September 2020
Upper Touchet Basin Habitat Restoration

Geomorphic Assessment and Restoration Prioritization

Prepared for Columbia Conservation District

DRAFT

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Geomorphic Assessment and Restoration Prioritization

Prepared for
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ABBREVIATIONS

CCD	Columbia Conservation District
cfs	cubic foot per second
CREP	Conservation Reserve Enhancement Program
CTUIR	Confederated Tribes of the Umatilla Indian Reservation
EDT	Ecosystem Diagnosis and Treatment
ELJ	engineered log jam
ESA	Endangered Species Act
LiDAR	Light Detection and Ranging
LWD	large woody debris
mi	mile
MSA	major spawning area
NMFS	National Marine Fisheries Service
PIT	Passive Integrated Transponder
RM	river mile
SE WA Recovery Plan	*Snake River Salmon Recovery Plan for SE Washington*
SRSRB	Snake River Salmon Recovery Board
the Forks	North Fork, Wolf Fork, Robinson Fork, and South Fork
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
WDFW	Washington Department of Fish and Wildlife
WWCCD	Walla Walla County Conservation District

1 Introduction

The Touchet River is a tributary to the Walla Walla and Columbia rivers and supports Endangered Species Act (ESA)-listed summer steelhead and bull trout, which have all been identified as aquatic focal species of concern in the Walla Walla Subbasin Plan (WWWPU and WWBWC 2004). Additionally, spring Chinook salmon were historically present in the basin before becoming extinct in the area in the 20th century. Recent efforts to reintroduce spring Chinook salmon have begun in the Upper Touchet basin and are expected to play a role in the larger recovery of Chinook salmon species in the Columbia basin. For this reason, the reintroduced spring Chinook salmon are also considered a focal species for this assessment. However, restoration efforts in the Touchet basin have not been widespread to date, although several projects by the Columbia Conservation District (CCD), Walla Walla County Conservation District (WWCCD), and Confederated Tribes of the Umatilla Indian Reservation (CTUIR) have been implemented in the past 10 years.

This Geomorphic Assessment and Restoration Prioritization is intended to help restoration decision making and set a baseline for evaluating future restoration locations and progress toward goals. Implementation of these efforts is expected to occur over the next 10 to 15 years, at which time it is expected that an evaluation of those efforts and update to these prioritizations will occur, similar to the evaluation currently occurring on the Tucannon basin. Some of this assessment may also be periodically updated and adapted as new data become available. The framework of this assessment follows the methods and analyses developed for the Tucannon Restoration Programmatic as directed by Snake River Salmon Recovery Board (SRSRB) and CCD. The availability of physical and biological data on the Touchet basin do not match those of the Tucannon basin, so there are some analyses that have a greater degree of built-in quantitative assessment than is seen in the more data-driven Tucannon basin assessment. It is the intent of the SRSRB to supplement data collection in the Touchet basin such that these analyses can be augmented in the future to include a similar degree of rigor to that of the Tucannon basin analyses.

Goals and Objectives

This section includes both the goals and objectives for this geomorphic assessment and prioritization as well as the larger goals and objectives for habitat restoration in the basin. For the latter, habitat restoration goals for the Upper Touchet basin (Table 1-1) are closely based on goals developed for the Tucannon basin assessment and by extension the Tucannon Restoration Programmatic. No Programmatic currently exists for the Touchet watershed, but restoration activities can be considered an extension to the Tucannon Restoration Programmatic. The goals and objectives for habitat restoration are tailored to the limiting factors for focal species in the basin. Limiting factors were identified for the Touchet basin in the *Snake River Salmon Recovery Plan for SE Washington* (SE WA Recovery Plan; SRSRB 2011). For the mainstem, these limiting factors include: sedimentation, habitat diversity, flow, channel stability, and temperature. In the North Fork, Wolf Fork, Robinson Fork, and

South Fork, similar limiting factors are identified with emphasis on the lack of habitat diversity. The limiting factors and how they influence the proposed restoration actions are discussed more in Section 6.

Table 1-1
Basin Goals and Restoration Objectives

Basin Goal	Restoration Objectives	Reference Section
Improve floodplain connectivity	The available 5-year recurrence floodplain is connected at the 2-year event	Appendix E and Section 7
Develop a high functioning riparian corridor	The available 5-year recurrence floodplain is vegetated with maturing riparian trees	To be discussed with stakeholder group
Increase channel complexity at low winter flows	Low winter flow complexity is at levels of current 90th percentile of basin	Data gap
Increase channel complexity during spring and winter peaks	1-year flow complexity is at levels of current 90th percentile of basin	Appendix F and Section 7
Increase quantity of pools	Increased pool frequency	To be completed by SRSRB during field assessments
Increase temporary storage of in-channel bedload sediments	No river segments significantly above the excess transport capacity regression line	Appendix G and Section 7

Note: Table 8-4 of this assessment provides more details on specific targets and assessment methods for each of these goals.

The analyses of this assessment were created to provide the information needed to meet the habitat targets and goals of the objectives. To that end analyses were developed with the following goals:

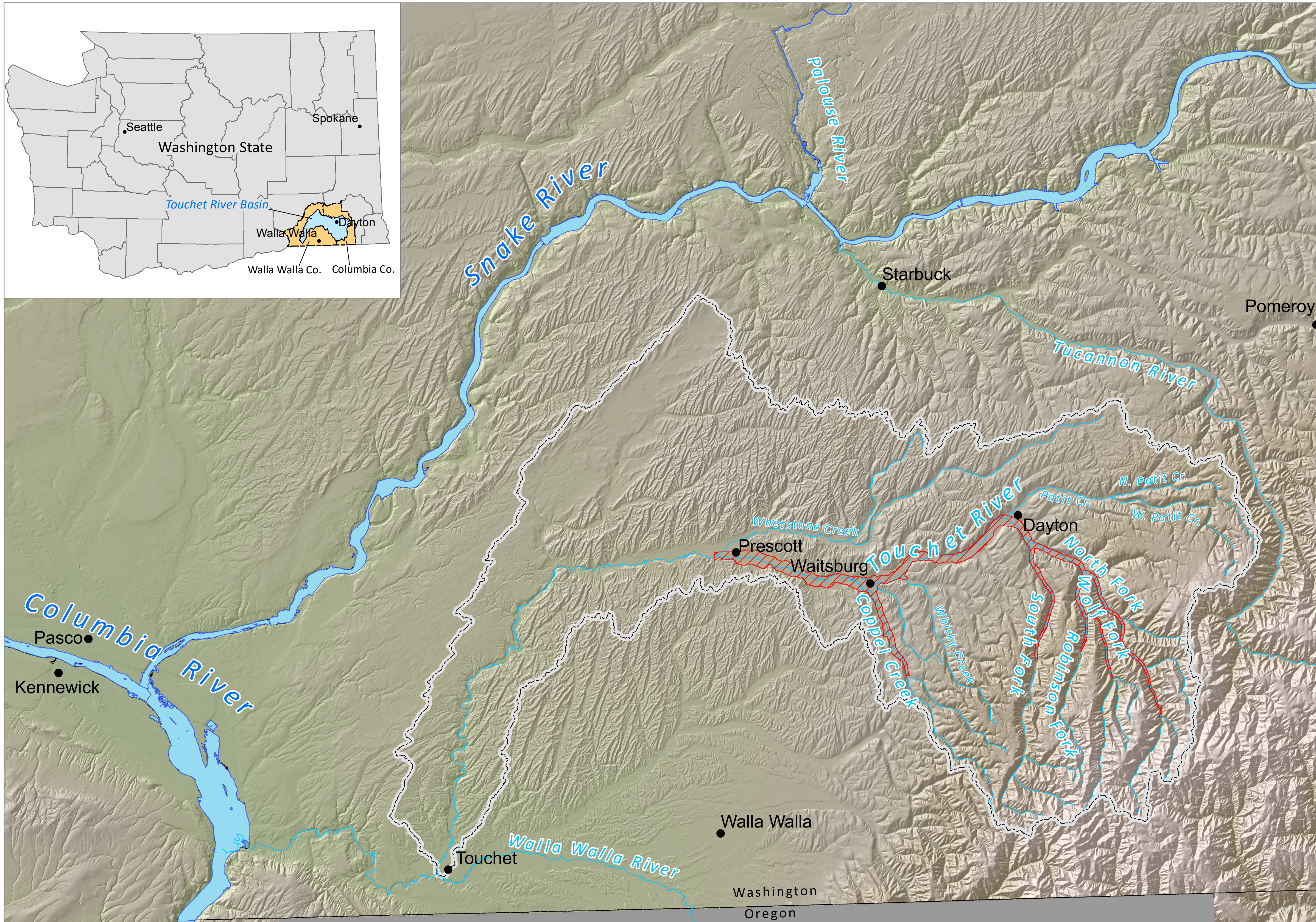
1. Use the available data and field observations to measure the key components of the habitat targets and basin goals including:
    a. Floodplain Connectivity: measure the existing connected floodplain and potential floodplain targets and determine floodplain potential.
    b. Channel Complexity: Measure channel complexity at a variety of flow conditions and determine which reaches are complex and which are not.
    c. Transport Capacity: Determine where the rivers of the Touchet basin have too much stream power for the maintenance of natural geomorphic processes of sediment transport.
2. Prioritize areas for restoration and recommend restoration actions that can provide the most benefit and uplift to species.
3. Provide the data on key components of habitat targets for future evaluation, target setting, and accomplishment tracking for each of these key metrics.

2 Basin Overview

The Touchet River is located in southeastern Washington and is a tributary to the Walla Walla River, which flows into the Columbia River just downstream of the confluence of the Columbia and Snake rivers, as shown in Figure 2-1. The headwaters of the Touchet River are located in the Blue Mountains and the Touchet basin drains much of the northwestern part of these mountains through four primary drainages: the North Fork, Wolf Fork, Robinson Fork, and South Fork (the Forks). Patit Creek, Whiskey Creek, and Coppei Creek also have headwaters in the Blue Mountains region, although they do not reach the same elevations or receive the same amount of precipitation as the four primary Forks. The Wolf Fork and Robinson Fork contribute to the North Fork, and the South Fork confluences with the North Fork just upstream of the city of Dayton to form the upstream end of the mainstem Touchet. Patit Creek enters the mainstem at Dayton, and Coppei Creek enters just downstream of the city of Waitsburg. Whetstone Creek, which enters the mainstem near the city of Prescott, drains from the northern part of the watershed, which is entirely occupied by arid loess deposit hills (Figure 2-2) and does not receive nearly as much precipitation as the tributaries draining from the Blue Mountains (Figure 2-4).

The SE WA Recovery Plan (SRSRB 2011) has considered the most viable portion of the Touchet River for steelhead survival to be above the confluence of Coppei Creek. The portion upstream of this is still heavily affected by the limiting factors of the basin but is widely considered the most valuable habitat for adult and juvenile salmon and steelhead, due in part to a wide range of hydrologic, topographic, and geomorphic conditions found throughout these subbasins. Below the North Fork/ South Fork confluence, the river's grade is reduced and is primarily depositional. Summer temperatures increase fairly rapidly and summer temperatures downstream of Waitsburg and the Coppei Creek confluence are commonly believed to be prohibitive for salmon and steelhead survival. In the Touchet River downstream of Dayton, land use is highly agricultural and occupies much of the river's historical floodplain. In many places, the river lacks instream structure, floodplain is disconnected, and riparian habitat is relatively spare through much of the valley. All of these attributes contribute to temperature issues downstream and very poor juvenile survival.

Historically, two major irrigation dams existed on the Touchet River, the Hofer Dam and Maiden Dam, although both were in the lower portion of the basin, far below the extents of this assessment area and near the confluence with the Walla Walla River. Today only Hofer Dam remains. This dam was identified as a fish passage barrier in 2005 but has since been equipped with adequate fish passage facilities and likely no longer serves as a significant barrier.



LEGEND:

Assessment Extent

NOTE(S):

1. Horizontal datum is WA State Plane South Zone, NAD 83, Feet.
2. Geologic unit data provided by Washington State Department of Natural Resources.

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Figure 2-1
Map of Touchet Basin
Geomorphic Assessment and Restoration Prioritization
Upper Touchet Basin Habitat Restoration

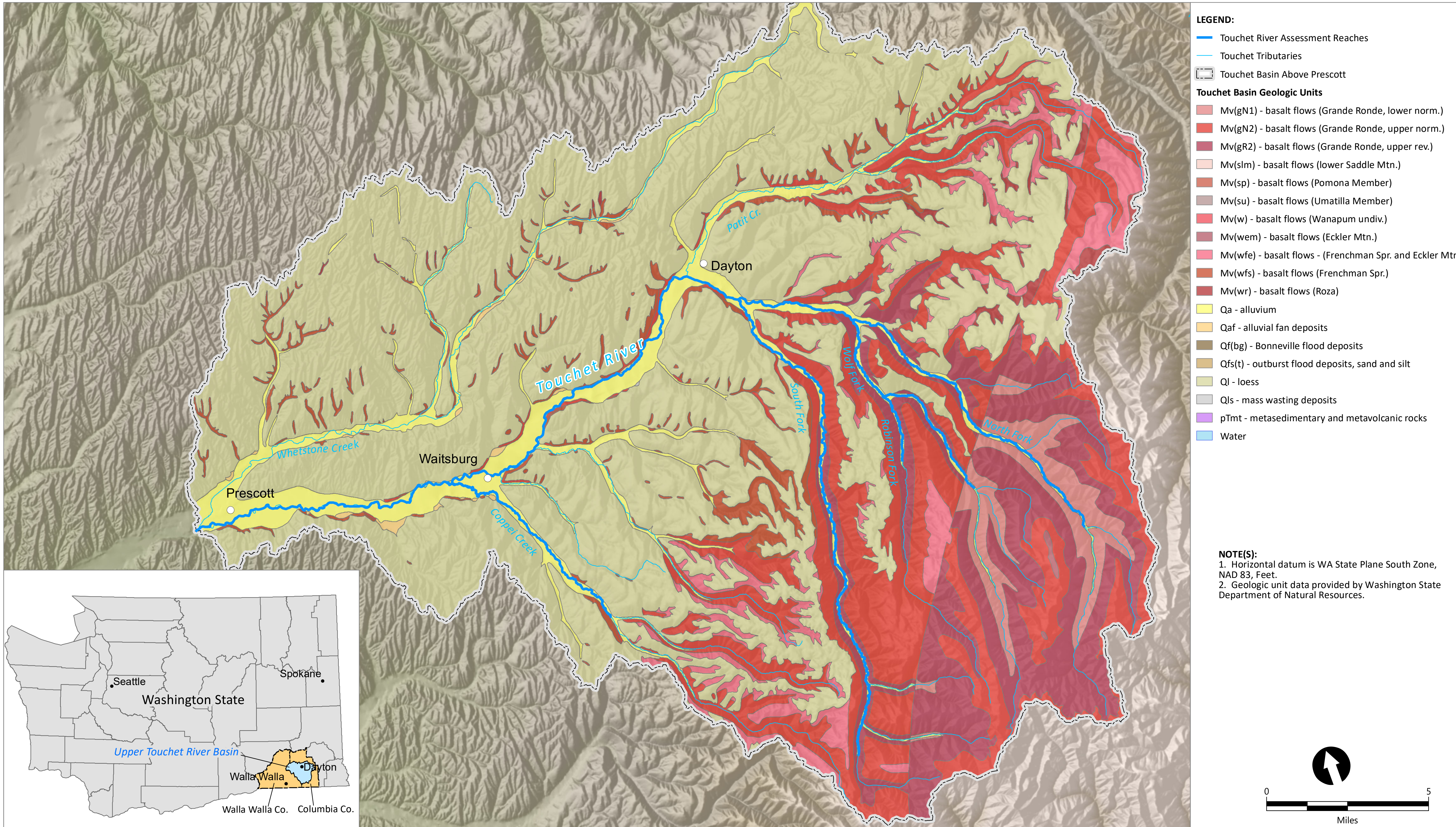

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Figure 2-2
Basin Geology
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Upper Touchet Basin Habitat Restoration

2.1 Regional Geology

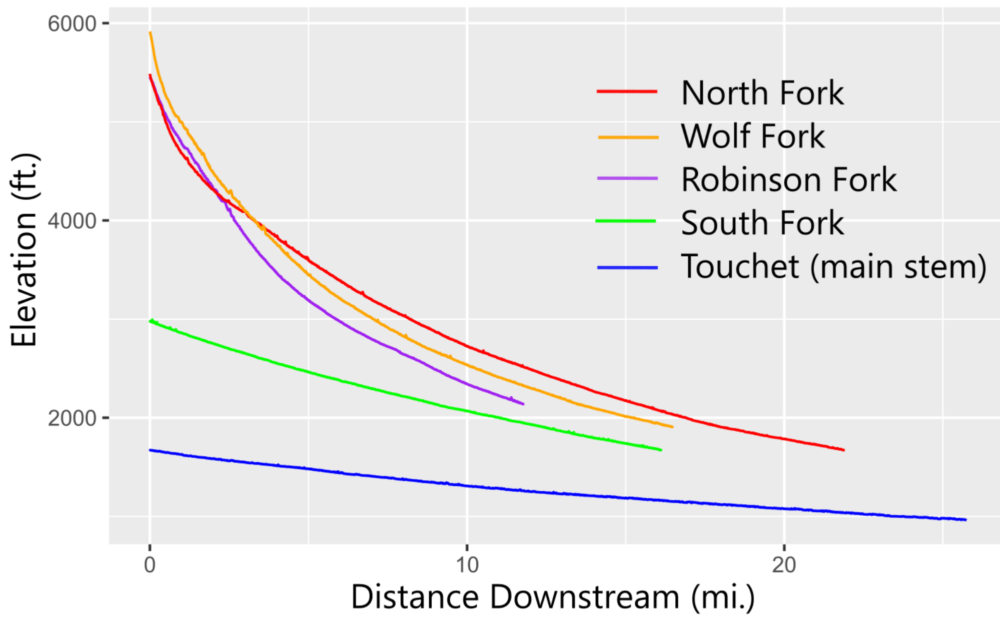
The Touchet basin resides in the south-central portion of southeastern Washington where the Blue Mountains and Columbia basin are the major geological features (SRSRB 2011). The subsurface of the Blue Mountains and much of the surrounding area was created by the basalt lava flows that occurred during the Miocene era and are part of the Columbia River Basalt Group (Figure 2-2). Other smaller outcroppings of basalt events from the Pleistocene era also occur in the Touchet basin. The basalts form the peaks of the Blue Mountains and are responsible for the characteristic high plateaus and deep valleys of the Blue Mountain region (Geoengineers 2011). Bedrock outcroppings found in many of the rivers through the Touchet basin are likely Columbia River Basalt in composition.

Loess deposits make up a large portion of the area in the Touchet basin, occupying the hills lower than the Blue Mountains. Loess deposits are sediments, often very fine in nature, that have been deposited by rivers, streams, and volcanoes on top of the Columbia River Basalts. The thickness of this loess layer varies but can reach over 100 feet thick in locations (Carson 1996). The valley bottom, where the mainstem Touchet and Forks are located, is primarily composed of alluvium (Figure 2-2).

2.2 Overview of Basin-Scale Geomorphic Processes

The Touchet River and its tributaries comprise a steep mountain system in an arid setting. Surrounding peaks at the headwaters reach 5,800 feet, and the mouth at its confluence with the Walla Walla River is at 425 feet. Much of that elevation is lost upstream of the city of Dayton, where the river transitions from the Blue Mountain physiographic province to the Columbia River Basin. The longitudinal profiles of the river and its tributaries shown in Figure 2-3 suggest a graded river system that is in equilibrium, incising and eroding sediment at a similar rate to the isostatic uplift of the Blue Mountains. The upstream reaches near the headwaters are erosional, with bedrock exposed or close beneath the surface. In the transport reaches closer to the mountain front, the valley floors widen where gradient slackens, and the river has historically been more likely to avulse and deposit sediment. Anthropogenic influence in the valley has disconnected much of the river from its floodplain, halting geomorphic and hydrologic processes like deposition, channel migration, and groundwater recharge. A prominent example is visible at the city of Dayton, where the widened valleys suggest a historically depositional, alluvial plain environment that is no longer connected to the river.

