Appendix D

Whipple Creek Watershed-Scale Stormwater Plan Report

Status of Aquatic Community with a Focus on Fish Use

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Introduction

This chapter summarizes the aquatic community status for the Whipple Creek Watershed Stormwater Plan to help meet Clark County's 2013-2018 NPDES stormwater permit section S5.C.5.c.ii.(1)d requirements. The complexity of an entire community, a self-sustaining system of interacting physical and biological components, forces a reduced scope of evaluation (Hauer and Lamberti, 2006, p. 490) for aquatic systems often to fishes. Under the permit, salmonids are the primary focus of the biological conditions assessment utilizing several existing sources of plan area data. Data sources and uses were: the Statewide Washington Integrated Fish Distribution (SWIFD) geodatabase (Washington State Department of Fish and Wildlife [WDFW], 2014) for salmonid presence / distribution; SalmonScape web page (WDFW, 2014) for fish passage barriers and Endangered Species Act listings; Whipple Creek Stormwater Needs Assessment Program (SNAP) report (Clark County, 2006) for a detailed stream reach physical habitat assessment; and an associated SNAP technical memo (Inter-Fluve, Inc., 2006) with field observations for multiple Whipple Creek watershed stream segments. ArcMap (ESRI, 2010) was used to summarize the latest Whipple Creek watershed salmonid presence and distribution spatial data.

Presence and Distribution of Salmonid Uses

Figure 1 through Figure 4 map the presence and distributions of salmonid species within the Whipple Creek Watershed based on SWIFD (WDFW, 2014). Each map presents the spatial distribution (and applicable general timing of the species run), basis for distribution definitions, and life cycle history for: coho salmon, fall chinook salmon, winter steelhead trout, and rainbow trout. Table 1summarizes salmonid use information on a stream reach basis for Whipple Creek mainstem, Packard Creek, an unnamed mid-watershed tributary, and the lower watershed's Green Lake and its outlet stream.

Three SWIFD fish distribution types are applicable to the Whipple Creek watershed (WDFW, 2014): *Documented* - "Aquatic stream habitat that is documented to be presently utilized by fish (based on reliable published sources, survey notes, first-hand sightings, etc.). This includes habitat used by any life history stage for any length of time. This designation is applied to all stream sections downstream of a documented sighting to the next documented habitat section, unless otherwise indicated by a formal review group. Synonyms include 'Known' and 'Currently Occupied'."

Presumed – "Aquatic habitat lacking reliable documentation of fish use where, based on the available data and best biological opinion/consensus, fish are presumed to occur. For migratory fish, such habitat will extend upstream to the end of the stream OR to the first known natural barrier (including sustained 12% stream gradient or small stream size). Best biological judgment includes consideration of suitable (species-specific) habitat availability, life history strategies, proximity and connectivity to adjacent documented habitat sections or logical extrapolation of range from similar systems. Synonyms include 'Suitable Habitat'."

Potential – "Aquatic habitat that meets the basic criteria for 'Presumed' but is unused by fish due to artificial (man-made) obstructions, degraded habitat quality, or extirpation of local fish populations. This category is used in cases where habitat could be made available to fish through removal of obstructions, improvement of habitat, or re-introductions of fish. Synonyms include 'Recoverable Habitat'."

