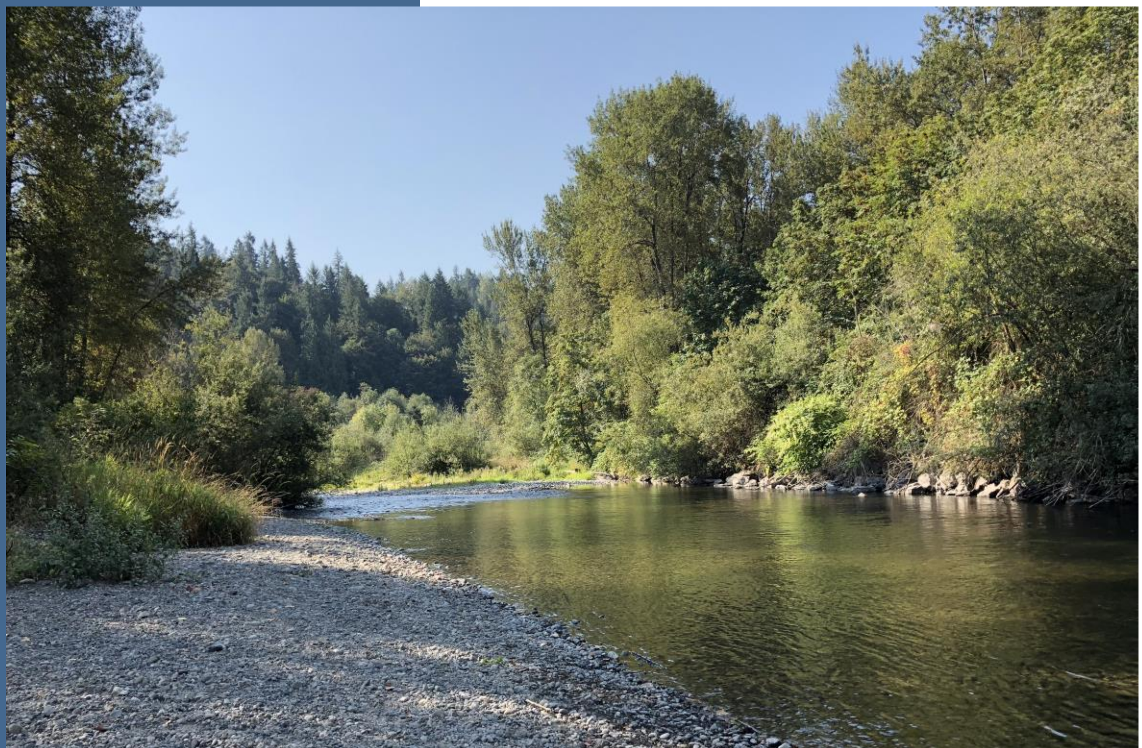

Watershed Restoration and Enhancement Plan

WRIA 8
Cedar-Sammamish Watershed

Adopted by Ecology December 2024

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Acronyms

Acronym	Definition
AE	Application Efficiency
AFY	Acre-Feet per Year
AU	Assessment Unit
CFS	Cubic Feet per Second
CU	Consumptive Use
CUF	Consumptive Use Factor
GPD	Gallons per Day
GIS	Geographic Information System
IR	Irrigation Requirements
LIO	Local Integrating Organization
MAR	Managed Aquifer Recharge
NEB	Net Ecological Benefit
PE	Permit-Exempt
RCW	Revised Code of Washington
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WRE	Watershed Restoration and Enhancement
WRIA	Water Resource Inventory Area
WWT	Washington Water Trust

Acknowledgements

Ecology based much of this plan on work conducted through numerous committee and workgroup meetings of the WRIA 8 Watershed Restoration and Enhancement Committee. While the committee was unable to approve their version of the plan, the committee's contributions were instrumental to the development of this plan. Much of the underlying technical work was completed by a team of technical consultants, including GeoEngineers and Northwest Hydraulic Consultants (Bridget August and team). Our facilitation team from Cascadia Consulting (Gretchen Muller and Caroline Burney) was also instrumental to advancing the input and decisions by the committee. Thank you to the Washington State Conservation Office and the Salmon Recovery Funding Board for providing a technical review of the final draft watershed plan prior to adoption.

Executive Summary

In January 2018, the Washington State Legislature passed the Streamflow Restoration law (RCW 90.94) to help support robust, healthy, and sustainable salmon populations while ensuring rural communities have access to water. The law directs the Department of Ecology to develop a Watershed Restoration and Enhancement Plan in Water Resource Inventory Area (WRIA) 8 that identifies projects to offset potential consumptive impacts of new permit-exempt domestic groundwater withdrawals on instream flows over 20 years (2018 – 2038), and provides a net ecological benefit to the watershed.

Following the provisions of the law, the Department of Ecology (Ecology) collaborated with a committee composed of tribes, counties, cities, state agencies, and special interest groups in WRIA 8 (the Cedar-Sammamish watershed) to prepare a committee draft plan. The law requires all members of the committee to approve the watershed plan prior to Ecology considering plan adoption. However the committee draft plan for WRIA 8 was not approved by all members of the committee ahead of the legislative deadline. The Streamflow Restoration law recognizes that some committees may not complete their plan preparation process. It establishes an alternative pathway for plan preparation, adoption, and rulemaking.

Therefore, as directed by the law, Ecology completed this watershed plan without additional committee input. As Ecology developed the final watershed plan, Ecology followed the law, the Final Guidance for Determining Net Ecological Benefit (Final NEB Guidance) (Ecology 2019a), and POL-2094 (Ecology 2019b). Ecology also considered all available information, including draft materials developed by the committee. The Salmon Recovery Funding Board reviewed this plan and submitted recommendations, which Ecology considered, and incorporated as appropriate, prior to finalizing the watershed plan.

This watershed plan estimates 967 new permit-exempt domestic well connections (PE wells) over the planning horizon[2] (2018-2038). The estimated consumptive water use associated with the new PE wells is 425.4 acre-feet per year (AFY) (0.59 cubic feet per second) in WRIA 8. The projects and actions in this watershed plan will address and offset the consumptive water use from those 967 new PE wells.

This watershed plan includes projects that provide an anticipated offset of 1,805.1 AFY to benefit streamflows and enhance the watershed. Additional projects in the plan provide benefits to fish and wildlife habitat through floodplain restoration, wetland reconnection,

[2] The Final NEB guidance defines the planning horizon as: “The 20-year period beginning on January 19, 2018 and ending on January 18, 2038, over which new consumptive water use by permit-exempt domestic withdrawals within a WRIA must be addressed.”

reduction in peak flow during storm events, increase in groundwater levels and baseflow, and increase in channel complexity.

