended by Section 208 of the Flood Control Act of 1954 (PL 83-780). Following the devastating floods of December 1964 and Janurary 1965, clearing and snagging work was accomplished at 31 locations along the Touchet River. Two levees at bridges and the levee system through Waitsburg, Washington were rehabilitated. High flows in Janurary 1969 scoured much of the channel and gravels, and other materials were deposited throughout portions of the channel. The combination of these events reduced channel capacity in several locations, and eroded previously constructed spoil bank levees. Erosive action also cut many bridge abutments. Bank erosion washed out and undermined numerous trees, which created large log jams and gravel bars and caused overbank flows. In response to a request from the Columbia County Commissioners, the Corps, Walla Walla District, inspected the area to determine measures that could be taken to return the channel to its pre-flood capacity. Gravel deposits were removed from 11 locations, and were pushed onto affected stream banks. Log and debris jams were removed and deposited on adjacent banks. The rehabilitated mainstem Touchet River channel was cleared to 60 feet of bottom width, the East Fork to 50 feet, and the South Fork to 30 feet. All work was completed in 1969.

- Touchet River, Dayton, Washington, 1965. This project was authorized by Section 2 of the Flood Control Act of 1941 (PL 77-228, 77th Congress, 1st Session), and was approved on August 18, 1941. The project consists of levees and bank protection works, as well as the improvement of the Touchet River and Patit Creek channels. This was accomplished by enlarging and straightening the reaches passing through and adjacent to the City of Dayton. Construction under this project began in May 1964. Some levees were constructed as emergency work in 1964 and 1965. The construction of new levees, and rebuilding of existing levees, under the authorized project, has been completed.

- Touchet River, Walla Walla County, Washington, 1983. This snagging and clearing project was authorized by Section 208 of the Flood Control Act of 1954 (PL 83-780). Snagging and clearing work was required in the Touchet River throughout Walla Walla County. The emergency work was completed in 1983.

- Walla Walla River, Milton, Oregon, 1949. This project was authorized by PLs 78-138, 79-75, and 80-102; and the Flood Control Act of 1948 (PL 80-858). Emergency repairs were needed in Milton, Oregon, on the Walla Walla River. All emergency repairs were completed in 1949.

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- Touchet River, Waitsburg, Washington, 1973. This small flood control project was authorized by Section 205 of the Flood Control Act of 1948 (PL 80-858) and the Flood Control Act of 1946 (PL 79-526). The plan of improvement on the Touchet River includes rehabilitating and revetting existing levees on the left bank for approximately 8,300 feet; constructing new levees on the right bank for 22,500 feet; and improving the channel with varying hydraulic widths for 29,900 feet. The improved channel will accommodate a 12,000-cubic-feet-per-second design flow. The work will begin at the US Highway 12 Bridge, just below Lewis and Clark State Park, and continues downstream through the City of Waitsburg to the mouth of Coppei Creek.

  Existing flood control improvements on the Touchet River were constructed under three separate authorities. In 1933, the Work Progress Administration constructed an unrevetted system of levees on the left bank of the river. Following the flood of December 1964, the levees were rebuilt to their original condition. In 1950, the Corps constructed 3,500 feet of both revetted and unrevetted levees from downstream of the Work Progress Administration levees to the mouth of Coppei Creek. A portion of these was also destroyed in 1964. A critical portion was repaired, but the remainder was left unrepaired. Walla Walla County built another system of revetted levees in the area to protect a road. These levees were completely destroyed in 1964, and subsequently repaired. The flooding in 1964 damaged the levee system and the river alignment. Gravel and other materials were deposited throughout portions of the channel, effectively reducing its capacity. Following the floods, emergency clearing and snagging work was done, but the channel was still badly choked.

- Touchet River Washington, 1963. A flood control study was requested for the Touchet River, in Washington, and completed in 1963. This report presents results of studies undertaken in the Touchet River Basin to evaluate flood control, overall water, and related needs of the basin. The main focus was to determine engineering and economic feasibility for development of multipurpose storage reservoirs, and to examine the need for local flood control channel improvement works, or combinations thereof.

- Touchet River, Waitsburg, Washington, 1951. This project was authorized by the Flood Control Act of 1937, as amended by the Flood Control Acts of 1939, 1941 (PL 77-228), and 1946 (PL 79-526). Local interests in Waitsburg covered the cost of their portion of the project, which was completed in 1951.

- Touchet River and Coppei Creek, Washington, 1980. This project was authorized by Section 205 of the Flood Control Act of 1948 (PL 80-858). Waitsburg sustained severe flooding from the Touchet River and Coppei Creeks during December 1964 and January 1965. This report covers preliminary studies and findings concerning flood problems on lower Coppei Creek. The proposed plan of improvement would consist of channel cleanout, tie-off levee, debris basin, and probable flood plain regulation.

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- Walla Walla River Milton-Freewater, Oregon, 1975. This project was authorized by Public Laws 78-138, 79-75, and 80-102; and the Flood Control Act of 1948 (PL 80-858). A floodplain information study was initiated for the Walla Walla River in the vicinity of Milton-Freewater, Oregon, and was completed in 1975. This report was prepared at the request of the Umatilla County Planning Commission. The Milton-Freewater area is subject to flooding from the Walla Walla River, and the floods of 1931 and 1965 caused severe damage to the city. Floods of at least the same magnitude, or greater, could easily occur in the future. The report focuses on the history of flooding, and identifies those areas that are subject to possible future floods through maps and photographs.

- Walla Walla River, Milton-Freewater Oregon, 1969. This project was authorized by Section 2 of the Flood Control Act of 1941 (PL 77-228, 77th Congress, 1st Session), and was approved on August 18, 1941. The project provided for channel rectification and improvement of about 7 miles of the Walla Walla River in the vicinity of Milton-Freewater, Oregon. The lower 5.3 miles, between McCoy Bridge and the Milton power plant, is protected by levees, with necessary revetment and channel improvement. The upper 1.7 miles, from the Milton power plant to Joe West Bridge, would be improved by channel clearing and rectification. Original levees and revetments, from McCoy Bridge to the Milton power plant, were completed during Fiscal Year 1952. However, serious riprap deterioration occurred, and the high floods of December 1964 and January 1965 inflicted massive damage on the levees.

  A contract for the reconstruction of the lower 5.3 miles of levees was awarded in September 1966, and includes a drop structure with a fish ladder at River Mile 51.9. Reconstruction began in October 1966, and was completed in October 1967. Clearing and rectification of the upper 1.7 miles of channel was postponed indefinitely, pending reopening by the sponsors.

- Walla Walla River, College Place Washington, 1976. A floodplain information study was initiated for the Walla Walla River in the vicinity of College Place, Washington. The floodplain information report was completed in 1976.

- Walla Walla River Milton-Freewater, Oregon, 1969. This report was done at the request of the Umatilla County Planning Commission, under the continuing authority provided in Section 206 of the 1960 Flood Control Act (PL 86-645), as amended.

- Walla Walla River, Umatilla County, Oregon, 1988. Snagging and clearing work was completed on the Walla Walla River in Umatilla County, Oregon, in 1988, under the authority of Section 208 of the Flood Control Act of 1954 (PL 83-780). A preauthorization study was also completed in 1988, under the authority of Section 14 of the Flood Control Act of 1946 (PL 79-526). This project is intended to provide river bank stabilization and protection along a 370-foot reach of the Walla Walla River in Umatilla County, Oregon. The site is located in the Walla Walla River Valley in the foothills of the Blue

Mountains. This reach experienced high flows during the spring of 1986, and the left bank was substantially eroded. If this erosion remains uncontrolled, the river will eventually cut a new channel behind the bridge abutment and through the county road and private buildings. The proposed project involves removing gravel from the gravel bar and placing it on the left bank of the river as a filter and riprap bedding. In addition, basalt riprap will be brought from a quarry, and placed on the bedding as armoring. Oversized boulders will be randomly placed along the toe of the riprap to create backwater areas for fish habitat. A temporary berm will be constructed between the eastern end of the gravel bar and an existing jetty on the left bank of the river. The berm will be removed once construction is complete. The snagging and clearing work and a preauthorization study were both completed in 1988.

- Walla Walla River, Washington, 1969. A flood control study was requested for the Walla Walla River in Washington to determine the need for additional flood protection. The study objective was to evaluate the feasibility of flood protection by local protection works, storage, or combinations thereof. In addition, the compatibility of local protective works with comprehensive basin development was considered. The flood control study was completed in 1969.

- Walla Walla River, Umatilla County, Oregon, 1969. This project was authorized by Section 208 of the Flood Control Act of 1954 (PL 83-780). Extensive flooding occurred on the upper Walla Walla River in early January 1969. This report was written in response to a request for flood control assistance from Umatilla County, Oregon. Bank erosion during the flood washed out and undermined many trees, which caused log jams and created gravel bars that greatly reduced the normal channel capacity. Overflow severely damaged existing orchards, pasture and small grain lands, farm buildings, and country roads and bridges. Investigation showed that clearing and snagging work was needed to clean out the channels so they could accommodate the impending high spring flows. All snagging and clearing work was completed in February 1969.

- Walla Walla River and Tributaries, Walla Walla, Washington, 1969. A floodplain information study was initiated for the Walla Walla River in the area surrounding the City of Walla Walla, Washington. The report describes flood problems along Mill Creek upstream and downstream of the City of Walla Walla and Russell and lower Yellowhawk creeks. The purpose of the report is to acquaint local people and public agencies with existing flood problems, and furnish basic data needed for determining the best utilization of lands subject to overflow. Flood information from 1931, 1945, and 1964 were used to determine the Standard Project Flood. Through the use of maps and photographs, the report identifies those areas subject to possible future floods. The floodplain information report was completed in February 1969.

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- Walla Walla River, Section 1135, 1997. This project was authorized by the Water Resources Development Act of 1986 (PL 99-662). This 1135 project has two phases, the first of which involves building a new fish ladder on the Walla Walla River in Milton-Freewater, Oregon. The existing fish ladder is located on the left bank, but is outdated and obsolete. The new fish ladder will be built on the right bank, and will work under a much wider range of flows than the current one. The second phase of the project involves the removal of Marie Dorian Dam, which is 2 miles upstream from the fish ladder. Marie Dorian Dam was undermined by high flows in 1997, and was breached by local interests under an agreement brokered by the Corps. Rubble from the dam breaching will be removed when the new fish ladder is built. The fish ladder was completed in 2001, but is experiencing significant channel degradation due to the installation of flood control levee structures. Currently, the project is on hold due to a lack of funding.

- Walla Walla River Watershed, Oregon and Washington, 1999. The reconnaissance study of the Walla Walla River Watershed, which covers parts of Oregon and Washington, was conducted under the authority of the resolution by the Senate Committee on Public Works, adopted July 27, 1962 (Columbia River and Tributaries). It was initiated on August 29, 1996. The study objectives are riparian and wetland restoration, fish and wildlife restoration and enhancement, flood damage reduction, water quality improvements, water supply, erosion control, low flow augmentation, and recreation.

- Walla Walla River, vicinity of Mojonnier, Walla Walla County Washington, 1976. This floodplain information report was prepared under the continuing authority provided in Section 206 of the 1960 Flood Control Act, as amended. A floodplain information study was initiated for the Walla Walla River in the vicinity of Mojonnier, Washington. This report was prepared at the request of Walla Walla County. The Walla Walla Valley is subject to flooding from the Walla Walla River, and the floods of 1931, 1964, and 1965 caused severe damage to residential and agricultural areas in the floodplain. Floods of at least the same magnitude, or greater, could easily occur in the future. The report focuses on the history of flooding and identifies those areas subject to possible future floods through maps and photographs. The floodplain information report was completed in February 1976.

1.7 The Corps Planning Process

The WWRBFS/EIS follows the first five steps of the six-step planning process specified in Engineering Regulation (ER) 1105-2-100, *Planning Guidance Notebook*, dated April 2000. This process is used to identify and respond to problems and opportunities associated with the Federal objective, as well as specific State and local stakeholder concerns. The process also provides a rational framework for problem solving and sound decision making. The plan formulation process is comprised of the following steps:

1. The specific problems and opportunities to be addressed in the study are identified, and the causes of the problems are discussed and documented. Planning goals are set, objectives are established, and constraints are identified.

2. Existing and future without project conditions are identified, analyzed, and forecasted. Resources, problems and opportunities critical to plan formulation, impact assessment, and evaluation of the existing condition are characterized and documented.

3. The study team formulates alternative plans to address the planning objectives. An initial set of alternatives is developed and evaluated at a preliminary level of detail.

4. Alternative project plans are evaluated for effectiveness, efficiency, completeness, and acceptability. The impacts of alternative plans are evaluated using the system of accounts framework specified in ER 1105-2-100, *Planning Guidance Notebook*.

5. Alternative plans are compared. A cost effectiveness and incremental cost analysis is used to prioritize and rank ecosystem restoration alternatives. Public input to the alternative identification and evaluation process is obtained through a public involvement program.

6. Selecting the Recommended Plan. For a typical feasibility study, a recommended plan is selected. Based on information provided by the NFS in close coordination with regional stakeholders, a recommendation under this authority was not made at this time. The foundation for this decision is discussed in Sections 5 and 6 and is the basis for this report concluding with No Action.

In addition to the planning process, the National Environmental Policy Act (NEPA) is the Nation's primary national charter for protection of the environment. This Act establishes policy, sets goals, and contains procedural provisions to ensure that Federal agencies act according to the letter and spirit of the Act. It provides for integration of the requirements of NEPA with other planning and environmental review procedures required by law.

SECTION 2 – PROBLEMS AND OPPORTUNITIES

2.1 Public Concerns

In general, non-Federal views and preferences regarding ecosystem restoration measures and the problems addressed by such measures were obtained through coordination with the local sponsor, various local and regional public agencies, community groups, resource conservation groups, and the general public. These coordination efforts consisted of public meetings (held during the reconnaissance and feasibility phases), points of contact for interested parties, and a distribution list used for notifications (i.e., public meetings, newsletters, etc.). Public meetings were announced in the local media; and dates, times, places, and subject matter to be discussed were clearly stated. The following list contains the primary concerns expressed during public scoping meetings:

- Coordinate the Walla Walla River Basin Feasibility Study effort and project with other aquatic habitat restoration activities in the subbasin to minimize duplication and competition for the same finite volume of seasonal water. All subbasin planning forums recognize the critical effects to salmonid and bull trout production caused by the seasonal dewatering of the mainstem Walla Walla River for irrigation.

- The natural hydrograph (instream flow levels without influence from irrigation withdrawals) must be the catalyst for determining fish passage conditions, and life stage production and survival for the target species [spring Chinook salmon (*Oncorhynchus tshawytscha*), and ESA-listed steelhead (*O. mykiss*) and bull trout (*Salvelinus confluentus*)].

- The public has the perception that the WWRB has sufficient net annual water, but lacks adequate storage to make this water available to the riverine ecosystem and agricultural interests of the subbasin when need is greatest.

- There is concern that instream flow restoration may come at the expense of irrigation rights.

- Riparian enhancement and other components of fish restoration should be considered.

- The implementation of irrigation efficiency could reduce or negatively modify aquifer recharge.

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- Redistributing the base flow of the Walla Walla River between seasons could allow the summer use of stored water from winter runoff and/or modify channel-shaping flood flows important to sustaining channel habitat. The seasonality of the hydrograph could potentially be flattened, with an emphasis on the difference between water availability and requirements.

In addition to the formal public meetings hosted by the Corps, the project manager and project delivery team (PDT) members often attended meetings hosted by others to provide updates on study progress. These meetings provided a network for collaboration and information exchange. Regular attendance at or facilitation of these meetings included the following agencies or groups:

- **National Marine Fisheries Service (NMFS) and US Fish and Wildlife Service (USFWS).** Both NMFS and USFWS have a vested interest in the WWRB especially towards the recovery of ESA-listed steelhead and bull trout. The USFWS produced a coordination act report that provides information that was necessary to evaluate and recommend a preferred plan.

- **The Oregon and Washington State Departments of Fish and Wildlife (ODFW and WDFW).** These state agencies have an interest in restoration of the Walla Walla River. Their participation, along with CTUIR and the Federal agencies, was a critical factor in establishing existing conditions and evaluating alternatives.

- **The Oregon Water Resources Department (OWRD) and Washington Department of Ecology (Ecology).** Both agencies are cooperating agencies under NEPA for this project and provide insight on state water law, processes, and procedures. Representatives from the state offices regular attend local meetings or host as necessary.

- **The Walla Walla Basin Watershed Council (WWBWC).** The WWBWC is a local, volunteer organization established to improve conditions in the local watershed, as part of the Oregon Plan for Salmon and Watersheds. The WWBWC has provided valuable insight on temperature, groundwater connectivity, and habitat concerns with the project footprint.

2.2 Existing Restoration Projects

2.2.1 "The Walla Walla Way"

After MCR steelhead and bull trout were listed as threatened under ESA in 1999 and 1998, respectively, it was apparent that change was necessary within the WWRB to balance the natural/human environment. Spring Chinook salmon were already extirpated in the mid-1920s. Using proactive approaches to partnering, local irrigation districts, Federal and state agencies, conservation groups, local non-profit organizations, and tribal partners came together to plan and implement efforts to meet

the needs of the ecosystem and still maintain the health of the farming community. This partnership has been labeled "The Walla Walla Way," and has become a model for collaboration on natural resources issues throughout the Western United States.

Local efforts are further supported by the recent decision in Washington State to empower the region to partner on a local and flexible water management program. In 2009, the Washington legislature passed a law creating the Walla Walla Watershed Management Partnership. With oversight from the State of Washington, the pilot Partnership will integrate local water and watershed management [Water Resource Inventory Area (WRIA) 32, Shared Governance Mechanism]. The goals of the pilot program, as described in the Water Management Program in the Walla Walla Basin (Ecology, 2008), are:

> "….solely to support a collaborative process to design a proposed comprehensive water management structure for the Walla Walla River Basin. The proposed structure should address the allocation of functions, authorities, resource requirements, and issues associated with interstate watershed management of the basin."

2.2.2 Current and Future WWRB Restoration

In order to adequately identify problems and opportunities for this restoration study, it is critical to understand efforts being completed through developed partnerships within the WWRB. As noted and identified during public scoping, this project must adequately account for restoration efforts already being implemented. If the project is to be successful, the focus of this effort must be on measures not being addressed by others.

Limiting factors for restoration efforts within the basin were also gathered. Limiting factors are scientific assessments of the status of species and their habitats, as well as requirements to support and/or recover populations in their ecosystem. Table 2-1 lists the primary limiting factors, based on the priority reaches from the Snake River Salmon Recovery Plan of 2006.

Through interaction with the local community, non-profit organizations, tribal partners, regulating agencies and other state and Federal agency representatives, an understanding of the number and type of successfully-implemented restoration projects was gained by the PDT. Additionally, databases were used to collect information regarding restoration projects within the basin, allowing the PDT to focus on limiting factors not being addressed by other entities.

2.2.3 Mill Creek

Mill Creek originates on the western slopes of the Blue Mountains in southeastern Washington, at an elevation of about 5,500 feet (1676 meters). It flows for 15 miles (24 kilometers) through a deep, narrow canyon before entering an alluvial fan a few miles east of the city of Walla Walla. Mill Creek drains a basin of 95.7 square miles (154

square kilometers) above the stream gage ["Mill Creek at Walla Walla," US Geologic Survey (USGS) 14013000] at RM 10.5, located near the Mill Creek project office. The chief tributary to Mill Creek is Blue Creek, which drains about 17 mi^2 (27 km^2), and joins Mill Creek at RM 16.8. Yellowhawk and Garrison Creeks are diverted from Mill Creek near the Mill Creek project office. Mill, Yellowhawk, and Garrison Creeks flow generally to the west, before emptying into the Walla Walla River. Figure 2-1 shows Walla Walla River tributaries.

Table 2-1. Limiting Factors in the WWRB

Stream	Species	Limiting Factor
Lower Mainstem Walla Walla River	Steelhead	Sediment Key Habitat Quantity Habitat Diversity Flow (low) Temperature
Upper Mainstem Walla Walla River	Steelhead	Flow (low) Habitat Diversity
Mid Touchet River	Steelhead	Sedimentation Key Habitat Quantity Habitat Diversity Flow (low) Temperature
Upper Touchet River	Steelhead	Sedimentation Habitat Diversity Flow (low) Temperature
Mill Creek	Steelhead	Fish Passage Key Habitat Quantity Sedimentation Habitat Diversity Temperature
Upper Walla Walla, Touchet Rivers, Mill Creek and Upper Tributaries	Bull Trout	Fish Passage Sedimentation Temperature

Source: Snake River Salmon Recovery Plan, 2006.

The need for adequate flood control for the City of Walla Walla became apparent after the flood of 1931. The Mill Creek Flood Control District was organized in 1935 to assume flood control responsibilities. Congress authorized the Mill Creek Flood Control Project (MCFCP) on June 28, 1938. Between 1935 and 1939, the Mill Creek flood control channel was constructed with Work Progress Administration funds. This concrete channel runs through the City of Walla Walla, from Gose Street Bridge to Tausick Way Bridge.

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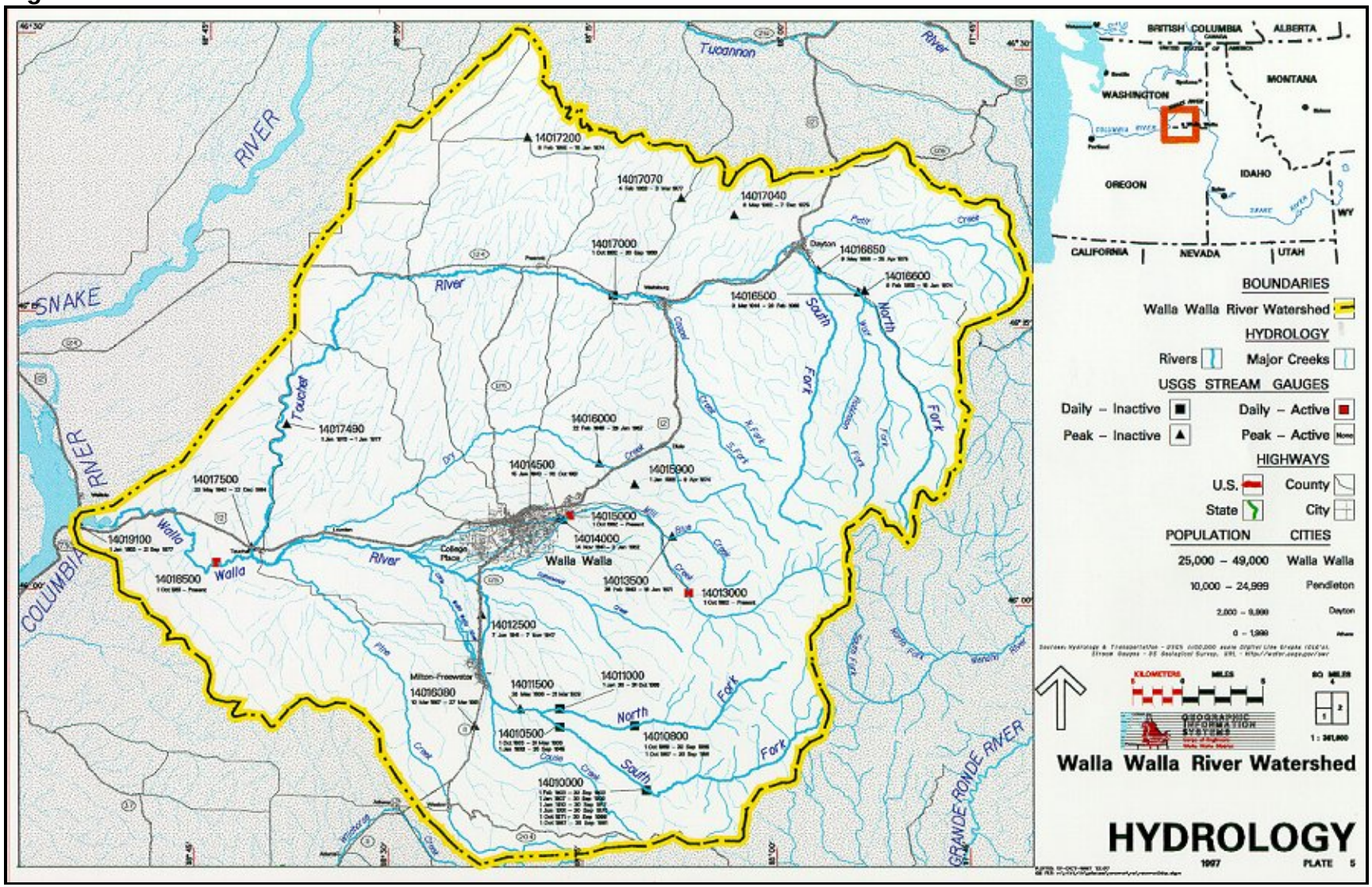
Figure 2-1. Walla Walla River Tributaries



The MCFCP begins about 1.75 miles (2.82 kilometers) east of Walla Walla, Washington. The western end of the flood control project begins near the east boundary of Walla Walla Community College, and follows Mill Creek approximately 1.5 miles (2.41 kilometers) upstream to the diversion dam for Bennington Lake (Mill Creek Dam). The flood control project area encompasses approximately 556 acres of land and 55 acres of open water (Bennington Lake) in Sections 13, 14, and 23, Township 7 North, Range 36 East, Willamette Meridian.

The original MCFCP was completed in 1942. In 1944, a concrete-lined auxiliary outlet channel from Mill Creek Dam to Russell Creek, and additional drainage facilities at the toe of Mill Creek Dam, were added. In 1948, a concrete flume was created by lining approximately 2 miles (3.2 kilometers) of the Mill Creek channel with concrete. Starting in 1951, existing wire bound channel stabilizers (sills) were capped with concrete. In 1982, the fish ladders were incorporated at the first division works and the diversion dam. Finally, the project included boulder placement in the channel for fish habitat in 1986 (Corps, 1991).

The stabilized Mill Creek channel extends downstream from the diversion dam through downtown Walla Walla (under structures and streets with small areas of daylight) to Gose Street, a distance of 6.9 miles (11.1 kilometers), on an average slope of 1.2%. The Corps maintains the stabilized channel from the diversion dam downstream to the project boundary, a distance of about 1 mile (1.6 kilometers). The lower 6 miles (9.7 kilometers), from the project boundary to Gose Street, are maintained by the Mill Creek Flood Control Zone District.

Mill Creek provides habitat for 22 species of fish, including MCR and hatchery steelhead, and bull trout. Much of this habitat is presently limited by barriers to migration, stream bank erosion, a lack of in-stream cover and riparian vegetation, high water temperatures, and low or zero flows (USFWS, 1984). These problems are widespread throughout the lower reaches of Mill Creek, and all occur within the footprint of the MCFCP.

Above the flood control project, the ecosystem health is adequate. The following paragraphs are excerpts from the Walla Walla Subbasin Plan [Northwest Power and Conservation Council (NPCC), 2004]. They describe the areas above Mill Creek Dam (referred to as “Bennington Dam” in these excerpts). Mill Creek Dam, Diversion Dam, and Division Dam are shown in Photos 2-1, 2-2, and 2-3, respectively.

> Priority protection geographic areas were also identified ……Protecting current habitat conditions in these geographic areas is expected to achieve no loss of function, and to allow for natural attenuation of limiting factors over time to benefit aquatic habitat (see Figure 2-2 for priority protection and restoration reaches).

The geographic areas above Bennington Dam should be given priority for protection. The EDT (Ecosystem Diagnosis and Treatment) results support the conclusion that this area be protected from further degradation until the barriers and flow problems in lower Mill Creek are resolved. The geographic areas involved are:

Mill Creek, Bennington Dam to Blue Creek

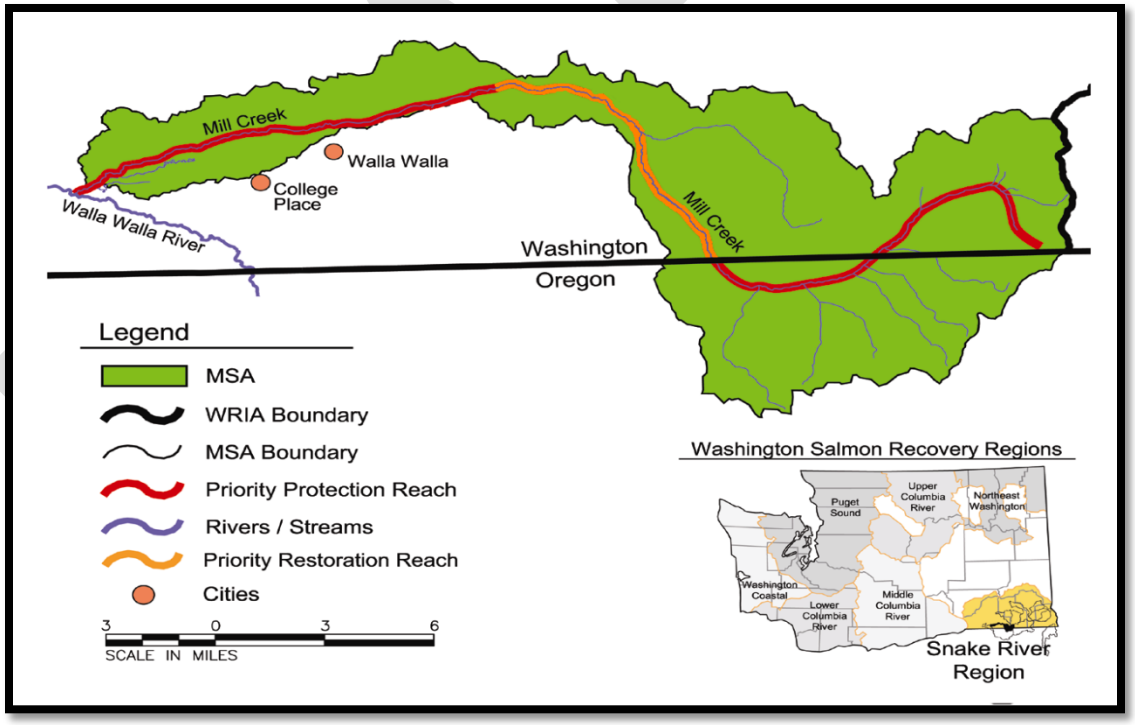
- Mill Creek, Blue Creek to Walla Walla water intake
- Mill Creek, Walla Walla water intake to steelhead access limit
- Upper Mill Creek Tributaries
- Blue Creek Drainage

Photo 2-1. Mill Creek Dam

Photo 2-2. Diversion Dam

Photo 2-3. Division Dam

Figure 2.2 – Priority Protection and Restoration Reaches of Mill Creek



Snake River Salmon Recovery Board, accessed online in Dec 2012

It is well known amongst the technical and public members of the workshop that the area upstream of Bennington is some of the best steelhead habitat within the subbasin. It is also understood that portions of this area are threatened by development. It is extremely important that these geographic areas be protected until and after

> solutions to the downstream problems are found. The resources that will be expended downstream will have added value if this valuable upstream habitat is protected.

In addition to the area above Mill Creek Dam, Yellowhawk Creek was also given acceptable habitat ratings, as shown in the following excerpt (NPCC, 2004):

> "The geographic area containing Yellowhawk Creek should remain as a priority for protection as noted in the Protection Priority Geographic Areas section above. Yellowhawk Creek is likely the only viable migration corridor for adult steelhead and salmon to access the good habitat above Bennington Dam. In order to preserve what population exists above the dam it is vital that this corridor is maintained. Yellowhawk Creek also contains valuable rearing area and serves as an escape alternative for juvenile salmonids that might otherwise rear in Mill Creek, but are unable to because of lack of water and high temperatures."

This information was the foundation for focusing efforts on problems with the corridor from Gose Street to Mill Creek Dam. The primary limiting factors are fish passage, key habitat quantity, sedimentation, temperature, and habitat diversity (Snake River Recovery Plan, 2008).

The Mill Creek Work Group (MCWG) is a technical working group of entities with water interests pertaining to Mill Creek. The Group includes Federal and state regulators, local governments, local tribes, and non-governmental organizations. The group meets for the purpose of keeping cooperators informed of habitat projects, management decisions, and other actions, and to form partnerships to accomplish actions deemed priorities by the group.

In 2009, an assessment of fish passage was conducted for this reach. The objectives of this assessment are described in the Mill Creek Fish Passage Assessment (Burns et. al., 2009):

> The objectives of this fish passage assessment were to identify the location and type of fish passage barriers, develop a prioritized list of fish passage problems, and then develop conceptual design options and cost estimates for correction of the problems. The assessment utilized a modeling approach, where hydraulic models were developed, and a fish energetics model was used to determine passability and the nature of barriers.

The recommendations of this study consist of approximately $12 million in potential restoration solutions for this corridor of Mill Creek. A number of these solutions have already been implemented. Continued efforts by local groups (i.e., Tri-State Steelheaders and Snake River Salmon Recovery Board) will aid in implementing the remaining solutions by 2025.

2.2.4 Touchet River

The Touchet River is approximately 80 miles (130 kilometers) in length, and drains an area of approximately 740 mi^2 (1900 km^2). The headwaters of the river lie in the Umatilla National Forest, in the Blue Mountains in Columbia County. The river originates above the town of Dayton, and passes through Waitsburg and Prescott before joining the Walla Walla River near Touchet, Washington.

The Touchet River is formed by the confluence of the North Fork Touchet River, which originates in the vicinity of the Bluewood Ski Area; and the South Fork Touchet River, which originates at Deadman Peak. The forks join approximately 2 miles (3.2 kilometers) upstream from Dayton, Washington.

A tributary of the Touchet River, Coppei Creek originates on the western slopes of the Blue Mountains in southeast Washington, at an elevation of 4,000 feet (1220 meters). With a total length of about 18 miles (29 kilometers), the creek flows for a combined total of about 19 miles (30 kilometers) as the North and South Forks. It winds through relatively deep and narrow canyons, mountainous terrain, and a valley before it finally reaches Waitsburg, Washington.

The Touchet River provides habitat for several fish species, including summer steelhead and bull trout. Much of this habitat is presently limited by barriers to migration, sedimentation, high water temperatures, and low or zero flows (Snake River Recovery Board, 2006).

Based on the assessment of the Touchet River reported in the draft Recovery Plan (Snake River Recovery Board, 2006), the reaches depicted in Figures 2-3 and 2-4 are described as either priority restoration or protection sections.

Figure 2-3. Priority Restoration Reaches - Upper Touchet River

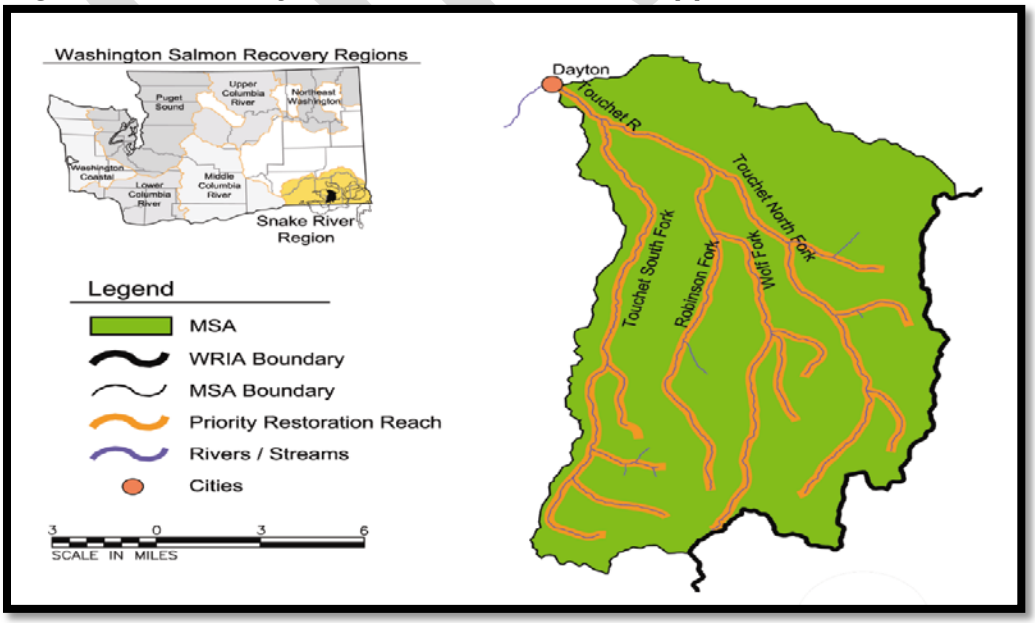
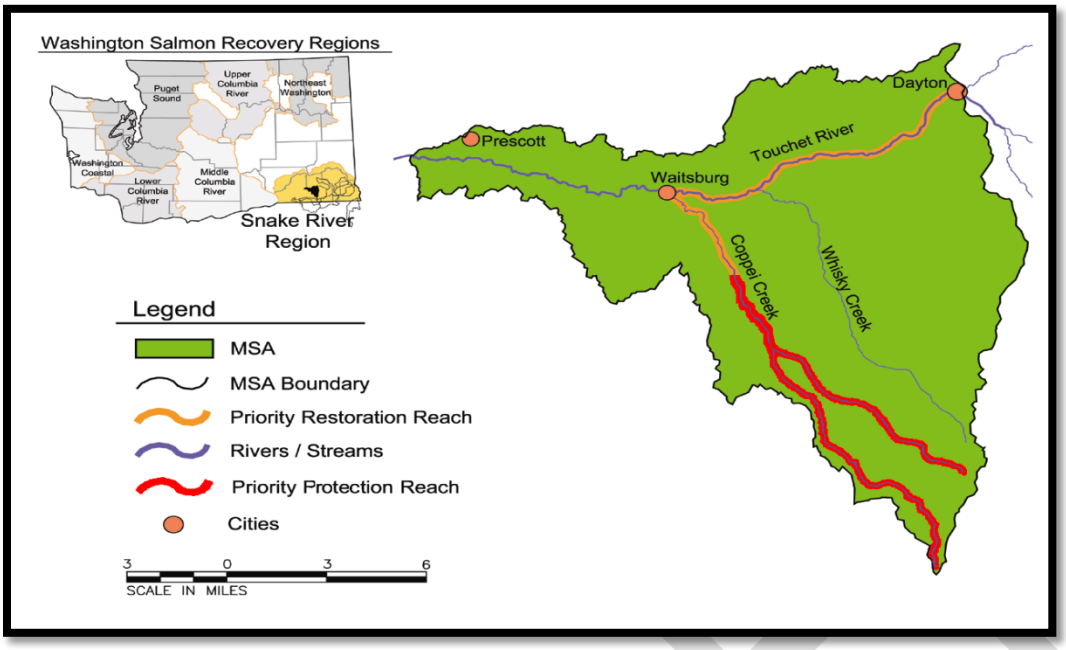


Figure 2-4. Priority Restoration and Protection Reaches - Mid Touchet River



The lower section of the Touchet River typically does not provide habitat for local species. Information provided in the draft recovery plan describes the reach in more detail (Snake River Recovery Board, 2006).

> Generally, steelhead do not use the lower portion of the Touchet River (approximately RM 0 to RM 51) during summer because of reduced flows, elevated water temperatures, and excessive sedimentation. Electrofishing and snorkel surveys conducted by WDFW in June through September 1998 documented the absence of yearling or older rainbow trout/steelhead in the Touchet River downstream of Waitsburg. During non-summer months, juveniles are occasionally found downstream of the Coppei Creek confluence (RM 50.8); however, this portion of the river appears to be used primarily as a migration corridor (WDFW, 2004d). Summer rearing has been documented in very low densities downstream to near Prescott.
>
> Spawning in the Touchet system occurs primarily upstream of the Coppei Creek confluence. This is particularly true in the North, South, and Wolf forks of the Touchet River and Coppei Creek, where temperatures and sediment levels are usually lower than in the mainstem. Densities of age 1+ steelhead in these reaches (along with Coppei and Patit Creeks) are some of the highest in the entire Walla Walla subbasin. Generally, few juveniles were observed in the mainstem of the Touchet River from its mouth to the confluence with Coppei Creek (RM 0 to 50.83).

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2.2.4.1 Upper Touchet River

Much of the land area in the Upper Touchet River and upper Mill Creek watersheds is covered with forest managed by the United States Forest Service (USFS). Forest land in the watershed not owned and managed by the USFS is subject to state forest practices rules (Ecology, 2008).

Ongoing efforts to improve habitat in the Upper Touchet River have focused on improving adult pre-spawning and juvenile survival. Sedimentation is also a concern, as forestry and agricultural practices contribute to the amount of instream sediment.

In 2005, the USFS replaced two road culverts within the North Fork Touchet River to allow fish passage. These projects, in conjunction with a final culvert removal planned for 2011, will complete removal of all identified fish passage barriers on the North Fork Touchet River on land managed by the USFS.

In addition, other groups have also removed passage barriers (gravel berms) and replanted riparian areas on the Upper Touchet River. These efforts have centered on improving passage and water quality in the upper river system.

2.2.4.2 Middle Touchet River

The middle Touchet River drains an area of 315 square miles (507 km^2). The river flows through a wide valley bottom bordered by gently rolling hills. A tributary of the Touchet River, Coppei Creek originates on the western slopes of the Blue Mountains, where it enters a narrow valley before reaching Waitsburg, Washington.

The middle Touchet River has a large floodplain, but portions of the floodplain have been blocked by levees. In 1933, the Work Progress Administration constructed an unrevetted system of levees on the left bank of the Touchet River. The Corps constructed additional levees in 1950. These levees were overtopped during the flood of December 1964, and they were rebuilt to their original condition. Some sections of levee were also repaired after floods in 1996. The existing levee system provides flood protection to Waitsburg up to approximately a 2% chance flood (50-year flood event).

In February 1996, a large flood occurred on Coppei Creek (Photo 2-4). This flood was estimated to have an approximate 1.4-percent chance exceedance and an associated discharge of approximately 1,700 cfs. During this flood, an unquantified portion of Coppei Creek flowed over the right bank through the fairgrounds, over US Highway 12, through a residential area, and ponded downtown in the business district of Waitsburg.

All documented floods have been of short duration, and were caused by either intense rainfall occurring on ground with high soil moisture content or by warm temperatures and rainfall on snow and frozen ground.

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Photo 2-4. Waitsburg, Washington – 1996 Flood

Efforts to investigate and implement solutions to the flooding problems, outside of the WWRBFS/EIS, are ongoing. Several small studies have been completed, and recommended solutions approved. In 2008, an identified non-Federal sponsor was forced to discontinue their participation in these projects due to lack of funding (Coppei Creek 1135). The Corps continues to work with the local community on support of this project, and is optimistic funding will be available to continue through to project completion.

Restoration efforts with the middle section of the river have revolved around willing land owners and concerned citizens. The city of Dayton (north of Waitsburg) recently secured a grant of more then $200,000 to improve habitat within this stretch of the Touchet River.

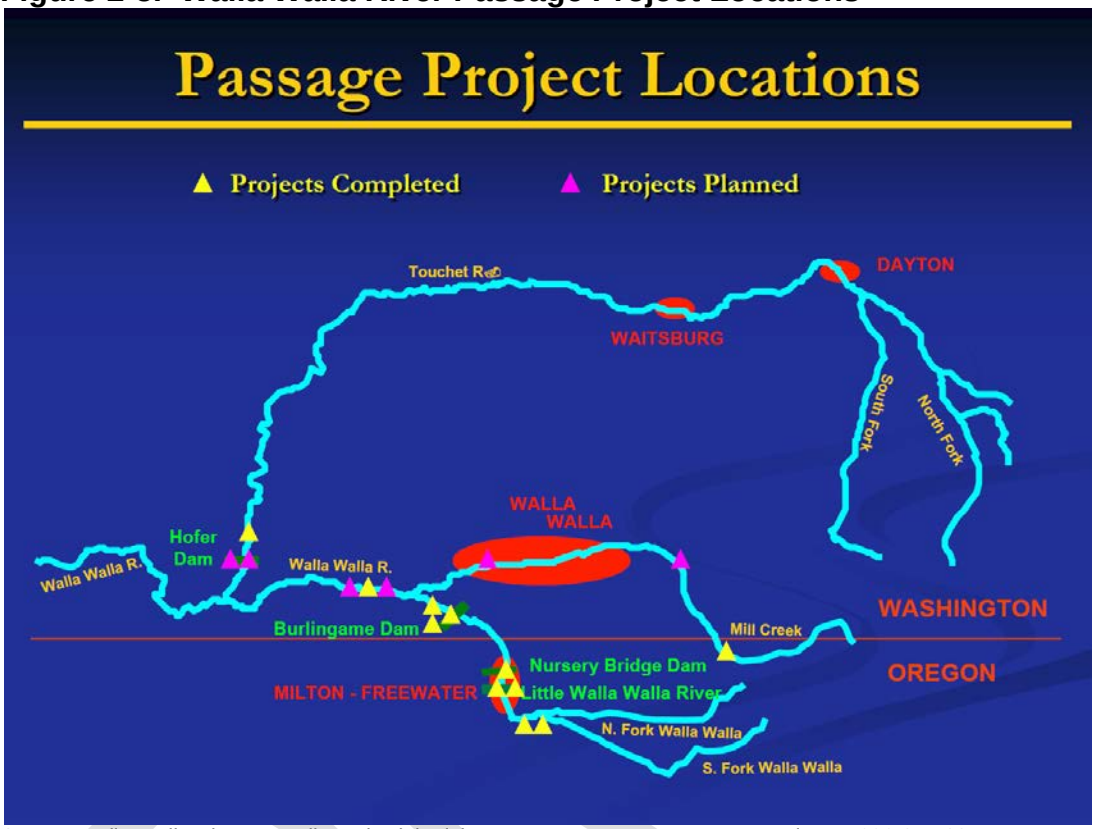
It is difficult to resolve restoration issues with the middle Touchet River until efforts for flood risk management are also addressed. The WDFW and the Snake River Salmon Recovery Board have a heavy presence in the area, and continue to make and support small improvements until a larger, multi-purpose project can be identified and implemented.

2.2.4.3 Lower Touchet River

In 2007, modifications to Hofer Dam (Figure 2-5) were completed on the Lower Touchet River. Hofer Dam was considered one of the largest passage barriers for local ESA-listed species, and a permanent impediment to recovery and restoration efforts.

Modifications to the dam included a poll-and-chute fishway, screens, and a constructed riffle. The project restored the passage corridor through this section of the river. It was a collaborative effort between Touchet Eastside and Westside Irrigation Districts, the CTUIR, Bonneville Power Administration (BPA), Walla Walla County Conservation District, and Tri-State Steelheaders.

Figure 2-5. Walla Walla River Passage Project Locations



CTUIR, Walla Walla River Juvenile and Adult Fish Passage Improvements, BPA Project #1996-011-00, http://www.cbfwa.org/FWProgram/Presentations/199601100FY04Update.pdf, accessed February 2010.

2.2.5 Riparian/Habitat Restoration

A consolidation of local restoration efforts was included in the 2008 report, *Recent Efforts, the Futures Focus*, completed by the Walla Walla County Watershed Planning team, with help from the Snake River Salmon Recovery Board and Ecology. An excerpt from the report summary includes a description of local riparian efforts:

> "Efforts to increase riparian vegetation, instream habitat, and stream function have been broadly implemented in the basin."

Two U.S. Department of Agriculture, Farm Service Agency, programs represent the majority of restoration: the Conservation Reserve Enhancement Program (CREP) and the Conservation Reserve Program (CRP).

The CREP is a Federal conservation program that addresses high priority conservation projects through a community-based partnership strategy. Typically, program partners include irrigators, tribal partners, state and Federal agencies and non-profit entities. Focuses within the WWRB include restoring and enhancing salmon habitat. The CREP has restored over 200 miles of stream within the WWRB, with riparian plantings of over 5,000 acres (Photo 2-5).

Photo 2-5. Typical Plantings

The CRP is a voluntary program that allows landowners and farmers to convert environmentally sensitive land into long-term conserving covers to improve the quality of water, decrease erosion, and enhance fish and wildlife habitat. The program within Walla Walla and Columbia Counties has near full enrollment, equating to over 200,000 acres.

In addition, the Tri-State Steelheaders planted countless trees and shrubs (Photo 2-6) along streams to improve fish habitat. This group of volunteers also removed illegally dumped concrete and other debris. The Steelheaders teach conservation to hundreds of local students in elementary and high school, and conducted the course in Spanish at a Walla Walla County farm-labor camp (Ecology, 2002).

In addition to these programs, organizations such as CTUIR, Natural Resources Conservation Service (NRCS), Oregon Water Resource Department (OWRD), Oregon Watershed Enhancement Board, the Snake River Salmon Recovery Board, and Walla Walla Basin Watershed Council (WWBWC) have accounted for the restoration of more than 200 river miles (ICF Jones & Stokes, 2009).

Photo 2-6. Woody Debris

2.2.6 Irrigation Efficiency and Diversion Screening

Irrigation efficiency has been a focus for the region. It is an attempt to provide efficiencies in the delivery of irrigation water to local users/farmers in exchange for an increase in instream flows. To date, many projects have been implemented, and are showing a reduction in conveyance losses and instream flow gains. From the summary report prepared by Walla Walla County Watershed Planning in 2008, over 6 cfs have been placed in trust during the peak irrigation season.

Some of the projects, as compiled by the Walla Walla County Conservation District, are as follows:

- Touchet Westside/Eastside Gravity Pipeline
- Touchet Westside/Eastside Pumping Station
- Touchet Westside Irrigation District pipeline – approximately 37,000 feet of pipeline, serving about 1,200 acres
- Touchet Eastside Irrigation District pipeline – approximately 35,500 feet of pipeline, serving about 800 acres
- Old Lowden/Bergevin-Williams pipeline consolidation – under design
- Garden City diversion/pipeline – under design
- Gardena Farms Irrigation District – North and South Laterals – under design
- Gardena-Riggs Road Lateral

Additionally, the Walla Walla Basin Watershed Council has implemented this list of efficiencies:

- Baker Irrigation Efficiency
- Downriver WWRID Irrigation Efficiency, including Eastside ditch piping
- Huffman Ditch Piping

- Milton Ditch Piping
- Richartz Ditch Piping
- Hy-Line Canal Piping

While piping irrigation lines allows an increase in instream flows, an understanding of the impacts to groundwater has been the center of controversy. As canals and ditches are lined, a reduction in the groundwater has been observed (Appendix A, *Hydrology*).

The WWBWC, through partnerships with Hudson Bay District Improvement Company (HBDIC), are leading recharge efforts in the Umatilla River Basin. Using excess winter flows, shallow recharge ponds are being constructed in an attempt to increase groundwater levels in the Basin.

In addition to efficiency, irrigation intakes have been screened in response to Oregon and Washington State laws requiring intakes (no matter the size) to be installed so there is no entrapment of fish species. Based on information provided by the Walla Walla County Conservation District (2009), over 350 projects have included screen installation on irrigation intakes. Of these, over 30 were large irrigation diversions with a capacity of over 1 cfs.

2.3 Problems and Opportunities

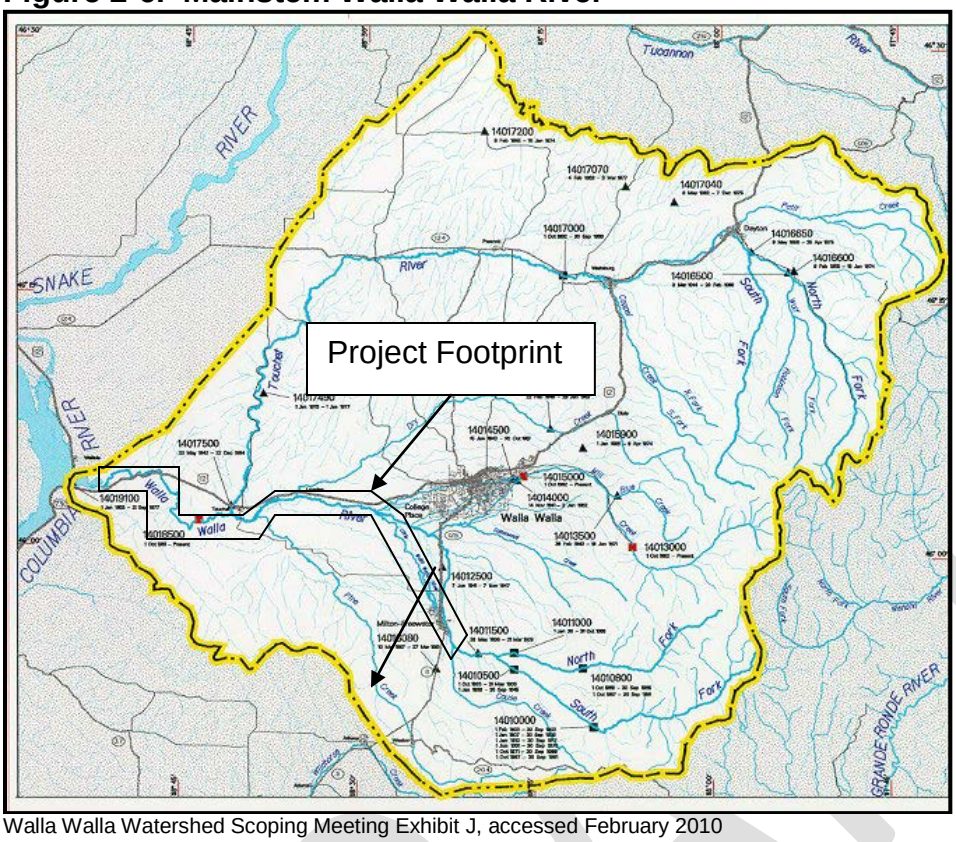
As a result of research completed to better understand current and future restoration project plans within the WWRB, problems and opportunities were developed that support the primary limiting factors not already being addressed by other entities. As research data was compiled, it became clear that a large portion of restoration needs are being accomplished by others in the area. The outstanding limiting factors for ESA-listed species that are not already addressed through developed partnerships within the WWRB deal directly with the Walla Walla River (Figure 2-6), and include the following:

- Key Habitat Quantity
- Habitat Diversity
- Flow (low)
- Temperature
- Fish Passage

2.3.1 Key Habitat Quantity and Diversity

Habitat diversity is a function of channel configuration, riparian function, large woody debris density and icing. Loss of riparian function most commonly occurs through hydromodifications (roads, dikes, bank armoring, channelization, etc.) and altered riparian vegetation and reduced large woody debris (from agriculture, development, past forest practices). For key habitat quantity, lack of pools and reduced base flow (reducing stream width and depth) are the most limiting to pre-spawning holding and

Figure 2-6. Mainstem Walla Walla River



Walla Walla Watershed Scoping Meeting Exhibit J, accessed February 2010

juvenile rearing life stages of both steelhead and spring Chinook. Reduced key habitat quantity had the biggest impact to age-2 migrants and prespawn migrants, however, high losses to fry colonization also occurred in Walla Walla River. The loss of habitat diversity had a moderate affect on juvenile migrants and a high to extreme affect on rearing juvenile life stages (Walla Walla Subbasin Plan, 2004).

2.3.2 Flow (Low)

There are some reaches within the Walla Walla River that go dry on a seasonal basis. Some of these may be caused by the natural hydrological regime of the area; others may be anthropogenic in origin. Anthropogenic causes can be water diversions or vegetation removal, which reduces infiltration of water in the watershed (Walla Walla Subbasin Plan, 2004).

Stream flows in the basin follow a fundamental pattern initiated by a rapid decline in discharge in late June, followed by low summer flows and increased discharge in the fall and winter. The reduced flows represent the end of the spring runoff, water diversions for agricultural irrigation, and the lack of summer precipitation in the WWRB. The

recharge in the fall is generated because of fall precipitation, and occurs after most water diversions are discontinued or reduced (Mendel et al., 2005). The seasonal variation in flow affects the capacity of a stream for various life stages, because flow determines water surface area and volume. For this reason, summer low flow (when the stream width is the smallest) often limits fish production (ICF Jones & Stokes, 2009).

2.3.3 Temperature

Flow has a strong effect on the maximum summer water temperature and the presence of thermal refugia that allows fish to survive during warm summer months (Poole and Berman, 2001). Slow-moving water accumulates temperature units from the sun to a greater degree than fast-moving water, and summer low-flow periods generally correspond to maximum summer water temperatures (McCullough et al., 2001). Cooler water from tributaries and subsurface hyporheic flow provides points where fish can find acceptable temperatures. Temperature has a strong physiological effect (Bjornn and Reiser, 1991), and is often a primary determinant of fish survival, especially in areas with high summer air temperature (e.g., the interior Columbia Basin). In these environments, flow is a primary determinant of fish survival because of its impact on temperature (Poole and Berman, 2001; and ICF Jones & Stokes, 2009).

2.3.4 Fish Passage

Passage is critical for anadromous and adfluvial coldwater fishes such as salmon, steelhead, and bull trout. Although passage actions only directly affect a small stream reach where construction and facility modifications occur, these actions can provide access to large swaths of habitat that might be otherwise inaccessible (ICF Jones & Stokes, 2009).

Passage obstructions are considered a source of potential immediate mortality to fish. Delay in passage can expose fish to habitat conditions that could be adverse to survival without the opportunity to escape. Delay in passage also can affect the ability of salmonids to successfully spawn. Fish can also be physically injured by inadequate passage facilities increasing exposure to disease or possibly causing direct mortality from the injuries (Walla Walla Subbasin Plan, 2004).

A number of barriers and impediments to salmonid passage or rearing were identified during the WDFW field seasons (Mendel et al., 1998; 1999; 2000) in the Washington State streams of the WWRB. A portion of those barriers (i.e., structures or dewatered streambeds) physically blocked salmonid movement.

2.3.5 Opportunities

Despite the numerous issues facing the Walla Walla River, opportunities do exist to restore beneficial aquatic ecosystem conditions, and support the recovery of ESA-listed salmonids and bull trout. Some potential planning opportunities include the following:

- Re-establish base flows within the mainstem Walla Walla River;
- Re-establish riparian corridors on tributary stream, and link sites to mainstem restoration sites;
- Re-establish hyporheic interaction between groundwater and the mainstem Walla Walla River and tributaries as applicable;
- Improve water quality through temperature reduction and sediment transport; and
- Re-establish and/or maintain the cultural heritage of the CTUIR within the WWRB and the ceded land of the 1855 Treaty.

2.4 Federal Planning Objectives

The Federal objective of water and related land resources project planning is to contribute to National Economic Development (NED) consistent with protecting the Nation's environment, pursuant to national environmental statutes and applicable executive orders, and following other Federal planning requirements [National Environmental Restoration (NER), Regional Economic Development (RED), Environmental Quality (EQ), and Other Social Effects (OSE) accounts]. Water and related land resources project plans are formulated to alleviate problems and take advantage of opportunities in ways that contribute to this objective. Contributions to NED are increases in the net value of the national output of goods and services, expressed in monetary units.

Ecosystem restoration is an important mission of the Corps' Civil Works Program. The Corps objective is to contribute to NER by increasing the net quality and/or quantity of desired ecosystem resources. Measurements are based on changes in ecological resource quality as a function of improvement in habitat quality or quantity. They are expressed quantitatively, in physical units or indices (not monetary units).

The RED account is intended to illustrate the effects proposed plans will have on regional economic activity (i.e., regional income and regional employment).

The EQ account is an alternate method for evaluating the alternatives and assisting in determining a recommended plan. This account is intended to display long-term effects to significant environmental resources of any potential alternatives.

Contributions to the OSE account include long-term impacts to public facilities, health and safety, recreation, and community values.

The Study focuses on benefits that are measured under the NER account, however, the NED, RED, EQ and OSE accounts will also be measured and evaluated.

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2.5 Corps Policy Initiatives

In addition to the Federal planning objectives, two Corps policy initiatives, the Actions for Change and the Environmental Operating Principles, guided the development of this study. These initiatives and their application to the Study are described in the following section.

2.5.1 Actions for Change

Following Hurricane Katrina, and in response to earlier internal and external evaluations of the Corps, the Corps developed the Actions for Change. The actions were created from analysis completed by the Interagency Performance Evaluation Task Force, American Society of Civil Engineers, a National Science Foundation-sponsored team, and Louisiana State University. The Actions for Change demonstrate the Corps' recognition that the organization has to transform and evolve to meet the changing needs of the nation and its Armed Forces. Originally presented as 12 Actions, they were further refined to reflect four themes:

- Comprehensive Systems Approach
  - Employ an integrated, comprehensive, and systems-based approach
  - Employ adaptive planning and engineering systems
  - Focus on sustainability
- Risk-informed Decision-making
  - Employ risk-based concepts in planning, design, construction, operations and major maintenance
  - Review and inspect completed works
- Communication of Risk to the Public
  - Effectively communicate risk
  - Establish public involvement risk reduction strategies
- Professional and Technical Expertise
  - Continuously reassess and update policy for program development, planning guidance, design, and construction standards
  - Employ dynamic independent review
  - Assess and modify organizational behavior
  - Manage and enhance technical expertise and professionalism
  - Invest in research

The Actions for Change guided the development of alternatives for the WWRB in the following ways:

- **Comprehensive Systems Approach.** The WWRBFS/EIS employs an integrated, systems-based approach to ecosystem restoration opportunities in the WWRB. The study is focused on providing benefits on a basin-wide scale through actions taken to fundamentally improve aquatic conditions in a reach that previously prevented access to necessary habitat conditions for ESA-listed species. The PDT recognizes that the benefits gained must be

sustainable in the long term for the environment as well as the human community to merit Federal investment. They employed adaptive planning and engineering systems in development of measures and alternatives to consider changes to the environment over time, including changes to the environment, (including global climate change), land use practices, and political policies and social values.

- **Risk-Informed Decision Making**. The PDT evaluated a potential range of benefits, range of costs associated with design and construction and potential operations, maintenance, repair, replacement, and rehabilitation (OMRR&R) over a 50-year project period. A detailed risk-based cost analysis was completed and is included as part of the recommendation. To insure long term benefit, the Corps, in collaboration with the project sponsors, will design a monitoring plan to track the progress of the proposed ecosystem restoration, which will include corrective actions when and where deemed necessary.

- **Communication of Risk to the Public.** The team has maintained regular communication with stakeholders throughout the study process. Besides standard public and scoping meetings, the PM and technical PDT members have regularly attended meetings related to watershed planning, irrigation operations, and salmon recovery to provide information about measures, alternatives, risks and benefits as the study has evolved.

- **Professional and Technical Expertise.** This project was initiated in 2002. The original study plan has been adapted to respond to new regulations and policy initiatives over time. Some of these adaptations have included model review and approval, agency technical review by team members from across the nation, and an independent external peer review conducted by ____. In addition, the project, through collaboration with regional stakeholders, was able to leverage information gained through the efforts and research by others in the basin, to inform the development and evaluation of alternatives for expected outcomes, and short- term and long-term benefits. This allowed the development of a project that would complement and enhance the multiple efforts being undertaken throughout the WWRB. Key relationships between the PDT, the States of Washington and Oregon, Federal agencies, local non-profit organizations, and other regional stakeholders assisted in the development and evaluation of alternatives.

2.5.2 Environmental Operating Principles (EOP)

The Corps affirmed its commitment to the environment by formalizing the Environmental Operating Principles through ER 200-1-5, *Environmental Quality - Policy for Implementation and Integrated Application of the U.S. Army Corps of Engineers (USACE) Environmental Operating Principles (EOP) and Doctrine***,** in Ocotober 2003. The purpose of the Environmental Operating Principles is to ensure that conservation,

environmental preservation, and restoration are considered in Corps decision-making programs and activities. By implementing these principles, the Corps will continue its efforts to develop the scientific, economic, and social measures to judge the effects of its projects on the environment and to seek better ways of achieving environmentally sustainable solutions. The principles are consistent with NEPA, the Army's Environmental Strategy (with its four pillars of prevention, compliance, restoration, and conservation), other environmental statutes, and WRDAs, all of which govern Corps activities.

The Corps Environmental Operating Principles are as follows:

- Strive to achieve environmental sustainability. An environment maintained in a healthy, diverse, and sustainable condition is necessary to support life.
- Recognize the interdependence of life and the physical environment. Proactively consider environmental consequences of Corps programs, and act accordingly in all appropriate circumstances
- Seek balance and synergy among human development activities and natural systems by designing economic and environmental solutions that support and reinforce one another
- Continue to accept corporate responsibility and accountability under the law for activities and decisions under our control that impact human health and welfare and the continued viability of natural systems
- Seek ways and means to assess and mitigate cumulative impacts to the environment, bring systems approaches to the full cycle of our processes and work
- Build and share an integrated scientific, economic, and social knowledge base that supports a greater understanding of the environment and impacts of our work
- Respect he views of individuals and groups interested in Corps activities, listen to them actively, and learn from their perspective in the search to find innovative win-win solutions to the Nation's problems that also protect and enhance the environment.

This study was carried out in a manner consistent with the EOP, particularly in seeking balance and synergy among human activities and natural systems by recommending economic and environmental solutions that support one another. In this process the Corps collaborated with the non-Federal sponsor and many regional stakeholders to arrive at a recommendation which recognizes the interdependence of the human and natural environments, and balances ecosystem considerations with the economic considerations of stakeholders.

2.6 Study Planning Objectives

The problems and opportunities identified in this study are restated as specific planning objectives to provide focus for the formulation of alternatives, and are based on key factors limiting aquatic habitat within the Walla Walla River. They also reflect the non-

Federal sponsor's desire to focus on a solution for low seasonal flows in the Walla Walla River, create opportunity to restore conditions in preparation for the reintroduction of spring and fall Chinook salmon, increase the prognosis for survival of the Middle Columbia River (MCR) steelhead Evolutionarily Significant Unit (ESU) and Columbia River Basin bull trout, improve the vitality of other indigenous stocks (mountain whitefish, lamprey), and improve passage and rearing conditions for all aquatic inhabitants.

Planning objectives represent desired positive changes in the current without project conditions related to the key limiting factors. The following planning objectives have been developed for the WWRBFS/EIS. These objectives are based on the assumption that potential authorization, design, and construction of alternatives may take 10 years to complete; and the evaluated project life for this restoration study is 50 years.