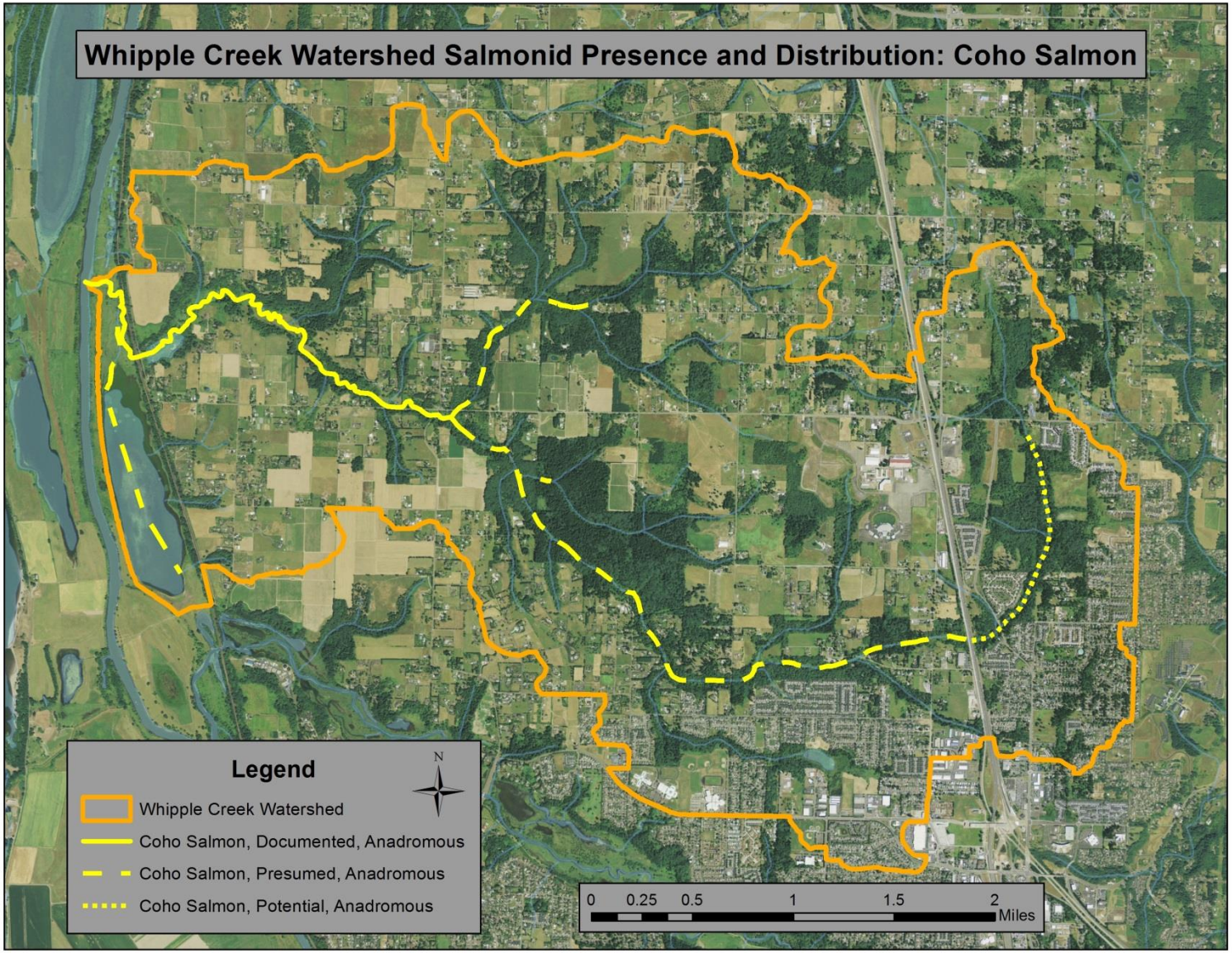

Figure 1 Whipple Creek Watershed Coho Salmon presence and distribution

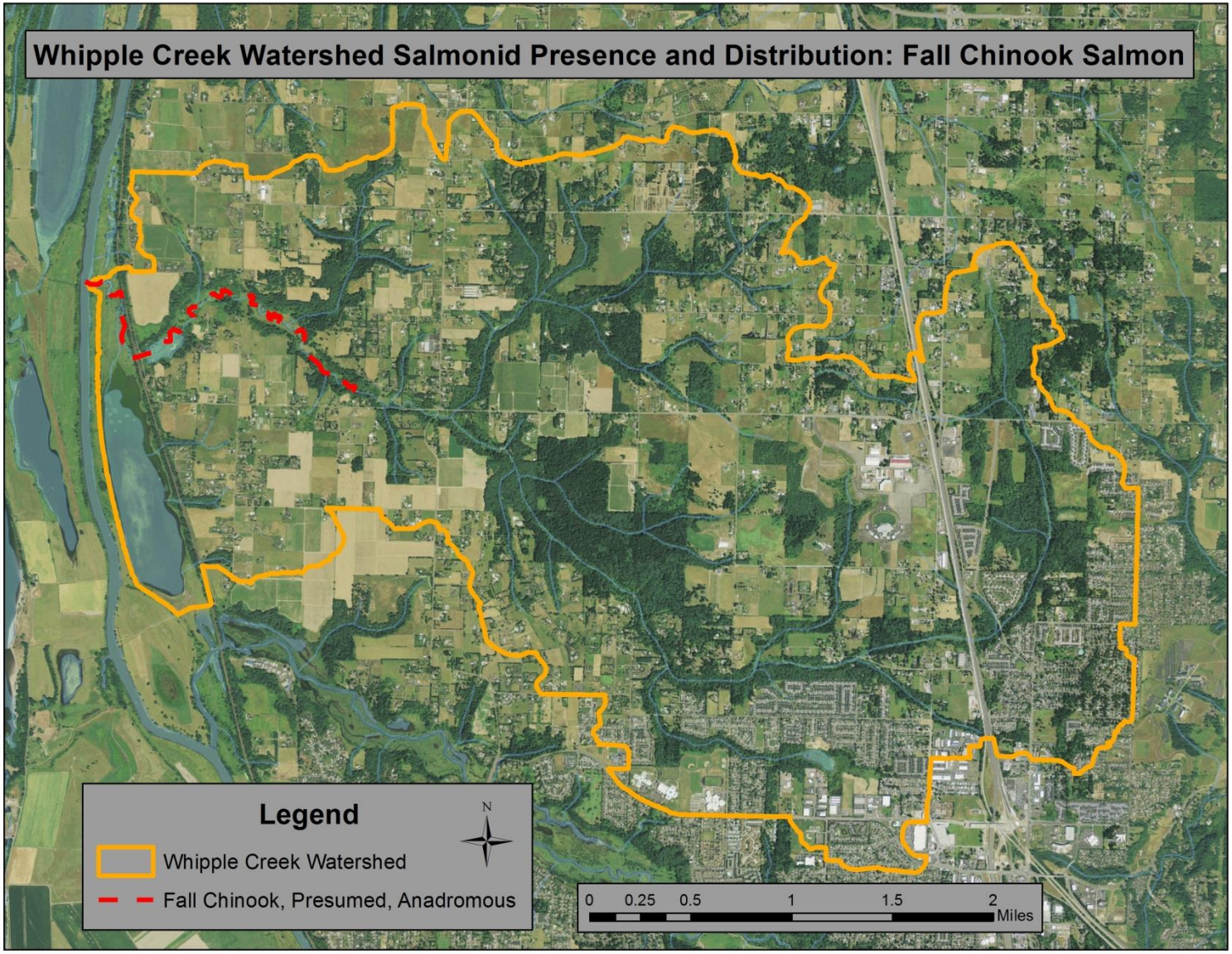