As required by the law and to allow for meaningful analysis of the relationship between new consumptive water use and offsets, this watershed plan divides the watershed into 12 subbasins. Subbasins help describe the location and timing of estimated new consumptive water use, the location and timing of impacts to instream resources, and the necessary scope, scale, and anticipated benefits of projects. The estimated consumptive water use associated with the new PE wells, the anticipated offsets, and the subbasins for this watershed plan are shown in Figure ES.1.

Based on the information and analyses summarized in this watershed plan, Ecology finds that this watershed plan, if implemented, would achieve a net ecological benefit, as required by RCW 90.94.030 and defined by the Final NEB Guidance (Ecology 2019a).

Ecology and the state of Washington are invested in the implementation of this watershed plan, including periodically assessing plan and project implementation and issuing competitive grants to local projects that demonstrably implement this watershed plan while benefiting streamflows and aquatic habitat.

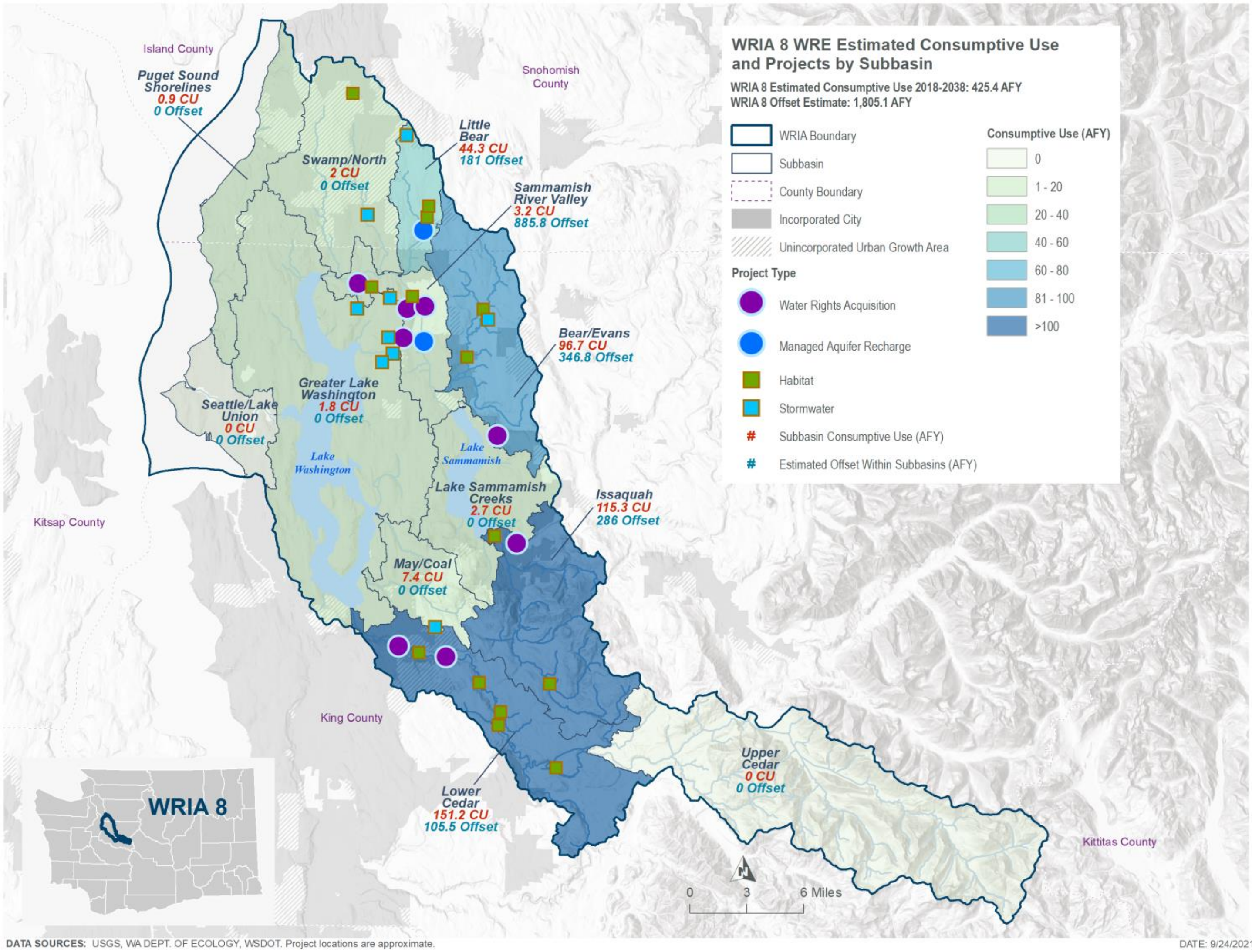

Figure ES.1: WRIA 8 Estimated Consumptive Use and Projects by Subbasin

Chapter One: Plan Overview

1.1 Plan Purpose and Background

The purpose of this Water Resource Inventory Area (WRIA) 8 Watershed Restoration and Enhancement Plan (watershed plan) is to identify the projects and actions necessary to "offset potential impacts to instream flows associated with permit-exempt domestic water use"[3] and "result in a net ecological benefit (NEB) to instream resources within the [WRIA]."[4] This plan achieves these purposes consistent with the requirements of RCW 90.94.030, the Streamflow Restoration Policy and Interpretive Statement (POL-2094) (Ecology 2019b) and Ecology's Final Guidance on Determining Net Ecological Benefit (GUID-2094, referred to as the Final NEB Guidance throughout this plan) (Ecology 2019a). This plan considered all available information including priorities for salmon recovery and watershed recovery and the draft materials prepared by the WRIA 8 Watershed Restoration and Enhancement Committee (Committee). In order to accomplish its purpose, all eight of the watershed plans required by RCW 90.94.030, including this one, estimated the potential consumptive impacts of new permit-exempt domestic wells (referred to as PE wells throughout this plan) on instream flows over the planning horizon (January 2018 to January 2038)[5] and identified the projects and actions necessary to offset those impacts and result in a NEB within the WRIA.

In January 2018, the Washington State Legislature passed Engrossed Substitute Senate Bill (ESSB) 6091 (session law 2018 c 1). This law was enacted in response to the State Supreme Court's 2016 decision in Whatcom County vs. Hirst, Futurewise, et al. (commonly referred to as the "Hirst decision"). The law, now primarily codified as RCW 90.94, clarifies how local governments can issue building permits for homes intending to use a PE well for their domestic water supply. Additionally, the law required the preparation of new local watershed plans for eight specified WRIAs, including this one.