Figure 2-3
Longitudinal Profiles of Rivers in the Touchet Watershed

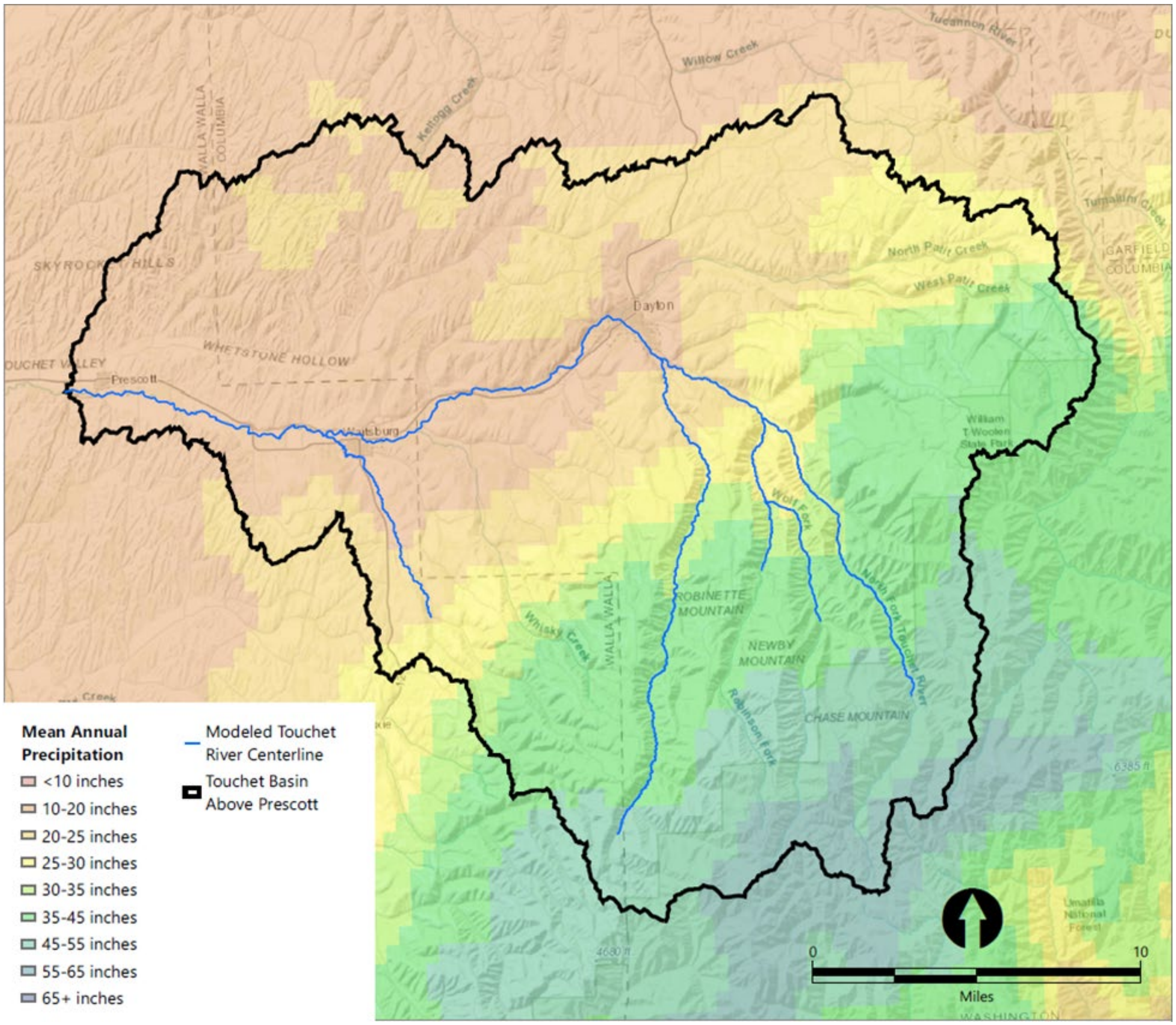


2.3 Precipitation and Runoff Overview

The basin climate is primarily continental, with some marine influences. Precipitation occurs primarily in the winter months as frontal storms pass over the basin. Frontal and convective storms occur in late spring through early summer. In the dry, late summer months, precipitation is primarily from convective events (Hecht 1982).

Mean annual precipitation data were available geospatially from Oregon State University through the PRISM climate model (OSU 2019), as shown in Figure 2-4. The distribution of precipitation in the Upper Touchet basin is highly dependent on elevation. Mean annual precipitation ranges from less than 10 inches at lower elevations to more than 50 inches at higher elevations. Runoff from precipitation events varies distinctly with antecedent moisture conditions and the extent and type of ground freezing. In the upper portions of the watershed in the Blue Mountains, 30% of winter precipitation falls as snow, and precipitation in the months from September to May make up the majority of precipitation in the basin (SRSRB 2011). The snow pack typically melts during the months of March, April, May, and June, with occasional rain on snow events in January through April causing rapid snowmelt below the freezing elevation. This precipitation pattern often means that the basin experiences multiple unique discharge peaks in a water year—one peak typically occurs as the result of a winter storm and the other as the result of spring snowmelt. Most large-scale events (<10-year return events) in the basin occur during this time period and many are likely rain on snow events.

Figure 2-4
Mean Annual Precipitation Distribution, Upper Touchet Basin



Note: Precipitation data were drawn from the Oregon State University PRISM climate model (OSU 2019) and represent the 30-year (1981 to 2010) annual average.

The lack of hydrologic gage sites in many parts of the basin, limited historical record, and local climate conditions (e.g., wet and drought year regime) make the development of statistically significant hydrology difficult. There are multiple gages in the basin, but many of them are either too recent, or have not been active for several years, and there are many rivers in the basin with no gages at all. In order to be consistent across all the different subbasins, this assessment uses regression curves based on basin area, land cover, and precipitation (Mastin 2016). More information about the methods of developing the hydrology can be found in Appendix C. The values used for this study are provided in Table 2-1. Peak-flow basin hydrology for the Touchet River was developed for input to the basin-scale hydraulic 1D model and for use in reach delineation.

Table 2-1
Return Flow Summary

Reach	Flow (cfs) per Return Period						
	1-year	2-year	5-year	10-year	25-year	50-year	100-year
Lower Mainstem Touchet	1,950	2,260	3,820	5,080	6,900	8,570	10,300
Upper Mainstem Touchet	1,944	2,250	3,780	5,020	6,800	8,430	10,100
Upper Coppei Creek	367	441	851	1,210	1,780	2,320	2,930
Lower North Fork	1,061	1,200	1,700	2,080	2,600	3,070	3,530
Upper North Fork	643	727	993	1,200	1,480	1,740	1,980
South Fork	539	624	978	1,260	1,670	2,040	2,420
Lower Wolf Fork	506	578	842	1,050	1,340	1,600	1,860
Upper Wolf Fork	309	349	461	550	672	782	888
Robinson Fork	223	257	379	477	615	740	865

Notes:
cfs: cubic foot per second

The Bolles Bridge gage was operated by the U.S. Geological Survey (USGS) from 1925 to 1929 and from 1952 to 1985. From 2002 to the present, a gage in a similar location has been operated by the Washington State Department of Ecology (USGS 14017000; Ecology Gage 32B100). This represents the most complete record of flood information in the basin. Because it is located below the Coppei Creek confluence, this gage also represents the cumulative flow off all of the major tributaries in the Upper Basin, with the exception of Whetstone Creek. The following significant flood events (>10-year, 5,080 cubic feet per second [cfs]) have been recorded at this location:

- 9,350 cfs in 1964 (December 23)
- 7,160 cfs in 1969 (January 7)
- 7,140 cfs in 1971 (January 19)
- 6,110 cfs in 1972 (January 21)
- 5,480 cfs in 1982 (February 21)
- 7,530 cfs in 2020 (February 7) *

*Notes:

1. Complete flow peaks not available for 2020 at the time of this report and actual peak may be slightly higher.
2. Flood events in 2019 were recorded at 4,780 cfs, just below the 10-year event.
3. Two flood events in 1996/1997 were not captured at a gage on the Touchet River. These floods are noted as some of the largest remembered, though, and it is possible they exceeded the 10-year mark.

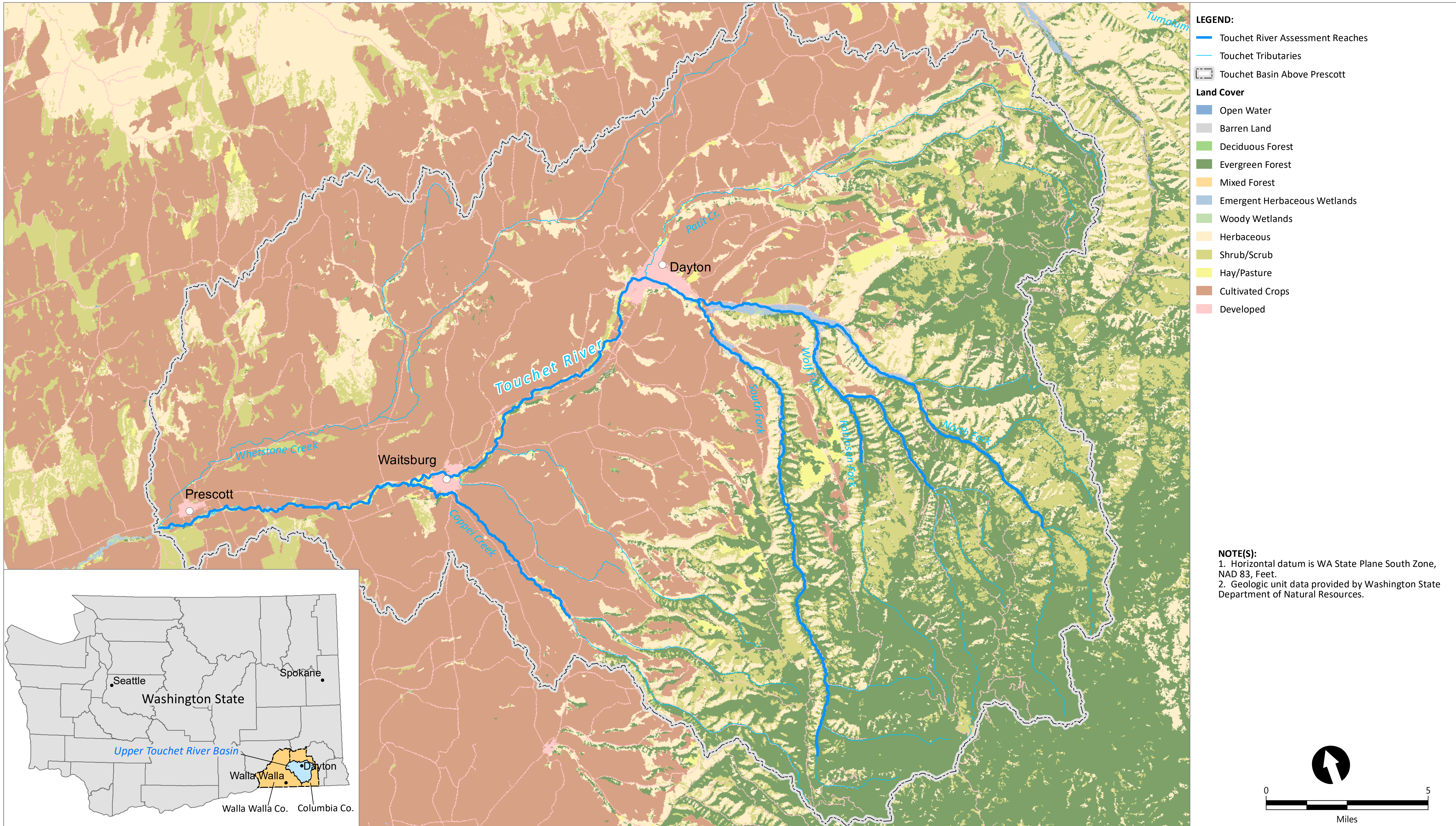
These events are all larger than the 10-year return period event according to regression equations detailed in Appendix C. The flood of record (9,350 cfs) is slightly more than the 50-year return period event. Flood events in 2019 were recorded at 4,780 cfs, just below the 10-year return event. Flood events in 1996 and 1997 were not captured at a gaged location on the Touchet River; however, these floods are remembered anecdotally as some of the largest in memory and are often compared to the 1964 floods. It is likely that these floods also exceeded the 10-year return event mark.

2.4 Anthropogenic Impacts

Significant anthropogenic impacts to this area can be traced to the mid-19th century when settlers began arriving in the Walla Walla River basin. With these settlements came agriculture to the valley bottoms and the establishment of infrastructure, both of which were likely associated with clearing of vegetation in the riparian and floodplain. Headwater logging and channel cleaning also played a role in the reduction of large woody materials in the channel and riparian areas, as well as the delivery of sediments to the channel and transport of these materials downstream. Today, agriculture including grains and the raising of livestock make up the vast majority of land use throughout the basin, especially on the loess hills and in the channel floodplain, as shown in Figure 2-5.

Historical irrigation and water use practices in the Touchet basin have created significant impacts to aquatic habitat. Hofer and Maiden dams, although no longer fish passage barriers, likely played a large role in the decline of steelhead and Chinook salmon in the basin (SRSRB 2011). Today irrigation in the form of surface water and groundwater pumping still have an impact on a variety of aquatic factors. Diversion of water for irrigation leads to a base flow that is lower than natural conditions, which greatly increases water temperatures during the dry season. Use of groundwater for irrigation also lowers the surrounding water table levels, which can have adverse effects on native vegetation, prevent the establishment of riparian areas, and decrease instream flow levels.

Several cities exist in the Upper Touchet basin, including Dayton near the North Fork and South Fork confluence, Waitsburg near the Coppei Creek confluence, and Prescott at the downstream extent of the study area. The presence of these cities creates the need for transportation and flood control, and these features represent impacts on the Touchet River’s natural fluvial processes. Several major highways and roads have been established through the Upper Touchet basin along with a railway line, all of which require many bridges and crossings. Large, actively maintained levees have been established in Dayton and Waitsburg for flood protection, and a number of smaller levees have been built historically to protect land use for specific interests. Many of these levees were likely constructed following the major floods in the basin (such as in 1964 and 1996) and were intended to control and route flood flows. However, these features limit active channel migration and prevent floodplain connectivity and riparian vegetation development.



NOTE(S):
1. Horizontal datum is WA State Plane South Zone, NAD 83, Feet.
2. Geologic unit data provided by Washington State Department of Natural Resources.

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Figure 2-5
Basin Land Use
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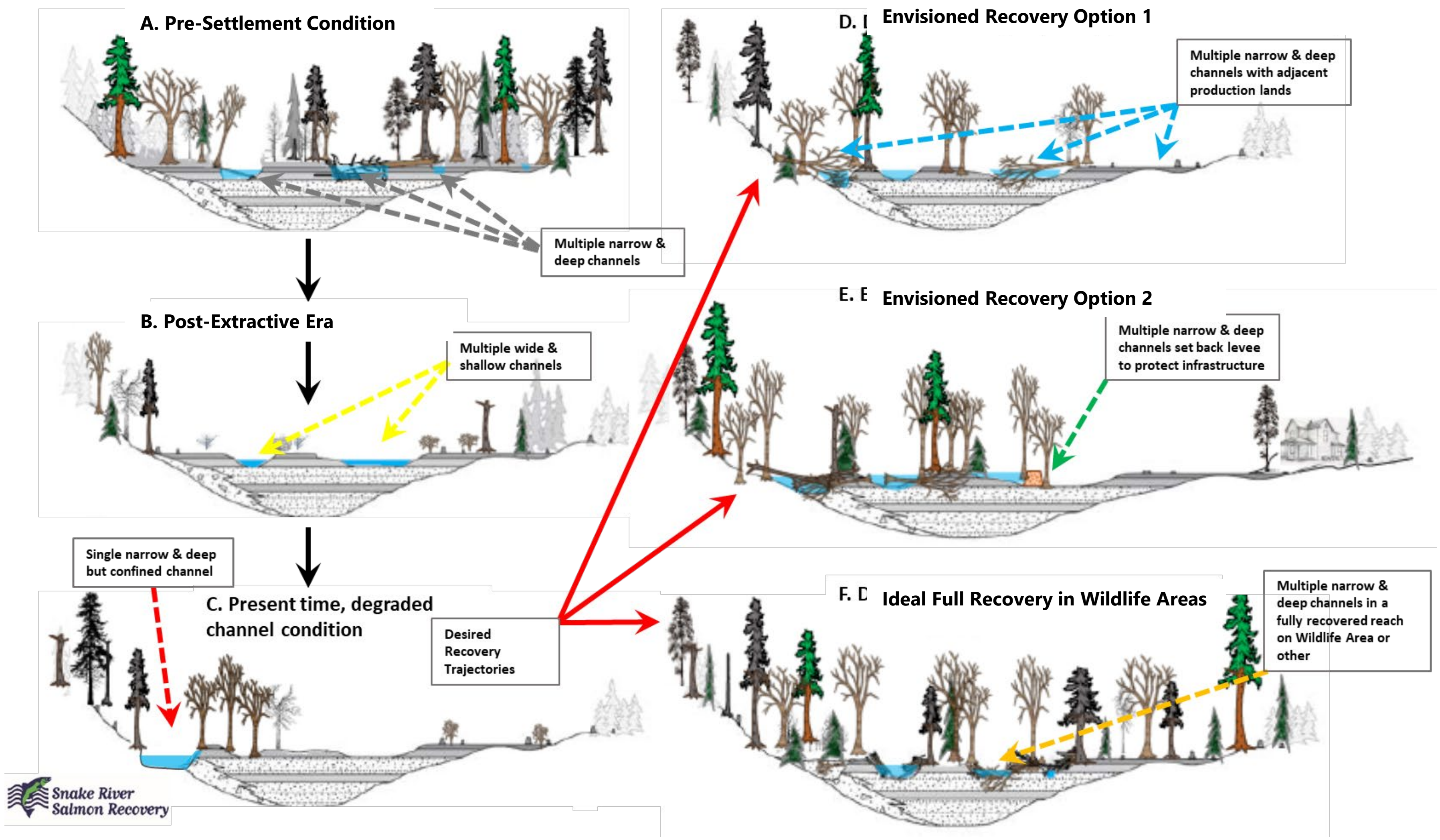
Figure 2-6 illustrates the effects of these anthropogenic actions with an idealized cross section of the Touchet River floodplain and riparian forests over time since pre-settlement:

- The transition from Sections A and B illustrate changes that have occurred through degradation with wide, shallow river channels that provide poor habitat for salmonids.
- Section C illustrates an improved but still degraded condition with a single, narrow channel that has confinement and recovering riparian habitat.
- The transition from section C to either sections D, E, or F all illustrate potential desired recovery trajectories and restoration objectives for three different land types that benefit salmon and steelhead:
  - Section D illustrates working lands where occasional flooding is possible.
  - Section E illustrates working lands with infrastructure protection setback levee.
  - Section F illustrates a full wild land restoration.

In a larger context and in addition to the above, the effects of climate change have begun to affect fluvial processes and will continue to play a larger role in these processes in the future. Changing precipitation patterns and rain/snowfall dynamics will affect the timing and duration of major flow events causing variability in geomorphic processes and major channel-shaping events. Additionally, warmer stream temperatures are projected throughout the Lower Columbia River basin and will place stress on salmonids particularly at key life history stages. Figure 2-7 shows projected stream temperatures and air surface temperatures from *The Washington Climate Change Impacts Assessment* (CIG 2009). The Touchet basin and Walla Walla basin as a whole will likely experience much warmer stream temperatures.



This model illustrates an idealized cross section of the Touchet River floodplain and riparian forests over time since pre-settlement. Sections A and B illustrate changes that had occurred through the period of degradation with wide, shallow river channels, and Section C illustrates an improved condition with a single, narrow channel that has confinement and recovering riparian habitat. Sections D and E illustrate desired recovery trajectories for three different land types that all benefit salmon and steelhead. Section D illustrates working lands where occasional flooding is possible, Section E illustrates working lands with infrastructure protection setback levee, and Section F illustrates a full wild land restoration. Source: Kris Buelow, Snake River Salmon Recovery Board, via email communication.

Figure 2-7
Projected Surface Air Temperatures and Stream Temperatures in Washington

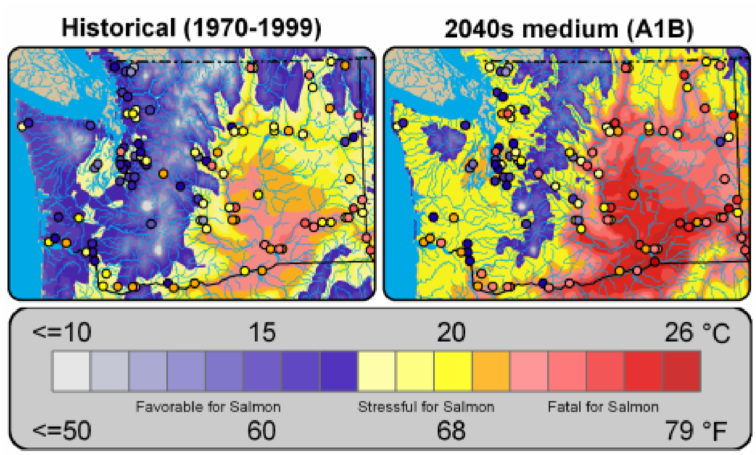


Figure 9. August mean surface air temperature (colored patches) and maximum stream temperature (dots) for 1970-1999 (left) and the 2040s (right, medium emissions scenario, (A1B)). The area of favorable thermal habitat for salmon declines by the 2040s in western Washington, and in eastern Washington many areas transition from stressful to fatal for salmon. Circles represent selected stream temperature monitoring stations used for modeling stream temperatures.

Notes: Excerpted From The Washington Climate Change Impacts Assessment (CIG 2009)

2.5 Restoration Actions To-Date

A number of federal and state programs have been implemented, with the assistance of local farmers and ranchers in the Touchet basin, to reduce fine sediment influx and increase stream temperatures (SRSRB 2011). These programs have worked cooperatively with local landowners and stakeholders to complete land management restoration actions such as the following:

- Improved grazing practices
- Converting tilled lands to minimum till agriculture
- Livestock exclusions
- Off-channel water sources for livestock
- Riparian plantings

While instream restoration has not been widespread in the Touchet basin thus far, the following projects have been completed by the CCD, CTUIR, SRSRB, and WWCCD:

- North Fork Touchet RM 2.0-2.7 Channel and Floodplain Restoration Project (SRSRB in 2019 to 2020)
- North Fork Touchet Floodplain Restoration and In-stream Enhancement RM 1.3-2.0 (CTUIR in 2020)
- North Fork Touchet Floodplain Restoration and In-stream Habitat Enhancement RM 3.3-4.3 (CTUIR in 2019)

- South Fork Touchet Restoration Projects (CTUIR in 2014)
- Dozier Fish Habitat Restoration Project (WWCCD in 2010)
- McCaw Reach Fish Restoration (WWCCD in 2010/2017)
- Hofer Dam Fish Passage Project (WWCCD in 2007)

3 Study Area

The study area for this assessment focuses on the middle and upper portions of the Touchet watershed, above the bridge for Highway 125 near the Whetstone Creek confluence. This area is described in the Middle Touchet major spawning area (MSA) (Whetstone Creek to Coppei Creek) and the Upper Touchet MSA (Coppei Creek confluence to the headwaters of the Forks), as shown in Figure 3-1. The extents of the assessment were truncated from the entire study area for a variety of physical, biological, managerial, and practical criteria. For the primary Forks (North, Wolf, Robinson, and South), the upstream extents of the assessment were determined primarily based on presumed extents of steelhead use, as well as where the primary restoration focus shifts from instream or floodplain restoration to land use management. For other tributaries, the extents of the assessment were determined based on fish use and primary restoration strategies focusing more on flow modification, sedimentation, and land use, and less on instream restoration. These exact extents are described further in Tables 3-1, 3-2, and 3-3.