Figure 2 Whipple Creek Watershed Fall Chinook Salmon presence and distribution

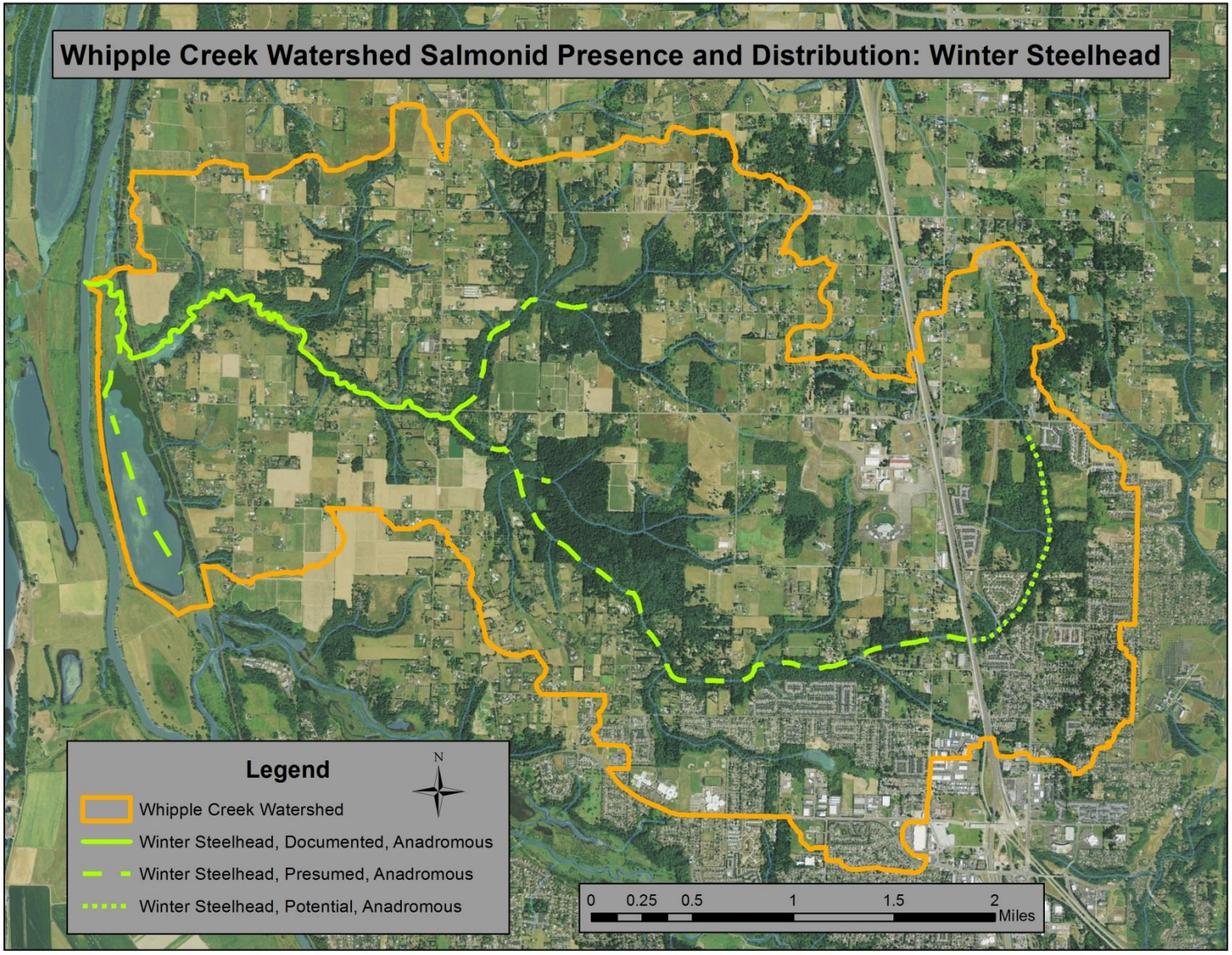

Figure 3 Whipple Creek Watershed Winter Steelhead Trout presence and distribution