To support local planning, the law required Ecology to establish a committee. The law tasked the committee with preparing a watershed plan approved by every member of the committee. Once the committee approved the draft watershed plan, the law required Ecology to review it and, presuming it met the requirements, adopt it no later than June 30, 2021. Despite working diligently over two and a half years, the WRIA 8 Committee did not submit an approved plan to Ecology for review before the mandated deadline.[6] Consequently, and as required by RCW 90.94.030 (3)(h), Ecology finalized this watershed plan and considered technical review and

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[3] RCW 90.94.030 (3)(b)

[4] RCW 90.94030(3)(c)

[5] The Final NEB guidance defines the planning horizon as: "The 20-year period beginning on January 19, 2018 and ending on January 18, 2038, over which new consumptive water use by permit-exempt domestic withdrawals within a WRIA must be addressed."

[6] See Section 1.2 of this watershed plan for more background on the WRIA 8 Committee and their planning process.

recommendations under an inter-agency agreement with the Salmon Recovery Funding Board. Within six months of adopting this plan, Ecology will initiate the rulemaking required by this law. Ecology's rulemaking activities are a public process guided by the Washington Administrative Procedure Act (APA), ch. 34.05 RCW. Rulemaking will occur consistent with the requirements of the streamflow restoration law (RCW 90.94.030) and will be completed within two years of initiation of this rule making.[7]

1.1.1 Permit-Exempt Domestic Wells

As noted above, this watershed plan, the law that calls for it and the Hirst decision are all focused on the potential impacts of new PE well use on streamflows. Pumping water from PE wells can reduce groundwater discharge to springs and streams, reducing streamflows (Barlow and Leake 2012). Several laws pertain to the management of PE wells in WRIA 8. This plan summarizes those laws below to provide context for this WRIA 8 watershed plan.

First and foremost, RCW 90.44.050, commonly referred to as "the Groundwater Permit Exemption," establishes that certain small withdrawals of groundwater are exempt from the state's water right permitting requirements, including small indoor and outdoor water use associated with homes. Although these withdrawals do not require a state water right permit, the water right is still legally established by the beneficial use.

Even though a water right permit is not required for small domestic uses under RCW 90.44.050, there is still regulatory oversight, including from local jurisdictions. Specifically, in order for an applicant to receive a building permit from their local government for a new home, the applicant must satisfy the provisions of RCW 19.27.097 for what constitutes evidence of an adequate water supply.

RCW 90.94.030 adds to the management regime for new homes using PE wells in WRIA 8 and elsewhere. For example, local governments must, among other responsibilities relating to new PE wells, collect an added $500 fee for each building permit and record withdrawal restrictions on the title of the affected properties. Additionally, this law restricts new PE wells in WRIA 8 to a maximum annual average of up to 950 gallons per days per connection, subject to the five thousand gallons per day and ½-acre outdoor irrigation of non-commercial lawn/garden limits established in RCW 90.44.050. Ecology, through working with the planning committee and finalizing this plan, has determined that these statutorily established fee amounts and water use restrictions are appropriate and will be considered in the rulemaking required in RCW 90.94.030(3)(h).

[7] RCW 90.94.030(3)(h)

Ecology published its interpretation and implementation of RCW 19.27.097 and RCW 90.94 in Water Resources POL-2094 (Ecology 2019b), which provide comprehensive details and agency interpretations.

1.2 Watershed Restoration and Enhancement Committee Planning under RCW 90.94.030

As discussed above, RCW 90.94.030 directed Ecology to establish the WRIA 8 Committee, invite the Committee participants, and chair the Committee.[8] As directed in RCW 90.94.030(3)(b) Ecology collaborated with the WRIA 8 Committee to prepare the watershed plan. In practice, the process of this collaboration and plan development was one of broad integration, collectively shared work, and a striving for consensus.

Ecology convened the WRIA 8 Committee in October 2018, and Ecology served as the Chair. The roster of Committee members is available in Table 1.1 and Appendix B. Over the course of the following two and a half years and with the support of the Committee's consulting team,[9] the WRIA 8 Committee held formal monthly Committee meetings as well as periodic technical sub-group meetings. Ecology distributed the WRIA 8 Committee's draft watershed plan in November 2020 for Committee member review and official approval from the entities they represented. The WRIA 8 Committee voted on the draft watershed plan in February 2021. This vote yielded 15 entities voting to approve, and 1 entity voting to disapprove. The final WRIA 8 Committee meeting summary, along with the voting record, is available in Appendix C. Because the law required that all Committee members approve the watershed plan, the Committee did not approve their draft watershed plan.[10] Therefore, the watershed plan was not available for Ecology's review, and the June 30, 2021 statutory deadline for adoption was not met. Consequently, Ecology then implemented its mandate under RCW 90.94.030(3)(h) by finalizing this watershed plan. Ecology prepared the final plan based on all available information including priorities for salmon recovery and watershed recovery, draft materials developed by the WRIA 8 Watershed Committee, and recommendations from the Salmon Recovery Funding Board.

[8] RCW 90.94.030(2)(b) and (3)

[9] GeoEngineers and Northwest Hydraulic Consultants were the primary technical consultants for WRIA 8. Funding for these consulting services was provided by Ecology through Legislative appropriations that accompanied the passage of RCW 90.94.

[10] "…all members of a Watershed Restoration and Enhancement Committee must approve the plan prior to adoption" – RCW 90.94.030(3)

Table 1.1: WRIA 8 Committee Roster

Entity Name[1]	Primary Representative	Alternates
King County	Denise Di Santo	Joan Lee
Snohomish County	Terri Strandberg	Elisa Dawson Ann Bylin
City of Bothell	Janet Geer	Chris Hall
City of Issaquah	Allen Quynn	Bob York
City of Kenmore	Richard Sawyer	
City of Kent	Evan Swanson	Mike Mactutis Shawn Gilbertson
City of Seattle	Michele Koehler	Elizabeth Garcia
Muckleshoot Indian Tribe	Henry Martin	Carla Carlson
Snoqualmie Indian Tribe	Matt Baerwalde	Ann House
Tulalip Tribes	Kurt Nelson	Anne Savery
Washington Department of Ecology	Stephanie Potts (chair)	Ingria Jones
Washington Department of Fish and Wildlife	Stewart Reinbold	Ezekiel Rohloff
Alderwood Water and Wastewater, Non-municipal Water Purveyor	John McClellan	Jenifer Galatas
King County Agriculture Program, Agricultural interest	Rick Reinlasoder	Melissa Borsting
Master Builder Association of King and Snohomish Counties, Residential Construction Interest	Gina Clark	Jennifer Anderson
Center for Environmental Law and Policy, Environmental Interest	Dan Von Seggern	Trish Rolfe
WRIA 8 Salmon Recovery Council, ex officio[2]	Jason Wilkinson	Jason Mulvihill-Kuntz

Notes:

[1] Ecology was required to invite entities listed in RCW 90.94.030(2)(a) to participate in the committee. The law did not require invited entities to participate, and some chose not to participate on the Committee. The cities of Bellevue, Mukilteo, Redmond, and Sammamish withdrew from the Committee prior to the vote on the draft plan.