- Objective 1 – Establish a minimum instream flow of 25 cfs to provide habitat connectivity by 2020.
- Objective 2 – Improve instream habitat to support critical life stages for summer steelhead, spring Chinook salmon, and bull trout by 2020.
- Objective 3 – Improve water temperatures so no more than 4 days of temperatures above 72°F (22°C) exist to support critical life stages for summer steelhead, spring Chinook salmon, and bull trout by 2020.
- Objective 4 – Reduce fish passage non-structural barriers by 50% by 2020.

2.7 Planning Constraints

Planning objectives represent potential desired changes. Planning constraints, on the other hand, represent restrictions that should not be violated. For the WWRBFS, the following constraints must be considered:

- Minimize negative impacts to ESA-listed threatened and endangered species.
- Maintain compatibility with existing habitat restoration activities in the WWRB.
- Minimize or avoid negative economic impacts to the local community.
- Avoid any additional impacts to the shallow aquifer.
- Avoid any diminishment in water rights to existing water right holders.
- Legally protect natural flows left in the river in exchange for replacement irrigation flows in both Oregon and Washington.
- Avoid conflicting or interfering with ESA protection/restoration responsibilities prescribed by the Habitat Conservation Plan (HCP) and Comprehensive District Irrigation Management Plan (CDIMP) for the local irrigation districts.
- Maintain authorized functions of the existing WWRB projects already identified in Section 1 of this document.
- Ensure that National Historic Preservation Act procedures are followed.
- Comply with water quality standards for the States of Oregon and Washington.

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SECTION 3 – EXISTING AND FUTURE WITHOUT PROJECT CONDITIONS

In order to evaluate the effectiveness of a proposed project it must be compared to the most likely future conditions anticipated for the study area if no action is taken. This is known as the 'future without project condition.' By comparing the future without project condition to the most likely 'future with project' condition it is possible to assess the difference or amount of improvements or enhancements the project may provide over the long term. In the case of a restoration project, improvements are expressed in the amount and value of habitats affected. That is, the plan is a good one if the resulting change from implementing the project over the future without project condition provides significant and measurable environmental benefits. For this project, improvements are related to restoring the natural function of the Walla Walla River, the value of the system to ESA-listed aquatic species, including reconnected passage corridors, temperature improvements, and overall benefits to the quality of habitat to support critical life stages.

The without project condition is universally regarded as a vital and important element of the evaluation and must adequately describe the future (2000). Significant variables, elements, trends, systems and processes must be sufficiently described to support good decision-making. Forecasts must be based on appropriate methods, and professional standards must be applied to the use of those methods. Accuracy is an important element of a rational scenario. A good scenario must also reflect common sense.

This section of the document describes the future without project condition. The detailed description of the impacted environment provides the foundation for successful alternative evaluation, which occurs in Section 5, *Environmental Consequences*, and Section 6, *Alternative Evaluation and Recommended Plan*.

3.1 Environmental Setting of the Study Area

The WWRB is comprised of approximately 4,455 km^2 (1,720 mi^2) along the Oregon-Washington boundary east of the Columbia River. It is bordered by the gently rising Blue Mountains on the east and south, the Touchet Highlands on the north and northwest, and an extension of the Horse Heaven Hills on the southwest. In length, the Basin extends eastward about 89 kilometers (55 miles) from the mouth at the Columbia River to the drainage divide in the Blue Mountains. At its widest point, it spans roughly 84 kilometers (52 miles) from the Eureka Flats area in the Touchet River drainage to the Pine Creek drainage in Oregon south of the community of Milton-Freewater. Basin elevations range from a high of 1,905 meters (6,250 feet) mean sea level (msl) at Table Rock in the Mill Creek drainage to a low of 104 meters (340 feet) msl at the mouth near Wallula, Washington.

In general, the climate is subject to the moderating influence of the prevailing westerly flow of maritime air from the Pacific Ocean, resulting in relatively mild winters. Occasionally, influxes of polar air masses cause brief periods of extreme cold weather,

but winters are generally damp and foggy. The Basin exhibits a large seasonal temperature variation, ranging from well above 38°C (100°F) in the summer to below -18°C (0°F) in the winter. Annual precipitation for climate stations in the WWRB varies from about 240.0 millimeters (9.45 inches) at Ice Harbor Dam [elevation 112 meters (368 feet) msl], north of the western end of the basin, to around 1,066.8 millimeters (42.0 inches) at Walla Walla 13 ESE [elevation 732 meters (2,400 feet) msl] in the Mill Creek drainage.

The mainstem Walla Walla River originates at the confluence of its North and South Forks, about 6.4 kilometers (4 miles) southeast of Milton-Freewater, Oregon. From the confluence, the river flows westward a short distance, swings toward the north, and then flows through the community of Milton-Freewater. It continues its northward course into the State of Washington, where it changes direction, again following a westward course to its confluence with the Columbia River.

The WWRB lies principally within Umatilla County, Oregon, and Walla Walla and Columbia Counties, Washington. Umatilla County lies in northeastern Oregon. It is 5200 km^2 (3,231 mi^2) in size, with a population of over 64,000. The county seat is Pendleton, while other major communities include Hermiston and Milton-Freewater. The county is bounded by the Columbia River in the north, Morrow County in the west, Grant County in the south, and Union and Wallowa Counties in the east.

The CTUIR, home to the Umatilla, Walla Walla, and Cayuse Indian Tribes, was established in 1855 by the Treaty of Walla Walla. The reservation is located southeast of Pendleton, Oregon.

Walla Walla County contains the earliest American settlements in the State of Washington. The Whitman Mission, site of the infamous Whitman Massacre, was established about 11.3 kilometers (7 miles) west of the present-day City of Walla Walla, the county seat and largest population center in the county.

Columbia County contains portions of the traditional Nez Perce Trail, as well as stops along Lewis and Clark's return trip to St. Louis. The largest city is the town of Dayton, which boasts the oldest courthouse in Washington. Columbia County relies heavily on agricultural crops, most notably, wheat, peas, and asparagus. Garbanzo beans and grass seed have entered the agricultural field in recent years.

Resources with potential to affect, or be affected by, the proposed project are identified in the following sections. Each resource is discussed in terms of both the existing condition and predicted changes to it, over a period of analysis of 50 years, if no project is implemented.

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3.2 Air Quality and Noise

3.2.1 Air Quality – Existing Condition

The Clean Air Act (CAA) identifies US Environmental Protection Agency (EPA) responsibilities for protecting and improving air quality. As a response, the EPA formed National Ambient Air Quality Standards (NAAQS) for common pollutants considered harmful to public health and the environment. The NAAQS consist of primary standards designed to protect public health, and secondary standards designed to protect public welfare (e.g., pollution damage to property and vegetation). The EPA set NAAQS for six principal pollutants [ozone (O_3), fine particulate matter (PM_{10} and $PM_{2.5}$), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and lead (Pb)], and developed regional or local classifications for each criteria pollutant (EPA, 2010).

Areas are classified as in "attainment" if pollutant concentrations meet NAAQS. Areas where concentrations exceed NAAQS for a specific pollutant are designated as "nonattainment" areas. To be re-designated as in attainment, States must develop a 10-year compliance plan for any pollutant that has exceeded air quality standards. The State Implementation Plan (SIP) describes a rigorouse monitoring program with more stringent air quality standards. During that period of time those areas are labeled, "Maintenance Areas".

The EPA also established an Air Quality Index (AQI) for reporting daily air quality. The AQI is a tool used by state agencies to indicate current air pollution levels. Using a scale of 0 to 500, the higher the AQI value, the greater the level of air pollution and the greater the health concern. The index is divided into six color-coded ranges, as shown in Figure 3-1. Air Pollution Advisories are issued when pollution levels are expected to be above the "yellow" AQI category for a period of 48 hours or more. Both Washington and Oregon have adopted the NAAQS and AQI.

Throughout southeastern Washington and northeastern Oregon, the dominant air pollutant is fine particulate matter. Particulate matter consists of particles of soot, dust, unburned fuel, or liquid droplets suspended in the air. Sources of these pollutants are most commonly anthropogenic (agricultural field burning, motor vehicles, and other combustion sources). However, they can also be the result of naturally-occurring events (forest fires and windblown dust). Particulate Matter is measured as PM_{10} (smaller than 10 micrometers in diameter) and $PM_{2.5}$ (smaller than 2.5 micrometers in diameter). The AQI for PM_{10} and $PM_{2.5}$ is based on an average of the previous 24-hour readings.

Within the project area, potential areas affected by impacts to air quality include Walla Walla and Columbia Counties in Washington; and Umatilla, Union, and Wallowa Counties in Oregon. The Washington Department of Ecology (Ecology) regulates air quality in Washington; while the Oregon Department of Environmental Quality (ODEQ) regulates air quality in Oregon.

Figure 3-1. Air Quality Index Values*

Air Quality Index (AQI) Values	Levels of Health Concern	Colors
When the AQI is in this range:	***...air quality conditions are:***	***...as symbolized by this color:***
0 to 50	Good	Green
51 to 100	Moderate	Yellow
101 to 150	Unhealthy for Sensitive Groups	Orange
151 to 200	Unhealthy	Red
201 to 300	Very Unhealthy	Purple
301 to 500	Hazardous	Maroon

*Courtesy of AIRNow.gov

3.2.1.1 Washington

The State of Washington uses the Washington Air Quality Advisory (WAQA) tool for informing people about the health effects of air pollution. The WAQA supports a more stringent $PM_{2.5}$ standard than its Federal counterpart.

A network of monitoring stations is maintained by Ecology throughout the state to ensure NAAQS are met. The network consists of three major categories of monitoring stations that measure the criteria pollutants: State and Local Air Monitoring Stations (SLAMS), National Air Monitoring Stations (NAMS), and Special Purpose Monitoring Stations (SPMS). The program monitors CO, Pb, NO_2, O_3,$PM_{2.5}$ and PM_{10}, SO_2, total suspended particulate (TSP), visibility (B-scat) and meteorological conditions (Ecology, 2009).

Eastern Washington's principle air quality issue is particulate matter. The rural region is dominated by agricultural practices. Storm activity in the summer and fall leads to strong wind gusts, making the arid area prone to wind erosion and dust storms. Farming practices such as field burning, and other anthropogenic activities also contribute to particulate levels (Ecology, 2009).

Air quality monitoring stations in proximity to the project area are located at Burbank, Walla Walla, Starbuck, and Dayton. The project area is located in Walla Walla and Columbia Counties. Both are in attainment with all air quality standards. The Wallula area is currently an EPA-designated Maintenance Area, due to particulates (PM_{10}) resulting from windblown dust. Currently, Walla Walla (including the Wallula Maintenance Area) and Columbia County monitoring sites AQI are listed as Green ("good"), meaning pollution is less than half of the NAAQS for any pollutants measured (EPA, 2009).

3.2.1.2 Oregon

The ODEQ Air Quality Division monitors air quality statewide to ensure that national air quality standards are being met. The Air Quality Division operates 37 monitoring stations throughout the state.

Similar to Washington, northeastern Oregon's principal air quality issue is particulate matter. Much of the predominantly rural region is used for agriculture. This is especially true in the counties potentially affected by the proposed project. Storm activity in the summer and fall leads to strong wind gusts, making the arid area prone to wind erosion and dust storms. Farming practices such as field burning, and other anthropogenic activities also contribute to particulate levels (ODEQ, 2006).Air quality monitoring stations in proximity to the project area are located in Pendleton, La Grande, Cove, Mount Fanny, and Enterprise. The Pendleton monitoring station is located 24 kilometers (15 miles) south of the project area. This station monitors for light-scattering (the ability of small particles in the air to scatter light and reduce visibility), PM_{10}, $PM_{2.5}$, wind, and temperature.

In 2007, Pendleton's AQI for $PM_{2.5}$ had a rating of green ("good") for 301 days; Yellow ("moderate") for 50 days; and Orange and Red for 1 day each. Presently, no portions of the project area within Oregon are designated non-attainment or a maintenance area, as of the latest information from ODEQ.[1]

3.2.1.3 Air Quality – Future Without Project Conditions

At present, a large majority of established nonattainment areas in Washington and Oregon have been re-designated as Maintenance Areas. State and Federal agencies, environmental groups, industry, and the general public have combined efforts to improve air quality throughout the region. As a result, southeastern Washington and northeastern Oregon consistently meet the NAAQS.

3.2.2 Noise – Existing Conditions

In addition to the pollutants described above, noise is also a pollutant transmitted through the air. Noise control standards have been adopted in Washington and Oregon for various noise-generating activities.

Noise levels are measured in terms of decibels (dB) scaled to approximate the hearing capability of the human ear [dB(A)]. A decibel is a unit of measurement that quantifies the sound pressure differences in the air. Zero decibels is the threshold of human hearing, 40 to 50 dB(A) is normal for a peaceful neighborhood, 70 to 80 dB(A) is the level adjacent to a busy urban street or 15 meters (50 feet) from a major freeway, and 120 to 140 dB(A) is a typical level at which sound is painful.

[1] *www.deq.state.or.us/aq/planning/**nonattainment**.htm*

The WWRB area is primarily rural. Although the Cities of Walla Walla and Milton Freewater are situated within the Basin, relatively few noise sources occur in the area. These sources include traffic from visitors and local residents, as well as distant agricultural machinery and highway noise.

3.2.2.1 Washington

In recent years, Washington has exhibited trends depicting improved air quality. These trends are expected to continue on into the future. With or without project implementation, air quality will continue to improve as a consequence of more rigorous state and Federal air quality standards.

The Wallula Maintenance Area is located within the WWRB, approximately 50 kilometers (31 miles) west of the City of Walla Walla. Historically, the Wallula area has had numerous particulate matter violations (PM_{10} and $PM_{2.5}$), due to human activities and natural events. As a result of more stringent air quality standards and a comprehensive maintenance plan, the Wallula area will likely maintain its designation as a Maintenance Area and eventually be redesignated as “in attainment”. Currently, air qualities in proximity to the Wallula maintenance area are exhibiting an AQI of “good.” These trends are projected to continue and, with or without project implementation, as a consequence of more rigorous state and Federal air quality standards.

3.2.2.2 Oregon

Oregon has exhibited trends depicting improved air quality as well. With or without project implementation, air quality will continue to improve as a consequence of more rigorous state and Federal air quality standards.

3.2.2.3 Noise – Future Without Project Conditions

Because the WWRB is in a rural and sparsely populated area, background noise levels at locations distant from traveled roadways are likely to be between 30 and 40 dBA under calm wind conditions. Noise levels in nearby Walla Walla and Milton Freewater are likely typical of those found in urbanized areas, and vary by location and time of day. Noise levels in proximity to roadways range from 60 to 70 dBA along arterials and freeways, and are affected primarily by traffic volumes and speed. Noise levels in residential areas are likely near 50 dBA, and may be quieter during evening and night-time hours. Currently, noise levels in the project areas are increasing as a function of an increasing population. These trends are projected to continue, with or without project implementation.

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3.3 Water Quality

3.3.1 Hydrology

Winter months receive the majority of precipitation in the region, with 64 percent falling from October through March. The lower elevations in the watershed experience precipitation mainly as rain, while higher elevations receive snow for the most part. Annual precipitation near the mouth of the Walla Walla River is less than 25 centimeters (9.8 inches). This increases progressively eastward towards the headwaters, which receiver over 100 centimeters (39.4 inches) annually. Thunderstorms take place an average of 11 days per year, mostly during the summer months, but can be intense. When thunderstorms do occur, they often produce significant increases in stream flows, causing sediment deposition.

The runoff pattern in the WWRB (Table 3-1) generally consists of high flows from November through May, and low flows from June through October (Table 3-2). The spring snowmelt period usually extends from March through May, but peak discharges resulting from snowmelt runoff rarely result in damaging stages. In the past, winter flood peaks from December through February have been responsible for most of the flood damage occurring in the WWRB. These runoff events, which tend to be flash-type floods of relatively short duration, are usually caused by intense rainfall on saturated ground (high soil moisture content) or by warm temperatures and rainfall on snow and frozen ground.

Low flows have significant impacts in the basin, and flows are annually depressed due to natural variability and human water use. Water diversions during the irrigation season have been known to dewater some reaches of the river and principle tributaries during parts of the year. Such conditions have been documented in the Walla Walla River near the Oregon-Washington border. The duration of dewatering is dependent on the amount of water available during any given year.

Table 3-1. Drainage Area and Runoff in the Walla Walla Subbasin

Drainage	Drainage Area (km^2/mi^2)	Drainage of Subbasin (%)	Average Annual Runoff (af)	Runoff of Subbasin (%)
South Fork Walla Walla River (near Milton-Freewater)	163/101	4	139,000	30
North Fork Walla Walla River (near Milton-Freewater)	88/55	2	39,200	8
Mill Creek (near Walla Walla)[1]	154/96	4	69,073	15
Touchet River (at Bolles)	935/581	22	180,300	40
Local Runoff (remainder of subbasin)	2,857/1,775	66	37,500	8
TOTAL—Walla Walla River near Touchet	4,292/2,667	100	462,000	100

Table 3-2. Average Monthly Flows for Portions of the Mainstem Walla Walla River

Tributary Stream Segment	USGS Gage #	General Location	Period of Record	Average Monthly Flows (cfs)											
				Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mill Creek	14013000	Near Walla Walla, WA	1913-2006	132	154	159	174	137	74	37	31	31	37	72	112
Dry Creek	14016000	Near Walla Walla, WA	1949-1966	37	53	48	46	24	10	12	1	2	4	12	31
East Fork Touchet R	14016500	Near Dayton, WA	1941-1967	135	189	183	218	187	102	54	44	44	51	82	144
Touchet R	14017000	At Bolles, WA (near Waitsburg)	1924-1988	393	440	433	428	279	140	50	35	44	65	137	268
Touchet R	14017500	At Touchet, WA (near confluence with Walla Walla River)	1941-1954	329	577	441	475	354	173	54	26	33	60	145	272
Walla Walla R	14018500	Near Touchet, WA	1951-2006	1,090	1,280	1,190	1,080	721	262	42	19	40	78	287	777
SF Walla Walla R	14010000	Near Milton-Freewater, OR	1907-1990	175	188	214	280	305	205	24	109	107	111	135	166
NF Walla Walla R	14011000	Near Milton-Freewater, OR	1930-1968	56	66	82	119	96	41	8	4	5	11	27	52

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3.3.2 Water Supply and Use

Water supplies in the WWRB are limited, and tend to be poorly distributed over the water year. Irrigation demands usually begin in early spring and continue into the fall, well beyond the period when natural spring flows in the rivers recede to low summer levels. The irrigation demand is quite heavy in the summer, and the river channels are actually dry in some locations because of upstream irrigation withdrawals. There are no irrigation storage reservoirs within the WWRB.

3.3.3 Study Reaches

The river flows from a confined narrow valley onto an alluvial fan as it leaves the foothills just southeast of Milton-Freewater, Oregon. Most of the irrigation to the north and west of Milton-Freewater is situated on this feature. The soils of the alluvial fan are very porous, consisting of gravels and cobbles deposited by the river. As more and more people came to the Walla Walla Valley over the past century, water rights from the Walla Walla River were over-appropriated. The majority of the historically-granted water rights are active today, resulting in more water rights than the river can naturally supply during the summer.

Surface flows in the Walla Walla River are impacted not only by irrigation withdrawals, but by infiltration into the channel bed as well. Seepage measurements were made in June and August in 2002, 2003, and 2003. The results showed that the Walla Walla River has both gaining and losing (surface-water) reaches. Some of these reaches consistently lost or gained water (to/from groundwater), while other reaches appear to alternate between losing and gaining (Figure 3-2). Many external factors may explain the changes between losing and gaining surface flow, including groundwater pumping close to the river and annual changes in groundwater levels. The surface-water and groundwater interactions are very dynamic and difficult to quantify or predict in the Walla Walla River downstream of Tum-a-Lum Bridge.

Between Nursery Street and Tum-a-Lum Bridges, the Walla Walla River has historically been dry during parts of July and August, due to irrigation withdrawals and high infiltration rates. The local irrigation districts have bypassed enough flow since 2001 to maintain surface flows as part of an agreement with USFWS, NMFS, and environmental groups. However, much more water is required to maintain fish passage and/or rearing habitat. Because of low flows, this reach of the Walla Walla River prevents or hinders access to the largest area of high quality headwater habitat in the basin, the upper South Fork Walla Walla River.

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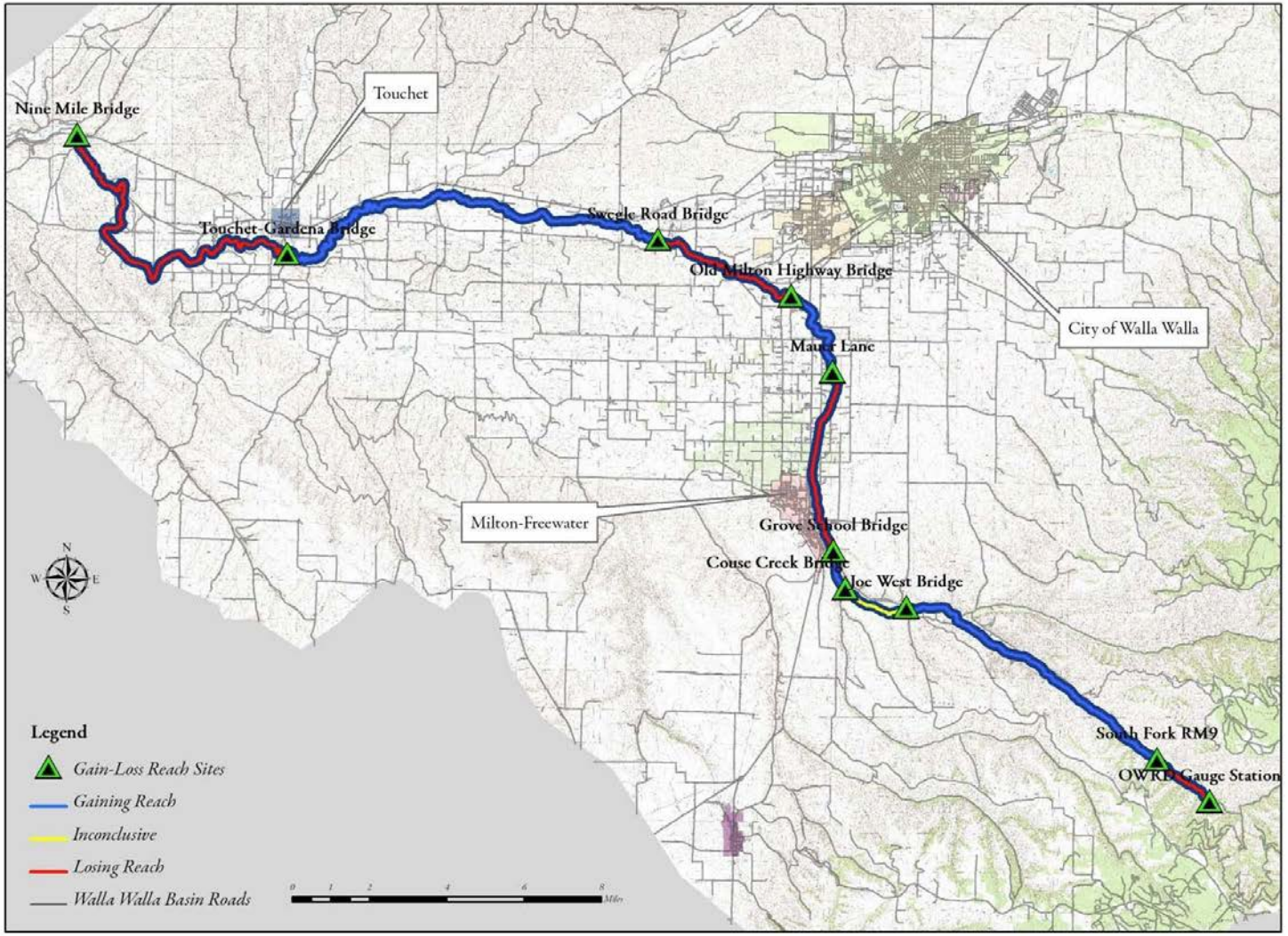
Figure 3-2. Walla Walla River Gaining and Losing Reaches (Walla Walla River Budget Project, WWBWC, 2009)



3.3.4 Surface Water

3.3.4.1 Water Quality (Washington)

Water quality in the WWRB is highest in the upper drainage, but generally degrades in lower elevations. The States of Washington and Oregon each have their own system of surface water quality definitions and management. As such, the 303(d) listings were chosen as the primary source of discussion, since they are based on beneficial use criteria and must be approved by the EPA. Temperature is the parameter of primary concern in the drainage, with much of the lower Walla Walla River above 21°C (70°F) for most of the summer. Other 303(d) listings include flow, pesticides, pH, dissolved oxygen (DO), and fecal coliforms

When a water body does not meet Washington State water quality standards, it is placed on the State's Section 303(d) list of impaired water bodies. The Walla Walla River was identified for Category 5 impairment in the 2004 Integrated 303(d)/305(b) report (*http://www.ecy.wa.gov/programs/wq/303d/2002/2002-index.html*) for the parameters identified in Table 3-3.

Table 3-3. Section 303(d) Listed Parameters for the Walla Walla River

Temperature	Polychlorinated biphenyls (PCBs)
Fecal coliform	Several chlorinated pesticides
pH	Zinc
Ammonia-N	Mercury
Instream flow	Nickel
	Lead

Once placed on the 303(d) list, a Total Maximum Daily Load (TMDL) is normally completed. Work on the WWRB TMDLs began in 2002, and four evaluations for 1) Chlorinated pesticides and PCBs; 2) Fecal coliform bacteria; 3) Dissolved oxygen and pH; and 4) Temperature, were approved by the EPA by August 2007. A multi-parameter Implementation Plan was subsequently approved in December 2008.

The Walla Walla River was listed by the State of Washington under Section 303(d) of the Clean Water Act for non-attainment of the EPA human health criteria for 4,4'- dichlorodiphenyldichloroethylene (DDE), 4, 4'- dichlorodiphenyldichloroethane (DDD), dieldrin, chlordane, hexachlorobenzene, heptachlor epoxide, and PCB-1260 in edible fish tissue in 1996. The listings were based on sampling done by Ecology in 1993 (Davis et al., 1995). The 1996 303(d) listings were maintained on the 1998, 2002/2004, and 2008 lists.

A TMDL evaluation of chlorinated pesticides and PCBs in the Walla Walla River and its tributaries was subsequently initiated by Ecology in 2002 and 2003. The evaluation was based on a field study that sampled concentrations of these pollutants in fish tissue collected from resident, mainstem species (upper river fish were analyzed separately from lower river fish).

The historical application of chlorinated pesticides to soils and crops is the primary source of these chemicals in rivers and streams in agricultural areas like the WWRB. Because chlorinated pesticides bind strongly to soil particles, the primary method of meeting pesticide standards in the Walla Walla River and its tributaries is to reduce the amount of soil entering these water bodies. A report by Economic and Engineering Services, Inc., referenced in the TMDL, concluded that erosion of fine sediment is a problem in the lower WWRB. The report identified a number of sources of sediment, including road-building and logging activities in the upper reaches of tributaries, recreational vehicle use, and urban runoff. It concluded, however, that "given the predominance of agricultural land use in the watershed, agricultural practices have been identified as the principal source of fine sediment." Historically, agricultural areas have been large contributors to the suspended sediment problem in some drainages in the WWRB. However, the correlation between PCBs and sediment loads was weaker. The TMDL evaluation and historical data also showed that the period of highest stream flow and sediment load is January to June, and this interval coincides with the times of highest chlorinated pesticide and PCB concentrations. As such, the primary source of these chemicals is historical agricultural pesticide application in the area, and sediment transport to the tributaries.

Most forestry operations are likely to occur on lands on the Oregon side of the Walla Walla River drainage. The Ecology TMDL concluded that activities on the Oregon side of the border were relatively minor contributors to the toxin problem in the WWRB.

The strategy for implementing the TMDL is based on the continuation of existing efforts already underway throughout the watershed to reduce suspended sediment in project area waterways. For example, the Walla Walla Watershed Plan suggests that total sediment loading can be reduced by 85 percent if no-till practices are used instead of historical cropping practices involving significant tillage operations. In recent years, irrigators have made progress towards reduced suspended sediment and pesticide levels in area waterbodies, and will continue to implement best management practices (BMPs) in these areas to meet TMDL targets. Additionally, the Pesticide Stewardship Partnership launched by ODEQ has resulted in: 1) the installation of vegetative buffer strips adjacent to surface waters; 2) increased use of less toxic pesticides and mineral oil; 3) individualized applicator training; 4) use of calibrated sprayers to avoid overspray; and 5) collection events to remove unwanted waste pesticides from the watershed with great success.

Continued monitoring of implementation activities and water quality is essential in assessing the progress of the TMDL. The goal of the TMDL is to reduce chlorinated pesticides and PCBs in the Walla Walla River and its tributaries, so that levels meet water quality standards.

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3.3.4.1.1 Fecal Coliforms

The basin-wide fecal coliform bacteria evaluation was conducted by Ecology concurrently with evaluations of other parameters on the 303(d) list. The final TMDL (Joy et al., 2006), approved in April 2007, was used extensively to develop this section. The Walla Walla River at RM 15.6 was on the 1996, 1998, 2004, and 2008 303(d) lists for fecal coliforms.

The low-flow issues in the WWRB significantly affect water quality, including fecal coliform contamination and contact recreation uses. As such, water allocation is a major issue that must be resolved if water quality, irrigation and municipal water uses, the ESA and other issues are to be balanced. Many water rights in the WWRB have very early priority dates (dates of origin), some dating back to the mid- to late-1800s. Water rights issues are not in the scope of the TMDL, but some fecal coliform contamination problems in the basins are affected by water volume.

The recommended fecal coliform reduction targets were applied toward reducing both nonpoint and point sources. The implementation strategy mitigating nonpoint contributions consists of identifying sources, prioritizing sites for implementation, finding funding, educating watershed residents, and implementing Best Management Practices. Specifically, the implementation strategy calls for local and state entities to work together to reduce bacteria from septic systems, livestock, stormwater, wildlife, and waterfowl. Also included in the strategy is riparian corridor restoration to filter overland flow and nutrient management methods (i.e., composting and spreading manure at agronomic rates). Point sources of pollution consist of waste water treatment plants (WWTP) for the Cities of College Place, and Walla Walla, as well as potential Phase 2 municipal stormwater permittees. The current or proposed National Pollution Discharge Elimination System (NPDES) permits for the WWTPs were evaluated during the TMDL process and were considered adequate if fecal coliform limits were properly enforced and analytical or operational questions were resolved. The WWTPs were given specific fecal coliform wasteload allocations to meet instream targets.

The recommended fecal coliform reduction targets will be assessed by Ecology after a period of 5 to 10 years in order to ascertain if implementation measures have been successful. The assessment will determine if the fecal coliform criteria are met, if the reductions will be sustained over the long-term, or if the targets need adjustment because of additional increased understanding of sources and their effect on recreational uses.

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3.3.4.1.2 The DO and pH

The Walla Walla River was on Washington State's 303(d) list of impaired waterbodies in 1996, 1998, 2004, and 2008 for not meeting pH and DO water quality standards.

From June 2002 to June 2003, Ecology completed additional pH and DO measurements. They collected other water quality samples from sites along the rivers, as well as in several other tributaries in the basin. The resulting draft TMDL (Joy et al., 2007) was excerpted for this document. The study found that pH and DO problems are widespread in the basin and are most severe from June through September, but problems do exist longer (May through October) in some areas. The data show that several factors contribute to DO and pH problems in the WWRB, including:

- Naturally high phosphorus concentrations in the headwaters [>40 micrograms per liter (*µ*g/L) soluble reactive phosphorus]
- Naturally elevated pH (>7.5)
- Diversion of water out of river channels
- Wide, shallow reaches with very little riparian shade that: 1) raise instream temperatures; and 2) provide light exposure for excessive algae growth on the channel bottoms
- Excessive nutrient loading from point and nonpoint sources

Some of these factors cannot be controlled or easily alleviated. For example, the high background (natural) phosphorus and pH values are outcomes of geology rather than anthropogenic (human-caused) sources. Also, maximum potential riparian shade in the Columbia Basin Ecoregion is not adequate to cool the wide reaches of the lower Walla Walla River. Water rights control where and when water is diverted in the basin. As a result, some areas are unlikely to fully meet their assigned numeric criteria even after the TMDL is completely implemented.

The TMDL proposes nutrient reductions from point and nonpoint sources to stream reaches and whole tributaries, where appropriate. Reducing nutrient loads to rivers and tributaries in the basin should increase the number of reaches in compliance with applicable water quality criteria for pH and DO, or meet the best potential conditions for pH and DO.

Decreasing water temperatures by increasing instream water volumes and riparian shading is also recommended to decrease physical and biological factors contributing to the DO and pH problems. The overall effect of temperature reduction and nutrient control will promote healthy aquatic habitats and provide better conditions for salmon rearing and migration.

The following conclusions are based on the results of this study:

- Critical conditions for pH and DO in the WWRB occur during the growing season (May through October).

- Nutrient stimulation of primary productivity creates conditions throughout the basin where pH and DO fail to comply with criteria.

- Phosphorus concentrations and pH values in some headwater reaches appear to be naturally elevated. Therefore, controlling nutrients to levels where pH and DO meet current water quality criteria will not be possible at all sites in the basin.

- Low instream flows, high instream temperatures, and poorly-shaded stream reaches contribute to excessive instream primary productivity.

- The nutrient loading capacity of the Walla Walla River is exceeded during the critical period from May through October.

- There is no capacity for nonpoint and point source nutrient loads from May through October in any of the waterbodies evaluated.

- Nonpoint sources, groundwater sources, and sources along the Walla Walla River in Oregon require nutrient reductions as near to background as is possible to achieve.

- Nutrient reductions, increased streamflows, increased potential shade, and lower instream temperatures will all be necessary to achieve the best potential pH and DO conditions in the WWRB. After these are accomplished, pH and DO in some reaches will likely still not meet Washington State water quality standards.

3.3.4.1.3 Temperature

The draft TMDL (Stohr et.al., 2007) prepared by the State of Washington Department of Ecology focused on the tributaries to the Walla Walla River and can be downloaded from *http://www.ecy.wa.gov/biblio/0703013.html*. Temperature assessment and modeling of the entire mainstem was completed vis-à-vis an interstate coordination agreement between Oregon DEQ and Ecology, and included in the Walla Walla subbasin TMDL prepared by ODEQ (*www.deq.state.or.us/wq/tmdls/wallawalla.htm*).

3.3.4.2 Water Quality (Oregon)

The Walla Walla River is 303(d) listed for temperature in both Oregon and Washington. For example, a 7-day maximum temperature of 23.1 °C (75.4 °F) was measured at Tum-a-Lum Bridge (RM 43.7), Oregon, in July 2002. Farther downstream in Washington at McDonald Road (RM 31.2) the analogous temperature for the same month was 28.3 °C (83 °F).

The ODEQ analyzed the entire length of the Walla Walla River in 2000 and 2002. The TMDL goals for the Oregon part of the WWRB were developed in coordination with a similar effort in Washington. The text in the following paragraphs was excerpted from the resulting TMDL (Butcher and Bower, 2003).

The Oregon water quality standard for temperature (revised in 2004) includes biologically-based temperature targets, and accounts for naturally high temperature. The TMDL assessment found that natural temperatures are relatively high. Given this situation, not uncommon in Eastern Oregon, the following text in the standard describes the objective addressed by the TMDL:

> "Natural Condition Criteria. Where ODEQ determines that the natural thermal potential of all or a portion of a water body exceeds the biologically-based criteria in Section (4) of this rule, the natural thermal potential temperatures superseded the biologically-based criteria, and are deemed to be the applicable temperature criteria for that water body."

In the WWRB, a substantial cause of stream heating results from the removal of trees and other shade-producing vegetation adjacent to the stream. This allows direct sunlight to heat the water. In addition, vegetation disturbance and stream straightening are common causes of bank erosion within the Basin, resulting in wider channels with more solar heating.

The ODEQ worked with the WWBWC, and in collaboration with the various affected organizations and watershed managers to analyze river temperatures. Based on historical information, existing areas with little disturbance and literature, a TMDL team estimated natural thermal conditions for the Walla Walla River and the South Fork up to its confluence with Skiphorton Creek, totaling roughly 70 miles of river. Many other temperature profiles were generated to account for varying levels of shade, channel width, and flow. The outcomes of the study are:

- Increased vegetation, increased flow, and decreased channel width would all lead to similar reductions in stream heating. Each of these factors will need to be addressed in order to attain a more natural heating pattern.
- The upper South Fork is managed with special protections by the Umatilla National Forest and is already at natural temperatures.
- Substantial heating occurs at the Milton-Freewater levee and further downstream, due to low flow, vegetation reduction, and a widened channel. Much of the flow loss is due to irrigation diversion, some due to bed loss.
- Channel straightening has led to a 50-percent increase in channel width in parts of the Basin.
- From the South Fork (at Harris County Park) to the mouth of the Walla Walla River, vegetation has been compromised. Most of the river has the potential for large willow, cottonwood, alder, and other trees.
- Roughly 50 percent of the existing solar heating of the river is caused by human activities (i.e., vegetation and bank disturbance).

Meeting the TMDL allocations will require reductions in heating associated with agriculture, forestry, and transportation corridors. In general, this means restoring stream-side areas so that banks are stable and vegetated. Where feasible, floodplains, sinuosity, and channel complexity should be restored to more natural conditions. The TMDL management plans and land use authorities should provide guidance, planning, incentives, and rules to implement these measures.

3.3.5 Groundwater Quality

The WWRB is underlain by two geologically distinct aquifers. The confined basalt aquifer underlies the entire basin, and can be up to 3,000 feet thick. It receives recharge from the Blue Mountain region. Water is generally transmitted through the basalt aquifer in cracks and fissures in its structure, and between basalt flows. This gravel aquifer underlies a much smaller area extending from near the City of Walla Walla west along the Walla Walla River. The groundwater table in the gravel aquifer is shallow, at stream level in some areas. Recharge to the gravel aquifer occurs from precipitation infiltration; recharge from streams, ditches, and canals; and, to a lesser degree, from upward recharge from the basalt aquifer.

Data for groundwater quality is not as readily available as surface water data. Most of the information is localized near the City of Walla Walla, in the central portion of the WWRB. The Washington State Department of Health maintains water quality sampling results for wells that are part of public water systems, but this data is not readily available in a centralized database.

The following discussion on general groundwater quality for the WWRB relies, often verbatim, on a report prepared by Economic Engineering Services (2002), which should be consulted for additional details. Comprehensive general water quality parameters were collected or obtained from 27 representative wells. Partial analyses were made on water samples from 140 representative wells and springs throughout the basin for the Newcomb (1965) report; and discussions of hardness, sodium, potassium, chloride, fluoride, and temperature were all included.

The two other primary sources of water quality information focused on groundwater within the gravel aquifer. The Walla Walla/College Place Pre-Groundwater Management Plan (Economic Engineering Services, 1995) focused on this area, because it generally coincided with the urban planning area of the study. The groundwater quality assessment in this plan included a review of the City of Walla Walla's production wells for general water quality parameters, as well as sampling for nitrates, pesticides, and coliform bacteria from surrounding wells. *Pesticide Residues in the Walla Walla Surficial Aquifer* (Larson, 1995) was particularly focused on pesticide impacts to the gravel aquifer. This study included sampling 27 wells screened in the gravel aquifer, and analyzing them for various pesticides and breakdown products.

3.3.5.1 General Water Quality Parameters

The review of general water quality parameters by Economic Engineering Services (1995), utilized production wells in the City of Walla Walla and College Place, and other surrounding wells screened in the basalt aquifer. The results of the isotope geochemistry and major ion chemistry results from this study indicate that groundwater in the basalt aquifer may be as much as 20,000 years old, and was recharged up to 20,000 years ago in the vicinity of Walla Walla. Groundwater in the gravel aquifer ranges from less than 50 years of age to more than 3,000 years old, and was recharged from infiltration of precipitation within the last 40 years. It was locally recharged by upward leakage from the underlying basalt aquifer.

Newcomb (1965) included wells throughout the WWRB in his study. Based on his findings, groundwaters of the WWRB are generally considered to have excellent water quality in terms of having low mineral content and concentrations of undesirable constituents. In addition, the analysis indicated that the wells are drawing water with similar chemical composition.

More recent sampling from the City of Walla Walla's production wells was conducted as part of the pre-groundwater management plan (Economic Engineering Services, 1995). Water samples were taken from six wells used by the City of Walla Walla (three each from the basalt and gravel aquifers). Two sets of samples were collected, one in the spring and the other in late summer 1993. Results indicate that sodium concentrations are higher in groundwater from the basalt aquifer wells, and calcium and magnesium concentrations are lower in groundwater from basalt aquifer wells. Hardness data is consistent with these trends: hardness is lower in groundwater from basalt aquifer wells than from gravel aquifer wells. These data are consistent with regional trends for groundwater flow paths as a result of secondary weathering alteration reactions. In addition, the major ion chemistry of groundwaters in the basalt and gravel aquifers is consistent with that of water which has reacted with agneous rocks. Carbonate minerals are an insignificant source of ions. Despite Newcomb's observations that groundwater quality in the Basin is similar, the isotope study conducted in 1994 (Economic Engineering Services, 1995) indicated that groundwater from the basalt aquifer is separate and distinct from the groundwater in the gravel aquifer. The sampling of wells for major ions in this study also indicated the chemical distinctness of the two groundwater systems.

3.3.5.2 Areas of Impaired Groundwater Quality

Wells reviewed by Economic Engineering Services (1995) for nitrates, coliform bacteria, and pesticides included wells screened in the gravel aquifer over an area of 10,000 acres south of the City of Walla Walla. Several of the wells in the gravel and basalt aquifers had nitrate concentrations exceeding the drinking water standard. Seven wells screened in the gravel aquifer sampled by Larson (1995) also had total nitrate concentrations above the drinking water standard. In addition, several wells screened in the gravel aquifer had "unsatisfactory" bacteria counts, according to the study

conducted by Walla Walla County in 1989 (Economic Engineering Services, 1995). Most of the elevated concentrations were detected in samples from wells screened in the gravel aquifer. Based on maps generated in the study by Economic Engineering Services (1995), nitrate levels above 10 milligrams/liter (mg/L) are generally located in areas designated as agricultural or rural. The highest nitrate levels were located near the confluence of Yellowhawk and Cottonwood Creeks. The high bacteria counts were located northeast and southwest of the City of Walla Walla.

The study by Larson (1995) detected pesticides in 14 of the 27 wells sampled in the gravel aquifer. However, none of the concentrations were above maximum contaminant levels (MCLs). Typically, pesticide concentrations were two or more orders-of-magnitude lower than their MCLs, and Larson concluded no impairment of the water use based on the detected pesticide concentrations. Their presence, however, indicates that current land use is impacting the shallow groundwater.

Excessive drawdown in the basalt aquifer may cause migration of impaired groundwater to the basalt aquifer. More recent sampling of wells in the basalt aquifer has not been performed to assess impacts from vertical leakage of the gravel aquifer groundwater downward. Two of the deepest wells in the gravel aquifer (at 100 feet) sampled in Larson (1995) did have nitrate concentrations near or slightly above the MCL. This indicates that there is downward movement of contamination in the central Walla Walla subbasin. It is unclear whether these concentrations have yet impaired the basalt aquifer.

3.3.5.3 Natural and Man-Made Causes of Groundwater Quality Impairment

Groundwater quality is primarily controlled by two factors. The first is the source of the water (recharge), which includes chemicals that may be present in the source of recharge. For example, land use practices affect the water quality of infiltrating water that eventually reaches groundwater. The second factor is the geological materials that come in contact with the moving groundwater. The geochemistry of the water can change as minerals leach or dissolve into the groundwater. In the case of the WWRB, water quality impairment is primarily associated with man-made causes in the central Walla Walla subbasin.

The elevated nitrate levels and coliform bacteria counts in groundwater in the central Walla Walla subbasin, where residential land uses predominate, indicate contamination from septic systems or sewage lines. Livestock may also be a source of nitrate concentrations, but to a lesser degree, because that land use is not as predominant.

The gravel aquifer is hydraulically connected with the network of streams, canals, and ditches in the WWRB. Therefore, besides direct vertical recharge from the ground surface, water from streams and canal leakage can impact the groundwater quality. As mentioned earlier, vertical migration to the basalt aquifer can occur with lowering of groundwater levels caused by pumping.

3.3.6 Water Quality - Future Without Project Condition

Surface water quality would continue to be affected by various pollutants. However, TMDL allocations have been developed for the WWRB for several parameters, and provide insight to projected water quality conditions. The ODEQ temperature TMDL states that "DEQ expects that water quality standards will be attained as soon as feasible given technical, political, and economic constraints." Furthermore, with respect to water temperatures, the document asserts that "with disturbance minimized and recovery enabled, substantial reduction in solar heating could be achieved in much of the Subbasin in 25 to 75 years." Similarly, the Ecology Water Quality Implementation Plan (WQIP) estimates that temperature standards can be achieved in 50 years or less. Furthermore, the WWRB PCB, chlorinated pesticide, fecal coliform, pH, and dissolved oxygen TMDL WQIP estimates that Washington State water quality standards for these parameters are anticipated to be met in 10 years from completion of the WQIP.

Without a better understanding of the connectivity between surface and groundwater, maintaining the status quo will likely lead to a deterioration of regional groundwater resources. The efforts directed at retaining more water in the Walla Walla River, with measures such as increased irrigation efficiency and other conservation projects, have shown some success. However, making more water available for instream needs has resulted in a reduction in shallow groundwater resources, due to less recharge. Decreased aquifer flow has resulted in desiccation of springs and groundwater seeps that feed the Walla Walla River. These once perennial springs that returned cooler groundwater now only flow intermittently. One possible outcome of this could be an increase in mainstem river temperatures. Wells that have been monitored by the State of Oregon since 1933 show a steady decline in the elevation of the shallow water aquifer table, due to pumping. This change could lead to a vertical migration of water from the shallow aquifer that often has higher concentrations of nitrates and other organic constituents to the basalt aquifer.

3.4 Aquatic Resources

3.4.1 Fish Habitat

Historic and contemporary land-use practices have had a profound effect on the salmonid species abundance and distribution in the watershed. Severe habitat degradation in area streams from urban and agricultural development, grazing, tilling, logging, recreational activities, and flood control structures has contributed to the problem of reduced water quality and quantity. Agricultural diversions have severely impacted streamflows in the Walla Walla River since the 1880s (Neilson, 1950).

Around 60 percent of current water usage in the basin is used for crop irrigation (Corps, 1997). The reduced streamflows created by irrigation withdrawals adversely impact salmonid and bull trout survival within the basin by reducing habitat, reducing streamflows, increasing water temperatures, and impairing passage.

Additionally, out-of-basin impacts to local fish populations have been substantial. Salmon migrating to or from the ocean must pass through four dams and reservoirs on the lower Columbia River. Other out-of-basin impacts include over-harvest of fish resources, habitat destruction in the lower Columbia River and estuary, predation, unscreened and poorly screened diversions, and industrial and municipal pollution.

Concerns about the decline of native salmon and trout populations in the Walla Walla River have increased among natural resource managers and the public. As a result, a multitude of complimentary and overlapping initiatives to protect and restore salmonid fishes and their habitats have been planned or implemented at the local, state, and Federal levels of government.

Historically, the Walla Walla River produced substantial runs of both spring Chinook salmon and summer steelhead. The last substantial run of wild Chinook salmon took place in 1925. Thereafter, Chinook salmon populations continued a precipitous decline, and the species is considered extirpated in the basin (Neilson, 1950). Chum (*O. keta*) and coho (*O. kisutch*) salmon may have occurred in the drainage before the early 1900s, but little written documentation exists. Anecdotal accounts and reports of historic fisheries in adjacent basins indicate that chum and coho salmon could have occurred in substantial numbers in the WWRB (Pirtle, 1957). Endemic steelhead persist throughout much of the WWRB, but the population is considered depressed (WDFW, 1993). The MCR steelhead Evolutionarily Significant Unit (ESU), which occupy the Walla Walla River and its tributaries, was listed as threatened under ESA in 1999. This determination was reaffirmed in 2006 (70 CFR 834).

In addition, approximately 300,000 non-endemic hatchery steelhead (Lyons Ferry stock) are released in the middle Touchet and lower Walla Walla Rivers each year under the Lower Snake River Compensation Program to provide harvest mitigation for the four lower Snake River dams.

The WDFW has assessed salmonid distribution, relative abundance, genetics, and condition of salmonid lifestage habitats in the WWRB since 1998. In this assessment (Mendel et al., 1998; 1999; 2000; 2001; 2002; and 2007), one of the study goals was to identify and document physical barriers to salmonid passage, spawning, and rearing in a “limiting factor identification” framework. Field biologists noted the presence of potential barriers, and provided information to local agency biologists to coordinate habitat rehabilitation efforts to remove physical barriers.

Historically, the section of the Walla Walla River from the Washington-Oregon State line upstream to Cemetery Bridge in Milton-Freewater, Oregon was a passage barrier during periods when water was withdrawn for irrigation. Adult passage has improved since a minimum instream flow agreement between the USFWS and several irrigation districts was developed in 2000 at this location. A fish ladder was also constructed at Nursery Bridge in 2001.

Prior to completion of the new adult passage ladder in 2001, WDFW assisted ODFW and the CTUIR in salmonid rescue efforts on the Walla Walla River below Nursery Bridge in Milton-Freewater, Oregon due to lack of water in the river. All water from a section of the Walla Walla River, just south (upstream) of the Washington-Oregon border, was diverted in mid-July 2000 for irrigation. The reach below the Cemetery Bridge diversion (about 1 mile upstream of Nursery Bridge) was left nearly dry until the diversion terminated at the end of the irrigation season (typically September or October of each year at Cemetery and Nursery Bridges).

Physiological barriers to salmonid passage and survival, in the form of high water temperatures, inadequate flows, and degraded habitat were also identified by examining data collected by instream monitors and manual sampling. The strong relationship between flow and other environmental attributes means that flow is often the dominant parameter determining fish abundance.

3.4.2 Streamflows

Reduction and regulation of flow is a primary factor constraining the biological integrity of streams in the Pacific Northwest (Williams, 2006), across the world (Dynesius and Nilsson, 1994), and in the WWRB (ICF Jones and Stokes, 2009).

Streamflow is a primary determinant of the amount of space available for fish (Bjornn and Reiser, 1991) and the availability of key habitats. Flow can have a major effect on other aspects of water quality by diluting and flushing pollutants and other chemicals. Extreme low flow, and the concentration of biological oxygen demand, can also result in low levels of DO. Low DO levels are a key physiological determinant of survival, thereby amplifying the effect of flow on fish survival (ICF Jones and Stokes, 2009).

The seasonal variation in flow affects the capacity of a stream for various life stages, because flow determines water surface area and volume. For this reason, summer low flow (when the stream width is the smallest) often limits fish production (ICF Jones and Stokes, 2009).

Upstream migration of many salmonid species typically involves rapid movements through shallow areas, followed by periods of rest in deeper pools. Some species, such as spring Chinook salmon and summer steelhead, may arrive at spawning sites several months before spawning or hold in mainstem rivers for several weeks or months prior to moving into their natal streams to spawn (Bjornn and Reiser, 1991). Upstream migration of adult steelhead and spring Chinook salmon has been documented in every month except July in the Walla Walla system.

Streamflow during the spawning migration must be sufficient to allow passage over physical barriers (i.e., falls, cascades, and debris). As a result, the migrations of many stocks occur coincident with high flows. Spring and summer Chinook salmon stocks migrate during periods of high flows, allowing them to reach spawning tributaries in headwater reaches. Minimum depths that allow salmonid passage are approximately

0.4 feet (12 centimeters) for trout, 0.6 feet (18 centimeters) for the smaller anadromous species (i.e., pink, chum, steelhead, sockeye, and Coho salmon), and 0.8 feet (24 centimeters) for large Chinook salmon (Bjornn and Reiser, 1991). Substantially greater depths may be required to negotiate larger barriers.

No specific instream criteria has been identified by NMFS for natural channels, but they do emphasize passage requirements of 1.0 foot (30.5 cm) for upstream salmonid passage in design criteria for mixed substrates (gravel to boulder-size material) (Aaron Beavers, NMFS, personal communication, March 1, 2010). Washington adult passage criteria call for 0.8 foot (23.4 cm) for small trout (bull trout) and 1.0 foot (30.5 cm) for Chinook salmon and steelhead. The Oregon criterion is similar, requiring 8 inches (20.3 cm) for trout and juvenile salmonids, and 1.0 foot (30.5 cm) for Chinook salmon and steelhead.

Passage is critical for anadromous and adfluvial coldwater fishes (i.e., salmon and bull trout). Considerable attention and investments have focused on restoring passage conditions in the WWRB. Although passage actions only directly affect a small stream reach where construction and facility modifications occur, these actions can provide access to large swaths of habitat that might be inaccessible otherwise. Passage in the Walla Walla River has improved by the removal of Nine Mile Dam, which now provides access for a considerably larger portion of the steelhead run. This action was followed by large-scale improvements at several facilities, including Nursery Bridge Dam, where fish enumeration occurs on the mainstem Walla Walla River.

In 2000, irrigation districts in Oregon maintained a minimum instream flow of 13 cfs at Nursery Bridge in Milton-Freewater, Oregon, based on a settlement agreement with USFWS. The minimum instream flow at Nursery Bridge was increased to 18 cfs in 2001, and then increased again to 25 cfs in 2002. In 2003 and 2004, the minimum flow increased to 27 cfs through June 30th, and then decreased to 25 cfs for the remainder of the year. The additional water in 2000 made an immediate impact in Oregon by considerably reducing the historic dewatered area from Nursery Bridge downstream to below Tum-a-Lum Bridge. In 2001, the Walla Walla River had continuous overland flow from Nursery Bridge to the state line for the first time in decades. Measurements at the bridge on Pepper Bridge Road showed little or no increase in streamflows until July to September 2001, when flows increased 300 to 400% over summer flows in the previous 3 years. Flows at Pepper Road Bridge in 2002 showed increases of 110 to 185% from July through September. In 2004, a wet spring created above normal summer flows, but flows in October were the lowest seen since the settlement went into effect in 2000.

Washington's GFID maintained at least a 10-cfs streamflow past Burlingame Dam (just above Mojonnier Road), under the auspices of the settlement agreement, during the spring, early summer, and fall irrigation season of 2000. In 2001, the 10 cfs was increased to 14 cfs, and further increased to 18 cfs in 2002. In 2003 and 2004, the

minimum flow increased to 19 cfs through June 30, and then returned to 18 cfs for the remainder of the year. Flows showed a general increase from 1999 to 2001 at continuous flow monitoring sites near Mojonnier and Detour Roads, especially in July and August, but were not consistent from 2002 to 2004 (Mendel et al., 2005).

The WWRB is available for recreational fishing throughout the range of salmonid spawning and rearing habitat. However, flow regimes in the basin do not optimize flows needed to support salmonids as reported by ICF Jones and Stokes, 2009. For example, summer steelhead juvenile rearing is well supported, at about 80 cfs, in the middle reach of the Walla Walla River. Actual flows, however, are considerably lower, as a result of agricultural removals. Summer steelhead spawning conditions are maximized at about 100 cfs in the mainstem. Flows are much higher than 100 cfs when steelhead first enter the system, but drop below 100 cfs as the irrigation begins. Consequently, flows are rarely optimized for the biology of the fish. Under normative conditions, flows would persist near 100 cfs for long periods.

3.4.3 Stream Temperatures

From 1998 through 2001, physiological barriers and impediments to salmonid passage and rearing were extensive throughout the Washington reaches of the WWRB in terms of stream miles affected (Mendel et al., 1999; 2000; 2001; and 2002). The primary physiological factor was water temperature, although high pH and low dissolved oxygen concentrations were also documented in some mid- or lower mainstem Walla Walla River reaches. In WWRB streams, water temperature likely represents the most critical physiological barrier to salmonids, particularly for passage and rearing (Mendel et al., 2000).

Flow has a strong effect on the maximum summer water temperature and the presence of thermal refugia that allows fish to survive during warm summer months (Poole and Berman, 2001). Slow-moving water accumulates temperature from the sun to a greater degree than fast-moving water, and summer low-flow periods generally correspond to maximum summer water temperatures (McCullough et al., 2001). Cooler water from tributaries and subsurface hyporheic flow provides points where fish can find preferred temperatures. Temperature has a strong physiological effect (Bjornn and Reiser, 1991), and is often a primary determinant of fish survival, especially in areas with high summer air temperature (e.g., the interior Columbia Basin). In these environments, flow is a primary determinant of fish survival because of its impact on temperature (Poole and Berman, 2001; and ICF Jones and Stokes, 2009).

The Walla Walla River and its tributaries are not cool enough in the summer to fully protect salmonids as they rear and spawn. A substantial cause of stream heating is the removal of trees and other shade-producing vegetation adjacent to the stream, thus allowing direct sunlight to heat the water. Of the fish species in the Walla Walla River, Chinook salmon, steelhead trout, and bull trout are most sensitive to excessive heat. Reaches with mean water temperatures exceeding 24°C (75°F) during the summer have been associated with very low salmonid densities. At temperatures above 18° to

21°C (63.4 to 69.8°F), these fish are inefficient at hunting, hiding, and processing food. In addition, warmer water can also harm salmonids by increasing the incidence of disease, impairing their ability to spawn, reducing growth rates, and decreasing egg survivability (Oregon Walla Walla Subbasin Temperature TMDL, 2005). Hicks (2002) estimated that, to fully protect (with no detrimental effect) adult steelhead and Chinook salmon migration, the 7-day average maximum temperatures should not exceed 17.0 to 19.0°C (62.6 to 66.2°F). In addition, a barrier to migration appears when 7-day average maximum temperatures reach 20.1 to 23.6°C (68.1 to 76.3°F).

The WDFW has collected temperature data in the WWRB since 2000. Sites where mean water temperatures were less than or equal to 60°F (15°C) during summer months were generally located in tributaries associated with the Blue Mountains. Stream temperatures reflect the region's hot and arid climatic regime, and do not meet the Washington or Oregon State water quality criteria to best support cold water species (criteria available at *www.deq.state.or.us/wq/tmdls/wallawalla.htm*).

Peak daily temperatures at some instream monitoring sites (WDFW, 1998-2007) routinely exceeded lethal temperatures for salmonids [75 to 84°F (23.9 to 29.4°C) – Bjornn and Reiser, 1991] during mid-summer (late June to early August), when the photo-period is long and evening cooling is brief. Sites in the Walla Walla River frequently had daily maximum water temperatures that were high enough [greater than 68°F (20°C)] to inhibit migration of adults and young salmonids, and to sharply reduce the survival of embryos and fry (Bjornn and Reiser, 1991). Often maximum daily temperatures in these areas exceeded 75 to 85°F (25 to 29.4°C). At night, water temperature usually decreased to within reasonable physiological limits for steelhead/rainbow trout [<18 to 20°C (<65 to 68°F)] (Mendel et al. WDFW, 2007).

3.4.4 Anadromous Fish

Fish that travel between freshwater and salt water are called diadromous. Among diadromous fish, those that live mostly in the ocean, but are born in, and move into freshwater to breed are called anadromous.

3.4.4.1 Limiting Factors

Limiting factors are defined by NMFS (2008) as: physical, biological, or chemical features (e.g., inadequate spawning habitat, high water temperature, insufficient prey resources) experienced by the fish that result in reductions in viable salmonid population (VSP) parameters (abundance, productivity, spatial structure, and diversity).

The Walla Walla Subbasin Plan [Northwest Power and Conservation Council (NPCC), 2004] identified sediment load, habitat diversity, and obstructions as the most common and severe limiting habitat factors in the WWRB. High water temperatures, lack of instream flow, lack of channel stability, and a lack of key habitat were also significant limiting factors. In addition, turbidity, sedimentation, and a lack of pools and cover present challenges to migrating, breeding, and rearing cycles.

In 2008, NMFS identified the major factors limiting the viability of MCR steelhead DPS in general as degraded tributary habitat; impaired fish passage in the mainstem Columbia River and tributaries; hatchery-related effects; and predation, competition, and disease. Two other factors, degradation of estuarine and near shore marine habitat, and harvest-related effects, pose some risk to steelhead viability for the entire DPS, but less than the other factors. Climate change also represents a potentially significant threat to the recovery of MCR steelhead DPS throughout the recovery domain (NMFS, 2008).

Major limiting factors for the Umatilla/Walla Walla steelhead Major Population Group (MPG) (NMFS, 2008) include:

- *Mainstem passage:* The Walla Walla populations must pass four major dams on the Columbia River as they migrate.
- *Tributary habitat:* For the Walla Walla population, water quality (temperature), sediment routing dysfunction, blocked and impaired fish passage, degraded floodplain and channel structure (key habitat quantity and habitat diversity), and hydrologic alterations are limiting factors in the tributaries.
- *Hatchery-related effects:* Non-endemic-origin hatchery fish are considered a potential threat to the Walla Walla wild steelhead population.
- *Predation, competition, and disease:* Predation, competition, and disease issues in the mainstem and estuary affect all of the Middle Columbia steelhead populations.

A number of barriers and impediments to salmonid passage or rearing were identified during the WDFW field seasons (Mendel et al., 1998; 1999; 2000). A portion of those barriers (i.e., structures or dewatered streambeds) physically blocked salmonid movement. Several previously unknown barriers were discovered by WDFW, during 1999, in the Washington State streams of the WWRB (Mendel et al, 2000).

In 1999, the Walla Walla River fish rescue efforts at the Nursery Bridge diversion spillway structure collected a total of 6,619 wild salmonids that included bull trout, rainbow/steelhead trout (wild), and whitefish (Mendel et al., 2000). A new passage ladder was constructed at Nursery Bridge during the 2000 and 2001 summer in-water work window. Salvage during July 2001 yielded spring Chinook salmon, steelhead, bull trout, and a few Pacific lamprey (*Lampetra tridentata*).

Throughout the Washington State reaches of the WWRB between 1998 and 2001, physiological barriers and impediments to salmonid passage and rearing were extensive in terms of stream miles affected (Mendel et al., 1999; 2000; 20001; and 2002). The primary physiological factor was water temperature, although high pH and low DO concentrations were also documented in some mid- or lower mainstem Walla Walla River reaches. In WWRB streams, water temperature possibly represents the most critical physiological barrier to salmonids, particularly for passage and rearing (Mendel et al., 2000). Water temperature-related barriers for salmonids generally occur

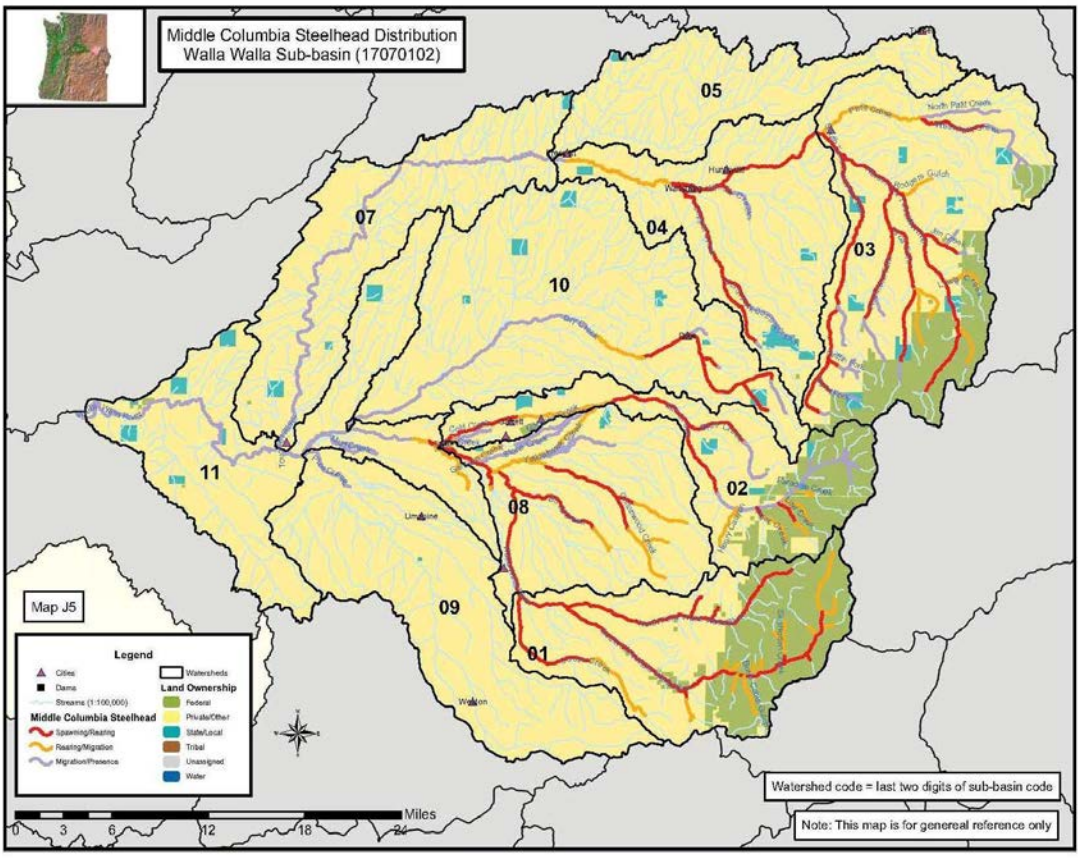
in the Walla Walla River and its tributaries. Stream reaches exceeding 75°F (24°C) during the summer are associated with very low densities of salmonids; primarily age 0+ rainbow/steelhead trout.