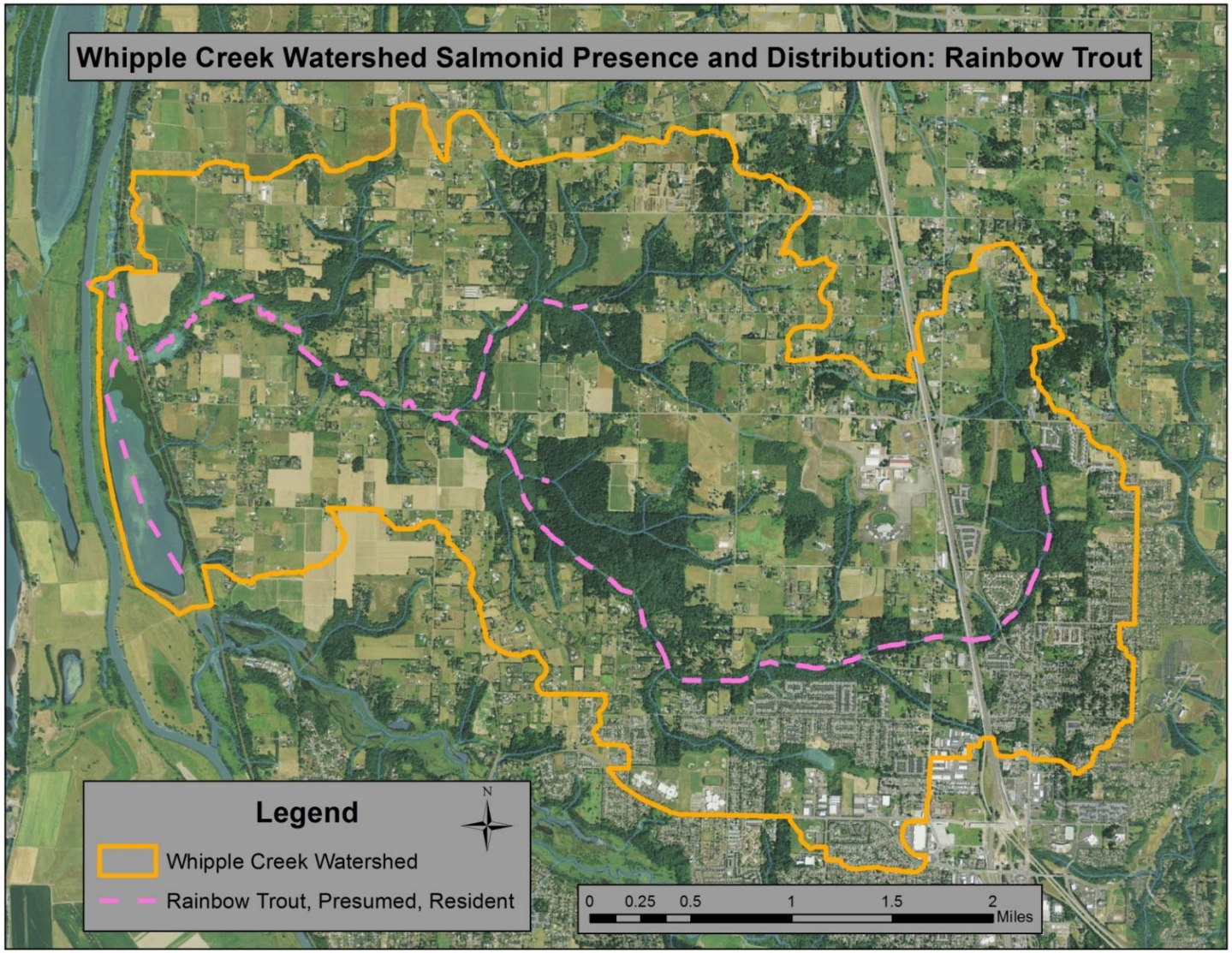

Figure 4 Whipple Creek Watershed Rainbow Trout presence and distribution

Table 1 Summary of presence and distribution of salmonid uses in the Whipple Creek watershed

Salmonid Species / Run	Whipple Creek Watershed Waterbody*	Timing of Species Run	Distribution Type	Use Type Description	Life Cycle History	Stream Reach Length (ft.)	% of Specie's Stream Reaches	Total Reach Length (ft.)	Brief Reach Descriptor (Approximate Distances)
Coho Salmon	Whipple Creek Mainstem	Unknown	Documented	Presence	Anadromous	15,944	40		Whipple Mainstem to Packard Tributary
		Unknown	Presumed	Presence	Anadromous	17,369	44		Whipple Mainstem between Packard & I-5
		Unknown	Potential	Presence	Anadromous	6,460	16	39,772	Whipple Mainstem above Interstate 5 (I-5)
	Packard Creek Tributary	Unknown	Documented	Presence	Anadromous	178	3		Lowest 0.1 mi. of Packard Creek
		Unknown	Presumed	Presence	Anadromous	4,899	89		All Packard Crk. except uppermost 0.1 mi.
		Unknown	Presumed	Presence	Anadromous	410	7	5,486	Uppermost 0.1 mi. Packard Creek
	Unnamed Tributary	Unknown	Presumed	Presence	Anadromous	874	100	874	Unnamed Right Bank Tributary 0.5 mi. upstream of Packard Creek
	Green Lake*	Unknown	Presumed	Presence	Anadromous	7,579	100	7,579	Green Lake and outlet reach
Fall Chinook Salmon	Whipple Creek Mainstem	Fall	Presumed	Presence	Anadromous	12,941	100	12,941	Whipple Mainstem from mouth to 3/4 way up to Packard Creek
Winter Steelhead Trout	Whipple Creek Mainstem	Winter	Documented	Presence	Anadromous	15,941	40		Whipple Mainstem to Packard Tributary
		Winter	Presumed	Presence	Anadromous	17,372	44		Whipple Mainstem between Packard & I-5
		Winter	Potential	Presence	Anadromous	6,460	16	39,772	Whipple Mainstem above I-5
	Packard Creek Tributary	Winter	Documented	Presence	Anadromous	388	7		Lowest 0.1 mi. of Packard Creek
		Winter	Presumed	Presence	Anadromous	4,689	86		Packard Creek except lowest & uppermost 0.1 miles
		Winter	Presumed	Presence	Anadromous	375	7	5,451	Uppermost 0.1 mi. Packard Creek
	Unnamed Tributary	Winter	Presumed	Presence	Anadromous	855	100	855	Unnamed right bank tributary 0.5 mi. upstream of Packard Creek
	Green Lake*	Winter	Presumed	Presence	Anadromous	7,579	100	7,579	Green Lake and outlet reach
Rainbow Trout	Whipple Creek Mainstem	NA	Presumed	Presence	Resident	39,772	100	39,772	All Mainstem Whipple Creek
	Packard Creek Tributary	NA	Presumed	Presence	Resident	5,077	93		All Packard Crk. except Uppermost 0.1 mi.
		NA	Presumed	Presence	Resident	386	7	5,463	Uppermost 0.1 mi. Packard Creek
	Unnamed Tributary	NA	Presumed	Presence	Resident	808	100	808	Unnamed right bank tributary 0.5 mi. upstream of Packard Creek
	Green Lake*	NA	Presumed	Presence	Resident	7,579	100	7,579	Green Lake and outlet reach

* Green Lake waterbody includes its outlet stream reach; Data source: Statewide Washington Integrated Fish Distribution (SWIFD), WDFW, 2014

Fish Passage Barriers

The WDFW SalmonScape interactive computer mapping website was utilized to research Whipple Creek watershed's salmonid fish passage barriers and possible Endangered Species Act (ESA) status. This information can help identify and prioritize potential salmonid protection areas, mitigation activities, and restoration sites that offer the most benefit to fish (WDFW SalmonScape Help webpage "Interacting with SalmonScape", 2014). The website merges into an integrated, accessible system salmonid fish distribution, use and habitat data collected by state, federal, tribal and local biologists from Limiting Factors Analysis and Salmonid Data Information Integration projects. SalmonScape is based on the Washington Integrated Fish Distribution (WIFD) dataset, which combines WDFW and NorthWest Indian Fish Commission (NWIFC) fish distribution information. SalmonScape hydrology utilizes the National Hydrographic Dataset (NHD), the new state and federal standard for depicting waterbodies.

Based on existing Whipple Creek watershed information downloaded from WDFW SalmonScape website, Figure 5 depicts fish passage barriers for all salmonid fish species (same anadromous species as shown in this chapter's previous figures). Table 2 summarizes the SalmonScape salmonid fish passage barriers information (from downstream to upstream, including tributaries) along applicable stream reaches depicted as black stream lines in Figure 5.