[2] The WRIA 8 Committee invited the WRIA 8 Salmon Recovery Council to participate as an "ex officio" member. Ex officio members were active but non-voting participants of the WRIA 8 Committee and are not identified in the law.

1.3 Plan Requirements and Overview

The law, Ecology's interpretation of the law, and the NEB Guidance set the structure of the watershed plan by describing the required elements. At a minimum, the watershed plan must include projects and actions necessary to offset potential impacts of new PE wells on streamflows and provide a NEB to the WRIA. The legislation requires the watershed plan to include the following elements:

- Recommendations for projects and actions that will measure and enhance instream resources and improve watershed functions that support the recovery of threatened and endangered salmonids (RCW 90.94.030(3)(a)).
- Actions determined necessary to offset potential impacts to instream flows associated with permit-exempt domestic water use (RCW 90.94.030(3)(b)).
- A cost evaluation or estimation of those actions (RCW 90.94.030(3)(d)).
- An estimate of the cumulative consumptive use impacts over the twenty year period (2018-2038) (RCW 90.94.030(3)(e)).

This watershed plan includes six chapters:

- Plan overview.
- Overview of the watershed.
- Summary of the subbasins.
- PE well projections and consumptive use estimate.
- Description of the recommended projects and actions identified to offset the future permit-exempt domestic water use in WRIA 8.
- Determination of net ecological benefit.

Chapter Two: Watershed Overview

2.1 Brief Introduction to WRIA 8

The Cedar-Sammamish watershed is one of the 62 designated major watersheds in Washington State, formed as a result of the Water Resources Act of 1971. The Cedar River historically flowed into the Black River and the Cedar-Sammamish watershed was formed when the Cedar River was diverted into Lake Washington. The Cedar-Sammamish watershed is approximately 692 square miles in area and includes all the lands drained by the Cedar River, the Sammamish River, Lake Washington, and marine nearshore areas that drain directly to Puget Sound. Approximately 85 percent of the watershed is located within King County and the remaining 15 percent is located within Snohomish County. WRIA 8 is bounded on the north by WRIA 7 (Snohomish), on the west by Puget Sound, on the south by WRIA 9 (Duwamish-Green), and on the east by WRIA 39 (Upper Yakima).

The upper Cedar River watershed is the municipal drinking water supply for the City of Seattle and managed under a Habitat Conservation Plan (HCP) (City of Seattle 2000). The upper portion of the Cedar River watershed contains two dams, Masonry Dam and Landsburg Dam, which City of Seattle operates for municipal water supply and hydropower generation. The northwestern portion of the watershed contains the Sammamish River, Lake Washington, Lake Union, and Lake Sammamish. Numerous smaller lakes, ponds, and wetlands are present throughout the watershed. The construction of the Lake Washington Ship Canal, reservoirs, and various flood control projects in the 20th century altered the watershed from its pre-development state (WRIA 8 Steering Committee 2005).

The Cedar River originates in the Cascade Range near Yakima Pass and flows in a generally northwest direction for approximately 51 miles before discharging to the south end of Lake Washington. The mean annual flow in the Cedar River is 679 cubic feet per second (cfs), measured near Renton (U.S. Geological Survey 2020).

The Sammamish River originates at the north end of Lake Sammamish and flows northwest for approximately 14 miles before discharging to the north end of Lake Washington. The mean annual flow in the Sammamish River is 304 cfs, measured near Woodinville (U.S. Geological Survey 2020).

Lake Washington discharges to the Lake Washington Ship Canal, a highly channelized and urbanized waterway that traverses Portage Bay, Lake Union, and Salmon Bay before exiting the Chittenden Locks and entering Puget Sound at Shilshole Bay. Other tributaries within the system include Issaquah Creek, May Creek, Coal Creek, Bear Creek, Evans Creek, Little Bear Creek, Swamp Creek, and North Creek.

2.1.1 Land Use in WRIA 8

The City of Seattle's Cedar River Municipal Watershed covers over 90,000 acres in the eastern or upland portion of the watershed and generally consists of forestland (City of Seattle 2020a). Land uses shift to suburban developments and urban centers such as Maple Valley and Hobart in the foothills of the Cascade Mountains. Extending from the city of Issaquah to the cities of Bellevue, Redmond, Seattle, and Everett the northwest portion of WRIA 8 is highly urbanized, characterized by a combination of residential, industrial, commercial, transportation, communication, and utility land covers. Over 50 percent of the watershed is within a city or designated urban growth area.

The Cedar-Sammamish watershed is the most heavily populated watershed in Washington. Industry, agriculture, commercial facilities, individual residences, and municipalities compete for a limited water supply, causing a strain on water availability. These out-of-stream uses compete with instream water needs, including providing water for salmon and other aquatic resources.

2.1.2 Tribal Reservations and Tribal Treaty Rights

WRIA 8 is located within the ancestral homelands of Indian tribes and bands that occupied this area since time immemorial. Tribes hold reserved treaty rights to fish, hunt and gather throughout the watershed (Treaty of Point Elliott). Tribal claims to reserved water rights include the earliest (most senior) priority rights to water within the Cedar-Sammamish Watershed. While they have not been confirmed and quantified through an adjudication in federal or state court, these federally reserved water rights, intended to serve current and future uses, may be reserved by and protected in treaties, executive orders, federal court decisions, and state court adjudication decrees. Tribal water rights may extend to instream flows and minimum lake levels necessary to protect resources in all areas where Tribes have reserved rights. Treaty rights to fish may support claims for fish habitat, including water rights for instream flows. Nothing in this plan can alter tribal rights.

Indian people have always relied on the natural resources of this land. Their personal, cultural and spiritual survival depended on the ability to fish, hunt and gather the bountiful natural resources that once blessed this country (NWIFC 2014). Salmon are one of those resources that is critical to the cultural, spiritual and economic wellbeing of Tribes. Tribes depend upon salmon that originate from the waters found in the Cedar River and Lake Washington areas.