Land use, anthropogenic impacts, and geomorphic and ecological character can all vary significantly in subbasins throughout the study area, so the assessment has been divided into reaches of similar hydraulic and geomorphic character. These reaches were delineated based on major hydrologic inputs, floodplain connectivity and confinement, geomorphic character, changes in primary land use, and changes in habitat suitability. Through the reach delineation process, it was determined that certain reaches would be the primary focus of the study and included in the prioritization. Other reaches were not included in the prioritization, but restoration should be considered on an opportunistic basis.

The reaches were grouped into three primary categories:

- **Reaches included in the restoration prioritization:** These reaches are the focal point of the assessment and are divided into project areas and ranked for restoration potential based on the methods discussed in this report. Table 3-1 and Figure 3-2 describe these reach locations, and Appendix I provides cut sheets and conceptual restoration actions.
- **City reaches outside the restoration prioritization:** These reaches go through one of the two cities of Dayton and Waitsburg. They are not included in the prioritization ranking due to concerns regarding restoration within the confines of U.S. Army Corps of Engineers (USACE)-protected levees. However, the geomorphic analyses were completed through these reaches and restoration should be considered on an opportunistic basis. Table 3-2 describes these reach locations, and Appendix J provides abbreviated cut sheets and general restoration strategies.
- **Other reaches outside the restoration prioritization:** These reaches either have major concerns about their viability for supporting effective habitat restoration projects, or the primary restoration focus will not be on instream restoration but rather long-term impairment restoration. These reaches include the smaller tributaries and headwaters that are addressed in this assessment but were not divided into project areas or ranked for prioritization. Table 3-3 describes these reach locations, and Appendix J provides abbreviated cut sheets and general restoration strategies.

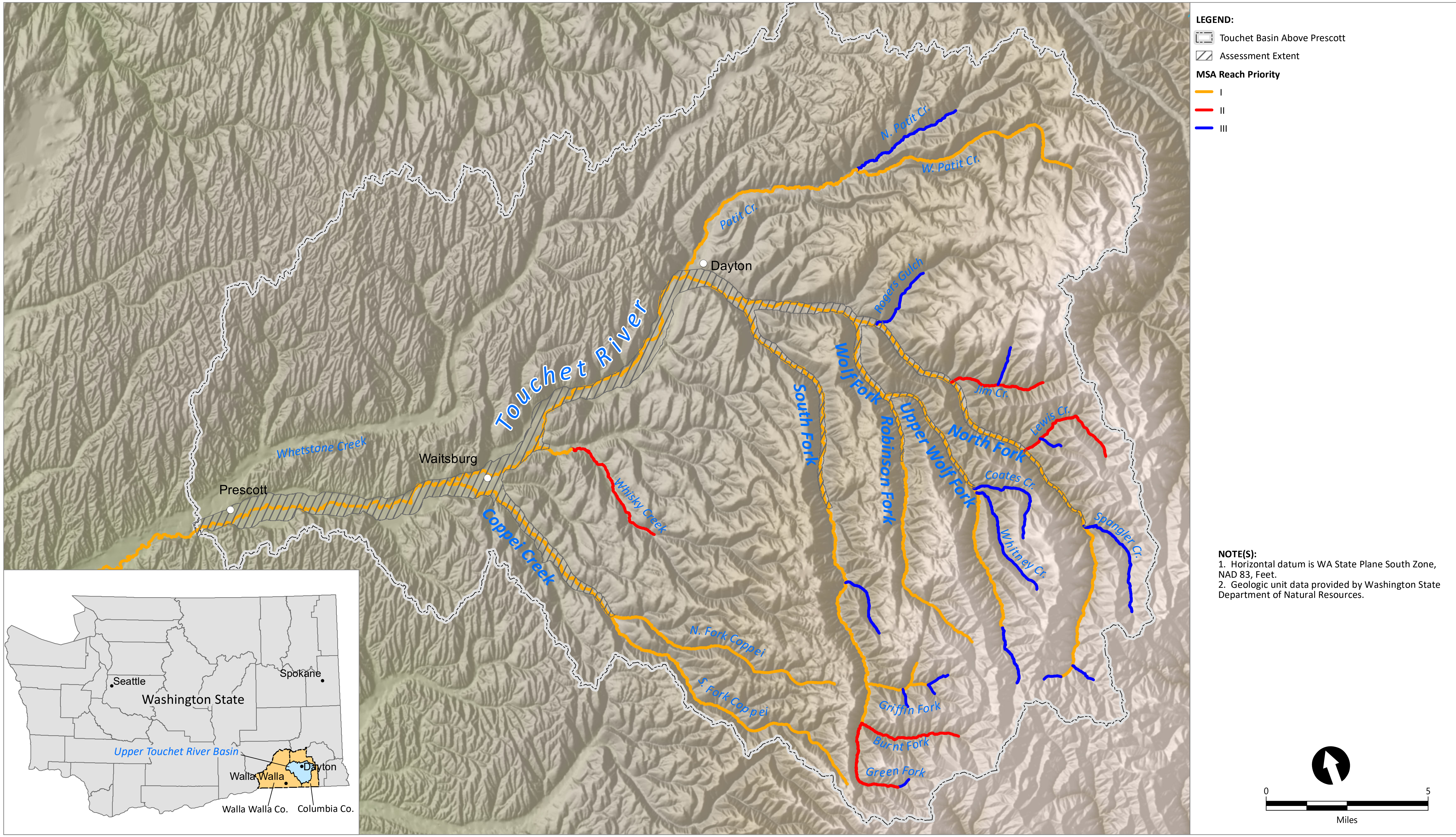


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Figure 3-1
Upper Touchet Basin Study Area
Geomorphic Assessment and Restoration Prioritization
Upper Touchet Basin Habitat Restoration

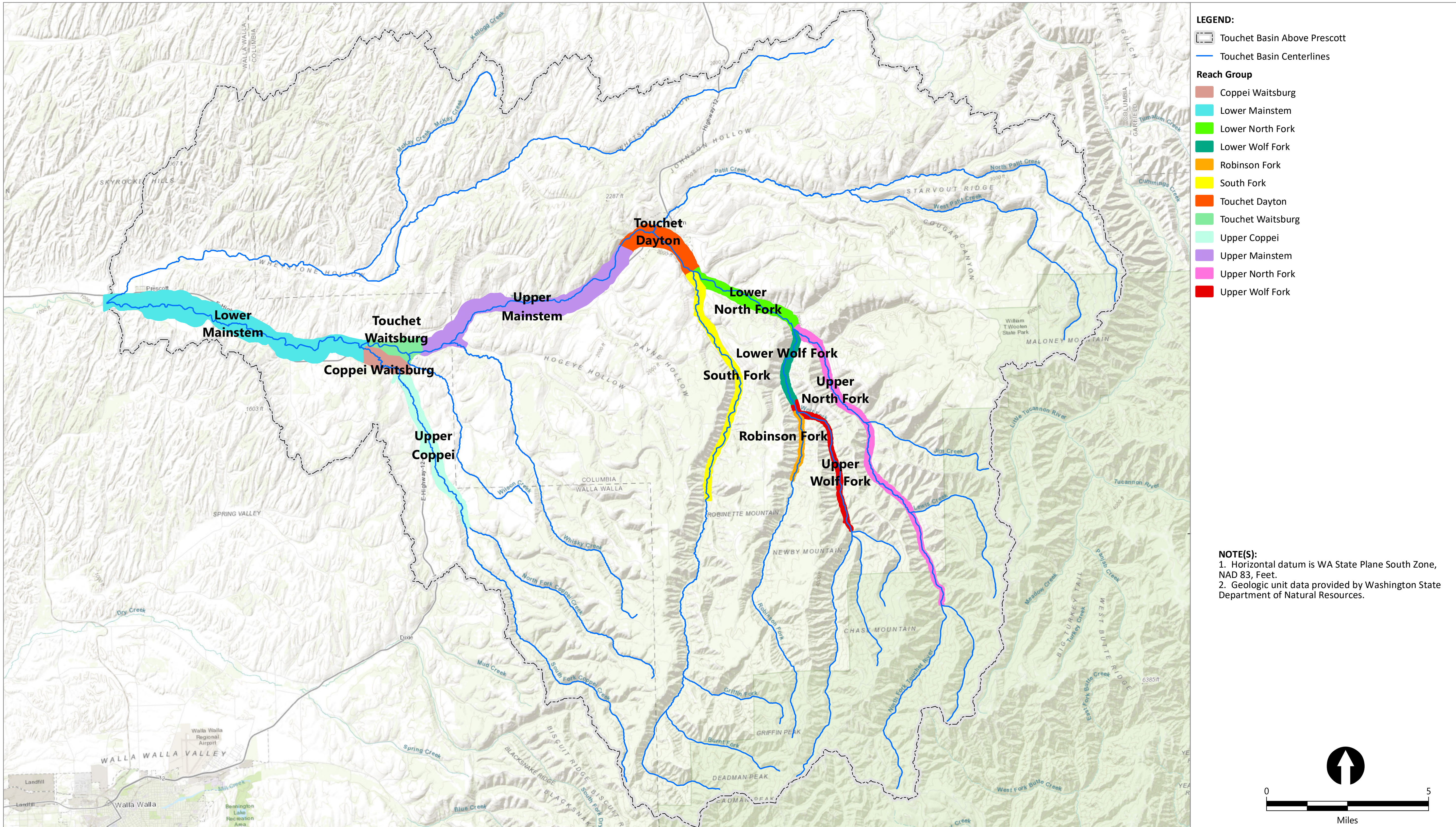

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Figure 3-2
Reaches Included in the Prioritization
Geomorphic Assessment and Restoration Prioritization
Upper Touchet Basin Habitat Restoration

Table 3-1
Reaches Included in the Restoration Prioritization

Reach	Location Description	RM Start to Stop
Lower Mainstem Touchet	From the confluence of Whetstone Creek to the confluence of Coppei Creek	41.14 to 51.33
Upper Mainstem Touchet	From the upstream end of the Waitsburg levee to the downstream end of the Dayton levee	53.44 to 61.86
Upper Coppei Creek	From the Meinberg Road Bridge to North/South Fork split	2.20 to 8.11
Lower North Fork Touchet	From the mainstem Touchet confluence to the Wolf Fork confluence	0.00 to 4.03
Upper North Fork Touchet	From the Wolf Fork confluence to Spangler Creek	4.03 to 15.38
South Fork Touchet	From the mainstem Touchet confluence to Rainwater Wildlife Area boundary	0.00 to 8.90
Lower Wolf Fork	From the confluence with North Fork to the Robinson Fork confluence	0.00 to 2.92
Upper Wolf Fork	From the Robinson Fork confluence to Coates Creek	2.92 to 7.94
Robinson Fork	From the confluence with the Wolf Fork to the end of the road	0.00 to 2.52

Notes:
RM: river mile

The cities of Waitsburg and Dayton are present along the mainstem Touchet River within this study area. Both cities are protected by large levees built by the USACE. Because of these levees, as well as the amount of infrastructure within close proximity of the channel, these city reaches have been excluded from the restoration prioritization (Table 3-2). However, the hydraulic model and data-driven geomorphic analysis were performed here and results can be found in the reach cut sheets in Appendix J. The city of Prescott is also within the study area but is far enough removed from the Touchet floodplain that it has not been considered a city reach.

Table 3-2
City Reaches Outside the Restoration Prioritization

Reach	Location Description	RM Start to Stop
Mainstem Touchet Waitsburg	Mainstem Touchet under the protection of the Waitsburg levee	51.33 to 53.44
Coppei Creek Waitsburg	From the confluence with the mainstem Touchet to Meinberg Road Bridge	0.00 to 2.20
Mainstem Touchet Dayton	Mainstem Touchet under the protection of the Dayton levee	61.86 to 65.02

Table 3-3
Other Reaches Outside the Restoration Prioritization

Reach	Approx. Total River Length (mi)	Reason For Exclusion from Prioritization
Whetstone Creek	29.30	Not a significant population of focal species. Non instream actions such as flow and riparian management will be driving restoration strategy.
Coppei Creek Headwaters	19.13	Reach starts at confluence of North and South Fork Coppei Creek. Restoration opportunities exist mainly in the form of non-instream actions such as flow and riparian management.[1]
Whisky Creek	12.62	Focal species fish use has been reported in this smaller tributary. Whiskey Creek was excluded from the prioritization due to data limitations and as directed by the Touchet Watershed Group. Restoration opportunities may be available, and this tributary should be considered for future assessment.
Lower Patit	7.84	Migration reach with little habitat currently available. Lower Patit Creek was excluded from the prioritization due to data limitations and as directed by the Touchet Watershed Group. Restoration opportunities may be available, and with additional data this tributary should be considered in any future assessment.
South Fork Patit	11.68	Ephemeral stream without flow for portions of the year. Restoration opportunities exist mainly in the form of non-instream actions such as flow and riparian management.[1]
North Fork Headwaters	6.20	Reach starts at Spangler Creek confluence. Terminated assessment boundary at the presumed extent of steelhead use. Restoration opportunities exist mainly in the form of non-instream actions such as flow and riparian management.[1]
Wolf Fork Headwaters	8.08	Property and access limitations upstream Coates Creek. Restoration opportunities exist mainly in the form of non-instream actions such as flow and riparian management.[1]
Robinson Fork Headwaters	8.88	Reach starts at end of road access. Restoration opportunities exist mainly in the form of non-instream actions such as flow and riparian management.[1]
South Fork Headwaters	11.83	Reach starts at Rainwater Wildlife Area Boundary. Restoration opportunities exist mainly in the form of non-instream actions such as flow and riparian management.[1]

Note:

1. Evaluation of forest and wilderness area riparian management restoration opportunities is outside the scope of this assessment. However, many of these reaches do provide existing habitat for focal species, and upstream land management restoration is an important piece of basin-scale restoration. These reaches should be considered in future evaluations for non-instream and forest management or riparian restoration opportunities.

4 Fish Management

The primary species of concern identified in the Walla Walla Subbasin Plan (WWWPU and WWBWC 2004) include summer steelhead, reintroduced spring Chinook salmon, and bull trout. This section summarizes the historical and current management of these three focal fish species in the Upper Touchet basin.

4.1 Steelhead Trout

Historical wild-origin steelhead abundance in the Touchet River is unknown but was likely between 1,000 and 3,000 fish annually. By the mid-1970s, sport harvest in the Touchet River (which was solely supported by wild-origin steelhead) was declining (Figure 4-1), and steelhead fishing in the Touchet River was limited. The Lower Snake River Compensation Plan (a hatchery program initiated in the early 1980s to compensate for fish losses from the construction and operation of the four lower Snake River dams) started releasing hatchery origin steelhead for harvest in the Touchet River in 1983. The hatchery stocks used for the harvest mitigation program varied over the years. Shortly after hatchery releases were initiated, harvest in the Touchet River quickly rebounded (Figure 4-1). Spawning ground surveys upstream of Dayton were also initiated in the late 1980s as part of the Lower Snake River Compensation Plan monitoring activities, with those surveys continuing to the present day.

In 1999, all Mid-Columbia River steelhead populations were listed under the ESA as threatened. Following the ESA listing, the National Marine Fisheries Service (NMFS) questioned the Washington Department of Fish and Wildlife (WDFW) about the harvest mitigation program, and the hatchery stocks used for implementation. From those inquiries, WDFW initiated a new stock from "localized" adult steelhead (i.e., wild origin returns that could have either wild or hatchery parents), with the eventual goal of potentially replacing the mitigation stock with the new "local" stock. The new hatchery endemic stock program began in 2000, with a 50,000 smolt production goal. To date, the endemic program has performed poorly (smolt-to-adult survivals have been <0.5% compared to the mitigation stock of 1.5%), and as such has not been fully implemented at this time. Total hatchery steelhead production in the Touchet River has been relatively consistent since the mid-1980s, with generally between 120,000 and 150,000 smolts released annually (Figure 4-2). WDFW continues to evaluate these two hatchery steelhead programs, with changes possible in the future.

Current Status and Management: Determining the status of steelhead returning to the Touchet River is difficult because fish return over many months, and spawn during periods of higher stream flows with poor visibility, so operation of adult traps or conducting redd surveys throughout the entire Touchet River where steelhead are present are often ineffective. Data from spawning ground surveys above Dayton, and adult traps in more recent years, have provided an index of stock status (Figure 4-3) but are incomplete for the entire basin. The average number of wild origin spawners has averaged 375 steelhead per year in the estimated index area from 1987 to 2019. Moving forward, WDFW will be using Passive Integrated Transponder (PIT)-tagged juvenile steelhead captured and released at a smolt trap in the Lower Touchet River, along with instream PIT tag arrays, to estimate future adult returns to the entire Touchet River basin. Some of the main factors limiting the recovery of Touchet River summer steelhead include habitat degradation in the basin, the mainstem Columbia River migration corridor (including predation in the lower Walla Walla/Touchet rivers and the mainstem Columbia River), and overshoot of returning adult Touchet River steelhead into the Snake River, with limited ability of those fish to return to the basin.

Figure 4-1
Estimated Harvest of Summer Steelhead in the Touchet River as Reported from WDFW Catch-Record Cards (1968 to 2018)

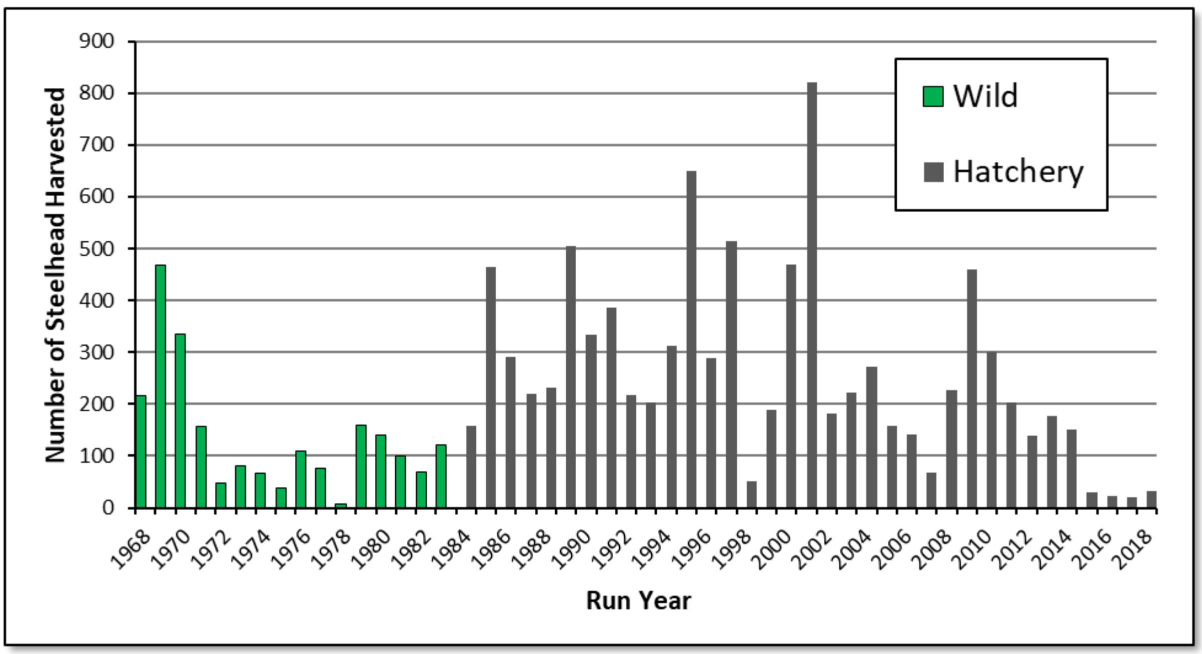


Figure 4-2
Number of Hatchery Origin Steelhead from Either the Mitigation Stocks or the Touchet River Endemic Stock Released into the Touchet River (1983 to 2020)