ESA Listings

SalmonScape also provides mapped distribution information on Endangered Species Act (ESA) listing units that are current as of January 2013 (WDFW - SalmonScape, 2014, "Interacting with SalmonScape" Help web page). These include National Oceanic and Atmospheric Administration (NOAA) Fisheries Evolutionary Significant Units (ESUs) for salmon and US Fish and Wildlife Service (USFWS) Distinct Population Segments (DPS) for Steelhead trout. Under ESA, a "species" can be listed as *endangered* if it is in danger of extinction throughout all or a significant portion of its range or *threatened* if it is likely to become an endangered species within the foreseeable future (NOAA, 2014).

The 1991 NOAA Technical Memorandum MFS F/NWC-194 (NOAA, 1991) states: 'For the purposes of the ESA, a "species" is defined to include "any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature". For anadromous Pacific salmonids, a distinct population segment is interpreted as 'a population (or group of populations) will be considered "distinct" (and hence a "species") if it represents an evolutionary significant unit (ESU) of the biological species. A population must satisfy two criteria to be considered an ESU: 1. It must be reproductively isolated from other conspecific population units, and 2. It must represent an important component in the evolutionary legacy of the species.' The memo further clarifies: 'Isolation does not have to be absolute, but it must be strong enough to permit evolutionarily important differences to accrue in different population units. The second criteria would be met if the population contributed substantially to the ecological /genetic diversity of the species as a whole.'

SalmonScape maps indicate all of Whipple Creek watershed's respective anadromous salmonid distributions (also shown in Figure 1 through Figure 3) have ESA Listing Units that are "Threatened, Accessible" (portions free of manmade blockage, dams). These Lower Columbia River ESA Listing Units include fall chinook and coho salmon ESUs as well as winter steelhead DPS. "ESU/DPS are the spatial

extents of populations, defined under the ESA, as Endangered, Threatened, a Species of Concern, or Not Warranted for listing" (WDFW - SalmonScape, 2014, "Interacting with SalmonScape" Help web page).

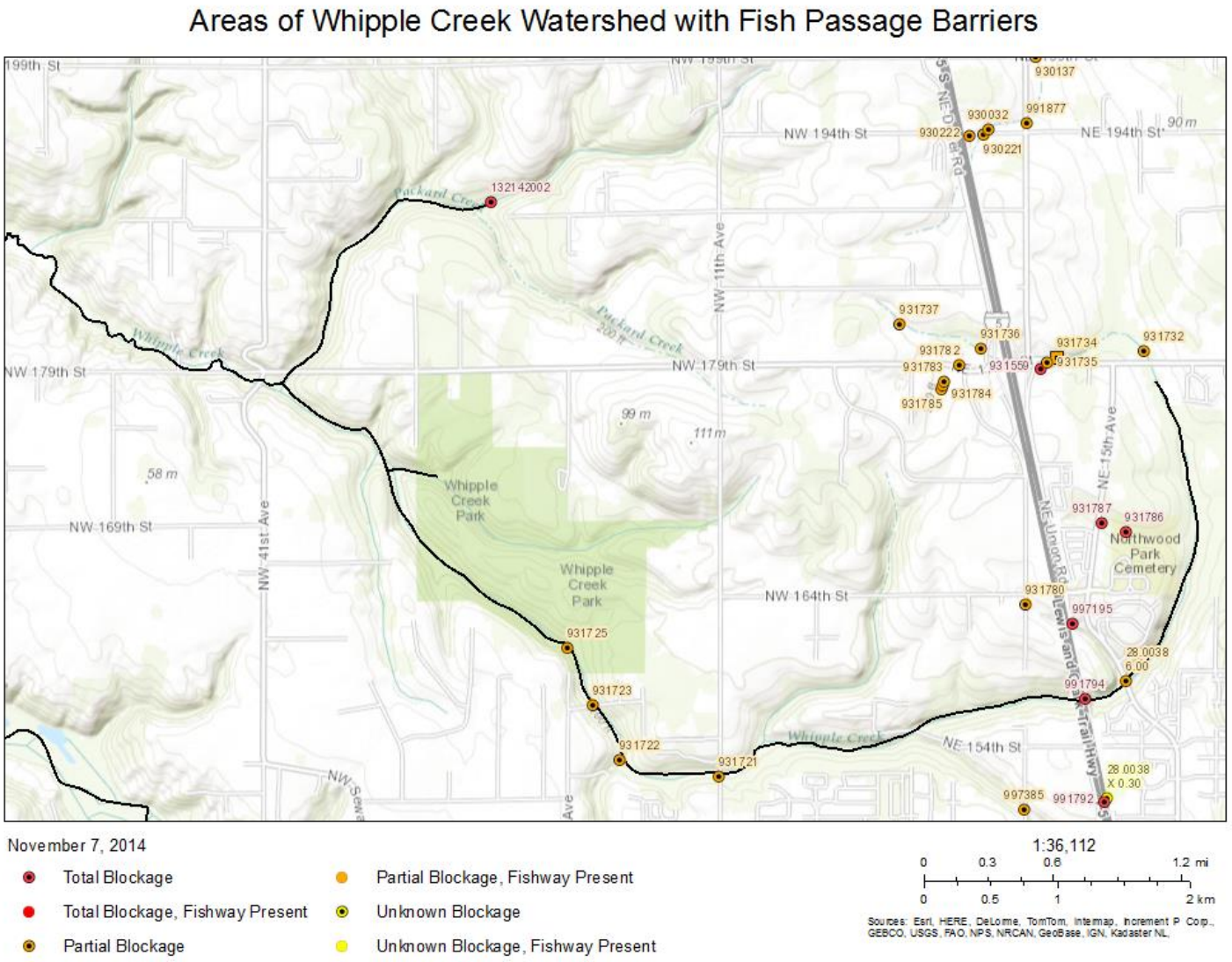

Figure 5 Salmonid fish passage barriers within the Whipple Creek Watershed based on WDFW SalmonScape web page