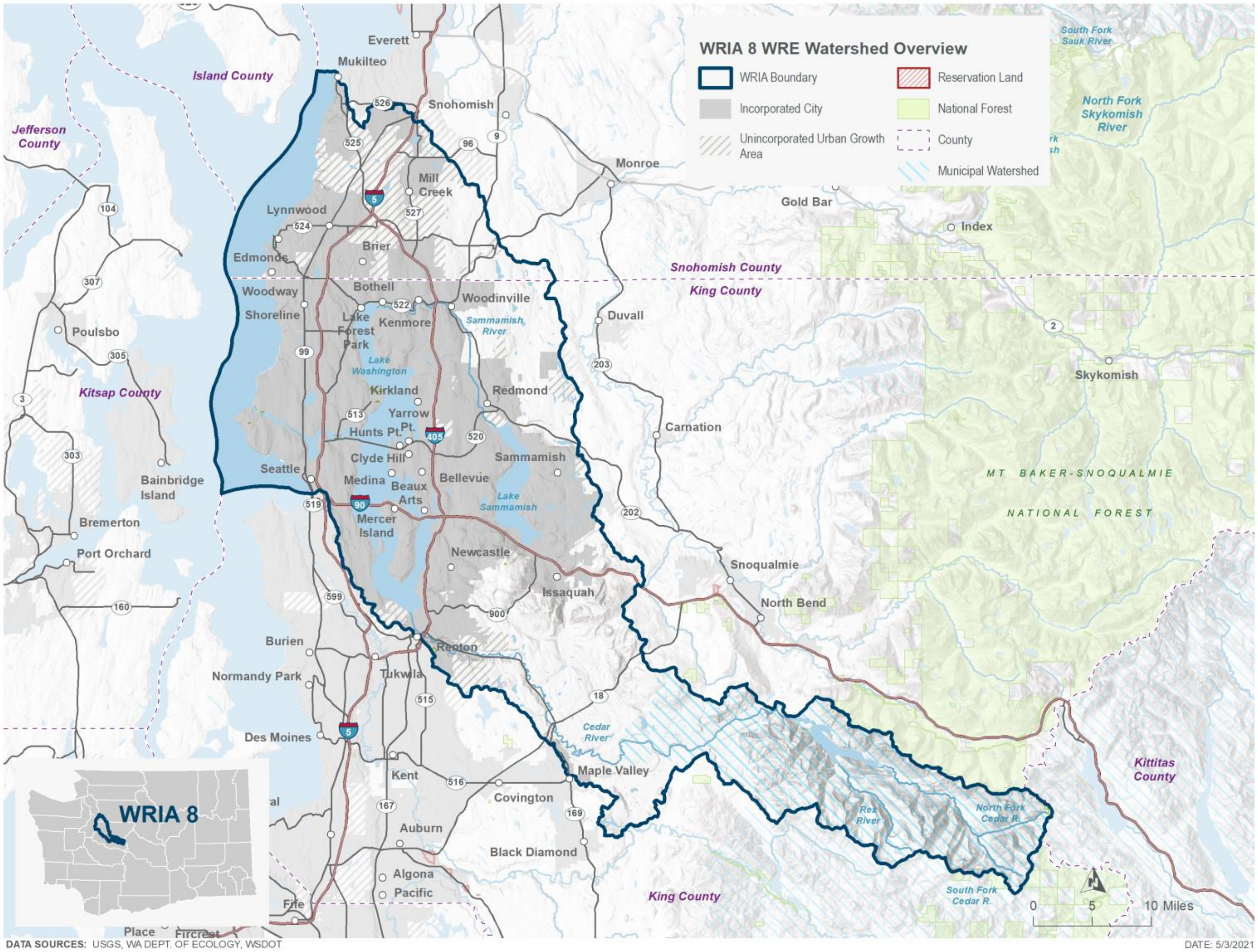

Figure 2.1: WRIA 8 Watershed Overview

2.1.3 Salmonids in WRIA 8

The Cedar-Sammamish watershed is an important and productive system for salmonids. Many tributaries provide spawning and rearing habitat for salmonids. These streams often experience low streamflows during critical rearing, migration, and spawning time. In addition, levees and other flood control and navigation measures have further limited habitat in lakes, rivers, and tributaries. The quality and quantity of spawning and rearing habitat, habitat access, water quality, including water temperature, and low streamflow, all affect local salmon populations (WRIA 8 Salmon Recovery Council 2017).

Salmon Presence (Fish Population and Life Histories)

The Cedar-Sammamish watershed has anadromous salmon runs that include three of the five North American Pacific salmon species (WDFW Salmonscape 2020a, SWIFD 2020). Chinook (*Oncorhynchus tshawytscha*), Coho (*Oncorhynchus kisutch*), and Sockeye Salmon (*Oncorhynchus nerka*) migrate in and out of the Cedar-Sammamish watershed from Puget Sound. Cutthroat Trout (*Oncorhynchus clarkii clarkii*), Rainbow trout (*Oncorhynchus mykiss*), kokanee (*Oncorhynchus nerka*) and Bull Trout (*Salvelinus confluentus*) also inhabit the watershed. Steelhead trout (*Oncorhynchus mykiss*) may now be functionally extirpated from this basin.

The Puget Sound evolutionarily significant unit of Chinook salmon was designated as threatened under the Endangered Species Act (ESA) in 1999 (64 FR 14308). Designated critical habitat for Chinook salmon includes marine nearshore and freshwater habitats within WRIA 8 (70 FR 52629). The Puget Sound distinct population segment of steelhead trout was designated as threatened under ESA in 2007 (72 FR 26722). Final designated critical habitat (DCH) for Puget Sound steelhead includes freshwater and estuarine habitat in Puget Sound, Washington (81 FR 9251) including areas within WRIA 8. The Coastal-Puget Sound Distinct Population Segment of Bull Trout was designated as threatened under ESA in 1999. Critical habitat has been designated for Bull Trout and includes both freshwater and saltwater aquatic habitat within WRIA 8 (75 FR 63897). Table 2.1 below lists the species present in the Cedar-Sammamish watershed and their regulatory status.