3.4.4.2 Anadromous Fish Stock

3.4.4.2.1 Distribution and Abundance (Middle Columbia River Steelhead)

In 2007, the Interior Columbia Basin Technical Recovery Team (ICBTRT) identified 19 populations of MCR steelhead in four MPGs (Cascades Eastern Slopes Tributaries, John Day River, the Walla Walla and Umatilla Rivers, and the Yakima River), and one unaffiliated independent population (Rock Creek) within this species (ICBTRT, 2007). The Willow Creek population, within the Walla Walla and Umatilla Rivers MPG, is also extirpated. Figure 3-3 is a Critical Habitat Analytical Review Team (CHART) map (NMFS, 2005) showing MCR steelhead spawning/rearing, rearing/migration, and migration/presence.

Figure 3-3. Middle Columbia River Steelhead Distribution in the WWRB (NMFS, 2005)



The DPS-level viability criterion developed by ICBTRT is that all extant (existing fish that are not extinct), and any extirpated (locally extinct), MPGs critical for proper functioning of the DPS should be at low risk of extinction over the next 100 years (ICBTRT, 2007; and NMFS, 2008). The majority of natural MCR steelhead populations are rated at moderate risk for all four VSP parameters – abundance, productivity, spatial structure, and diversity. Thus, the MCR steelhead DPS does not currently meet viability criteria, based on the determination that the four component MPGs are not at low risk (NMFS, 2008).

Currently, the Umatilla/Walla Walla MPG is not considered viable. To be considered viable, the Umatilla/Walla Walla MPG must meet the following criteria:

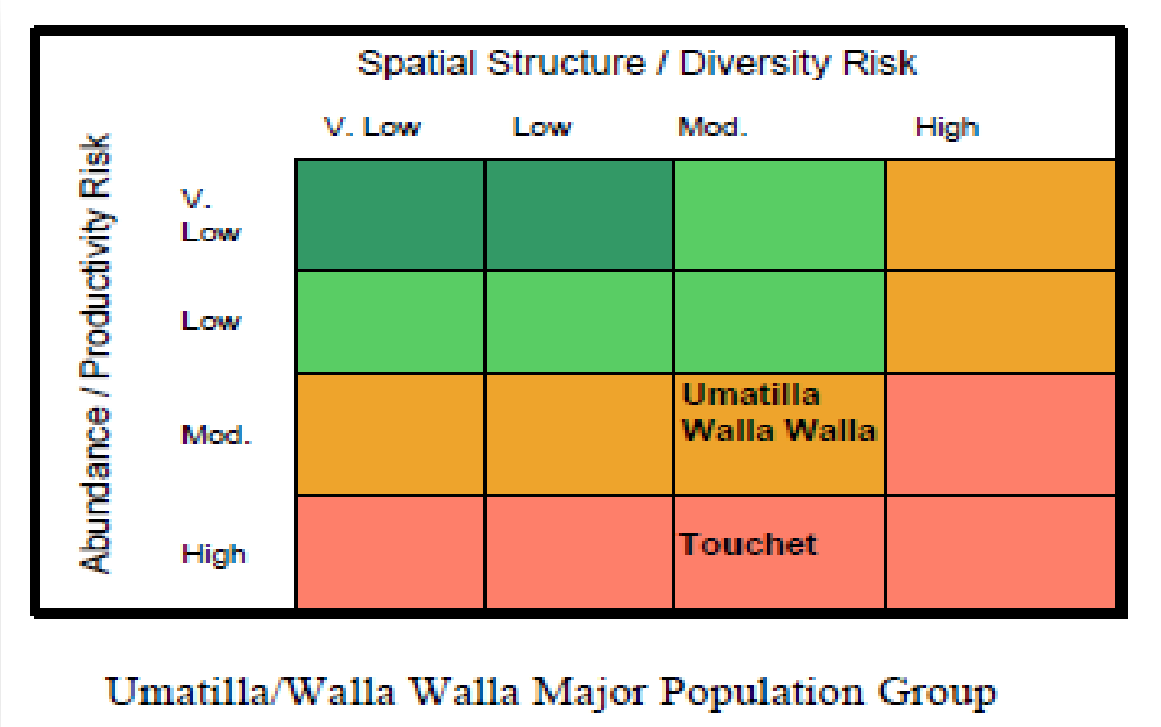
1. Two of the three historical populations [Umatilla, Walla Walla, Touchet, and Willow Creek (extirpated)] must meet ICBTRT viability criteria;
2. Viable populations within the Umatilla/Walla Walla MPG must include two populations classified as large or very large (only the Umatilla population satisfies this criterion);
3. All major life history strategies must be present;
4. One of the populations must be highly viable (none of the populations currently satisfy this criterion); and
5. All populations that do not meet viable status must be maintained [as defined by ICBTRT (2007) and NMFS (2008)].

For the Umatilla/Walla Walla MPG to be viable, two populations should achieve viable status (less than 5% risk of extinction within the next 100 years), and one should be highly viable (less than 1% risk of extinction within the next 100 years) (NMFS, 2008).

Based on the VSP matrix laid out by the ICBTRT (2007) (Figure 3-4), the Umatilla and Walla Walla populations do not currently meet the ICBTRT criteria for viable status, but they do meet the criteria for maintained populations. This means they have only a moderate risk of extinction (less than 25% chance) within the next 100 years (NMFS, 2008).

The ICTRT assessed the difference between the current status for abundance and productivity and the viability criteria. This difference is called the “gap.” The gap, as used in the recovery plan as a measure, although it is inevitably imprecise, of the improvement in survival needed to meet viability criteria. As such, it is also an indicator of the level of effort needed to achieve recovery. The ICTRT calculated the gap for each MCR steelhead population based on current abundance and productivity for the listed salmon and steelhead in the Interior Columbia Basin (ICTRT, 2007). They estimated the minimal survival rate changes needed for Middle Columbia steelhead populations to meet the abundance and productivity viability criteria for a 5 percent risk of extinction in a 100-year time frame (NMFS, 2008).

Figure 3-4. Viability Ratings for the MCR Steelhead, Umatilla/Walla Walla MPG (NMFS, 2008)



Assuming base hydrosystem and recent ocean conditions, the survival gaps for the Umatilla and Walla Walla populations are 0.09 and 0.34, respectively. There is insufficient data to estimate the gap for the Touchet population. The Umatilla population is projected to achieve the 5% extinction risk criteria only under historical ocean conditions. The Walla Walla population, however, fails to meet the 5% extinction risk criteria under all ocean scenarios (NMFS, 2008).

Populations are assigned to a size category based on the total amount of weighted spawning habitat. A complexity rating is given on the estimated relative distribution of historical spawning habitat. The Umatilla population was assigned to a "large" size category, while the Walla Walla and Touchet populations were assigned to an "intermediate" size category. The Umatilla and Walla Walla populations were given a complexity rating of "B," which means that there is a dendritic (branching like a tree) tributary structure including two or more major spawning areas. A minimum threshold abundance for long-term viability of 1500 and a minimum productivity value of 1.26 are required in order for the Umatilla population to achieve a 95% probability of persistence over 100 years. Currently, the 10-year geometric mean abundance is 1472, the abundance range is 592 to 3542, and the 20-year geometric mean productivity is 1.50, with a standard error of 0.15. A minimum threshold abundance for long-term viability of 1000 is also required for the Walla Walla population, but it needs a minimum productivity value of 1.35 to achieve a 95% probability of existence. Currently, the 10-

year geometric mean abundance is 650, the abundance range is 270 to 1746, and the 20-year geometric mean productivity is 1.34, with a standard error of 0.12. There is insufficient data to adequately address the Touchet population (ICBTRT, 2007; NMFS, 2008).

There was sufficient information available to estimate gaps for only two of the three MCR steelhead populations within the Umatilla/Walla Walla MPG. For the Umatilla/Walla Walla MPG to be viable, two populations should meet viability criteria, and one should be highly viable. The Umatilla River is the only large population and, therefore, needs to be viable. Either the Walla Walla or Touchet River population also needs to be viable (NMFS, 2008).

According to NMFS (2008), the abundance and productivity are projected to increase markedly in both populations with sufficient empirical data, and for all scenarios analyzed for the effectiveness of proposed recovery actions outlined in the Oregon Steelhead Recovery Plan (Carmichael, 2008). The largest contribution to performance for MCR steelhead improvements, compared to baseline conditions calculated by ICBTRT (2007) for the period of 1980 through 2001, results from tributary habitat actions, with greatest benefit accruing for the 100-year scenario. Because hatchery-origin steelhead are the same species, benefits would be the same. Spring Chinook would also show similar benefits because of similarities in life history characteristics and physiological requirements.

It should be noted that hatchery-origin steelhead in the basin contribute to the overall steelhead population.

3.4.4.2.2 Distribution and Abundance (Spring Chinook Salmon)

The spring Chinook salmon historically found in the WWRB were part of the MCR Spring-Run ESU. This ESU includes stream-type Chinook salmon spawning in the Klickitat, Deschutes, John Day, and Yakima Rivers. Spring-run populations from the Walla Walla River may have also belonged in this ESU, but this population is now considered extinct (Myers et al., 1998). In 2000, CTUIR began outplanting adult Chinook salmon in the WWRB. Adults were surplus Umatilla-run “Carson” hatchery brood stock. Adults were held at the South Fork Walla Walla CTUIR fish processing facility until August, and then direct stream-released to the South Fork Walla Walla River and Mill Creek (NPCC, 2004a; CTUIR, 2009). These fish are considered part of the ESU, but, since they are fin-clipped at hatcheries to identify them as hatchery-origin fish, are not afforded any protections that may apply to the natural-origin fish in the ESU under the ESA.

3.4.4.2.3 Spawning Surveys (Steelhead)

Without genetic sampling, surveys cannot distinguish between MCR steelhead offspring and hatchery-derived steelhead offspring.

Mendel et al. (2000) calculated the densities and biomass of five salmonid species from electrofishing and snorkeling surveys. Snorkeling provided densities only, based on fish size (age) estimations by the surveyors. Adult rainbow trout densities represent wild or unknown origin trout. Salmonid species included mountain whitefish (*Prosopium williamsoni*), brown trout (*Salmo trutta*), bull trout rainbow trout/steelhead, and Chinook salmon.

Steelhead represent the most common salmonid found in the WWRB. Age 0+ steelhead densities are typically higher than older age classes for most sites on the Washington State side of the basin sampled by Mendel et al. (2000). Young-of-the-year trout were found downstream to RM 27.4 on the Walla Walla River (above Lowden/Gardena Road) during July, but not during August. The large number of age 0+ steelhead found in the Walla Walla River was unexpected, and suggests that spawning is commonly occurring in this river during some years.

Electrofishing-based surveys by Mendel et al. (2000) found densities of steelhead ranging from 0 to 1,289 fish per 100 square meters (1,076.39 square feet) at sampled sites. Subyearling (age 0+) steelhead were the most abundant age class at most sites. Densities and biomass of salmonids were reduced in the mainstem compared to the tributaries, which have lower water temperatures. Biomass of salmonids ranged from 0 to 4,380 grams (9.66 pounds) per 100 square meters (1,076.39 square feet). Steelhead parr (juveniles that have reached a year old) (age 1+) yielded the greatest biomass at most sites.

Snorkeling-based surveys by Mendel et al. (2000) were conducted at sites during different times in the summer to compare salmonid densities and distribution. A general decline in densities occurred between early and late summer. Subyearling steelhead (age 0+) were still the most abundant age class at all occupied sites (Figure 3-5).

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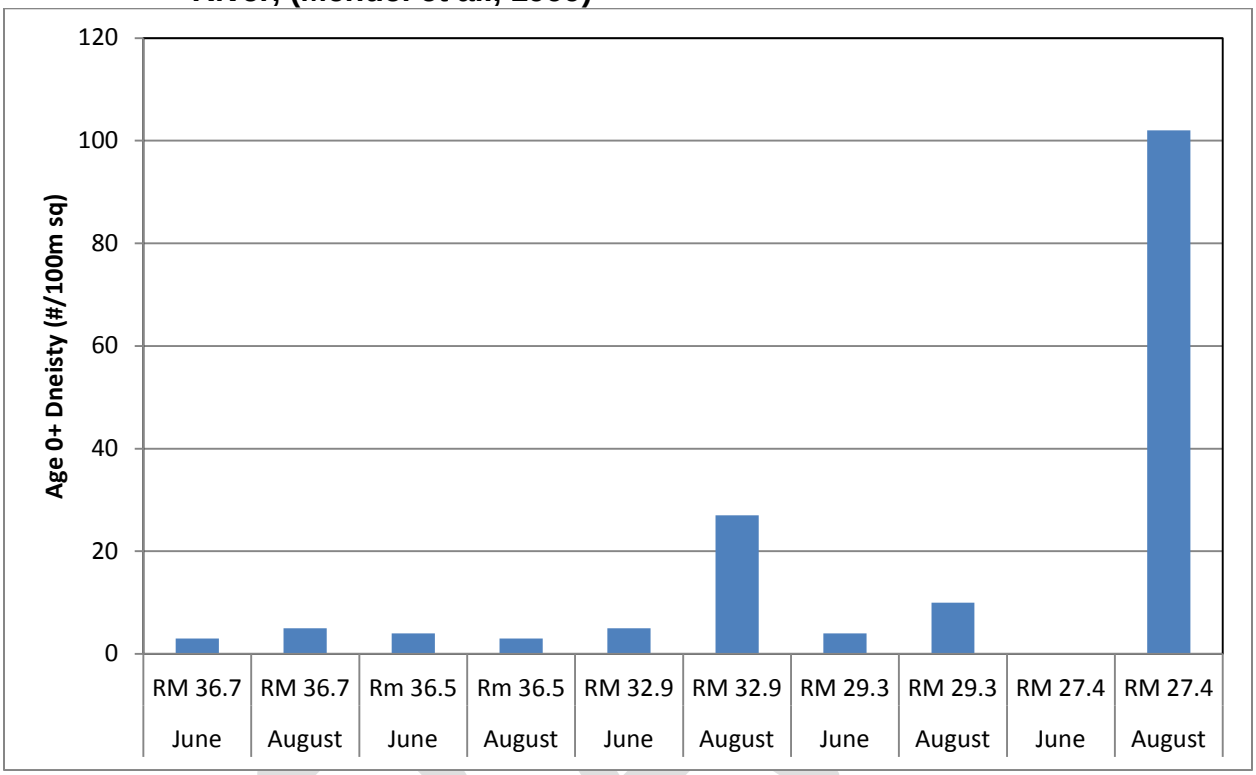
Figure 3-5. Comparison of Age 0+ Rainbow/Steelhead Trout Densities Observed During Snorkeling in Summer Months between Burlingame Diversion (RM 36.7) and Lowden Gardena Bridge (RM 27.4) on the Walla Walla River, (Mendel et al., 1999)



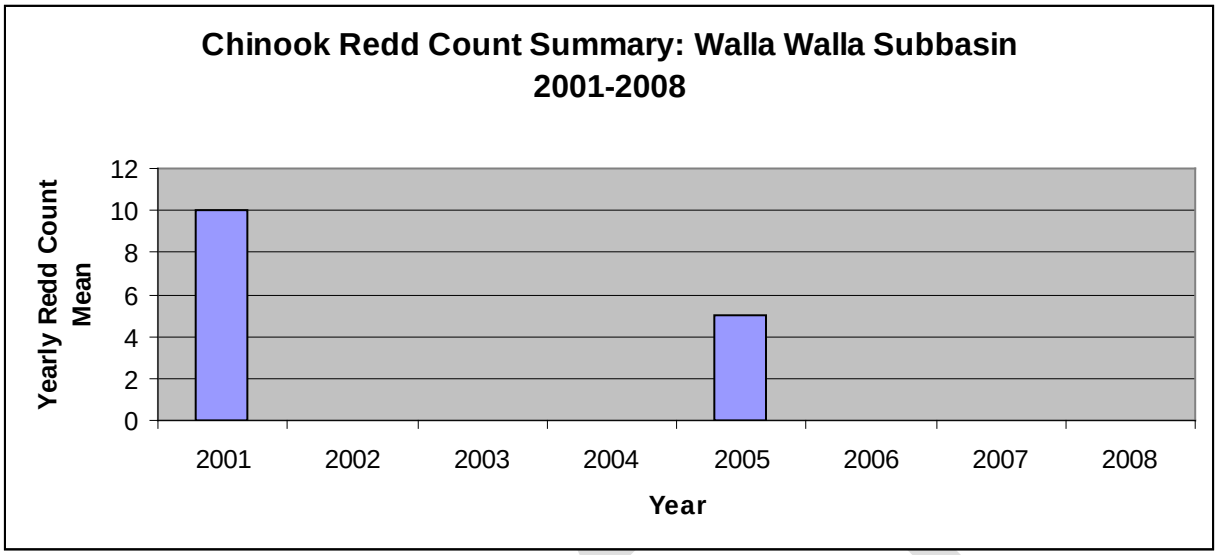
3.4.4.2.4 Spawning Surveys (Spring Chinook salmon)

The CTUIR used traditional spawning ground survey methods to evaluate the spawning of adult outplants (NPCC, 2004b). Table 3-4 and Figure 3-6 show a summary of the StreamNet data from redd surveys for the WWRB from 2001 to 2008 (StreamNet, 2009d).

Table 3-4. Spring Chinook Adult Outplants in the Walla Walla Subbasin 2000 to 2003 (NPCC, 2004)

Year	Females	Adult Males	Jacks	Total
2000	150	76	33	259
2001	641	418	33	1092
2002	190	126	13	329
2003	138	171	4	313

Figure 3-6. Chinook Salmon Redd Summary for the WWRB (StreamNet, 2009d)



3.4.4.3 Fish Population Status and Goals

3.4.4.3.1 Middle Columbia River Steelhead

MCR steelhead were listed as threatened under the ESA on March 25, 1999 [64 CFR 14517], and confirmed as threatened on January 5, 2006 (71 CFR 834). Protective regulations for Middle Columbia River steelhead were issued under section 4(d) of the ESA on June 28, 2005 (70 CFR 37160). The spawning range of the MCR steelhead DPS extends over an area of approximately 35,000 square miles (56,327 square kilometers) in the Columbia Plateau of eastern Washington and eastern Oregon. The DPS include all naturally-spawning populations of steelhead in streams within the Columbia River Basin from above the Wind River in Washington and the Hood River in Oregon (exclusive) upstream to, and including, the Yakima River in Washington, and excluding steelhead from the Snake River Basin (64 CFR 14517, March 25, 1999).

The major tributaries occupied by this species are the Deschutes, John Day, Klickitat, Umatilla, Walla Walla, and Yakima River systems. The John Day River represents the largest naturally spawning, native stock of steelhead in the region. These salmonids exhibit a complex life history, and can be either anadromous (migratory) or freshwater residents. Under some circumstances, steelhead apparently yield offspring of the opposite form. The MCR steelhead DPS, as defined, does not include the resident form of *O. mykiss* (rainbow trout) co-occurring with these steelhead.

The NMFS MCR steelhead recovery plan (2008) lists the following as a summary of the MPG recovery strategy. Natural steelhead production from the three populations in this MPG are projected to benefit from the combined effects of improved tributary habitats and enhanced survival through the migration corridor connecting upper tributary rearing habitats with the ocean. Tributary restoration strategies in these three populations put a high priority on building out from existing reaches of relatively good spawning and

rearing habitat in the upper ends of major tributaries. The downriver tributary reaches targeted for restoration include a substantial amount of habitat projected to have historically supported steelhead production. Increased water temperatures during summer rearing periods, increased fine sediment levels, and loss of natural stream structure all limit survival and capacity for summer rearing and overwintering in these reaches.

An important element of the restoration strategy for each population in this MPG is to increase survivals during the smolt outmigration phase through improvements to the spring flow and temperature regimes in the tributary mainstems and the Columbia River. Actions proposed in the recovery plans are designed to build upon the flow and passage improvements that have been gained in recent years. Hatchery programs designed to boost natural recovery efforts and to provide fish for harvest operate within each of the populations. The recovery plan includes strategies designed to limit long-term risks to natural production by controlling the distribution and level of hatchery contributions within each population

Until 2001, steelhead were the only anadromous salmonid that spawned in the Walla Walla River system. Some spring Chinook salmon spawned in 2004, representing the returns from the adult outplanting done by CTUIR in 2000. Natural production of steelhead in the Walla Walla River occurs throughout the system.

3.4.4.3.2 Spring Chinook Salmon

Historically, spring Chinook, coho, and chum salmon all utilized the WWRB. Natural production of spring Chinook salmon occurred in the middle and upper mainstem and its tributaries. Because spring Chinook salmon, and the MCR spring-run Chinook salmon ESU, were extirpated from the system in the early 1920s, prior to the collection of detailed records, accurate data on the extent of the natural production is lacking. Information on chum and coho spawning locations and numbers is also lacking.

The subbasin planners' (CTUIR et al., 1990) recommended objective for the spring Chinook salmon return is 5,000 adults, of which 2,000 would spawn naturally and 2,500 would be harvested. The summer steelhead objective is for a return of 11,000, of which 3,000 would be naturally produced and 7,680 would be harvested. Objectives for chum and coho were not established by the subbasin planners.

The Hatchery Scientific Review Group (HSRG) used a rating system similar to that used by recovery planners for the lower Columbia and Willamette Rivers for the CTUIR reintroduction plan. The plan resulted in a population designation of "Primary." The current viability rating is extirpated; the recovery goal for abundance is unknown; and productivity improvement expectation is 1.2 to 1.3. NMFS (2008) defines productivity as the average number of surviving offspring per parent. Productivity is used as an indicator of a population's ability to sustain itself or its ability to rebound from low numbers. The terms "population growth rate" and "population productivity" are interchangeable when referring to measures of population production over an entire life

cycle. Productivity can be expressed as the number of recruits (adults) per spawner or the number of smolts per spawner. Habitat productivity and capacity (from EDT) is productivity, 3.0; and capacity, 443 (HSRG, 2009).

According to HSRG, benchmarks for proportionate natural influence (PNI) and proportion of effective hatchery-origin spawners (pHOS), as defined by HSRG (2009), are not currently attainable. Under current habitat conditions, the size of an integrated hatchery program is limited to about 100,000 smolts if standards for a "Primary" population are to be met and 200,000 smolts if standards for a "Contributing" population are to be met. The Walla Walla population has no genetic legacy and, therefore, HSRG suggests that managers may want to consider it a "Contributing" or even a "Stabilizing" population. Habitat improvements must be implemented prior to achievement of a naturally sustainable population (HSRG, 2009).

3.4.4.4 Problems Impacting Anadromous Fish Resources

Although problems associated with gravel mining, diking, and forest and grazing practices exist, the most significant habitat impacts in the Walla Walla River system are associated with the extensive network of irrigation diversions (CTUIR et al., 1990). Numerous passage problems for both adults and juveniles exist throughout the basin. The subbasin plan recommends that the passage problems be corrected (CTUIR et al., 1990). Three areas that affect fish in the basin, 1) passage obstructions; 2) fish screens; and 3) areas of the stream that seasonally go dry, were identified by NPCC (2004a) and CRITFC (1995).

In addition to habitat problems, the WWRB has received little or no mitigation for losses incurred. The steelhead program in Washington State is directed more at providing harvest opportunities than restoring natural spawning populations.

The outplanting of spring Chinook salmon (as well as summer steelhead), even with the potential repopulation of the area with a previously extirpated species, has the potential to cause problems with other fish species. Competition for food and space between these fish, MCR steelhead, and bull trout exists where none has existed for many decades.

According to NMFS, climate change is likely to have negative implications for the conservation value of designated critical habitats in the Pacific Northwest [Climate Impacts Group (CIG), 2004; Scheuerell and Williams, 2005; Zabel et al., 2006; and Independent Scientific Advisory Board (ISAB), 2007].

The ISAB (2007) also identified the likely effects of projected climate changes on Columbia Basin salmon. These long-term effects may include, but are not limited to, depletion of cold water habitat, variation in quality and quantity of tributary rearing habitat, alterations to migration patterns, accelerated embryo development, premature emergence of fry, and increased competition among species.

To mitigate for the effects of climate change on listed salmonids, the ISAB (2007) recommended planning now for future climate conditions by implementing protective tributary, mainstem, and estuarine habitat measures; as well as protective hydropower mitigation measures. In particular, the ISAB (2007) suggests increased summer flow augmentation from cool/cold storage reservoirs to reduce water temperatures or to create cool water refugia in mainstem reservoirs and the estuary; the protection and restoration of riparian buffers, wetlands, and floodplains; removal of stream barriers; implementation of fish ladders; and assurance of high summer and autumn flows (NMFS, 2008).

Climate change predictions were made on a gross scale for the entire Pacific Northwest, the data based on 'averaging' multiple greenhouse gas emission scenarios as well as using multiple Global Climate Change models (GCM) outputs. The predictions are meant to be a general indicator of climate impacts in the future. Each watershed will have significant variability in the amount of temperature and precipitation changes due to topography and local weather patterns. The numeric predictions for change in the greater Columbia Basin were not used in the stream temperature analysis due to the spatial scale in which they were modeled.

3.4.4.5 Related Actions in the WWRB

As part of the Lower Snake River Fish and Wildlife Compensation Plan, a steelhead acclimation and release program exists in the Touchet River, Mill Creek, and the mainstem Walla Walla River. The fish are reared at Lyons Ferry Hatchery, located near the mouth of the Palouse River. In 2000, prespawner releases of Carson stock spring Chinook salmon began. Until that time, hatchery production of spring Chinook salmon did not exist in the WWRB. Coho and chum hatchery production still does not exist. Rearing and release programs for these stocks have not been planned under any of the past mitigation programs [i.e., Mitchell Act or Lower Snake River Fish and Wildlife Compensation Plan (LSRFWCP)].

The CTUIR have implemented restoration efforts for spring Chinook salmon in the Walla Walla River system. The tribe is currently developing a spring Chinook salmon program under the Northeast Oregon Hatchery Plan. A spring Chinook salmon rearing/adult holding and spawning facility site exists on the South Fork Walla Walla River, and CTUIR is proposing to expand this facility to a full-scale hatchery in order to produce spring Chinook salmon for release into the river (CTUIR, 2009).

Surplus adult spring Chinook salmon were first released into the Walla Walla River by CTUIR and ODFW in 2000 to begin reintroduction of the species, as well as conduct monitoring to track success and guide future fish management. In 2004, almost 300 adults returned as a result of the outplanting in the WWRB. These were the first Chinook salmon to return to the basin in 80 years. In 2005, CTUIR released 250,000 Chinook salmon smolts (CTUIR, 2009).

The BPA and CTUIR are working together on a variety of plans and projects in the WWRB, including the implementation of a diversion structure removal program, irrigation canal screening, consolidation, and conservation of irrigation ditches, enhancement of instream flows and stream habitat, and hatchery actions.

Fish passage improvements have included the removal of Marie Dorian Dam on the upper mainstem Walla Walla River and Maiden Dam on the lower Touchet River. New fish ladders and screens at the Burlingame and Little Walla Walla diversions have recently been completed, and plans for modifications to the ladder at Nursery Bridge Dam are being developed.A passage project which included a new fishway, screening, and ditch piping was completed at Hofer Dam on the Touchet River. The BPA has provided most of the funding for passage. Additionally, numerous stream channel and riparian habitat improvement efforts are being implemented by state fish and wildlife agencies, local conservation districts, the WWBWC, and the CTUIR. Efforts are also being made to reduce soil erosion and sediment yield from farmed land (CTUIR, 2009).

3.4.4.6 Existing Artificial Production Actions for the WWRB by BPA and CTUIR

The LSRFWCP is a complex program to compensate for the loss of fish in Washington due to the construction and operation of the hydropower system. The program was initiated in response to the Water Resources Development Act of 1976, which Congress adopted to mitigate for the construction of the four Federal dams on the lower Snake River. The fisheries mitigation provisions of the act have evolved into a highly complex program involving several co-managers. The program is described in three parts. The first part is for the overall program at Lyons Ferry, and Washington's Lower Snake River Compensation Plan Hatchery Evaluation Program. The second part describes the Tucannon River portion of the program, and the third part describes the Walla Walla River portion [Independent Scientific Review Panel (ISRP), 2001].

- *Spring Chinook Salmon*. Spring Chinook salmon are produced in two programs of the Tucannon Basin: LSRFWCP supplementation and a BPA-funded captive broodstock project (Project #200001900). Supplementation fish are produced by trapping about 100 adult spring Chinook salmon from the Tucannon River at the Tucannon Fish Hatchery and hauled to Lyons Ferry Hatchery, where they are spawned and their progeny are reared for 1 year. The fish are then marked and transported back to Tucannon Fish Hatchery for rearing and release.

  The program includes monitoring and evaluation of adult run size to the Tucannon River, trapping and using only brood fish that will help maintain the genetic integrity of the population (excluding strays), estimating juvenile survivals by age-class, abundance of migrating smolts, smolt size, and comparative performance of supplementation production with captive broodstock production (BPA Project #200001900). The results were not included in the proposal, but should be summarized in the response.

- *Fall Chinook Salmon*. Monitoring of fall Chinook salmon includes counts of adults in the Tucannon River. Carcass surplus and coded-wire tags help to document the origin of spawners, and smolts are counted in the lower river. The results were not included in the proposal, but should be summarized in the response.

- *Summer Steelhead*. The proposal reported that numeric goals for returning adult summer steelhead were not included in the LSRFWCP, but steelhead are reared and released in the Tucannon River to provide harvest opportunity. Later in the proposal, however, it was required that the overall program attempts to return 4,656 steelhead adults to the Snake River in Washington. The response should clarify the the program goals for steelhead.

  The possibility of reducing the number of steelhead released and developing a locally-adapted broodstock were discussed in the proposal as a means to help prevent harmful interaction of hatchery steelhead with ESA-listed species. Project personnel have concluded that releasing steelhead in lower river areas may keep them away from spring Chinook salmon and natural steelhead rearing areas, while providing opportunity for harvest. Cessation of the release of fish that could be causing further jeopardy was not included or discussed as an option. This option should be addressed in the response.

3.4.4.6.1 Natural Brood Summer Steelhead Program

Goals include:

- Begin a natural brood summer steelhead program of 100,000 yearling smolts into the South Fork Walla Walla River. This program was also identified in the Northeast Oregon Hatchery Plan.
- Releases would occur directly from the South Fork Walla Walla River hatchery facility.
- Phase out the use of non-native stocks in the existing Washington State summer steelhead program. Replace with natural brood, as available through the Northeast Oregon Hatchery Plan.
- These production actions should proceed concurrently with passage improvement projects identified in the habitat recommendations section.
- Evaluate coho and chum current production potential in the subbasin for re-establishment of species.
- Discontinue all catchable trout programs in areas where they may affect anadromous salmonid restoration activities.
- A program to restore lamprey populations, utilizing either transplantation or artificial propagation, should be developed under the overall leadership of the affected tribes.
- Monitor and evaluate all artificial production actions. Use adaptive management to determine whether program changes (i.e., release number, size, time, location, and/or life history) are needed in order to meet restoration objectives.

3.4.4.6.2 Spring Chinook Salmon Reestablishment Program

Goals include:

- Begin a spring Chinook salmon reestablishment program of 600,000 yearling smolts, using Carson stock spring Chinook salmon to take place in both the South Fork Walla Walla and Touchet Rivers. This program was identified in the Northeast Oregon Hatchery Plan.
- Further expand proposed South Fork Walla Walla River hatchery facility to accommodate this production requirement.
- Releases into the South Fork Walla Walla River would occur directly from the facility.
- Develop adult capture facilities in the WWRB to support future broodstock collection. Adults would be held and spawned at the South Fork WWR hatchery facility.

3.4.5 Non-Anadromous Fish

Not all native salmonids in the basin are anadromous. Mountain whitefish, bull trout, and rainbow/redband trout exist within the WWRB. However, only rainbow/redband trout retain a wide distribution throughout the watershed. Bull trout are a species of char and, in the past, are thought to have been widely distributed in the WWRB. Bull trout distribution is generally of a resident (fluvial) life history; and is limited to montane upper tributaries of the Touchet River, Walla Walla River, and Mill Creek (Mongillo, 1993). Bull trout are known to migrate into the middle or lower reaches of these rivers during the winter months. Many factors have led to the decline of bull trout in southeast Washington. Decreased water flows, damaged riparian vegetation, and increased sedimentation have contributed to elevated water temperatures beyond the tolerance of this colder water species (Mongillo, 1993). Introduced fish species may also have increased competition or predation for bull trout.

Several non-native fish species have been introduced to support recreational fishing, or have strayed into basin streams (Table 3-5). The Washington Department of Game (now WDFW) began stocking brown trout in the Touchet River in the 1960s. Stocking was discontinued in 1999 due to concerns about competition, hybridization, and predation with native bull trout and steelhead. Carp (*Cyprinus carpio*) were introduced as early as 1884 (Walla Walla Daily Journal, 1884). Channel catfish (*Ictalurus punctatus*), smallmouth bass (*Micropterus dolomieui*), and bluegill (*Lepomis macrochirus*) are some of the fish species that now occur in the lower reaches of the basin. In 1998, WDFW found tadpole madtoms (*Noturus gyrinus*) in the lower Walla Walla River. The tadpole madtom is a small catfish indigenous to some Atlantic “Ocean and Gulf of Mexico drainages. They were first collected in the Snake River in 1942,

possibly introduced with a shipment of channel or bullhead catfish (*Ictalurus* spp.) (Wydoski and Whitney, 1979). In 1999, WDFW discovered three-spine stickleback (*Gasterosteus aculeatus*) in the Walla Walla River, a fish found primarily in California and Europe.

Table 3-5. Non-Native Species in the WWRB (HUC 17070102)

Group	Family	Scientific Name	Common Name	Native Habitat	Native Transplant
Fishes	Centrarchidae	*Lepomis macrochirus*	bluegill	Freshwater	Native Transplant
Fishes	Centrarchidae	*Micropterus dolomieu*	smallmouth bass	Freshwater	Native Transplant
Fishes	Centrarchidae	*Micropterus salmoides*	largemouth bass	Freshwater	Native Transplant
Fishes	Centrarchidae	*Pomoxis nigromaculatus*	black crappie	Freshwater	Native Transplant
Fishes	Cyprinidae	*Cyprinus carpio*	common carp	Freshwater	Exotic
Fishes	Ictaluridae	*Ameiurus melas*	black bullhead	Freshwater	Native Transplant
Fishes	Ictaluridae	*Ameiurus natalis*	yellow bullhead	Freshwater	Native Transplant
Fishes	Ictaluridae	*Ameiurus nebulosus*	brown bullhead	Freshwater	Native Transplant
Fishes	Ictaluridae	*Ictalurus punctatus*	channel catfish	Freshwater	Native Transplant
Fishes	Ictaluridae	*Noturus gyrinus*	tadpole madtom	Freshwater	Native Transplant
Fishes	Percidae	*Perca flavescens*	yellow perch	Freshwater	Native Transplant
Fishes	Salmonidae	*Salmo trutta*	brown trout	Freshwater -Marine	Exotic
Mollusks-Bivalves	Corbiculidae	*Corbicula fluminea*	Asian clam	Freshwater	Exotic
Plants	Iridaceae	*Iris pseudacorus*	yellow iris	Freshwater	Exotic

In 1998, the Columbia River bull trout DPS in the Walla Walla River and its tributaries were listed as Threatened under the ESA (63 CFR 31647). The WDFW began a 5-year study in 1998 to assess salmonid distribution, relative abundance, genetics, and condition of salmonid lifestage habitats in the WWRB.

Bull trout exhibit four distinct life history patterns: anadromous, adfluvial, fluvial, and resident. Anadromous populations spend the early portion of their life in streams, grow to adulthood in the ocean, and eventually return to the tributaries in which they were born to spawn. Adfluvial populations spend between one and four years growing in their natal stream and then migrate to lakes. Fluvial populations spend about the same

amount of time in their natal streams as their adfluvial siblings but migrate to larger rivers and streams instead of lakes (Fish, 2004). Resident bull trout remain in the stream where they were spawned.

Bull trout adult migration generally occurs between 10°C (50°F) and 12°C (53.6°F), and juvenile migration generally occurs under 12°C (53.6°F). Temperatures typically allow for migration in early May, but temperatures start to rise rapidly after the first part of the May to the point of becoming a temperature-related migration barrier by June.

After 1 to 4 years in their natal stream, migratory smolt populations will travel downstream to the coast, a large river, or lake (depending on specific life history) to recruit to the adult stage. Adult individuals achieve sexual maturity at between four and seven years of age. Spawning is usually biennial, occurring only every other year or sometimes every three years, at which point the sexually mature adults fight the current back to the specific headwater in which they were produced to spawn. Several studies have shown a strong preference for spawning in small streams as opposed to larger rivers; although McPhail (1996) suggests that this may be the result of sampling biases, due to the difficulty of sampling large swift rivers (Fish, 2004).

Spawning begins when water temperatures drop below 9°C (48.2°F), typically 5°C (41°F) to 9°C (48.2°F). Spawning typically occurs in August and September, although in recent years warm water has been persisting increasingly further into the year and effectively delaying the spawn (Baxter et al., 1997). As with many salmonids, bull trout exhibit varying degrees of sexual dimorphism, or differences in appearance between males and females of the same species. Females do not exhibit significant changes during the spawn, but the males will develop bright red or orange sides and a kype (hooking of the lower jaw), although these distinctions vary from population to population (Fish, 2004).

Bull trout are brood hiders, which means that their reproductive strategy is to hide their young from potential predators in the substrate instead of defending or protecting the young inside the mouth (mouth brooders) (Breder, 1966). Once spawning commences the females will focus all of their time and energy into digging redds in the loose gravel substrate into which they will deposit their eggs. Bull trout prefer small gravel, usually digging their redds in areas dominated by substrate particles less than 20mm in diameter. Redds can range in water depth from 10cm to over a meter, and range in size from less than a meter (3028 feet) in diameter to over 2 meters (6.56 feet) (McPhail and Baxter, 1996).

Spawning seems to cease when water temperatures drop to about 5°C (41°F) (Allen, 1987). Unlike salmon species, and like steelhead, bull trout have iteroparity (the ability to spawn multiple times), so after spawning the adults will drift back downstream to their winter homes. Spawning is thought to occur biannually due to the fact that the fish survive spawning and need a year or so to recover afterwards (Fish, 2004).

Stream flow, stream temperature, and water quality conditions for non-anadromous species are the same as those presented for anadromous species.

3.4.5.1 Limiting Factors

Many of the limiting factors affecting anadromous fish species (see section 3.4.4.1) also affect non-anadromous fish. Historical land uses affecting bull trout habitat in the WWRB include forest management, livestock grazing, irrigated agriculture, urbanization, and flood control management. Liberal harvest regulations and fish stocking programs have also been implicated in the decline of bull trout. Existing land management facilities and activities that contribute to fish habitat problems include riparian road and railroad construction and use and associated toxic spills, riparian grazing, riparian (and to a lesser extent, upland) timber harvest, recreational and municipal water developments and withdrawals, recreational use of riparian areas, livestock water developments, channel modification for flood control, agricultural development, and competition with stocked hatchery rainbow trout (USFWS, 2002).

Many actions identified for bull trout recovery will overlap with recovery objectives for anadromous fish species (USFWS, 2002)

3.4.5.2 Non-Anadromous Fish Stock

3.4.5.2.1 Distribution and Abundance (Bull Trout)

According to USFWS (2002), Bull Trout are distributed among six or more local populations in the recovery unit, three in the Umatilla Core Area, and three or more in the Walla Walla Core Area. In a recovered condition Walla Walla Core Area local populations would include the upper Walla Walla River, Mill Creek, and the Touchet River.

Estimated abundance of adult bull trout (as of 2002) is a range between 3,500 and 10,000 individuals in the recovery unit distributed in each core area as follows: Umatilla Core Area from 500 to 5,000; Walla Walla Core Area from 3,000 to 5,000 (USFWS 2002).

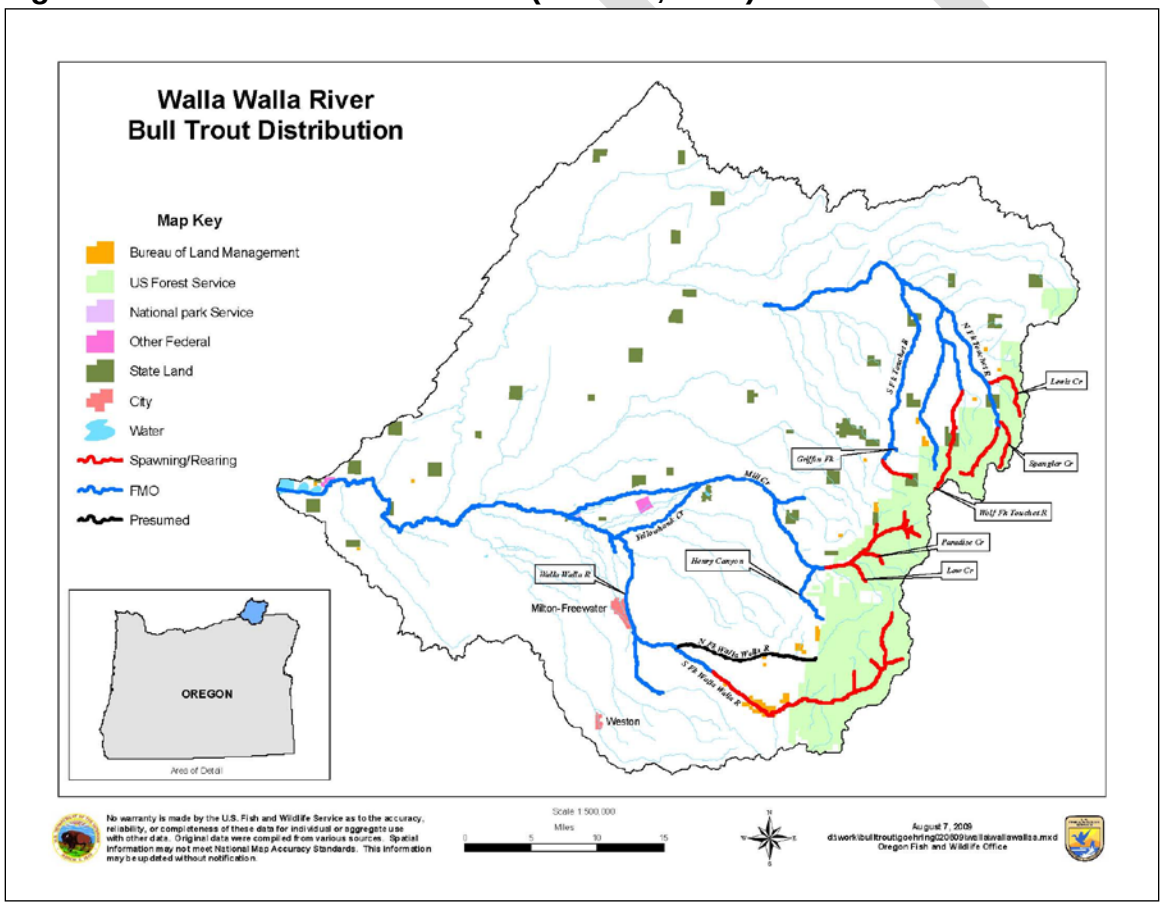
Adult bull trout exhibit a stable or increasing trend in abundance for at least two generations at or above the recovered abundance level within the recovery unit. Recovery criterion achievement would be based at least 10 years of monitoring data.

For purposes of recovery planning, the recovery unit team has identified three local populations: 1) Upper Walla Walla Complex, which includes the North and South Forks of the Walla Walla River; 2) Mill Creek and tributaries; and 3) the Touchet River and tributaries. Other tributary streams where bull trout may occur, but where their presence/absence has yet to be confirmed, include Cottonwood Creek (mainstem Walla Walla tributary), Little Meadows Canyon and Big Meadows Canyon (North Fork Walla Walla River tributaries).

The USFWS (2002) showed that bull trout spawn mainly in the South Fork Walla Walla River between Table Creek and the second major tributary above Reser Creek (River Kilometer 23.6 to 33.9, RM 15 to 22), the lower 1.6 kilometers (7 miles) of Skiphorton,

and the lower 0.8 kilometer (0.5 mile) of Reser Creek. The majority of spawning fish are found above Bear Creek (ODFW *in litt*., 1999c). From 1992 to 2000, bull trout have been captured annually in a screen bypass trap on the South Fork Walla Walla River, approximately 3 kilometers (2 miles) upstream of the forks. The largest number of bull trout captured was 211, in 1992 (USFWS, 2002). Figure 3-7 illustrates current USFWS information for bull trout distribution. The figure also shows spawning/rearing, foraging, migrating, and overwintering (FMO), as well as presumed presence (USFWS, 2009). Use by subadult and juvenile bull trout in the North Fork Walla Walla River has been observed; as has adult fish use during winter and spring months. Ten redds were observed during October 2000 (T. Johnson, OWRD, personal communication, 2001a). Some bull trout were captured in a screen bypass trap on the North Fork Walla Walla River located approximately 6.4 kilometers (4 miles) upstream of the forks between 1990 and 1992 (Confederated Tribes of the Umatilla Indian Reservation (CTUIR, *in litt*., 2001). Bull trout distribution and use of the North Fork Walla Walla River needs further investigation.

Figure 3-7. Bull Trout Distribution (USFWS, 2009)



The mainstem Walla Walla River, from the forks downstream to Cemetery Bridge in Milton-Freewater, provides year round subadult rearing habitat. From this reach downstream to the confluence with the Columbia River the habitat is considered overwintering and migration, although bull trout use-data are limited.

The ODFW screen bypass capture data from 1992 through 2000 show bull trout were captured at both the Eastside and Little Walla Walla diversions during the irrigation season (April to October) (B. Kilgore *in litt.,* 2001). During fish distribution surveys conducted in the summer of 1998 in the Walla Walla River mainstem in Washington and in Yellowhawk Creek, bull trout were not encountered (Mendel *et al*. 1999). However, one bull trout adult was found in June 1999 below Burlingame Dam and in May 2000, an adult bull trout [approximately 34 kilometers (21 miles) in length] was observed in the mainstem Walla Walla River at McDonald Bridge (southeast of Lowden) moving upstream in 12°C (59°F) water and streamflow of about 124 cfs (G. Mendel, personal communication, 2000).

Martin *et al*. (1992) measured juvenile densities in Mill Creek and Wolf Fork Touchet River by electroshocking, with results showing juvenile densities of 5.2 fish per 100 square meters (119.6 square yards) in Mill Creek and 1.9 fish per 100 square meters (119.6 square yards) in Wolf Fork Touchet River (USFWS, 2002).

In 1999, bull trout were only found on the North Fork, South Fork, Robinson Fork, Lewis Creek, and Wolf Forks of the Touchet River by Mendel et al. (2000). Bull trout distribution was generally isolated to the North Fork and the Wolf Fork of the Touchet River, as only one individual bull trout was observed in each of the other tributaries listed above. Mountain whitefish were only found in low densities at a few sites; one site in the Walla Walla River and 3 sites in the Touchet River. Brown trout were found in low densities (but included some very large individuals) in the mainstem Touchet River downstream of Dayton, Washington and upstream into the major tributaries. Qualitative electrofishing produced five large adult brown trout (up to 4-6 lbs each), but very few juveniles were collected. Brown trout were not stocked in 1999 for the first time in many years because of ESA concerns for listed steelhead and bull trout.

Budy et al. (2007) provide bull trout population estimates by three size classes: greater than 120 mm, greater than 220 mm, and greater than 370 mm. Over the five-year period from 2002-2006 bull trout abundance in the South Fork Walla Walla River for the >120 mm group ranged from 7,287 in 2002 to 10,600 in 2006; >220 ranged from 2,700 in 2002 to 2,056 in 2006; >370 estimate was 1,113 in 2006 which was similar to the 2005 estimate. Budy et al. (2007) also estimated survival rates and noted that survival has varied substantially since 2002. The abundance of the migratory component of the South Fork Walla Walla River is declining, based on mark-recapture from 2002-2006 (Budy et al., 2007). The mark-recapture method is used to estimate population size by capturing live individuals,

fish in this case, marking them with a numbered tag or some other unique device to identify that particular fish, and then releasing them unharmed. The fish may then be recaptured during subsequent captures. The data gathered will generate "capture histories," which can be mathematically analyzed to estimate population size, movement, or survival.

Anglin et al. (2008) provided an update of work conducted up to the 2007 sampling season. South Fork Walla Walla River migratory bull trout redd counts were similar to the 2006 count at 128, but considered relatively low when compared across information from 1994 to 2007. Sampling (all capture methods) in Mill Creek and the mainstem Walla Walla River resulted in 110 bull trout captures; 37 adults, and 73 subadults in 2007 (Anglin et al., 2008).

In 2009, thirteen bull trout that had been passive integrated transponder (PIT) tagged were detected at the Oasis Road Bridge PIT detection array during the year (Figure 3-7); twelve were detected moving downstream in the Walla Walla River toward the Columbia River from November through February, and one was detected moving upstream in the Walla Walla River past the array in June [Anglin et al. 2009b]. It is presumed that fish moving downstream past the Oasis road bridge PIT array were entering the Columbia River (Anglin et al. 2009).

3.4.5.2.2 Distribution and Abundance (Other)

Speckled dace (*Rhinichthys osculus*) and sculpins (*Cottus* spp.) were the most common non-salmonids found at most of the WDFW sample sites (Mendel et al., 2000). Speckled dace generally did not exist at upper sites where water temperatures were relatively cold. Torrent sculpin (*Cottus rhotheus*) distribution was limited and these fish were usually in low abundance. Mendel et al. (2000) observed large numbers of bridge-lip suckers (*Catostomus columbianus*) spawning in Coppei Creek, but later found very low densities of juvenile suckers during electrofishing surveys. Tailed frog tadpoles (*Rana* spp.) were found only in upper sites in cold water, and appeared to be associated with bull trout distribution.

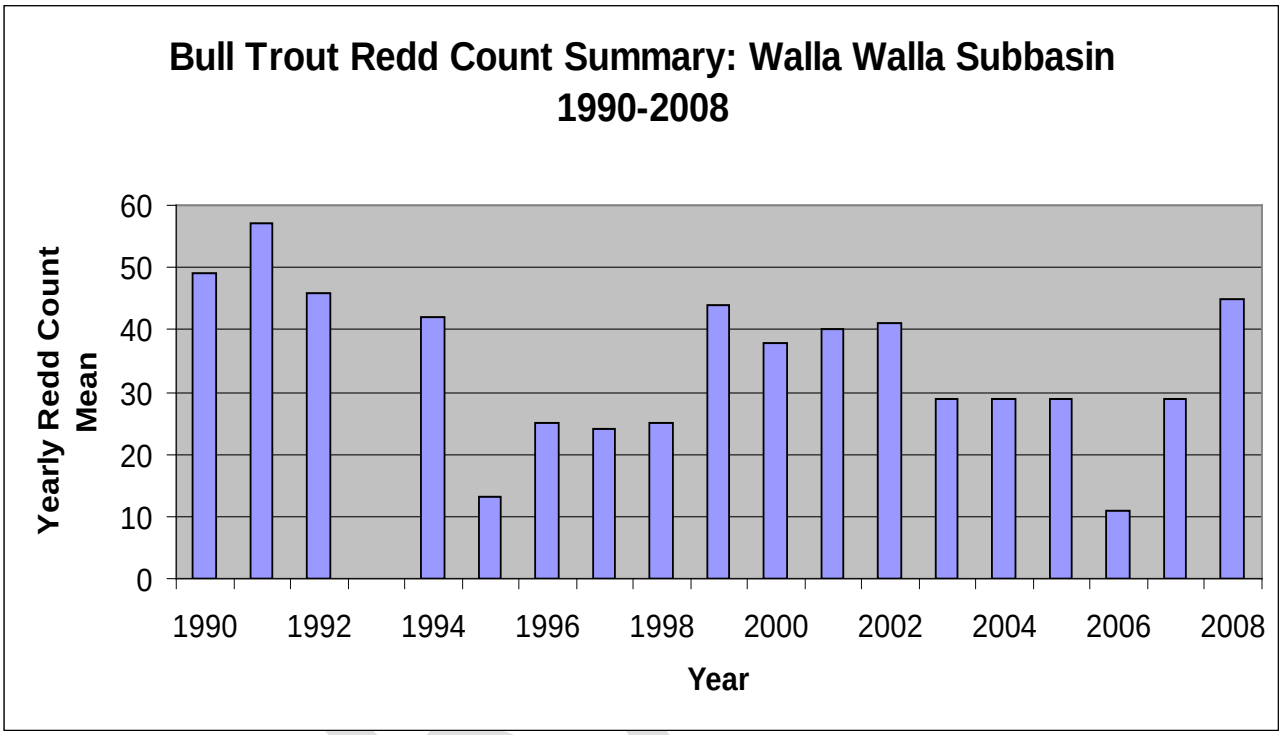
3.4.5.3 Spawning Surveys

Spawning in Mill Creek has been documented upstream of the Umatilla National Forest boundary. Spawning surveys from 1998 to 2002 from the City of Walla Walla intake dam upstream documented bull trout spawning in the mainstem and tributaries upstream of Low Creek, with Low Creek accounting for the highest redd densities (10 per kilometer or 6 per mile) in spawning tributaries. The mainstem Mill Creek between North Fork Mill Creek and Deadman Creek had the highest densities of bull trout redds (15 per kilometer or 9 per mile) (USFWS, 2002).

Bull trout spawning surveys have been conducted in the Touchet River and select tributaries for a number of years (Mendel et al. 2007). Counts in the North Fork Touchet River and Wolf Fork Touchet River appear to be declining as of 2006, with counts on

the Wolf Fork totaling 37 redds and nine live fish, and nine redds and three live fish in the North Fork Touchet River. According to Mendel et al. (2007) this was the lowest total red count since 1998 on the Wolf Fork, and represented five years of red counts below 30, and the first count below ten since surveys began in 1993. Figure 3-8 illustrates a summary of bull trout redd counts in the WWRB.

Figure 3-8. Bull Trout Redd Summary for the WWRB (StreamNet, 2009d)



3.4.5.4 Fish Population Status and Goals

The USFWS issued a final rule listing the Columbia River population of bull trout as a threatened species on June 10, 1998 (63 CFR 31647). Bull trout are currently listed throughout their range in the continuous United States as a threatened species. Bull trout critical habitat was designated in 2005. In the final listing rule (63 CFR 31647) two bull trout subpopulations in the Umatilla River Basin were identified (Meacham Creek and the North Fork-South Fork Umatilla River), and three subpopulations were identified in the WWRB (South-North Fork Walla Walla River, Mill Creek, and Touchet River) (USFWS, 2002).

3.4.5.5 Problems Impacting Non-Anadromous Fish Resources

Barriers to bull trout movement in the WWRB limit opportunities for passage within each core area which would ensure opportunities for genetic exchange among local populations within each core area. In the Umatilla Core Area actions to address thermal and low flow barriers in the mainstem need to be addressed. In the Walla Walla Core Area this means providing suitable habitat conditions downstream of Nursery Bridge on

the mainstem Walla Walla River, ensuring the ladder at Nursery Bridge will successfully pass bull trout, and screening diversions that impact bull trout need to be addressed (USFWS, 2002).

3.4.6 Related Actions in the WWRB

The Corps is currently monitoring fish passage at Mill Creek, and at the passage facilities at the Columbia and Snake River dams. The WDFW, ODFW, and CTUIR, as well as other state, regional, and local agencies all have various monitoring programs in the WWRB. The USFWS is also tagging bull trout below the Oasis Road Bridge.

3.4.7 Aquatic Resources - Future Without Project Conditions

Numerous historic land use practices (e.g., over-allocation of water and passage barriers) have resulted in degraded conditions in the Walla Walla River system. Current conditions limit the river's ability to establish proper functioning conditions for habitat creation and prevent the full support of critical life stages for all species currently using the Walla Walla River. Without this project, it is likely that these conditions will persist negatively in the foreseeable future.

The establishment of increased flows to provide habitat connectivity and minimum instream flows is unlikely to occur under without project conditions. The establishment of viable habitat and support for all life stages of fishes is also highly unlikely without flow improvement. Additionally, without increased flows in the Walla Walla River, it is not likely that other ongoing efforts in the basin will improve water temperatures to a point where they do not exceed 72°F (22°C) for more than 4 days. In order to evaluate both existing conditions and potential biological benefits for the project, upper temperature thresholds must be identified for specific life history events for MCR steelhead, spring Chinook salmon, and bull trout in the Walla Walla River. These temperatures were identified through extensive literature review, and are specific to the Walla Walla River. They represent reasonable thresholds, and were used for analytical purposes.

Hours of upper tolerable temperature exceedances in the Walla Walla River, based on average hourly temperatures during the proposed project operational period (June 1 through November 30) were calculated for each species at each gage for each life history event identified in Table 3-6. An hourly analysis shows how much time fish are actually exposed to harmful temperatures, as well as a more accurate picture of periods when salmonids and bull trout can recover from high temperatures. Examples of thermal exceedances, by life history stage and species, are shown for four stream gages on the Walla Walla River (32A100, 32A105, 32A120, and 14018500) in Tables 3-7 through 3-10. Tables 3-11 through 3-14 depict the percentage of operational period currently exceeding life history for without project conditions at each gage. More details can be found in Appendix H, *Biological Benefits Analysis*.

Low flows in the Walla Walla River system will continue to present passage barriers to both anadromous and resident fish species. Low flows promote a rise in water temperature. This is not only harmful to fish species, but creates thermal passage barriers during periods of increased solar radiation and reduced flows. Irrigation diversions also slow water movement, increasing the likelihood of migration delays and predation opportunity on aquatic species.

Table 3-6. Identified Life History Temperature Upper Thresholds Used for Analysis

Life History Event	MCR Steelhead	Spring Chinook Salmon	Bull Trout
Upstream Migration Upper Limit	17.5	13.3	12.2
Adult Spawning	9.4	13.9	10.0
Egg Incubation	14.0	14.4	12.2
Alevin	14.0	14.5	6.1
Fry Emergence	14.4	14.5	12.2
Downstream Juvenile Migration	14.4	*	12.2
Juvenile Rearing	14.6	14.4	10.0
Lethal Limit	23.9	25.0	21.1

*No temperature threshold identified.

Table 3-7. Hours of Life History Temperature Threshold Exceedances for Without Project Conditions at Ecology Stream Gage 32A100 from 2003 through 2009

Life History Event	MCR Steelhead	Spring Chinook Salmon	Bull Trout
Upstream Migration Upper Limit	860	652	2908
Adult Spawning Upper Limit	720	2095	2197
Egg Incubation Upper Limit	2697	9	3158
Alevin Upper Limit	1324	3	0
Fry Emergence Upper Limit	1324	3	0
Downstream Juvenile Migration Upper Limit	0	*	3158
Juvenile Rearing Upper Limit	2542	2560	3661
Upper Lethal Limit	8	0	490

*No temperature threshold identified.

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Table 3-8. Hours of Life History Temperature Threshold Exceedances for Without Project Conditions at Ecology Stream Gage 32A105 from 2003 through 2009

Life History Event	MCR Steelhead	Spring Chinook Salmon	Bull Trout
Upstream Migration Upper Limit	887	712	2927
Adult Spawning Upper Limit	720	2116	2013
Egg Incubation Upper Limit	1401	7	2830
Alevin Upper Limit	1401	6	0
Fry Emergence Upper Limit	1401	6	0
Downstream Juvenile Migration Upper Limit	0	*	3106
Juvenile Rearing Upper Limit	2634	2678	3477
Upper Lethal Limit	8	0	521

*No temperature threshold identified

Table 3-9. Hours of Life History Temperature Threshold Exceedances for Without Project Conditions at USGS Stream Gage 32A120 from 2003 through 2009

Life History Event	MCR Steelhead	Spring Chinook Salmon	Bull Trout
Upstream Migration Upper Limit	659	519	2857
Adult Spawning Upper Limit	720	2068	2019
Egg Incubation Upper Limit	1180	10	2833
Alevin Upper Limit	1180	8	0
Fry Emergence Upper Limit	1180	8	0
Downstream Juvenile Migration Upper Limit	0	*	3062
Juvenile Rearing Upper Limit	2345	2398	3483
Upper Lethal Limit	0	0	359

*No temperature threshold identified.

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Table 3-10. Hours of Life History Temperature Threshold Exceedances for Without Project Conditions at USGS Stream Gage 14018500 from 2003 through 2009

Life History Event	MCR Steelhead	Spring Chinook Salmon	Bull Trout
Upstream Migration Upper Limit	1006	687	2923
Adult Spawning Upper Limit	720	2180	1912
Egg Incubation Upper Limit	1409	95	2410
Alevin Upper Limit	1409	88	0
Fry Emergence Upper Limit	1409	88	0
Downstream Juvenile Migration Upper Limit	0	*	3177
Juvenile Rearing Upper Limit	2882	2913	3376
Upper Lethal Limit	879	567	1535

*No temperature threshold identified.

Table 3-11. Percentage of Operational Period Exceeding Life History for Without Project Conditions at Ecology Stream Gage 32A100 from 2003 through 2009

Life History Event	MCR Steelhead	Spring Chinook Salmon	Bull Trout
Upstream Migration Upper Limit	19.6%	14.8%	66.2%
Adult Spawning Upper Limit	16.4%	47.7%	50.0%
Egg Incubation Upper Limit	61.4%	0.2%	38.8%
Alevin Upper Limit	30.1%	0.1%	0.0%
Fry Emergence Upper Limit	30.1%	0.1%	0.0%
Downstream Juvenile Migration Upper Limit	0.0%	*	71.9%
Juvenile Rearing Upper Limit	57.9%	59.0%	83.4%
Upper Lethal Limit	0.2%	0.0%	11.2%

*No temperature threshold identified.

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Table 3-12. Percentage of Operational Period Exceeding Life History for Without Project Condition at Ecology Stream Gage 32A105 from 2003 through 2009

Life History Event	MCR Steelhead	Spring Chinook Salmon	Bull Trout
Upstream Migration Upper Limit	20.2%	16.2%	66.6%
Adult Spawning Upper Limit	16.4%	48.2%	45.8%
Egg Incubation Upper Limit	31.9%	0.2%	64.4%
Alevin Upper Limit	31.9%	0.1%	0.0%
Fry Emergence Upper Limit	31.9%	0.1%	0.0%
Downstream Juvenile Migration Upper Limit	0.0%	*	70.7%
Juvenile Rearing Upper Limit	60.0%	61.0%	79.2%
Upper Lethal Limit	0.2%	0.0%	11.9%

*No temperature threshold identified.

Table 3-13. Percentage of Operational Period Exceeding Life History for Without Project Condition at Ecology Stream Gage 32A120 from 2003 through 2009

Life History Event	MCR Steelhead	Spring Chinook Salmon	Bull Trout
Upstream Migration Upper Limit	15.0%	11.8%	65.1%
Adult Spawning Upper Limit	16.4%	47.1%	46.0%
Egg Incubation Upper Limit	26.9%	0.2%	64.5%
Alevin Upper Limit	26.9%	0.2%	0.0%
Fry Emergence Upper Limit	26.9%	0.2%	0.0%
Downstream Juvenile Migration Upper Limit	0.0%	*	69.7%
Juvenile Rearing Upper Limit	53.4%	54.6%	79.3%
Upper Lethal Limit	0.0%	0.0%	8.2%

*No temperature threshold identified.

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Table 3-14. Percentage of Operational Period Exceeding Life History for Without Project Conditions at USGS Stream Gage 14018500 from 2003 through 2009

Life History Event	MCR Steelhead	Spring Chinook Salmon	Bull Trout
Upstream Migration Upper Limit	22.9%	15.6%	66.6%
Adult Spawning Upper Limit	16.4%	49.6%	43.5%
Egg Incubation Upper Limit	32.1%	2.2%	54.9%
Alevin Upper Limit	32.1%	2.0%	0.0%
Fry Emergence Upper Limit	32.1%	2.0%	0.0%
Downstream Juvenile Migration Upper Limit	0.0%	*	72.3%
Juvenile Rearing Upper Limit	65.6%	66.3%	76.9%
Upper Lethal Limit	20.0%	12.9%	34.9%

*No temperature threshold identified.

Water withdrawals will continue to limit flows. Persistent limited flows during the irrigation season suppress the opportunity for free passage to higher quality habitat in the upstream reaches of the system. Under existing conditions, 64% of all measured cross sections did not meet depth criteria for adult salmonid passage (1 foot/30.5 centimeters) from May through December (see Technical Volume III, Appendix M, *Biological Benefits Analysis*, for methods). This percentage would be even higher if only the months of June through November were evaluated, due to the large amount of irrigation withdrawals. Diversion structures delay migration increase predation potential and, in the case of push-up dams, increase turbidity and substrate disturbance. Push-up dams are used in shallow water areas to create pools deep enough to be pumped or direct water to gravity-fed irrigation ditches. Annual maintenance of push-up diversions requires the manipulation of the channel and associated substrate.

Current limiting factors, as well as other existing impacts on aquatic resources (primarily fisheries) will likely continue with current trends.

Increased water temperatures during the summer resting period, increased sediment levels, and loss of natural stream structure will continue to limit survival and capacity for summer rearing and overwintering in the Walla Walla River.

Future without project conditions, including limited flows, reduced passage, and habitat degradation, will likely continue to limit the productivity and survivability of ESA-listed fish species and hatchery-origin salmonids in the basin.

Under existing conditions, as well as future without project conditions, it is likely that ongoing restoration efforts in the basin will continue with funding from BPA and others. Some structural passage improvements could be included in these efforts. However, under future without project conditions, the absence of additional flow in the Walla Walla River may reduce the success of such ongoing and future restoration efforts, since passage would continue to be limited and temperatures would likely remain elevated.

In order to identify existing conditions, future without project conditions, and to evaluate the impacts of the proposed alternatives, 14 miles of the Walla Walla River were modeled. This section of the river was broken into four reaches (Figure 3-9), which were modeled using the modified Physical Habitat Simulation (PHABSIM) model. The PHABSIM calculated WUA expressed in square feet for each measured reach of the river (Table 3-15 and Figure 3-10). The existing conditions and future without project condition represent the baseline against which all alternatives were compared.