Table 2 Whipple Creek watershed's stream fish passage barrier details from WDFW SalmonScape

Site Number	Road	Stream	Fish Use	Fish Use Criteria	Feature Type	Barrier Status	Blockage	Fishway	Survey Date	Owner Type
132142002	Prvt; NW 189th St	Fraser Creek (Trib. to Packard Creek)	Yes	Mapped	Culvert	Yes	Total	No	6/27/2014	Private
931725	<Null>	Whipple Creek	Yes	Biological	Culvert	Yes	Partial	No	1/25/2011	County
931723	<Null>	Whipple Creek	Yes	Biological	Culvert	Yes	Partial	No	1/25/2011	Private
931722	<Null>	Whipple Creek	Yes	Biological	Culvert	Yes	Partial	No	1/25/2011	Private
931721	NW 11th Ave	Whipple Creek	Yes	Biological	Culvert	Yes	Partial	No	1/24/2011	County
991794	I-5	Whipple Creek	Yes	Physical	Culvert	Yes	Total	No	2/8/2011	State
28.0038 6.00	NE Union Rd	Whipple Creek	Yes	Biological	Culvert	Yes	Partial	No	2/8/2011	County

Aquatic Community Status Focused on Multiple Stream Segments

In addition to the above statewide salmonid database perspective, this section utilizes more detailed local information to summarize historical impacts to and the present status of the Whipple Creek watershed aquatic community's physical and biological components. Figure 6 and the following four subsections (Aquatic Habitat, Fish Species Presence, Passage Barriers, and Physical Habitat Availability) are primarily excerpts from a consultant's technical memorandum (Inter-Fluve, Inc., May 18, 2006) supplement to the 2006 Whipple Creek SNAP report (Clark County, 2006, p. 102 [Figure 6] and pp. 134-136). The consultant reviewed existing watershed information, made field observations of targeted stream segments, and suggested further evaluations. Figure 6 depicts the stream segments surveyed by Inter-Fluve, Inc. staff on five field trips during the winter –spring of 2005-2006. Unless noted otherwise in the text, location identifiers (e.g., tributary W#.##, R.M #.#) utilize river mile distances upstream from the mouth of Whipple Creek as shown in Figure 6.

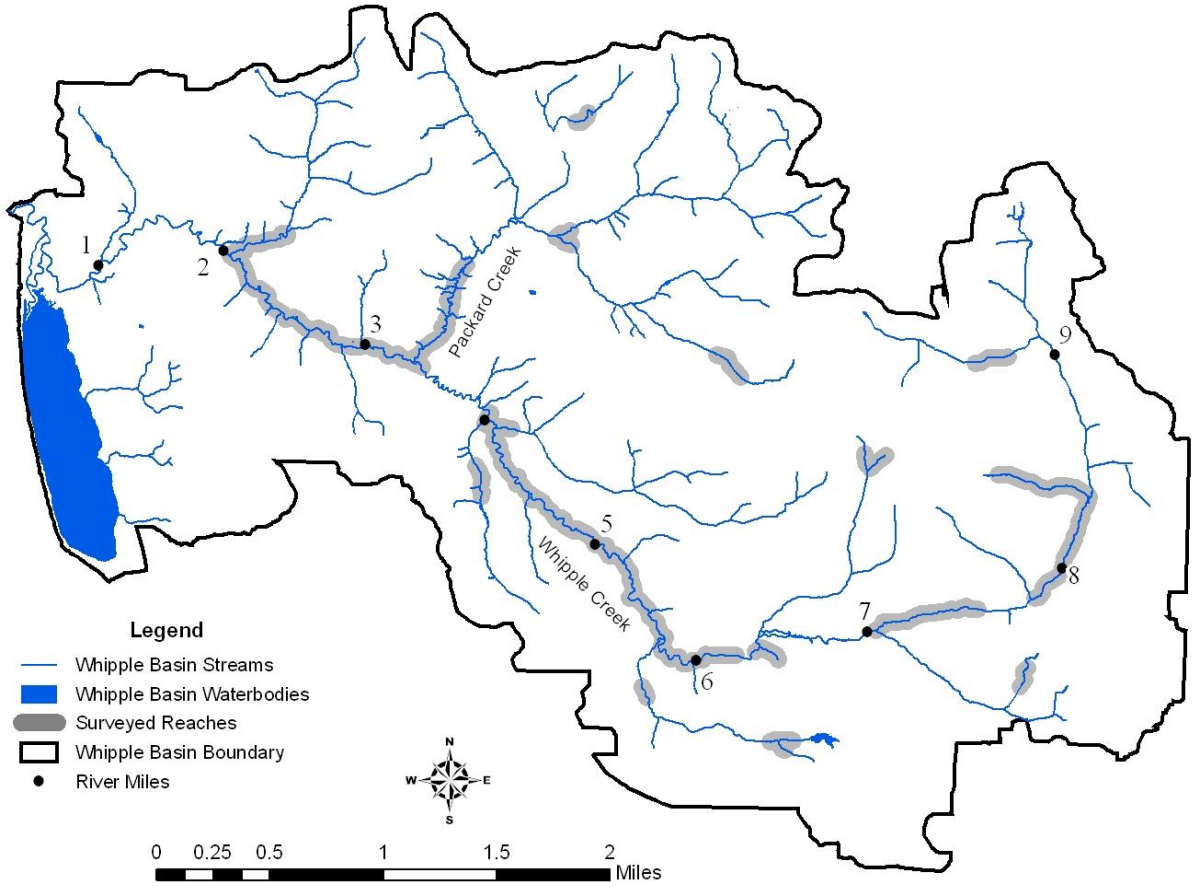

Figure 6 Stream segments surveyed by Inter-Fluve, Inc. (graphic from 2006 Technical Memo)

Aquatic Habitat

Aquatic habitat conditions would historically have been good in Whipple Creek, especially for fish such as coho, steelhead, and cutthroat trout that utilize small streams (Clark County, 2006, p. 134). Habitat has been affected by a century of land use impacts and may have improved considerably since the original phase of timber harvest and land clearing for agriculture (except possibly in currently urbanized areas). Land clearing would have altered flow regimes and increased fine sediment delivery. Riparian timber harvest would have reduced streambank integrity, reduced shading, and reduced large wood recruitment. As with many streams in the region, direct removal of wood from channels would have altered channel morphology and removed important fish habitat including pools and cover.