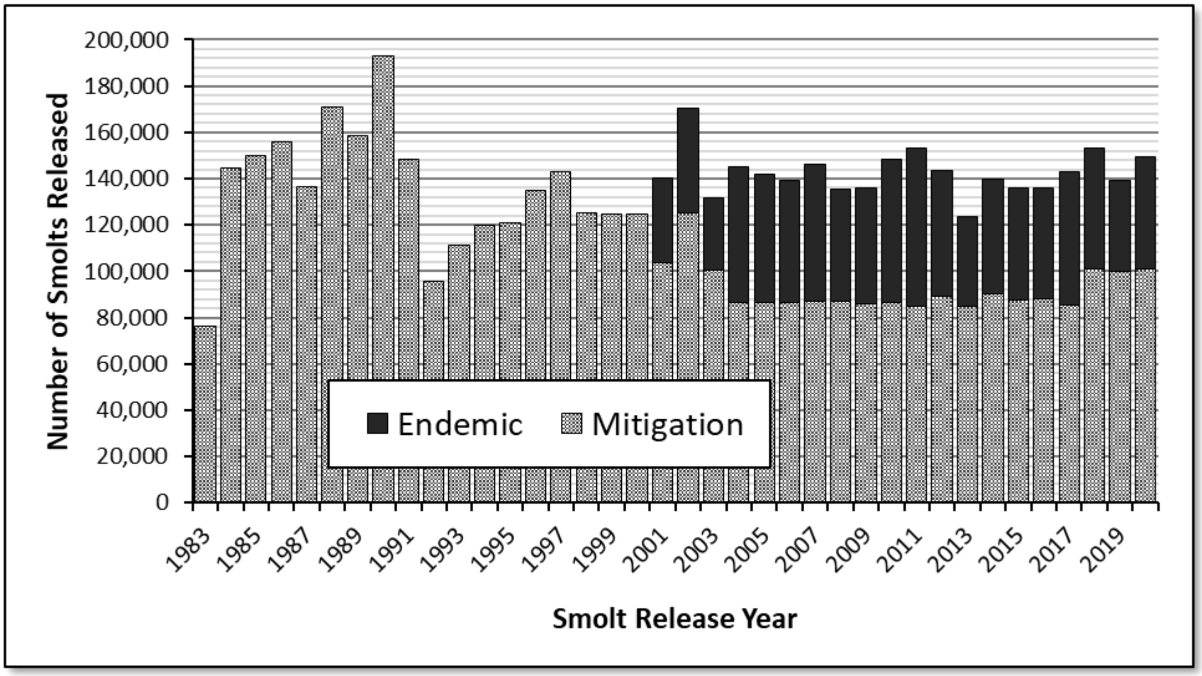
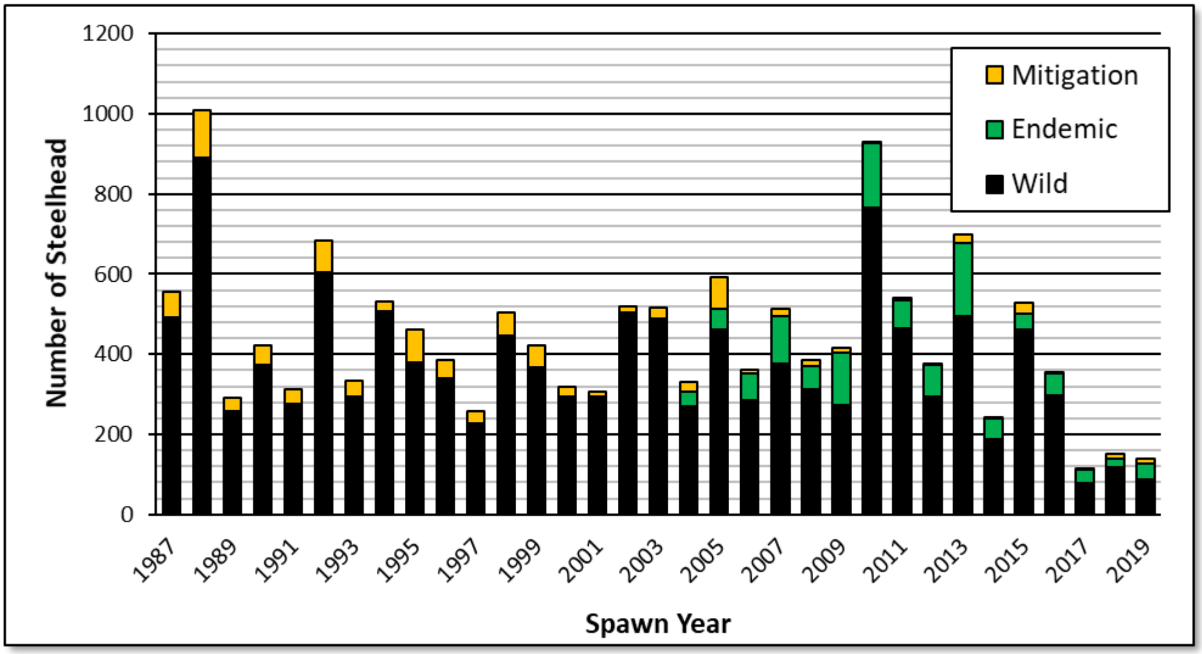


Figure 4-3
Estimated Number of Wild and Hatchery Origin Steelhead (Mitigation or Endemic Stocks) that Spawned in Index Areas of the Touchet River (1987 to 2019 Spawn Years)



Note: Portions of the Touchet River basin cannot be estimated at this time, so these should be considered a minimum estimate.

4.2 Spring Chinook Salmon

Spring Chinook in the Walla Walla/Touchet river basins likely went extinct back in the 1950s (WWWPU and WWBWC 2004) due to limiting factors such as habitat degradation from irrigation diversions and resultant passage issues, sediment loads, migration corridor alterations, and pressures from downriver harvest (Mendel et al. 2014). Because they went extinct, no ESA listings for spring Chinook salmon in the basin have occurred, thereby greatly reducing the federal restrictions to reintroduce the species with a hatchery program. As such, reintroduction efforts in the Walla Walla basin by the CTUIR (CTUIR 2015) began in 2000 with adult outplants in the South Fork Walla Walla and Mill Creek (Mendel et al. 2014). Smolts (up to 250,000) have also been released into the Walla Walla basin by CTUIR since 2005. The fully implemented CTUIR hatchery spring Chinook salmon program plans a total release of 500,000 smolts annually, with 100,000 smolts to be released into the Touchet River. The primary goal for CTUIR is to re-seed the suitable spawning and rearing habitats in the Walla Walla basin with hatchery origin spring Chinook salmon (Carson stock), with the plan that natural production will occur and bring back a sustainable number of adults to spawn both in the wild and for CTUIR's hatchery program in the South Fork Walla Walla (CTUIR 2015). Harvest opportunities within the Walla Walla basin are also expected. Specifically, in the Touchet River, CTUIR has outplanted between 25 and 50 pairs of adults from 2015 to 2018, but no juveniles have been released in the Touchet River from their program to date.

In addition to CTUIR efforts, WDFW began releasing spring Chinook juveniles in the Touchet River in 2020 (WDFW 2018). The goals for the WDFW program are to: 1) provide harvest mitigation under the Lower Snake River Compensation Plan; 2) collect broodstock to support the WDFW hatchery program (and CTUIR's hatchery program if needed); and 3) promote natural spawning of hatchery returns and encourage eventual natural production in the basin.

Current Status and Management: Currently in the Touchet River, spring Chinook salmon abundance has been minimal, apart from when the CTUIR has provided adults for outplanting. As such, monitoring activities in the Touchet River for spring Chinook salmon are currently minimal. As adults return from the WDFW program (in 2022), harvest monitoring, broodstock collections, and spawning ground surveys will be implemented as needed to meet program objectives.

4.3 Bull Trout

Bull trout in the Columbia Basin were ESA-listed as threatened in 1999. The Touchet River bull trout population is part of the Mid-Columbia Recovery Unit (USFWS 2015). Connections between the Umatilla and Walla Walla core populations are uncommon but have been documented (USFWS 2015). Currently, local populations in the Touchet River occur in the North Fork, Wolf Fork, and Burnt Fork of the South Fork (Kassler and Mendel 2007; Mendel et al. 2014). Both fluvial migratory and resident forms are present throughout these areas.

Current Status and Management: During bull trout recovery planning, the Recovery Unit team determined that bull trout are at an intermediate risk because adult abundance and the number of local populations are just below what is necessary to reduce inbreeding depression and losses from stochastic events (Bull Trout Core Area Templates, USFWS, February 2005). Redd counts in the North Fork and Wolf Fork between 1999 and 2017 suggest that these two local populations appear relatively stable, though depressed (Figure 4-4). Due to lack of available funding, redd surveys following 2017 have been discontinued. WDFW also encounters bull trout at the Dayton adult trap (Figure 4-5). Currently, the only monitoring of bull trout in the Touchet River basin consists of PIT-tagging all bull trout captured annually at the Dayton adult trap, the Patit Creek adult trap, the Coppei Creek adult trap, or those that have been opportunistically captured in the Touchet River smolt trap. Redetections of PIT-tagged bull trout are being used to monitor migration times (upstream and downstream) and travel rates of bull trout between the instream PIT tag array locations and/or area adult traps.

Figure 4-4
Bull Trout Redd Surveys on the North Fork and Wolf Fork, Touchet River (1998 to 2017)

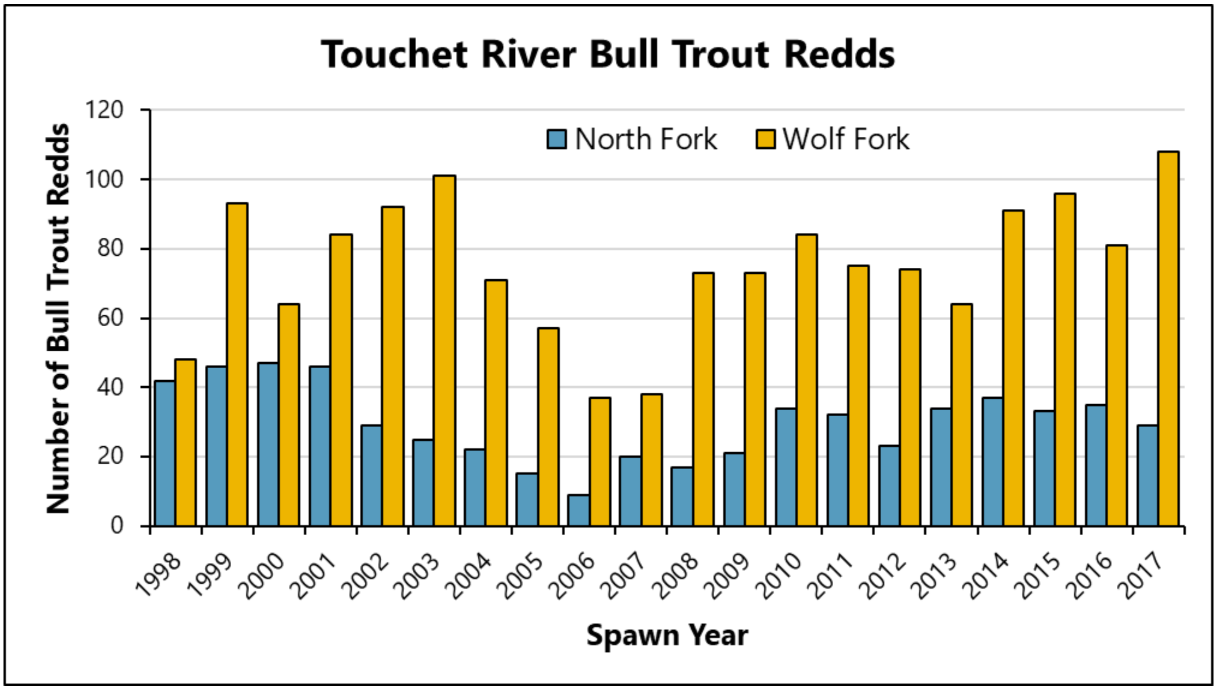
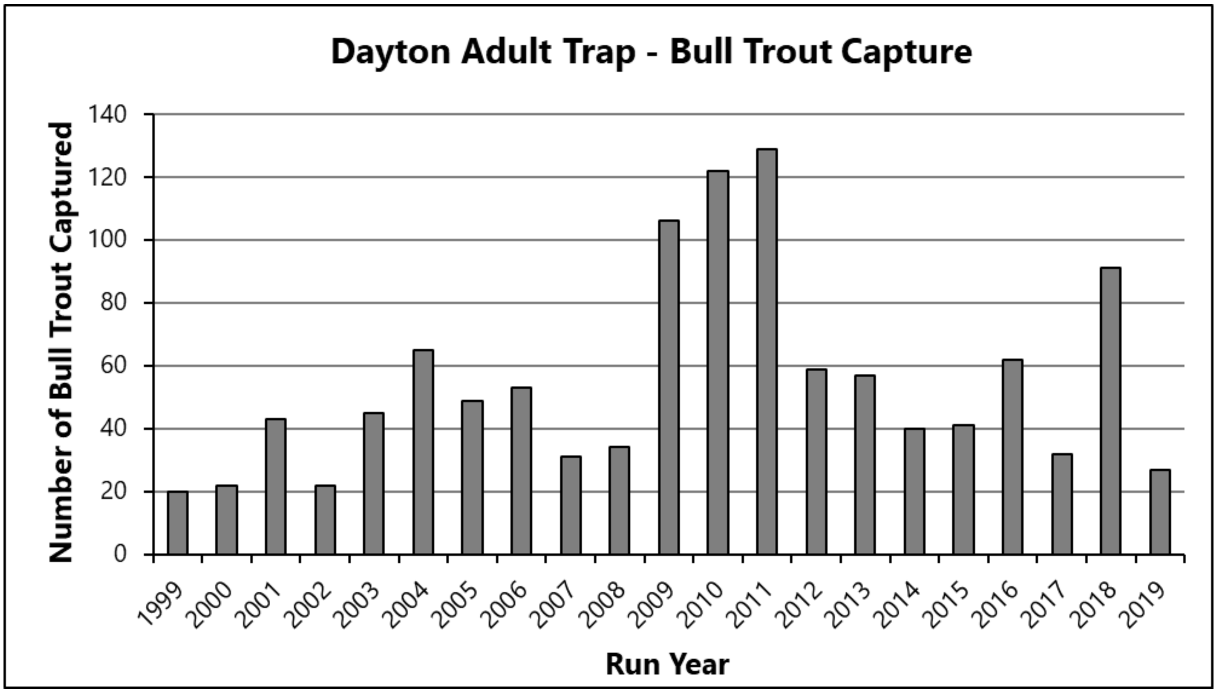


Figure 4-5
Bull Trout Captured at the Dayton Adult Trap (1999 to 2019)



Note: Data do not represent fish that are able to bypass the adult trap/dam in certain flow conditions.

5 Fish Habitat and Distribution

The Touchet River supports two ESA-listed Mid-Columbia River salmonid populations throughout all or a portion of their life history stages. Summer steelhead and bull trout were identified in the Walla Walla Subbasin Plan as aquatic focal species (WWWPU and WWBWC 2004). Collectively, these two species use the main channel from the mouth to the headwaters of the South Fork, North Fork, Wolf Fork, and Robinson Fork, as well as major tributaries in the lower/middle Touchet River including Dry, Whiskey, Coppei, and Patit creeks. In addition, while not ESA-listed, both the CTUIR and WDFW have released spring Chinook salmon into the Touchet River for reintroduction and/or harvest mitigation. The following information is summarized from the Walla Walla Subbasin Plan (WWWPU and WWBWC 2004) and the SRSRB (2011), and revised to include new information from recent data being collected by WDFW and others in the basin. Table 5-1 shows the spatial distribution of summer steelhead and bull trout in the Touchet River, with darker shades of gray indicating higher densities of fish present during their respective life history stages. Information on bull trout was generally not sufficient to provide distribution data as reported for the other focal species. Figure 5-1 shows the location of PIT tag detection and traps in the Touchet basin.

Touchet River summer steelhead and spring Chinook salmon both express anadromous life cycles, where they spend at least a portion of their life span in fresh water (the Touchet, Walla Walla, and Columbia rivers for this group), followed by a portion in the brackish Columbia River estuary and the Pacific Ocean. The time spent in each ecosystem varies by each species and within species depending on environmental conditions, such as stream temperature, ocean productivity, etc. Bull trout within the Touchet River are potamodromous, meaning they are migratory without going to the ocean, spending their life in the freshwater system.

Figure 5-2 is a simplified life cycle for Touchet River summer steelhead, starting with the adult life history stage entering the Columbia River in June/July 2019, entering the Touchet River in October/November 2019, and spawning in late February through May of 2020. The eggs remain in the gravel during the spring months, hatching into alevins and leaving the gravel in June/July 2020 as fry. Steelhead fry/parr/fingerlings can rear in the Touchet River from 1 to 4 years depending on where they rear and how fast they are growing. Smolts can leave the system as age 1 to 4 smolts, and migrate to the Columbia River estuary where they feed on the productivity of the brackish estuary environment for a few months before entering the marine environment. Steelhead from the Touchet River will typically spend from 1 to 2 years in the ocean before returning to spawn. A portion of the adult steelhead that return to spawn can recondition in either the fresh water, or return to the ocean, grow larger, and return to spawn again. In the Touchet River population, repeat spawners comprise about 5% of the returning population annually based on scale age analysis.

Table 5-1
Fish Distribution Estimates for Focal Species

Reach	From (RM)	To (RM)	From (KM)	To (KM)	Summer Steelhead			Spring Chinook			Bull Trout		
					Spawning	Juv. Rearing	Adult Holding	Spawning	Juv. Rearing	Adult Holding	Spawning	Juv. Rearing	Adult Holding
Lower Touchet	35.1	45.3	56.5	72.9	Low	Low	High	None	None	Unknown; assumed to be simliar to spawning	None	None	Unknown; assumed to be simliar to spawning
Upper Touchet	45.3	56.1	72.9	90.3	Moderate	Moderate	High	Low	Low		None	Low	
Coppei Creek	2.2	8.1	3.5	13.0	Moderate	High	None	None	None		None	None	
Lower North Fork	0	4.03	0.0	6.5	Moderate	High	Low	Moderate	Low		None	Low	
Upper North Fork	4.03	15.4	6.5	24.8	Moderate	High	None	High	Moderate		Low	Moderate	
Lower Wolf Fork	0	2.92	0.0	4.7	Moderate	High	Low	High	Moderate		None	Low	
Upper Wolf Fork	2.92	7.94	4.7	12.8	Moderate	High	None	High	Moderate		Low	Moderate	
Robinson Fork	0	2.52	0.0	4.1	Moderate	High	None	None	None		None	None	
South Fork	0	8.9	0.0	14.3	Moderate	High	Low	None	None		None	None	
North Fork Headwaters	15.4	-	24.8	-	Low	Low	None	Low	Low	Unknown; assumed to be simliar to spawning	High	High	Unknown; assumed to be simliar to spawning
Wolf Fork Headwaters	7.94	-	12.8	-	Low	Moderate	None	Moderate	Low		High	High	
Rob. Fork Headwaters	2.92	-	4.7	-	Low	Moderate	None	None	None		None	None	
South Fork Headwaters	8.9	-	14.3	-	Moderate	High	None	None	None		Low	Low	
NF/SF Coppei	8.1	-	13.0	-	Moderate	High	None	None	None		None	None	
SF Patit	0	-	0.0	-	Low	Moderate	None	None	None		None	None	
Whiskey Creek	0	-	0.0	-	Low	Low??	None	None	None		None	None	

Notes:

1. Darker shades of gray indicate higher densities of fish present during their respective life stages.

Figure 5-1
Map of PIT Tag Detection and Traps in the Touchet Basin

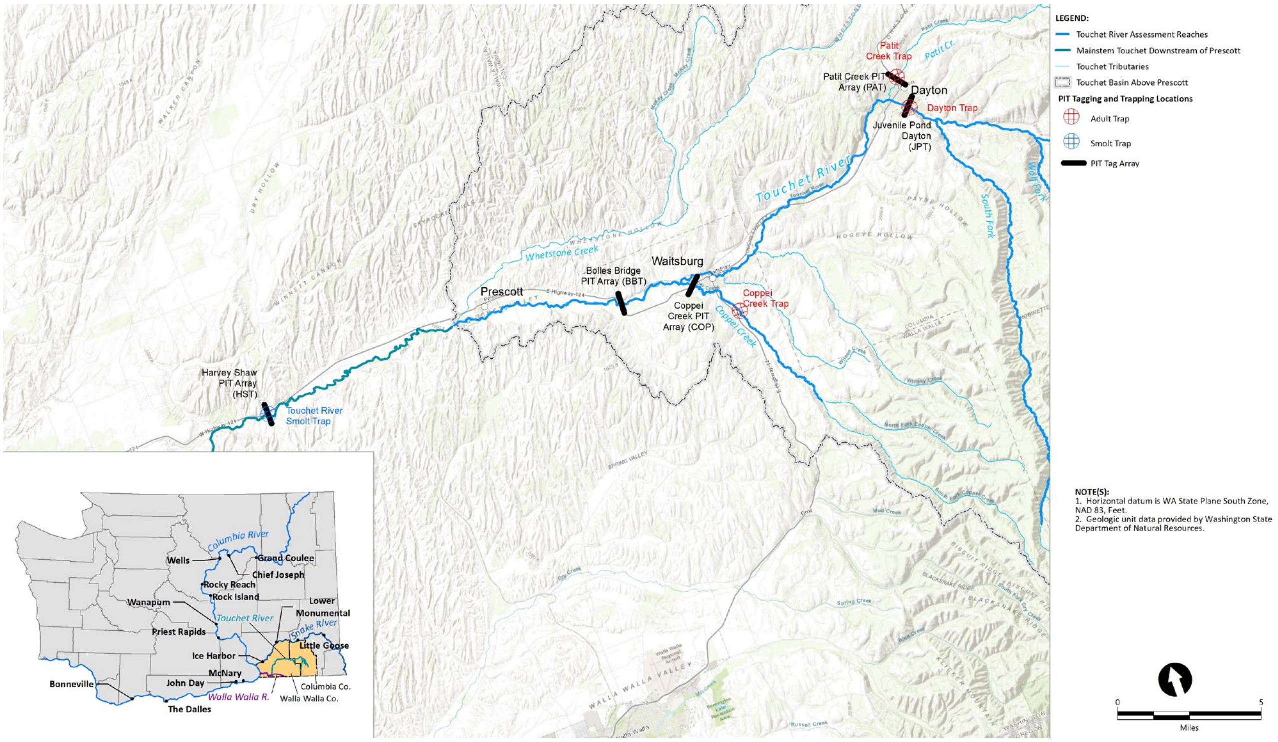
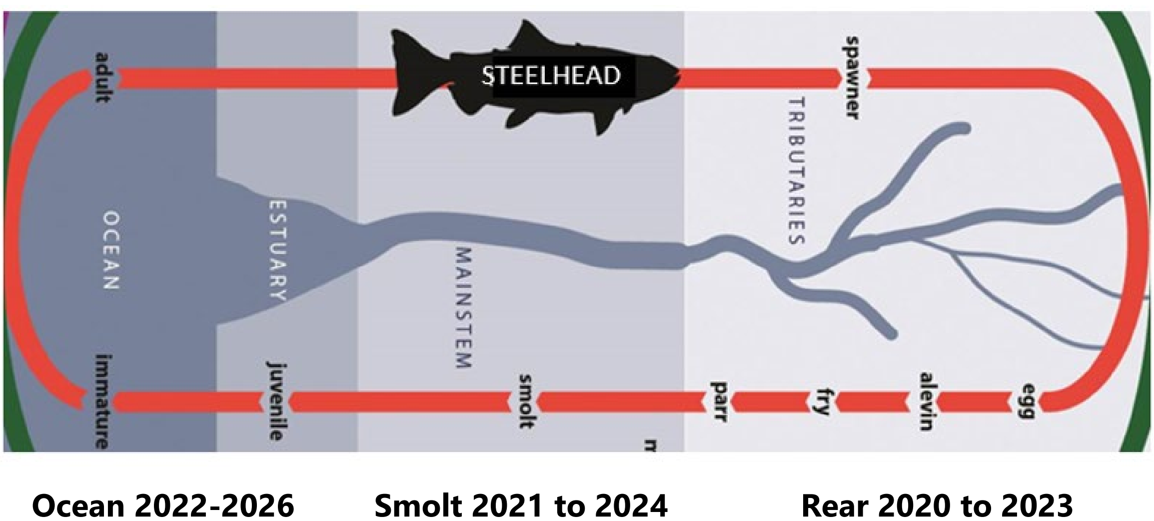