Table 2.1: Selected Salmonids Present within the Cedar-Sammamish Watershed

Common Name	Scientific Name	Evolutionary Significant Unit	Critical Habitat	Regulatory Agency Status
Chinook Salmon	Oncorhynchus tshawytscha	Puget Sound Chinook	Yes/2005	NMFS/ Threatened/ 1999
Coho Salmon	Oncorhynchus kisutch	Puget Sound/Strait of Georgia Coho	No	NMFS/Species of Concern/ 1997
Sockeye Salmon	Oncorhynchus nerka	No listing	No listing	No listing
Kokanee	Oncorhynchus nerka	No listing	No listing	No listing

Common Name	Scientific Name	Evolutionary Significant Unit	Critical Habitat	Regulatory Agency Status
Steelhead Trout	Oncorhynchus mykiss	Puget Sound steelhead	Yes/2016	NMFS/ Threatened/ 2007
Bull Trout	Salvelinus confluentus	Puget Sound Dolly Varden/Bull Trout	Yes/2010	USFWS/ Threatened/ 1999
Coastal Cutthroat Trout	Oncorhynchus clarkii clarkii	No listing	No listing	No listing
Rainbow Trout	Oncorhynchus mykiss	No listing	No listing	No listing

Table 2.2: Salmonid Life History Patterns within the Cedar-Sammamish Watershed

Sockeye in Bear Evans, Greater Lake Washington, Issaquah, Lake Sammamish Creeks, Little Bear Creek, Lower Cedar, May Coal, Sammamish River Valley, Seattle Lake Union, Swamp North, and Upper Cedar subbasins:

- Upstream migration May 15 through November 15.
- Spawning September through January.
- Incubation September 15 through April 15
- Fry emergence in April and May
- Juvenile rearing all year
- Juvenile outmigration April, May, to mid-June.

Chinook Salmon (fall) in all subbasins:

- Upstream migration August through November 15.

below lists the run timing and life stages of anadromous salmon and trout present throughout the watershed. Watershed specific data concerning salmonid life history and timing was largely summarized from the 2001 Salmon and steelhead Habitat Limiting Factors Report for the Cedar-Sammamish Basin (Water Resource Inventory Area 8) (Kerwin 2001).

Table 2.2: Salmonid Life History Patterns within the Cedar-Sammamish Watershed

Species	Freshwater Life Phase	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Subbasin Presence
Sockeye	Upstream migration										■	■	■	■	■	■	■	■	■	■	■	■				Bear Evans Greater Lake Washington Issaquah Lake Sammamish Creeks Little Bear Creek Lower Cedar May Coal Sammamish River Valley Seattle Lake Union Swamp North Upper Cedar
	Spawning	■	■															■	■	■	■	■	■	■	■	
	Incubation[1]	■	■	■	■	■	■	■											■	■	■	■	■	■	■	
	Fry emergence							■	■	■	■															
	Juvenile rearing	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
	Juvenile outmigration							■	■	■	■	■														
Chinook (fall)	Upstream migration															■	■	■	■	■	■	■				All
	Spawning																		■	■	■	■	■			
	Incubation	■	■	■	■	■													■	■	■	■	■	■	■	
	Juvenile rearing	■	■	■	■	■	■	■	■	■	■	■	■	■	■											
	Juvenile outmigration		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■									
Coho	Upstream migration															■	■	■	■	■	■	■	■	■		All
	Spawning																					■	■	■		
	Incubation	■	■																					■	■	
	Juvenile rearing	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	

Species	Freshwater Life Phase	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Subbasin Presence
Sockeye	Upstream migration	□□	□□	□□	□□	□■	■■	■■	■■	■■	■■	■□	□□	Bear Evans Greater Lake Washington Issaquah Lake Sammamish Creeks Little Bear Creek Lower Cedar May Coal Sammamish River Valley Seattle Lake Union Swamp North Upper Cedar
	Spawning	■■	□□	□□	□□	□□	□□	□□	□□	■■	■■	■■	■■	
	Incubation[1]	■■	■■	■■	■□	□□	□□	□□	□□	□■	■■	■■	■■	
	Fry emergence	□□	□□	□□	■■	■■	□□	□□	□□	□□	□□	□□	□□	
	Juvenile rearing	■■	■■	■■	■■	■■	■■	■■	■■	■■	■■	■■	■■	
	Juvenile outmigration	□□	□□	□□	■■	■■	■□	□□	□□	□□	□□	□□	□□	
Chinook (fall)	Upstream migration	□□	□□	□□	□□	□□	□□	□□	■■	■■	■■	■□	□□	All
	Spawning	□□	□□	□□	□□	□□	□□	□□	□□	□■	■■	■■	□□	
	Incubation	■■	■■	■□	□□	□□	□□	□□	□□	□■	■■	■■	■■	
	Juvenile rearing	■■	■■	■■	■■	■■	■■	■■	□□	□□	□□	□□	□□	
	Juvenile outmigration	□■	■■	■■	■■	■■	■■	■■	■■	□□	□□	□□	□□	
Coho	Upstream migration	□□	□□	□□	□□	□□	□□	□□	■■	■■	■■	■■	■□	All
	Spawning	□□	□□	□□	□□	□□	□□	□□	□□	□□	□□	■■	■□	
	Incubation	■■	□□	□□	□□	□□	□□	□□	□□	□□	□□	□□	■■	
	Juvenile rearing	■■	■■	■■	■■	■■	■■	■■	■■	■■	■■	■■	■■	
	Smolt outmigration	□□	□□	□□	□■	■■	■■	■□	□□	□□	□□	□□	□□	

Species	Freshwater Life Phase	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Subbasin Presence
Bull Trout[2]	Upstream migration														■	■	■	■	■							Greater Lake Washington Lake Sammamish Creeks Lower Cedar Sammamish River Valley Seattle Lake Union Upper Cedar
	Spawning																	■	■	■	■	■	■	■	■	
	Incubation	■	■	■	■	■	■	■	■											■	■	■	■	■	■	
Coastal Cutthroat Trout	Upstream migration																									All
	Spawning	■	■	■	■	■	■	■	■	■														■	■	
	Incubation	■	■	■	■	■	■	■	■	■	■															
	Fry emergence					■	■	■	■	■	■	■	■													
	Juvenile rearing	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
	Smolt outmigration						■	■	■	■	■	■														
Steelhead Trout (winter)	Upstream migration	■	■	■																				■	■	Bear Evans Greater Lake Washington Issaquah Lake Sammamish Creeks Little Bear Creek Lower Cedar May Coal Sammamish River Valley Seattle Lake Union Swamp North Upper Cedar
	Spawning			■	■	■	■	■	■	■	■															
	Incubation[3]	■															■	■	■	■	■	■	■	■	■	
	Juvenile rearing	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
	Smolt outmigration[3]					■	■	■	■	■	■	■	■													