In the years following initial land clearing, conditions would have improved due to channel adjustment to the new sediment and flow regime and re-growth of riparian forests (Clark County, 2006, p. 134). In the 1970s, however, urbanization in the upper watershed began to alter stream hydrology and increase pollutants that not only impacted the aquatic habitat again but also had the potential for long-lasting effects. Aquatic habitat integrity generally declines with urbanization (Schueler 1994, May et al. 1997). The hydrologic, channel geomorphic, riparian, and floodplain processes resulting from urbanization tend to reduce and simplify the habitats that are available for aquatic organisms. The presence of suitable substrates, pools and riffles, cover, cool temperatures, dissolved oxygen, and access to channel habitats can all become impaired.

Fish Species Presence

According to accounts from local biologists, cutthroat trout have been observed in the mainstem upstream of I-5 and steelhead have been observed in the mainstem near the Packard Creek confluence and in Packard Creek itself (Clark County, 2006, pp. 134-135). A field visit on December 14, 2005 noted a potential coho redd in lower Packard Creek. The mainstem up to I-5, Packard Creek, and the lower quarter mile of tributary W2.04 are accessible to anadromous fish. However, given the lack of quality habitat in the mainstem above Packard Creek, anadromous use probably does not extend much beyond this point.

The species most likely to be present in the watershed are coho, steelhead, and cutthroat trout (Clark County, 2006, p. 135). The watershed's streams are too small for any significant use by chinook salmon. Although chum salmon may have historically been present in low numbers in the lower mainstem, their poor status in the region suggests they are currently absent from the system. The numbers of all species are likely to be low because of lack of quality habitat.

Passage Barriers

The I-5 and Union Road crossings likely obstruct fish passage on the mainstem. Passage through this area needs further evaluation. There are also barriers on several mainstem tributaries (Clark County, 2006, p. 135). One of the most significant is a perched culvert at an abandoned stream crossing about a quarter mile up tributary W2.04. This stream contains good gravels and the basin is relatively intact, suggesting that opening up this barrier could provide access to quality habitat. Additional investigation into the extent of upstream habitat should be conducted. A damaged culvert at tributary W4.09 may also be blocking access to suitable habitats on this tributary stream. The extent and quality of habitat above this blockage also warrants further investigation.

There are many large, channel-spanning beaver dams on the mainstem and Packard Creek that could potentially limit fish passage (Clark County, 2006, p. 135). Some large beaver dams that remain in place year after year may warrant investigation for fish passage. The potential benefits of removing beaver dams to increase passage should be weighed against the potential impacts on channel and floodplain function.

Physical Habitat Availability

Field observations suggest spawning habitat is the greatest limiting factor for salmonids in the basin. Habitat is naturally limited due to stream sizes, topography, and substrate conditions. Human alterations have further limited available habitat through changes to the sediment and flow regimes, fish passage conditions, and increased channel degradation (Clark County, 2006, p. 135).

Rearing habitat in the form of beaver ponds is abundant (Clark County, 2006, p. 135). These areas provide important winter refuge for young coho salmon. Studies on the Oregon coast have shown that winter rearing habitat is typically limiting for coho (Nickelson, 1998). Whipple Creek, in contrast, contains scarce spawning habitat but abundant beaver pond habitat, suggesting that spawning is limiting factor. Compared to coho, steelhead rearing habitat is less abundant. Steelhead prefer to rear in higher gradient channels, where they can seek flow refuge behind structures (wood, substrate) while having quick access to adjacent high flow areas for drift feeding. Age-0 steelhead are likely to rear in their natal stream. Age-1 steelhead, due to their larger size and feeding requirements, are more likely to rear in the mainstem.

A quick gage of available habitat can be conducted by looking at stream gradient and channel type (Clark County, 2006, pp. 134-135). Suitable spawning habitat for anadromous salmonids is typically located in pool-riffle or plane-bed channels with gradients less than 3% (Montgomery et al. 1999). In the Whipple Basin, channels below approximately 0.5% slope contain sand and silt substrate that is unsuitable for spawning. This leaves a few isolated areas where conditions are suitable. These include the mainstem between river mile 2.4 and 3.2, lower Packard Creek, and the lower end of tributary W2.04. Other potentially suitable areas, such as tributary W4.09 and the mainstem above I-5, are isolated by passage barriers but may contain suitable habitat for resident cutthroat.

The best habitat is located on the mainstem between river mile 2.4 and 3.2 (Clark County, 2006, p. 136). This is a pool-riffle and plane-bed reach with suitable gradient and spawning gravels. Wood accumulations create pools, cover, and habitat complexity. Moderate-to-high shading is provided by relatively intact riparian canopies and by topography in some areas. The pasture reach downstream of RM 2.2 may have provided suitable habitat historically, but incision has lowered the gradient and simplified the channel.

The lower portion of Packard Creek also contains suitable habitat, although gravels are less abundant than in the mainstem (Clark County, 2006, p. 136). Pool-riffle sequences are interspersed with segments of lesser quality, where channel incision has degraded habitat complexity.

Tributary 2.04, while small, contains abundant gravels that would be suitable for coho, steelhead and resident trout spawning. The lower few hundred feet, which courses through the low gradient floodplain of mainstem Whipple Creek, is deeply entrenched and would have to be evaluated for fish passage (Clark County, 2006, p. 136).