Figure 5-2
Life Cycle of Steelhead in the Touchet River



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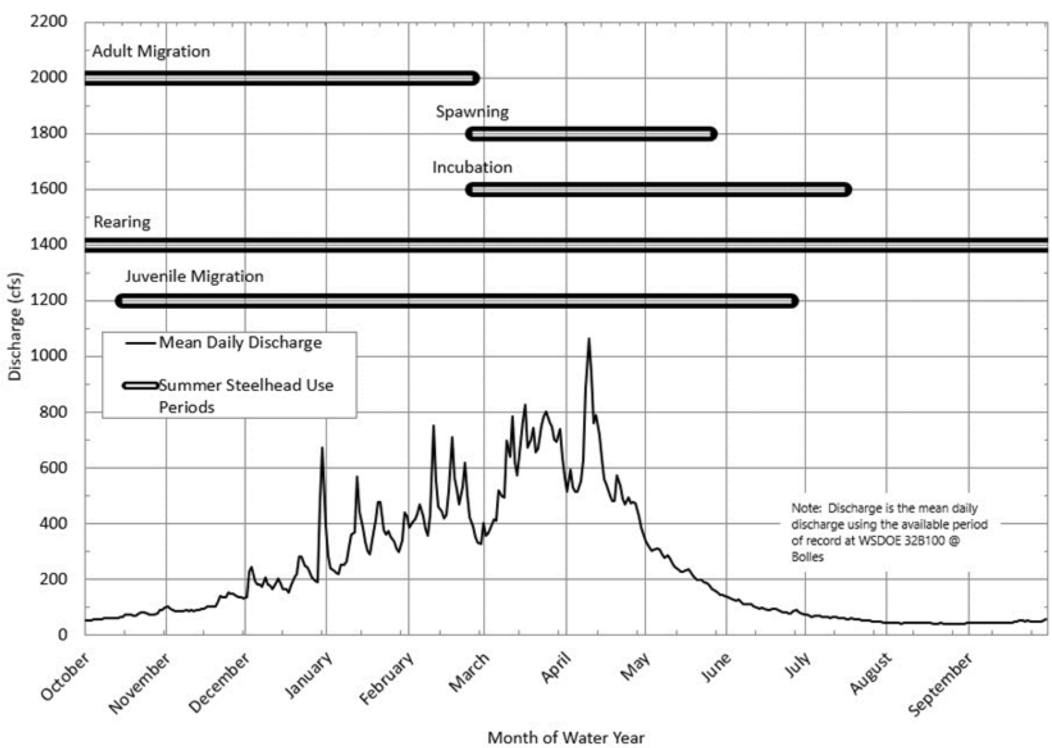
5.1 Summer Steelhead

Summer steelhead in the Touchet River are part of the Mid-Columbia River summer steelhead Distinct Population Segment and were listed as threatened in 1999. Summer steelhead enter the Touchet River as early as October and begin spawning in late February to early March with spawning continuing to late May (Figure 5-3). Spawning occurs in the mainstem from about the city of Prescott (valley mile 35) upstream into the headwaters of the South Fork, North Fork, Wolf Fork, and Robinson Fork (including some of the small tributaries to these), as well as within Dry, Whiskey, Coppei, and Patit creeks in the lower/middle Touchet River; the greatest concentration of steelhead spawning is typically found in the mainstem between the city of Waitsburg and into the lower 10 to 15 miles of the South, North, and Wolf forks, and the other major tributaries listed. Juveniles also rear throughout the mainstem but are typically found in the greatest numbers in the mainstem between the cities of Waitsburg and Dayton, and the South, North, Wolf, and Robinson forks, and Coppei Creek, with the other tributaries typically having lower densities due to summer rearing conditions. Rearing of juveniles from below the city of Waitsburg to the mouth is marginal or inhospitable likely due to summer water temperatures.

Figure 5-3
Mean Annual Hydrograph and Typical Timing of Life History Stages for Summer Steelhead Trout in the Touchet River Basin



5.2 Spring Chinook Salmon

Spring Chinook salmon in the Walla Walla/Touchet basins likely went extinct back in the 1950s (WWWPU and WWBWC 2004) due to limiting factors such as habitat degradation from irrigation diversions and resultant passage issues, sediment loads, migration corridor alterations, and pressures from downriver harvest (Mendel et al. 2014). Recent hatchery efforts by both the CTUIR and WDFW should increase the abundance and distribution of spring Chinook salmon in the Touchet basin in the future. Spring Chinook adults will return to the Touchet River in late April through June. Adults will hold over the summer and spawn in late August to the end of September. Similar to bull trout, it is anticipated that the highest densities of spawners will occur in the upper North and Wolf forks. However, with WDFW-released juveniles occurring from the Dayton Acclimation Pond, it is possible some fish might return and spawn in the mainstem and lower North Fork. Natural origin juveniles are expected to rear primarily in the North and Wolf forks and possibly in the mainstem Touchet River. However, it is believed that summer stream temperatures below Dayton are marginal or lethal for spring Chinook juveniles.

5.3 Bull Trout

Bull trout in the Columbia Basin were ESA-listed as threatened in 1998. The Touchet River bull trout population is part of the Lower Mid-Columbia Recovery Unit (USFWS 2015). Connections between the Umatilla and Walla Walla core populations are uncommon but have been documented (USFWS 2015). Currently, local populations in the Touchet River occur in the North Fork, Wolf Fork, and Burnt Fork of the South Fork (Kassler and Mendel 2007; Mendel et al. 2014). Both fluvial migratory and resident forms are present throughout these areas. Migratory bull trout move upstream from the lower Walla Walla/Touchet rivers into the Upper Touchet River in the spring and early summer. Some bull trout can potentially migrate further than the mainstem Walla Walla/Touchet rivers. Large fluvial bull trout have been recorded to range throughout the mainstem Columbia River and over-summer in streams other than their natal stream. Juvenile rearing occurs primarily in the specific streams identified above to their specific headwaters. The lower and middle mainstem Touchet River, North, Wolf, and South forks are important as migratory corridors to adult and juvenile spawning and rearing areas upstream in the watershed. Bull trout appear to begin their upstream migration in the Touchet River from February through July and continue to the spawning areas in July and August, with spawning beginning in late August/early September and continuing through October.

5.4 Other Species of Concern

Besides the two ESA-listed species and Spring Chinook salmon, many other aquatic species are present in the Touchet River. Unfortunately, there is little to no biological information on their current status and health. Based on previous surveys by WDFW, species such as sculpins (multiple species), dace (long-nose or speckled), and red-sided shiners are plentiful throughout the basin. Other species such as whitefish, suckers, Pacific lamprey, and freshwater mussels were also once abundant within the basin but are now thought to be at critically depressed levels and their distribution is more restrictive from historical levels. Previous actions within and outside the basin likely contributed to their decline, and it is hoped that habitat restoration actions described within this assessment will assist in their recovery.

6 Limiting Factors

Many efforts have been made to understand the factors negatively affecting salmon and steelhead growth and survival across varying life history stages throughout the Pacific Northwest. The primary habitat factors limiting survival and production within a given river segment, tributary, or basin change over time as conditions continue to degrade or improve. Early watershed assessments often focused on limiting factors that were directly killing fish (called imminent threats) such as dewatered streams, migratory blockages, or unscreened diversions. As the imminent threats were addressed across the watershed, restoration efforts transitioned toward limiting factors that indirectly killed fish or limited their growth or survival over several or part of their life cycle. Simplified instream conditions, lack of deep pools, degraded riparian conditions, and fine sediment input from logging, farming, and other land use activities are often considered limiting factors affecting fish.

6.1 Limiting Factors in the Touchet Basin

In the Upper Touchet basin, few efforts have been implemented to identify factors limiting the life cycles of focal species. This assessment covers the MSA of the Upper Touchet watershed (upstream of Coppei Creek) and the MSA of the Middle Touchet (from Whetstone Creek to Coppei Creek). The Walla Walla Subbasin Plan (WWWPU and WWBWC 2004), which includes the Touchet watershed) was developed in 2004 and focused on the steelhead and bull trout that are ESA-listed species within the Touchet basin. The spring Chinook salmon, which was once native to the Touchet basin, has been extinct likely since the 1950s (WWWPU and WWBWC 2004) and only recently has begun to be reintroduced.

As a part of the Walla Walla Subbasin Plan, an Ecosystem Diagnosis and Treatment (EDT) analysis was performed that assessed habitat conditions in the Touchet basin for aquatic focal species. This EDT analysis determined the factors that were limiting steelhead and spring/fall Chinook salmon production in the basin (Table 6-1). Only the reaches listed in Table 6-1 were included in the EDT analysis; other reaches of this assessment were not included.

Although the Lower Touchet basin was not included in this analysis, the SE WA Recovery Plan (SRSRB 2011) updated and summarized the following limiting factors in the Lower Touchet basin from the mouth to Coppei Creek:

- Sedimentation
- Reduced habitat diversity
- Flow
- Channel stability
- Temperature

Table 6-1
Touchet Basin Limiting Factors

Reach	Limiting Factors							
	LWD	Confinement	Riparian Function	Sediment	Key Habitat (pools)	Temp.	Flow	Bed scour
Upper Mainstem Touchet	x	x	x	x	x	x	x	x
South Fork Touchet	x	x	x	x	x	x		x
South Fork Touchet Headwaters	x	x	x	x	x			
Upper and Lower North Fork Touchet	x	x	x	x	x	x		
North Fork Touchet Headwaters	x				x			
Lower Wolf Fork	x	x	x	x	x	x		
Upper Wolf Fork	x	x	x	x	x			

Notes:
Modified from Table 3-13 in the Walla Walla Subbasin Plan (WWWPU and WWBWC 2004) to use the reach names defined in this assessment.
LWD: large woody debris

Watershed planners and stakeholders collected known information and reviewed progress made to date within the basin. The goals of this effort were to identify the primary limiting factors to aquatic focal species in discrete reaches throughout the river. These data were compiled and the restoration objectives were listed in order of greatest priority for both the Middle Touchet (Coppei Creek to Patit Creek) and the Upper Touchet (upstream of Patit Creek), as shown in Tables 6-2 and 6-3 (SRSRB 2011).

The following approaches were recommended for achieving these restoration objectives:

1. **Temperature:**
   a. Improve riparian areas
   b. Improve water quantity
   c. Improve channel complexity and floodplain connectivity
   d. Improve instream habitat abundance and quality

2. **Embeddedness:**
   a. Decrease input of fine sediments (sand)
   b. Improve sediment transport and routing
   c. Improve sediment retention in upstream areas.
3. **Riparian:**
   a. Improve riparian areas
   b. Improve channel and floodplain function
   c. Improve water quantity
4. **Large Woody Debris (LWD):**
   a. Improve channel and floodplain
   b. Improve riparian areas
   c. Improve instream habitat
5. **Confinement:** 25 to 50% of streambank length
   a. Improve channel and floodplain
   b. Improve riparian areas

Table 6-2
Middle Touchet (Coppei to Patit Creeks) Habitat Objectives

Habitat Factor	Priority	Middle Touchet Objective
Embeddedness	I	Less than 10% embedded
Temperature	II	No more than 4 days above 72°F
Large Woody Debris	III	One or more pieces per channel width
Confinement	IV	Less than 15% to 40% of streambank length

Table 6-3
Upper Touchet (Upstream of Patit Creek) Habitat Objectives

Habitat Factor	Priority	Upper Touchet Objective
Temperature	I	No more than 4 days above 72°F
Riparian	II	62% to 82% of maximum
Large Woody Debris	III	One or more pieces per channel width
Confinement	IV	Less than 10% to 40% of streambank length

These restoration efforts should help and work in concert with addressing the longer-term processes that the current strategies target. Addressing impaired processes such as floodplain connectivity will contribute to reversing negative trends in longer term processes, for example establishing and maturing riparian forests, increasing resiliency and the natural long-term recovery of the basin.

Table 6-4 summarizes the impaired processes and limiting factors as understood by the SRSRB and its restoration partners at the time of this assessment.

Table 6-4
Summary of Impaired Processes and Limiting Factors

Impaired Processes	Causes	Limiting Factors for Fish and Wildlife
Reduced in-channel structure (e.g., wood)	Past removal of wood from channel	• Low diversity of in-channel habitats • Lack of deep pools for holding or rearing • Limited quantity of off-channel habitat • Lack of cover
	Lack of large trees in the riparian zone	
	Historical channel straightening and levee building	
	Much of the existing wood is highly mobile	
Modified sediment delivery and transport	Loss of in-channel structure increases transport and bed incision	• Low diversity of substrates and potential for coarsening over time • Reduced quality of spawning gravel
	Levees reduce floodplain storage and exchange	
	Reduced riparian density increases bank erosion potential (i.e., fine sediment delivery)	
	Bank armoring reduces channel migration (i.e., coarse sediment delivery)	
Reduced floodplain connectivity and function	Channel incision from reduced in-channel structure	• Limited quantity of off-channel habitats • Low diversity of off-channel habitats • Lack of high-flow refugia • Reduced groundwater recharge and discharge
	Bank armoring and other geomorphic impediments	
Reduced riparian condition and function	Past removal or harvest of riparian vegetation	• Limited cover • Low diversity of in-channel or off-channel habitats • Reduced nesting and foraging habitats • Reduced productivity of food webs • High water temperatures (primarily downstream)
	Widespread colonization by invasive species	
	Rapid bank erosion and human/animal trampling prevents maturation of riparian plantings (some locations)	

Revitalizing impaired processes and where possible restoring ecological function to the watershed is a comprehensive task. These process-based approaches take time, understanding of physical processes in play, and in many cases physical space to allow the river to adjust through time. Revitalization may take more than one restoration action over a number of years to achieve ecological function.

6.2 Potential Restoration Actions

The overall approach to developing process-based restoration alternatives is to restore a sufficient area (i.e., a restoration corridor) along the river, provide the materials necessary (i.e., LWD or sediment) and time, to allow for natural processes to occur in order to create and sustain a diversity of natural and resilient habitats over the long term. An appropriate corridor that could form aquatic habitats over time must consider both the historical and current extent of the floodplain, off-channel habitats, and potential channel migration. The restoration plan identifies potential restoration actions that are intended to treat and potentially address impaired processes and target specific limiting factors identified in the basin. The correlation between potential restoration actions, processes addressed and limiting factors targeted by each action in summarized in Table 6-5.

Table 6-5
Summary of Potential Restoration Actions

Potential Restoration Actions	Processes Addressed	Limiting Factors Addressed	Benefiting Life Stage and Species[1]
Install large wood structures in the river	• Improves in-channel structure • Promotes floodplain connectivity • Retains and sorts sediments	Increases diversity and complexity of in-channel habitats (e.g., creates deep pools)	Migration/holding (STS, CHS)
		Promotes connectivity with and formation of off-channel habitats	Rearing (ALL)
		Deflects flows and slows erosion in the short term to protect riparian plantings	Ecosystem processes (ALL)
Remove bank armoring or other geomorphic impediments to process	• Allows for channel migration and formation of habitats • Allows recruitment of wood and coarse sediment • Promotes floodplain connectivity	Increases diversity and complexity of in-channel habitats	All life stages (ALL)
		Promotes connectivity and formation of floodplain and off-channel habitats	Rearing (STS, CHS)
Excavate pilot channels	• Promotes floodplain connectivity and formation of habitats	Increases quantity and diversity of off-channel habitats	Rearing (STS, CHS)
Install native riparian forest plantings	• Increases large wood recruitment over time for in-channel structure • Increases bank erosion resistance • Reduces solar heating of river over long term • Improves food web cycling and function	Increases diversity and complexity of in-channel habitats	All life stages (ALL)
		Increases diversity and complexity of off-channel habitats	Rearing (ALL)
		Provides insects, detritus to food web	Rearing (ALL)
		Provides nesting and foraging habitats for wildlife	Ecosystem processes (ALL)
		Increases shading and reduces local air temperature	Migration/holding (STS, CHS)
Increase conifer succession through supplemental plantings	• Increases large wood recruitment over time for in-channel structure • Increases bank erosion resistance • Reduces solar heating of river over long term	Increases diversity and complexity of in-channel habitats	All life stages (ALL)
		Increases diversity and complexity of off-channel habitats	Rearing (ALL)
		Provides nesting and foraging habitats for wildlife	Ecosystem processes (ALL)
		Increases shading and reduces local air temperature	All life stages (ALL)
Manage invasive species	• Improves riparian condition and functions	Increases diversity and complexity of off-channel habitats	Rearing (ALL)
		Improves nesting and foraging habitats for wildlife	Ecosystem processes (ALL)

Potential Restoration Actions	Processes Addressed	Limiting Factors Addressed	Benefiting Life Stage and Species[1]
Install floodplain wood	• Promotes deposition or reduced erosion in localized areas of floodplain • Improves riparian maturation and function	Provides cover and wintering habitats for wildlife	Ecosystem processes (ALL)
		Increases complexity of floodplain habitats	Rearing (ALL)
		Reduces fine sediment delivery to channel	Spawning (STS, CHS)

Note:

1. Life stages in the Benefiting Life Stage and Species column are directly linked to the corresponding limiting factors in the Limiting Factors Addressed column. The acronyms following each life stage indicate the species that primarily benefit from the limiting factor being addressed.
   STS: steelhead trout salmon; BT: bull trout; CHS: spring Chinook salmon; ALL: all three key species

7 Restoration Strategies

7.1 Habitat Restoration Actions

7.1.1 Reconnect Side Channels and Disconnected Habitat

Off-channel habitat provides critical holding and rearing habitat for juvenile salmonids during moderate to high flows and often provides preferred habitat conditions to main channel habitat at lower flows. Many disconnected features are present throughout the Touchet basin's floodplain, including off-channel wetlands that are wetted during part of the year and become disconnected at lower flow periods.

Encouraging reconnection of these features will increase habitat complexity by providing off-channel habitat and increased connectivity with the channel where disconnected features become cut off or create stagnant conditions during the dry season. Reconnecting these areas will allow fish to move in and out of these features for longer periods of time and enhance water quality conditions, particularly during low winter flows. This will also help lessen the possibility of entrapment of fish associated with the long periods of disconnection from the main channel.

Actions for reactivating disconnected habitat may include earthwork to establish hydraulic connections with the main channel and installation of LWD to provide cover or assist in keeping pathways to the main channel accessible.

Side channels often provide preferred rearing habitat during low flows and provide hydraulic refuge and cover during high flows. Encouraging multiple flow paths will increase habitat complexity by diversifying the planform, dissipating stream energy, distributing sediment load, and providing hydraulic complexity. Diverse floodplain and side channel networks often have multiple flow paths at various elevations across the valley bottom. Therefore, different channels are accessed at different water surface elevations. In this manner, off-channel habitat is accessed in different areas of the channel network under changing flow regimes, providing a variety of habitat during a large range of flow conditions.

7.1.2 Address Encroaching Features

Tens of thousands of linear feet of levees confine the Touchet River, the Forks, and Coppei Creek and prevent or limit a surface water connection to the adjacent floodplain. In these areas, levee removal and/or setback may be used to increase the active floodplain area, thereby promoting floodplain and side channel connectivity and more natural channel migration processes. In a majority of the locations identified, widening the floodplain corridor may occur without significant changes to agricultural practices by working outside the limits of existing irrigation areas as much as possible.

Removing levees and promoting floodplain connectivity encourages geomorphic processes while dissipating velocities during high flows as floodwaters are distributed onto the floodplain. This also allows fine sediment to deposit on the floodplain, promoting ecological processes. Decreased channel velocities may also lessen erosive energy along the banks in areas of concern for landowners. Allowing the channel to migrate throughout a wider corridor will encourage development of complex channel and planform geometry, distributing energy and sediment load. It will be important to consider the reach-scale effects of widening the floodplain, particularly at the downstream end of confined reaches. For example, creating an unconfined floodplain below a tightly confined section will likely result in a large amount of sediment deposition and channel migration.

7.1.3 Develop Instream Structure – Wood Placement

Instream habitat complexity is correlated to hydraulic complexity created by the channel geometry, bedforms such as gravel bars and pools, hardpoints such as bedrock, and perhaps most importantly to the presence of LWD. The primary biological function of LWD in rivers and streams is to provide complexity that creates hydraulic refuge and cover for adult and juvenile salmonids. Geomorphically, LWD also plays a major role in influencing the channel form.