The four reaches are described below.

Figure 3-9. Depiction of Designated Study Reaches in the WWRB

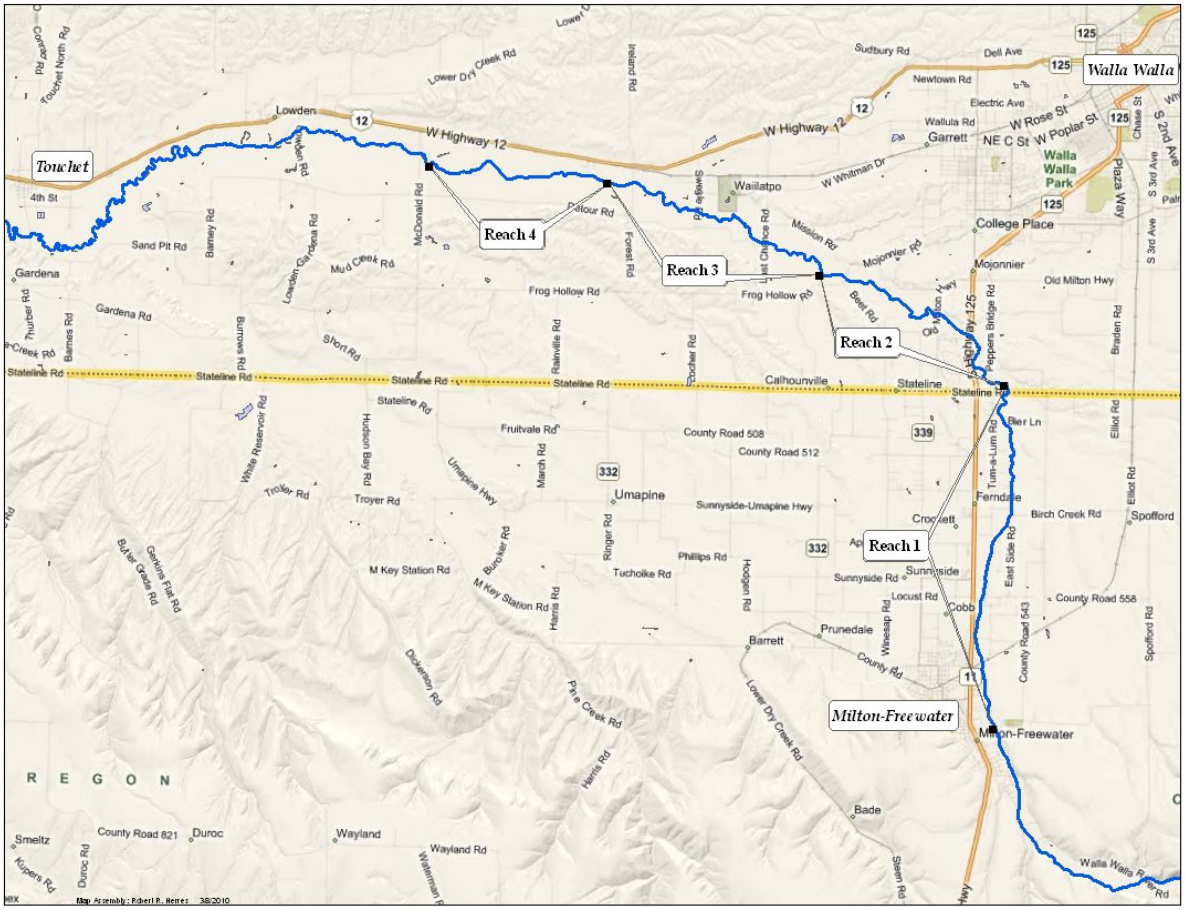

Table 3-15. Summary of WUA Values for Existing Conditions in Specified Reaches of the Walla Walla River for Adult Salmon and Steelhead, Juvenile Spring Chinook Salmon and Steelhead, and Bull Trout

BASELINE 'FUTURE WITHOUT PROJECT' CONDITION												
Sum of WUA [square feet (ft^2)] per 1000 feet[1]					Spring Chinook salmon Juvenile							
Reach	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
After LWW Reach 1	35	40	41	35	38	24	14	12	8	16	42	38
Stateline Reach 2	86	89	156	126	121	14	3	3	2	8	45	47
After Yellowhawk Reach 3	146	157	237	159	192	27	14	15	9	29	34	87
After Mill Creek Reach 4	148	166	316	178	245	9	7	8	3	10	10	63
WUA SUM	**415**	**451**	**750**	**498**	**595**	**74**	**38**	**39**	**22**	**63**	**131**	**235**
Steelhead_Juvenile												
Reach	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
After LWW Reach 1	117	121	268	182	228	44	19	23	13	27	77	86
Stateline Reach 2	137	150	329	227	287	16	3	3	1	7	51	62
After Yellowhawk Reach 3	269	293	542	334	407	27	11	12	6	30	67	114
After Mill Creek Reach 4	192	219	497	251	373	8	7	7	3	8	8	52
WUA SUM	**714**	**784**	**1636**	**994**	**1296**	**95**	**40**	**44**	**24**	**73**	**202**	**313**
Steelhead_Spawning												
Reach	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
After LWW Reach 1	1009	1019	1027	972	974	390	180	170	102	236	668	782
Stateline Reach 2	262	231	199	286	215	101	25	19	11	50	189	223
After Yellowhawk Reach 3	559	584	506	670	683	164	90	63	31	155	175	340
After Mill Creek Reach 4	557	604	408	593	602	67	60	37	14	54	54	292
WUA SUM	**2388**	**2437**	**2141**	**2521**	**2475**	**721**	**355**	**288**	**157**	**496**	**1086**	**1638**
Bull Trout												
Reach	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
After LWW Reach 1	569	537	563	540	517	348	116	116	69	155	438	485
Stateline Reach 2	554	600	923	805	865	110	20	20	13	55	323	379
After Yellowhawk Reach 3	1058	1105	1471	1170	1271	193	105	105	49	199	298	592
After Mill Creek Reach 4	860	929	1534	971	1168	65	52	52	15	65	65	346
WUA SUM	**3041**	**3171**	**4491**	**3487**	**3821**	**716**	**294**	**294**	**146**	**473**	**1124**	**1801**

[1]Values of WUA represent habitat quality for each reach under existing conditions

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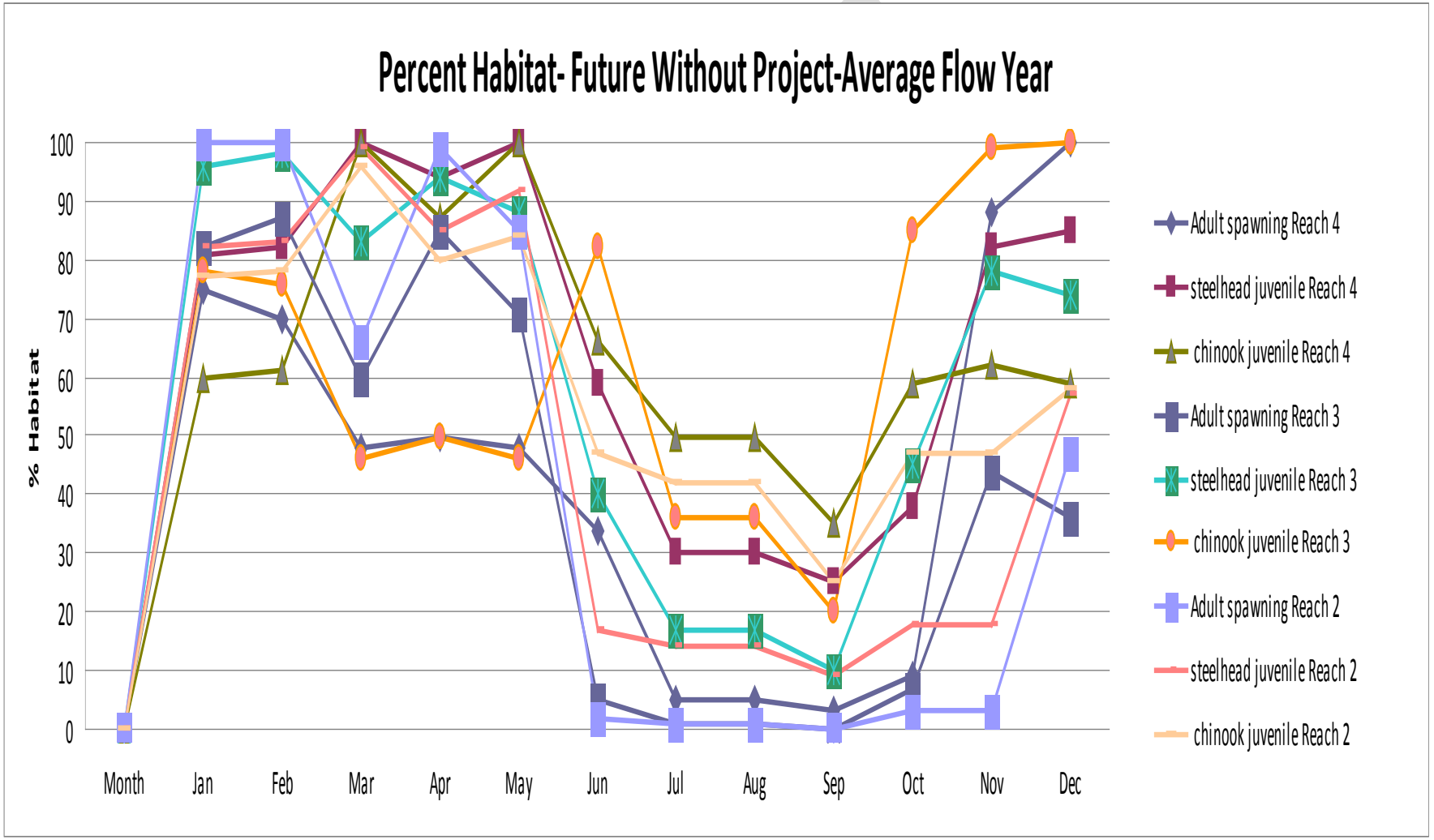
Figure 3-10. Future Without Project Percent Suitable Habitat for Reaches 2, 3 and 4 in the Walla Walla River Over an Average Flow Year



- **Reach 1: Walla Walla River from Cemetery Bridge to the Oregon and Washington state line [4.84 miles (7.79 kilometers)].** Through this reach, the river is channelized on the upper end. There is a significant losing reach at the lower end that impacts upstream fish passage in the summer and late fall. There is little to no riparian vegetation or channel complexity in this reach.

- **Reach 2: Walla Walla River from the state line to the confluence with Yellowhawk Creek [2.07 miles (3.33 kilometers)].** An Instream Flow Incremental Methodology (IFIM) study was developed by WDFW and Ecology for the Walla Walla River, using the Riverine Habitat Simulation (RHABSIM) model. The IFIM site was approximately 1000 feet (304.8 meters) in length, and was located immediately downstream of the State Route 125 overpass (RM 38.7).

- **Reach 3: Walla Walla River from the confluence of Yellowhawk Creek to the confluence with Mill Creek [4.67 miles (7.51 kilometers)].** A second IFIM study was developed by WDFW and Ecology. The IFIM was approximately 1000 feet (304.8 meters) in length, and located downstream of Yellowhawk Creek (RM 36.5).

- **Reach 4: Walla Walla River from the confluence with Mill Creek to Bergevin (Frenchtown) [3.32 miles (5.34 kilometers)].** This is the furthest downstream reach on the Walla Walla River with an IFIM/RHABSIM evaluation. A site immediately downstream of Mill Creek (RM 32.9) was selected by WDFW and Ecology.

3.5 Terrestrial and Wildlife Resources

3.5.1 General Wildlife Resources

The WWRB is inhabited by approximately 10 amphibian species, 207 bird species, 69 mammal species, and 15 reptile species during all or part of the year. This may not be a complete enumeration of all vertebrate species ever observed in lower elevations of the basin, and may contain species that very rarely, or no longer, occur in the WWRB. For example, the leopard frog (*Rana pipiens*) and Canada lynx (*Lynx canadensis*) were observed in the WWRB historically, but recent surveys have failed to detect their presence (McAllister et al., 1999; and Stinson, 2000). Detailed information on wildlife population numbers and locations is scarce, with most in-depth data focused on the game species.

Avian species can be good indicators of relative habitat quality for both upland and riparian habitats. Changes in the structure and distribution of vegetation communities have influenced the distribution and abundance of many avian species (Marcot et al., 1997). Species that have declined in abundance regionally include the montane forest

dependant white-headed woodpecker (*Picoides albolarvatus*) and flammulated owl (*Otus flammeolus*), as well as the sage-steppe and mixed shrub-grass dependant Columbia sharp-tailed grouse (*Tympanuchus phasianellus columbianus*) (Saab and Rich, 1997; Andelman and Stock, 1994a and 1994b).

Conversely, past practices have increased habitat suitability for some species. Species that have increasing or stable trends in the region include Wilson's warbler (*Wilsonia pusilla*), chipping sparrow (*Spizella passerina*), varied thrush (*Ixoreus naevius*), and western tanager (*Piranga ludoviciana*) (Saab and Rich, 1997; Andelman and Stock, 1994 and 1994b). Table 3-16 lists land bird species with declining population trends in the WWRB.

There are a number of areas throughout the WWRB that are protected areas. While the reasons and methods of protection differ, each area is similar in that its unique characteristics merit special methods of preservation. Figure 3-11 defines the land status in the WWRB that are protected and/or are managed using a conservation strategy.

Of the 301 wildlife species estimated to occur in the WWRB, many are of special concern to wildlife managers in the basin. Of the wildlife inhabitants in the basin, 42 have listed or candidate status in Oregon State, Washington State, at the Federal level, or are of special concern to the USFS (Table 3-17; WDFW, 2000); ODFW, 2000a; USFS, 1990). Many species not yet listed in the basin have declining population trends.

Table 3-16. Land Bird Species Inhabiting the WWRB Project Area with Identified Declining Population Trends

Species Common Name	Scientific Name	Primary Breeding Habitat
American kestrel[1]	*Falco sparverius*	coniferous forest, grassland
Mourning dove[1]	*Zenaida macroura*	coniferous forest, riparian
Vaux's swift[1]	*Chaetura vauxi*	coniferous forest, riparian
Rufous hummingbird[1]	*Selasphorus rufus*	coniferous forest, riparian
Belted kingfisher[1]	*Megaceryle alcyon*	riparian
Lewis' woodpecker[2]	*Melanerpes lewis*	coniferous forest, riparian
Williamson's sapsucker[1]	*Sphyrapicus thyroideus*	coniferous forest, riparian
Olive-sided flycatcher[3]	*Contopus cooperi*	coniferous forest
Western wood-pewee[1]	*Contopus sordidulus*	coniferous forest, riparian
Violet-green swallow[1]	*Tachycineta thalassina*	coniferous forest, riparian
Barn swallow[1]	*Hirundo rustica*	riparian
Rock wren[1]	*Salpinctes obsoletus*	grassland, cliff, rock, talus

Table 3-16. Land Bird Species Inhabiting the WWRB Project Area with Identified Declining Population Trends (continued)

Species Common Name	Scientific Name	Primary Breeding Habitat
Swainson's thrush[1]	*Catharus ustulatus*	coniferous forest, riparian
Orange-crowned warbler[1]	*Vermivora celata*	riparian
White-crowned sparrow[1]	*Zonotrichia leucophrys*	riparian
Dark-eyed junco[1]	*Junco hyemalis*	coniferous forest, riparian
Western meadowlark[3]	*Sturnella neglecta*	grassland
Pine siskin[2]	*Carduelis pinus*	coniferous forest
American goldfinch[1]	*Carduelis tristis*	riparian

[1]Species identified as having a "significant declining population trend" by Anderman and Stock, 1993.
[2]Species identified as being a "high concern to management" by Saab and Rich, 1997.
[3]Species identified as declining by Andleman and Stock, 1994; and Saab and Rich, 1997.

Figure 3-11. The WWRB Land Status

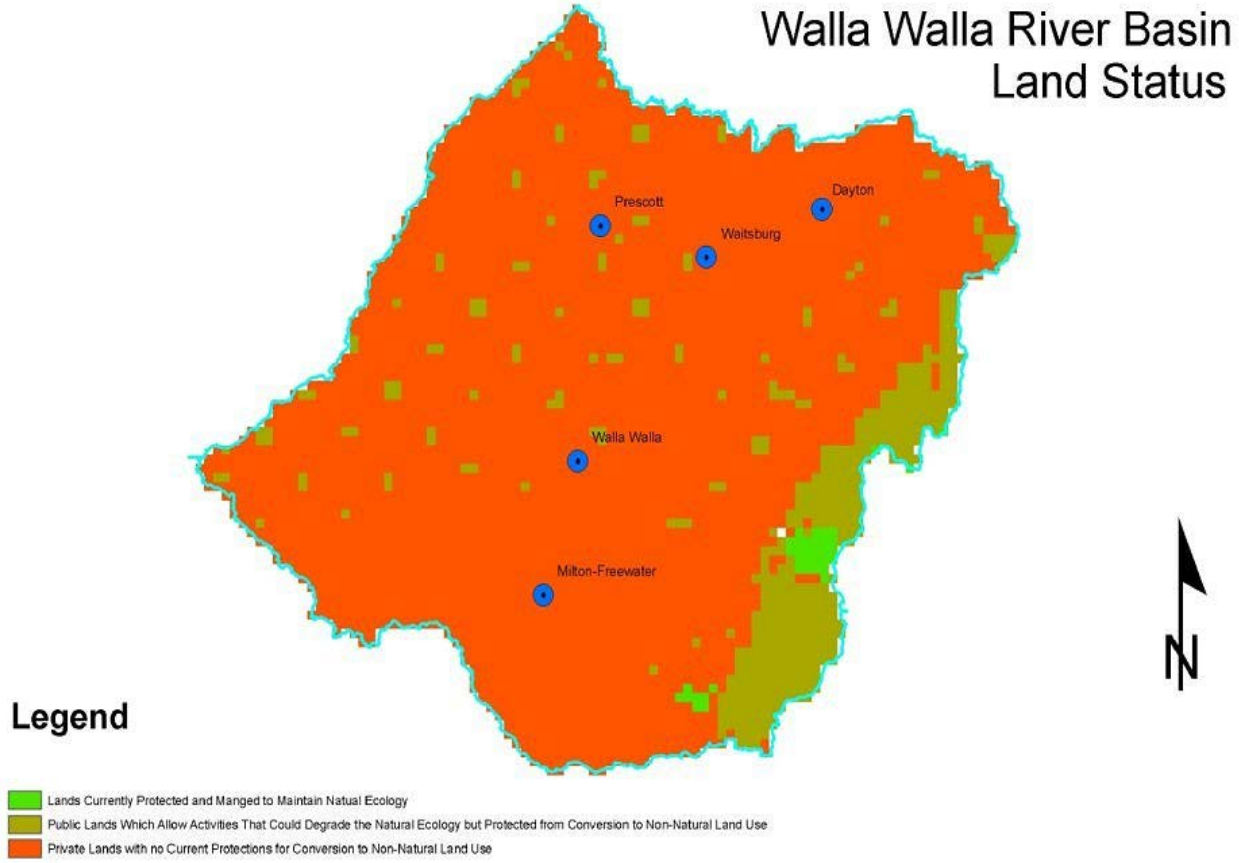


Table 3-17. Listed Wildlife Species within the WWRB

Species Common Name	Scientific Name	Status
American Marten	*Martes Americana*	Oregon-Sensitive Vulnerable, USFS-Management Indicator Species
Bank Swallow	*Riparia riparia*	Oregon-Sensitive Unknown
Black-Backed Woodpecker	*Picoides arcticus*	Washington-Candidate
Boreal Owl	*Aegolius funereus*	Oregon-Sensitive Unknown
Burrowing Owl	*Athene cunicularia*	Washington-Candidate, Oregon-Sensitive Critical, US-Species of Concern
Ferruginous Hawk	*Buteo regalis*	Washington-Threatened, Oregon-Sensitive Critical, USFS-Sensitive, US-Species of Concern
Flammulated Owl	*Otus flammeolus*	Washington-Candidate, Oregon-Sensitive Critical, USFS-Sensitive
Fringed Myotis	*Myotis thysanodes*	Oregon-Sensitive Vulnerable, US-Species of Concern
Golden Eagle	*Aquila chrysaetos*	Washington-Candidate
Grasshopper Sparrow	*Ammodramus savannarum*	Oregon-Sensitive Vulnerable
Great Gray Owl	*Strix nebulosa*	Oregon-Sensitive Vulnerable, US-Species of Concern
Loggerhead Shrike	*Lanius ludovicianus*	Washington-Candidate, Oregon-Sensitive Vulnerable, US-Species of Concern
Long-Billed Curlew	*Numenius americanus*	Oregon-Sensitive Vulnerable
Long-Eared Myotis	*Myotis evotis*	Oregon-Sensitive Unknown, US-Species of Concern
Long-Legged Myotis	*Myotis volans*	Oregon-Sensitive Unknown, US-Species of Concern
Lynx	*Lynx canadensis*	Washington-Threatened, US-Threatened
Merriam's Shrew	*Sorex merriami*	Washington-Candidate
Northern Goshawk	*Accipiter gentilis*	Washingon-Candidate, Oregon-Sensitive Critical, US-Species of Concern
Northern Leopard Frog	*Rana pipiens*	Washington-Endangered
Northern Pygmy Owl	*Glaucidium gnoma*	Oregon-Sensitive Critical
Olive-Sided Flycatcher	*Contopus borealis*	Oregon-Sensitive Vulnerable, US-Species of Concern

Table 3-17. Listed Wildlife Species within the WWRB (continued)

Species Common Name	Scientific Name	Status
Pallid Bat	*Antrozous pallidus*	Oregon-Sensitive Vulnerable
Peregrine Falcon	*Falco peregrinus*	Washington-Endangered, Oregon-Endangered, USFS-Sensitive, US-Endangered
Pileated Woodpecker	*Dryocopus pileatus*	Washington-Candidate, Oregon-Sensitive Vulnerable, USFS-Sensitive
Preble's Shrew	*Sorex preblei*	USFS-Sensitive
Pygmy Nuthatch	*Sitta pygmaea*	Oregon-Sensitive Critical
Rocky Mountain Elk	*Cervus elaphus*	FS-Management Indicator Species
Sage Thrasher	*Oreoscoptes montanus*	Washington-Candidate
Sagebrush Lizard	*Sceloporus graciosus*	Oregon-Sensitive Vulnerable, US-Species of Concern
Silver-Eared Bat	*Lasionycteris noctivagans*	Oregon-Sensitive Vulnerable
Striped Whipsnake	*Masticophis taeniatus*	Washington-Candidate
Swainson's Hawk	*Buteo swainsoni*	Oregon-Sensitive Vulnerable, USFS-Sensitive
Tailed Frog	*Ascaphus truei*	Oregon-Sensitive Vulnerable, US-Species of Concern
Three-Toed Woodpecker	*Picoides tridactylus*	Oregon-Sensitive Critical, USFS-Management Indicator Species
Vaux's Swift	*Chaetura vauxi*	Washington-Candidate
Washington Ground Squirrel	*Spermophilus washingtoni*	Washington-Candidate, US-Candidate
Western Boreal Toad	*Bufo boreas*	Washington-Candidate, Oregon-Sensitive Vulnerable, US-Species of Concern
Western Small-Footed Myotis	*Myotis cillolabrum*	Oregon-Sensitive Unknown, US-Species of Concern
White-Headed Woodpecker	*Picoides albolarvatus*	Oregon-Sensitive Critical, Washington-Candidate
White-Tailed Jackrabbit	*Lepus townsendii*	Washington-Candidate, Oregon-Sensitive Unknown
Wolverine	*Gulo gulo*	Washington-Candidate, Oregon-Threatened, USFS-Sensitive, US-Species of Concern

Source: WDFW, 2000a; ODFW, 2000; USFS, 1990.

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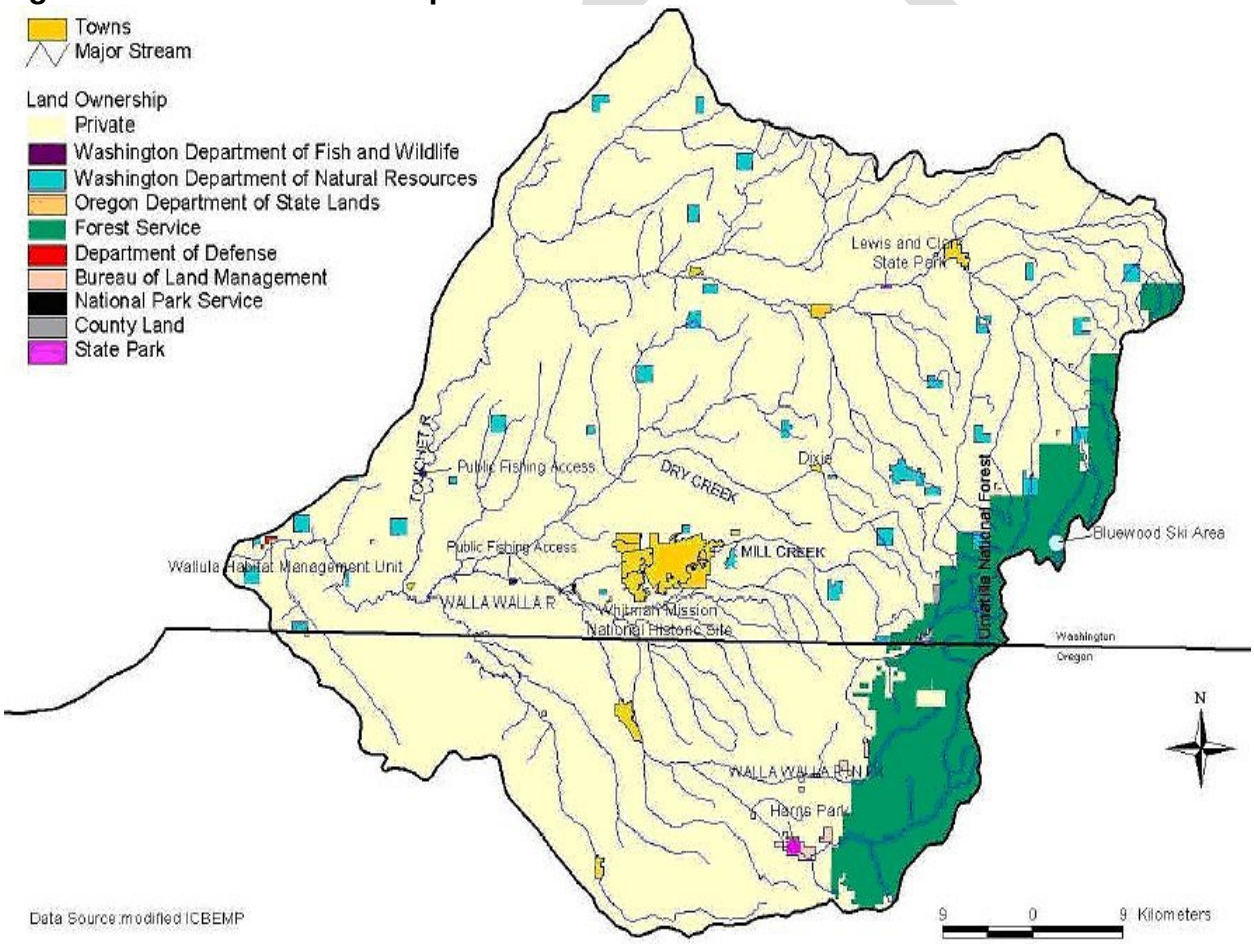
3.5.2 Land Use

Land uses in the WWRB are subject to the jurisdiction of five counties and two states, Walla Walla and Columbia Counties in Washington State; and Umatilla, Union, and Wallowa Counties in the State of Oregon. The majority of the subbasin is located in Washington (96%), is privately owned, and is primarily used for agriculture. A variety of other management entities and land uses also occur (Figure 3-12).

Federal land management entities include the USFS, who is responsible for Umatilla National Forest, and the US Bureau of Land Management (BLM). All lands managed by the USFS and BLM are located in the Blue Mountains. State management entities in the subbasin include the WDFW, ODFW, Oregon Department of Forestry (ODF), Washington Department of Forestry (WDF), Washington Department of Natural Resources (WDNR), ODEQ, Ecology, and the OWRD.

Figure 3-12. Land Ownership within the WWRB



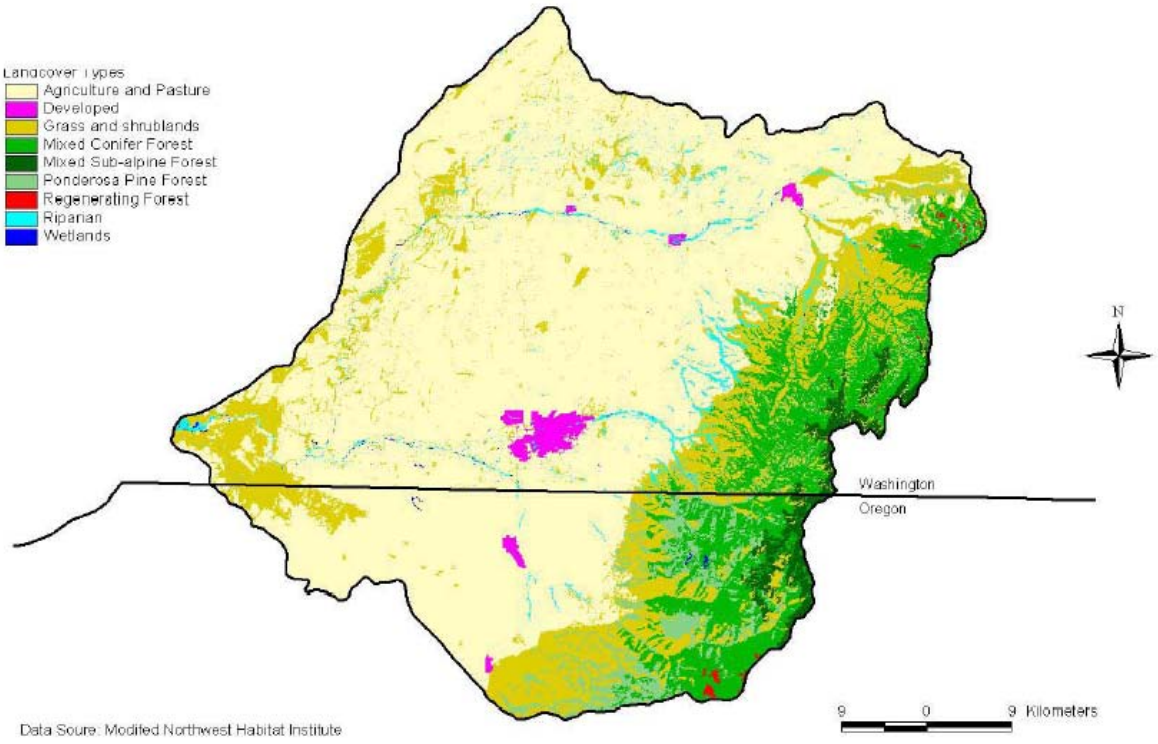
3.5.3 General Upland Conditions

Historically timber and brush mixed with grass and forbs were found in the Blue Mountains. Bunch grasses thrived in the middle portions of the WWRB; and wild rye and sagebrush inhabited the valleys (US War Department, 1860; and US Department of Agriculture, 1941).

Ultimately the WWRB rangelands were overgrazed, leading to the replacement of native plant species (e.g., steppe grass vegetation associations) by more competitive, introduced, and often invasive plant species (Grable, 1974). Dominant species now include cheatgrass (*Bromus tectorum*), velvet grass (*Holcus lanatus*), yellow starthistle (*Centaurea solstitialis*), barnyard grass (*Echinochloa crus-galli*), common tansy (*Tanacetum vulgare*), and rattlegrass (*Bromus brizaeformis*). Approximately 77 percent of historic shrub-steppe and grassland vegetation has been converted to agriculture, and the remaining shrub-steppe habitats in the Basin are small isolated patches.

Today, most of the plateau surrounding the Walla Walla River valley (from the foothills to the river mouth) is dry-farmed. Remnant strips of grassland steppe vegetation exist throughout the WWRB in steep terrain or areas of poor soil. Figure 3-13 illustrates current land cover within the WWRB.

Figure 3-13. Land Cover in the WWRB

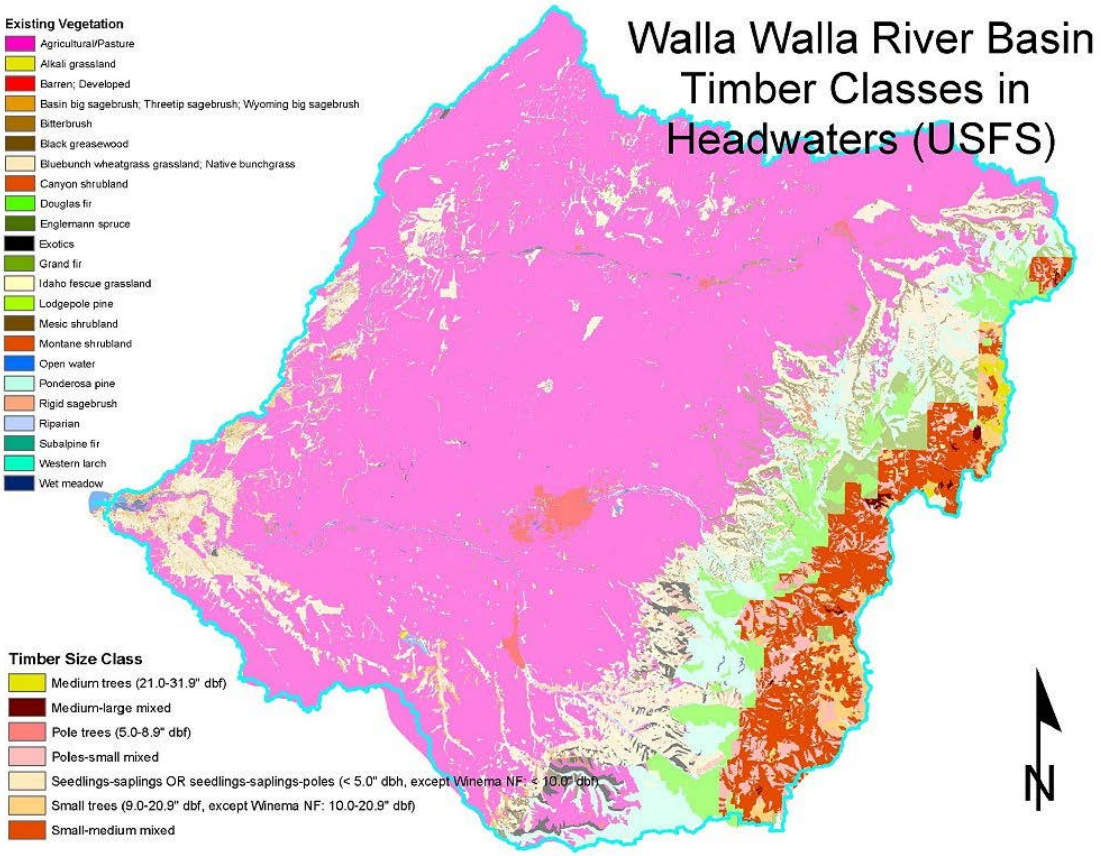


Rabbitbrush (*Chysothamnus spp.*) and scattered sagebrush (*Artemesia spp.*) are mosaiced with cheatgrass (*Bromus tectorum*), bluegrass (*Poa spp.*), and wheatgrass (*Agropyron spp.*) at lower elevations where no farming occurs. Protected canyons have

deciduous trees (*Populus spp.*, *Alnus spp.*) mixed with pine (*Pinus spp.*). At higher elevations, on north-facing slopes, pine gives way to Douglas fir and grand fir. Sage/forb/grass communities can still be found high in the mountains on exposed southern slopes.

Douglas fir (*Pseudotsuga menziesii*) and grand fir (*Abies grandis*) dominate the higher elevations, while ponderosa pine (*Pinus ponderosa*) dominates the lower elevations of the Blue Mountains (Corps, 1997). However, late seral ponderosa pine forests in the region have declined 75 to 80 percent over time (Henjum et al., 1994). The forested lands in the Oregon and Washington portions of the WWRB are shown on Figure 3-14. The majority of timber harvested on Federally-managed lands occurs in the higher elevations, while privately-harvested timber is generally taken from mid-elevation lands. There is no harvestable timber within 30 miles of the proposed project.

Figure 3-14. The WWRB Timber Classes in Headwaters (USFS)



Further, there has been a steady increase in the acres of irrigated croplands in the Walla Walla subbasin since the mid-1800s. The estimated area of irrigated Walla Walla County land in 1987 was 75,333 acres, compared to 97,136 acres a decade later (National Agricultural Statistics Service, 1997; 1999). The areas around Touchet, Gardena Farms, Walla Walla, and College Place hold the largest proportions of alfalfa

and wheat, the dominant irrigated crops in the WWRB. In addition to irrigated grain crops, fruit crops (orchards and vineyards) represent a growing portion of irrigated agriculture in the WWRB. Irrigated orchard acreage in Walla Walla County has increased from 6,910 acres in 1992 to 8,003 acres in 1997 (National Agricultural Statistics Service, 1997).

3.5.4 Upland Habitats and Dependent Species

3.5.4.1 Upland Habitats

Most of the remnant shrub-steppe ecosystems in the basin occur on shallow soils or near rock outcroppings, where farming is difficult. These are usually privately owned, relatively small fragments of land surrounded by agriculture (Dobler et al., 1996). Small shrub-steppe remnants are particularly prominent in the southern part of the Basin, between Athena, Oregon, northward to the Washington State line (Kagan et al., 2000).

Shrub-steppe communities consist of one or more layers of perennial grass with a conspicuous, but discontinuous, layer of shrubs above (Daubenmire, 1988).
Most of the land within the proposed project area not already converted to agriculture, livestock grazing, or housing developments is grass and shrubland cover. Historically, much of the WWRB was covered by shrub-steppe and grassland ecosystems. In the drier western sections of the subbasin, big sagebrush (*Artemesia tridnetata*), bluebunch wheatgrass (*Agropyron spiciatum*), and Sandberg bluegrass (*Poa sandbergi*) were the dominant vegetation types. The eastern lowlands of the Basin receive more precipitation, and were historically dominated by Idaho fescue (*Festuca idahoensis*) (Clarke and Bryce, 1997).

A geographic information system (GIS) overlay of the historic vegetation layer, developed by the Interior Columbia Basin Ecosystem Management Project (ICBEMP) with a current land use map indicates that 77 percent of the Basin that was covered by native grass and shrub-steppe vegetation is now cultivated. Most of the historic grass and shrubland areas that are not cultivated are now grazed by livestock. A comparison of Landsat data with the modeled historic extent of shrub-steppe habitats found that Walla Walla County's shrub-steppe lands have declined from 777,017 to 178,037 acres (Dobler et al., 1996). Most of the remaining shrub-steppe habitats in the WWRB are small and disjunct from other remnants. Fragmentation compounds the negative effect of habitat loss on the shrub-steppe obligate species of the Basin, as many areas are too small or isolated to support viable populations. The invasion of non-native weeds [cheatgrass (*Bromus tectorum*), yellow starthistle (*Centaurea soistitialis*), and tumbleweed] has also contributed to the decline in quality of shrub-steppe habitat in the WWRB. The primary plant species/communities of concern found in or near the WWRB are listed in Table 3-18.

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Table 3-18. Sensitive Plant Species/Communities Found In or Near the WWRB

Common Name	Scientific Name	Federal Status	State Status	Global Rank	State Rank
(Quaking Aspen)/Black	*(Populus tremuloides)/Cralaegus*			G1	S1
Hawthorn/Cow Parsnip	*Douglasii/heracleum maximum*				
Sierra Onion	*Allium campanulatum*		S	G4	S1
Robinson's Onion	*Allium robinsonii*	SC		G3	SH
Rosy Balsamroot	*Balsamorhiza rosea*			G4G5	S1
Bristly Sedge	*Carex comosa*		S	G5	S2
Cordilleran Sedge	*Carex cordillerana*			G5	S2
Gray Cryptantha	*Cryptantha leucophaea*	SC	S	G2G3	S2S3
Beaked Cryptantha	*Cryptantha rostellata*		S	G4	S1
Male Fern	*Dryopteris filix-mas*			G5	S3
Piper's Daisy	*Erigeron piperianus*		S	G3	S3
Snake Canyon Desert Parsley	*Lomatium serpentinum*		S	G4	S2
Prairie Lupine	*Lipinus cusickii*	SC	R1	G1	SRF
Sabin's Lupine	*Lupinus sabinii*		E	G4	S1
Pulsifer's Monkey-Flower	*Mimulus pulsiferae*		S	G4?	S2
Washington Monkey-Flower	*Mimulus washingtonensis*		R1	G4	SR
Many-Flowered Phlox	*Phlox multiflora*			G4	S1
Black Cottonwood/Western	*Populus balsamifera* spp.			G1	S1
Water Hemlock	*Trichocarpa/cicuta douglasii*				
Bluebunch Wheatgrass-Idaho	*Pseudoroegneria spicata-festuca*			G3	S2
Fescue Canyon	*Idahoensis canyon*				
Subalpine Spiraea	*Spiraea densiflora var splendens*		R2	G5T5	S2
Plumed Clover	*Trifolium plumosum var plumosum*		S	G4T3?	S1

Federal Status:
- SC Species of Concern. Unofficial status for a taxon of conservation concern, but for which the USFWS does not have sufficient information to support proposals to list it as endangered or threatened.

State Status:
- E Endangered. In danger of becoming extinct or extirpated from Washington within the foreseeable future if factors contributing to its decline continue. Populations of this taxon are at critically low levels or its habitats have been degraded or depleted to a significant degree.
- S Sensitive. Vulnerable or declining, and could become Endangered or Threatened in the state without active management or removal or threats.
- R1 Review Group 1. Vascular plant species of potential concern, but no status has yet been assigned. This taxon is in need of additional field work before a status can be assigned.
- R2 Review Group 2. Vascular plant species of potential concern, but for which no status has yet been assigned. This taxon has unresolved taxonomic questions.

Global Rank:
- G1 Critically imperiled globally because of extreme rarity or because of some factor(s) making it especially vulnerable to extinction (typically 5 or fewer occurrences or very few remaining individuals or acres).
- G3 Either very rare and local throughout its range, or found locally (even abundantly in some locations) in a restricted range (e.g., a single western state, a physiographic region in the east), or because of other factors making it vulnerable to extinction throughout its range (21 to 100 occurrences).
- G4 Widespread, abundant, and apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery. Thus, the element is of long-term concern (usually more than 100 occurrences).
- G5 Demonstrably widespread, abundant, and secure globally, though it may be quite rare in parts of its range, especially at the periphery.
- G? Sufficient time and effort have not yet been devoted to ranking of this taxon.
- G*n*G*n* Two codes (e.g., G1G2) are used to indicate a range of ranks.
- T*n* Where *n* is a number or letter similar to those for G*n* ranks, above, but indicating subspecies or variety. For example, 'G3TH' indicates a species that is ranked G3 with this subspecies ranked as historic.

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Table 3-18. Sensitive Plant Species/Communities Found In or Near the WWRB (continued)

State Rank:	
S1	Critically imperiled in the state because of extreme rarity or other factors making it especially vulnerable to extirpation from the state (typically 5 or fewer occurrences or very few remaining individuals or acres).
S2	Imperiled in the state because of rarity or other factors, making it very vulnerable to extirpation from the state (typically 6 to 20 occurrences or few remaining individuals or acres).
S3	Rare or uncommon in the state (typically 21 to 100 occurrences).
SH	There are historical occurrences, perhaps not verified in the past 20 years, but the taxon is suspected to still exist in the state.
SR	Reported in the state, but without persuasive documentation that would provide a basis for either accepting or rejecting the report (e.g., misidentified specimen).
SRF	Erroneously reported in the state, but the error persists in the literature.
S?	Sufficient time and effort have not yet been devoted to ranking of this taxon.
S*n*S*n*	Two codes (e.g., S1S2) are used to indicate a range of ranks.

3.5.4.2 Large Upland Game Mammals

Two deer species occur in the basin, mule deer (*Odecoileus hemionus*) and white-tailed deer (*O. virginianus*). Mule deer dominate in upper elevation forested habitats and arid lowland areas. White-tailed deer typically are the dominant deer species in riparian areas with a constant flowing water source, and in foothill areas with hawthorn groves in the draws, hillsides, and agricultural lands (Corps, 1997).

Whitetail deer populations have increased in most game management units in the region in the last few years. White-tailed deer are more commonly seen along the Walla Walla River than mule deer, but both species are present and hunted during the annual season.

Rocky Mountain mule deer are a priority habitat species (PHS) in Washington, and a primary big game species within the WWRB. Mule deer populations in the lowland habitat increased significantly over the last 15 years. Mule deer populations in the foothills are considered at good levels, whereas those in the mountains are depressed. This discrepancy is likely due to poor habitat conditions in the forested lands, caused by high road densities, logging activities, and fire suppression.

Mule deer populations for the Oregon section of the WWRB are below the ODFW's management objective of 1,900 animals. Mule deer populations in Oregon peaked during the mid-1950s and early 1960s, and have declined ever since. Overgrazing by domestic livestock and increases in large predator populations are considered factors in the decline.

Cougar (*Felis concolor*) populations in the basin appear to be increasing. Complaints have increased from almost nonexistent levels prior to 1990. Multiple sightings have occurred in areas where cougar have not been reported in the past (e.g., west of the town of Walla Walla). The increased sightings are possibly due, in part, to lower cougar harvest rates in the subbasin since the passing of Initiative 655 in Washington and

Measure 18 in Oregon. Both laws prohibit the use of hounds when hunting cougar (WDFW, 2000c). Although sightings have increased in lower elevation areas, cougars are primarily found in mountainous areas of the WWRB. Cougar densities in the forested region of the subbasin are estimated at around 1 per 8 mi^2 (20.7 km^2) (Akenson, 1993).

3.5.4.3 Upland Game Birds

Numerous migratory game bird species are common in the basin, including mourning dove, common snipe, ducks, coots, and geese. Mourning dove (*Zenaida macroura*) and snipe (*Gallinago gallinago*) populations in the region are considered stable, while waterfowl populations have experienced a significant increase (ODFW, 1999). Waterfowl population increases have been attributed to the increase in habitat resulting from the advent of irrigated agricultural practices following the construction of John Day and McNary Dams.

Ruffed grouse (*Bonasa umbellus*), blue grouse (*Dendragapus obsurus*), and spruce grouse, often called Franklin's grouse (*Dendragapus canadensis franklinii*), are native galliformes that inhabit forested areas in the WWRB. Ruffed grouse are the only forest grouse rarely found in the riparian zone along the Walla Walla River, within the project area.

Mountain quail (*Oreortyx pictus*) are uncommon game birds in the basin. Populations in the region are thought to have declined in recent years, largely from declining habitat quality. Because of their secretive nature and reliance on brushy habitats usually associated with riparian zones, they are not capable of extensive movements away from suitable patches of habitat. Once these habitats are degraded or removed, mountain quail become isolated from other habitat that may be available (Larsen and Nordstrom, 1999).

Wild turkey (Rio Grande subspecies – *Meleagris gallopavo intermedia*), ring-necked pheasant (*Phasianus colchicus*), California quail (*Callipepla californica*), chukar partridge (*Alectoris chukar*), and Hungarian partridge (*Perdix perdix*) are species that were introduced to the WWRB in order to provide recreational activities. These species are popular game species that have effectively naturalized in the WWRB, and wildlife managers in the basin work to maintain their populations.

The ring-necked pheasant is the most popular upland game bird species in Washington. The annual pheasant harvest peaked in the basin during the 1980s, at nearly 36,000 birds. By 1999, the pheasant harvest had declined 82 percent to 6,554 (WDFW, 2000b). Factors impacting pheasant harvest include pheasant population abundance,

hunter participation, and weather during the hunting season. The loss of both riparian and shrub-steppe/grassland habitat, along with the industrialization of agricultural practices, has resulted in a tremendous decline in the pheasant population within the WWRB.

California quail spend most of their time on the ground, foraging and scratching for food. They prefer brushy habitat with small, interspersed openings; and are common in city parks, suburban neighborhoods, and agricultural areas. Harvest records for California quail are higher than average in Washington.

Introduced Chukar populations crashed in the Snake River region of Washington in the early 1980s, and have continued a long-term decline since (WDFW, 2008). Noxious weeds, especially yellow starthistle (*Centaurea solstitialis*), are continuing to expand over thousands of acres of prime chukar habitat in southeast Washington. Chukar partridge appear to thrive on lands that tend to be overgrazed and covered with cheatgrass (*Bromus tectorum*). They do not appear to favor areas inundated with yellow starthistle.

Hungarian, or gray, partridge were introduced from Eurasia. They prefer flat agricultural land or rolling hills for all stages of their life so the wheat fields and shrub-steppe habitats of the Walla Walla Valley suit them well. Harvest levels for Hungarian partridge were relatively stable from 1984 through 2007. The Walla Walla County portion of the total 2007 partridge harvest for southeast Washington totaled only nine birds, or three-tenths of 1 percent (WDFW, 2003).

3.5.4.4 Protected Upland Species

A number of wildlife species associated with shrub-steppe and grassland habitats are listed as Oregon sensitive species. These include the long-billed curlew, loggerhead shrike, sage sparrow, grasshopper sparrow, burrowing owl, ferruginous hawk, Swainson's hawk, black-throated sparrow, sagebrush lizard, Washington ground squirrel, and white-tailed jackrabbit. Burrowing owl, loggerhead shrike, ferruginous hawk, the white-tailed jackrabbit and the Washington ground squirrel were selected as focal species for evaluating species dependant upon this habitat type.

The burrowing owl (*Athene cunicularia*) is listed as a state candidate species (Table 4-14). Burrowing owl populations in the WWRB have declined significantly over the last 25 years. Only five nesting pairs were documented in Walla Walla County during the 2000 survey, and only two pairs nested successfully (Peggy Bartels, USFWS personal communication). The loss of habitat to agricultural development and rural housing development appear to be the main factors contributing to the decline.

Data from a USFWS breeding bird survey reflected a highly significant decline for the loggerhead shrike (*Lanius ludovicianus*) in the Columbia Plateau region from 1968 to 1998 (Sauer et al., 1999). The loggerhead shrike is associated primarily with sagebrush and juniper steppe, particularly high density, tall sagebrush plants with a variety of understory conditions (Altman and Holmes, 2000a and 2000b). However, bare soil

understory (including that with cryptogrammic crust) is favored by feeding shrikes (Leu, 1995). According to the ICBEMP analysis, the big sagebrush habitat type has declined approximately 50 percent in the Columbia Plateau (Wisdom et al., 2000).

The ferruginous hawk (*Buteo regalis*) is listed as a state threatened species (Table 4-14), and is dependent on large areas of shrub-steppe habitat. Forty-two artificial nesting structures were constructed in the WWRB in 1993 (WDFW, 1993) to provide nest structures where nesting habitat is limited within the basin. Although ferruginous hawks are prominent shrub-steppe raptors throughout Washington, occupancy rates are low. Since 1987, fewer than 27 percent of historic ferruginous hawk territories have been occupied each year. Consequently, nesting populations have declined to levels where ferruginous hawks are a state-designated threatened species. Breeding data in 1995, from complete basin surveys, found only a 22% occupancy (Jim Watson, WDFW, personal communication, February 2001). Only 14 nesting pairs of ferruginous hawks were found within the WWRB in 1997, although 27 ferruginous hawk territories are documented.

It is not known why the occupancy of ferruginous hawk territories in Washington and the WWRB is so low. Regional declines of ferruginous hawks have been tied to changes in native habitat conditions from factors such as cultivation and grazing that may be associated with prey declines. Changes in the abundance and distribution of prey associated with shrub-steppe habitats in the basin, particularly white-tailed rabbits (*Lepus townsendii*) and Washington ground squirrels (*Urocitellus washingtoni*, both discussed further below), may reduce nesting of ferruginous hawks. Historic information suggests jackrabbits were important prey for nesting ferruginous hawks in Washington, but a sampling of 34 nests in 1995 found an absence of jackrabbits and ground squirrels and a predominance of northern pocket gophers (*Thomomys talpoides*) in the diet.

The Washington ground squirrel is a candidate for listing under the ESA and is a protected species in Washington. The continued existence of Washington ground squirrels depends upon maintenance of the remaining suitable habitat, large tracts of sagebrush and perennial bunchgrass (particularly on Warden soils where higher silt concentrations are found).

The white-tailed jackrabbit is a Washington State species of concern due to statewide declines and is being considered for listing under ESA. Jackrabbits inhabit desert scrubland, prairies, farmlands, and dunes. They favor arid regions and areas of short grass rangeland from sea level to about 3,800 meters (12,467.2 feet). Many different vegetation types are used, including sagebrush-creosote bush, mesquite-snakeweed and juniper-big sagebrush. They also frequent agricultural areas where they can impact fruit and grain crops. The white-tailed jackrabbit prefers bunchgrass and more open habitat than the black-tailed jackrabbit.

As a result of habitat loss or change, many plant species reliant on shrub-steppe habitat have become a focus of protection. The Oregon and Washington Natural Heritage Centers keep databases of these species of concern. .

3.5.4.5 Extirpated Upland Species

Historically, the Columbian sharp-tailed grouse (*Tympanuchus phasianellus*) inhabited most of eastern Oregon, including the WWRB. Excessive hunting in the mid- to late-19th century caused an initial reduction of Columbian sharp-tailed grouse population and range (Crawford and Coggins, 2000). In 1899, L.B. Quimbly of ODFW noted that sharp-tailed grouse were declining rapidly. He ascribed the decrease in abundance to overharvest during winter, and expressed the need for hunting restrictions (Crawford and Coggins, 2000). Since the turn of the century, the conversion of native habitats to crop production, and their degradation as a result of livestock grazing, has contributed to further population declines and range reduction (Hays et al., 1998). The WWRB is being considered as a potential site for additional sharp-tailed grouse reintroduction efforts (Walla Walla County and Walla Walla Basin Watershed Council, 2004).

Canada lynx (*Lynx canadensis*) and gray wolves (*Canis lupus*) are locally extirpated and suitable habitat does not exist in the project area.

3.5.5 General Wetland and Riparian Conditions

Lewis and Clark referred to the Touchet River as a series of beaver (a keystone riparian species) dams in a wide, densely forested riparian community. Historically, extensive riparian zones existed along streams in the WWRB (Corps, 1997). Literature indicates that the Walla Walla and Touchet Rivers have supported large and diverse riparian communities. Both snow interception and the influence of forests on the redistribution of snow are of great interest to the WWRB, where snowmelt is the primary source of stream flow. In this region, snow may be 80 to 90 percent of the annual precipitation.

A lack of infiltration may present difficulties on grazed, compacted, and cultivated soils, but is not usually problematic on areas of natural vegetation (Anderson and Ohmart, 1990). The natural forest or grassland floor absorbs the energy from falling rain, and permits only clean water to penetrate to the mineral soil layers. The infiltration capacity of the soils is nearly always greater than prevailing rainfall intensities in these areas. The reduction of infiltration is a regional problem affecting streamflow and associated riparian and wetland vegetation.

3.5.5.1 Wetland and Riparian Habitats and Dependent Species

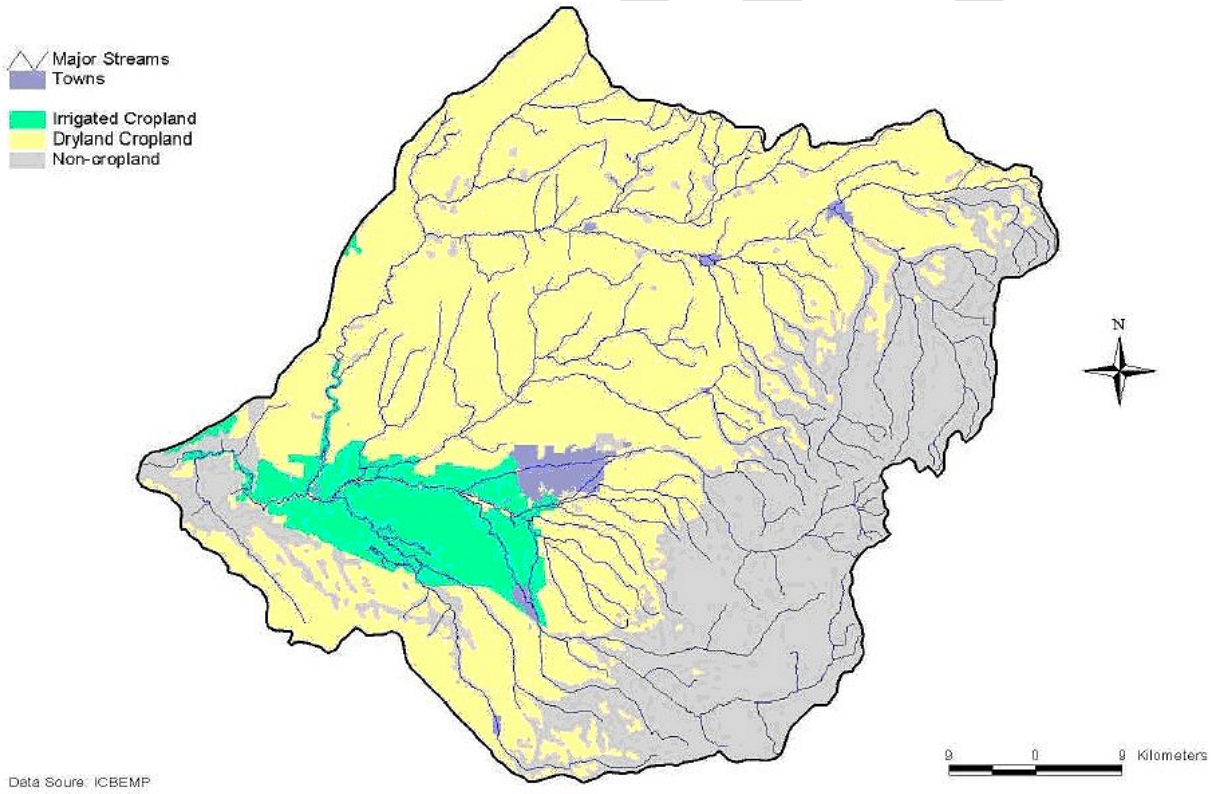
3.5.5.1.1 Wetland and Riparian Habitats

Mudd (1975) reported that only about 37 percent of the Touchet River riparian zone is defined as riparian vegetation. Along the Oregon portion of the river, 70 percent of the existing riparian zone is in poor condition (Water Resources Commission, 1988 *in*

Corps, 1997). Livestock operations occur throughout the WWRB wherever lands are not suitable for farming. Impacts from livestock grazing include loss of infiltration due to soil compaction, and erosion from trails and overgrazing. These impacts also reduce base flow and plant diversity, and increase sediment loads and down-cutting in affected streams.

The Walla Walla River valley is heavily irrigated, primarily in the narrow lowland portions of the subbasin. This represents the largest use of surface and groundwater in the subbasin (Figure 3-15). The primary water sources include the Touchet and Walla Walla rivers, via canals from direct river diversions or shallow aquifers. A 1991 Bureau of Reclamation report estimated there are about 14,000 acres irrigated from surface flows and shallow wells, and about 2,000 acres irrigated from deep wells in Oregon. Irrigation withdrawals, in combination with farming to the edge of stream courses, have contributed to the loss of riparian forest vegetation. This is especially true in the lower basin, where little of the formerly extensive riparian forest habitat remains.

Figure 3-15. The WWRB Agricultural Lands



Wetland habitats in the WWRB have decreased in the past hundred years, but it is difficult to quantify how much. Many wetland areas have been filled to increase the amount of acreage available for agricultural crops (Quigley and Arbelbide, 1997b). Incising stream channels, due to alterations in flow and sedimentation processes, has resulted in a reduced availability of moisture to wet meadow vegetation. It has also permitted invasion by more drought-tolerant vegetation (Johnson, 1994). Trapping and

loss of habitat have reduced beaver populations in the Basin, subsequently reducing the number of wetlands formed by beaver dam-building activities (Langston, 1995). The remaining wetlands in the Basin are primarily off-channel habitats along streams.

Declines in the quality and quantity of wetland and riparian habitat in the WWRB have negatively impacted wildlife populations dependent on this habitat type. It is estimated that over 80 percent of all wildlife in the western states is dependent on riparian habitat for at least one life-cycle requirement. Amphibians are considered good indicators of wetland health and function. Of the ten amphibian species that occur in the basin, 5 are listed as sensitive by ODFW (Marshall et al., 1996).

3.5.5.1.2 Wetland and Riparian Birds

Bald eagles (*Haeliaeetus leucocephalusi)*, red-eyed vireo (*Vireo olivaceus*), and the great blue heron (*Ardea herodias*) are birds native to the WWRB that depend on riparian and wetland habitats for nesting, rearing young, and foraging and are considered riparian obligate species. The bald eagle and the great blue heron were selected for further discussion due to the sensitive colonial nesting habits of the heron and the protected status of the eagle under the Bald and Golden Eagle Protection Act and former protection under ESA.

Currently, the bald eagle is not known to nest in the WWRB. Wintering eagles are occasionally observed in the subbasin, but their population status and distribution is undetermined. Preferred nesting habitat for bald eagles is predominately coniferous, uneven aged stands, with an old growth component, near a large body of water (i.e., rivers or lakes) that supports an adequate food supply (Marshall et al., 1996). Wintering habitat for bald eagles within the project area is limited to a few small patches of mature cottonwood trees along the Walla Walla River, and the area around the river mouth (near Wallula). Potential nesting habitat along the Walla Walla River within the project area is very limited, due to the lack of mature conifers or other suitable trees.

The great blue heron is listed as a PHS in Washington. Two known heron rookeries occur within the subbasin, one on the Walla Walla River and one on the Touchet River. The Walla Walla River rookery contains approximately 13 active nests. Disturbance from housing developments, industry, logging, etc., can result in the abandonment of rookeries. Maintaining adequate riparian habitat for nesting where human disturbance is minimal is important for heron rookeries located within the subbasin (Paul Allen, WDFW, personal communication, February 2001).

3.5.5.1.3 Wetland and Riparian Amphibians

There are 10 known species of amphibian in the WWRB. Of these, the northern leopard frog (*Rana pipiens*), spotted frog (*Rana pretiosa*), western toad (*Bufo boreas*), tailed frog (*Ascaphus truei*), and woodhouse's toad (*Bufo woodhousii*) are listed as sensitive by ODFW (Marshall et al., 1996). Of these, the northern leopard frog, tailed frog, and spotted frog are listed as critical, while the western toad and woodhouse's

toad are considered vulnerable and peripheral or naturally rare, respectively. The spotted frog was formerly considered threatened in western Oregon by ODFW, but subsequently listed as critical due to lack of documentation on its disappearance. It is currently a category two species on the USFWS Notice of Review for its entire range (Marshall et al., 1996). In Washington, the leopard frog was recently listed as endangered, while the western toad is a candidate for listing (WDFW, 2000a).

3.5.5.1.4 Wetland and Riparian Protected Species

Almost all migratory birds in the WWRB are protected by the restrictions in the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act. As described above, an estimated 80% of all species are dependant upon riparian or wetland areas for at least one critical life stage. Protected fish species utilizing riverine habitats are described under the aquatic resources section of this chapter.

State protected amphibians are mentioned above. Although current ESA species lists do not indicate that the Columbia spotted frog (*Rana luteiventris*) is currently a Federal species of concern, the Fish and Wildlife Coordination Act Report has identified it as such, and is therefore being considered herein. The Columbia spotted frog is a sensitive wetland obligate species that prefers lakes, ponds, wetlands, beaver ponds but are also found in moving waters. The habitat may be permanent or ephemeral and emergent or floating vegetation is often present. Basking habitat is also thought to be important for the species. Breeding sites are often in the warmest areas of a pond, have high solar radiation (often the north side), and are associated with shallow water.

The yellow-billed cuckoo (*Coccyzus americanus*) is also a candidate for listing under the ESA that is considered a riparian obligate species, dependant upon large tracts of mature riparian forest.

Although potentially suitable habitat exists for the ESA-listed (threatened) Ute-ladies'-tresses orchid (*Spiranthes diluvialis*) in the area of the project, there are no known occurrences of that species in the area [Washington Natural Heritage Program (WNHP) and WDNR, 1999]. The orchid occurs along riparian edges, gravel bars, old oxbows, high flow channels, and moist to wet meadows along perennial streams. It typically occurs in stable wetland and seepy areas associated with old landscape features within historical floodplains of major rivers. It also is found in wetland and seepy areas near freshwater lakes or springs.

3.5.5.1.5 Extirpated Wetland and Riparian Species

Although common historically, the northern leopard frog may have become extirpated from the basin. Of the 42 museum records of leopard frogs collected in Washington, 25 were obtained in the WWRB. These records range from 1881 to 1970, and were obtained from a variety of locations in Walla Walla County (McAllister et al., 1999). In

Oregon, past records show northern leopard frog habitat in wetlands in Umatilla County (Nussbaum et al., 1983). Leopard frog surveys conducted in the basin during the 1990s, by WDFW and ODFW, failed to detect the species (McAllister et al., 1999; Kevin Blakely, ODFW, personal communication, January 2001).

3.5.6 Terrestrial and Wildlife Resources - Future Without Project Conditions

3.5.6.1 Habitat Effects

The dominant, "natural" plant community in the WWRB is the shrub-steppe ecosystem. Additional reductions in the number of acres in this plant community, as well as habitat fragmentation, is likely to continue in the next 50 years due to the probable expansion of agriculture and housing. The absence of this project will have no additive effect on the shrub-steppe ecosystem.

The absence of this project will likewise have no effect on the foothill plant communities or the Blue Mountain forested habitats within the WWRB. However, these habitats may continue to change due to increased farming, livestock grazing, urban development, logging, or wild fires.