Species	Freshwater Life Phase	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Subbasin Presence
Kokanee[4]	Spawning													Bear Evans Greater Lake Washington Issaquah Lake Sammamish Creeks Little Bear Creek Lower Cedar Sammamish River Valley Swamp North Upper Cedar
	Incubation													
Rainbow Trout[5]	Spawning													-Greater Lake Washington -Sammamish River Valley -Upper Cedar
	Incubation													

Notes:

1. Information on Sockeye Salmon incubation timing from the South Puget Sound Salmon Enhancement Group.
2. Information on Bull Trout life history patterns specifically within the Cedar-Sammamish watershed is unavailable. Bull Trout life history patterns for the Puget Sound Region were used within this report (King County 2000).
3. Information on Steelhead incubation and migration timing specifically within the Cedar-Sammamish watershed is unavailable. Steelhead incubation and out-migration timing for the Puget Sound Region were used within this report (Blanton et al. 2011).
4. Information on kokanee taken from the Lake Sammamish Late Run Kokanee Synthesis Report (HDR Engineering 2009).
5. Information on Rainbow trout life history specifically with the Cedar-Sammamish watershed is unavailable. Rainbow trout life history patterns for the Puget Sound Region were used within this report (Blanton et al. 2011).

Current Habitat Conditions[11]

The Cedar-Sammamish watershed is one of the more significantly altered watersheds on the West Coast. A variety of land uses have severely impacted the watershed, ranging from commercial forestry in the Upper Cedar River subbasin to intense urban and suburban development throughout the western portion of the watershed. Fundamental historical changes to WRIA 8 include:

- Seattle's use of the Cedar River as its main water supply (early 1900s).
- The construction of the Lake Washington Ship Canal and Hiram M. Chittenden locks (1911-1934).
- The redirection of the Cedar River from joining the Duwamish River via the Black River to entering the south end of Lake Washington (1910s).
- The channelization of the Sammamish River corridor (1920s).
- The conversion of forests and farmlands to residential, commercial, and industrial uses (1945-present).

The 2001 Salmon and Steelhead Habitat Limiting Factors Report (Kerwin 2001) and the 2005 WRIA 8 Chinook Salmon Conservation Plan list the following primary limiting factors in the Cedar-Sammamish watershed:

- Fish habitat access and passage barriers.
- Increased sedimentation and altered sediment transport processes.
- Loss of channel and shoreline complexity and connectivity.
- Degradation or lack of riparian conditions.
- Altered hydrology, including increased peak and reduced low flows.
- Water quality issues.
- Biological processes.
- Loss of floodplain connectivity.

Other emerging priority issues that limit salmon survival and recovery include parasites, nighttime lighting, warming waters especially in the ship canal and Sammamish River, and predation on juvenile salmon by invasive non-native fish. Although some issues are common

[11] The information on habitat conditions described in this section comes from the following sources: the 2001 Salmon and Steelhead Habitat Limiting Factors Report (Kerwin 2001), the 2005 WRIA 8 Chinook Salmon Conservation Plan (WRIA 8 Salmon Recovery Council 2005), and the 2017 WRIA 8 Chinook Salmon Conservation Plan Update (WRIA 8 Salmon Recovery Council 2017).

across WRIA 8, habitat conditions vary within the watershed's subbasins and are described below.

Puget Sound Shoreline

The Puget Sound Shoreline subbasin includes marine nearshore areas and independent tributaries to the Puget Sound. WRIA 8 tributaries to the Puget Sound have been substantially impacted by residential, commercial, and industrial uses. Development has caused fish passage barriers, altered stream hydrology, reduced channel complexity, and degraded riparian habitat in these highly impacted streams that can no longer support naturally reproducing salmonid populations. Residential and commercial development have adversely impacted the WRIA 8 marine nearshore habitat; however, the construction of a railroad line along 87% of the shoreline represents the most significant impact within this area of the watershed. The railroad construction destroyed marine, riparian vegetation and severely impacted nearshore processes by cutting off pocket estuaries and backshore habitats and the supply of beach sediment from bluff erosion to nearby beaches.

Seattle/Lake Union

The Seattle/Lake Union subbasin was drastically altered by the construction of the Lake Washington Ship Canal and opening of the Hiram M. Chittenden Locks, which created a connection between the Puget Sound, Lake Washington, and Lake Union. The subbasin is characterized by intensive commercial and recreational boat traffic and extensive residential, commercial, and industrial shoreline development. Bulkheads and shoreline armoring have greatly reduced natural overwater cover and riparian habitat quality. High water temperatures in the Ship Canal at lethal and sub-lethal levels during adult migration for both Chinook and Sockeye are key constraints to Chinook recovery (WRIA 8 Salmon Recovery Council 2017).

Greater Lake Washington

The Greater Lake Washington subbasin has a history of intense human impacts beginning in 1916 when its original outlet to the Black River was blocked and flow from the Cedar River was redirected to Lake Washington and the Lake Washington Ship Canal and Ballard Locks. As a result, the water level in Lake Washington dropped by about 10 feet, leading to a dramatic reduction in overall lake surface area, shallow water habitat, and adjacent wetland area. Currently, the lake shoreline consists primarily of dense urban residential development. Approximately 71% of the Lake Washington shoreline is classified as hardened by either rip-rap or bulkheads. According to the Limiting Factors Report, "current and future land use practices all but eliminate the possibility of the shoreline to function as a natural shoreline to benefit salmonids (Kerwin 2001)." Limited natural vegetation, large wood, and natural shoreline conditions exist along the shoreline. Lake Washington tributaries have also suffered due to intense development. These streams are characterized by numerous fish passage barriers, limited pool habitat, fragmented or non-existent riparian habitat buffers, and changes to natural hydrologic regimes, including reduced low flows. Water temperature and dissolved oxygen are known to be significant limiting factors for both juvenile and adult salmon. The Lake Washington Ship Canal, the sole migration route for salmon to and from Lake Washington, routinely reaches temperatures of 21-23+ degrees Celsius by July each year. These high temperatures are believed to have contributed to disease leading to the pre-spawn mortality of approximately 40% of the Cedar River Sockeye run in both 2014 and 2015 (NWIFC 2016).

Swamp/North

The Swamp/North subbasin combines the Swamp Creek and North Creek watersheds and drains to the Sammamish River Valley. The subbasin is characterized by a mix of urban and suburban residential and commercial development. Numerous fish passage barriers are scattered throughout the subbasin. Road crossings, streambank hydromodification, channel incision, historical and on-going clearing, and development in riparian areas have greatly reduced channel complexity and floodplain connectivity. Water quality issues within the subbasin include excessive fecal coliform bacteria, water temperature, copper, lead, zinc, chromium, and low dissolved oxygen. The main issues within this subbasin include a lack of large wood, high levels of impervious surfaces, impaired riparian areas, and reduced floodplain connectivity.