In natural systems, riparian trees often enter a watercourse as the result of erosion, windfall, disease, beaver activity, or natural mortality. However, in most Pacific Northwest river systems, including the Upper Touchet Basin, LWD has been removed from the river channels and cleared from riparian areas. In addition, a significant quantity of natural LWD that would otherwise be recruited from riparian areas has been removed by logging and agricultural practices. Anthropogenic activities in the basin have been detrimental to the system, leading to a decrease in the number, size, and volume of LWD being introduced to the river through natural processes. Therefore, installing LWD is necessary to supplement existing conditions, recognizing that it will take decades of riparian planting and development to begin to provide natural replenishment rates. In the long term, the added channel and bank roughness created by wood structures will help retain additional mobile wood and sediment, diversifying hydraulic and bedform complexity and contributing to increased floodplain connectivity and functionality of floodplain processes over time. Installation of rock structures is also considered as an option to add instream complexity, particularly in areas where bedrock already interfaces with the channel.

LWD Placements

Because of the wide range of fluvial conditions in the Upper Touchet basin, suitable LWD placements range from human-placed post-assisted log structures to single-log placements to multiple-log assemblies with rootwads that are installed in the channel bed or bank to create beneficial fish habitat and desired geomorphic effects. These features emulate natural tree fall of mature riparian trees and provide a base for mobile wood to accumulate. The different types of LWD placements have varying levels of engineering and construction effort and range in magnitude of physical and biological benefit.

Engineered Log Jams

Engineered log jams (ELJs) are large wood structures that can be placed in the main channel that emulate naturally occurring, stable log jams. Historically, several log jams per mile were likely present in the main channel, but they have either been cleared or are no longer able to become established due to a lack of mature riparian trees being recruited to the system, particularly in reaches where the local riparian conditions are poor. ELJs are typically placed along the bank or mid-channel with the bottom of the structure at the anticipated scour depth and the top built to the approximate height of the 100-year flood water surface elevation. The structure is backfilled with streambed materials for stability, and a gravel bar deposit may be placed in the lee of the structure that emulates the natural sediment deposit that would occur in the lee of this type of structure.

ELJs can create large flow stagnation areas upstream and downstream of the structure and contain a substantial amount of void space within the logs and root masses, providing considerable area for fish refuge. During high flows, the rootwads interact with hydraulic forces from the river and scour large, deep pools that provide holding areas for adults while the void space within the face of the structure is used by juveniles. In addition, these structures are able to retain mobile wood debris. Because of the hydraulic conditions and hard points created by ELJs, they may also be used as "deflectors" to influence flow direction to promote channel expansion or activation of side channels.

On a reach scale, installation of multiple ELJs can influence gravel movement and deposition to create localized pool-riffle sequences, increased hydraulic complexity, and a more stable channel profile. Sediment storage and deposition adjacent to the ELJs can create large gravel bars in the active channel allowing for colonization of riparian vegetation and eventually the development of forested islands. The overall roughening of the active channel and aggrading of the riverbed promotes rehabilitation of natural processes by increasing floodplain connectivity and promoting channel migration.

7.1.4 Riparian Zone Enhancement

Riparian habitat enhancement will involve protection of healthy riparian areas, removal of undesirable vegetation, and planting of native riparian communities on the channel banks, on higher elevation gravel bars, and in the floodplain. However, establishment of the ideal riparian buffer width may be limited by the location of agricultural fields, infrastructure, and the feasibility of irrigating and maintaining plantings. Riparian planting may also be conducted in conjunction with LWD structure placement, including ELJs.

The riparian zone provides several habitat and physical process benefits including increased bank and floodplain roughness, cover, and nutrients for instream species and wildlife. Increased roughness encourages sediment deposition and decreased channel and overbank velocities during floods. Additionally, fully developed mature riparian areas are a source of LWD to the river over time. Riparian restoration should begin with protection of existing healthy riparian areas through programs such as the U.S. Department of Agriculture Conservation Reserve Enhancement Program (CREP). Where riparian habitat has been degraded, removing invasive plants and vegetation and replacing with native species in appropriate environments should be performed. For example, cottonwoods or willows may be planted in wetter areas such as along the banks, as opposed to drier floodplain terraces. Monitoring and maintenance of plantings for at least the first few years after planting, which will greatly contribute to the success of the restoration effort, may be required for permitting approval. Eradication of invasive species such as reed canarygrass will likely require a longer and more involved maintenance and monitoring effort.

7.1.5 Protect and Improve Existing Channel Migration Areas

Channel Migration Areas are areas of the floodplain and riparian area where a river has previously occupied and is likely to occupy in the future. Several sections of the Touchet basin, particularly in the Lower Mainstem Touchet reach and to some degree the Forks have existing Channel Migration Areas where no active land use practices are occurring and would likely cause little or no adverse effects to infrastructure or agriculture if the channel avulsed within these areas. These areas of potential active migration should be identified and protected from future development if possible. Channel migration and avulsion are part of the natural fluvial processes of wood recruitment and sediment transport and continuity. These areas should also be the target of other restoration actions listed in this section, such as establishing riparian vegetation, and stabilizing bars with large woody material. Adding these restoration actions to areas where the channel can freely migrate will allow the historical channel processes that promote habitat diversity and complexity.

7.2 Restoration Actions for Climate Change Resiliency

Climate change is one of the major anthropogenic influences on fluvial processes and instream habitat for the Touchet basin and should be a primary consideration in any restoration project in the basin. While climate change will likely have complex and far-reaching effects on fluvial processes, many experts (CIG 2009; Mantua 2010; Beechie 2013) agree that for southeast Washington major changes for salmon can be summarized as follows:

- Increased variability in timing and magnitude of flows
  - Higher high flows and at different times of the water year
  - Lower low flows and at different times of the water year
- Increased stream temperatures

Fluvial restoration projects focused on recovery of the focal species should, therefore, look to counter the effects of these changes. Increased variability and unpredictability should be met with targeting resiliency and diversity of habitat and ecosystems, and restoration actions should be taken whenever possible to reduce peak stream temperatures.

7.2.1 Target Resiliency and Diversity

Many habitat restoration projects today are focused on restoring the physical and ecological processes that promote diverse habitat conditions for focal species. With increased variability and unpredictability it is important that river systems maintain resiliency through diverse habitat conditions. The restoration actions described previously in this section are focused on actions that will allow natural process such as sediment and large wood transport, floodplain connection and channel migration, and riparian growth to occur. These processes all help maintain a dynamic equilibrium that promotes more habitat conditions at all levels of flow, allowing flow timings and magnitudes to change but habitat conditions to remain.

7.2.2 Reduce Peak Stream Temperatures

Peak stream temperatures are already a problem for salmonids in the mainstem Touchet and some of the Forks, with peak summer temperatures being sustained for several weeks above 25°C, near the upper limit for Chinook salmon and steelhead (Justice 2017). In general, the recommended restoration actions can have far-reaching effects on ameliorating peak stream temperatures. Reconnecting side channels allows for more residence time, often in areas that are more shaded and more connected to groundwater. Removing encroaching features allows more lateral connection to the floodplain for many of the same benefits. Finally, enhancing and promoting riparian vegetation increases shaded areas and provides wood recruitment, which can provide overhanging cover.

8 Geomorphic Analyses Overview

The assessment analyses were developed to provide the information needed to meet the habitat targets and goals of the objectives. The analyses used the updated data available to measure the key metrics of the habitat targets, including floodplain connectivity, channel complexity, and transport capacity. The floodplain connectivity analysis measures the existing connected floodplain and potential floodplain targets and determines floodplain potential. The channel complexity analysis measures channel complexity at a variety of flow conditions and determines which reaches are complex and which are not. The transport capacity analysis determines where the Touchet River, the Forks, or Coppei Creek have too much sediment transport capacity for maintenance of natural geomorphic processes.

The results from these analyses provide the data that can be used for future evaluation, target setting, and accomplishment tracking for each of the key metrics. The following summaries describe in more detail what these analyses are, and why they are important to the Touchet River system and focal species recovery. Detailed instructions for repeating these analyses as well as results for each project area can be found in the respective appendices.

8.1 Connectivity

Floodplain connectivity is an important metric for understanding the state of a riparian area. In this analysis, floodplain connectivity refers to floodplains that are connected hydraulically to the river through periodic inundation at 1- to 5-year return intervals, hyporheic flows, and groundwater connectivity. In other words, this analysis looks only at the hydraulic connection of the floodplain to the river channel. However, hydraulic connections in the floodplain are the building blocks for riparian ecosystems processes that provide multiple habitat benefits. Connected floodplains provide benefit for nearly all riverine aquatic species in the form of hyporheic and riparian habitat, high-flow refugia, nutrient influx, and woody material supply. Additionally, connected floodplains, and the resilient ecosystems they support, provide the material for instream wood, which in turn is a key part of the geomorphic processes associated with a functioning and resilient river system.

Confining features along the banks of the rivers in this assessment as well as on the floodplain have influenced hydraulic conditions during large floods, affecting local and reach-scale geomorphic processes such as sediment mobility and channel migration. Confining features may be both natural and influenced by anthropogenic activities. Inspections of aerial photography, Light Detection and Ranging (LiDAR), and field reconnaissance were used to identify confining features within the study area. These features include bedrock along the valley wall, alluvial fan deposits, bank armoring (e.g., riprap), levees and pond berms, and road prisms. Additionally, the rivers of the Upper Touchet basin can be disconnected from the floodplain through channel incision and downcutting. Channel incision is often associated with encroaching features such as levees or bedrock valley walls because straightened channels provide more stream power for sediment transport. Channel incision is often the beginning of a cycle of sediment starvation. Appendix E of this report discusses channel incision in more detail, as well as a possible root cause and where it might be happening. Section 8.1.2 discusses the potential benefits of reversing this trend of channel incision, as well as the benefit of removing encroaching features and increasing the total area of connected floodplain.

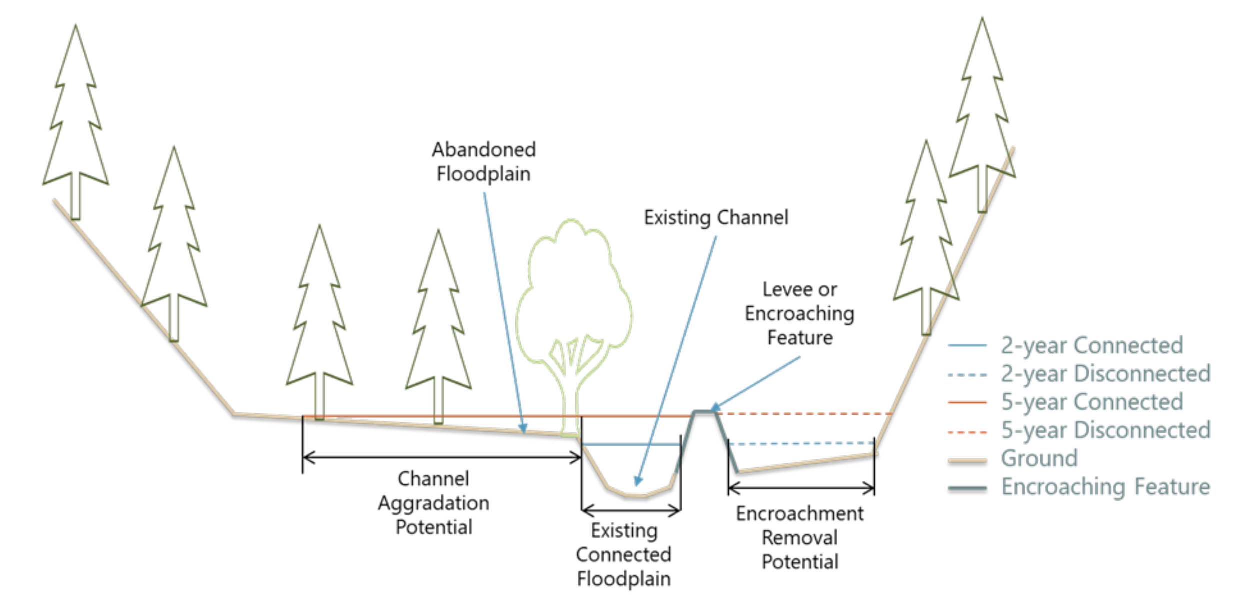
8.1.1 Assessing Potential for Floodplain Connectivity

The purpose of this analysis is to describe the floodplain connectivity of a reach in a way that can be compared to the other reaches in the system and help inform potential restoration actions. The analysis focused on three characteristics of the floodplain:

1. The area of floodplain currently accessed and connected at a given flow event
2. The area that could potentially be accessed given the removal of encroaching features
3. The area that could be accessed given sediment deposition and reversal of channel incision

Figure 8-1 provides a conceptual valley cross section showing these three floodplain characteristics. The existing floodplain and potential floodplains are represented as lengths in this cross section but will be discussed as 2D (areas) for this assessment as the concept in Figure 8-1 is applied along the length of the valley for each assessment reach.

Figure 8-1
Conceptual Cross Section of Floodplain and Floodplain Potential



Removal of encroaching features and channel bed aggradation (or reversing channel incision) were identified as restoration actions that have the potential to provide the most benefit to increasing floodplain connection. They are also two metrics that are directly related to floodplain connectivity, making representations of these actions easy to compute using the available data and analysis. It should be noted that these restoration actions, particularly channel bed aggradation, may be treating symptoms of other underlying problems with the geomorphic processes of the reach. When performing any restoration action, it is essential to consider the underlying drivers behind the current state of the reach in question, and address those as well. The restoration actions discussed here are recommended simply as a measure of potential in the floodplain only. Section 5 explores additional restoration actions, measures, or considerations that may need to be taken to ensure the success of either of the restoration actions discussed here.

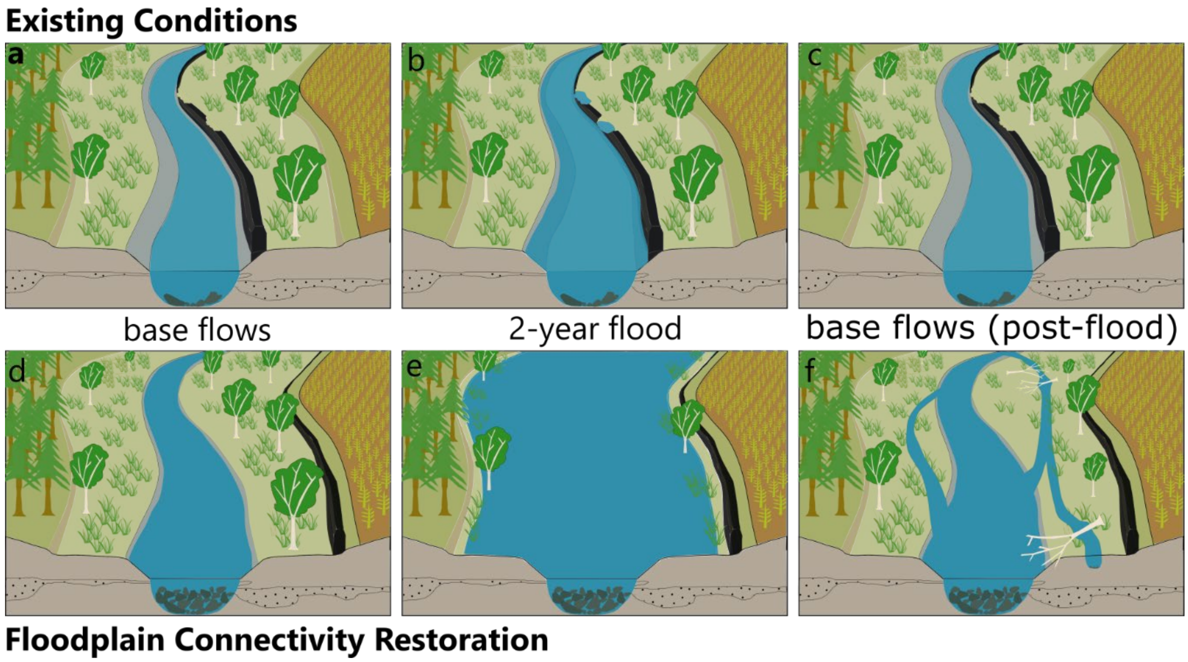
For this analysis, floodplain connectivity is a measure of the potential floodplain that could be gained through removal of encroaching features or channel bed aggradation. Each of the three floodplain characteristics noted in Figure 8-1 are weighted and combined for one connectivity score per project area. For more details on how this analysis calculates floodplain connectivity, see Appendix E.

8.1.2 Additional Benefits of Increased Floodplain Connectivity

The peak flows that occur during flood events (such as the 2-year and 5-year floods) make up only a very small portion of the total hydrograph that the river experiences. However, increasing the amount of floodplain area that is hydraulically connected during those flood events can still have multiple benefits to both fluvial processes and instream habitat, and at the same time provide benefit to people who live around the river.

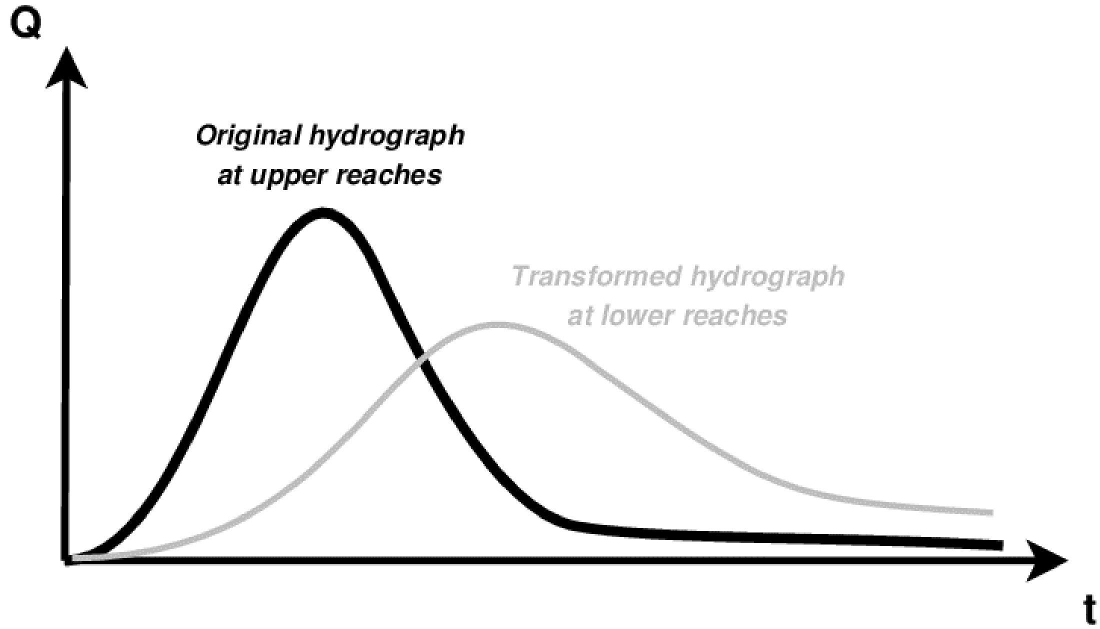
If a flood flow is confined between a levee and a high bank, the riparian ecosystems are not provided the regular inundation that they need to thrive. Furthermore, when flood flows recede, the lower flow path of the river is still confined in the same channel, providing no additional habitat benefit through new side channels or other complexity features. By removing or setting back the encroachment or reconnecting the high bank in this scenario, flood flows are allowed to interact hydraulically with the floodplain and, given the right conditions, will cause a geomorphic response. Figure 8-2 demonstrates this concept. Panels a–c illustrate how these features can limit the river's connectivity with the floodplain, reducing available habitat by constraining the river to a narrower, deeper channel. Panels d–f illustrate the potential geomorphic response to these restoration efforts. When floodplain reconnection is combined with other habitat restoration actions, such as those discussed in Section 7, this can help ensure that the geomorphic response that occurs provides more habitat in the form of: planform complexity from new side channels that now have room to form in the floodplain, and instream complexity from new roughness elements and LWD provided from the newly reconnected floodplain. In addition, the increased floodplain connection can benefit the riparian ecosystem and allow for more robust riparian vegetation.

Figure 8-2
Geomorphic Response to Bed Aggradation and Removal of Encroaching Features



Finally, although not directly related to instream habitat but of vital importance to the human/river relationship, is the ability of increased floodplain connection to lessen the negative effect of flood flows downstream in the watershed. By providing an increased area that a flood event must inundate, floodplain storage and increased hydraulic floodplain connection can effectively lessen and slow the peak of a storm hydrograph. When floodplain connection is increased in the upper watershed, this can effectively lessen the probability that storm event will cause downstream inundation and flood damage in places such as cities and towns where flood damage can be most devastating. Figure 8-3 demonstrates the effect that increasing floodplain connectivity in the upstream reaches can have on the downstream hydrograph; the peak flow is decreased, which can decrease the chance of flooding and spread out over a longer period of time.

Figure 8-3
Effects on the Hydrograph from Increased Floodplain Connectivity



Source: Krauße 2007

This assessment has focused on the 2-year and 5-year flows as being likely to promote the geomorphic response that will provide more habitat. But this scale of floodplain reconnection also provides opportunities to improve the human-river relationship. In many places in the Touchet valley, the existing flood protection systems are aging, in disrepair, or were never meant to hold back greater than a 5-year flow; when a 2-year or 5-year flow occurs, flooding and flood damage might occur without providing the habitat or flood relief benefits discussed previously. One of the most useful restoration tools for floodplain reconnection is to provide a "setback levee," which is offset from the channel far enough to allow connection at the 5-year flood but is built more robustly and able to resist the higher flood events that can cause devastating damage. Figure 8-2 can also demonstrate this concept. In this figure, panels a–c show a levee on the right bank that does not provide adequate protection even at the 2-year flow shown, and at higher flood events the farmland in the background may even experience flooding with this dilapidated levee. Furthermore, the old levee also prevents useful habitat from forming on the floodplain when flows recede back to baseflows. With the old levee, neither the habitat nor the landowner gets what they need. In panels d–f of Figure 8-2, the old levee has been removed, allowing complex planform habitat to form in the floodplain, and a new levee has been built further back on the floodplain that will protect the farmland from the higher flood events that may have caused damage with the old levee.