Riparian habitat quality and quantity along the Walla Walla River, from the headwaters to the mouth (at Wallula), may decrease to an unknown extent, limited by water availability and land use. Existing laws protecting riparian habitat, as well as increased interest and incentive in conservation easements for private land owners, may help improve riparian habitat during the next 50 years.

Land uses in the WWRB are not likely to change substantially from their current status over the next 50 years. Agriculture will continue to be the primary land use in the WWRB. Housing development may increase, but large housing tracts are not likely to increase adjacent to the Walla Walla River.

Invasive species will continue to require management and habitats may continue to degrade due to shifts in vegetative communities, particularly in riparian areas or heavily disturbed upland areas or along agricultural fringes but the absence of this project will not contribute to the spread of these species.

3.5.6.2 Obligate Species Effects

Forest-dependent species, as well as wetland-riparian species like the bald eagle and great blue heron, should not be affected under future without project conditions. Wildlife dependent on the shrub-steppe habitats in the valley may continue to experience habitat declines resulting from other land development actions and may to decline in number.

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Habitat and populations of game species such as mule deer and California quail are not likely to improve or decline significantly under current land management regimes. In general, the absence of this project will have no additive effect on sensitive habitat-specific (obligate) species (those species economically or ecologically significant, but not of protected status but that are very dependant upon a specific habitat for a significant life stage or stages) within the WWRB.

The future without project condition will not alter negative trends for sensitive shrub-steppe plant species nor improve habitat structure or distribution.

3.5.6.3 Protected and Extirpated Species Effects

The future without project condition will not increase the existing effects on any protected species within the WWRB. Extirpated species will not be affected by the future without project condition or by any other project alternative and will therefore not be subject to further consideration in this document.

3.6 Cultural Resources

Early on in the study, the CTUIR contracted with Northwest Archaeological Associates to complete a summary of the prehistory, ethnohistory, and history of the study area; previous cultural resources investigations and cultural resource types and distributions; and current data gaps and potential project effects (Northwest Archaeological Associates, 2005). The findings are summarized in the following sections.

3.6.1 Pre-Contact Period (Before Arrival of Europeans)

Based on the existing archaeological record, documented human occupation within the Columbia Plateau extends back to the Late Pleistocene (10,000 years ago). Some of the earliest archaeological work done near the project area was carried out in the late 1940s and 1950s, in connection with proposed dam construction on the Columbia and Snake Rivers. Excavations at a number of riverine village sites located near the confluences of the Snake and Walla Walla Rivers with the Columbia River provided information on pre-contact Native American culture (i.e., dwelling construction, artifact manufacture and use, and mortuary practices). Subsequent investigations continued to add data to a growing body of information, allowing researchers to develop chronological (time) and culture-historical sequences for various areas within the Columbia Plateau. These sequences are defined by such things as time periods, particular types of tools, shapes of those tools, predominant raw materials used, and generalizations about subsistence activities (e.g., subsistence round), settlement patterns, and inter-group relationships. Researchers recognize limitations with these sequences due to gaps in available information or other issues, and note that further refinement is needed. Archaeologists have also proposed a number of hypotheses to

explain the development of culture on the Columbia Plateau. While existing sequences/hypotheses are based on archaeological data gathered outside the study area, they have none-the-less been used to help describe the prehistory of the WWRB in the absence of any cultural overview or sequence developed specifically for this area.

In very broad terms, the current thought on human occupation in the Columbia Plateau has native inhabitants settling in to their environment over time. The earliest people were nomads who lived in small groups, occupying caves and rockshelters and relying on big game animals as a major food source. The climate was cooler and moister than present times. This was followed by a period when people came together in larger groups, and there was a shift towards semi-sedentism, as evidenced by the appearance of semi-subterranean housepits. There was a growing reliance on certain types of plant foods. Weather conditions became hotter and drier in some areas. The period of time prior to Euroamerican contact (i.e., 2000 to 3000 years) saw the emergence of what has come to be viewed as the Plateau culture. People lived together in large numbers (e.g., villages), and occupied not only housepit dwellings but, eventually, a new type of house – the mat lodge. Large houses were built, and greater numbers of houses were occupied. A pattern of seasonal land use followed that relied heavily on the harvesting of certain meadow and upland plant foods (i.e., camas, bitterroot, etc.) and salmon, supplemented by hunting. Food storage was also an important feature of this period. Climate was similar to that of present times.

3.6.2 Ethnohistoric Period

The WWRB was the traditional territory for three Native American groups: the Walla Walla, Umatilla, and Cayuse. The Walla Walla and Umatilla both spoke versions of the Sahaptin dialect, while the Cayuse spoke an extinct traditional dialect closely related to that of the Mollala Indians of the Oregon Cascad Mountains. The Walla Walla lived along the lower reaches of the Walla Walla and Snake Rivers, as well as along the Columbia River. The Cayuse occupied the middle and upper reaches of the Walla Walla River; and the Umatilla lived along the Umatilla River and its tributaries, as well as the Columbia River (near its confluence with the Umatilla).

As with other Plateau people, these groups maintained a seasonally-mobile living and food procurement strategy. This consisted of congregating at villages along larger rivers during the winter, and subsisting off stored food supplies. During the remainder of the year, the people lived in dispersed settlements throughout the basin while hunting, fishing, and gathering plants of storage and use during the winter. The size and number of dwellings depended on the number of people present, the type of activities occurring, and the time of year when the habitation site was occupied. Houses consisted of elongated mat lodges or smaller conical dwellings. The Walla Walla, Umatilla, and Cayuse bands were comprised of autonomous local groups without paramount chiefs, but the Euroamerican concepts of boundaries did not exist among these people. While fishing sites near villages might be controlled by those villages, these sites could be used by others as well, along with hunting and gathering areas. The acquisition of the horse provided greater mobility for these three bands. The

Cayuse were particularly known for their expert horsemanship. Using the horse for transportation enabled some of the Columbia Plateau communities to participate in buffalo hunts, and become more involved in trading and interacting with other groups.

The lifeways of the Walla Walla, Umatilla, and Cayuse, as well as for all native Columbia Plateau people, changed dramatically with the arrival of Euroamericans. New concepts, currency, and technologies were introduced. Many communities were decimated by diseases both prior to and after direct contact with Euroamericans. The Treaties of 1855 saw the removal of Plateau people to various reservations, eliminating the land and freedom to which these people had long been accustomed. Many of the Walla Walla, Umatilla, and Cayuse moved onto the Umatilla Indian Reservation.

3.6.3 Historic Period

The 1805 Lewis and Clark expedition was the first documented presence of Euroamericans in the WWRB. Other explorers and trappers (e.g., David Thompson and Donald McKenzie) soon followed, intent on establishing the fur trade within the area. In 1818, a fur trading post, Fort Nez Perce (later called Fort Walla Walla), was established near the confluence of the Walla Walla and Columbia Rivers. It remained an important center of interaction between Euroamericans and local Native American groups until the decline of the fur trade in the mid-1840s. The 1830s saw the arrival of both Protestant missionaries (1836) and Catholic priests (1838). The most well known of this group to settle in the project area were Marcus and Narcissa Whitman, who established a mission 7 miles west of present-day Walla Walla.

Following the Treaties of 1855 and the end of the Indian Wars (1855 to 1858), settlers began to move into the WWRB and Columbia Plateau in greater numbers. Some of the first to arrive were miners and others connected with the mining industry (e.g., merchants, suppliers, etc.). Early roads included the Oregon Trail; and the Colville, Mullan, and Washtucna wagon roads. Starting in the 1870s, railroad lines were being built to help move goods and people. by the late 1880s, the Walla Walla Valley was connected by rail to Puget Sound, Portland, Spokane, and points further east, thus helping to facilitate the growth of the wheat farming industry. The growth and development of agriculture continued throughout the late 1800s, and was assisted by improvements to and expansion of railroad lines and roads. Coinciding with these improvements and expansion was the start of irrigation projects in the 1890s. While early irrigation systems were mostly small localized ditches, farming needs eventually required the development of extensive irrigation districts. Within the project area, irrigation networks were developed on the Walla Walla and Umatilla Rivers. Agriculture remained the primary economic force in the WWRB throughout the 20th century.

As happened in other rural regions of Washington and Oregon, as well as the rest of the country, the late 19th and early 20th century saw the start of populations concentrating in towns and cities within the Basin. Smaller communities (i.e., Lowden and Touchet) grew as agricultural centers, while Milton-Freewater and Walla Walla grew as municipal centers. Besides community growth, the WWRB also witnessed growing diversity within its population. Along with Native Americans, other ethnic groups began to settle in the

area: Italians, French-Canadian, Chinese, Japanese, and Scottish-Canadians, among others. All brought a rich cultural background that contributed to the historical diversity of the Basin.

3.6.4 Existing Conditions

Cultural resources investigations have been conducted in the WWRB since the 1940s. However, they have been somewhat limited in scope, due to the types of studies undertaken. In addition, investigations have generally been conducted on public lands, which make up only a small portion of the total study area. Because of this situation, recorded cultural resources should be seen as indicative, but not necessarily representative of the overall archaeological and historic record of the WWRB.

Based on available information from both ethnographic and ethnohistoric records, as well as prior investigations, many types of Native American archaeological sites are known or are anticipated to be found within the Basin. Cairns (rock features), burials, campsites, hunting blinds, and isolated artifacts are cultural items/features that can be expected in upland settings. Along riverine settings, villages and more intensive activity areas (i.e., fishing and fish processing sites) are likely to be found. Historically, there are many readily apparent features that reflect Euroamerican settlement in the Basin, including towns, buildings, roads, bridges, railroads, irrigation structures, and gristmills. Within the project area itself, a total of 44 archaeological sites have been recorded: 16 prehistoric sites (e.g., Native American), 19 historic sites, 1 prehistoric and historic site, and 8 sites not identified as being either prehistoric or historic.

Presently, insufficient information exists to develop a cultural sequence (particularly in the pre-contact period) for the WWRB. Because of this situation, the Lower Snake River cultural sequence has served as the basis for interpreting the record of human activity in the Basin. However, such an approach can present serious problems, the most basic of which is not knowing how closely the Lower Snake River cultural sequence actually reflects what happened in the WWRB. There are physical differences between the lower Snake and Walla Walla River drainages that could have resulted in different settlement and development in each area.

3.6.5 Cultural Resources - Future Without Project Conditions

Selection of the “no action” alternative would result in a continuation of existing conditions for cultural resources. However, in the absence of sufficient data/information, it is difficult to project specific details of what might be involved under such a scenario. Large data gaps and unknowns would continue to exist in the archaeological record, with limited opportunities for increasing our knowledge of the resource base within the project area. The lack of specific cultural resources information would also make it difficult to know the types and extent of impacts occurring to historic properties, or the appropriate level of response.

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3.7 Recreation and Tourism

3.7.1 Recreation

The WWRB contains a full spectrum of recreational opportunities linked to a landscape abounding in rivers, streams, woods, mountains, hills, canyons, and flat lands. The area averages 270 days of sun each year, and has a mild climate. These factors, alone, make the Walla Walla Valley a great place for the recreationist. The Walla Walla Valley is also a gateway to Umatilla National Forest and thousands of acres of forest located in the Blue Mountains of Southeast Washington and Northeast Oregon.

Public parks located with the Cities of Walla Walla, College Place, Milton-Freewater, as well as other outlying communities, provide a wide array of recreational opportunities. Activities at these parks include recreational sport programs for youth, teens, and adults; fishing; playgrounds; baseball; soccer; tennis; basketball; football; BMX biking; skate boarding; disk golf; and other unstructured activities that traditionally take place at public parks. Walking, jogging, and biking are also largely popular recreational activities that occur on many miles of designated trails in and around the city park systems. Several golf courses are also located in the area.

The WWRB provides many recreation opportunities for the outdoors enthusiast. The beautiful rivers, streams, mountains, and canyons provide excellent opportunities for hunting, fishing, hiking, and camping. The Basin is also a great place for horse riding, off-road vehicle use, downhill snow-skiing, cross-country skiing, and recreational water sports (i.e., water-skiing, wakeboarding, wind surfing, and sailing).

There are no public parks located along the alignment of the proposed alternatives. One public park, Madame Dorian Memorial Park, is located along the north shore of the Walla Walla River, near its confluence with the Columbia River. This Park consists of 46 acres and provides year-round facilities for camping and day-use activities such as picnicking. River bank access and camping is available near boat launches. This park is leased from the Corps by the USFWS.

The Wallula Habitat Management Unit is located just upstream of Madame Dorian Memorrial Park, along the north and south shorelines of the Walla Walla River. The unit consists of 1,896 acres and provides opportunty for day-use activities such as hiking and hunting with special restrictions. The unit is open year-round and is leased from the Corps by the USFWS.

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3.7.2 Tourism

Tourism is growing in importance for the local economy of the WWRB. Over 300,000 people visit Walla Walla County each year. In 2005, $71.6 million dollars were spent by tourists visiting the area (Dean Runyan Associates, 2006). The Walla Walla Valley is a popular tourist destination because of the natural beauty of the area, recreational opportunities, a growing wine industry, and historic sites and features of the individual communities.

From 1960 to 1990, population, economic, and tourism growth in the Walla Walla area was slow and relatively consistent. Since 1990, the transition from traditional agricultural crops (i.e., wheat and onions) to the production of grapes supporting the wine industry has been the cause of unprecedented growth. Many people travel to this area specifically to take in the wine culture. The people who support this industry help create a more stable economy than in many other areas of southeastern Washington and northeastern Oregon.

The revitalization of historic downtown Walla Walla has also attracted many new tourists with shopping, dining, art galleries, and special events. Community events like the weekly Farmers Market, Walla Walla County Fair and Frontier Days, car shows, the Sweet Onion Festival, and other community events also attract many tourists to the area. Many visitors come to the area to see historic buildings, while taking advantage of the community's designated historic walks. Others come to attend performing arts events at community theaters or one of the three colleges in the Valley.

3.7.3 Recreation - Future Without Project Conditions

Growth trends for the WWRB population over the past 20 years are typically 1.2% per year (Mabley et al., 2008). No new development or analysis indicates this growth will accelerate or decline over the next 30+ years. The growth and development of this area is influenced by factors such as market conditions and economic vitality. The nature of these factors makes it hard to predict future growth patterns.

Additional structured recreation resources (i.e., parks and trails) are likely to be developed as the population base increases. Other factors, including user preferences, could be the means for additional recreation in certain areas. These same factors, however, could also stop growth and force existing recreation facilities to be closed in other areas.

Recreation trends show that outdoor recreation like that already occurring in the WWRB is becoming more popular (Cordell et al., 2008). The resources in the area are expansive, and will not likely limit the numbers participating in these recreational activities.

3.7.4 Tourism – Future Without Project Conditions

In the future, it is probable that tourism will continue to grow steadily in the WWRB. Economic vitality will also affect visitation numbers negatively or positively, as will other factors discussed in previous paragraphs. Economic stability and individual prosperity have especially close ties to tourism, because tourism is an activity that is most often exercised with disposable income.

Visitation to the Walla Walla area will continue to grow as the wine industry continues to grow. The wine industry is projected to grow 25% annually over the next 10 years (Robison et al., 2007) and, as this region becomes more visible as a "hot spot" for wineries, more and more people will come. Continued efforts to restore and vitalize downtown Walla Walla could also lead to more tourism, as people come to shop, dine, and participate in the arts.

3.8 Socioeconomic Resources

The typical Corps economic analysis quantifies the effects of alternatives, and optimizes the output of goods and services from the NED perspective. The primary outputs of alternatives for the WWRBFS/EIS are environmental benefits. These are quantified in non-monetary terms, but are considered from the NER standpoint. The primary decision point for this study is the optimization of environmental outputs.
This section discusses current socioeconomics within the study area (Columbia, Franklin, Umatilla, and Walla Walla Counties), and evaluates effects that may result from project implementation.

The current socioeconomics conditions of the study area have been established, and are used as a baseline for forecasts and assumptions made in creating future without project and future with project conditions. The size of the study area necessitates that the area is broken up into counties in order to gather accurate socioeconomic information. The current conditions of the five counties are presented individually, but are then summarized using general trend data.

Future without project conditions are established to determine the effects of not implementing the proposed alternative. They are also established as the baseline for comparing the future with project conditions and determining the effects each alternative would have on the local economy or social infrastructure. The future with and without project conditions are evaluated over a 50-year period of analysis.

The socioeconomic data was assembled from the 2000 US Census, with updated information where signified by reference from the US Census Bureau (*http://quickfacts.census.gov*). Information was also gleaned from the Bureau of Economic Analysis, US Department of Commerce; Pacific Northwest Regional Economic Analysis Project (*http://www.pnreap.org*). Forecast data was gathered from the Office of Financial

Management, State of Washington (*http://www.ofm.wa.gov*); and the Office of Economic Analysis, State of Oregon (*http://www.oregon.gov/DAS/OEA/index.shtml*). Agricultural land information was gathered from the US Department of Agriculture, the Census of Agriculture (*http://www.agcensus.usda.gov*).

3.8.1 Existing Conditions

The study area consists of a five-county area in the southeastern corner of Washington and northeastern Oregon. The proposed project will be located in Walla Walla County, Washington, and Umatilla County, Oregon. Therefore, these two counties will be impacted most by the project (Figure 3-16).

The study area contains a number of major interstates and highways. Interstates 84 to the south and west, and 82 to the west surround the borders of the area, while State Highway 12 runs through the middle of the area. Highways 730 and 11 also provide access to the core of the study area. The Walla Walla River is specifically accessed from Highways 11 and 12.

The US Census 2000 data for the two counties were compiled to describe the socioeconomic characteristics of each county, as well as for the overall study area. Updated census data was used whenever available.

Figure 3-16. Study Area for Socioeconomic Analysis

3.8.1.1 Umatilla County, Oregon

- **Land Use and Location**

  Umatilla County is located on the south side of the five-county study area. Much of the proposed project is located in Umatilla County, and the socioeconomics of the county will be impacted directly by the initial construction and future project effects. Umatilla County consists of a total of 2,057,600 acres, of which 1,447,321 acres (approximately 70%) of the land base is used for agricultural uses. The county seat is Pendleton, and

other major communities include Hermiston and Milton-Freewater. The county is strongly agriculturally-based. Fruit, grain, timber, cattle, and sheep are important agricultural products. The Umatilla Indian Reservation is located within the county boundaries as well. The socioeconomics of the proposed alternatives will greatly affect the socioeconomics of the CTUIR.

- **Population, Income, and Employment Characteristics**

  Umatilla County had an estimated population of 73,526 in 2008, and an actual population of 70,548 in the 2000 Census. The population percent change from 2000 to 2008 is estimated to be 3.2%. The population in 1990 was 59,249. The median age as of the year 2000 is 33.6. The percent of population 65 years of age and over in 2007 was 12.4%. In the same year, 26.2% of the county population was under the age of 18 years. Median household income estimated in 2007 was $40,773, and estimates indicated that 15.1% of the county population was living below the poverty level. Unemployment in Umatilla County was 3.8% as of the 2009 Census.

- **Housing Characteristics**

  In 2007, there were 29,158 housing units in Umatilla County. The median value of owner-occupied housing units in 2000 was $98,100.

3.8.1.2 Walla Walla County, Washington

- **Land Use and Location**

  Walla Walla County is centrally located within the five-county study area. Much of the proposed project alternative is located in Walla Walla County, and the socioeconomics of the county will be impacted directly from initial construction and future project effects. Walla Walla County consists of a total of 812,800 acres. Of this, 84% of that land (682,350 acres) is used for agricultural purposes. The county seat is the City of Walla Walla. Other major communities include College Place, Touchet, Burbank, and Waitsburg. Walla Walla County supports a diversity of industry, including agriculture, food processing, wine, higher education, and various government agencies.

- **Population, Income, and Employment Characteristics**

  Walla Walla County had an estimated population of 57,788 in 2008, and an actual population of 55,180 in the 2000 Census. The population percent change from 2000 to 2008 was estimated to be 3.7%. The population in 1990 was 48,439. The median age in 2000 was 33.9. The percent of population 65 years of age and over in 2007 was 13.5%. In the same year, 22.7% of the county population was under the age of 18.

Median household income estimated in 2007 was $44,167, with an estimated 17.4% of the county population living below the poverty level. Unemployment in Walla Walla County was 3.9% in the 2000 Census.

- **Housing Characteristics**

  In 2007, there were 22,547 housing units in Walla Walla County. The median value of owner-occupied housing units in 2000 was $114,300.

3.8.1.3 General Trends in Population, Household, and Employment within the Study Area

Table 3-19 summarizes population, employment, and housing characteristics for the two-county study area. For comparison purposes, Oregon and Washington states are also displayed.

Table 3-19. Trends in Population, Employment, and Housing Estimates

	Umatilla County	Walla Walla County	Oregon State	Washington State
Population 2008	73,526	57,788	3,790,060	6,549,224
% Chg 2000-2008	4.2%	4.7%	10.8%	11.1%
Median Age (2000)	34.6	34.9	36.3	35.3
% Under Age 18 (2007)	26.2%	22.7%	23.0%	23.8%
% Over Age 65 (2007)	12.4%	14.5%	13.0%	11.7%
Median Household Income (2007)	$40,733	$44,167	$48,735	$55,628
% Population Below Poverty Level (2007)	15.1%	17.4%	13.0%	11.4%
% Unemployment Rate (2000)	4.8%	4.9%	4.2%	4.1%
Housing Units (2007)	29,158	22,547	1,609,595	2,744,069
Median Value of Owner Occupied Housing	$98,100	$114,300	$152,100	$168,300

Table 3-20 estimates population, employment, and housing with the most current data available from US Census Data, as well as from the Bureau of Economic Analysis, US Department of Commerce; and Pacific Northwest Regional Economic Analysis Project.

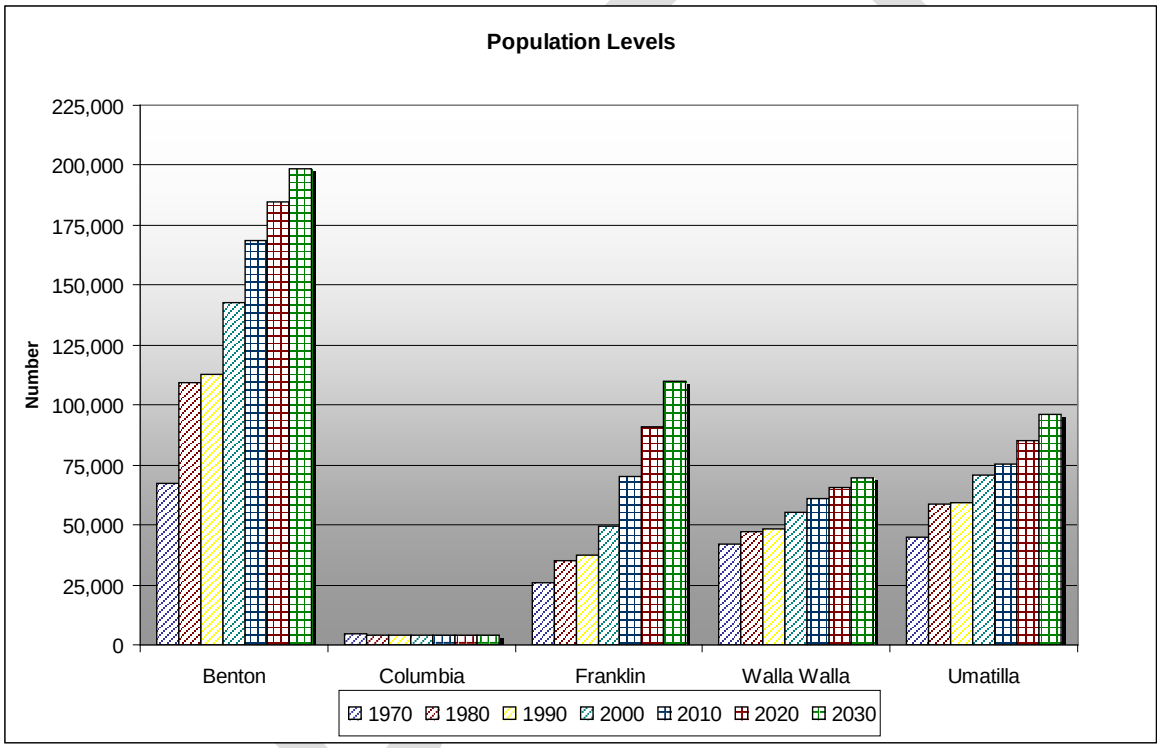
Table 3-20. Population, Employment, and Housing Estimates

County	Population (2008)	Employment (2000)	Housing Units (2007)
Walla Walla	57,788	31,508	29,158
Umatilla	73,526	38,577	22,547
Study Area Total	**371,145**	**175,926**	**128,941**

General trends in population were described by census data from 1970 to 2000, Office of Economic Analysis, State of Oregon (April 2004 forecast), and the Office of Financial Management, State of Washington – October 2007 forecast. The average growth for each county, from 1970 to 2000, represents steady growth. The future growth patterns projected through 2030 also represent steady growth (Figure 3-17).

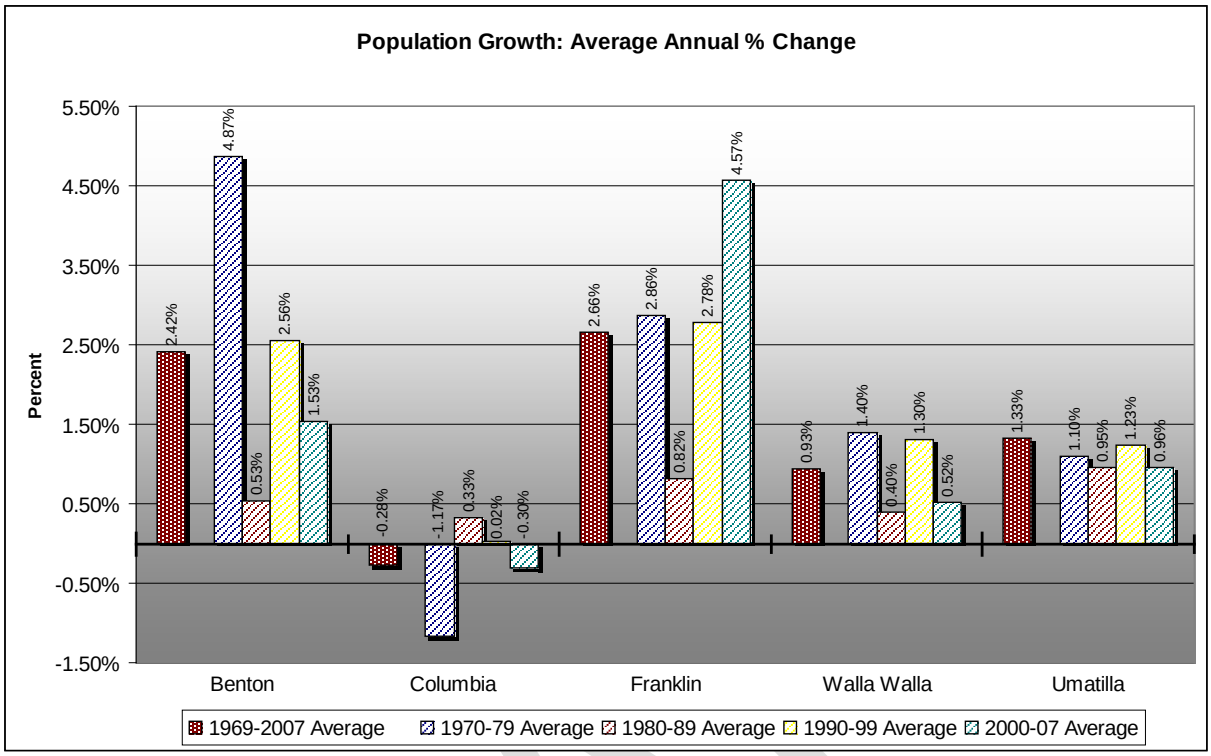
Data gathered from the Bureau of Economic Analysis, US Department of Commerce; and Pacific Northwest Regional Economic Analysis Project 2007, is used to show average annual population growth for the study area (Figure 3-18). Each county has experienced ups and downs in average annual population growth, but these trends follow the general trends of the United States as a whole. The average annual population growth for the State of Washington is 1.75%; the State of Oregon, 1.58%; and the United States, 1.07%.

Figure 3-17. Future Growth Trends



Source: US Census Bureau; Office of Financial Management, State of Washington; Office of Economic Analysis, State of Oregon

Figure 3-18. Average Annual Population Growth

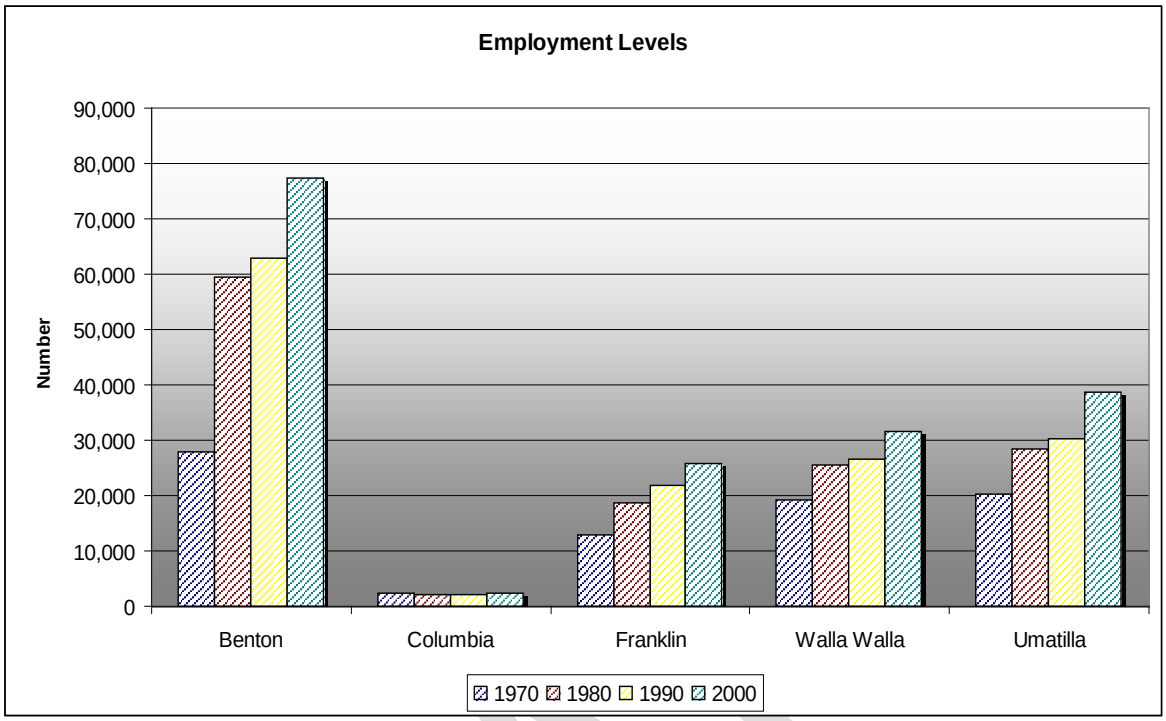


Source: US Census Bureau and Bureau of Economic Analysis

Data gathered from the Bureau of Economic Analysis, US Department of Commerce; Pacific Northwest Regional Economic Analysis Project 2007, is used to show trends in employment for the five counties in the study area. Employment levels show steady growth, similar to population growth over the same period of analysis of years 1970 to 2000. Employment levels as a percentage of total population do not show the same steady growth, although growth over the period of analysis is generally positive. No future projection data was available for this area for 2000 to 2030 (Figures 3-19 and 3-20).

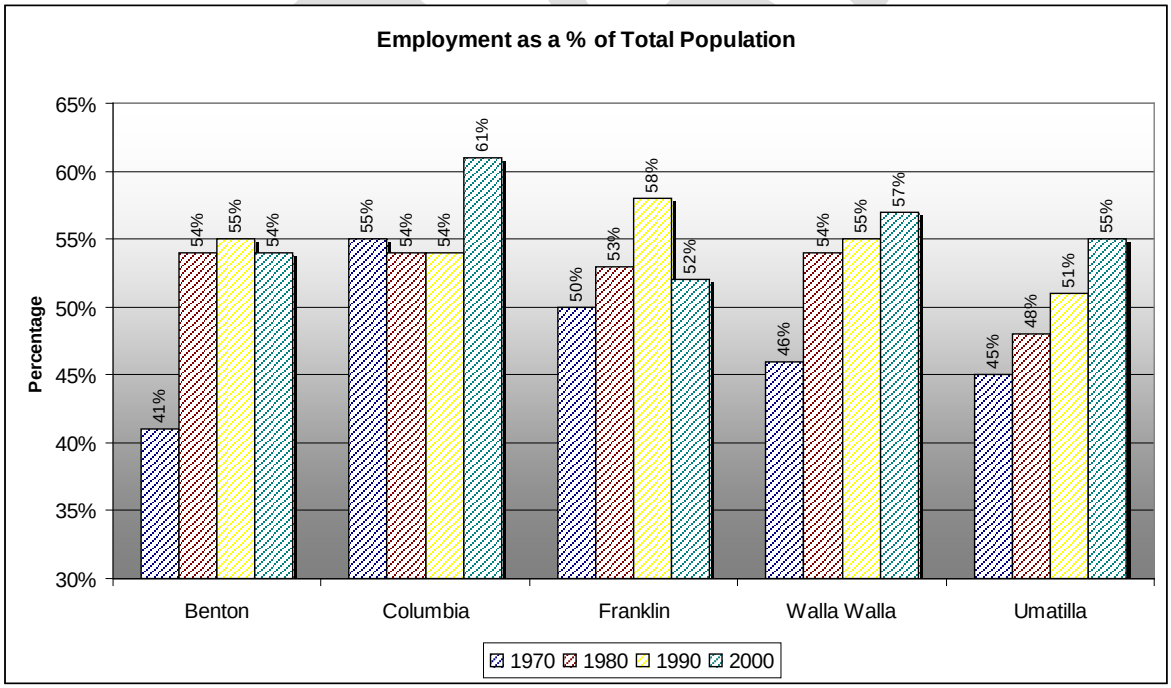
Table 3-21 lists major occupational categories for the counties within the study area. Although agriculture encompasses a large percentage of land ownership in the study area, a very low percentage of the population is actually employed in farming occupations.

Figure 3-19. Employment Level Trends



Source: US Census Bureau and Bureau of Economic Analysis

Figure 3-20. Employment as a Percent of Total Population



Source: US Census Bureau and Bureau of Economic Analysis

Table 3-21. Major Occupational Categories

Occupation Category	Walla Walla	Umatilla
Management, professional, and related occupations	35.4%	25.4%
Service occupations	18.9%	17.4%
Sales and office occupations	23.4%	23.3%
Farming, fishing, and forestry occupations	3.9%	3.5%
Construction, extraction, and maintenance occupations	8.8%	11.1%
Production, transportation, and material moving occupations	9.6%	19.3%
Total	**100%**	**100%**

3.8.2 Future Without Project Conditions

Only gradual, minor changes in population, employment, and land use are expected within the study area over the next 50 years. The current socioeconomic conditions of the two-county area will not be impacted significantly by not implementing a project that would restore fish habitat on the Walla Walla River.

3.8.2.1 Land Use

Only minor changes in land use are expected over the 50-year period of analysis. Agriculture is the largest land use in the area, and it is unlikely that significant changes will take place. A lack of water in the area and excessive drought over a long period, however, could have significant impacts. As the population of the study area increases, it is also likely that more agricultural land will be converted to developed acreage.

3.8.2.2 Population, Income, and Employment Characteristics

Based on the historical trends of all two counties in the study area, significant changes in population growth (in relation to historic conditions) are not expected. Population growth will occur over the period of analysis, but its effects on socioeconomics will be minimal.

Employment-level forecasts indicate that significant changes will not occur from the established current trends and conditions. Employment related directly to recreation on and around the Walla Walla River has already been impacted by a lack of water and fisheries. It is unlikely that those conditions will change over the period of analysis. Low water availability could, however, have additional impacts to recreation based-employment as well as employment supported by recreation and tourism.

3.8.2.3 Housing Characteristics

Housing characteristics are not expected to change from established current conditions over the period of analysis. Minor population growth will necessitate an increased number of housing units, but household values are unlikely to change from historical trends.

3.9 Aesthetic Resources

Aesthetic resources refer to visual, auditory, and olfactory perceptions. They play an important role in the way humans experience and relate to their environment. The management of aesthetic resources is necessary to maintain the quality of the environment. Aesthetics contribute to human quality of life, and often serve to reduce the stress of today's high-paced world. For this study, aesthetic resources are evaluated using *Landscape Aesthetics: A Handbook for Scenery Management* (USFS, 1995).

3.9.1 Existing Conditions

The WWRB covers approximately 4,558 km^2 (1,760 mi^2), located primarily in the rolling foothills of the Blue Mountains. Approximately 20%t of the basin is located in the steep, lightly-timbered western slopes of the Blue Mountains. Portions of two national forests and two wilderness areas fall within the WWRB. The city of Walla Walla is the largest urbanized area, covering approximately 26 km^2 (10 mi^2).

Urbanized areas are typical of smaller communities, with a mix of older and newer homes in various stages of aesthetic appeal and structural quality. Streets are typically narrow, and lined with mature street trees. Parks and other preserved open spaces along streams or rivers within the urbanized areas add to the visual appeal of each community.

Agricultural lands cover approximately 58 percent of the land within the basin, preserving open space. In recent years, residential development has spread into those agricultural areas not protected under zoning laws, resulting in a reduction in open spaces and intrusion into view sheds.

Land not urbanized or used for agriculture is typically rolling hills covered with native and/or invasive grasses. Basalt rock outcroppings are also typical, especially nearing the Columbia and Snake Rivers.

Rivers, streams, and other water bodies are lined with both native and ornamental vegetation in areas, creating green corridors in an otherwise arid climate. Many of these streams are natural in appearance, while others are heavily altered, particularly when moving through more urbanized areas.

Energy-producing windmills have also become ubiquitous on ridgelines visible throughout many areas of the basin, negatively impacting the natural look of the surrounding hills.

3.9.2 Future Without Project Conditions

Much of the landscape character and aesthetics of the WWRB will likely remain the same over the next 50+ years. The greatest changes will occur as the population of the

area grows, forcing homes to sprawl out from the city cores. More and more continuous farmland will be broken up by homes, and the landscape will appear more fragmented. As the wine industry continues to grow, typical row crops and wheat fields will be replaced by vineyards. This change will have moderate impact on the aesthetic qualities of the area.

3.10 Hazardous, Toxic, and Radioactive Wastes (HTRW)

Any material listed as a "hazardous substance" under the Comprehensive Environmental Response, Compensation and Liability Act, 42 USC 9601 et seq (CERCLA) falls under the umbrella heading of HTRW. Hazardous substances regulated under CERCLA include "hazardous wastes" under Section 3001 of the Resource Conservation and Recovery Act (42 USC 6921 et seq), "hazardous substances" identified under Section 311 of the Clean Air Act (33 USC 1321), "toxic pollutants" designated under Section 307 of the Clean Water Act (33 USC 1317), "hazardous air pollutants" designated under Section 112 of the Clean Air Act (42 USC 7412); and "imminently hazardous chemical substances or mixtures" on which the US Environmental Protection Agency (EPA) has taken action under Section 7 of the Toxic Substance Control Act (15 USC 2606). Petroleum or natural gas is not included unless already under one of the above categories.

This study seeks to facilitate the early identification and appropriate consideration of HTRW-contaminated areas, including the determination of viable options to avoid those areas and the establishment of procedures for the resolution of HTRW issues. The policy of the Corps is to avoid, where practicable, construction of projects in HTRW-contaminated areas. Consequently, determination is routinely accomplished before any land acquisition begins.

Due to the large geographic expanse of the area within which the alternatives could occur, the Corps conducted an extensive regional scale review of Federal, state, and local environmental records and databases for the Counties of Umatilla, Oregon, and Walla Walla, Washington. Reviews included the Superfund National Priority List of sites, underground storage tank (UST) site lists, and spill reports. Historical records were also reviewed. Two areas of concern were identified within the potential project footprint: 1) USTs and leaking USTs (LUSTs) at or near Wallula Junction; and 2) USTs and LUSTs within the Milton-Freewater city limits. The evaluation further revealed remedial clean-up actions, including contaminated soil removal and groundwater monitoring, has been done by landowners and state agencies in both locations.

Following completion of the feasibility study phase, during the Preconstruction, Engineering, and Design (PED) phase, the Corps will conduct an on-site assessment within the footprint of the selected alternative. If the assessment identifies potential HTRW's, testing and analysis would be conducted. This would include a determination of the nature and extent of contamination, as well as a qualitative analysis of the impacts of any contamination in the absence of response action. This will also

incorporate a preliminary identification of potential source areas, contaminant release mechanisms, exposure routes, potentially exposed populations, and a determination of the non-numerical risk or possible adverse health effects of the identified potential receptors.

3.11 Global Climate Change

Global climate change has become a point of concern, and the Corps recognizes the need to move toward incorporating climate projection information into the planning process. The most comprehensive climate change studies in the Northwestern United States, are being conducted by the Climate Impacts Group (CIG) at the University of Washington (UW). The following analysis of the effects of climate change on the study alternatives is based on the work of the UW CIG.

The CIG and many others have developed a number of GCMs to model global climate change beginning in the early 19th century. The GCM models have a large grid size, approximately 200 miles per side. Due to the size of the grid, detailed information for watersheds smaller than the entire Columbia Basin is not available. Each GCM is used to generate a variety of climate change scenarios based on different assumptions of initial conditions and future greenhouse gas production levels. The CIG is in the process of downsizing GCM results to a smaller, more regional, and temporally relevant resolution. These results have been applied to research topics that attempt to answer the impact expected from climate change on water supply and flood control. The Corps is attempting to incorporate some of this understanding in project planning and design; although climate change is a new, complex, and constantly changing science.

The UW's CIG has refined its understanding of potential Pacific Northwest Climate (PNW) climate changes through "downscaling" efforts of 10 GCMs and 40 scenarios. The GCMs make coarse scale forecasts of future precipitation and temperature levels, based on climate changing scenarios. Downscaling refers to reducing GCM results to smaller spatial and temporally useful data sets. The results of these analyses make for a more informed and discriminating decision-making ability for choosing between project alternatives.

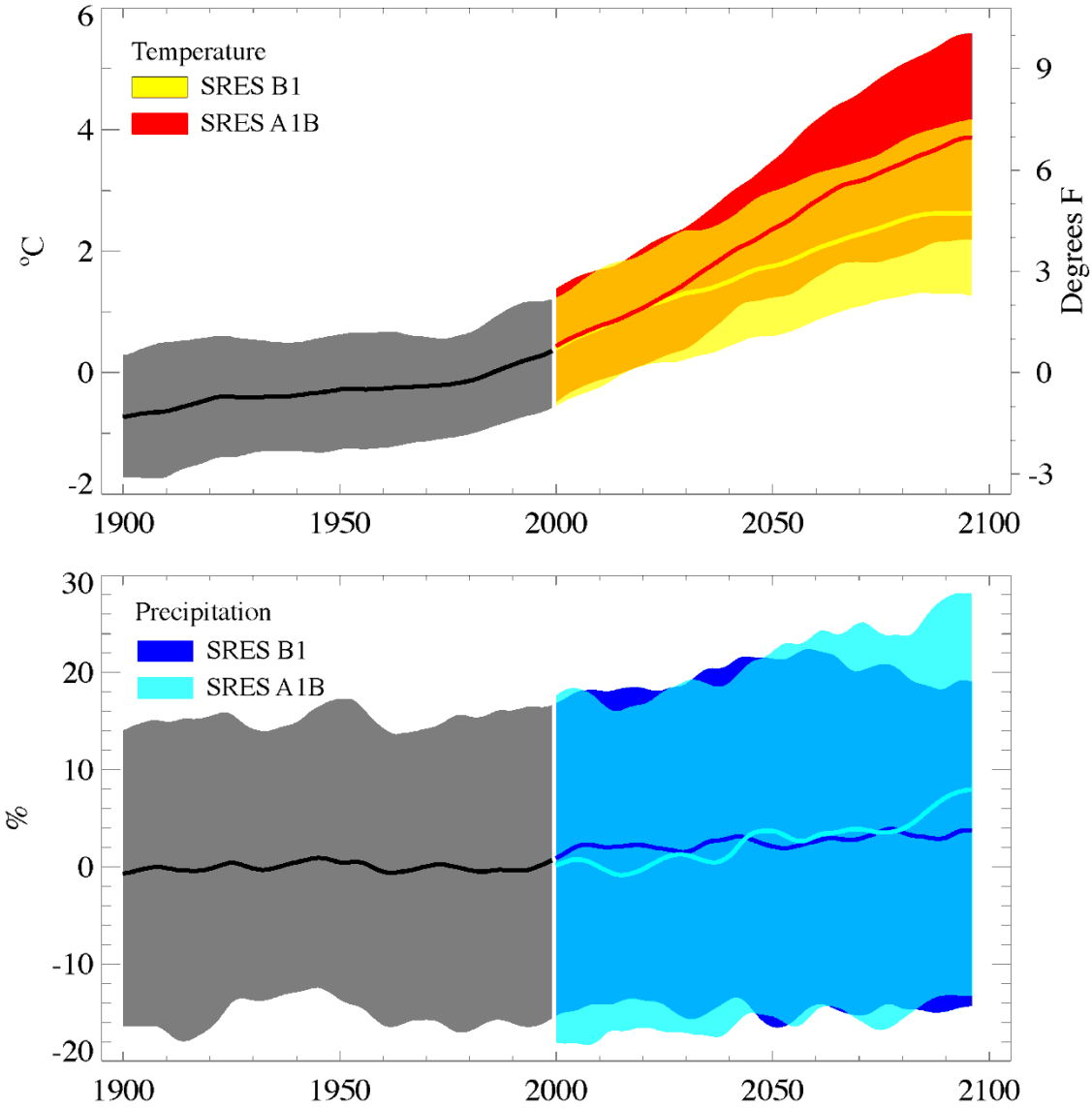
The CIG has identified the following general trends for the Pacific Northwest Climate:

- Average annual temperatures are predicted to rise 3 to 5 °F within the 2050 to 2060 timeframe (Figure 3-21).
- Overall annual precipitation will remain approximately the same.
- Warmer temperatures are expected to drive snow levels higher. Snow pack is expected to consistently decrease across the PNW region. In the context of the project timeframe, this is expected to amount to an approximately 40-percent reduction.

- Streamflow temporal patterns will change. Winters are expected to be warmer, but wetter. Spring and summer precipitation totals will decrease as temperatures increase. For watersheds dominated by snowpack, the pattern will transition to a more rain-like runoff response (Figure 3-22).

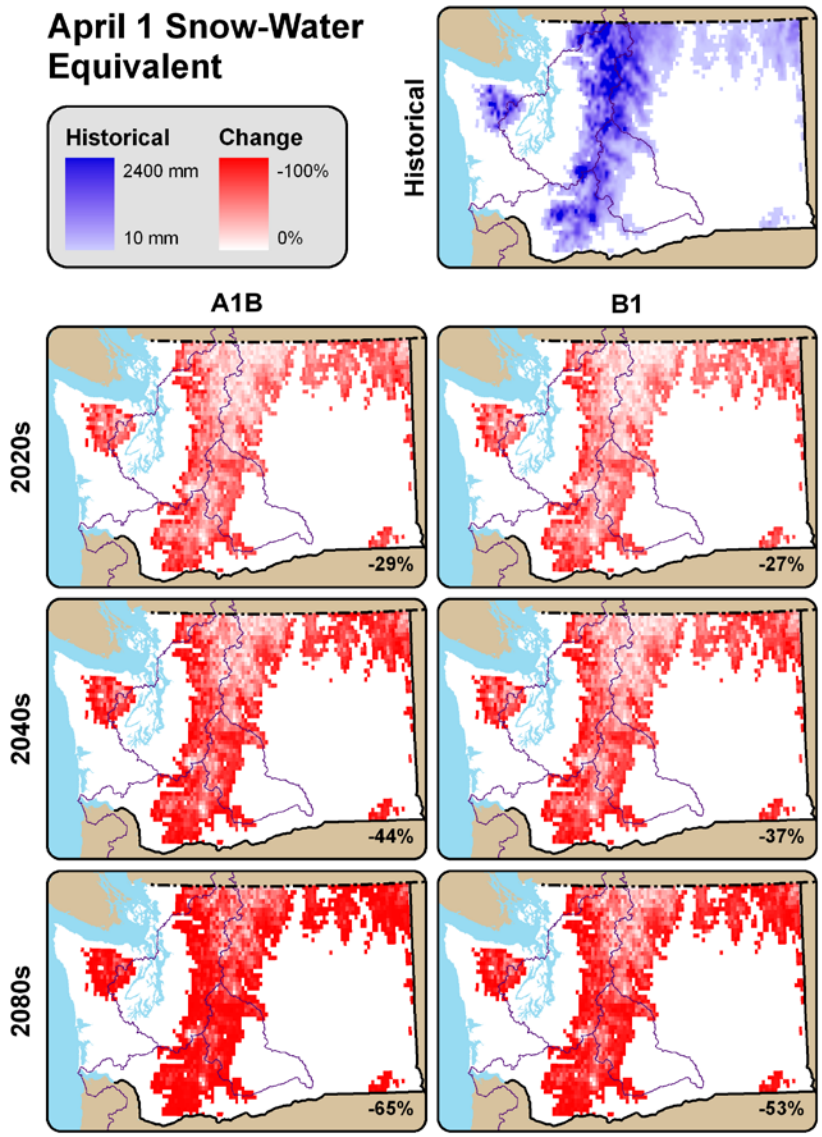
Different parts of the PNW may be affected differently by projected temperature increases. High elevation snow pack may not be as affected as severely as low elevation regions, with historic snow pack. Areas with little snow pack will also be affected less by temperature change.

Figure 3-21. Average Annual Temperatures and Precipitation



Source: Alan F. Hamlet, "A Comprehensive Hydrologic Data Base Incorporating IPCC Climate Change Scenarios to Support Long-Range Water Planning in the Columbia River Basin" June 2009.

Figure 3-22. Snow-Water Equivalent

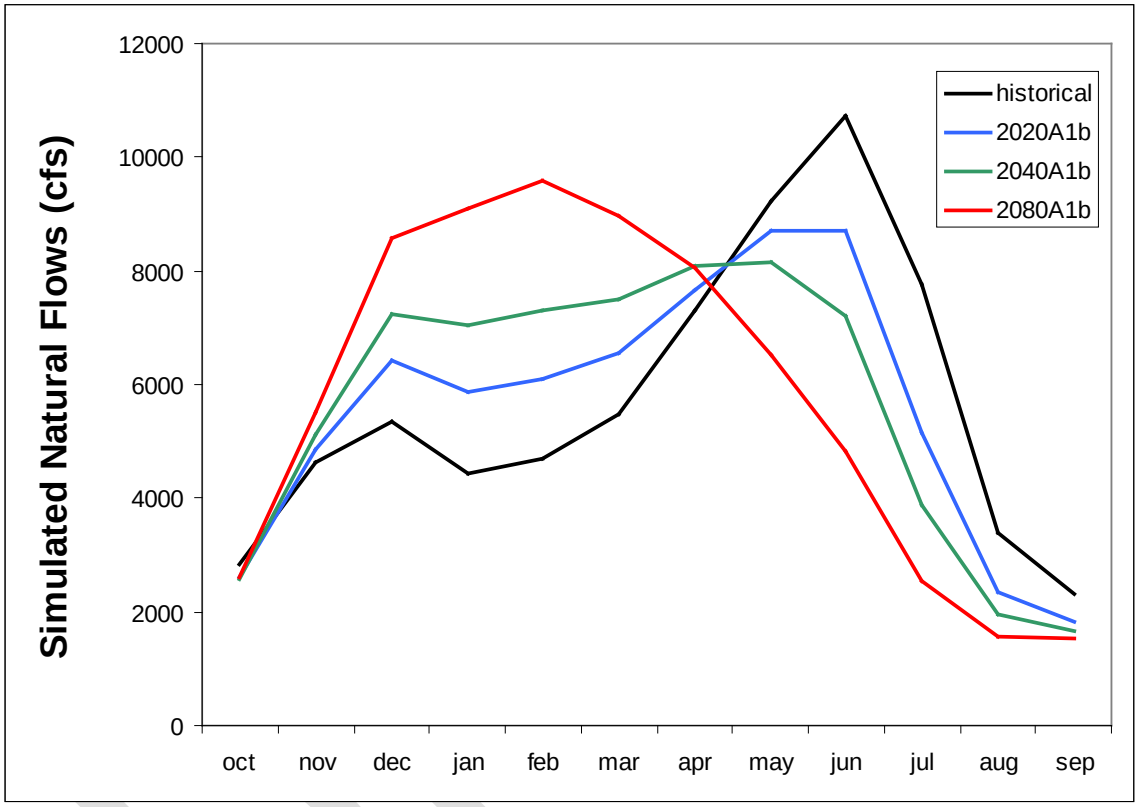


Source: Alan F. Hamlet, "A Comprehensive Hydrologic Data Base Incorporating IPCC Climate Change Scenarios to Support Long-Range Water Planning in the Columbia River Basin" June 2009.

The WWRB is located in northeast Oregon and southeast Washington, which is very similar climatically to the southeastern region. The natural hydrograph for the Walla Walla River is characterized by numerous "flow spikes" and a general high flow season in the late spring. This indicates that basin rain fall and snow pack both drive climates in the basin. Peak flows are generated by rain events, while highest volumes are the result of snow melt. Based on CIG modeling, the WWRB hydrograph will likely become more rainfall driven (like the red and green lines shown in Figure 3-23).

It is anticipated that higher runoff volumes will occur during the winter and early spring, and be less during the summer months. These shifts may potentially increase flood risks in the early spring, and change the timing and volume of water in spring and early summer. Climate change may increase the value of storage for the purpose of providing irrigation flows, but this is not the purpose of the project. Therefore, this will not be considered in the selection of the preferred alternative.

Figure 3-23. Precipitation



Source: Alan F. Hamlet, "A Comprehensive Hydrologic Data Base Incorporating IPCC Climate Change Scenarios to Support Long-Range Water Planning in the Columbia River Basin" June 2009.

SECTION 4 – FORMULATE AND EVALUATE ALTERNATIVE PLANS

4.0 Alternative Formulation Rationale

A broad range of alternative approaches were considered during development of the proposed project. Alternatives were generated from the combination of measures recommended by the local sponsor (CTUIR), local interest groups, public meeting participants, input from other governmental resource agencies, non-governmental organizations, and the Corps PDT.

4.1 No Action

The Corps is required to consider "No Action" as one alternative for any potential project in order to comply with the requirements of the National Environmental Policy Act (NEPA). With the No Action plan, synonymous with the "Future Without Project Condition," it is assumed that no project will be implemented by either the Federal government or local interests to achieve the planning objectives. The No Action plan forms the base condition against which all other alternative plans are measured.

4.2 Measures to Address Identified Planning Objectives

A measure is a feature or activity at a site that addresses one or more of the planning objectives identified for this study. A wide variety of measures were considered, although several were found to be infeasible due to technical, economic, or environmental constraints. Each measure was assessed, and a determination was made regarding whether it should be retained in the formulation of alternative plans.

The measures were divided into two categories: stand-alone and optional measures. A stand-alone measure is a measure that can be constructed independent of others with varying levels of restoration output. A stand-alone measure cannot be combined with any other stand-alone measure.

Optional measures can be constructed with any other measure. Optional measures may be combined with each other, as well as with any of the stand-alone measures.

Descriptions and results of the evaluations of measures considered in this study are presented in the following paragraphs.

4.3 Stand-Alone Measures

4.3.1 Measure 1—Off-Channel Storage

The construction of an off-channel reservoir (or reservoirs) was considered as a means of meeting the goals and objectives of the study. The concept behind the storage reservoir is that water from the mainstem Walla Walla River, or another existing

creek/river within the overall basin, will be diverted and stored when flows are in excess of instream flow needs. This stored water would then be delivered to local irrigators. As a result, these irrigators will not withdraw instream flows from the mainstem Walla Walla River. Water exchanged with irrigators will be equal to the amount of water left instream ("bucket for bucket" exchange). Water from the storage reservoir will be conveyed to an irrigation dispersal point for distribution. This exchange of water will allow for the irrigation community to use the stored water for beneficial use (farming, etc.), while the mainstem Walla Walla River will benefit from increased instream flows that work towards meeting the objectives and goals of the restoration study.

The Reconnaissance Report (Corps, 1997) identified four potential off-channel storage reservoir options (sites): 1) Scott Canyon; 2) Keseberg Canyon; 3) Russell Creek; and 4) Whiskey Creek. When the feasibility study was initiated, it was determined that an evaluation of a wider range of sites was warranted, and efforts began to identify other sites along the Walla Walla River. Several possible reservoir locations were identified, principally through offsite terrain analysis and screened through informal site visits. Sites containing homes or other improvements, or other incompatible onsite features (i.e., wind power generators), were eliminated from the initial list of sites.

From this analysis, 42 sites (Table 4-1) were identified by the team as potential storage reservoirs. Sites were chosen based on their location in the watershed system, as well as the potential to supply water to irrigators in lieu of water withdrawal from the Walla Walla River. Various sizes/scales of storage were analyzed to determine feasibility and level of benefit. The United States Geological Survey (USGS) quad maps were used to describe the locations. These 42 sites were then screened against the following criteria:

- Impacts to ESA-listed species
- Geologic site characteristics
- Amount of storage
- Area of in-flow
- Impacts to agricultural production

Table 4-1. Potential Reservoir Locations

Site	State	Location	USGS Quad Map	Drainage Area (Acres)
Dry Creek (Oregon) #1	OR	Dry Ck (OR)	Milton-Freewater	24569.0
Little Rayburn Canyon	OR	Dry Ck (OR)	Weston Mountain	917.0
Cup Gulch	OR	NF WW	Peterson Ridge	2114.0
Pine Creek (Oregon) #1	OR	Pine Ck	Waterman	36525.0
Cup Gulch	OR	NF WW	Peterson Ridge	2114.0
Pine Creek (Oregon) #1	OR	Pine Ck	Waterman	36525.0
Burnt Cabin Creek	OR	SF WW	Tollgate	3834.0
Flume Canyon	OR	SF WW	Blalock Mountain	2608.0
Keseberg Canyon	OR	SF WW	Weston Mountain	1214.0

Table 4-1. Potential Reservoir Locations (continued)

Site	State	Location	USGS Quad Map	Drainage Area (Acres)
McDougall Camp	OR	SF WW	Blalock Mountain	1294.0
Scott Canyon	OR	SF WW	Weston Mountain	600.0
South Fork Walla Walla	OR	SF WW	Blalock Mountain	31622.0
Tamarack Basin	OR	SF WW	Blalock Mountain	1104.0
Upper Couse Creek	OR	SF WW	Blalock Mountain	2927.0
Whiskey Spring	OR	SF WW	Tollgate	1361.0
Birch Creek	OR	WW	Bowlus Hill	3575.7
Cache Hollow	OR	WW	Bowlus Hill	1911.0
Eastside Gravel Pits	OR	WW	Milton-Freewater	103739.0
Milton-Freewater (field)	OR	WW	Milton-Freewater	103730.0
Milton-Freewater (foothill)	OR	WW	Bowlus Hill	23744.0
Cottonwood Creek	OR	Yellowhawk Ck	Peterson Ridge	11226.0
Russell Creek	WA	Dr Ck (WA)	Valley Grove	84032.0
Small Draw near Stovall Road and Frog Hollow	WA	Little WW	College Place	103730.0
Bennington Lake	WA	Mill Ck	Walla Walla	48824.0
Blue Creek	WA	Mill Ck	Kooskooskie	5884.0
Mill Creek Watershed	WA	Mill Ck	Big Meadows	22012.0
Griffin Fork	WA	Touchet	Deadman Peak	3487.0
South Fork Touchet River	WA	Touchet	Robinette Mtn	16485.0
Whiskey Creek	WA	Touchet	Coppei	4028.0
Whitney Creek	WA	Touchet	Eckler Mountain	1745.0
Deadman Gulch	OR	SF WW	Tollgate	648.0
Patit Creek #1	WA	Touchet	Dayton	34619.0
Dry Creek #1 (WA)	WA	Dry Ck (WA)	Lowden	153294.0
Dry Creek #2 (WA)	WA	Dry Ck (WA)	Hadley	96184.0
Dry Creek #3 (WA)	WA	Dry Ck (WA)	Valley Grove	35444.0
Dry Creek (OR) #2	OR	Dry Ck (OR)	Milton-Freewater	21787.0
Patit Creek #2	WA	Touchet	Dayton	32800.0
Pine Creek (OR #2	OR	Pine Ck	Athena	22614.0
Pine Creek (OR) #3	OR	Pine Ck	Athena	9005.0
Patit Creek #3	WA	Touchet	Cahill Mountain	11617.0
Tracy Diversion to Dry Creek	WA	Dry Ck (WA)	Buroker	44655.0
Pine Creek (OR) #4	OR	Pine Ck	Weston Mountain	5365.0
North Fork Walla Walla	OR	NF WW		2845.0
Tiger Creek	OR	Mill Ck		4685.0

Of the 42 sites, 21 were eliminated based on the presence of ESA-listed species. The study team, along with various agency and irrigation district representatives, conducted an onsite review of the remaining 21 sites (Table 4-2). These sites were further screened based on:

- Proximity to known existing low-flow reaches of the Walla Walla River and tributaries
- Proximity to participating irrigation districts
- Hydraulic and hydrologic capacity/yield
- Impacts to species not listed under the ESA
- General suitability (seepage, etc.)

Following the second round of screening, two off-channel storage sites were selected as appropriate for storage development. This selection was based on further screening, using three criteria: 1) size; 2) landowner issues (willingness to partner); and 3) potential benefits (amount of flow left instream, etc.). The upper and lower Pine Creek locations were selected based on their general suitability and hydraulic and hydrologic capacity and yield (Table 4-3).

A primary benefit of off-channel storage is the ability to capture water in the basin that is normally passed downstream during high flow events in winter and early spring. This allows demand to be met for instream habitat conditions and regional irrigation to continue without impacts. Another benefit is a decrease in water temperatures in the mainstem Walla Walla River as flow levels increase, benefiting water quality. The system is also fairly self-sufficient. The two site locations will allow the use of gravity to fill and empty the reservoir most of the time. This is a significant savings in both pumping costs and the long-term operations and maintenance required for this project. No ESA issues exist within the storage footprint and, therefore, mitigation is minimal for the Pine Creek sites. Offsite storage lowers the risk of realizing project benefits, as well. Some amount of carryover is calculated to account for the 30-year historic water flows, while dam sizes were optimized to account for the variability of water flows. This allows water to be carried over in high flow years to aid during lower flow years.

Other benefits revolve around process and the protection of instream flows. Under current Oregon water law, the implementation of offsite storage requires only minor changes for this project to be implemented. Offsite storage also allows instream flows to be protected. Any water left in the river can be protected by Oregon water law.

Table 4-2. Potential Storage Reservoir Sites after Initial Screening

Site	State	Location	Maximum Capacity (AF)	Maximum Dam Height (Feet)
Dry Creek (Oregon) #1	OR	W of Milton	58734	300
Dry Creek (Oregon) #2	OR	S of Milton	74389	300
Dry Creek (Oregon) #3	OR	S of Milton	44943	300
Little Rayburn Canyon	OR	SE of Milton	2959	25
Cup Gulch	OR	E of Milton	5075	250
Pine Creek (Oregon) #1	OR	SW of Milton	25000	200
Pine Creek (Oregon) #2	OR	SW of Milton	60000	250
Flume Canyon	OR	E-SE of Milton	3737	250
Keseberg Canyon	OR	SE of Milton	2540	250
Scott Canyon	OR	SE of Milton	2410	250
Upper Couse Creek	OR	SE of Milton	5802	250
Cache Hollow	OR	E-SE of Milton	2729	200
Milton-Freewater (field)	OR	W of Milton	17499	250
Milton-Freewater (foothills field)	OR	E of Milton	20408	250
Russell Creek	WA	N of WW	2476	100
Blue Creek	WA	E of WW	6323	250
Whiskey Creek	WA	SE of Waitsburg	12458	250
Patit Creek #3	WA	E of Dayton	59670	300
Tiger Creek	OR	E of WW	5398	250
White Reservoir	OR	W of Milton	1158	40
Milton-Freewater (Humbert)	OR	E of Milton	21004	250

Table 4-3. Potential Storage Reservoir Sites after Second Screening

Description	Lower Reservoir Site	Upper Reservoir Site		
		Small	Medium	Large
Total Storage (AF)	28,000	37,500	50,000	65,000
Active Storage (AF)	25,000	34,000	45,000	60,000
Spillway Length (feet)	100	100	100	100
Spillway Elevation	865,0	1,035.5	1,057.0	1,079.5
Standard Project Flood Water Surface Elevation	871.4	1,041.9	1,064.4	1,085.9
Probable Maximum Flood Water Surface Elevation	875,2	1,045.7	1,067.2	1,089.7
Top of Dam Elevation	878.0	1,048.5	1,070.0	1,092.5
Approximate Height of Dam (feet)	200	230	250	275

With the benefits come potential disadvantages, as well. As discussed, dam sizes were optimized to meet demand. If the 30-year hydrographic changes in the future, there may not be enough water for storage purposes and project demand will not be met.