Detailed Physical Habitat Assessment for Lower Watershed Stream Segment

During 2002, Clark County staff collected detailed quantitative habitat measurements for a 500-foot mainstem stream reach just upstream from the mouth of Packard Creek in the lower portion of the Whipple Creek watershed (Clark County, 2006, pp. 96-98, 191). This analyzed reach is mostly just upstream from the upper extent of the mainstem reach identified by Inter-Fluve, Inc. as the best suitable spawning habitat in the Whipple Creek watershed. The USEPA Environmental Monitoring and Assessment Program (EMAP) Western Pilot Study: Field Operations Manual for Wadeable Streams (Peck et al., eds. 2001) methods guided this reach work.

The EMAP protocols are designed for robust, quantitative descriptions of reach-scale habitat that could be used for site classification, trend interpretation, and analysis of possible causes of biotic impairment (Peck et al., 2001). The protocols allow calculation of numeric results for several habitat categories metrics such as channel morphology, substrate composition, fish cover, and canopy density, as well as overall habitat quality (e.g., Habitat Quality Index: HQI).

The calculated HQI, reflecting the overall habitat quality for the monitored Whipple Creek reach, indicated a highly disturbed system with marginally functional stream conditions (Clark County, 2006, pp.96-98). Site-specific overall riparian quality rated good based on relatively abundant fish cover and moderate riparian shading but these do not necessarily integrate or reflect watershed-wide conditions. For most other metrics, including those that integrate impacts from the upstream watershed, Whipple Creek fell short of desired conditions including being the most “flashy” of ten streams evaluated during 2002. The monitored reach channel morphology was dominated by glide habitat, with far fewer pools and riffles than recommended. The stream reach’s substrate was also dominated by sand, silt, and fine gravels, with a high level of embeddedness reflecting a relatively unstable streambed. Total Large Woody Debris (LWD) density was relatively high in the assessed reach but most pieces were not large enough to qualify as high quality wood. Invasive plants, especially Himalayan blackberry and Reed Canary grass, dominated the monitored riparian vegetation.

While the results from the EMAP evaluation of the single 500-foot reach may not be indicative of the entire stream system, the cumulative upstream land use impacts have resulted in a highly disrupted and unstable stream at the assessment site (Clark County, 2006, p. 98). The assessment metrics indicate that Whipple Creek is subject to high flows and carries a significant amount of silt and sediment. The SNAP report’s Physical Habitat Assessment section concludes “stormwater projects and watershed activities that help stabilize flow regime and control channel erosion could lead to localized improvements in stream habitat. However, due to the complexity and extent of influences on hydrologic condition, it is difficult to predict whether stormwater projects alone can have a substantial impact on watershed-wide habitat quality.”

Conclusions

From the stormwater permit focused perspective of salmonid uses, the overall status of the Whipple Creek watershed planning area's aquatic community appears seriously degraded. Good quality salmonid habitat is very limited due to small stream sizes, substrate conditions, and human alterations to the watershed.

While resident rainbow and cutthroat trout are presumed to utilize much of the watershed's streams, anadromous salmonids' use is much more limited by small stream size, fish passage barriers, and habitat quality (WDFW SWIFD, 2014 and SalmonScape, 2014). Based on state salmonid presence and distribution information for Endangered Species Act salmonids listed as threatened, there is documented presence of listed coho salmon and winter steelhead on the mainstem below its confluence with the Packard Creek tributary and the lowermost several hundred feet of this tributary. Additionally, there is a presumed presence of threatened fall chinook in the approximately 13,000 lowermost feet of the mainstem. Whipple Creek's main stem up to I-5, much of the lower half of the Packard Creek tributary, and the lower quarter mile of an unnamed tributary at river mile 2.04 have no known total blockages for fish passage. However, there are four partial blockage culvert barriers on the mainstem midway between the Packard Creek confluence and the total blockage culvert under I-5. Given the lack of quality habitat in the mainstem above Packard Creek, anadromous use probably does not extend much beyond this point.

Based on existing information and field observations across multiple stream reaches within the Whipple Creek watershed, land use activities over time have negatively impacted the aquatic community's physical and biological components. Prior to timber harvest and land clearing for agriculture, watershed aquatic habitat conditions were likely good for fish utilizing small streams (Inter-Fluve, Inc. 2006 / Clark County 2006, p. 134). Timber harvest and land clearing would have altered flow regimes, increased fine sediment delivery to streams, reduced streambank integrity and shading, and reduced large wood recruitment. These would have resulted in altered channel morphology and removal of important pools and cover habitat for fish. In the years following initial land clearing, conditions likely improved due to channel adjustment to the new sediment and flow regime and regrowth of riparian forests. However, starting in the 1970's impacts from urbanization in the upper watershed again altered stream hydrology and contributed pollutants, both with the potential for long lasting effects.

"Field observations suggest spawning habitat is the greatest limiting factor for salmonids in the basin. Habitat is naturally limited due to stream sizes, topography, and substrate conditions. Human alterations have further limited available habitat through impacts to the sediment and flow regime, fish passage conditions, and channel degradation (Inter-Fluve, Inc. 2006 / Clark County 2006, pp. 135-136)". The best habitat is located on the mainstem between river mile 2.4 and 3.2 where there is a pool-riffle / plane-bed reach with suitable gradient, spawning gravels, habitat complexity, and riparian shading.

While not necessarily indicative of the entire Whipple Creek watershed, cumulative upstream land use impacts have resulted in a highly disrupted and unstable 500-foot stream reach near the mouth of Packard Creek based on a habitat evaluation using EPA protocols (Clark County, 2006, p. 98). The SNAP report's Physical Habitat Assessment section concludes "stormwater projects and watershed activities that help stabilize flow regime and control channel erosion could lead to localized improvements in stream habitat. However, due to the complexity and extent of influences on hydrologic condition, it is difficult to predict whether stormwater projects alone can have a substantial impact on watershed-wide habitat quality."

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