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8.2 Complexity

Complexity has taken on many meanings in the realm of fluvial sciences in multiple contexts both ecologically and geomorphically. For this assessment, complexity primarily refers to the geomorphic concept of spatial heterogeneity of plan forms and channel types within the fluvial corridor. River reaches with multiple side channels, split flows, or high sinuosity are thought of here as complex. Based on the historical abundance of large wood, as well as the size, slopes, and valley widths of the Forks of the Touchet River, it is suspected that these were anabranching systems, which is defined as a multiple channel system characterized by forested and stable alluvial islands that divide flows up to bankfull, as shown in Figure 8-4. The mainstem Touchet in the Touchet valley is characterized by lower slopes and a much higher flow, combined from the Forks, and therefore it is suspected that historically this river was highly sinuous with large meander bends and cutoffs. Many oxbow and former channels can be recognized in aerial imagery and relative elevation maps. Much of the Touchet River has diverged from the natural condition to a single planner bed, which is straighter, steeper, and wider than would be expected given valley characteristics. The complexity evaluation in this assessment takes into account both the degree of anabranching and sinuosity that is indicative of the planform heterogeneity seen in this river system.

Figure 8-4
Example of Complexity: From Uniform and Confined (left) to Most Complex (right)

Complexity is an important factor for both the geomorphic and ecological processes in a river corridor, and the benefits of complexity have been discussed thoroughly in the literature of fluvial sciences (Amoros 2001; Sheldon 2006; Jeffres 2008; Harrison 2011; Wohl 2016). However, the geomorphic significance of complexity to river corridors has been well summarized into key points in Wohl 2016, of which four are directly relevant here (adapted from Wohl 2016, Part II):

1. Provides habitat and biodiversity to the river system
2. Attenuates downstream fluxes of water (floods), sediment, and instream wood
3. Provides resistance and resilience to catastrophic change
4. Influences river processes such as sediment and wood transport, groundwater recharge, and floodplain connectivity

Specific to the Touchet basin, channel and floodplain complexity have been identified as major objectives for habitat restoration—complexity has increasingly been associated with successful juvenile salmonid rearing and overwintering, as well as benefits for many other aquatic species of relevance. Because of this multi-species and multi-life stage benefit, it is important to examine a reach’s complexity at several different flow levels—typically at lower, sustained flows. When complexity is maintained during summer low flows and winter flows, it indicates that side channels, backwaters, and other off-channel areas that are important for a variety of ecological process are sustained for longer periods of time and will, therefore, provide these ecological benefits including juvenile salmonid rearing for a large portion of the hydrograph.

The LiDAR data available for this assessment did not include any bathymetric data and is not suitable for modeling lower flows (<1-year). For this reason, this analysis only considers complexity at the 1-year flow event for each river. The evaluation of complexity is intended to set a baseline for future evaluations of complexity as more data become available.

While the 1-year flow is episodic in nature, maintaining complexity at this flow level is important for both the geomorphic and ecological processes of the system. Channel systems that maintain and reoccupy alternative channels during high-flow events create geomorphically resilient systems that mobilize sediment stored in the floodplain and recruit wood material from riparian areas, both key aspects of the natural processes of a riverine system. Furthermore, the lower velocity channel alternatives, and backwaters indicated by complexity, provide essential hydraulic refugia for fish during these high-flow events. These three flows should represent the normal range of river conditions where habitat benefits from complexity are most relevant for juvenile salmonids.

This assessment uses three separate geomorphic indicators to determine the complexity of a reach:

- Number of islands in the channel (and therefore number of side channels/split flows)
- Total size of the islands in the reach (perimeter length)
- Reach length sinuosity of the main channel

These three characteristics were chosen for their insight into how complex, and how close to the original channel state, the rivers of the Touchet basin are on a reach-by-reach basis. For more information about how complexity is calculated for this assessment, see Appendix F.

8.3 Transport Capacity

The availability and abundance of gravel or small cobble-sized material in the Touchet River plays a large role in the geomorphic processes that force bedforms, complexity, and connectivity. Through on-site assessment, it is clear that the reaches with ample gravel to small cobble-sized material, available throughout the reach, form pools at instream wood locations more easily, access the floodplain more frequently, and develop complex side channels and split flows. This is particularly evident in the Mainstem Touchet in reaches in the Touchet valley. The low slopes through many of these reaches allow deposition of gravel and cobble material to occur frequently. In the Forks and Upper Coppei Creek reaches, site observations and desktop analysis show that many of these areas are associated with river avulsions or migrations shortly upstream, providing a potential source of these gravel-sized materials.

However, for many other reaches, especially in the Forks or upper basin, the channel is artificially confined or incised and upstream supply of material is moved quickly through the reach as the increased slopes and decreased sinuosity significantly increase transport capacity.

In the Touchet River system, this increase in transport capacity in the upper reaches creates a two-fold impairment to the historical geomorphic processes. With less retention of material in the upper reaches, sediment fine material is moved quickly downstream, until it reaches a section of the system with lower transport capacity. In this case, the mainstem Touchet River has much lower slopes than the headwaters, allowing excess material to deposit throughout this reach as flood flows recede.

The materials that do remain in the confined portions of the Forks often represent lag deposits and collectively form an armor layer that resists pool formation and temporary sediment storage and facilitates high energy flows through the reach. When this happens, a feedback loop of confinement and incision propagate. Without human intervention or a large natural change, such as a large tree falling into the river and capturing additional wood and sediment, the dominant channel bed material becomes resistant to regularly occurring geomorphic change. With less frequent geomorphic change, the floodplain and the smaller material stored therein are accessed and mobilized less frequently, contributing to this feedback loop. The process of confinement often continues until a threshold and possibly catastrophic flow breaks the cycle.

The excess transport capacity analysis establishes a basin-wide trend in transport capacity based on the modeled shear stress and uses this trend to identify reaches of the basin where shear stress and transport capacity differ from the expectations for the basin. While this method does not determine what the transport capacity of a reach is, it can indicate how the reach is different from other similar reaches in this basin, and offer enough information to provide better recommendations for sediment transport continuity in general. For more information about how transport capacity is calculated for this assessment, see Appendix G.

8.4 Reach Priority

The rivers and creeks of the Upper Touchet basin span a wide range of hydrologic, geomorphic, and land use conditions, and there are several secondary characteristics that are pertinent to prioritizing restoration but do not have the detailed data available to perform a quantitative analysis. These characteristics include the following:

- Water quantity
- Peak summer water temperature
- Ease of project implementation
- Existing fish presence
- Floodplain availability

Because these characteristics are lacking in specific data, a method of qualitative analysis was developed to help reflect some of these characteristics. Furthermore, the evaluation was done on a reach basis and the nine reaches of the assessment were scored as opposed to individual project areas. The process of scoring and ranking each reach uses these key reach characteristics to collate the existing local knowledge, identify how they affect the potential to restore critical habitat, and score them for use in the prioritization.

8.4.1 Reach Priority Ranking Methods

Because the process of scoring and ranking reach characteristics is qualitative in nature, it relies heavily on information from the technical team and local experts. Many of these characteristics have been identified as data gaps in Section 10 but are too important to leave out of consideration. Therefore, the overall process is also iterative (see Figure 8-5). As new data become available, scores can be updated for reaches and more data-driven methods of assessment and more accurate scores can be developed.

The qualitative metrics for scoring reaches are provided in Table 8-1. These metrics were identified based on site observations, field visits, and conversations with local experts. The Touchet technical team reviewed and modified these metrics during a January 2020 meeting. A qualitative scoring scale with a range of 1 to 5 was then set for each metric. This scale includes a defined set of characteristics that a reach should meet to earn a Poor (1), Moderate (3), or Good (5) score (Table 8-1). Intermediate scores were assigned where appropriate. Each of the nine reaches included in the prioritization was then scored based on this scale, as well as field observations and site visits. The Touchet technical team and stakeholder group reviewed and modified these scores and justifications in a February 2020 meeting (Table 8-2). All scores were averaged together for each reach, and the reaches were placed into three Reach Priority groups based on these final scores (Table 8-3).

Figure 8-5
Process of Reach Priority Ranking

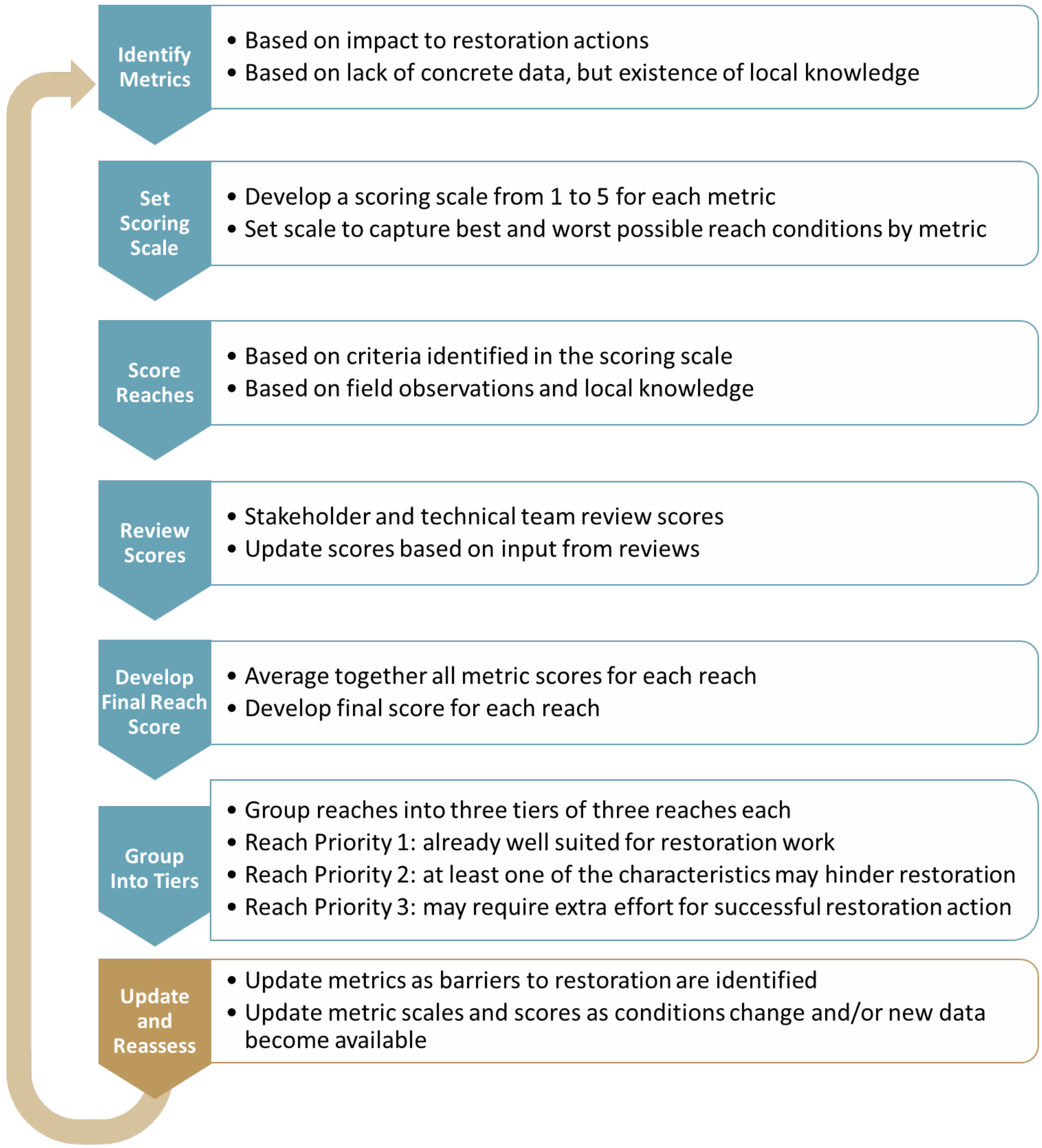

Table 8-1
Reach Metrics and Scoring Scale

Qualitative Metric	General Description	Poor (1)	Moderate (3)	Good (5)
Water Quantity	This metric is generally indicative of the amount of water the reach conveys. This quantity affects the reach's ability to form multiple habitat units within a typical cross section, although other considerations may determine if those conditions occur.	Enough water to support limited juvenile rearing but is very limited for multi-year smolts. Typical cross section has at most one habitat condition throughout the year. Portions of the reach may go subsurface at lowest flow conditions.	Enough water to create habitat that could support juvenile rearing habitat with availability throughout the year. Enough water to support a main channel and side channel habitat condition in a typical cross section throughout the year.	Enough water to create habitat conditions that support all life history stages throughout the year. Typical cross section has enough water to support multiple side channels, backwaters, or inundated floodplain habitat along with a defined gravel channel condition throughout the year.
Water Temperature – Summer High	This metric is based on peak instream temperatures.	Peak temperatures in this reach prevent survival in all but occasional pools.	Peak temperatures in this reach are likely survivable for short periods of time but not ideal. Many deeper or groundwater fed refugia are available.	Most or all sections of the reach have ideal temperatures for all life history stages of focal species.
Ease of Implementation	Considers accessibility and general ability to do larger projects. Small parcel sizes could lead to difficulty finding consensus among stakeholders. Lack of roads or access may make projects difficult to implement.	River is generally difficult to access. Parcels are small in the range of 1 to 5 acres making consensus and implementation difficult.	Access to the river is available in some places but may be difficult in others. Several large parcels exist but may be interspersed with smaller parcels.	River has easy access for majority of reach for large equipment. Large stretches of the reach are publicly owned or owned by a single landowner.
Fish Presence	Considers current fish use in the basin. Particular emphasis is based on key species: steelhead, bull trout, along with the predicted habitat for spring Chinook salmon.	Does not support a significant population of one of the species of steelhead, bull trout, and spring Chinook salmon.	Supports a population of one of the species of steelhead, bull trout, and spring Chinook salmon, or multiple life history stages of target species.	Supports significant population of more than one species of steelhead, bull trout, and spring Chinook salmon, or multiple life history stages of target species.

Qualitative Metric	General Description	Poor (1)	Moderate (3)	Good (5)
Floodplain Availability	Considers the general availability of the floodplain connected as riparian area.	Reach is highly confined by human infrastructure throughout most areas.	Reach has mixed confinement with some areas having high amounts of infrastructure and others not confined by human infrastructure.	Reach is not confined by human infrastructure throughout most areas.

Table 8-2
Qualitative Reach Characteristic Scores (on a scale from 1 to 5)

Reach	Water Quantity	Water Temperature – Summer High	Ease of Implementation	Fish Presence	Floodplain Availability
Lower Mainstem Touchet	5	1	4	1	4
Upper Mainstem Touchet	5	1	3	2	1
Upper Coppei Creek	1	2	4	4	2
Lower North Fork Touchet	3	3	3	4	1
Upper North Fork Touchet	3	5	2	5	2
Lower Wolf Fork Touchet	3	4	3	5	3
Upper Wolf Fork Touchet	3	5	3	5	3
Robinson Fork Touchet	2	5	3	4	3
South Fork Touchet	2	2	2	5	3

Notes: Scores are based on field work completed by Anchor QEA in the summer of 2019 and largely represent those conditions. Scores were reviewed and updated by the Touchet technical team and project stakeholders in February 2020.

8.4.2 Reach Priority Rankings Results

Reaches were placed into the following three Reach Priority groups based on their relative scores:

- **Reach Priority 1:** These reaches generally have favorable characteristics for implementing a successful restoration project. While there are some concerns, none of the reaches received a Poor (1) rating in any category. Few additional considerations will likely be necessary to implement a successful project.
- **Reach Priority 2:** These reaches have at least one characteristic that may present a major obstacle to restoration but still show potential and should be strongly considered. However, addressing the restoration challenges of the reach should be a part of any restoration effort.
- **Reach Priority 3:** These reaches have several characteristics that could pose a barrier to implementing a successful restoration project. While this should not prevent projects from being implemented in these reaches, especially in high-ranking project areas, all of the reach's challenges should be addressed as part of any restoration project implementation plan.

Table 8-3 provides the Reach Priority groupings for each of the nine reaches, and Figure 8-6 shows where these reaches occur in the watershed. These groupings are used in the final prioritization described in Section 9. For more detailed information about how each reach was scored, see Appendix I.

Table 8-3
Reach Priority Groupings

Priority 1	Priority 2	Priority 3
Upper Wolf Fork Touchet	Lower Mainstem Touchet	Upper Coppei Creek
Lower Wolf Fork Touchet	South Fork Touchet	Upper Mainstem Touchet
Robinson Fork Touchet	Lower North Fork Touchet	
Upper North Fork Touchet		

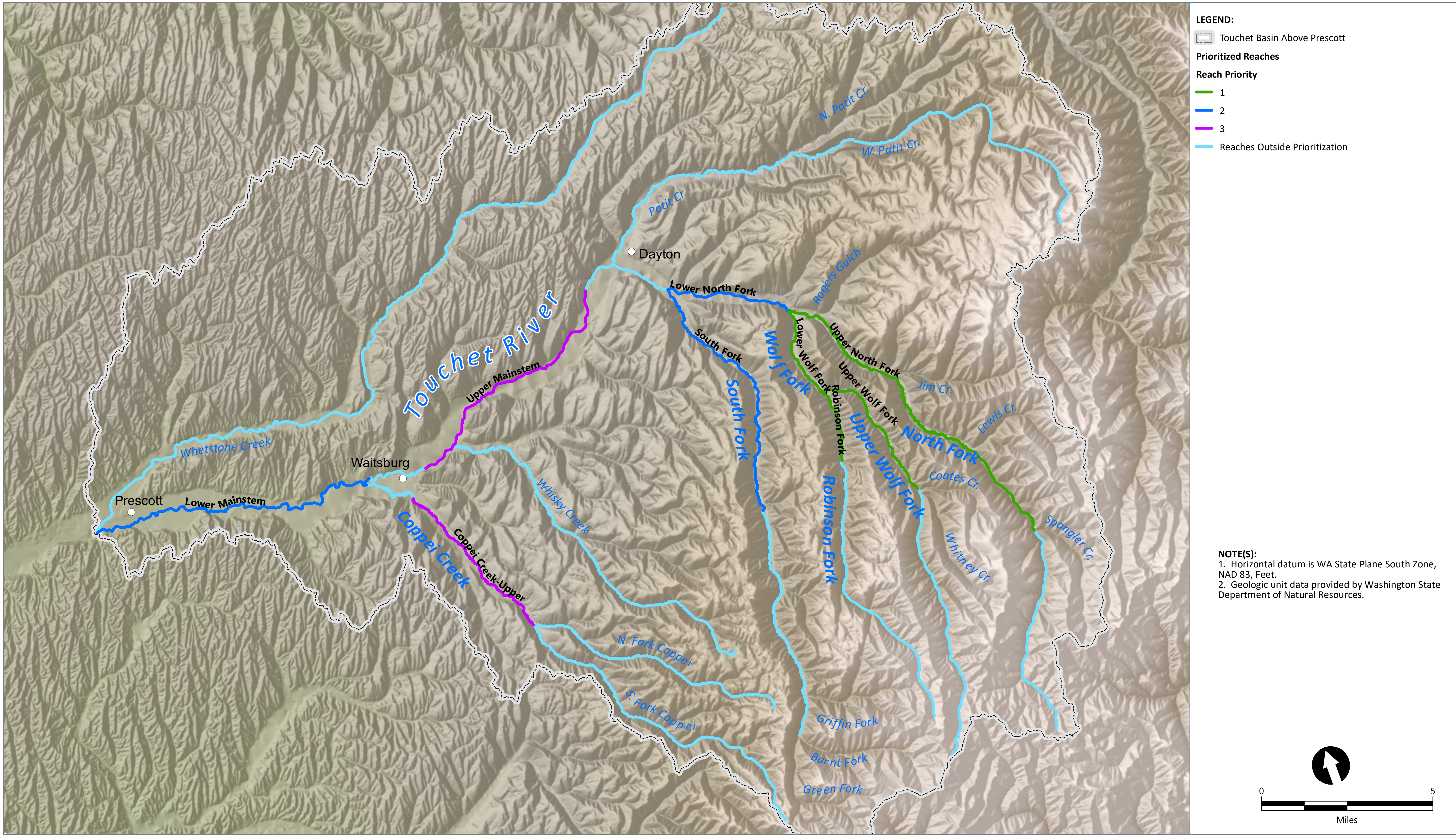

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Figure 8-6
Reach Priority Overview Map
Geomorphic Assessment and Restoration Prioritization
Upper Touchet Basin Habitat Restoration

8.5 Assessing Goals and Objectives and Setting Restoration Targets

As outlined in Section 1, the primary goals of this assessment are to: 1) use the available data and field observations to measure the key components of the habitat targets and basin goals; 2) prioritize areas for restoration and recommend restoration actions that can provide the most benefit and uplift to species; and 3) provide the data on key components of habitat targets for future evaluation, target setting, and accomplishment tracking for each of these key metrics. To do this, the basin goals and restoration objectives outlined in Section 1 are tied to target values pertaining to one of the analyses done for this assessment, as shown in Table 8-4. All of the goals are tied to one or more of the analyses, with the exception of increasing channel complexity at low flows. Not enough data (blue-green LiDAR, bathymetry, and a 2D model) were available for this goal, but it has been identified as a data gap with the hope that future assessment and updates can take this goal into account.