The second disadvantage is the cost. While operation and maintenance costs have been optimized, the cost to build storage dams and reservoirs of this size is quite high. Thirdly, there are no ESA issues within the storage footprint and, therefore, mitigation is minimal for the Pine Creek sites. Building a reservoir in the Pine Creek location prevents irrigators from using Pine Creek water and, as a result, water will need to be supplied to these irrigators. Another disadvantage is the potential for the possible relocation of home owners in the area. Each potential landowner facing relocation has been heavily involved in this project. Landowners are amenable to relocation, and it appears that it could occur in a timeframe supportive of the project schedule. Yet another disadvantage is that, while instream flows can be protected in Oregon, no legal instrument exists to protect the flows once they cross into Washington State. Washington relinquishment laws make this especially problematic. If a Washington water right holder does not use water available to them for beneficial use in a successive 5-year period, their water right is lost. That means that the water left instream by Oregon irrigators must be used by Washington irrigators, or Washington irrigators will lose their water rights. Therefore, the instream flow passes statelines, it will be intensively withdrawn by water right holders, thereby discounting any benefits that might have been realized by this section of the river.

For planning purposes, both earth embankment and roller compacted concrete (RCC) dams were considered for construction. The RCC dams proved to be more expensive, and carried the same amount of risk as earth embankment structures. As a result, RCC dam structures were removed from further consideration.

Under the earth embankment scenario, a single system of pipeline, pump station, and discharge structures were considered. Each reservoir, including the damsite, will encompass over 300 acres. The dam alignments will span Pine Creek Valley, and a water intake will be constructed at Cemetery Bridge to withdraw water from the Walla Walla River for reservoir fill. Appendix B-3, *Off Channel Storage*, contains further details on sub-options at each site.

4.3.2 Measure 2—Columbia River Water Exchange

Similar to the storage reservoir, an exchange pipeline with the Columbia River was considered as a means of meeting the goals and objectives of this study. The concept of an exchange pipeline involves the delivery of Columbia River water to irrigators in lieu of their withdrawal of instream flows from the Walla Walla River. Water exchanged with the irrigators will be a “bucket for bucket” exchange. Additionally, the exchange results in no net loss for the Columbia River. While water is taken from the Columbia River and delivered to irrigators in the basin, the instream flows left in the Walla Walla River return to the Columbia River at the confluence of the two rivers.

The general concept for the Columbia River Water Exchange (CRWE) measure is to reduce irrigation surface water withdrawals from the Walla Walla River by supplying an alternative source of water directly to irrigation distribution systems, thus leaving more

of the natural Walla Walla River flows instream. The alternate source of water for this measure is the Columbia River. Current sources of irrigation water include surface waters of the Walla Walla River, Touchet River, Mill Creek, and Yellowhawk Creek.

The water for the CRWE will be routed from a pump station located on the Columbia River near the mouth of the Walla Walla River. It will then be delivered to a total of ten existing points of delivery (POD) operated by the Gardena Farms Irrigation District (GFID), Walla Walla River Irrigation District (WWRID), and Hudson Bay District Improvement Company (HBDIC).

Using this general concept, the Corps used historical irrigation demand and available flow in the Walla Walla River to develop a peak delivery rate of 175 cubic feet per second (cfs) from the Columbia River. The Corps then contracted an evaluation of the CRWE measure, and this 175-cfs peak delivery rate was used by the contractor to develop alternatives.

The contractor's evaluation explored several realistic configurations for a conveyance system to deliver Columbia River water to irrigation distribution systems, and developed sufficient detail to screen the conveyance alternatives. The result of these evaluations led to the further consideration of five conveyance systems for CRWE. Further details can be found in Appendix B-1, *Columbia River Water Exchange*.

4.4.2.1 Conveyance System 1—Independent Conveyance Systems

Conveyance system 1 will pump water from the Columbia River into a pipeline, and deliver it into the existing canal system at six PODs. The first POD is at the Gardena Farms Bifurcation. Booster pumps, storage tanks, and smaller pipelines will be used to deliver water from this point to subsequent PODs, with the final POD located at the Frog (the structure, near Milton-Freewater, where the Little Walla Walla River is divided into separate conveyance channels by WWRID and HBDIC). The conveyance pipeline system will reduce in size as flow is discharged along its alignment.

4.4.2.2 Conveyance System 2—Integrated Conveyance Systems with No Pumping from the Walla Walla River

Conveyance system 2 will pump water from the Columbia River into a pipeline, and deliver it into the existing canal system at four PODs. The existing canals within WWRID and HBDIC, as well as a portion of the GFID main canal, will be replaced with pipelines suitable for operation at relatively low pressures.

4.4.2.3 Conveyance System 3—Integrated Conveyance Systems, Including Pumping from the Walla Walla River

For conveyance system 3, water will be pumped from the Columbia River into a pipeline, and delivered into the existing canal system at four PODs. The existing canals within GFID, WWRID, and HBDIC will be replaced with pipelines operating at irrigation delivery pressure rather than low pressure pipes. When flow is available from the Walla Walla River, a portion will be pumped into the closed, fully-pressurized system in order to serve the higher elevation lands near the Frog. Flow will also be pumped from the Walla Walla River at the Gardena Farms diversion point.

4.4.2.4 Conveyance System 4—Independent Conveyance System (Following Parts of Burlingame Ditch)

The alignment of conveyance system 4 follows the same route as the previous three systems between the Columbia River and the Gardena Farms Bifurcation. Starting at the bifurcation, a new pipeline will be installed parallel to the existing siphon, and will generally follow the Burlingame Ditch alignment (approximately 7.5 miles to the east). The existing siphon will remain in service to convey flow from the Walla Walla River whenever adequate river flow exists to provide both instream fish requirements and irrigation needs.

4.4.2.5 Conveyance System 5—Independent Conveyance System (Relatively Direct Alignment from Gardena Farms Bifurcation to the Frog), With Connector Pipe and Provision for Piping of Selected Ditches

Conveyance system 5 is a blend of systems 1 and 2. The blended system will consist of a trunk line, pump stations, and tanks, as described for system 1 (Appendix B-1, *Columbia River Water Exchange*. It will pipe only those ditches where eliminating seepage losses will have a minimal impact on nearby wells and natural springs. Conveyance system 5 will also include a relatively short connector pipe between the Richartz and Huffman Canal system and the upper Burlingame Ditch. This connector pipeline will be sized to convey water to the turnouts along the upper Burlingame Ditch, and will be used when adequate flow to serve these turnouts is not available in the Walla Walla River. The connector pipe could be used at other times as well, depending on operational preferences. Based on an analysis of existing hydrologic records, this connector pipeline will allow full exchange demand to be met 100 percent of the time.

It is noted that the conveyance systems for CRWE can be altered in delivery capacity (to deliver more or less water) to accommodate the “bucket for bucket” exchange. The intent of this measure is to mimic the natural hydrograph, rather than attempt to level it out or meet water right allocations in an over-allocated system. In most years, a 140-cfs capacity system is highly reliable in the months where water exchange is necessary (Table 4-4, June through November). For the higher flow water years (water years above the 90th percentile), a 175-cfs exchange system is warranted. For low-flow water years (flows in the bottom 10th percentile), a 100-cfs system is ideal.

Table 4-4. Statistical Data for the 38-Year Historic Record above Cemetery Bridge

	5th Percentile (cfs)	10th Percentile (cfs)	50th Percentile (cfs)	90th Percentile (cfs)	95th Percentile (cfs)
Jan	116	129	297	535	782
Feb	124	142	336	565	719
Mar	173	297	373	615	759
Apr	258	285	466	728	842
May	217	244	483	791	889
Jun	130	142	277	474	622
Jul	109	114	146	188	210
Aug	103	106	130	162	168
Sep	98	104	128	155	160
Oct	95	103	131	159	174
Nov	109	114	192	288	385
Dec	117	125	255	447	620

The ability of different-sized exchange systems will be evaluated against the entire 38-year historic record, and the days out of compliance will be calculated. This information will be used so that the use of the system is accounted for during the decision-making process. For instance, while a 175-cfs system is highly reliable for higher flow water years, it would only be operated 65 percent of the time. The remaining 35% of the time, the "bucket for bucket" limitation does not require a system that large.

As with storage, there are many benefits to the CRWE measure. First, flow will be augmented with Columbia River water, allowing habitat conditions and regional irrigation to co-exist. Temperatures in the Walla Walla River will likely decrease with increased summer flows. Columbia River flows are more reliable than those of the Walla Walla River at this time. Therefore, the "bucket for bucket" exchange with irrigators has very little risk in its ability to deliver water during subsequent low-flow years. The implementation cost of an exchange pipeline is less than that of a storage reservoir. Since the instream benefits of the projects are virtually the same, the implementation cost savings is a benefit. Lastly, the pipeline runs along existing ditches and roads, and has no major impacts to irrigators or ESA-listed species, significantly reducing the amount of mitigation required by a project of this size.

There are also many disadvantages to the CRWE measure. The annual operation and maintenance costs for CRWE are significant. The electrical power required to pump water through approximately 39 miles of pipeline is extensive. In addition, the sponsor does not own any of the land through which the pipeline will run. Many landowners and orchards will be impacted by this project, although none require relocation. There are restrictions on getting water rights from the Columbia River, which include a "no net loss" policy. Summer appropriations are limited, as well. Therefore, restrictions will need to be waived for this measure to be implemented. By far the largest disadvantage, as with storage, is that no legal instrument exists to protect the flows once they cross

into Washington State. As stated in paragraph 4.1.1, above, if Oregon irrigators leave instream flow in the Walla Walla River, Washington irrigators will have to withdraw the water or risk losing water rights.

Appendix B-1, *Columbia River Water Exchange*, contains further details on the five conveyance systems.

4.3.3 Measure 3—Irrigation Efficiency

In addition to storage and water exchange, irrigation efficiency was pursued as a way of accomplishing the goals and objectives of the study. This measure improves the efficiency with which irrigation water is conveyed and utilized within the WWRB. The intent of irrigation efficiency is to reduce irrigation water withdrawals from the instream flows of the mainstem Walla Walla River by reducing irrigation water lost through inefficient irrigation practices, seepage and evaporation, consolidation of systems, or by reducing or eliminating tailwater discharges. The quantity of conserved water will remain in the river to aid in meeting the goals and objectives of this study.

The PDT invited several irrigation districts to participate in this measure, based on the potential to provide irrigation efficiency benefits when and where needed and in sufficient quantity to support the planning objectives of this study. The PDT did not invite the participation of other irrigation districts in the basin because, principally based on location, they had little or no potential to support the planning objectives of this study. Once the focus of the study was narrowed, only four irrigation districts were located within the focus area. The GFID, WWRID, and HBDIC expressed interest in participating in an irrigation efficiency measure. The Dayton Irrigation District chose not to participate. Appendix B-2, *Irrigation Efficiency*, Plate 1, contains locations and areas served by each participating district.

Through discussion with internal and external stakeholders, the primary modes of achieving study goals and objectives for irrigation efficiency involved reducing seepage and consolidating infrastructure. The majority of efficiency measures involving irrigation water practices (reducing inefficient water applications, etc.) have already been implemented in the area. Two options were evaluated as a way to reduce seepage: 1) lining irrigation ditches; and 2) piping irrigation ditches. The replacement of multiple canals, a more efficient and compact piping system, and the elimination of all duplicate conveyance systems, were evaluated under the consolidation option. Appendix B-2, *Irrigation Efficiency*, contains more information regarding the consolidation option.

Based on initial efficiency discussions and a better understanding of goals and objectives of this study, more data on the irrigation practices of the three irrigation districts were compiled. The Corps contracted HDR Engineering to evaluate WWRID and HBDIC, due to the complexities and layout of the two irrigation districts. The PDT evaluated GFID. The findings of these evaluations are contained in Appendix B-2, *Irrigation Efficiency*.

One of the benefits of irrigation efficiency is that water currently being diverted and lost to seepage is now available for instream flow. This is a direct benefit to the mainstem Walla Walla River. The second advantage is that efficiency will be implemented through current canals and ditches, thus minimizing impacts to ESA-listed species and landowners. The third benefit is that water saved by Washington irrigators through efficiency can be protected in Washington by the Washington Water Trust Program. The ability to secure instream water under this program relies heavily on the seniority of the water rights.

The disadvantages of irrigation efficiency are substantial, however. Water has been over-appropriated in both states. Even the most efficient water delivery system cannot provide adequate water to irrigators to meet instream goals. The aquifer in the region is declining at a significant pace. Lining or piping irrigation canals and ditches takes more water away from the aquifer, thereby causing it to decline even further (see Appendix A, Hydrology and Hydraulics). In addition, agreements must be created between the irrigations districts and the non-Federal sponsor, and those agreements will need to be coordinated and approved through state water masters. This complicated process could take years, thereby increasing the risk of realizing benefits. Since water has been over-appropriated in both states, many water right holders currently do not get their full quantity of water authorized by their certificate of water right. Because of this, irrigation districts may be unwilling to negotiate water savings for instream flow use when the full legal water right is not realized even now. The timing of the saved water is critical in meeting the goals and objectives of this study. Saving water in March does not benefit the project, because there is usually plenty of instream flow in March to meet both irrigation demand and instream flow goals. As with storage and exchange, the biggest disadvantage of this measure is the lack of a legal instrument to protect instream flow as it crosses the border between Washington and Oregon. The “use or lose” policies in the State of Washington do not protect water saved for instream flow purposes by Oregon irrigators once it crosses state lines.

4.3.4 Measure 4—Water Right Acquisition

In addition to structural solutions, water right acquisition was also evaluated. By purchasing water rights, the non-Federal sponsor or the State of Washington or Oregon (as applicable) will hold the right and choose to leave the water instream. The Corps does not have the authority to purchase or legally hold individual water rights, so the sponsor is the responsible manager of a water right acquisition implementation plan. It is possible that the individual state may be required to hold the water right because of laws and regulations in each state regarding who can hold and protect an instream water right from consumptive use.

For the feasibility phase of this study, efforts for this measure focused on the development of a strategy for acquiring water rights. The identification of specific water rights for both potential and actual acquisition of water rights will occur following completion of the feasibility phase.

The services of the Oregon Water Trust (OWT) and the Washington Water Trust (WWT) were enlisted by the Sponsor to investigate water right acquisition options and assist in the development of a recommended acquisition strategy (Appendix I, *Water Law and Water Right Acquisition*). The report details the process used in building a comprehensive water rights database, prioritized by geographical locations, with a priority value calculated for many of the individual water rights in the basin. It provides an assessment of the current methods and approaches for valuing water, as well as a recommendation for a preferred strategy for valuing water rights within the context of this study. It also discusses the variety of methods and tools used for acquiring water rights.

The main benefit behind water right acquisition is the cost. If there are water right holders amenable to selling their rights for instream flow use, the cost of implementing a project will be drastically reduced, particularly when compared to structural measures. Water rights can also be sold without purchasing land, significantly reducing the real-estate acquired in support of this project. It is assumed that current landowners will transition their land from a crop with irrigation needs to either a dry-land crop or residential development. Since only the rights will be purchased, mitigation will not be required as long as wetlands/habitat are not impacted by the land conversion.

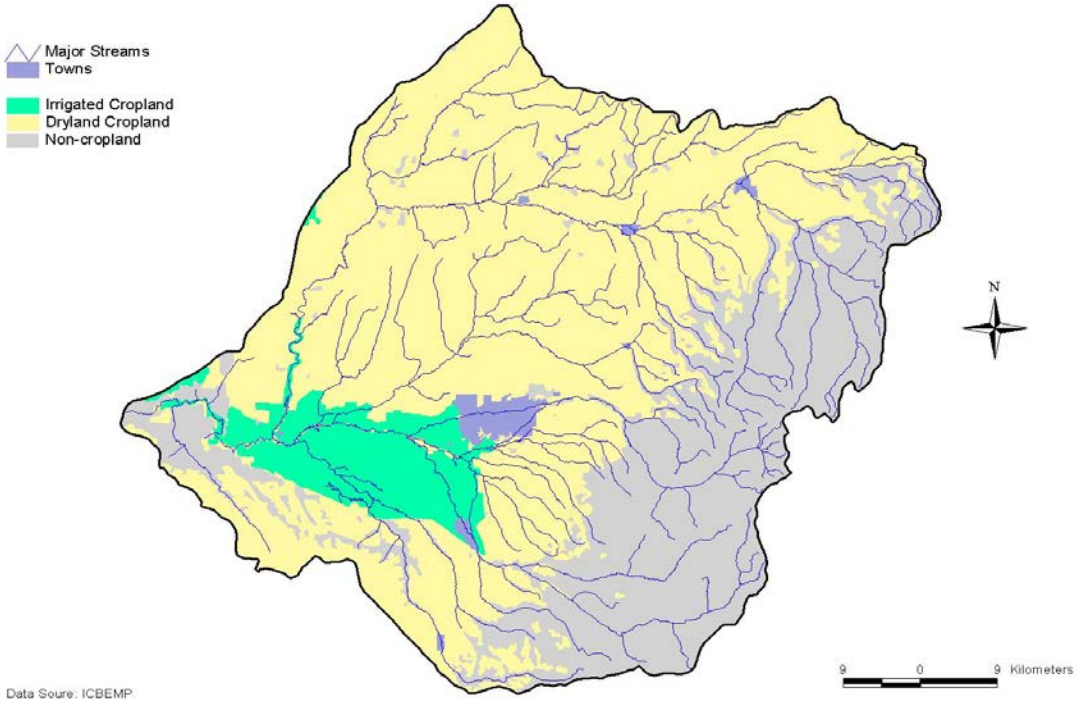
There are numerous disadvantages to water right acquisition. The Walla Walla Valley has a very successful farming industry. The farming community is the center of economics for the region (Figure 4-1), and most land use requires water. Purchasing water rights directly impacts the success of the community and its supporting industries (banking, mechanics, labor, etc.). Also, most water right acquisitions or transfers occur between farmers, and the farming community continues to dominate the use of water from the Walla Walla River system.

4.3.5 Measure 5 – Shallow Aquifer Recharge

The final stand-alone measure evaluated to meet the goals and objectives of this study is shallow aquifer recharge. Shallow aquifer recharge involves storing water in the shallow aquifer that can later be supplied to the river as instream flow (storage and recovery). Aquifer recharge also has the potential to increase instream flow by increasing the level of water in the shallow aquifer. There is a high interdependency between the river system and the aquifer in this region (see Appendix A, *Hydrology*).

Shallow aquifer recharge includes many methods for increasing the amount of water entering the shallow gravel aquifer, including natural infiltration from streams, rivers, lakes, and floodplains. Other artificial methods include seepage from irrigation ditches, deep percolation of irrigation water not used by plants, infiltration from recharge basins, and injection via wells. Typically, water is not treated prior to being introduced into the aquifer. Therefore, care must be taken to ensure that pollutants and contamination are not introduced or spread once a recharge method is implemented. Testing will be required to ensure state water standards are met prior to shallow aquifer recharge.

Figure 4-1. Location of Cropland



It should be noted that many shallow and basalt recharge projects could (and should) be done, but not all will meet the objectives of this study. This project is intended to be a partial, rather than a complete solution to all of the problems and issues within the Walla Walla River system. As such, there are some opportunities for shallow aquifer recharge that have been excluded from this study. Shallow aquifer recharge opportunities that do not result in measureable, protectable (protected by an instream priority water right or other tool) flows have been excluded. An example would be reforestation of the headwaters of the North and South Fork Walla Walla Rivers. Such a project will likely increase groundwater infiltration and summer base flows over a period of 30 to 50 years, but the increase will not be measureable over that amount of time, nor will it be protectable even if it could be measured.

Based on this information, shallow aquifer recharge was investigated as a stand-alone measure to meet project goals and objectives. It is possible to use shallow aquifer recharge as a storage mechanism, similar to building an above-ground reservoir with the water stored underground. However, concerns abound with this usage of shallow aquifer recharge for storage and recovery. To meet project goals, a total of about 60,000 acre-feet (kaf) annually is required. This represents an average volume of approximately 45,000 kaf for aquatic habitat plus any additional water needed to restore the water table to historic levels (approximately 15 kaf). This volume of water recharged and potentially recovered (withdrawn) annually from the aquifer could induce significant subsidence issues, and will also result in the increased flushing and spread of pollutants. Little is known about the length of travel time (residence) before groundwater exits the basin (at the Columbia River), severely limiting the ability to carry

water over from high water years to low water years, resulting in less project-generated instream flows in the most critical low-flow years. The groundwater table is declining. Uncertainty in the rate of decline generates uncertainty in the long-term success of this option. In addition, the non-Federal sponsor does not own any land in the area where aquifer recharge will potentially be implemented. Acquiring real-estate rights for a groundwater storage system for 60 kaf annually would be extensive.

Shallow aquifer recharge, as a stand-alone measure, is risky and costly to implement. Therefore, benefits cannot be identified at this time.

4.4 Screening—Stand-Alone Measures

For a stand-alone measure to be considered "stand-alone," it must have the potential to meet the goals and objectives of this study on its own merit. The significant weakness of the Walla Walla River is the lack of instream flow during critical passage and rearing months for a number of species, including extirpated spring Chinook salmon and ESA-listed MCR steelhead and bull trout. While all goals and objectives are considered important for the study, the following criteria will be used to further screen measures.

4.4.1 Preliminary Screening Criteria

The WDFW and Ecology conducted an IFIM study for sections of the Walla Walla River in 2002. One output of the study was the correlation between fish habitat (WUA) and river flow (cfs) displayed in Figure 4-2 for a 1000-foot section of the Walla Walla River just downstream from the Oregon/Washington border. The IFIM study focused on the range of flows and corresponding percent habitat achieved for juvenile Chinook salmon and steelhead, and adult spawning steelhead (Table 4-5). The percent habitat and corresponding flow level was used as the initial screening criteria to evaluate alternatives. The WDFW study did not address bull trout or adult spring Chinook and therefore neither are part of the initial screening for this project.

Figure 4-2. Walla Walla River Mainstem (below Yellowhawk) WUA versus Flow (cfs) (Caldwell et al., 2002)

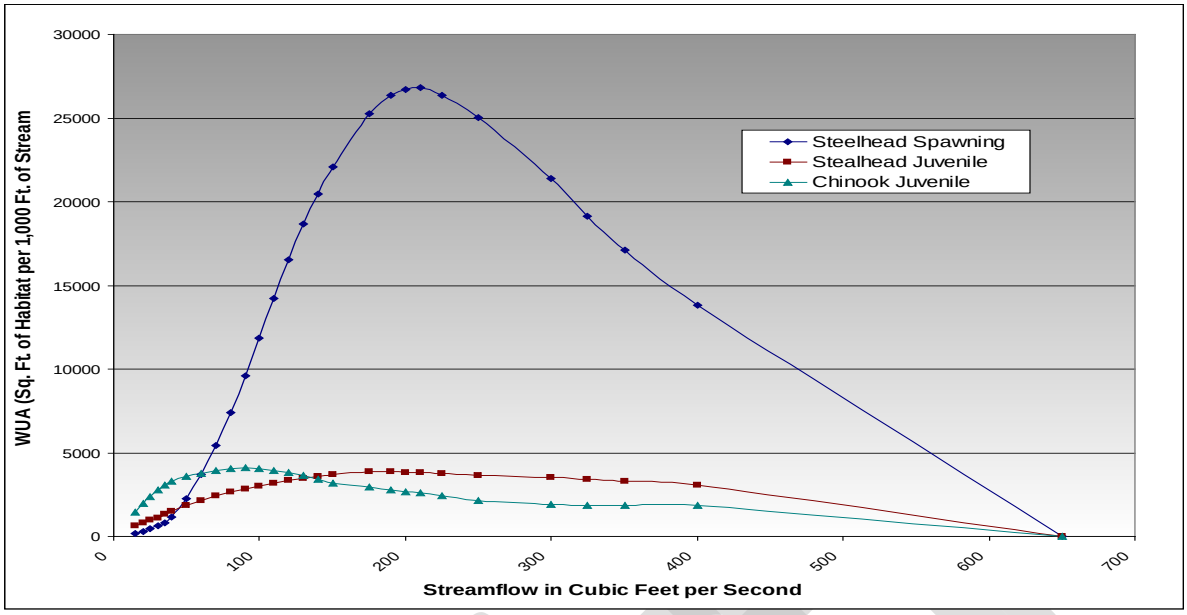


Table 4-5. Percent of Peak Habitat versus Flow (Caldwell et al., 2002)

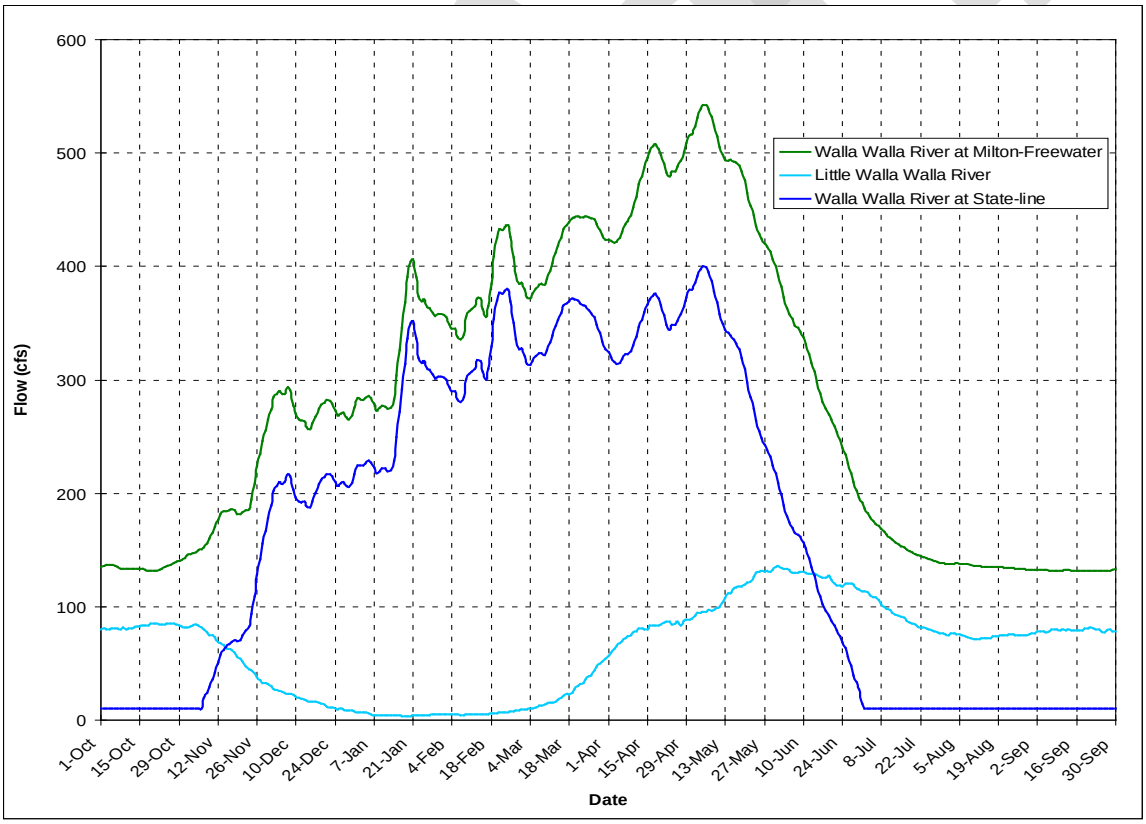
Flow	Steelhead Spawning	Steelhead Juvenile	Chinook Juvenile
15	1%	17%	36%
20	1%	21%	48%
25	2%	25%	57%
30	2%	29%	67%
35	3%	34%	74%
40	4%	39%	80%
50	8%	48%	87%
60	14%	56%	92%
70	20%	63%	95%
80	28%	69%	99%
90	36%	74%	100%
100	44%	78%	98%
110	53%	82%	95%
120	62%	86%	93%
130	69%	90%	89%
140	76%	93%	83%
150	82%	96%	78%
175	94%	100%	72%
190	98%	100%	68%
200	100%	99%	65%
210	100%	99%	63%

In conjunction with the WUA analysis, the life cycle of the target species and critical time periods for rearing and spawning were evaluated. These critical timeframes are:

- spring Chinook salmon rearing – January through December
- steelhead rearing – January through December
- steelhead spawning – February through June

In the analysis of the preliminary hydrology (29-year historic record) for the Walla Walla River, instream flows in excess of 200 cfs exist within the river from December through May, with a 95-percent exceedance (Figure 4-3). In a more detailed review of the hydrologic data (38-year historic record), less then 25 days show instances where water levels below Stateline dropped lower than 27 cfs within this time period. Changes to the amount of instream flow begin to occur most significantly in June at the Little Walla Walla River Diversion (shown as Little Walla Walla River). Based on the historic record, up to 140 cfs is withdrawn in the month of June and then 90% of the river is withdrawn thereafter leaving 10 cfs at Stateline from the months of July through mid-November.

Figure 4-3. Walla Walla River Average Hydrographs based on 29-Year Record (7-Day Rolling Average)



Up through the late 1990's most of the water in-river was withdrawn from the Little Walla Walla Diversion leaving no instream flow. This was the foundation for the Habitat Conservation Plan (HCP) and a Comprehensive Irrigation District Management Plan (CIDMP) between US Fish and Wildlife Service (USFWS), State of Oregon, Washington

State Department of Agriculture and three irrigation districts (WWRID, HBDIC and GFID). These plans dictated a baseline for minimum flows in the Walla Walla River from January through December (see Figures 4-4 and 4-5 for footprint). These plans will continue to regulate flows in the future without project condition. Photos 4-1 and 4-2 show the area near the State line before (July 1999) and after (2002) the HCP was in effect.

Photo 4-1. Mainstem Walla Walla River near the State line (1999)

Photo 4-2. Same Reach (2002)

Draft

Figure 4-4. Footprint for HCP (Technical Memorandum, Walla Walla HCP –2005)

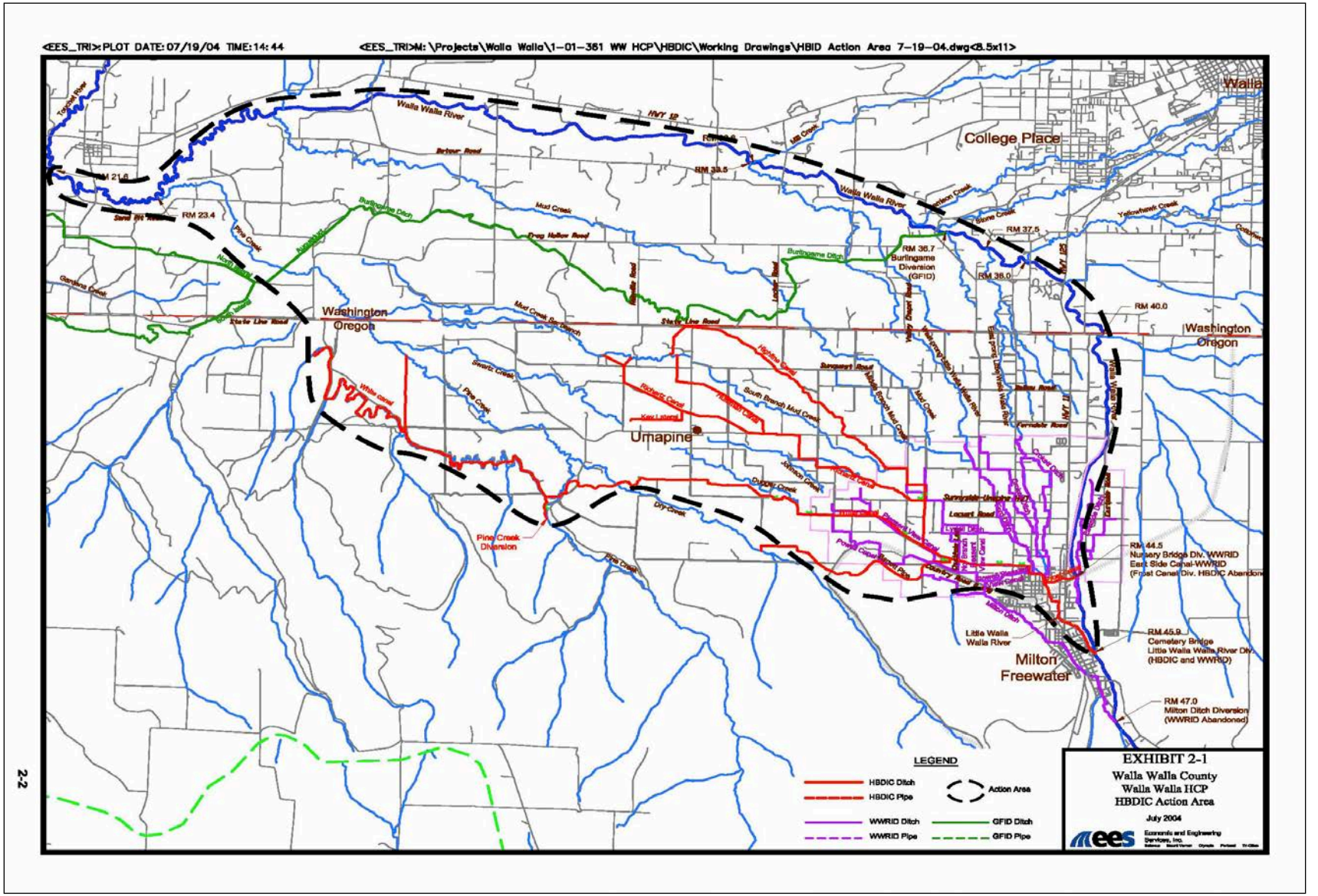
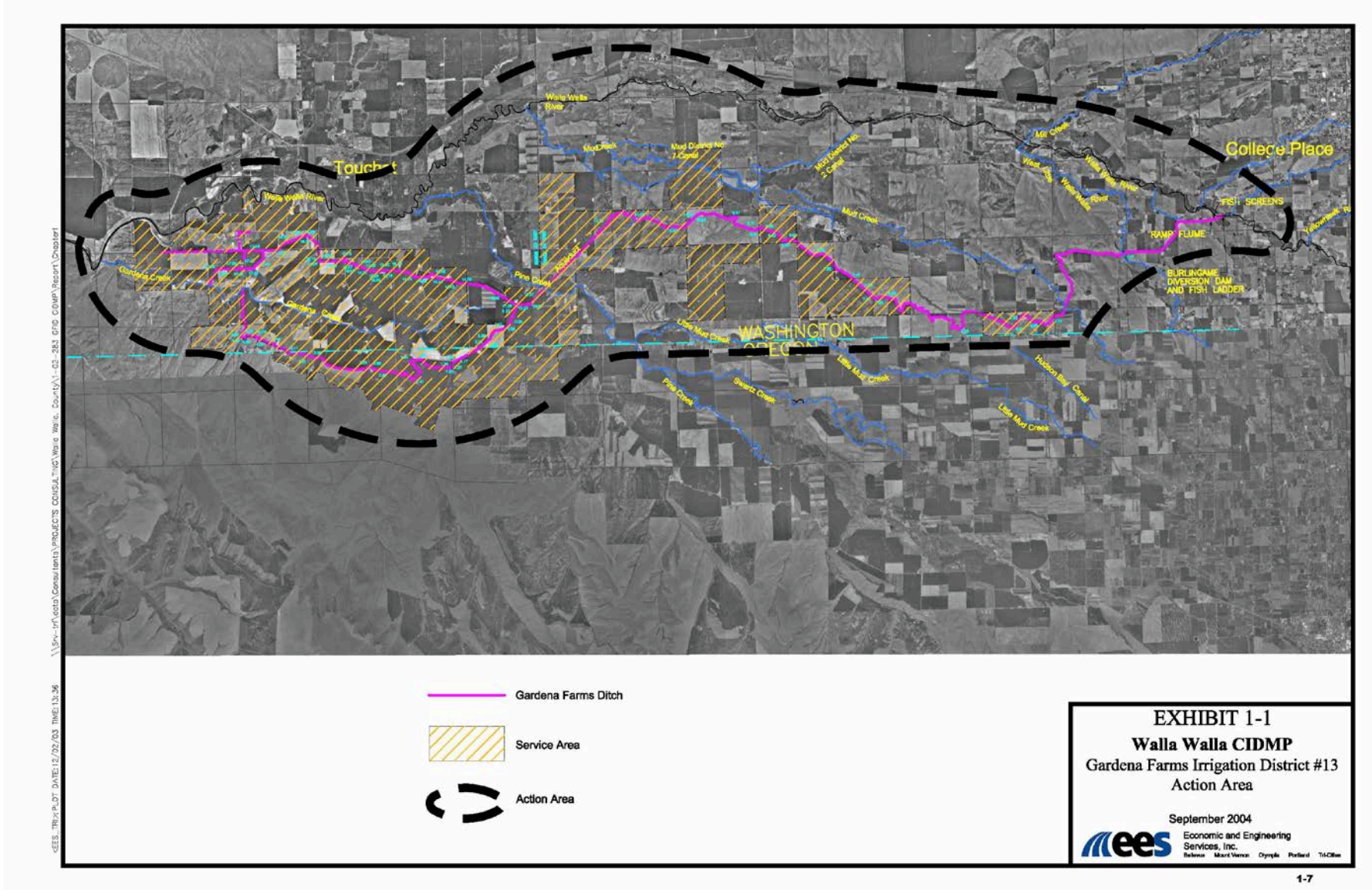


Figure 4-5. Footprint for CIDMP (CIDMP, GFID #13, 2004)



Through the month of June, the HCP requires, HBDIC and WWRID ensure that 27 cfs remain instream at the Nursery Bridge Dam (RM 46) diversion (Technical Memorandum, Walla Walla HCP –2005). For the months of July through December, the minimum flow requirement decreases to 25 cfs. Although the HCP was not finalized until 2005, the irrigation districts began working towards these standards in 2000.

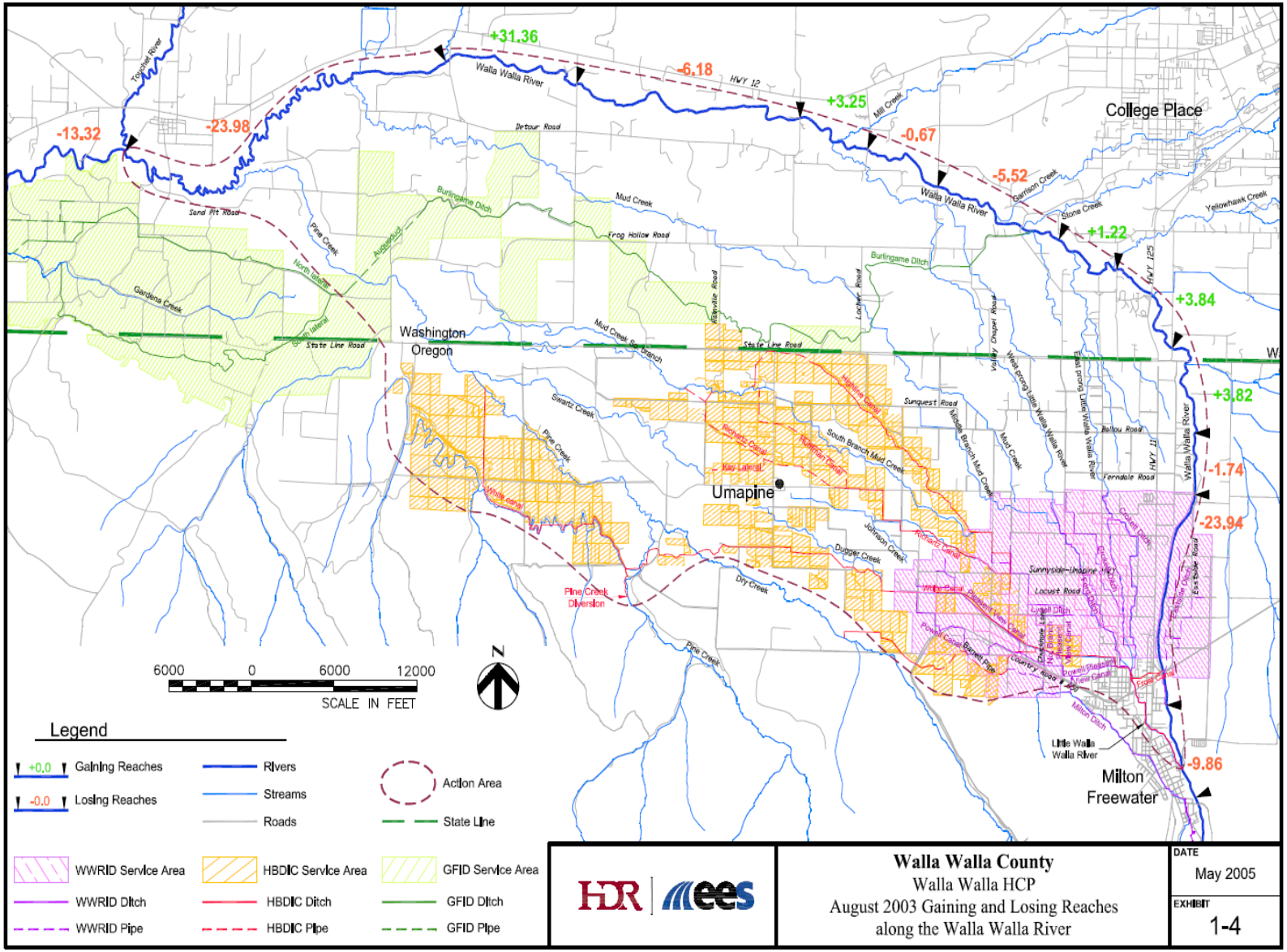
In addition to the HCP flow requirements, GFID is required to leave a minimum amount of flow in-river (CIDMP, GFID #13, 2004). The GFID is required to leave 19 cfs instream through the month of June, and 18 cfs for the remainder of the year. The diversion point for GFID is Burlingame Dam, which is around river mile 36.9, very near the reach studied by the State of Washington in 2002.

The GFID requirement is largely dependent on the senior water right holders upstream of their diversion. Regarding the prioritization of water withdrawal from the Walla Walla River, WWRID holds the most senior rights, followed by HBDIC and then GFID. This is also an important factor to consider when determining WUA habitat values met by the future without project condition versus what should be used as a threshold for screening. Despite the requirement for WWRID and HBDIC to leave a minimum of 27 or 25 cfs in the river, significant losses occur between Nursery Street (Cemetery Diversion) and the Burlingame Diversion. Quite frequently, only 10 cfs actually reach the Burlingame diversion (see Appendix A, *Hydrology and Hydraulics*, and Figure 4-6).

Reviewing the habitat/flow correlation in Table 4-5, 10 cfs approximates to about a 1% habitat condition for steelhead spawning in June, a 17% habitat condition for juvenile steelhead, and a 36% habitat condition for juvenile spring Chinook salmon and approximates what the future without project condition produces in this stretch of the river. If the full 27 cfs or 25 cfs was realized through this section of the river the habitat conditions would be 2% for steelhead spawning, 25% for juvenile steelhead, and 57% for juvenile spring Chinook salmon. Based on information provided by the team biologists and coordination with regional experts, the 27 cfs through the month of June and the 25 cfs from May through December applied at Stateline would capture the intent of the HCP and CIDMP agreements and would be appropriate for use as screening criteria at this phase of measure evaluation. The fish flow regimes, considered of equal importance, are lumped into one category (Improve Fish Habitat) in the evaluation tables.

To meet or exceed the 2% WUA condition for steelhead spawning, 25% WUA condition for juvenile steelhead, and the 57% WUA for juvenile Chinook, preliminary evaluations of each measure was conducted. Each measure for this level of screening was compared to each other (storage versus storage, not storage versus exchange). During the cost effective analysis and incremental cost analysis the measures are compared against each other. In addition to this, the subsequent options under each measure have the same level of risk making trade off analysis within measures not necessary at this time (see Appendix B, *Engineering*; and Appendix I, *Water Law and Water Right Acquisition*). Therefore, for screening purposes, evaluating measures against each other ensures the best valued measures are carried forward for further analysis.

Figure 4-6. Walla Walla River Losing and Gaining Reaches



For comparison purposes, average annual costs were calculated. Average annual cost calculations allow an equal cost comparison to occur between measures that realize benefits under differing time frames. Annualized costs were determined using implementation costs and durations. Implementation items included pre-construction, engineering and design (PED), real-estate acquisition, supervision and administration (S&A) of a contract, the amount of time it takes to construct a project, annual power consumption costs, and overall construction contract costs.

Also required to determine the average annual cost is the economic cost of the project and its various components. The economic cost for the each measure was determined through interest during construction (IDC) calculations. The IDC is added to the implementation costs of the project, and included as part of the average annual cost. The IDC is calculated using the appropriate discount rate for Federal Water Projects for costs incurred during project construction.

Therefore the team ranked each option for the following:

- Ability to meet or exceed juvenile goals for steelhead and spring Chinook and steelhead spawning
- Lowest average annual cost

A comparison matrix was then used to score each option under each measure. Because the PDT only compared measures to each other, a simple scoring system was utilized. Each option was scored against its ability to meet the criteria, and then scored against other measures. For instance, to score a “1” in improve fish habitat, an option must be able to meet the flow regimes described with a 95-percent confidence interval. This is a high standard. However, missing the minimum flow goals, which are a very low threshold for spawning and rearing habitat, is detrimental to the survival of the species in the Walla Walla River. Any measure that cannot meet this critieria is scored with a “2.”

In addition to the biological criteria, the costs of the measures are scored. A score of “1” is given to the least cost measure, a “2” to the next least cost measure, and so on. Depending on the number of measure the more expensive a measure is, the higher the score is that it receives. While this cost does not eliminate the measure from further consideration, it is considered as part of the evaluation.

The numeric scores are intended to show the relative position of the option, with respect to other options for that measure. They are not based on a specific formula, nor are they intended to be summed and presented as a total score. The scores are intended only to serve as an aid in comparing the options to one another and aid in selecting options to move forward for further evaluations.

In addition to the screening, it was critical that water left in the Walla Walla River be protected. As identified earlier, this issue was problematic. In coordination with the local irrigation districts, the States of Oregon and Washington, and other agencies, the non-Federal sponsor for the project was ultimately able to complete a reasonable plan to protect flows. This plan is shown in Appendix I, *Water Law and Water Right Acquisition*. Such protection ranges from the use of existing laws and regulations to employing new laws and policy to protect the flows. This plan has been endorsed by the local irrigation community, as well as the Washington/Oregon State departments responsible for managing water.

4.4.2 Measure 1—Off-Channel Storage

To determine the ability of the off-channel storage measure to meet minimum instream flow goals, an evaluation of the 38-year historic record was necessary. While both off-channel storage and CRWE are a "bucket for bucket" exchange, off-channel storage depends on the ability of the reservoir to be filled. This must be considered when determining the reservoir size needed to meet demand. Low-flow winter months equate to a smaller amount of water stored in the reservoir. If this is followed by an average or high spring/summer water season, the ability of the storage reservoir to meet the demand of the bucket for bucket exchange is low. Because the majority of water rights on the system are not being met, during a higher spring/summer water year, irrigators pull more water out of the system because they own the right to do so. This makes the demand on a bucket for bucket exchange extremely high, and a large amount of water is required to meet this demand. In effect, a low-flow winter season, followed by an average or high spring/summer season is the highest risk scenario for off-channel storage. Under this scenario the ability of an off-channel storage reservoir to meet a demand of the bucket for bucket system is very low. This has occurred three times within the 38-year historic record: in 1988, 1990, and 1991.

Two reservoir sites were carried forward to potentially house reservoirs ranging in size from 28 kaf to 65 kaf (Table 4-3). Preliminary construction cost estimates and annual power costs are presented in Table 4-6 at the October 1, 2008 price level. The cost of power was estimated at $0.06 per kilowatt hour (kWh), determined through discussions with two local power entity marketing managers. All costs were present-valued to the beginning of the period of analysis, amortized and include IDC at the Fiscal Year (FY) 2009 Federal discount rate of 4.625 percent over the 50-year period of analysis, to develop equivalent average annual costs.

At this level of design, estimated construction costs for the lower reservoir are the least expensive. The three upper reservoir sites are increasingly expensive, due to the increase in dam height and the amount of material needed for construction.

The estimated annual power cost for the 37.5 kaf structure is the least expensive, primarily due to gravity feed efficiencies not possible with the other options. The most expensive annual power investment is the lower Pine Creek site, due to its location and inability to gravity feed either for fill or emptying purposes.

Each storage option was evaluated on its ability to meet the screening criteria and then annualized costs are ranked. This is presented in Table 4-7.

Table 4-6. Average Annual Costs, Off-Channel Storage (October 1, 2008 price level)

Location and Size	Budgetary Implementation Cost* ($1,000)	Annual Power Cost ($1,000)	Real Estate Cost ($1,000)	Average Annual Costs ($1,000)
Lower Pine Creek - 28000 acre-feet	$216,977	$644	$1,123	$12,748
Upper Pine Creek - 37500 acre-feet	$304,200	$66	$1,384	$17,443
Upper Pine Creek - 50000 acre-feet	$335,915	$150	$1,550	$19,806
Upper Pine Creek - 65000 acre-feet	$374,877	$736	$1,768	$22,675

*Budgetary Implementation Costs include PED, S&A, construction contract costs and contingency

Table 4-7. Off-Channel Storage Measures Relative Rankings

Location and Size	Average Annual Costs ($1,000)	Improve Fish Habitat	Lowest Average Annual Cost
Lower Pine Creek - 28000 acre-feet	$12,748	2	1
Upper Pine Creek - 37500 acre-feet	$17,443	1	2
Upper Pine Creek - 50000 acre-feet	$19,806	1	3
Upper Pine Creek - 65000 acre-feet	$22,675	1	4

Based on the evaluation, only the 28-kaf reservoir does not meet minimum instream flow goals and was, therefore, eliminated. The 37.5-kaf reservoir has the lowest annual power investment and the second lowest potential real estate investment. Due to capital costs and annual power cost increases presented in the 65-kaf option, as well as the fact that the 50-kaf option is the largest reservoir supported by the Walla Walla River (available winter water for filling purposes), the 65-kaf reservoir was also eliminated. As a result, the two off-channel storage reservoirs carried forward are the 37.5-kaf and the 50-kaf reservoirs.

4.4.3 Measure 2—Columbia River Water Exchange

The same matrix (Table 4-8) was used to screen the five water exchange systems.

A preliminary cost estimate and annual power costs were computed for each system at the October 1, 2005 price level. The annual power costs represent the majority of annual operation and maintenance costs the sponsor will bear if this project is

implemented. The cost of power was estimated at $0.05 per kilowatt hour (kWh). All costs were present-valued to the beginning of the period of analysis, amortized and include IDC at the FY 2006 Federal discount rate of 5.125 percent over the 50-year period of analysis, to develop equivalent average annual costs.

Table 4-8. Average Annual Costs, Water Exchange (October 1, 2005 price level)

Water Exchange System	Budgetary Implementation Cost ($1,000)	Annual Power Cost ($1,000)	Real Estate Cost ($1,000)	Average Annual Costs ($1,000)
1 – Independent Conveyance System (relatively direct alignment from Gardena Farms Bifurcation to the Frog)	$297,440	$2,850	$1,300	$20,477
2 – Integrated Conveyance System with No Pumping from Walla Walla River	$348,816	$3,110	$1,300	$23,766
3 – Integrated Conveyance System including Pumping from Walla Walla River	$358,280	$3,360	$1,300	$24,574
4 – Independent Conveyance System (following parts of the Burlingame Ditch)	$299,468	$2,910	$1,300	$20,657
5 – Independent Conveyance System (relatively direct alignment from Gardena Farm Bifurcation to the Frog) with Connector Pipe and Provision for Piping of Selected Ditches	$300,144	$2,800	$1,300	$20,587

*Budgetary Implementation Costs include PED, S&A, construction contract costs and contingency

At this level of design, estimated average annual cost for systems 1, 4, and 5 can be considered essentially equal. The estimated average annual cost for system 2 (an integrated system with relatively low pressure deliveries) are approximately 16 percent higher, and the estimated average annual cost for system 3 (an integrated system with higher pressure deliveries) are approximately 20 percent higher. System 5 will likely have the lowest annual power cost. Power costs for system 1 will be slightly higher, followed by system 4, system 2 and, lastly, system 4. Real estate costs of the five systems can all be considered equivalent, even though the amount of water and type of system changes for water delivery.

When compared to system 1, system 4 has a higher estimated annual power cost. This occurs for two reasons: 1) system 1 serves additional lands along Upper Burlingame Ditch; and 2) system 1 delivers to ten serving PODs at one pump station, resulting in deliveries with positive pressure. The higher annual power cost for systems 3 and 4 is because of the additional pumping required to serve pressurized water to the turnouts.

The relative rankings (Table 4-9) show that system 1 is ranked lower than the other systems for improving fish habitat, because it does not provide exchange water for delivery to turnouts on Upper Burlingame Ditch. This requires irrigators to pull water from the mainstem Walla Walla River more frequently, and reduces the instream benefit associated with this action. All other systems have facilities for serving exchange water to these turnouts and, as a result, are ranked equally with a score of "1."

Table 4-9. Water Exchange Measures Relative Rankings

Location	Average Annual Costs ($1,000)	Improve Fish Habitat	Lowest Average Annual Cost
1 – Independent Conveyance System (Relatively Direct Alignment from Gardena Farms Bifurcation to the Frog)	$20,477	2	1
2 – Integrated Conveyance System with No Pumping from Walla Walla River	$23,766	1	4
3 – Integrated Conveyance System including Pumping from Walla Walla River	$24,574	1	5
4 – Independent Conveyance System (Following Parts of the Burlingame Ditch)	$20,657	1	3
5 – Independent Conveyance System (Relatively Direct Alignment from Gardena Farms Bifurcation to the Frog)	$20,587	1	2

Based on the comparison of criteria, system 5 is the preferred system. It is the most cost effective system to meet the requirements of the target ESA-listed species. The estimated operating cost is the lowest of the systems, and it is anticipated that the impact to groundwater resources will be minimal. Additionally, system 5 will provide pressurized service to some farm turnouts, and operational complexity would be relatively low.

4.5 Stand-Alone Measures Eliminated from Further Consideration

The following measures do not, by themselves, have the potential to meet the minimum instream flow goals of the project. They are, therefore, screened from further consideration.

4.5.1 Measure 3—Irrigation Efficiency

Based on an analysis of the three irrigation districts (GFID, HBDIC, and WWRID), preliminary flow benefits were computed. The potential water saved (cfs) is shown in Table 4-10.

Through further discussions with the three irrigation districts, only one (WWRID) lent support for a system to save water through efficiency. The other two districts indicated they were not willing to reduce withdrawals for a more efficient delivery system.

Table 4-10. Seepage Losses for Irrigation Districts

Ditch	Loss Range			Seasonal Loss	
	Min cfs	Median cfs	Max cfs	Min (AF)	Max (AF)
WWRID					
East Crockett*	-4.0	-6.50	-9.0	1,190	2,678
West Crockett	0.5	-1.00	-2.0	149	595
West Fork of West Crockett	0.5	-1.50	-4.0	149	893
Ford Branch (North)*	2.0	-0.25	-0.5	595	149
Ford Branch (South)*	0.0	-0.75	-1.5	0	446
West Ford*	0.5	-1.00	-2.0	149	595
East Ford	0.0	-2.00	-4.0	0	1,190
Pleasant View	0.0	-4.50	-7.0	0	2,083
HBDIC					
Richartz	-6.0	-8.50	-11.0	1,785	3,273
Upper White Ditch*	-1.0	-4.00	-7.0	298	2,08
GFID					
Diversion Ramp Flume		-4.30		589	
Upstream Locher Road		-0.40		71	
Modified at Locher Road		-0.80		143	
Downstream Locher Road		-6.40		1,142	

*Denotes gaps in data collection due to broken or missing probe

Therefore, only WWRID was further evaluated for its potential to meet instream flow levels. A preliminary cost estimate and annual power costs were computed for the irrigation district (Table 4-11). The preliminary estimates are at the October 1, 2008, price level, with power costs estimated at $0.06 kWh.

Table 4-11. Implementation Cost – Irrigation Efficiency

Measure	Construction Cost ($1,000)	Annual Power Cost ($1,000)	Real Estate Cost ($1,000)
Irrigation Efficiency – WWRID	$5,974	$0	$661
Irrigation Efficiency – HBDIC	$9,250	n/a*	n/a*
Irrigation Efficiency – GFID	$9,229	n/a*	n/a*

*Information not computed due to position of irrigation district

Based on an average water year, approximately 10 cfs can be saved by implementing irrigation efficiency for WWRID. This is drastically short of the instream goals for this project. However, initial evaluations of the potential cost per benefit for this measure support being carried forward as long as it is supplemented with a project that shows potential to make up the gap in instream benefits. In addition, based on how the district operates today, no increase in the amount of pumping would be required. Therefore, the annual power costs are shown as "0."

4.5.2 Measure 4—Water Right Acquisition

The acquisition of water rights is, by far, the most cost-effective solution considered to meet the goals and objectives of this study. However, the holders of such rights must be willing to relinquish them. To date, no such water right holders have been identified. As shown in Appendix I, *Water Law and Water Right Acquisition*, less than 10 transfers to instream flow benefits occurred between 2000 and 2004. Only one of these transactions was perpetual (at a cost of over $65,000 per cfs). To meet the needs of this project, perpetual transfers are required.

Based on preliminary appraisals, the average cost of a water right is approximately $2000 per acre, or $550 per acre-feet of water right. However, as shown in Appendix I, *Water Law and Water Right Acquisition*, it is not often that the water right is the only cost. Typically, costs associated with crop transition or farm purchase are necessary to actually acquire the water right. These costs will far exceed amounts shown in appraisals, thereby making the cost per acre (or cost per cfs) difficult to predict and unreliable.

Farming is still one of the primary sources of employment in the Walla Walla Valley. As a result, a lack of motivation to relinquish water rights exists (Appendix I, *Water Law and Water Right Acquisition*). Until this situation is altered, water right transfers from irrigation use to instream flow cannot be relied upon, further demonstrating why this measure was removed from further consideration.

4.5.3 Measure 5—Aquifer Recharge

The maximum amount of water that can be stored in the shallow aquifer, within a reasonable risk level, is 15 kaf. There is no indication that shallow aquifer recharge, on its own merit, has potential to increase instream flows during the time water is needed to improve fish habitat and/or passage. Even strategically located recharge sites do not represent a direct benefit to the mainstem flows of the Walla Walla River.

4.6 Optional Measure—WWRID Irrigation Efficiency

Optional measures can be combined with any other measure to help meet project objectives. As stated in Section 2.4 the main goal of this study is to improve habitat through specific flow regimes in the mainstem Walla Walla River.

Based on information provided in previous sections, exploring irrigation efficiency in combination with other measures was evaluated. In an average water year, 10 cfs can be realized instream through implementation of WWRID irrigation efficiency. The cost for this measure is approximately $6 million, with an additional real-estate cost of $661,000.

4.7 Combination of Measures

Environmental plan evaluation consists of a comparison of environmental outputs and economic costs of alternative plans. The cost effectiveness analysis and incremental cost analysis procedures provide a structured framework to assist in environmental plan evaluation. The following analysis was accomplished by utilizing the planning methodology found in the Institute of Water Resources' Cost Effectiveness and Incremental Cost Analysis Program (IWR-PLAN). Every possible combination of solutions is derived and, for each combination, an average annual cost and average annual output is calculated.

A cost effectiveness analysis is then conducted to ensure that the least-cost solution is identified for various levels of environmental output. This is intended to eliminate inefficient alternatives, based on comparing average annual environmental outputs with the average annual cost of an alternative. The program classifies a plan as cost effective if no other plan provides the same level of output for less cost, and no other plan provides more output for the same cost or less. Once, the cost effective set of plans is identified, an incremental cost analysis is conducted to show changes in costs for increasing levels of environmental outputs. It measures the incremental, or additional, cost of the next additional level of environmental output. From the cost effective plans, the program identifies 'best buys." Best buys are the plans most efficient at producing the output variable. In other words, they provide the greatest increase in the value of the output parameter variable for the least increase in the value of the cost parameter variable. The first best buy is the most efficient plan. If a higher level of output is desired than that provided by the first best-buy, the second best buy is the most efficient plan for producing additional output, and so on.

Measures evaluated include the future without project alternative (no action) and various combinations of restoration measures (both stand-alone and optional). The ecosystem output is summarized in the subsequent sections and, in detail, in Appendix H, *Biological Benefits Analysis*.

Table 4-12 presents the study measures carried forward following initial screening. The storage and exchange measures could be implemented as stand-alone alternatives, while the irrigation efficiency measure needs to be combined with either storage or exchange to realize improved environmental outputs. In addition, the storage and exchange alternatives cannot be combined together. Given consideration of the stand-alone alternatives and the potential combinations of alternatives resulted in 11 workable combinations for analysis as listed in Table 4-13.

Table 4-12. Measures

Stand Alone Measure	Description
S0E0	No Action
S1	Upper Pine Creek – 37.5 kaf
S2	Upper Pine Creek – 50 kaf
E1	Columbia River Water Exchange (100 cfs)
E2	Columbia River Water Exchange (140 cfs)
E3	Columbia River Water Exchange (175 cfs)
Optional Measure	**Description**
O1	Walla Walla River Irrigation District Efficiency (WWRID)

Table 4-13. Alternative Combinations

Code	Alternative Description
S0E0	No Action
S1E0	Upper Pine Creek Storage – 37,500 acre-feet
S2E0	Upper Pine Creek Storage – 37,500 acre-feet + WWRID irrigation efficiency
S3E0	Upper Pine Creek Storage – 50,000 acre-feet
S4E0	Upper Pine Creek Storage – 50,000 acre-feet + WWRID irrigation efficiency
S0E0	Columbia River Water Exchange - 100 cfs
S0E0	Columbia River Water Exchange - 100 cfs + WWRID irrigation efficiency
S0E0	Columbia River Water Exchange - 140 cfs
S0E0	Columbia River Water Exchange - 140 cfs + WWRID irrigation efficiency
S0E0	Columbia River Water Exchange - 175 cfs
S0E0	Columbia River Water Exchange - 175 cfs + WWRID irrigation efficiency

4.8 Average Annual Environmental Outputs

The non-monetary benefits of environmental restoration alternatives are calculated as average annual environmental outputs. The environmental outputs are measured as weighted usable area of habitat in cubic feet [WUA per cubic foot ft^3)].

The WUAs were first identified on a monthly basis, for a representative future with and without project condition. The monthly WUAs for all sections of the river were then totaled and divided by 12 to derive net average annual WUA ft^3, representing outputs expected over a 50-year period of analysis. It should be noted that average annual outputs listed represent a net increase in output above and beyond the no action alternative.

As part of the environmental assessment, different aquatic species and life stages were noted as potential environmental outputs. As a result, three aquatic species and two life stages for one species represent the environmental outputs for cost effectiveness/

incremental cost analysis: juvenile steelhead, steelhead spawning, spring Chinook, and bull trout. A separate cost effectiveness/incremental cost analysis was performed for each category of output in order to assess outcomes from each, as well as determine if any comparisons resulted or if there were any clear cost effective or non-cost effective alternatives.

Because the output is WUA, these species and life stages are shown not only because of their significance but also because they represent the range of habitat conditions necessary to support a healthy habitat environment for fish species living within the Walla Walla River system. For the majority of the biological discussions (Appendix H, *Biological Benefit Analysis*), the WUA is used as well as the involved reach of river it is evaluated against.

Table 4-14 shows average annual benefits for the life stages and species listed. For economic purposes, the WUA was consolidated into an average annual number. The average annual output is calculated by summing the WUA values across each of the four river reaches evaluated over the 12 month period. This number is then divided by the 12-month period resulting in a species-specific average annual output.

Reviewing the data reveals that under the reservoir plans (combination of measures), the benefits are negative for juvenile steelhead and for spring Chinook salmon. This means that these plans do not show a habitat improvement over existing conditions. Since the target species and life stages are all considered critical for evaluation purpose, the plans that include off channel reservoir will not prove to be cost effective and will be removed from further consideration.

Table 4-14. Total and Average Annual Net Benefits

Species/Life Stage	Juvenile Steelhead WUA ft^3		Steelhead Spawning WUA ft^3	
Scenario	Total Net Benefits (before annualized) (WUA ft^3)	Average Annual Net Benefits (WUA ft3)	Total Net Benefits (before annualized) (WUA ft^3)	Average Annual Net Benefits (WUA ft^3)
No Action	0	0	0	0
37.5 kaf	-958506	-79875	1912535	159378
37.5 kaf WWRID	-747418	-62285	2310439	192537
50 kaf	-895729	-74644	2149636	179136
50 kaf WWRID	-681508	-56792	2530380	210865
100 cfs	676118	56343	3158493	263208
100 cfs WWRID	989881	82490	3529175	294098
140 cfs	1362261	113522	4844418	403701
140 cfs WWRID	1651682	137640	4963920	413660
175 cfs	2071072	172589	5406203	450517
175 cfs WWRID	2369896	197491	5429933	452494

Table 4-14. Total and Average Annual Net Benefits (continued)

Scenario	Total Net Benefits (before annualized) (WUA ft^3)	Average Annual Net Benefits (WUA ft^3)	Total Net Benefits (before annualized) (WUA ft^3)	Average Annual Net Benefits (WUA ft^3)
Species/Life Stage	**Spring Chinook WUA ft3**		**Bull Trout WUA ft^3**	
No Action	0	0	0	0
37.5 kaf	-154657	-12888	268385	22365
37.5 kaf WWRID	2323	194	1011947	84329
50 kaf	-88803	-7400	540578	45048
50 kaf WWRID	82148	6846	1335002	111250
100 cfs	729361	60780	4510847	375904
100 cfs WWRID	933029	77752	5247612	437301
140 cfs	1370258	114188	7127381	593948
140 cfs WWRID	1531194	127600	7669908	639159
175 cfs	2006630	167219	9419327	784944
175 cfs WWRID	2193154	182763	9991089	832591

4.9 Budgetary Estimates

All preliminary cost estimates for construction, design, and implementation costs were further refined and updated to reflect an October 1, 2008 price level. Table 4-15 shows the resulting budgetary estimates and the planned duration for design and implementation that will be used to calculate average annual costs for each measure.

The operation, maintenance, repair, rehabilitation and replacement (OMRR&R) costs for each measure were also estimated. The most significant OMRR&R cost is the cost for power to operate pumping stations for the reservoir and exchange options. As previously stated, two utility companies near the study area provided current energy rates. In addition to standard charges related to energy usage, there are charges based on load size and whether power is used during peak or off-peak periods.

The calculation methods used to compute annual power costs vary by utility company. However, the similarity in the computation among utility companies is that energy is based on both usage (kWh) and demand (kW). However, since the usage and demand are measured in different units, a rate per hour cannot be directly computed. In communication with a marketing manager at one of the local utility companies, it was noted that a rate of $0.06 per kWh would capture both the energy usage and demand charges. In order to verify this rate, the annual usage and demand charge for the 175-cfs water exchange alternative was calculated using actual rates and methods provided by the two utility companies. In both instances, the annual cost computed using the rates and methods provided by each utility company was just slightly lower than the annual cost derived using a rate of $0.06 kWh, with an annual cost percentage error ranging from 1.9 percent to 5.6 percent. Thus, the $0.06 rate was used as a base rate in calculating annual power charges for each alternative, as it ensures capturing costs related to both usage and demand by local utility companies.

Table 4-15. Total Budgetary Cost Estimates (October 1, 2009)

Stand Alone Measure	Contract Cost ($1,000)	PED ($1,000)	Duration of Plans and Specs	Real-Estate Cost ($1,000)	Duration of Real-Estate Acquisition	S&A ($1,000)	Duration of Construction	Total Cost* ($1,000)
Upper Pine Creek – 37,500 acre-feet	$292,500	$5,850	4	$1,384	4	$5,850	4	$305,584
Upper Pine Creek – 50,000 acre-feet	$322,995	$6,460	4	$1,550	4	$6,460	5	$337,465
Columbia River Water Exchange (175 cfs)	$283,920	$5,678	4	$1,300	4	$5,678	5	$296,576
Columbia River Water Exchange (140 cfs)	$173,680	$3,474	4	$1,300	5	$3,474	5	$181,928
Columbia River Water Exchange (100 cfs)	$157,170	$3,143	4	$1,300	4	$3,143	5	$164,756
Optional Measure								
Irrigation Efficiency – WWRID	$8,167	$799	1	$631	1	$506	2	$10,103

* Total cost does not include IDC and includes a 30% contingency

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Other costs that contribute to annual OMRR&R are labor for staff positions, vehicles (including fuel, tires and service), facilities and utilities, heavy maintenance (including replacement and major rehabilitation over the 50-year life of the project), as well as items such as the cost of dredging if required to maintain operations over the life of the project. Table 4-16 displays the estimated annual OMRR&R costs for each measure.

Table 4-16. Average Annual O&M Estimates

Stand Alone Measure	Average Annual OMRR&R Cost			
	Power ($1,000)	Power Rate	Other ($1,000)	Total ($1,000)
Upper Pine Creek – 37,500 acre-feet	$66	.06 kWh	$503	$569
Upper Pine Creek – 50,000 acre-feet	$150	.06 kWh	$503	$653
Columbia River Water Exchange (175 cfs)	$2,199	.06 kWh	$655	$2,854
Columbia River Water Exchange (140 cfs)	$693	.06 kWh	$396	$1,089
Columbia River Water Exchange (100 cfs)	$442	.06 kWh	$341	$783
Optional Measures				
Irrigation Efficiency – WWRID	$0	.06 kWh	$33	$33

4.10 Calculating Average Annual Costs

The costs of project implementation include all costs associated with the project (i.e., development costs, real estate costs, and operation and maintenance costs). In order to compare costs with average annual environmental outputs, it is necessary to convert implementation costs to average annual costs. The stream of costs associated with the project occurs at various points in time. Therefore, all costs were present-valued to the beginning of the period of analysis, and amortized at the Fiscal Year (FY) 2010 Federal discount rate of 4.375 percent over the 50-year period of analysis, to develop equivalent average annual costs.

To determine the economic cost of the project and its various components, a calculation was made to determine the cost of IDC. The IDC is added to the implementation costs of the project, and included as part of the average annual cost. It is included as an economic cost, but not as a financial cost. The IDC is also calculated using the FY10 discount rate of 4.375 percent for costs incurred during project construction. Table 4-17 shows the annualized cost for each measure.

Table 4-17. Average Annual Costs (October 1, 2009)

	Total Cost* ($1,000)	IDC ($1,000)	Total Investment Cost ($1,000)	Annualized Cost at 4.375% ($1,000)	Total Annualized Costs ($1,000)
Stand-Alone Measure					
Upper Pine Creek - 37500 acre-feet	$305,584	$29,208	$334,792	$16,598	$17,167
Upper Pine Creek - 50000 acre-feet	$337,465	$40,742	$378,208	$18,750	$19,403
Columbia River Water Exchange (175 cfs)	$296,576	$35,791	$332,367	$16,478	$19,332
Columbia River Water Exchange (140 cfs)	$181,928	$22,141	$204,069	$10,117	$11,206
Columbia River Water Exchange (100 cfs)	$164,756	$20,017	$184,773	$9,161	$9,944
Optional Measures					
Irrigation Efficiency – WWRID	$10,103	$671	$10,774	$534	$567

4.11 Cost Effective and Incremental Cost Analysis

In conjunction with the environmental analysis of the impacts, cost effectiveness and incremental cost analyses of potential alternatives are required. The following explanations clarify the difference between cost effectiveness and incremental cost analyses, and the purpose for each analysis.

- *Cost effectiveness analysis* is conducted to ensure that the least cost solution is identified for various levels of environmental output. Its purpose is to eliminate inefficient alternatives, based on comparing average annual environmental outputs with the average annual cost of an alternative. The IWR-Plan[1] classifies a plan as cost effective if no other plan provides the same level of output for less cost, and if no other plan provides more output for the same or less cost.

- *Incremental cost analysis* is conducted to show changes in costs for increasing levels of environmental outputs. It provides data for decision-makers to determine if the next level of effort is warranted." It measures the incremental or *additional cost* of the next higher level of environmental output. The IWR-Plan model identifies "best buys," the subset of a scenario's cost-

[1] IWR-Planning Suite 2.0.1.0 Beta – 26 February 2009, Corps-certified.

effective plans that are superior financial investments. Best buys are the most efficient plans for producing the output variable. They provide the greatest increase in the value of the output parameter variable for the least increase in the value of the cost parameter variable. The first best buy is the most efficient plan, producing output at the lowest incremental cost per unit. If a higher level of output is desired than that provided by the first best buy, the second best buy is the most efficient plan for producing additional output, and so on.

Table 4-18 summarizes the net gains in average annual environmental outputs (WUA ft^3), average annual costs, and the average annual cost per environmental output for each aquatic species. As Table 4-19 shows, the average annual cost per environmental output is directly associated with the number of environmental outputs gained by development of each alternative. Note that the base condition (Alternative A, No Action) is listed first, and the average annual environmental outputs represent the net gain over the no action alternative.

Table 4-18. Average Annual Environmental Outputs, Average Annual Costs, and Average Annual Cost Per Environmental Output (October 1, 2009)

Alternative	Average Annual Cost ($1000)	Juvenile Steelhead		Steelhead Spawning		Spring Chinook		Bull Trout	
		Ave Annual Output (WUA ft^3)	AAC/ Output ($1000)	Ave Annual Output (WUA ft^3)	AAC/ Output ($1000)	Ave Annual Output (WUA ft^3)	AAC/ Output ($1000)	Ave Annual Output (WUA ft^3)	AAC/ Output ($1000)
No Action	$0	0	$0.00	0	$0.00	0	$0.00	0	$0.00
37.5 kaf	$17,167	-79,875	($0.21)	159,378	$0.11	-12,888	($1.33)	22,365	$0.77
37.5 kaf+ WWRID	$17,734	-62,285	($0.28)	192,537	$0.09	194	$91.41	84,329	$0.21
50 kaf	$19,403	-74,644	($0.26)	179,136	$0.11	-7,400	($2.62)	45,048	$0.43
50.0 kaf+ WWRID	$19,970	-56,792	($0.35)	210,865	$0.09	6,846	$2.92	111,250	$0.18
100 cfs	$9,994	56,343	$0.18	263,208	$0.04	60,780	$0.16	375,904	$0.03
100 cfs+ WWRID	$10,511	82,490	$0.13	294,098	$0.04	77,752	$0.14	437,301	$0.02
140 cfs	$11,206	113,522	$0.10	403,701	$0.03	114,188	$0.10	593,948	$0.02
140 cfs + WWRID	$11,773	137,640	$0.09	413,660	$0.03	127,600	$0.09	639,159	$0.02
175 cfs	$19,332	172,589	$0.11	450,517	$0.04	167,219	$0.12	784,944	$0.02
175 cfs + WWRID	$19,899	197,491	$0.10	452,494	$0.04	182,763	$0.11	832,591	$0.02

Figures 4-7 through 4-10 display all plan alternatives differentiated by cost-effectiveness for each aquatic species. Once again, the purpose of the cost-effective analysis is to eliminate inefficient alternatives, ensuring that the least-cost plan alternative is identified for each possible level of environmental output. For any level of investment, the maximum level of output is identified. This method is based on comparing average annual environmental outputs with the average annual cost of an alternative.

Figure 4-7. Cost Effectiveness/Incremental Cost Analysis (CE/ICA) Based on Juvenile Steelhead

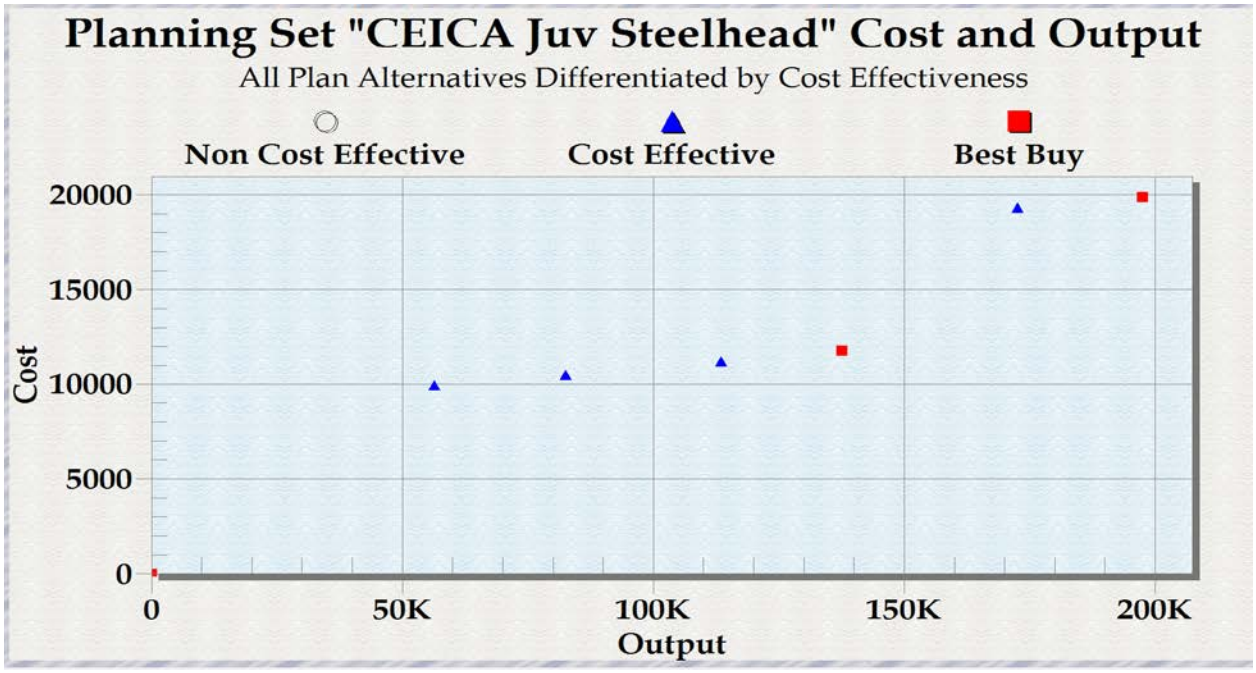


Figure 4-8. The CE/ICA Based on Steelhead Spawning

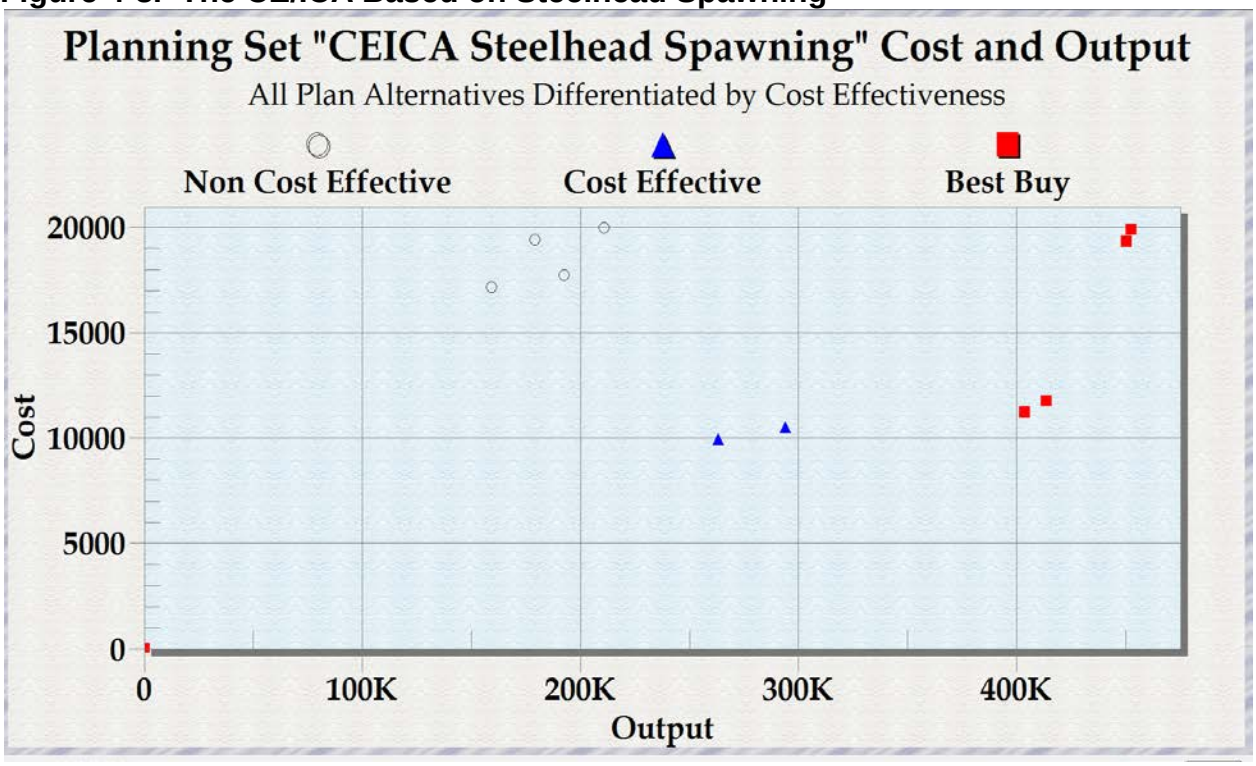


Figure 4-9. The CE/ICA Based on Spring Chinook

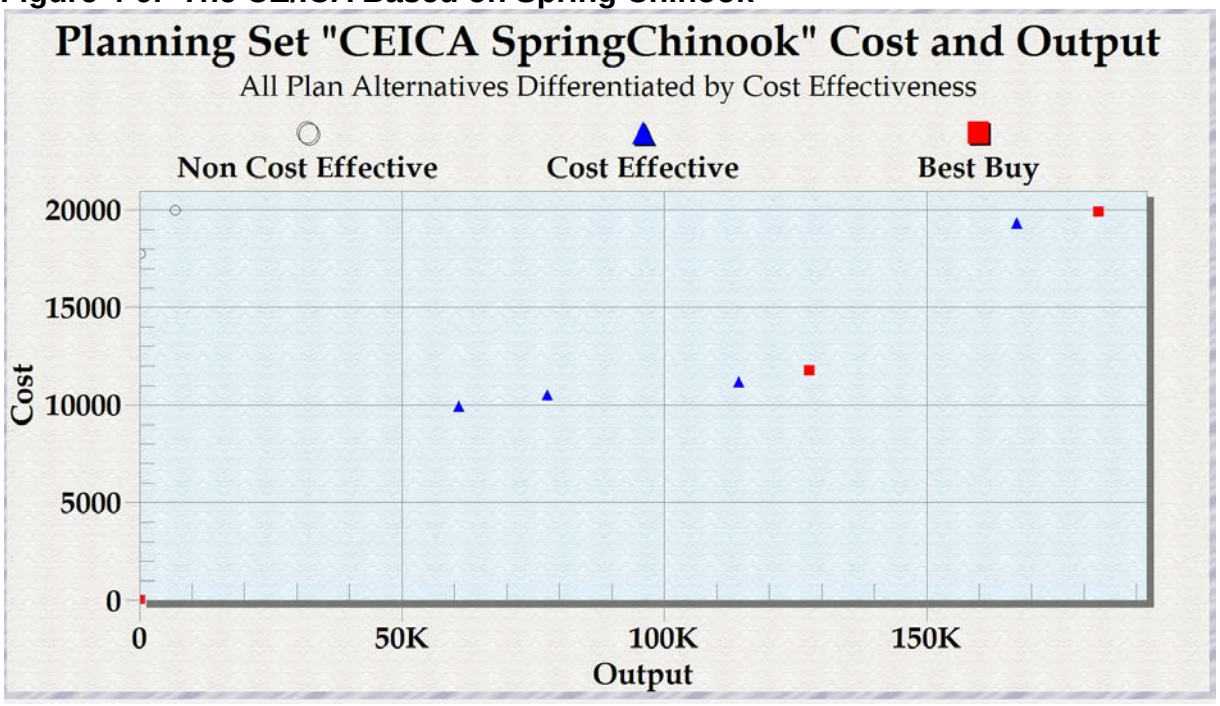


Figure 4-10. The CE/ICA Based on Bull Trout

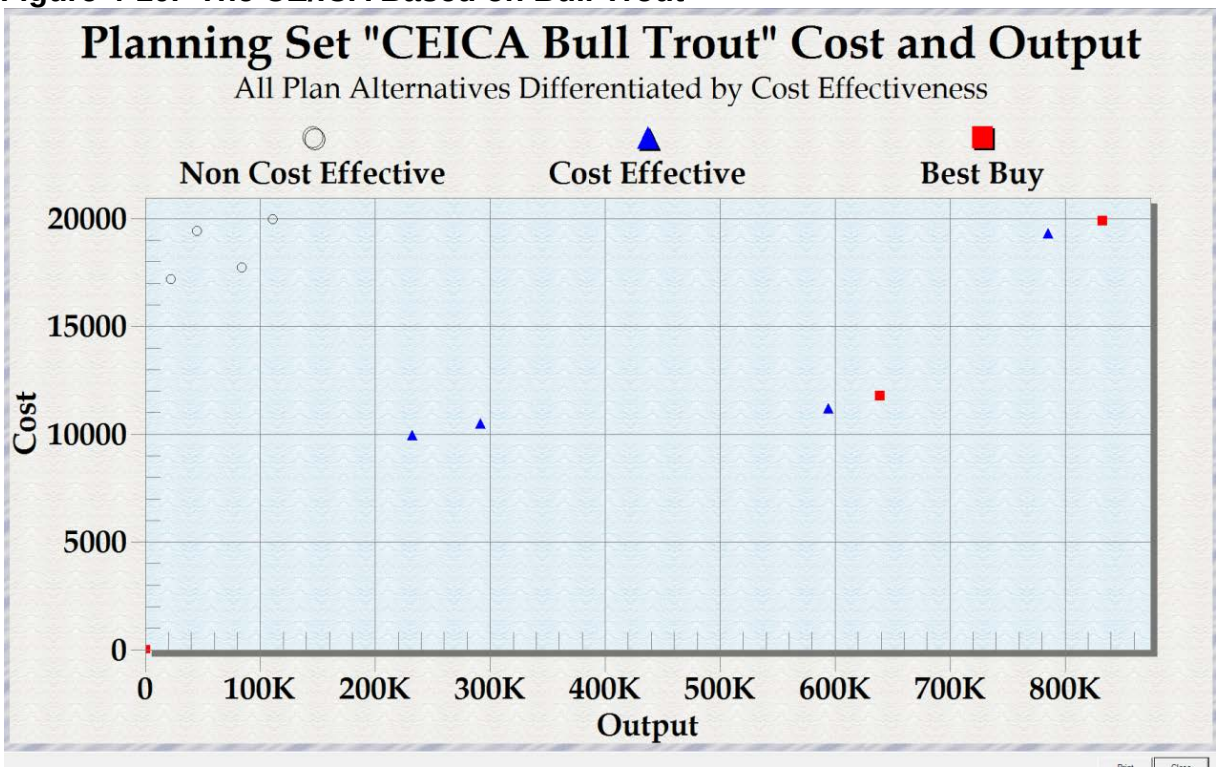


Table 4-19 displays the cost-effective and least-cost alternatives, listed in ascending order of average annual environmental outputs for each species. Cost effectiveness can support decision-making by filtering out and eliminating inefficient plan alternatives.

Alternatives with a higher cost for a given level of environmental outputs were not cost-effective, and were dropped from further consideration. As noted, the storage alternatives proved to be not cost-effective plans regardless of which species was used as outputs. The exchange alternatives were all cost effective when comparing results using the different aquatic species as outputs.

Table 4-19. Cost-Effective, Least-Cost Alternative (Displayed by Aquatic Species)

Plan Description	Average Annual Cost ($1000)	Average Annual Output (WUA ft^3)	AAC/ Output ($1000)
Juvenile Steelhead			
No Action	$0	0	$0.00
100 cfs	$9,994	56,343	$0.18
100 cfs+ WWRID	$10,511	82,490	$0.13
140 cfs	$11,206	113,522	$0.10
140 cfs + WWRID	$11,773	137,640	$0.09
175 cfs	$19,332	172,589	$0.11
175 cfs + WWRID	$19,899	197,491	$0.10
Steelhead Spawning			
No Action	$0	0	$0.00
100 cfs	$9,994	263,208	$0.04
100 cfs+ WWRID	$10,511	294,098	$0.04
140 cfs	$11,206	403,701	$0.03
140 cfs + WWRID	$11,773	413,660	$0.03
175 cfs	$19,332	450,517	$0.04
175 cfs + WWRID	$19,899	452,494	$0.04
Spring Chinook			
No Action	$0	0	$0.00
100 cfs	$9,994	60,780	$0.16
100 cfs+ WWRID	$10,511	77,752	$0.14
140 cfs	$11,206	114,188	$0.10
140 cfs + WWRID	$11,773	127,600	$0.09
175 cfs	$19,332	167,219	$0.12
175 cfs + WWRID	$19,899	182,763	$0.11
Bull Trout			
No Action	$0	0	$0.00
100 cfs	$9,994	232,344	$0.04
100 cfs+ WWRID	$10,511	291,713	$0.04
140 cfs	$11,206	593,948	$0.02
140 cfs + WWRID	$11,773	639,159	$0.02
175 cfs	$19,332	784,944	$0.02
175 cfs + WWRID	$19,899	832,591	$0.02

4.12 Final Array of Alternatives

Based on the cost effective analysis a final array of alternatives was formulated. The final array of alternatives represents the combination of measures that attempt to meet the goals and objectives of the study, survived the screening process, as well as represent the combination that are cost effective. The following describes the alternatives that are carried forward for further evaluation.

4.13 Alternatives

4.13.1 Alternative A - No Action

Alternative A is the no action alternative. It considers possible changes to the existing condition over the life of the project. The resulting future without project condition is the condition against which all alternatives for the Walla Walla River system will be measured. This no action alternative is discussed in detail in Section 3.

Over the past century, the condition of the Walla Walla River aquatic ecosystem has been degraded through industrial, urban, agricultural, and rural development. The lack of instream water volumes and flow durations has disconnected habitat corridors and contributed to the inadequacy of life-sustaining aquatic conditions. As a result, migration attraction flows, passage, spawning, and juvenile rearing habitat have been decreased significantly. Water quality is poor, water temperatures are elevated, riparian vegetation has been eliminated in many areas, and water is unavailable in the channels at critical life stages of anadromous fish. This has resulted in the extirpation of spring Chinook salmon, as well as the listing of both summer steelhead and bull trout under the ESA.

Under the HCP and CDIMP agreements, a minimum stream flow is established for the entire calendar year. However, as a general rule, only the months of June through November require these agreements in order to maintain a minimum flow level downstream of the Cemetery Bridge diversion, as well as at the Burlingame diversion. The 25 cfs at Cemetery is provided by WWRID and HBDIC, and the 18 cfs requirement is provided by GFID at Burlingame.

While the ecosystem has shown improvements to the once dry stretch of river because of these minimum flow levels, the resultant habitat improvements are minimal. In the study completed by the Washington Department of Fish and Wildlife in 2002, the 18 cfs flow only results in a 22% habitat condition for juvenile steelhead and a 31% habitat condition for juvenile Chinook (Caldwell et al., 2002).

Additional habitat improvements gained through irrigation efficiency programs and other coordinated efforts [e.g., Walla Walla Subbasin Plan (Northwest Power and Conservation Council, 2004)] were done by regional conservation groups, non-profits, other Federal and State agencies, and Tribal partners. While efforts and partnerships support advances to balance the human/natural environment, one of the main limiting

factors remains the lack of instream flows within the Walla Walla River. While these restoration efforts will likely continue, the need for stream augmentation still proves to be a catalyst toward restoration efforts.

A brief discussion of current and likely future negative ecosystem conditions is contained in the following paragraphs:

- **Flow Volume and Duration** – The minimum flow in June through November is insufficient to support migration, spawning, and juvenile rearing areas utilized by ESA-listed Chinook salmon, summer steelhead, and bull trout.

- **Water Quality** – The cold, clear water necessary for salmonid and bull trout life stages is not available throughout the entire year. Water quality is degraded due to erosion and sedimentation, elevated temperatures, and irrigation withdrawals and returns.

- **Water Temperature** – Reduced flow volumes and a decrease in riparian vegetation on the Walla Walla River and its tributaries have resulted in elevated water temperatures. Elevated temperatures result in negative impacts to natural migration cues for salmonids, preventing them from fulfilling their life cycles and effectively acting as passage barriers.

- **Passage Barriers** (non-structural) – Over 35,000 af of instream flow is withdrawn each year from the Walla Walla River, primarily between June and mid-November. While efficiency projects have been implemented in the past, the resultant withdrawal is still an impediment for migration within the mainstem Walla Walla River.

- **Natural/Human-Caused Impacts** – Impacts to stream channels, from both natural and human causes, have resulted in a lack of connectivity in aquatic and riparian habitats, and have impacted life stages of target fish species.

4.13.2 Alternative B – Columbia River Water Exchange – 100 cfs

The Columbia River Water Exchange alternatives are based on the maximum capacity system of 175 cfs (Figure 4-11). That alternative is described in Alternative F. The 100 cfs system is very much the same as Alternative F except the maximum capacity of the system is 100 cfs. This is designed to meet the demand of the three participating irrigation districts under low flow years (see Appendix A, *Hydrology*). Listed for comparison purposes are the general differences between the two alternatives. Appendix B-1, *Columbia River Water Exchange*, lists the details of the 175 cfs exchange system.

In comparison of Alternative F, the number of pumps, pipe size, annual operation and maintenance change for this alternative. Delivery locations were not altered. The pipe costs do change with this size of an exchange system. At each branch new standard pipe sizes are identified. In comparison of the 175 cfs system (24 inch to 78 inches) the 100 cfs system only requires pipe sizes from 18 inches to 66 inches.

Pumps are adjusted to handle the maximum delivery of 100 cfs. This results in a reduction of 2 pumps from the main pump station, another two each from BP#1, BP#2, and BP#3 and the reduction of 1 pump from the BP#4. Finally the pump capacity is alternated for all four booster pump resulting in a savings from Alternative F.

The reduction in the number pumps and capital investment for the pipe results in an operation and maintenance (O&M) change from the 175 cfs system. Heavy maintenance costs are assumed to be 1 percent of the capital equipment costs and result is a lower O&M cost.

In addition to the O&M change, the amount of power required to operate this system is less. This is a function of the reduction in flow requirements because the delivery points and head remain the same.

4.13.3 Alternative C – Columbia River Water Exchange – 100 cfs plus WWRID Irrigation Efficiency

Alternative C is the same as alternative B, with the addition of WWRID Irrigation Efficiency. As described in Section 3, *Plan Formulation and Alternatives Development*, and Appendix B-2, *Irrigation Efficiency*, irrigation efficiency would convert existing irrigation canals to buried pipe for WWRID as well as consolidating lines. With irrigation efficiency, three aquifer recharge ponds would also need to be implemented to overcome the groundwater losses associated with piping the irrigation canals. The aquifer recharge for this effort is also described in Appendix B-2, *Irrigation Efficiency*.

The WWRID lies completely within Oregon, and serves areas primarily north of the City of Milton-Freewater. The current water right for WWRID is 16.8 gallons per minute per acre (gpm/acre). The total demand for the proposed system is 65.4 cfs. The design discharge for the new system would be 11.2 gpm/acre.

There are three branches of Crockett Ditch and two branches of Ford Ditch. In laying out a new pipe network to replace the open-channel ditch system, new alignments were selected to follow an abandoned railroad right-of-way and existing road rights-of-way, rather than trying to follow the sinuous alignments of the existing ditches. This allows a more consolidated system with easier access for construction, while still providing service to all the PODs (Figure 4-12).

Figure 4-11. Columbia River Water Exchange Alignment

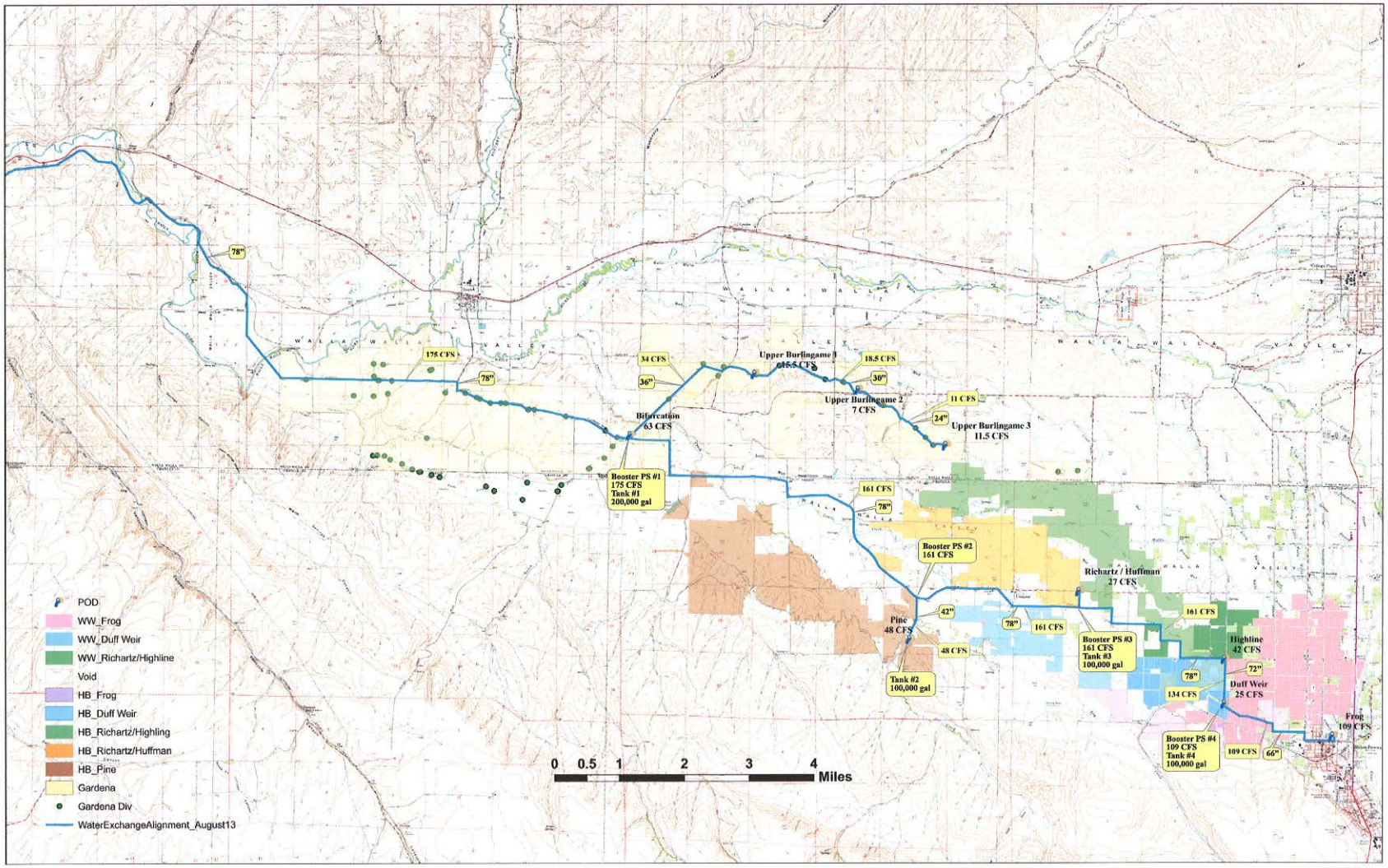
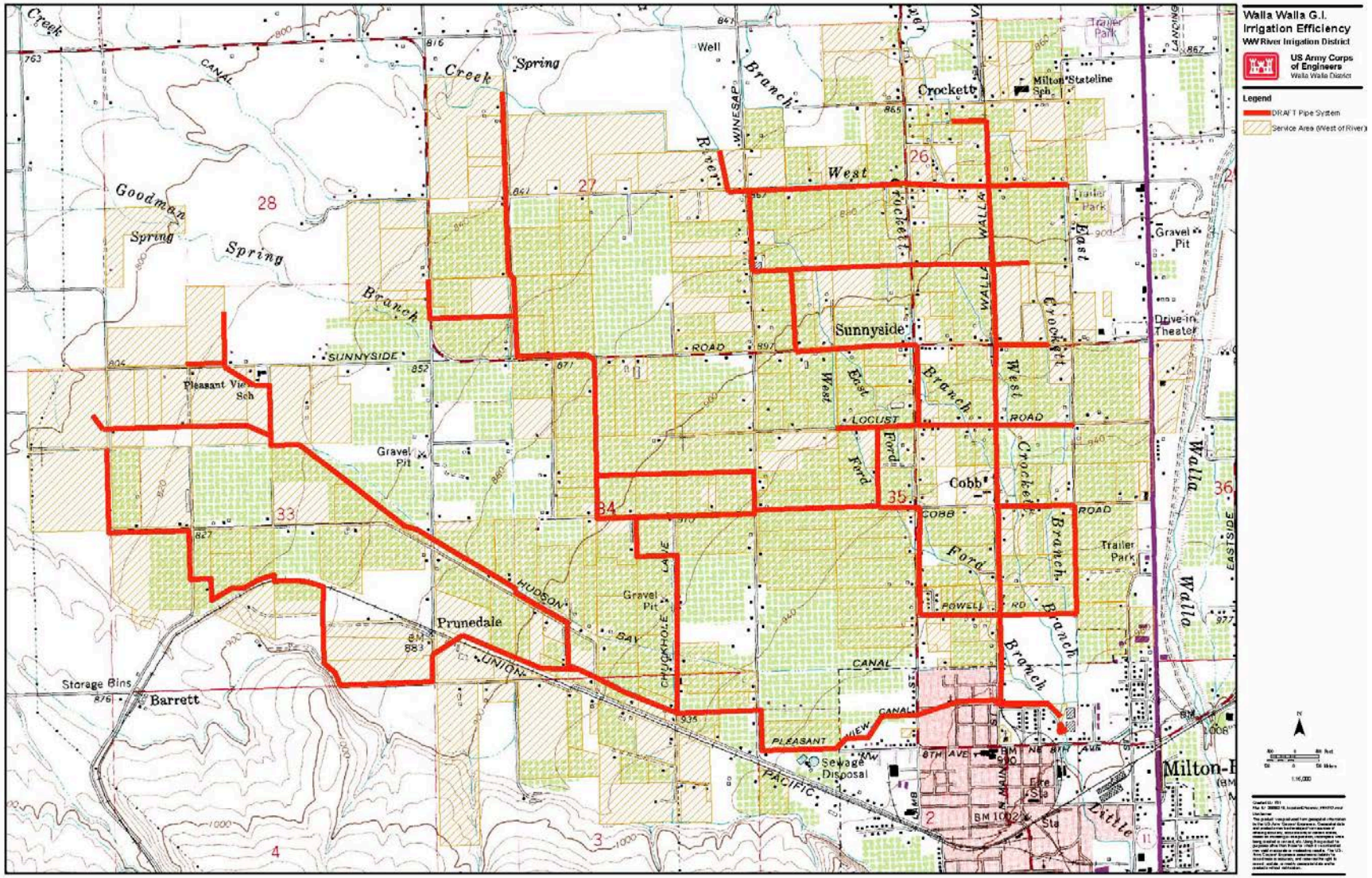


Figure A2-1
System Map

Figure 4-12. The WWRID Irrigation Efficiency Alignment



The inlet for the new buried pipe alignment will be located at the existing junction of Ford and Crockett Canals. The inlet has a trash rack to prevent debris from entering the system and potentially plugging smaller lateral lines. Energy dissipaters will be constructed at each of the pipeline's two outlets. The first outlet is located at the current Lydell Ditch, while the second is situated at the northwestern end of Lower Ford Ditch. The pipeline will be buried a minimum of 3 feet below the surface of the ground. Pipe diameters will vary from 3 to 48 inches, and primarily made of HDPE. Laterals smaller than 4 inches or branching vertically off junctions will be constructed from PVC.

The estimate of annual recharge required for implementation of WWRID irrigation efficiency is based on canal seepage measurements conducted by the Corps in 2004. Based on seepage measurements, the annual total seepage loss for the WWRID is approximately 4,000 acre-feet, and likely ranges from 2,000 to 5,500 acre-feet (see Appendix A, *Hydrology*).

4.13.4 Alternative D – Columbia River Water Exchange – 140 cfs

Alternative D is very much the same as Alternative F except the maximum capacity of the system is 140 cfs. This is designed to meet the demand of the three participating irrigation districts under most flow years (see Appendix A, *Hydrology*). Listed for comparison purposes are the general differences between the two alternatives. Again, Appendix B-1, *Columbia River Water Exchange*, lists the details of the 175-cfs exchange system.

In relation to Alternative F, the number of pumps, pipe size, annual operation and maintenance change for this alternative. Delivery locations were not altered. The pipe costs do not change significantly from Alternative F. This is due to the fact that for the level of cost estimate completed standard sized pipes were priced. Most of the requirements of the 140-cfs system fall within the pipe sizes of the 175 system. The main difference is related to the pipe size associated with the delivery from BP#4 to the Frog. Under this alternative, the pipe size would reduce from a standard 66-inch-diameter line to a 60-inch-diameter line.

Pumps are adjusted to handle the maximum delivery of 140 cfs. This results in a reduction of 1 pump from the main pump station, another one at BP#1, BP#2, and BP#4. Finally the pump capacity is alternated for all four booster pump resulting in a savings from Alternative F.

The reduction in the number pumps and capital investment for the pipe results in an O&M change from the 175 cfs system. Heavy maintenance costs are assumed to be 1 percent of the capital equipment costs and result is a lower O&M cost.

In addition to the O&M change, the amount of power required to operate this system is less. This is a function of the reduction in flow requirements because the delivery points and head remain the same.

4.13.5 Alternative E – Columbia River Water Exchange – 140 cfs plus WWRID Irrigation Efficiency

Alternative E is the same as Alternative D with the addition of irrigation efficiency for WWRID. The optional measure WWRID irrigation efficiency is described in Alternative C; Section 4, *Formulate and Evaluate Alternative Plans*; and Appendix B-2, *Irrigation Efficiency*, irrigation efficiency would include piping the irrigation network for WWRID as well as consolidating lines. With irrigation efficiency three aquifer recharge ponds would also need to be implemented to overcome the groundwater losses associated with piping the irrigation canals. The aquifer recharge for this effort is also described in Appendix B-2, *Irrigation Efficiency*.

4.13.6 Alternative F – Columbia River Water Exchange – 175 cfs

Under Alternative F, water would be pumped from surface flows of the Columbia River into a pipeline and transported to PODs within the GFID located in Touchet, WA, WWRID and HBDIC located in the vicinity of Milton-Freewater, Oregon. In exchange, the irrigation district(s) would use this water to irrigate and would not withdraw an equivalent amount of water from the Walla Walla River. Natural flows in the Walla Walla River would be increased due to the reduced irrigation withdrawal. The intent of the 175 cfs Exchange system is to provide adequate supply from the Columbia River to match historical irrigation diversions based on the flow rates that were diverted under historic conditions for the listed irrigation districts.

This alternative in general includes a new pump intake in the Columbia River, new pipeline to transport the water, booster pumps and regulating tanks along the pipeline alignment, modification of the existing irrigation distribution structure in Old Milton, Oregon, called the “Frog”, and stream gauges to provide flow data. In addition, various staging sites, storage areas, and disposal sites would be required. For details on this alternative review Appendix B-1, *Columbia River Water Exchange*.

As part of this alternative a pump station would be constructed. The pump station is a shore-based concrete structure with a foundation averaging 103 feet by 140 feet and housing six canned vertical turbine, constant speed, pumps. Each pump would have a 48-inch diameter tee screen and a capacity of 35 cfs. One of the pumps would be a redundant unit for emergency use if one of the other five pumps is out of service. The pump station would be sized to withdraw up to 175 cfs of surface flows from the Columbia River. A bridge crane would allow servicing of the pumps.

The pump station would be used to pump Columbia River water into the pipeline system for transport to the Booster Pumps and regulating tanks and on to six major PODs along its alignment and three additional PODs along the Upper Burlingame Lateral.

Based on the 38-year historic flow record, the 175-cfs system meets the demand of the participating irrigation districts almost 100% of the time. This allows the natural flows of the Walla Walla River to remain instream, maximizing the potential restoration benefits that could be realized through increasing instream flow within the Walla Walla River.

The pipeline system would generally consist of a steel trunk line and several branch laterals to serve the PODs. The pipeline would extend approximately 39 miles overall, with pipe diameters ranging from 78 inches to 24 inches. The pipeline would be buried with a minimum cover of three feet. Trench excavations would vary based on pipe size. Access roads would be constructed where the pipeline does not follow existing public roadways and the area is not used for agricultural purposes. The pipeline route would cross various features including railroad, State Highway 12, several county roads, high pressure gas pipelines, several creeks, the Walla Walla River in two locations, several canals, and numerous utilities.

Booster pumps (BPs) maintain flow pressures through specific sections of the pipeline. Booster pumps would generally be constant speed and operate on a fill-and-draw scheme with the regulating tank.

Regulating tanks would be ground-supported welded steel tanks sitting on a concrete ring wall and typically situated adjacent to the Booster Pump Stations. Tank sizes may range from 100,000 gallons averaging 30 feet in diameter and 22 feet high to 200,000 gallons averaging 42 feet in diameter and 22 feet high. The tanks are designed to allow a more controlled environment for water supply and therefore, a control system would be required for operation of the facilities. The tanks house water and then are used to deliver water when necessary.

A 78-inch-diameter pipe would extend from the pump station for approximately 17.5 miles to Regulating Tank #1 and the adjacent Booster Pump Station #1 at the Gardena Farms Bifurcation. The static lift in this section of the pipeline would be approximately 280 feet and the friction loss at peak flow would be approximately 83 feet, for a total dynamic head of 363 feet. The 78-inch pipeline would cross under the Walla Walla River at two locations through this 17.5 mile section. One of river crossings would likely involve construction of a gravel lined temporary diversion channel and the other placement of a large diameter culvert to divert water surface flows during construction of the under-river pipeline crossings.

The BP Station #1 would be located at the first POD, Gardena Farms Bifurcation. This BP would be sized for a peak demand of 175 cfs. Pump Station #1 would pump water through a 78-inch diameter steel pipe for approximately 5.9 miles to Booster Pump Station #2. Upper Burlingame Lateral extends from the first POD at Gardena Farms Bifurcation 31,421 feet. Three additional PODs are located within the Gardena Farms Irrigation District along the Upper Burlingame Lateral which supplies flow to the Burlingame Ditch.

A 0.7-mile long, 42-inch-diameter pipeline spur would extend south from the main trunk line and terminate at Tank #2 and the 48 cfs POD near Pine Creek Diversion within/serving the Hudson Bay District Improvement Company.

Booster Pump Station #2 would be located at the pipe junction for the Pine Creek Diversion. It would be sized for 161 cfs. The pump station would pump water through a 78-inch diameter steel pipe for approximately 2.7 miles to Tank #3 located adjacent to Booster Pump Station #3 near the 27 cfs POD at Richartz/Huffman canal within/serving Hudson Bay District Improvement Company.

Booster Pump Station #3 would be located at the Richartz/Huffman POD. It will be sized for 161 cfs. The station would pump water through 78-inch diameter reducing to 72-inch diameter steel pipes for approximately 4.1 miles to Tank #4 located adjacent to Booster Pump Station #4 at the 25 cfs POD, Duff Weir within/serving Hudson Bay District Improvement Company and Walla Walla River Irrigation District.

Booster Pump Station #4 would be located south of the Highline POD (42 cfs) and near the Duff Weir. It would be sized for 109 cfs. The station would pump water through a 66-inch-diameter steel pipe for approximately 1.9 miles to the last POD, 109 cfs, at Frog Junction within/serving HBDIC and WWRID. An estimated six pumps would be installed at Booster Pump Station #4. The wide flow-range capacity of the pumps along with variable speed drives would allow very close control of the water level at the Frog Junction.

Revisions to the Frog Junction would include replacement of the existing flashboard openings with undershot gates (which are less sensitive to flow changes resulting from slight variations in the water surface), addition of a weir gate for control of overflows, and new walkways over the ditches which would meet current safety standards, an energy dissipation structure where the exchange pipeline discharges into the Frog, and a water level monitoring station and stilling well.

4.13.7 Alternative G – Columbia River Water Exchange – 175 cfs plus WWRID Irrigation Efficiency

Alternative G is the same as Alternative F with the addition of irrigation efficiency for WWRID. The optional measure WWRID irrigation efficiency is described in Alternative C as well as in earlier in this section; and in Appendix B-2, *Irrigation Efficiency*, irrigation efficiency would include piping the irrigation network for WWRID as well as consolidating lines. With irrigation efficiency three aquifer recharge ponds would also need to be implemented to overcome the groundwater losses associated with piping the irrigation canals. The aquifer recharge for this effort is also described in Appendix B-2, *Irrigation Efficiency*.

SECTION 5 – COMPARISON OF ALTERNATIVES

5.0 Alternative Comparison

To make a selection of the preferred alternative a comparison of the alternatives is required. To determine the Federal interest alternatives are evaluated for:

1) Completeness (against their ability to realize restoration benefits);
2) Effectiveness (to meet the objectives of the study while avoiding the constraints);
3) Efficiency (the ability of an alternative to maximize the restoration benefits of the project; and
4) Acceptability (the ability of an alternative to be compliant with applicable laws and policy).

5.1 Incremental Cost Analysis

Incremental cost analysis is required to address whether the incremental (additional) cost of the next level of output is warranted. In this environmental study, the comparison occurs between dollar incremental costs and non-dollar incremental units of output. Incremental cost analysis is performed by determining the incremental cost per unit between successively larger (e.g., more output) plan alternatives, and identifying best buy plans as those plans for which the incremental cost per unit is lowest for a particular output level. Incremental cost per unit is defined as the plan alternative's incremental cost divided by its incremental output.

In order to facilitate the required calculations, IWR-Plan was used to perform the calculations necessary to eliminate the irregular, non-continuously increasing cost changes that occur in the incremental average annual cost per output calculations. To get to the final incremental cost table, the model performs a series of calculations to determine the lowest average cost for additional output from among the remaining levels of output. Each of the recalculations begins with the previous step's lowest average cost per unit of output set as the new "zero level." The calculation in this step uses the additional cost and additional outputs above those of the previously identified level of output with the lowest average cost. (For further details on this process, refer to *Cost Effectiveness Analysis for Environmental Planning: Nine Easy Steps*, IWR Report 94-PS-2, October 1994.) Table 5-1 summarizes the results of the final incremental cost analysis for each aquatic species.

Table 5-1. Summary of Final Incremental Cost Analysis

Plan Alternative	Average Annual Cost ($1000)	Average Annual Output (WUA ft^3)	Incremental cost ($1,000)	Incremental Output (WUA ft^3)	Incremental Cost Per Unit Output ($1000)
Juvenile Steelhead					
Alt A - No Action	$0.00	0	$0.00	0	$0.00
Alt E - 140 cfs + WWRID	$11,773	137,640	$11,773	137,640	$0.09
Alt G - 175 cfs + WWRID	$19,899	197,491	$8,126	59,851	$0.14
Steelhead Spawning					
Alt A - No Action	$0.00	0	$0.00	0	$0.00
Alt D - 140 cfs	$11,206	403,701	$11,206	403,701	$0.03
Alt E - 140 cfs + WWRID	$11,773	413,660	$567	9,959	$0.06
Alt F - 175 cfs	$19,332	450,517	$7,559	36,857	$0.21
Alt G - 175 cfs + WWRID	$19,899	452,494	$567	1,977	$0.29
Spring Chinook					
Alt A - No Action	$0.00	0	$0.00	0	$0.00
Alt E - 140 cfs + WWRID	$11,773	127,600	$11,773	127,600	$0.09
Alt G - 175 cfs + WWRID	$19,899	182,763	$8,126	55,163	$0.15
Bull Trout					
Alt A - No Action	$0.00	0	$0.00	0	$0.00
Alt E - 140 cfs + WWRID	$11,773	639159	$11,773	639,159	$0.02
Alt G - 175 cfs + WWRID	$19,899	832,591	$8,126	193,432	$0.04

When comparing results, the *140 cfs exchange + WWRID irrigation efficiency* and *175 cfs exchange + WWRID irrigation efficiency* alternative are the only two alternatives besides the no action plan that showed up as a best buy plan for all indicator species. When using steelhead spawning as the indicator species/life stage, two additional best buy plans resulted: *140 cfs exchange and 175 cfs exchange*. Table 5-2 shows the change from one combination to the next. Using juvenile steelhead as the example, moving from the *140 cfs exchange + WWRID to 175 cfs exchange + WWRID* shows a change of 59,851 additional average annual environmental outputs (197,491 total average annual environmental outputs for *175 cfs exchange + WWRID* minus 137,640 total average annual environmental outputs for the *140 cfs exchange + WWRID*); an additional average annual cost of $8,126,000 ($19,899,000 total average annual cost for *175 cfs exchange + WWRID* minus $11,773,000 total average annual cost for the *140 cfs exchange + WWRID*); and an incremental $135.77 per unit environmental outputs ($8,126,000 incremental cost divided by 59,851 of incremental environmental output).

The column on the right summarizes the incremental average annual cost per output, showing potential breakpoints where gaining the next level of output shows a significant increase in costs. Figures 5-1 through 5-4 also display the incremental output and incremental cost per unit output for the best buy alternatives. Figure 5-5 displays the union of best buy plans, showing all best buy plans using any of the four indicator species. For Figures 5-1 through 5-4, the vertical incremental cost per unit axis is in $1,000.

Figure 5-1. Best Buy Plan - Juvenile Steelhead

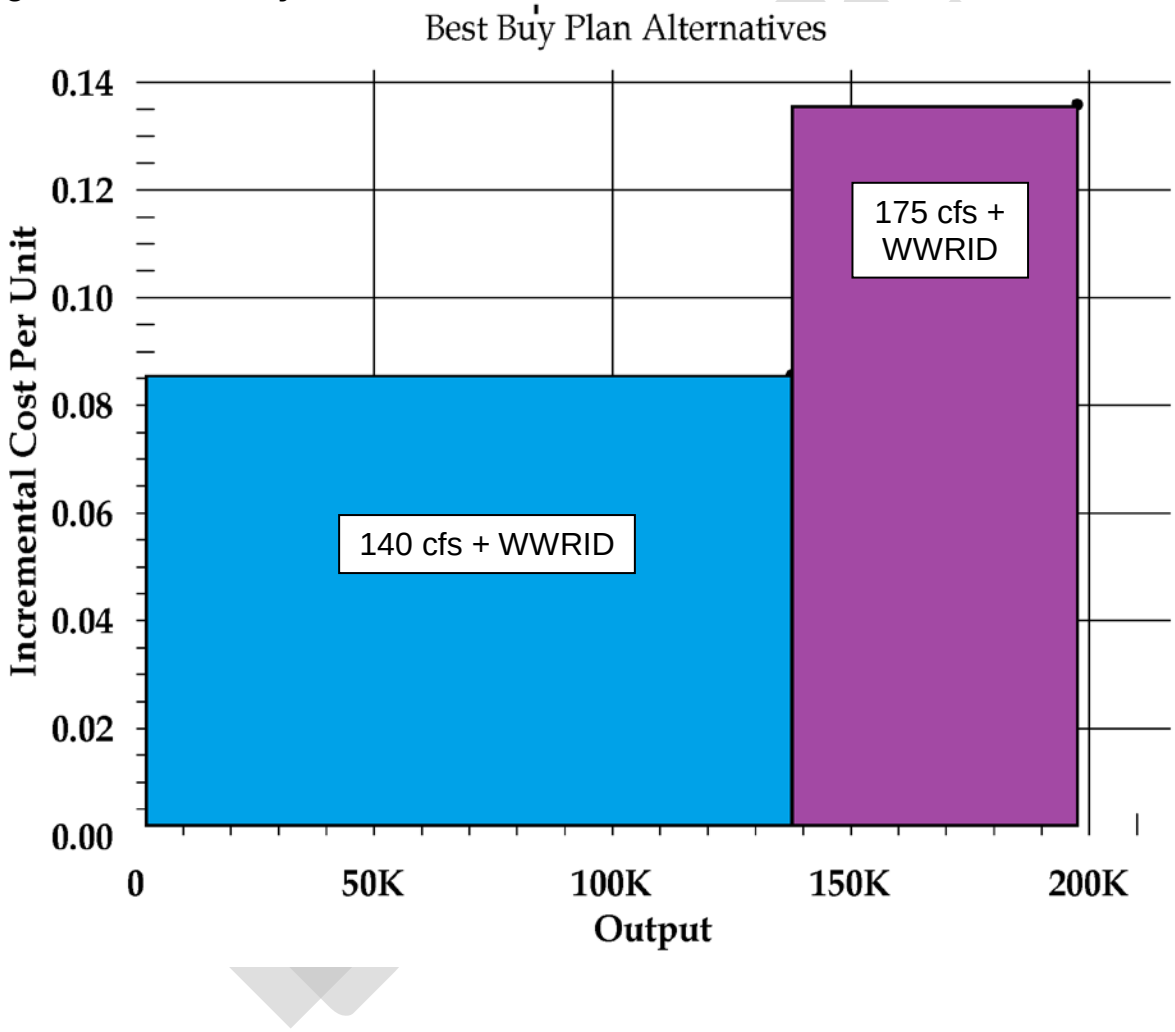


Figure 5-2. Best Buy Plan - Steelhead Spawning

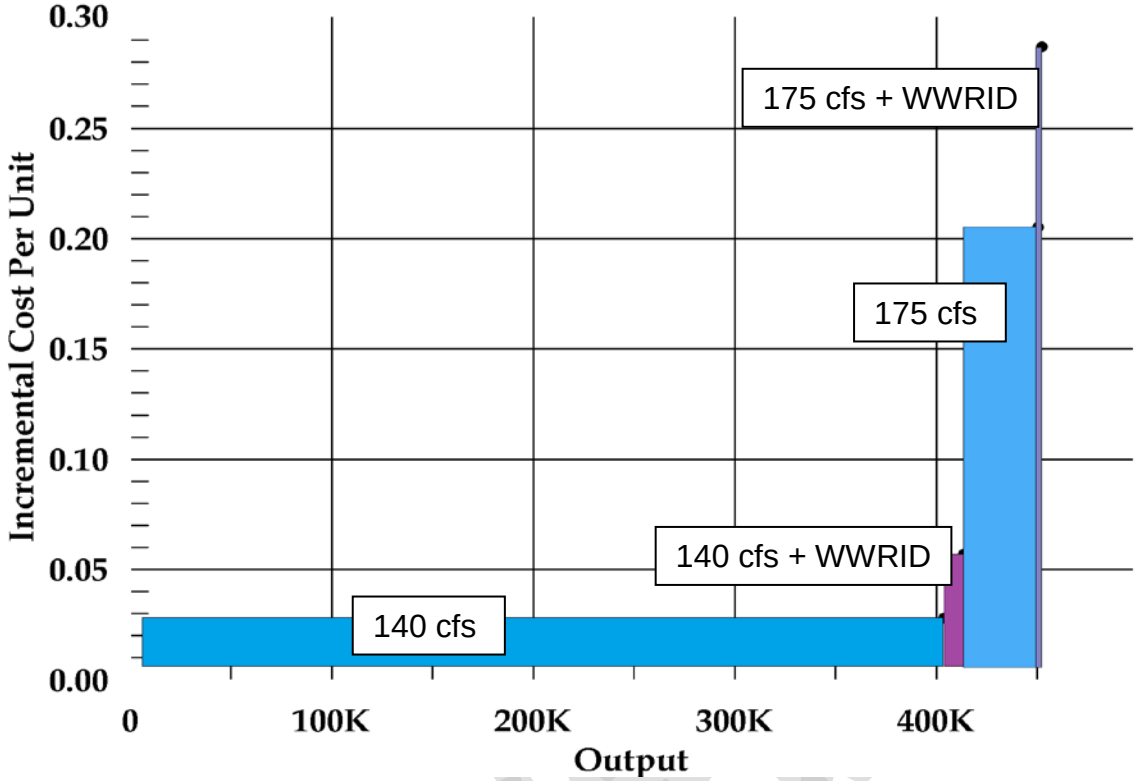


Figure 5-3. Best Buy Plan - Spring Chinook Salmon

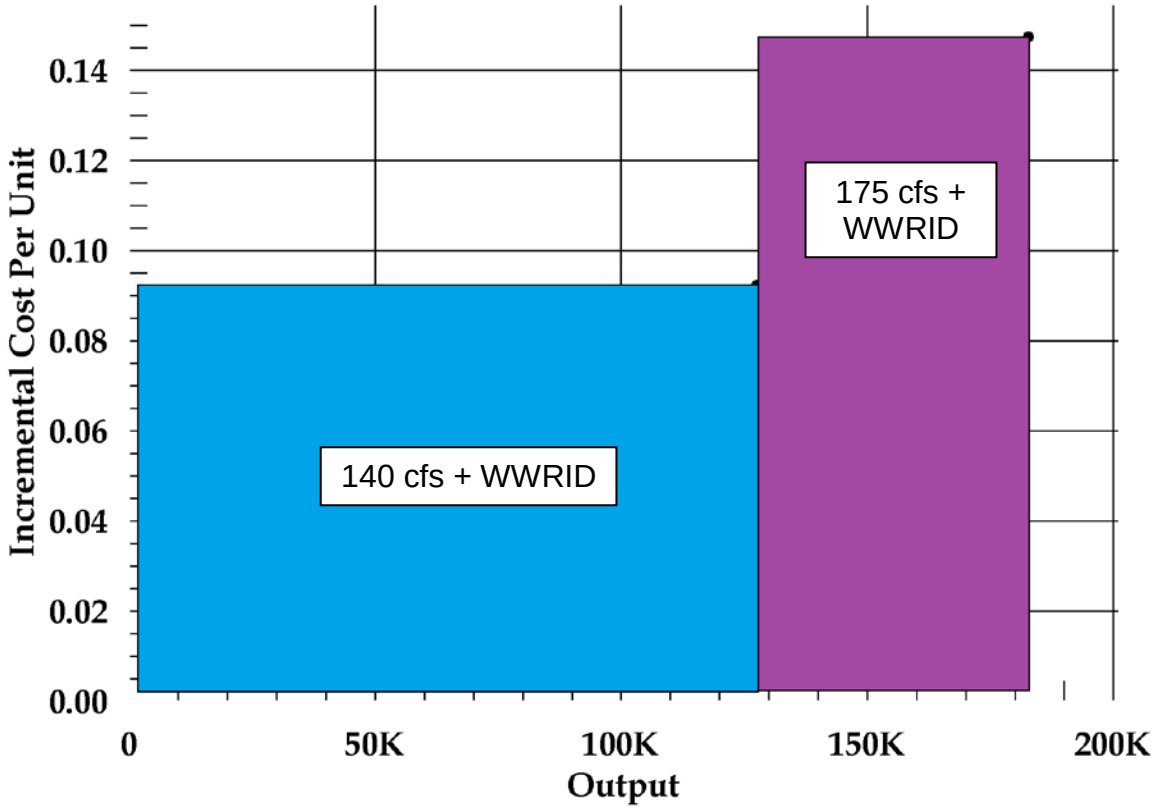


Figure 5-4. Best Buy Plan - Bull Trout

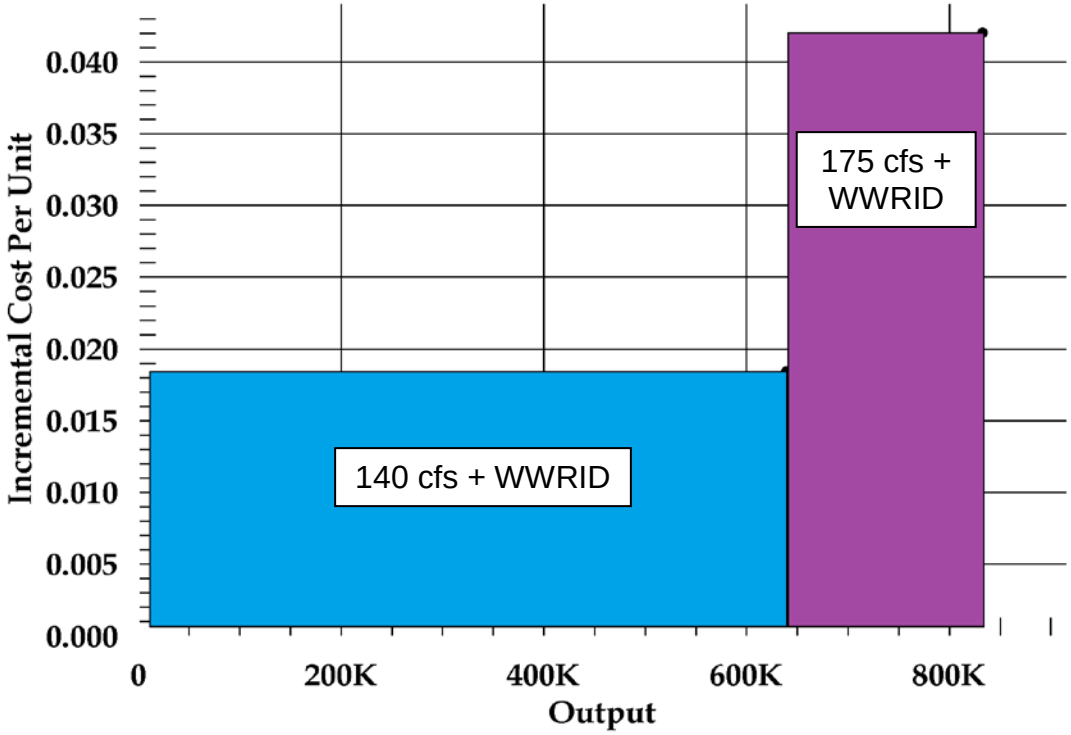
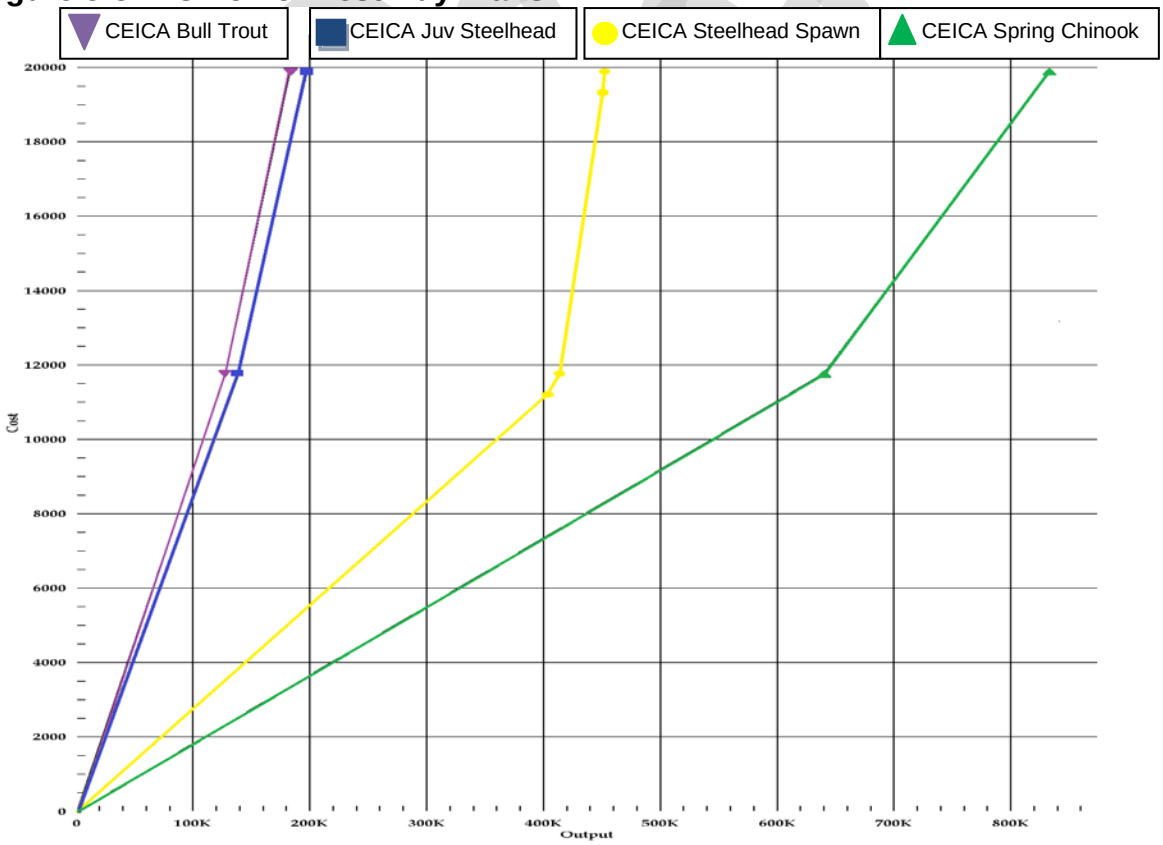


Figure 5-5. Union of Best Buy Plans



5.2 Ability to Meet Objectives

Biological Benefits by alternative and objective were summarized in Table 5-2 and 5-3 to provide a quick reference of how each alternative was able to meet or not meet the objectives of the Feasibility study.