Table 8-4
Goals and Objectives and Associated Assessment Methods

Basin Goal	Restoration Objectives	Key Analysis	Target Value	Target Data Source	Reference Section
Improve floodplain connectivity	The available 5-year recurrence floodplain is connected at the 2-year event	Connectivity	2-year Connected Inundated Area = 5-year Available Inundated Area	5-year available floodplain defined by the 1D model results. 2-year connected data to be updated as projects are completed.	Appendix E
Develop a high-functioning riparian corridor	The available 5-year recurrence floodplain is vegetated with maturing riparian trees	Riparian vegetation analysis	Riparian zone is intact with 81 to 150 feet in height	2017 LiDAR dataset analysis comparison of first returns to bare earth	To be discussed with stakeholder group
Increase channel complexity at low flows	Low to winter flow complexity to levels of current 90th percentile of basin	No analysis due to lack of blue-green LiDAR or channel bathymetry	Targets to be established with future data collection	Bathymetric or blue-green LiDAR along with a 2D model will be needed to establish low-flow complexity targets	Data gap
Increase channel complexity during spring and winter peaks	1-year flow complexity to levels of current 90th percentile of basin	Complexity	1-year Flow Complexity = 0.55	Complexity values from 1D model inundation results as developed for the analysis. New complexity values will be compared against only complexity values from this assessment.[1]	Appendix F
Increase quantity of pools	Increased pool frequency	Future in-channel data collection	1 pool per 7 channel widths[2]	Channel width is based on the inundated area 1-year flow defined by the 2018 1D model results for 1-year flow.	To be completed with ongoing field assessments
Increase temporary storage of in-channel bedload sediments	No river segments significantly above the excess transport capacity regression line	Excess transport capacity	Variation of 10% or less from transport capacity regression line	Based on the regression line defined in Appendix G.	Appendix G

Notes:

1. When calculating new complexity values for a project area, it is important to use only the 2017 complexity values for the other project areas in the calculation process and not an updated database of current complexity. Complexity values are “standardized” in the calculation against other values; see Appendix F for more information.
2. Pool frequency based on typical pool riffle sequences in mountain-fed streams (Montgomery and Buffington 1997).

9 Restoration Prioritization

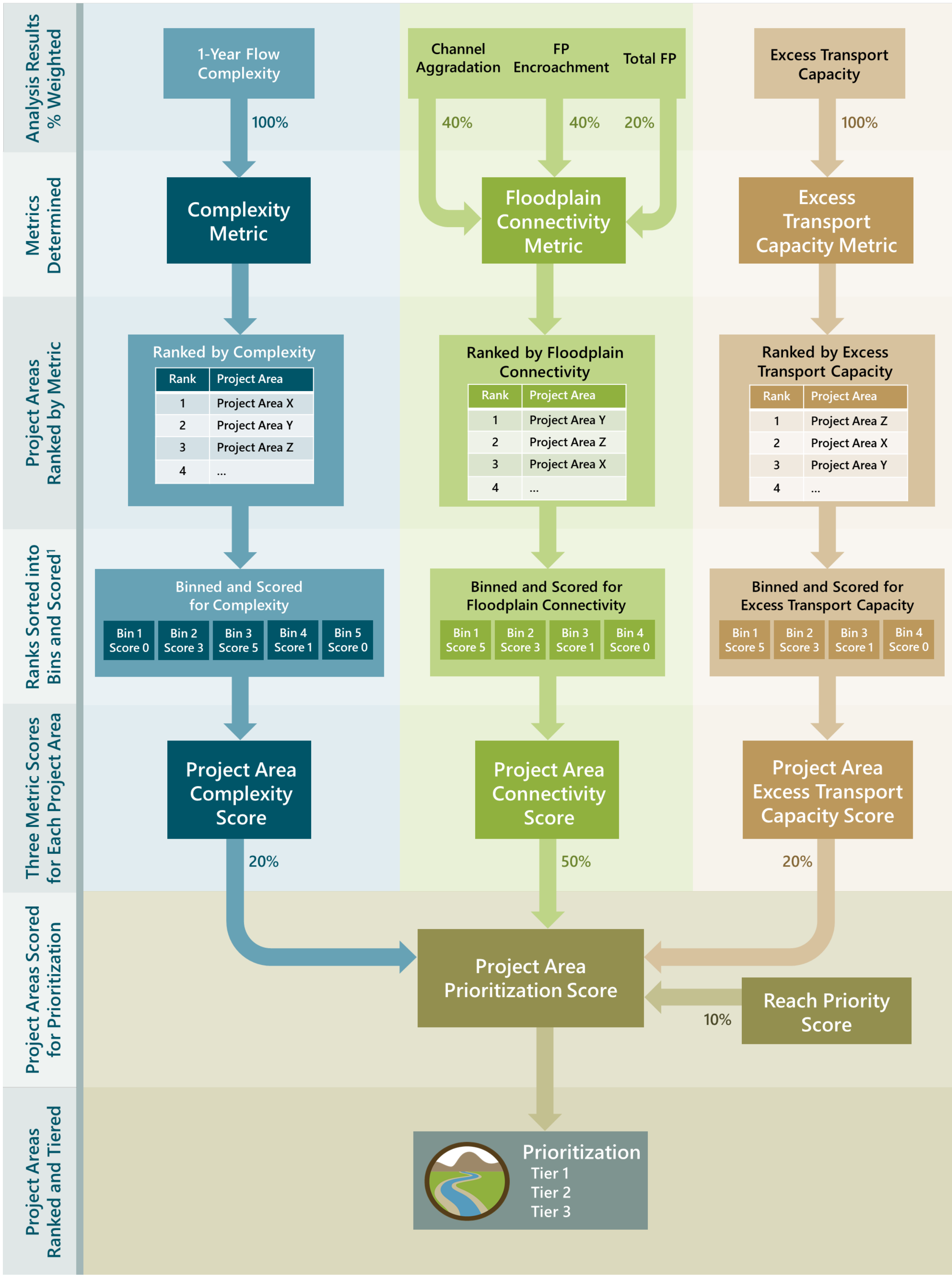
A primary goal of this report is to provide a framework for evaluating and choosing priority restoration actions within the Upper Touchet basin. The geomorphic analyses and assessments described in this report provide insight on the primary drivers of restoration and are the basis of the restoration prioritization. The prioritization methods and results described in this section are meant to target the project areas that have the most potential to provide uplift to the focal species. This potential for uplift from restoration actions is based on the data-driven analyses of floodplain connectivity potential, existing complexity, and excess transport capacity, as well as input from the qualitative assessment of reach characteristics described in Section 8.

The project area prioritization ranks the 55 project areas included in this assessment based on their potential to provide the most uplift to the focal species from the restoration actions described in Section 7. Six additional project areas located in the “city reaches” were not prioritized due to concerns regarding restoration within the confines of USACE-protected levees. This ranking is based on the geomorphic analyses that assess floodplain connection potential, existing complexity, and excess transport capacity, as well as some consideration of the qualitative reach-based characteristics.

9.1 Methods for Project Area Prioritization

The analysis results are used within a prioritization framework to provide recommendations for prioritizing different project areas for restoration. This framework distills five separate analysis results for each project area into the three analysis groupings or metrics described in Section 8: connectivity, complexity, and excess transport capacity. Each project is ranked and sorted according to these metrics, and receives a score based on the potential for restoration work to improve that metric. These scores are collated along with the scoring from the reach-based characteristics to form the final prioritization score, which is used to rank the project areas into three tiers of restoration potential. Figure 9-1 shows the process for weighting analysis results, ranking and scoring project areas by metric, and grouping project areas into three tiers for restoration priority. The following discusses this process in more detail.

Figure 9-1
Process for Prioritizing Project Areas



9.1.1 Weight the Analysis Results

The first step in the process is to group analyses results by metric and weight them. Both the Complexity metric and Excess Transport Capacity metric have only one contributing analysis result, so they each receive a weighting of 100%, as shown in the first row of Figure 9-1. The Floodplain Connectivity metric draws on three analysis results: the potential for channel bed aggradation restoration, the potential for encroachment removal restoration, and the benefit gained from both.

The Channel Aggradation Potential and Encroachment Removal Potential receive a higher weighting than the Total Floodplain Potential, as shown in Table 9-1. This is because the Total Floodplain Potential represents the areas where benefit can be gained only by performing both floodplain connection restoration actions; while these areas still have value, they would require more restoration effort for similar benefits and, therefore, are weighted lower. For a complete explanation of why the Total Floodplain Potential is different than the simple sum of the other two metrics, see Appendix E.

Table 9-1
Floodplain Connectivity Analyses Weighting

Analysis Result	Percent Weight
Channel Aggradation Potential	40%
Encroachment Removal Potential	40%
Total Floodplain Potential	20%

9.1.2 Rank and Score the Metrics

The next step in the prioritization process is to rank, classify, and score each project area in each of the three metrics (Complexity, Connectivity, and Excess Transport Capacity). Project areas are ranked from best to worst by the scores determined in the previous step. Each project area then has a rank for each metric and can be classified and scored according to the process outlined in the individual appendices for these analyses.

Scoring is done differently for each metric, as shown in the fourth row of Figure 9-1, because the three analyses measure different things. Floodplain connectivity measures the potential for restoration actions to improve the floodplain, and thus is simply scored from highest to lowest potential. Similarly, excess transport capacity is scored from highest to lowest, where project areas with the highest scores need restoration the most. Complexity, however, is scored differently. Project areas that are already very complex rank the highest, but this also means they may not need or receive the most benefit from restoration work. Project areas that rank near the middle for complexity have the most opportunity to improve in complexity, and are scored higher than those that rank very high or very low for complexity. A full explanation of these scores can be found in the respective appendices for these analyses.

9.1.3 Score Project Areas for Prioritization

The final step in the prioritization method is to take the scores for each project area based on the above rankings and classifications and weight them towards total importance for restoration. At this step, the qualitative reach-based characteristics, described in Section 8, are factored in as well. As shown in Table 9-2, the Floodplain Connectivity Potential metric is the most reliable indicator of restoration potential and provides 40% of the final score towards the prioritization ranking. The Complexity and Excess Transport Capacity metrics each provide 20% of the final score. The Reach Priority assessment was qualitative in nature and was only intended to contribute a small amount towards prioritization, so it provides 10% of the final score.

Table 9-2
Prioritization Weighting of Classified Metrics

Metric	Percent Weight
Floodplain Connectivity Potential	50%
Complexity	20%
Excess Transport Capacity	20%
Reach Priority	10%

Based on restoration experiences in the nearby Tucannon basin, complexity and connectivity have become recognized as the primary indicators of restored geomorphic processes in a reach. The specific restoration actions and strategies used to restore complexity and connectivity are all major influences on the larger geomorphic processes ongoing in the reach and will drive the achievement of the habitat restoration goals and objectives described in Sections 1 and 6 of this report. However, it has been increasingly recognized that some reaches simply do not have the easily transportable sediment supply within the active channel to induce the geomorphic processes that bring about both complexity and connectivity. For this reason, the Excess Transport Capacity metric is a valuable tool for identifying and understanding why geomorphic processes have not been restored in some areas where restoration actions targeted complexity and connectivity objectives.

9.2 Results of Project Area Prioritization

Once the final prioritization scores are calculated, projects areas are ranked and sorted into the following three tiers for restoration priority, based on the potential for floodplain connectivity, existing complexity, and excess transport capacity:

- **Tier 1 Project Areas:** These project areas show the most potential for restoration actions to provide uplift. They score above a 2.6 out of 5 in the prioritization scoring. These project areas have multiple opportunities to improve floodplain reconnection or channel complexity to easily provide both biological benefit and restoration of geomorphic processes.
- **Tier 2 Project Areas:** These project areas show slightly less benefit for the amount of work required to implement restoration actions. They score between a 1.5 and 2.6 out of 5 in the prioritization. However, they should still be strongly considered for restoration if project opportunities arise, because these project areas can still provide valuable benefit from increasing floodplain connectivity, improving channel complexity, or reducing excess transport capacity.
- **Tier 3 Project Area:** These project areas represent the least benefit for the amount of work required to implement restoration actions, and score a 1.5 out of 5 and below in the prioritization. This indicates that either the channel and floodplain conditions already provide as much benefit as possible for that project area, or the project area is so degraded that a large amount of effort may be required to provide measurable benefits to ecological function.

Table 9-3 lists the project areas under each prioritization tier, and Figure 9-2 shows an overview map of the project areas color-coded by tier. More detailed information about the assessment and recommended restoration actions for each project area can be found in Appendix I.

Table 9-3
Project Area Prioritization Tiers

Tier 1 Project Areas			Tier 2 Project Areas			Tier 3 Project Areas		
Project Area	Reach	River Length (miles)	Project Area	Reach	River Length (miles)	Project Area	Reach	River Length (miles)
MS-1	Lower Mainstem	1.00	MS-4	Lower Mainstem	2.90	MS-2	Lower Mainstem	1.53
MS-9	Upper Mainstem	1.26	MS-11	Upper Mainstem	0.87	MS-3	Lower Mainstem	1.67
MS-10	Upper Mainstem	1.40	NF-6	Upper North Fork	1.22	MS-5	Lower Mainstem	1.43
MS-12	Upper Mainstem	1.28	NF-9	Upper North Fork	0.52	MS-6	Lower Mainstem	1.66
MS-13	Upper Mainstem	0.67	NF-10	Upper North Fork	1.32	C-4	Upper Coppei Creek	1.82
MS-14	Upper Mainstem	1.59	NF-14	Upper North Fork	0.77	C-5	Upper Coppei Creek	0.73
MS-15	Upper Mainstem	1.36	NF-16	Upper North Fork	1.55	C-6	Upper Coppei Creek	1.03
C-3	Upper Coppei Creek	1.24	WF-2	Lower Wolf Fork	1.33	NF-1	Lower North Fork	0.47
C-7	Upper Coppei Creek	1.08	WF-3	Lower Wolf Fork	0.91	NF-4	Lower North Fork	1.00
NF-2	Lower North Fork	0.69	WF-4	Upper Wolf Fork	1.02	NF-5	Upper North Fork	0.66
NF-3	Lower North Fork	1.20	WF-6	Upper Wolf Fork	0.91	NF-7	Upper North Fork	0.93
NF-8	Upper North Fork	1.37	WF-7	Upper Wolf Fork	1.02	NF-12	Upper North Fork	0.85
NF-11	Upper North Fork	0.67	RF-2	Robinson Fork	0.60	WF-5	Upper Wolf Fork	0.76
NF-13	Upper North Fork	1.13	RF-3	Robinson Fork	0.58	WF-9	Upper Wolf Fork	0.67
NF-15	Upper North Fork	1.01	SF-1	South Fork	0.62	RF-4	Robinson Fork	0.60
WF-1	Lower Wolf Fork	0.69	SF-3	South Fork	1.32	SF-2	South Fork	1.36
WF-8	Lower Wolf Fork	0.64	SF-6	South Fork	0.68	SF-4	South Fork	1.34
RF-1	Robinson Fork	0.73	SF-7	South Fork	1.26	SF-5	South Fork	1.29
						SF-8	South Fork	1.02

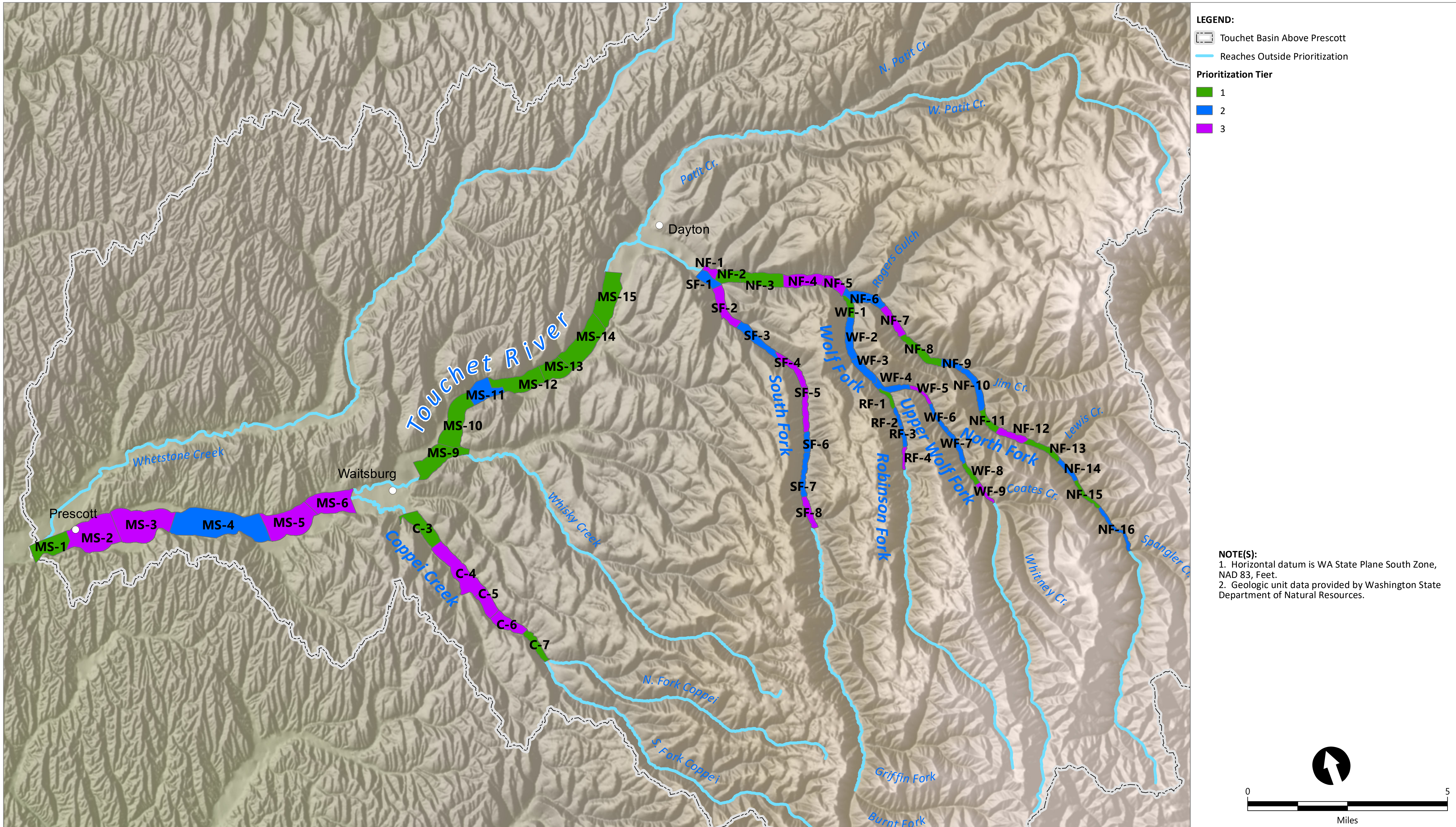


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Figure 9-2
Project Area Prioritization Overview Map
Geomorphic Assessment and Restoration Prioritization
Upper Touchet Basin Habitat Restoration

10 Data Gaps and Future Data Needs

This report is in part meant to provide a baseline for future evaluations and to serve as a guide for processing data as they become available. No data set is perfect, and a complex river system cannot be perfectly modeled. There are several gaps in the currently available data that, if addressed, could greatly increase the accuracy and usefulness of these analyses, as shown in Table 10-1. This includes, perhaps most importantly, the repeated collection of LiDAR and bathymetry data over time. The repetition of these analyses as they pertain to the available digital elevation model would provide a temporal picture of the geomorphic processes in each reach and allow for more insights into what is driving and hindering those processes. With the increased availability and affordability of collecting LiDAR data, it may be possible to conduct basin-wide surveys on a regular basis.

Hydrologic data are an important parameter that is limited in its availability and accuracy. Not much data on flows in the upper watershed are available, and much of the hydrologic data for this assessment were extrapolated using statistical methods and could be greatly improved through increasing the number of data points available. All of the analyses in this report focus on relatively frequent flow events, 5-year flow events or less, and the majority are focused on less than the 2-year flow event. Recently installed gages do not provide much information for estimating the higher flow events, but trends for the lower flow events could be established after only a few years of data collection. Finally, data on fish use and temperature are important for goal tracking and measurement of success, as well as identifying where restoration work will be most successful. Temperature tracking in particular will become more important in the face of climate change to ensure survivable habitat continues to be available for the focal species.

Table 10-1
Data Gaps and Future Data Needs

Data Type	Data Gap Description	Assessments or Evaluations Affected	Possible Data Sources
Fish Use	Monitoring of juvenile fish use throughout the basin	Fish presence for reach characteristics	Additional surveys in the reaches listed
Fish Survival	Identification of where mortality is happening and what life stages are being affected in those locations	Fish presence for reach characteristics, as well as identifying limiting factors in general	Additional surveys and monitoring of mortality causes (temperature, predation, harvest, etc.)
Low-Flow Hydrology	Low-flow data for: South Fork, Wolf Fork, Robinson Fork, Coppei Creek, and the Lower Mainstem	Complexity evaluations	Gages at the reaches listed; or measurements at low flow
Temperature	Year-round temperature data at multiple locations throughout the watershed	Summer high water temperature for reach characteristics	Temperature monitoring stations

Data Type	Data Gap Description	Assessments or Evaluations Affected	Possible Data Sources
Topography	Data that reflect how the river channel has changed. Multiple collections throughout the basin.	Floodplain connectivity assessment, channel process evaluation, riparian vegetation growth and change	LiDAR
Bathymetry	Data that describe the channel bottom and water depth throughout the study area	Complexity evaluation	Blue-green LiDAR
Re-evaluation of Limiting Factors	The limiting factors used in this assessment may be outdated and based on the EDT model.	Basin goals and objectives	Future evaluation

11 Limitations

We have prepared this report for use by the CCD to evaluate existing physical conditions in the Touchet River and tributaries and to identify appropriate potential restoration opportunities in the study reach. The information presented in this report is based on available data and limited site reconnaissance at the time of report development. Conditions within the study reach may have changed both spatially and with time, and additional scientific data may become available. Significant changes in site conditions or the available information may require re-evaluation. Within the limitations of scope, schedule, and budget, our services have been executed in accordance with generally accepted scientific and engineering practices in this area at the time this report was prepared.

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Appendix A
Project Area and Reach Overview

Appendix B
Viable Salmonid Population

Appendix C
Hydrologic Analysis Methods and Results

Appendix D
Hydraulic Modeling

Appendix E
Floodplain Connectivity Analysis

Appendix F
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Excess Transport Capacity Analysis

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Prioritized Reaches

Appendix J
Reaches Outside Prioritization