Table 5-2 shows a synthesis discussion of objectives by alterative. Again, the objectives of the study are as follows.

- Objective 1 – Establish a minimum instream flow of 25 cfs to provide habitat connectivity by 2020.
- Objective 2 – Improve instream habitat to support critical life stages for summer steelhead, spring Chinook salmon, and bull trout by 2020.
- Objective 3 – Improve water temperatures so no more than 4 days of temperatures above 72°F (22°C) exist to support critical life stages for summer steelhead, spring Chinook salmon, and bull trout by 2020.
- Objective 4 – Reduce fish passage non-structural barriers by 50% by 2020.

The first objective is to establish a minimum instream flow of 25 cfs to provide habitat connectivity by 2020. This objective was evaluated by comparing the hydrology data for each alternative that included a representative low, average, and high water year. Each alternative met the objective and was able to provide a minimum instream flow of 25 cfs (see Appendix H, *Biological Benefits Analysis*). Providing a minimum instream flow improves passage conditions for adult salmon, steelhead, and bull trout; moderates temperatures which range between 69.8 to 77°F (21 to 25°C) during summer and fall, and on a fundamental level provides water to a channel which frequently ran dry during the irrigation withdrawal season (June-November).

The second objective of the study is to improve instream habitat to support critical life stages for salmon, steelhead, and bull trout by 2020. Habitat conditions were evaluated using PHABSIM model outputs in weighted usable area (WUA) and percent habitat conditions based on the WUA/flow relationship tables (Appendix H, *Biological Benefits Analysis*). All alternatives were compared to baseline 'no action' conditions to derive numerical benefits. Habitat benefits are mainly realized June through October when extra water remains in the river rather than being diverted for irrigation. This period is important for various life stages, including adult upstream migrations, spawning, egg incubation, alevins (larval fish), fry emergence, juvenile rearing, and downstream juvenile migrations (see Appendix H, *Biological Benefits Analysis*, for life stage tables). All of the action alternatives are able to improve habitat conditions over existing conditions for each life stage due to water being left in river. The magnitude of habitat improvement increases proportionately with the rate of exchange for each alternative. Alternative G, Columbia River Water Exchange - 175 cfs with WWRID Irrigation Efficiency provides the highest habitat benefit by leaving the most water in-river.

Table 5-2. Synthesis of Objectives by Alternative

Objective	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E	Alternative F	Alternative G
1	Minimum flows of 25 cfs are not met June through November due to irrigation withdrawals.	Minimum flows of 25 cfs are met for all months under this alternative.	Minimum flows of 25 cfs are met for all months under this alternative.	Minimum flows of 25 cfs are met for all months under this alternative.	Minimum flows of 25 cfs are met for all months under this alternative.	Minimum flows of 25 cfs are met for all months under this alternative.	Minimum flows of 25 cfs are met for all months under this alternative.
2	Habitat values are low due to irrigation withdrawals dewatering the channel during baseflow months June-September.	Weighted usable area (WUA) percent improvement over 'no action': Spring Chinook juvenile 1558%, Steelhead juvenile 1289% Adult salmon and steelhead 882% Bull trout 1394%	Weighted usable area (WUA) percent improvement over 'no action': Spring Chinook juvenile 1875%, Steelhead juvenile 1545% Adult salmon and steelhead 1030% Bull trout 1555%	Weighted usable area (WUA) percent improvement over 'no action': Spring Chinook juvenile 2935%, Steelhead juvenile 2519% Adult salmon and steelhead 1343% Bull trout 2105%	Weighted usable area (WUA) percent improvement over 'no action': Spring Chinook juvenile 3037%, Steelhead juvenile 2601% Adult salmon and steelhead 1362% Bull trout 2144%	Weighted usable area (WUA) percent improvement over 'no action': Spring Chinook juvenile 4080%, Steelhead juvenile 3549% Adult salmon and steelhead 1544% Bull trout 2642%	Weighted usable area (WUA) percent improvement over 'no action': Spring Chinook juvenile 4193%, Steelhead juvenile 3626% Adult salmon and steelhead 1552% Bull trout 2679%
3	This objective was evaluated at the head of the project just upstream of the Milton-Freewater levee. Baseline assumptions for temperatures include 21° C in June, 24° C in July and August, and 24° C in September.	This alternative can meet the objective at the head of the project in June when temperatures are typically 21°C and lower, but none of the other months.	This alternative can meet the objective at the head of the project in June when temperatures are typically 21°C and lower, but none of the other months.	This alternative can meet the objective at the head of the project in June when temperatures are typically 21°C and lower and in July by providing 2.2°C reduction in temperature, but does meet the objective during August or September.	This alternative can meet the objective at the head of the project in June when temperatures are typically 21°C and lower and in July by providing 2.2°C reduction in temperature, but does meet the objective during August or September.	This alternative can meet the objective at the head of the project in June when temperatures are typically 21°C and lower and in July by providing 2.2°C reduction in temperature, but does meet the objective during August or September.	This alternative can meet the objective at the head of the project in June when temperatures are typically 21°C and lower and in July by providing 2.2°C reduction in temperature, but does not meet the objective during August or September.
4	Percent of measured cross sections (May-December) within the 14 mile study reach that do not minimum 1 ft depth passage criteria for adult salmon and steelhead is 64%.	This alternative meets the objective by reducing the percentage of blocked areas from 64 %(existing conditions) to 29% (May- December).	This alternative meets the objective by reducing the percentage of blocked areas from 64 %(existing conditions) to 26% (May- December).	This alternative meets the objective by reducing the percentage of blocked areas from 64 %(existing conditions) to 22% (May- December).	This alternative meets the objective by reducing the percentage of blocked areas from 64 %(existing conditions) to 21% (May- December).	This alternative meets the objective by reducing the percentage of blocked areas from 64 %(existing conditions) to 18% (May- December)	This alternative meets the objective by reducing the percentage of blocked areas from 64 %(existing conditions) to 17% (May- December).

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Table 5-3. Matrix of Alternatives Compared to Objectives

Objective	Alt A	Alt B	Alt C	Alt D	Alt E	Alt F	Alt G
1	No	Yes	Yes	Yes	Yes	Yes	Yes
2	No	Yes	Yes	Yes	Yes	Yes	Yes
3	No	June: Yes July: No Aug: No Sept: No	June: Yes July: No Aug: No Sept: No	June: Yes July: No Aug: No Sept: No	June: Yes July: No Aug: No Sept: No	June: Yes July: Yes Aug: No Sept: No	June: Yes July: Yes Aug: No Sept: No
4	No	Yes	Yes	Yes	Yes	Yes	Yes

The third objective is to improve water temperatures so no more than 4 days of temperatures above 72°F (22°C) exist to support salmon and bull trout migration, rearing, and spawning by 2020. In order to evaluate the temperature benefits realized under implementation of the exchange alternatives, the Oregon temperature TMDL model was referenced to apply temperature benefits associated with additional discharge in the Walla Walla River. The TMDL modeling was sampled and analyzed for August temperatures and captures the 'maximum' temperatures in the Walla Walla River. The analysis included an examination of how additional flow up to 100 cfs would influence stream temperatures and riparian conditions. The benefit of temperature reduction with up to 100 cfs discharge was extrapolated to the months June through September (for methods see Appendix H, *Biological Benefits Analysis*).

The Walla Walla River baseline temperatures used for estimation of benefits are 21°C for June, 24°C for July and August and 22°C for September.

For every 100 cfs not withdrawn for irrigation, a 3°C reduction in temperature was applied to represent project benefits (Butcher, 2004) (for methods see Appendix H, *Biological Benefits Analysis*).

Objective four is to reduce non-structural adult fish passage barriers by 50% by 2020. Adult passage analysis done for the Study used 1.0 ft as the criteria for passage for all flow years and months. Depth data was pulled from the Hydrologic Engineering Center's River Analysis System (HEC-RAS) modeling and compared the existing conditions to each alternative. The HEC-RAS model found that under existing conditions or 'future without project,' 31% of the four reaches do not achieve the 1.0 feet depth required by the above criteria under all months and low, average, and high water years on record (see Appendix H, *Biological Benefits Analysis*).

The modeled results would reduce impassability under these conditions to 8%. Since most of the passage barriers occur during the low flow conditions, the depth data was also sorted by the months of May through December when the majority of cross sections do not meet minimum depth criteria; under this analysis 64% of all cross sections in the river do not meet minimum passage requirements. The modeled result would reduce impassability under these conditions to 17%. Each alternative was compared against this baseline condition and all alternatives were able to meet the requirement of 50% reduction in blockages.

5.3 Effects to Existing Flood Risk Reduction Structures

Within the mainstem of the Walla Walla River a levee system exists. The purpose of the levees is to provide flood risk reduction to the town of Milton-Freewater, Oregon. The Corps must evaluate the impacts of the ecosystem restoration project upon this flood risk reduction structure.

While local entities continue to pursue certification and maintain the levees, none of the proposed alternatives would raise the water surface elevation during flood events and therefore does not affect existing levee performance in terms of annual exceedance probability, long-term risk, or conditional non-exceedance probability.

5.4 Evaluation of Alternatives for Environmental Resources

A summary of the environmental consequences is presented in Table 5-4. For every alternative, the environmental resource effects are categorized as either negative or positive. From there, duration and intensity are considered. Short term is used to describe an impact that is less than three years. Long term is used to describe an impact that is greater than three years. The intensities used are negligible, minor, moderate or major. For example, an action that could result in a change to a resource, but the change would be so small that it would not be of any measurable or perceptible consequence is rated “negligible”. This equates to no change over the no action. “Minor” is used to describe an action that could result in a change to a resource. The change would be measurable but small and localized and of little consequence. “Moderate” is used to describe an action that would result in some change to a resource. The change would be measurable and of consequence but would be of moderate scale and would occur over a limited area. Finally “major” is used to describe an action that would result in a significant change to a resource. The change would be measurable and either result in a major beneficial or major negative impact upon a resource. The impacts or benefits are very significant and occur over a wide geographic area

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Table 5-4. Summary of Environmental Impacts by Alternatives

Air Quality	
Alternative A – No Action	Long-term positive improvements as a consequence of more rigorous state and Federal air quality standards.
Alternative B – CRWE, 100 cfs	Short-term minor impacts associated with construction and post-construction operation and maintenance, including emissions associated with internal combustion-related and construction-related fugitive dust.
Alternative C – CRWE, 100 cfs, plus WWRID Irrigation Efficiency	Short-term minor impacts associated with construction and post-construction operation and maintenance, including emissions associated with internal combustion related emissions, construction related fugitive dust emissions. Short-term, minor impacts with the implementation of irrigation efficiency and shallow aquifer recharge.
Alternative D – CRWE, 140 cfs	Short-term minor impacts associated with construction and post-construction operation and maintenance, including emissions associated with internal combustion-related emission and construction-related fugitive dust emissions.
Alternative E – CRWE, 140 cfs, plus WWRID Irrigation Efficiency	Short-term minor impacts associated with construction and post-construction operation and maintenance, including emissions associated with internal combustion-related emissions, and construction-related fugitive dust emissions. Short-term, minor impacts with the implementation of irrigation efficiency and shallow aquifer recharge.
Alternative F – CRWE, 175 cfs	Short-term minor impacts associated with construction and post-construction operation and maintenance, including emissions associated with internal combustion related emissions, construction related fugitive dust emissions.
Alternative G – CRWE, 175 cfs, plus WWRID Irrigation Efficiency	Short-term minor impacts associated with construction and post-construction operation and maintenance, including emissions associated with internal combustion-related emissions, and construction-related fugitive dust emissions. Short-term, minor impacts with the implementation of irrigation efficiency and shallow aquifer recharge.
Water Quality	
Alternative A – No Action	• Moderate to major long-term, negative effects due to continued deterioration of regional, shallow groundwater resources. Less recharge has resulted in desiccation of springs and groundwater seeps feeding the Walla Walla River. • Implementation of existing TMDLs should result in moderate long-term water quality benefits to the Walla Walla River.
Alternative B – CRWE, 100 cfs	• Short-term, moderate, negative increases in turbidity, suspended solids, DO depletion, and possible release of sediment contaminants due to river crossing construction. • Long-term, minor, positive improvements to water temperature, DO, and pH due to increased mainstem Walla Walla River flows. • Long-term, moderate, positive impact due to improved riparian habitat and moderated summer stream temperatures. • Long-term moderate negative impact from sediment entrainment, along with the need for periodic dredging at the intake.

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Table 5-4. Summary of Environmental Impacts by Alternatives (continued)

Alternative C – CRWE, 100 cfs, plus WWRID Irrigation Efficiency	• Short-term, moderate, negative increases in turbidity, suspended solids, DO depletion, and possible release of sediment contaminants due to river crossing construction. • Long-term, minor, positive improvements to water temperature, DO, and pH due to increased mainstem Walla Walla River flows. • Long-term, moderate, positive impact due to improved riparian habitat and moderated summer stream temperatures. • Long-term moderate negative impact will result from sediment entrainment along with the need for periodic dredging at the intake. • Possible long-term, minor, positive impacts on stream temperature due to increased flow in the Walla Walla River resulting from irrigation efficiency and shallow aquifer recharge.
Alternative D – CRWE, 140 cfs	• Short-term, moderate, negative increases in turbidity, suspended solids, DO depletion, and possible release of sediment contaminants due to river crossing construction. • Long-term, moderate, positive improvements to water temperature, DO, and pH due to increased mainstem Walla Walla River flows. • Long-term, moderate, positive impact due to improved riparian habitat and moderated summer stream temperatures. • Long-term moderate negative impact from sediment entrainment, along with the need for periodic dredging at the intake.
Alternative E – CRWE, 140 cfs, plus WWRID Irrigation Efficiency	• Short-term, moderate, negative increases in turbidity, suspended solids, DO depletion, and possible release of sediment contaminants due to river crossing construction. • Long-term, moderate, positive improvements to water temperature, DO, and pH due to increased mainstem Walla Walla River flows. • Long-term, moderate, positive impact due to improved riparian habitat and moderated summer stream temperatures. • Long-term moderate negative impact from sediment entrainment, along with the need for periodic dredging at the intake. • Possible long-term, minor, positive impacts on stream temperature due to increased flow in the Walla Walla River resulting from efficiency and shallow aquifer recharge.
Alternative F – CRWE, 175 cfs	• Short-term, moderate, negative increases in turbidity, suspended solids, DO depletion, and possible release of sediment contaminants due to river crossing construction. • Long-term, moderate, positive improvements to water temperature, DO, and pH due to increased mainstem Walla Walla River flows. • Long-term, moderate, positive impact due to improved riparian habitat and moderated summer stream temperatures. • Long-term moderate negative impact from sediment entrainment along with the need for periodic dredging at the intake.
Alternative G – CRWE, 175 cfs, plus WWRID Irrigation Efficiency	• Short-term, moderate, negative increases in turbidity, suspended solids, DO depletion, and possible release of sediment contaminants due to river crossing construction. • Long-term, moderate, positive improvements to water temperature, DO, and pH due to increased mainstem Walla Walla River flows. • Long-term, moderate, positive impact due to improved riparian habitat and moderated summer stream temperatures. • Long-term moderate negative impact from sediment entrainment,

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	along with the need for periodic dredging at the intake. • Possible long-term, minor, positive impacts on stream temperature due to increased flow in the Walla Walla River resulting from efficiency and shallow aquifer recharge.
Aquatic Resources	
Alternative A – No Action	Moderate to major long-term negative impacts due to passage barriers from lack of water and elevated river temperatures in river during critical passage, rearing, and spawning times for all species.
Alternative B – CRWE, 100 cfs	• Short-term, moderate, negative increases in turbidity due to river crossing construction. • Long-term, moderate, positive improvements to water temperature and adult salmon and steelhead passage due to increased mainstem Walla Walla River flows, particularly in summer and fall months. • Long-term, moderate, positive impact due to improved riparian habitat and moderated summer stream temperatures.
Alternative C – CRWE, 100 cfs, plus WWRID Irrigation Efficiency	• Short-term, moderate, negative increases in turbidity due to river crossing construction. • Long-term, moderate, positive improvements to water temperature and adult salmon and steelhead passage due to increased mainstem Walla Walla River flows, particularly in summer and fall months. • Long-term, moderate, positive impact due to improved riparian habitat and moderated summer stream temperatures. • Long-term negligible positive impacts on water temperature from shallow aquifer recharge and efficiencies. Benefits from aquifer recharge will change from location of irrigation canals to shallow aquifer recharge ponds.
Alternative D – CRWE, 140 cfs	• Short-term, moderate, negative increases in turbidity due to river crossing construction. • Long-term, moderate, positive improvements to water temperature and adult salmon and steelhead passage due to increased mainstem Walla Walla River flows, particularly in summer and fall months. • Long-term, moderate to major, positive impact due to improved riparian habitat, and moderated summer stream temperatures.
Alternative E – CRWE, 140 cfs, plus WWRID Irrigation Efficiency	• Short-term, moderate to major, negative increases in turbidity due to river crossing construction. • Long-term, moderate, positive improvements to water temperature and adult salmon and steelhead passage due to increased mainstem Walla Walla River flows, particularly in summer and fall months. • Long-term, moderate to major, positive impact due to improved riparian habitat and moderated summer stream temperatures. • Long-term negligible impacts on water temperature from shallow aquifer recharge and efficiencies. Benefits from aquifer recharge will change from location of irrigation canals to shallow aquifer recharge ponds.
Alternative F – CRWE, 175 cfs	• Short-term, moderate, negative increases in turbidity due to river crossing construction. • Long-term, moderate, positive improvements to water temperature and adult salmon and steelhead passage due to increased mainstem Walla Walla River flows, particularly in summer and fall months. • Long-term, major, positive impact due to improved riparian habitat and moderated summer stream temperatures.

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Alternative G – CRWE, 175 cfs, plus WWRID Irrigation Efficiency	• Short-term, moderate, negative increases in turbidity due to river crossing construction. • Long-term, moderate, positive improvements to water temperature and adult salmon and steelhead passage due to increased mainstem Walla Walla River flows, particularly in summer and fall months. • Long-term, major, positive impact due to improved riparian habitat and moderated summer stream temperatures. • Long-term negligible impacts on water temperature from shallow aquifer recharge and efficiencies. Benefits from aquifer recharge will change from location of irrigation canals to shallow aquifer recharge ponds.
Terrestrial and Wildlife Resources	
Alternative A – No Action	• Neither habitats of concern, nor associated obligate species would experience direct, indirect or cumulative effects from the no action alternative. • Protected species would not be directly, indirectly, or cumulatively affected by the no action alternative.
Alternative B – CRWE, 100 cfs	• Construction of the Columbia River Pump station would result in a minor, long-term negative effect by removing several acres of poor quality shrub-steppe habitat and marginal shallow water habitat. • Shrub-steppe grassland habitats would experience a major short-term negative effect and moderate short-term direct effects to shrub-steppe obligate species from pipeline and associated road construction that would be corrected by site restoration efforts. The roads remaining in service for the operation and maintenance of the project result in moderate long-term effects to the habitat. • Riparian habitat would experience short-term minor negative effects from construction. These minor effects would be corrected by site restoration. Wetland and riparian obligate species would experience moderate, short-term negative effects.
Alternative B – CRWE, 100 cfs (continued)	• Riparian associated protected species could experience moderate, short-term negative direct effects from the construction efforts that would be corrected through the employment of BMPs and restoration. • The alternative will generate moderate long-term indirect and cumulative benefits to riparian and wetland habitats, obligate species, and protected species. It could also generate minor long term cumulative negative effects to upland species.
Alternative C – CRWE, 100 cfs, plus WWRID Irrigation Efficiency	• Similar to B, but ditch piping would result in minor long-term negative effects to wetland and riparian habitats. Constructing recharge ponds would cause very minor long-term direct negative effects to agricultural habitat values, and construction would temporarily disrupt movements of native birds and mammals. • Wetland and riparian obligate/protected species could experience minor long-term negative effects, but would also experience moderate long term indirect and cumulative benefits even greater than Alternative B with added Walla Walla River flow increase and an associated increase in riparian habitat quality. • The operation and maintenance activities along the piped ditches would be reduced over open ditch maintenance and may result in minor long term indirect benefit to species disturbed by ditch maintenance.

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Alternative D – CRWE, 140 cfs	Effects would be similar to Alternative B, with moderate positive indirect and cumulative effects to riparian habitats, for riparian obligate species and protected species associated with riparian habitats greater than for Alternative B.
Alternative E – CRWE, 140 cfs, plus WWRID Irrigation Efficiency	Effects would be similar to Alternative C, with moderate positive indirect and cumulative effects to riparian habitats, for riparian obligate species and protected species associated with riparian habitats greater than for Alternative C.
Alternative F – CRWE, 175 cfs	Short-term moderate negative increases in Effects would be similar to Alternative D or B, with moderate positive indirect and cumulative effects to riparian habitats, for riparian obligate species and protected species associated with riparian habitats greater than for Alternative D or B.
Alternative G – CRWE, 175 cfs, plus WWRID Irrigation Efficiency	Effects would be similar to Alternative E or C, with moderate positive indirect and cumulative effects to riparian habitats, for riparian obligate species and protected species associated with riparian habitats greater than for Alternative E or C.
Cultural Resources	
Alternative A – No Action	Minor to major negative impacts from ground disturbance. Impacts could be both short- and long-term
Alternative B – CRWE, 100 cfs	Minor negative impacts from ground disturbance. Impacts would be both short- (construction) and long- (river bank erosion) term.
Alternative C – CRWE, 100 cfs, plus WWRID Irrigation Efficiency	• Minor negative impacts from ground disturbance. Impacts would be both short- (construction) and long- (river bank erosion) term. • Minor negative impacts from both ground disturbance and filling of the aquifer recharge ponds. Impacts would be both short- (construction) and long- (aquifer recharge pond erosion) term.
Alternative D – CRWE, 140 cfs	Minor negative impacts from ground disturbance. Impacts would be both short- (construction) and long- (river bank erosion) term.
Alternative E – CRWE, 140 cfs, plus WWRID Irrigation Efficiency	• Minor negative impacts from ground disturbance. Impacts would be both short- (construction) and long- (river bank erosion) term. • Minor negative impacts from both ground disturbance and filling of the aquifer recharge ponds. Impacts would be both short- (construction) and long- (aquifer recharge pond erosion) term.
Alternative F – CRWE, 175 cfs	Minor negative impacts from ground disturbance. Impacts would be both short- (construction) and long- (river bank erosion) term.
Alternative G – CRWE, 175 cfs, plus WWRID Irrigation Efficiency	• Minor negative impacts from ground disturbance. Impacts would be both short- (construction) and long- (river bank erosion) term. • Minor negative impacts from both ground disturbance and filling of the aquifer recharge ponds. Impacts would be both short- (construction) and long- (aquifer recharge pond erosion) term.
Recreation and Tourism	
Alternative A – No Action	• Moderate long-term positive recreational impacts due to increasing outdoor recreation trends. • Major long-term positive impacts on tourism due to a rapidly expanding wine industry.
Alternative B – CRWE, 100 cfs	• Minor, long-term, positive effects to recreation due to fishing, and other recreational activity in response to increased river flows. • Negligible effects to recreation due to Columbia River intake pump, pipeline, and booster pump station construction.
Alternative C – CRWE, 100 cfs, plus	• Minor, long-term, positive effects to recreation due to fishing, and

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WWRID Irrigation Efficiency	other recreational activity in response to increased river flows. • Negligible effects to recreation due to Columbia River intake pump, pipeline, and booster pump station construction. • Negligible effects to recreation due to irrigation efficiency and associated shallow aquifer recharge construction and operation and maintenance.
Alternative D – CRWE, 140 cfs	• Minor, long-term, positive effects to recreation due to fishing, and other recreational activity in response to increased river flows. • Negligible effects to recreation due to Columbia River intake pump, pipeline, and booster pump station construction.
Alternative E – CRWE, 140 cfs, plus WWRID Irrigation Efficiency	• Minor, long-term, positive effects to recreation due to fishing, and other recreational activity in response to increased river flows. • Negligible effects to recreation due to Columbia River intake pump, pipeline, and booster pump station construction. • Negligible effects to recreation due to irrigation efficiency and associated shallow aquifer recharge construction and operation and maintenance.
Alternative F – CRWE, 175 cfs	• Minor, long-term, positive effects to recreation due to fishing, and other recreational activity in response to increased river flows. • Negligible effects to recreation due to Columbia River intake pump, pipeline, and booster pump station construction.
Alternative G – CRWE, 175 cfs, plus WWRID Irrigation Efficiency	• Minor, long-term, positive effects to recreation due to fishing, and other recreational activity in response to increased river flows. • Negligible effects to recreation due to Columbia River intake pump, pipeline, and booster pump station construction. • Negligible effects to recreation due to irrigation efficiency and associated shallow aquifer recharge construction and operation and maintenance.
Socioeconomic Resources	
Alternative A – No Action	Minor, long-term, positive impacts on population, employment and land use.
Alternative B – CRWE, 100 cfs	• Moderate long-term positive impacts due to operation and maintenance actions. • Minor, short-term, negative impacts to economic production. • Moderate, long-term, positive effects on local economy due to increased property values, adjacent home construction, fishing, and other recreational activity resulting from increased river flows.
Alternative C – CRWE, 100 cfs, plus WWRID Irrigation Efficiency	• Moderate long-term positive impacts due to operation and maintenance actions. • Minor, short-term, negative impacts due to diminished economic production of the affected agricultural lands during construction. • Moderate, long-term, positive effects on local economy due to increased property values, adjacent home construction, fishing, and other recreational activity resulting from increased river flows. • Minor, short-term positive impacts due to construction of the irrigation efficiency component • Minor, long-term, positive impacts due to annual maintenance of the irrigation efficiency component
Alternative D – CRWE, 140 cfs	• Moderate long-term positive impacts due to operation and maintenance actions. • Minor, short-term, negative impacts due to diminished economic

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	production of the affected agricultural lands during construction. • Moderate, long-term, positive effects on local economy due to increased property values, adjacent home construction, fishing, and other recreational activity resulting from increased river flows.
Alternative E – CRWE, 140 cfs, plus WWRID Irrigation Efficiency	• Moderate long-term positive impacts due to operation and maintenance actions. • Minor, short-term, negative impacts due to diminished economic production of the affected agricultural lands during construction. • Moderate, long-term, positive effects on local economy due to increased property values, adjacent home construction, fishing, and other recreational activity resulting from increased river flows. • Minor, short-term positive impacts due to construction of the irrigation efficiency component • Minor, long-term, positive impacts due to annual maintenance of the irrigation efficiency component
Alternative F – CRWE, 175 cfs	• Moderate long-term positive impacts due to operation and maintenance actions. • Minor, short-term, negative impacts due to diminished economic production of the affected agricultural lands during construction. • Moderate, long-term, positive effects on local economy due to increased property values, adjacent home construction, fishing, and other recreational activity resulting from increased river flows.
Alternative G – CRWE, 175 cfs, plus WWRID Irrigation Efficiency	• Moderate long-term positive impacts due to operation and maintenance actions. • Minor, short-term, negative impacts due to diminished economic production of the affected agricultural lands during construction. • Moderate, long-term, positive effects on local economy due to increased property values, adjacent home construction, fishing, and other recreational activity in response to increased river flows. • Minor, short-term positive impacts due to construction of the irrigation efficiency component • Minor, long-term, positive impacts due to annual maintenance of the irrigation efficiency component
Aesthetic Resources	
Alternative A – No Action	• Minor, long-term, negative impacts to aesthetic qualities due to agricultural landscape fragmentation caused by continued housing development. • Moderate, long-term impacts due to growing wine industry and resulting conversion of row crops to vineyards.
Alternative B – CRWE, 100 cfs	• Construction of the intake would produce minor to moderate short-term impacts. • Completed intake on that section of the shoreline would produce permanent, minor to moderate adverse effects. • Minor, long-term, negative impacts to visual landscape due to presence of pump station on Columbia River shoreline. • Minor, short-term, negative impacts to visual landscape during construction of buried pipeline. • Minor, long-term, negative impacts on the visual landscape due to construction of booster pumps.
Alternative C – CRWE, 100 cfs, plus WWRID Irrigation Efficiency	• Minor, long-term, negative impacts to visual landscape due to presence of pump station on Columbia River shoreline.

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	• Minor, short-term, negative impacts to visual landscape during construction of buried pipeline. • Minor, long-term, negative impacts on the visual landscape due to construction of booster pumps. • Negligible effects to aesthetics due to irrigation efficiency and associated shallow aquifer recharge. • Minor, long-term, negative impacts due to changed landscape character associated with aquifer recharge ponds.
Alternative D – CRWE, 140 cfs	• Minor, long-term, negative impacts to visual landscape due to presence of pump station on Columbia River shoreline. • Minor, short-term, negative impacts to visual landscape during construction of buried pipeline. • Minor, long-term, negative impacts on the visual landscape due to construction of booster pumps.
Alternative E – CRWE, 140 cfs, plus WWRID Irrigation Efficiency	• Minor, long-term, negative impacts to visual landscape due to presence of pump station on Columbia River shoreline. • Minor, short-term, negative impacts to visual landscape during construction of buried pipeline. • Minor, long-term, negative impacts on the visual landscape due to construction of booster pumps. • Negligible effects to aesthetics due to Irrigation Efficiency and associated shallow aquifer recharge. • Minor, long-term, negative impacts due to changed landscape character associated with aquifer recharge ponds.
Alternative F – CRWE, 175 cfs	• Minor, long-term, negative impacts to visual landscape due to presence of pump station on Columbia River shoreline. • Minor, short-term, negative impacts to visual landscape during construction of buried pipeline. • Minor, long-term, negative impacts on the visual landscape due to construction of booster pumps.
Alternative G – CRWE, 175 cfs, plus WWRID Irrigation Efficiency	• Minor, long-term, negative impacts to visual landscape due to presence of pump station on Columbia River shoreline. • Minor, short-term, negative impacts to visual landscape during construction of buried pipeline. • Minor, long-term, negative impacts on the visual landscape due to construction of booster pumps. • Negligible effects to aesthetics due to irrigation efficiency and associated shallow aquifer recharge. • Minor, long-term, negative impacts due to changed landscape character associated with aquifer recharge ponds.
Hazardous, Toxic, and Radioactive Waste (HTRW)	
Alternative A – No Action	No identified direct, indirect, or cumulative effects related to HTRW issues within the study area.
Alternative B – CRWE, 100 cfs	Minor potential to encounter HTRW in the Wallula Junction area and the City of Milton-Freewater.
Alternative C – CRWE, 100 cfs, plus WWRID Irrigation Efficiency	• Minor potential to encounter HTRW in the Wallula Junction area and the City of Milton-Freewater. • No identified impacts from HTRW anticipated from implementation of WWRID irrigation efficiency or shallow aquifer recharge.
Alternative D – CRWE, 140 cfs	Minor potential to encounter HTRW in the Wallula Junction area and the City of Milton-Freewater.

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Alternative E – CRWE, 140 cfs, plus WWRID Irrigation Efficiency	• Minor potential to encounter HTRW in the Wallula Junction area and the City of Milton-Freewater. • No identified impacts from HTRW anticipated from implementation of WWRID irrigation efficiency or shallow aquifer recharge.
Alternative F – CRWE, 175 cfs	Minor potential to encounter HTRW in the Wallula Junction area and the City of Milton-Freewater.
Alternative G – CRWE, 175 cfs, plus WWRID Irrigation Efficiency	• Minor potential to encounter HTRW in the Wallula Junction area and the City of Milton-Freewater. • No identified impacts from HTRW anticipated from implementation of WWRID Irrigation Efficiency or shallow aquifer recharge.

5.5 Shallow Aquifer

Groundwater conditions in the WWRB have been studied several times since the valley was settled. Early pioneers were attracted to the valley by the numerous springs, creeks, and distributaries that are located on the alluvial fans in the vicinity of the cities of Walla Walla, and Milton-Freewater. By the late 1800s, irrigators in Milton-Freewater were diverting all the flow from the Walla Walla River for irrigation, resulting in dry stretches of the river during summer growing periods. This practice continued for over 100 years. Only recently has the Walla Walla River been allowed to flow year round.

The WWRB and Blue Mountains were formed from fractured Columbia Basin basalt that is overlain with a layer of gravels, sands and silts. This layer of gravels, sands and silts is over 200 feet thick in places. These geologic layers result in two primary aquifers; the gravel aquifers and the basalt aquifer. The shallow gravel aquifer is actually several aquifers located within the alluvium, gravels, loess and other sediments that lie on top of the basalt. For the purpose of this study, all the gravel aquifers were lumped into the term 'Shallow Aquifer.' The basalt aquifer is recharged high in the Blue Mountains. Water entering the basalts in the mountains flows through fractures west toward the Columbia River and eventually joins the river flowing to the Pacific Ocean.

Due to the over-appropriation of the surface water resources in the Walla Walla valley and increasing demand for water irrigators, municipalities, industry and residents have extensively drawn on both aquifers. Most of the groundwater development and use has occurred since the 1900s. Mr. R.C. Newcomb, USGS, spent a number of years studying the Walla Walla basin groundwater system in the 1950s and 1960s, and is recognized for his extensive work and vision. Figure 5-7 is an example of a decline in historic aquifer levels observed in a well near Walla Walla River. In 1965, he authored Water Supply Bulletin #21 titled "Geology and Ground-water Resources of the Walla Walla River Basin Washington-Oregon" in which he made the following observations:

> Monthly measurements made in 1942 and 1943 showed total annual discharge of the springs on the alluvial fan of the Walla Walla River to be about 50,000 AF, as it was in 1933. The less frequent measurements since 1943 do not permit comparison of total annual discharge as of 1960. There is some evidence that the total annual discharge from the springs on the alluvial fan of the Walla Walla River

> has decreased progressively during the period 1950-60. All spring discharge is used in the growing season by holders of water rights downstream. Some holders of water rights to spring outflow find the springs no longer yield the amount of water they did 10 and 20 years ago.

Based on data Newcomb collected before 1965, he concluded that the groundwater table in the gravel aquifer in some localized area was already beginning to decline. The trends he observed have accelerated since then with many historical springs drying up and many of the hand-dug wells going dry. More recently, many irrigators have switched from flood irrigation to more efficient methods of irrigation such as sprinklers and drip systems. Further, several irrigation companies and individual irrigators have piped unlined ditches in an effort to conserve water. These efforts have resulted in a reduction in the amount of water recharging the shallow aquifer.

The Walla Walla Basin Watershed Council (WWBWC) in Milton-Freewater recently collected a large amount of groundwater data, including data from some wells that Newcomb measured in the 1960s. Figure 5-7, prepared by WWBWC, shows the historical decline in the gravel aquifer and the results of a recent aquifer recharge test project.

Based on the work of WWBWC and many others in the basin, the amount of aquifer recharge needed to stabilize the aquifer in the proximity of the Walla Walla River channel appears to be approximately 15,000 AF annually. A surface water and groundwater interactions model analysis in the Oregon portion of the basin near Milton-Freewater used Integrated Water Flow Model (IWFM) developed by a Oregon State

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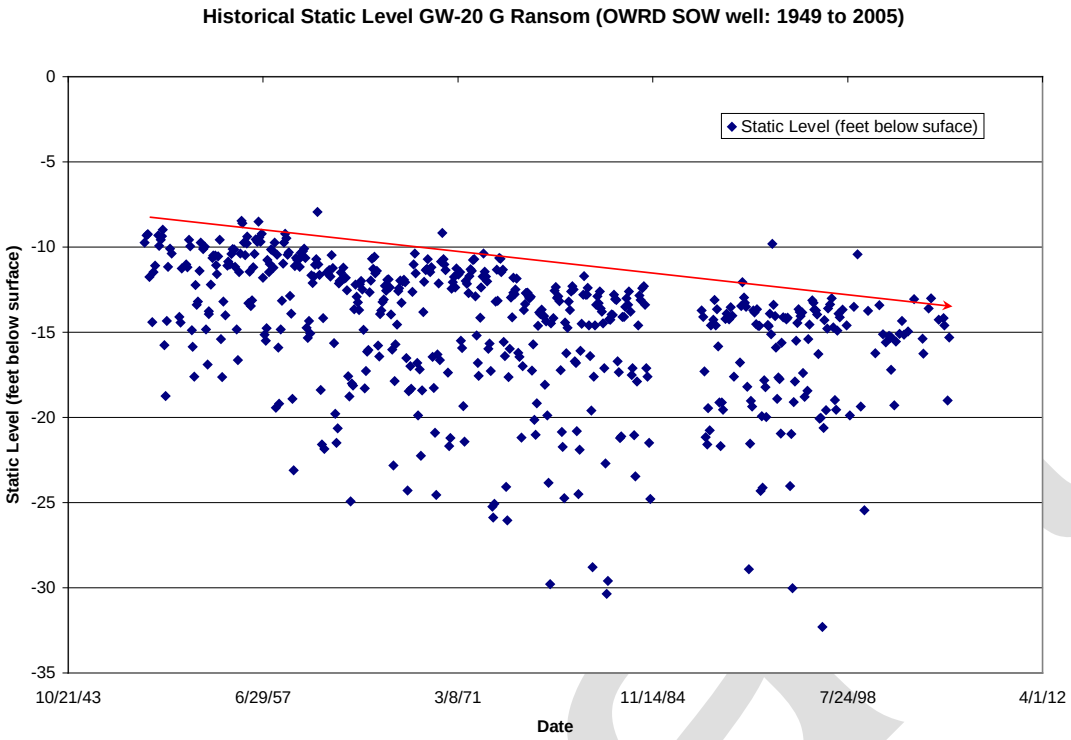
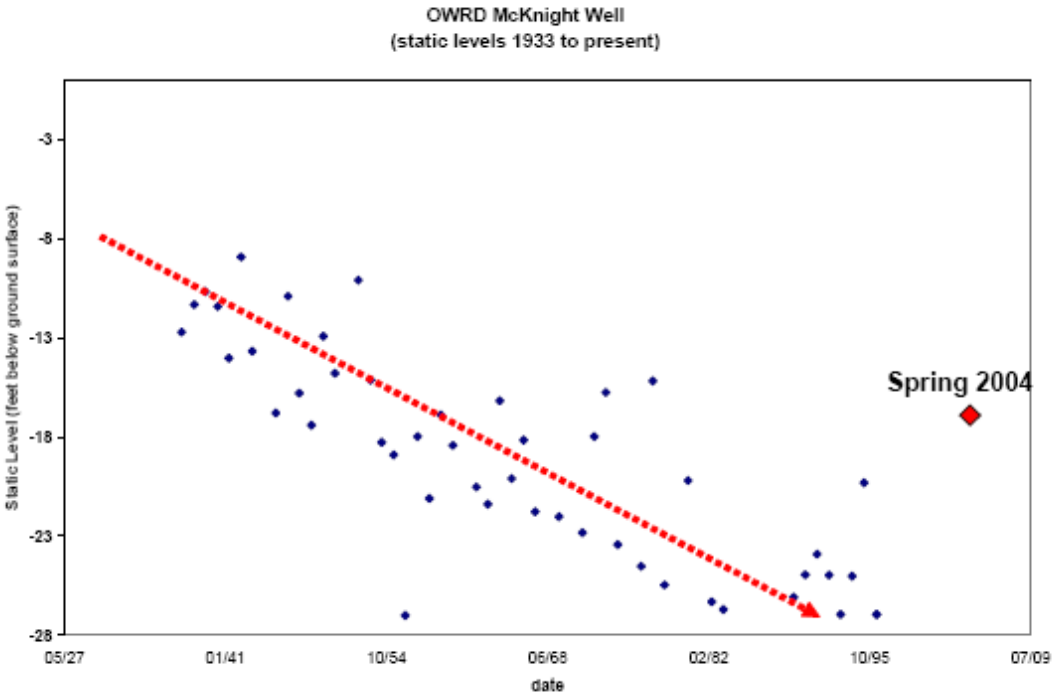
Figure 5-6. Drop in Aquifer at Observation Well Next to Walla Walla River



University graduate student, Aristides Jimenez. Mr. Jimenez developed a water budget for his study area as part of his modeling. He estimated the groundwater pumping per day in his study area at nearly 300 AF during the irrigation season or nearly 45,000 AF per year.

The 15,000 AF estimate has been derived based on several sources of information including the following. Pre-1950 the aquifer was relatively stable, according to reports and recorded spring flows. During this period in history the Little Walla Walla flowed year-round, contributing about 5,000 AF of annual stream flow. One estimate of the increase in irrigation withdrawals in the same period is roughly 10,000 AF annually. The combined total of these two estimates of annual discharge from the shallow aquifer represent a reasonably good estimate of annual recharge needed to stabilize the aquifer. This annual volume is also well within feasible shallow aquifer recharge opportunities as illustrated by the test projects in the valley. It should be stressed that the above estimate is based on limited data, and as more data and information is gained regarding the needs of the shallow aquifer and connections to the deeper basalt aquifer the amount of shallow aquifer needed to stabilize the shallow aquifer will likely change.

Figure 5-7. Historical Gravel Aquifer Decline



Significant channel losses (losing reach) start at Nursery Bridge and extend down to the McCoy Bridge and some times the State line. On low water years the losing reach extends further down stream. There is a shallow groundwater constriction just down-gradient from Touchet. Therefore, the potential future losing reach could extend downstream to Touchet. When the project is operational, the current losing reach will act as a large aquifer recharge site extending from Nursery Bridge to the State line. Within the aquifer the flow gradient has been shown to follow the springs to the river generally traveling in a North-Westerly direction. The "losing reach" turned SAR will benefit the aquifer down to roughly the Burlingame diversion or 38.5% of the potentially effected channel. To provide benefits below that point shallow aquifer recharge sites will need to be developed on the western side of Milton-Freewater. This portion is up-gradient to 61.5% of the channel.

Assuming the total annual shallow aquifer need is 15,000 AF annually, 38.5% should be supplied by the instream flows for a total of 5,800 AF of recharge. The remaining 61.5% (or 9,200 AF) should be supplied by shallow aquifer recharge basins located west of the East Crockett Branch of the Little Walla Walla.

Losses in the Walla Walla River between Nursery Bridge and Stateline should vary between 30 cfs and 40 cfs when the project goals are being met (note this is an educated guess based on extrapolation of measured data). Assuming roughly 100 day operation June to September and 30 cfs X 1.9835 = 5950 AF.

It is recommended that the inclusion of an additional 9,200 AF of shallow aquifer recharge be implemented with any alternative to assure the instream flow benefits are realized. This addition of shallow aquifer recharge can be implemented through shallow infiltration basins 2 acres in size located west of the East Crockett Branch Little Walla Walla (6 total basins). The basins will be filled in the winter with water from the Little Walla Walla diversion.

5.6 Risk and Uncertainty

A variability analysis was conducted on the average annual benefits. The sensitivity analysis takes other water years into consideration. Because the WUA is dependent on instream flows and the formulation of this project requires a bucket for bucket exchange with irrigators (supplementing instream flow was not considered), the natural hydrograph influences the variability in the weighted usable habitat values. The months of June through November were used for the analysis due to the fact that these months have the largest fluctuation of benefits. Irrigation is at its peak during this period and, therefore, the change from the future without project condition is the largest. This period is also critical for successful fish passage and spawning/rearing conditions. An average monthly WUA (cubic feet) was calculated for a typical average, low and high water years at targeted reaches in the river. The average year was represented by 1983, which best represented a typical water year (mean). The low flow year is represented by 1987 which closely mimics a low flow condition (5th to 10th percentiles). The high flow year is represented by 1997 which closely mimics a high flow condition (90 to 95th percentiles). Anticipated benefits were compared against the low, mean, and high flow years and displayed in Table 5-5.

Each species and their respective life stage needs are unique, but some trends can be drawn from Figures 5-8 through 5-11. For all species and respective life stages, the future without project condition does not create reasonable habitat conditions to sustain healthy populations of fish in the Walla Walla River system. Alternatives B and C, the 100 cfs and the 100 cfs exchange system plus WWRID, have small deviations from the most likely condition and the high and low water years. This conveys that the most likely condition closely mimics what would occur during any type of flow year. For most species, the largest deviations between the average water year and the high- and low-flow water years occur for Alternates F and G, the 175-cfs exchange system and the 175-cfs exchange paired with WWRID. While these alternatives represent the maximum amount of benefit that can be realized, the deviations indicate the range needs to be considered. Reviewing the data shows that, even under low-flow conditions, both of these alternatives have the potential to realize benefits above the future without condition as well as above all other alternatives. Therefore, while the range is larger then most, the potential benefits still exceed the benefits of any other alternative evaluated under similar conditions.

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Table 5-5. Total Benefits for Average, High, and Low Flow Water Years Compared for the Period of Influence

Target Species	Alt A	Alt B	Alt C	Alt D	Alt E	Alt F	Alt G
Chinook Juvenile	**WUA (ft^2) for June through November (period of influence)**						
Low Flow - % Below Ave	47%	10%	12%	30%	31%	45%	47%
Average Flow	4667	13940	15383	22088	22987	30178	31403
High Flow - % Above Ave	108%	19%	16%	6%	8%	1%	10%
Steelhead Juvenile							
Low Flow - % Below Ave	59%	16%	16%	34%	36%	49%	51%
Average Flow	6080	14675	16116	23398	24530	32410	33661
High Flow - % Above Ave	102%	31%	29%	18%	21%	16%	27%
Steelhead Spawning							
Low Flow - % Below Ave	56%	15%	15%	21%	22%	24%	25%
Average Flow	39457	79612	84626	101046	102867	108188	108791
High Flow - % Above Ave	90%	29%	27%	16%	17%	17%	20%
Bull Trout							
Low Flow - % Below Ave	56%	10%	11%	24%	24%	34%	36%
Average Flow	38737	96085	101720	129350	132515	158488	162025
High Flow - % Above Ave	102%	21%	20%	13%	16%	10%	18%

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Figure 5-8. Average Monthly Benefits – Juvenile Steelhead (WUA)

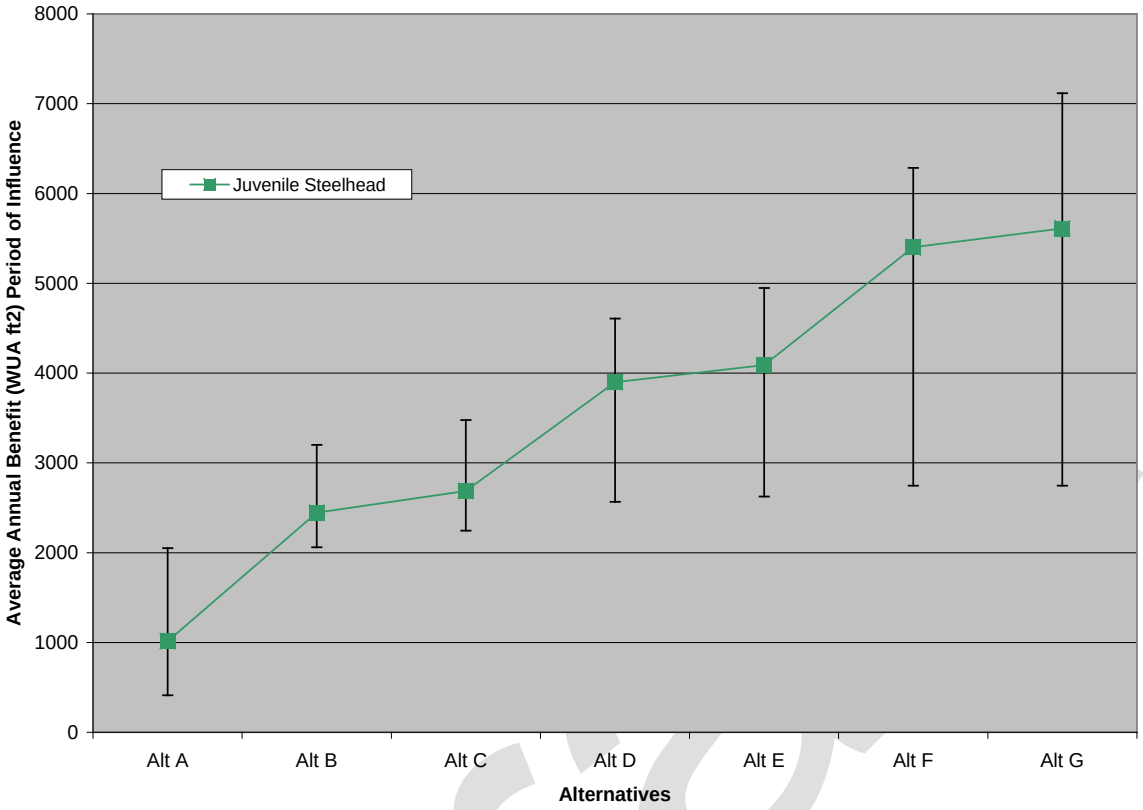


Figure 5-9. Average Monthly Benefits –Steelhead Spawning (WUA)

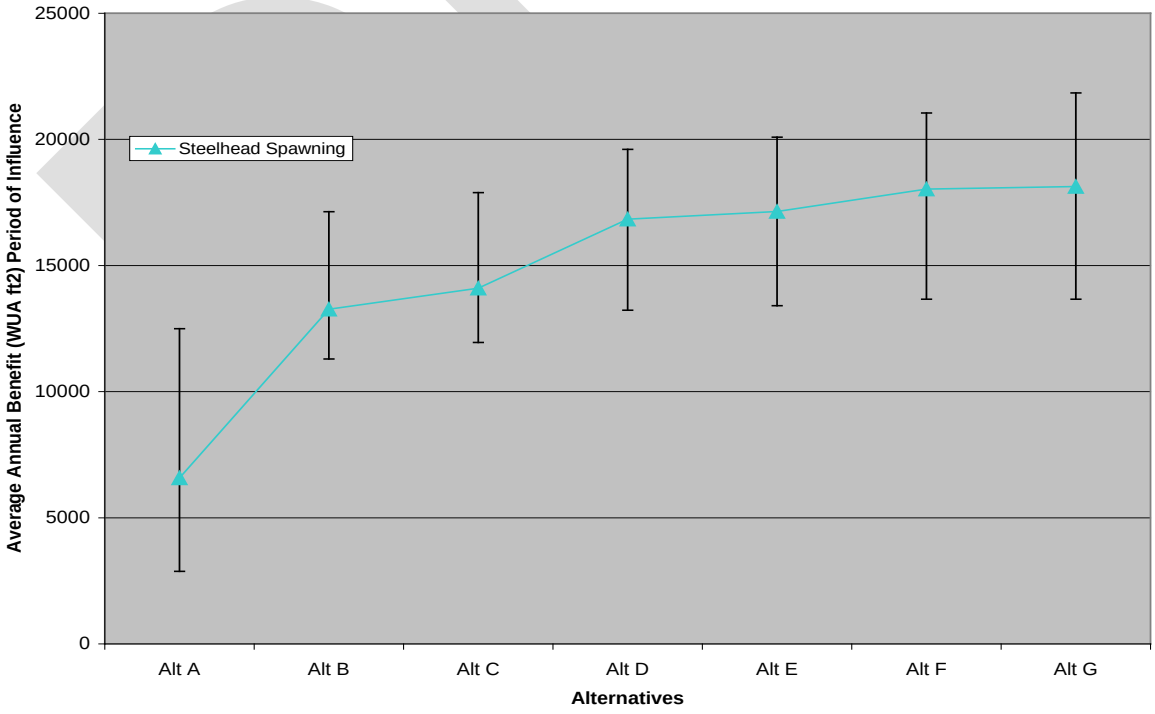


Figure 5-10. Average Monthly Benefits–Spring Chinook Salmon (WUA)

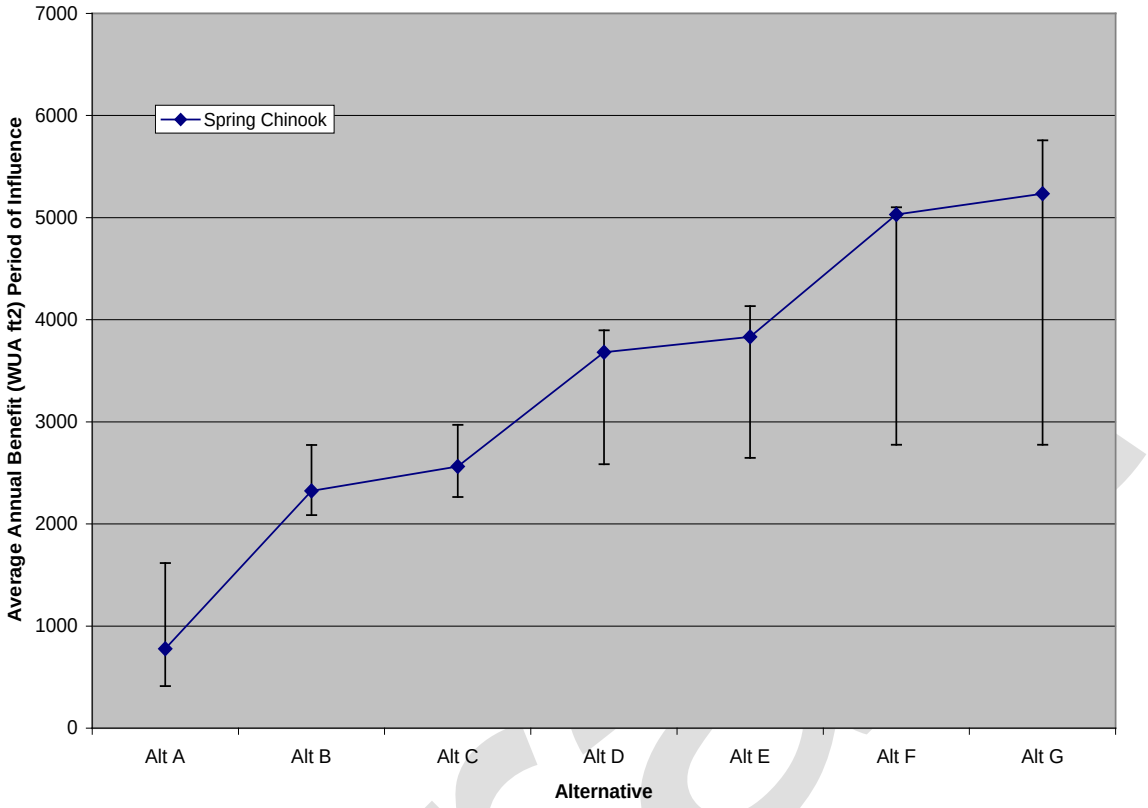
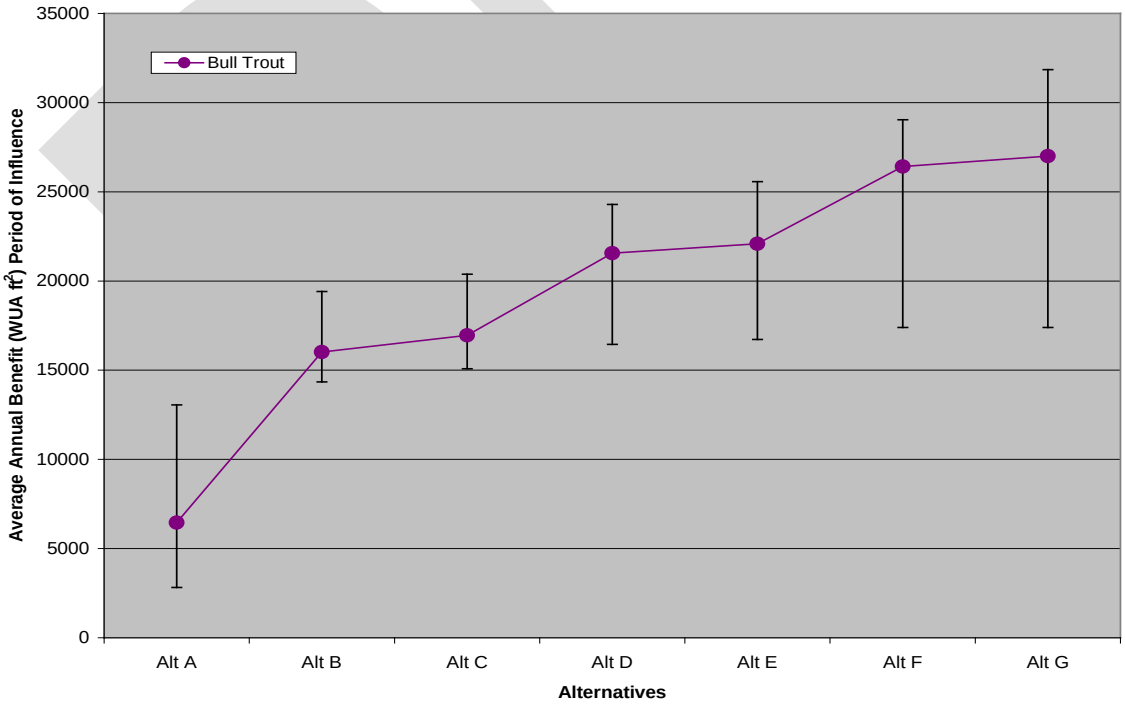


Figure 5-11. Average Monthly Benefits –Bull Trout (WUA)



5.7 System of Accounts

The comparison and evaluation of alternatives involves the consideration of the effects that the plans would have on planning objectives and constraints. The following discussions address the differences and similarities between the future without project conditions and alternatives. The four national accounts are also considered in the comparison and evaluation of alternative plans, as are the associated evaluation criteria. In the 1970 Flood Control Act, Congress identified four equal national accounts for use in water resources development planning. They are National Economic Development (NED), Regional Economic Development (RED), Environmental Quality (EQ), and Other Social Effects (OSE). Policy in the 1970s regarded making contributions to only two of these, NED and EQ, as national objectives.

Since the focus of the Walla Walla River Basin General Investigation project is ecosystem restoration, benefits are realized for the EQ as well as OSE accounts. For the NED and RED accounts, minor benefits are shown.

5.7.1 Environmental Quality

All of the best buy plans would contribute to the EQ account by increasing the amount and quality of high value habitat in the study area by their respective quantity of outputs. All best buy plans provide an increase in habitat and therefore benefits to the EQ account as quantified by average annual benefits shown in Table 5-1. Benefits to the EQ account increase with plan outputs as does the costs for the project but the incremental costs remain similar. As described earlier none of the plans meet the improvement objectives for temperature but do meet all the other objectives. Benefits would increase in the following criteria as the amount and quality of habitat increases.

- **Endangered Species –** Both steelhead and bull trout would benefit from project implementation with improved habitat function as well as increased area of suitable habitat. While spring Chinook are not listed under ESA on this river system, the species would benefit from project implementation as well.

- **Water Quality –** Allowing the cool water of the upper north and south fork to remain instream past Little Walla Walla diversion (RM 47) would provide a benefit to temperature. Additionally by re-establishing the habitat corridor the project would provide some improvements to water quality through natural filtration in the sustained riparian areas.

- **Terrestrial –** The increase in habitat diversity would provide benefits for aquatic species, but also for avian and terrestrial species. Providing more water in the river would help to decrease riparian habitat fragmentation by providing water to support natural regeneration of riparian vegetation.

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- **Air Quality –** Air quality could be temporarily affected due to construction. The majority of the construction would occur along a narrow corridor in areas sparsely populated.

- **Noise –** There would be a temporary increase in noise due to construction. The majority of the construction would occur in a narrow corridor in areas sparsely populated.

Essentially, the larger the project is the more benefits would be realized under this account. This is quantified both in total outputs and incremental costs per benefit in Table 5-1. The cost effective analysis has provided a measure of efficiency to determine what the incremental cost of these outputs would be.

5.7.2 Other Social Effects

The measure of impacts to the community, in terms of satisfaction, well-being, and happiness, is the definition of OSE. With this project, a balance between the demands on the water – aquatic versus agriculture – would be realized. Both communities would co-exist in the WWRB without further diminishment. This also improves the standard of living and happiness within the Umatilla and Walla Walla Counties. Sustaining fisheries and agriculture within the project footprint allows for communities to focus on the future of the region and next generations.

From a tribal perspective, the impacts are very beneficial. The reintroduction and recovery of spring Chinook salmon would help support the CTUIR economy, culture and subsistence needs for the next 7 generations. The project would protect, restore, and enhance the First Foods (water, salmon, deer, cous, and huckleberry) for the perpetual cultural, economic, and sovereign benefit of the CTUIR. This would be accomplished through utilizing traditional ecological and cultural knowledge and science to inform population and habitat management goals and actions; and natural resource policies and regulatory mechanisms.

The scoping and public involvement has provided input from the local community to study objectives. These objectives were incorporated to within the constraints of the project and reflected in the array of project alternatives. Further involvement through public meetings and public involvement of monitoring will continue to engage the community and promote public ownership of the project.

5.7.3 National Economic Development

The Federal objective of water and related land resources planning is to contribute to national economic development consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable Executive Orders, and other Federal planning requirements. "Contributions to national economic development (NED) are increases in the net value of the national output of goods and services, expressed in monetary units. Contributions to NED are the direct net benefits that accrue in the

planning area and the rest of the nation. Contributions to NED include increases in the net value of those goods and services that are marketed, and also those that may not be marketed." While the project will realize an increase in tourism and recreational opportunities the contribution to NED is negligible.

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SECTION 6 – RECOMMENDATION

6.1 Instream Flow Protection

To ensure benefits are realized under the formulated alternatives, water rights must be acquired to protect the flow as it transverses from the North and South Forks of the Walla Walla River in the State of Oregon, through the State of Washington, to its confluence with the Columbia.

Water rights are considered a real-estate interest. Therefore, acquiring the necessary water rights is the responsibility of the non-Federal sponsor. Although real-estate interests need to be solidified prior to commencement of construction, acquisition of water rights can be a lengthy and complicated process. All parties were in agreement that this process needed to start early so that a plan to acquire the rights could be reviewed and approved by all necessary participants prior to further funding obligations. While numerous solutions have been proposed, no solution has yet been identified that protects instream flows and protects the interests within the basin.

In Appendix I*, Water Law and Water Right Acquisition*, the non-Federal sponsor describes their initial proposal for the water rights necessary to support a project, and how those rights would be acquired. The appendix is very detailed and was vetted with numerous stakeholders in the basin.

Upon completion of this work, Ecology stated concerns regarding the ability of Washington State to support the identified process. After numerous meetings with the state and other stakeholders, the CTUIR embarked on a revision they called the "Reasonable Plan." This plan sets forth how a Columbia River Pump Exchange Project would be permitted under Oregon and Washington law.

The Reasonable Plan calls for a settlement of the CTUIR's instream flow claims on the Walla Walla River. Under Oregon law, a statutory process has been established authorizing the OWRD Director to negotiate a water rights settlement with Federally-recognized tribes located in Oregon (ORS 539.300-.350). Under this process, the OWRD Director would represent State water right permit holders in negotiations. All negotiations of the water rights settlement must to be in a public meeting, and any settlement agreement would be recorded with the Umatilla County Circuit Court so any objections filed could be resolved. Once the settlement agreement has been approved by the Court, the instream flow water rights are to be included in the Walla Walla River decree. This settlement process was effectively used by the State and the Warm Springs Tribe to settle the Warm Springs' rights in the Deschutes Basin.

No such statutory process for tribal water rights settlement exists in the State of Washington. The CTUIR has explored several options for the adjudication of CTUIR instream flow rights in the Walla Walla River under Washington law. Meetings between

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the CTUIR, Ecology, and the Attorney General's office have focused on alternative means of achieving a CTUIR water rights settlement in the WWRB. While no decision has been reached, these discussions will continue when the settlement proposal is fully developed.

6.2 No Action

The desire for fish passage, improved habitat, and survival for both ESA-listed and other fish species within the Walla Walla River system drove this study to focus on measures that would leave Walla Walla River flows instream and provide a connection from the confluence of the Columbia River to the pristine habitat in the upper forks of the Walla Walla River. In addition, it was critical to improve habitat within the middle sections of the Walla Walla River that are, at times, lethal to fish species.

While several measures were considered that met the goals and objectives of the study, the biological and economic analyses proved that not all were worthy of the investment. The analyses dropped measures for off-channel storage, aquifer recharge, water right acquisition, and irrigation efficiency from further consideration. Although these measures were screened from consideration, two alternatives not only proved to be beneficial to the target species, they proved to be a best buy solution for all species and respective life stages considered. Alternative E, *140 cfs exchange, with the addition of irrigation efficiency for the Walla Walla River Irrigation District; and* Alternative G, *175 cfs exchange, with the addition of irrigation efficiency for the Walla Walla River Irrigation District,* were cost-effective solutions that reasonably maximize benefits that could be realized for this project. These alternatives also show potential to produce adequate benefits under any flow condition, which is critical to the sustainability of the project and the habitat conditions it strives to create.

From a Federal perspective, a recommendation must be technically sound, economically justified, and environmentally and socially acceptable. Due to the inability to secure instream flows, a recommendation cannot be made at this time; and no action will be pursued. As the report discusses, instream flow protection is a critical element to realizing the ecosystem restoration benefits presented. This No Action decision was supported in a resolution by the CTUIR Board of Trustees dated November 19, 2012.

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