Little Bear

The Little Bear Creek subbasin drains to the Sammamish River Valley and is characterized by a mix of rural and suburban residential and commercial development. The majority of the subbasin is accessible to anadromous salmon and trout. Approximately 40% of the subbasin is still forested and the Little Bear Creek subbasin has the least degraded salmonid habitat compared to other Sammamish River tributaries. However, numerous fish passage barriers are scattered throughout the subbasin, large wood recruitment is limited, and low flow problems exist (Lombard and Somers 2004). Riparian habitat condition varies widely throughout the subbasin with some riparian forests intact and others severely degraded or completely cleared.

Bear/Evans

The Bear/Evans subbasin combines the Bear Creek and Evans Creek watersheds and drains to the Sammamish River Valley. The subbasin is characterized by a mix of rural and suburban residential and commercial development. According to the Washington Department of Fish and Wildlife (WDFW) Washington State Fish Passage Map (WDFW 2020b), numerous fish passage barriers including culverts, dams, weirs, high velocity streamflows, and beaver dams are scattered throughout the subbasin. The loss of large wood and wetland habitat and the conversion of floodplain and riparian habitat areas to residential, commercial, and industrial development have dramatically reduced channel complexity and floodplain connectivity. Water quality issues within the subbasin include increased turbidity, high water temperature, reduced low flows, and excessive fecal coliform bacteria.

Sammamish River Valley

The Sammamish River Valley subbasin extends from the north end of Lake Sammamish to the northern tip of Lake Washington. Prior to Euro-American settlement, the area was a vast complex of wetlands connected by the slow-moving Sammamish River. The river corridor and adjacent areas were heavily logged throughout the 19^{th} and 20^{th} centuries. The 1916 opening of the Chittenden Locks lowered Lake Washington and drained large areas of sloughs and wetland habitat within the river valley. As agricultural land use expanded into the floodplain, farmers began to straighten the Sammamish River channel and construct extensive drainage ditches. In the 1960s, U.S. Army Corps of Engineers began to dredge the mainstem Sammamish River to prevent flooding of the adjacent farmlands. The combination of agricultural development and dredging of the river dramatically decreased floodplain habitat connectivity and complexity. Ultimately, the length of the river was reduced by nearly four miles and became disconnected from the floodplain and many of its tributary streams. The Sammamish River and its contributing subbasins are impacted by numerous fish passage barriers, elevated water temperatures, bank hardening features, limited pool habitat, little floodplain hydrologic connectivity, reduced forest cover, increased impervious surfaces, reduced low flows, and reduced or fragmented riparian buffers. Lethal and sub-lethal temperatures in the Sammamish River during adult migration are a key constraint on recovery of Chinook (WRIA 8 Salmon Recovery Council 2017).

Lake Sammamish Creeks

A mix of residential, commercial, agricultural, and forestry land practices impact Lake Sammamish and its tributaries. The majority of the Lake Sammamish shoreline is privately owned and consists of residential development and associated hardened shoreline. Water quality issues, invasive plant and fish species, elevated water temperatures, low dissolved oxygen, and fragmented or inadequate riparian habitat buffers are the main habitat limiting factors within the lake. Of the 27 miles of streams that flow into Lake Sammamish, only 4 miles are accessible to anadromous fish. Erosion, dredging, and culvert blockages have rendered many of these streams inaccessible to migrating salmonids. Population density and the concomitant development of rural lands is expected to increase within the basin. Lake Sammamish tributaries are severely impacted by fish passage barriers, high levels of impervious surfaces, a lack of large woody debris, loss of channel complexity, reduced low flows, and fragmented riparian habitat buffers.

May/Coal

The May/Coal subbasin combines the May Creek and Coal Creek watersheds and drains to Lake Washington. This subbasin is characterized by a mix of residential and commercial development. Extensive coal mining in the early 1900s changed the course of streams and urban development continues to impede natural hydrology. Major habitat impacts within the subbasin include extensive sedimentation problems, loss of channel complexity, high water temperatures, reduced low flows, and increased impervious surfaces.

Issaquah

The Issaquah subbasin drains to Lake Sammamish and is characterized by a mixture of land uses including commercial forests; parks; quarry and mining; residential; commercial; and agricultural. The subbasin contains high quality habitat and productive populations of salmon (Kerwin 2001). However, habitat-limiting factors include limited off-channel rearing and refuge habitat, a lack of large wood, several fish passage barriers, and high water temperatures

(Ecology 2020). WDFW has a hatchery on Issaquah Creek that raises Chinook and Coho. Decreasing low flow trends are of concern (King County 2009).

Lower Cedar

The Lower Cedar River subbasin is characterized by agricultural and forestry in the east and residential, commercial, and industrial land uses in the west. The Lower Cedar River and its tributaries are characterized by a lack of floodplain connectivity, numerous fish passage barriers (WDFW 2020b), limited pool habitat, increase in impervious surfaces, fragmented or inadequate riparian buffers, reduced low flows, and several flood control facilities and bank hardening features. WDFW and Seattle Public Utilities co-operate a hatchery on the Cedar River near the Landsburg diversion dam.

Upper Cedar

Land use within the Upper Cedar River subbasin is slowly transitioning from commercial forestry to forest preservation. The Upper Cedar River is protected as Seattle's municipal drinking water source and is being restored following impacts from historic commercial forestry practices.

2.2 Watershed Planning in WRIA 8

Residents and local, state, federal, and tribal governments have collaborated on watershed and water resource management issues in WRIA 8 for decades. This section provides a brief summary of broad watershed planning efforts as they relate to the past, present, and future water availability in the Cedar-Sammamish watershed.

2.2.1 Related Planning Efforts in WRIA 8

This watershed plan builds on many of the past efforts to develop comprehensive plans for the entire watershed. For example, the South Central Action Area Caucus Group (South Central Local Integrating Organization) developed an ecosystem recovery plan as part of the Action Agenda for Puget Sound Recovery. The planning process to develop an ecosystem recovery plan is community based with engagement by local, state, and federal agencies. The approach is holistic, addressing everything from salmon to orca recovery, stormwater runoff, and farmland and forest conservation.

The WRIA 8 Salmon Recovery Council is the Salmon Recovery Lead Entity, a collaboration of local government partners and community groups, state and federal agencies, businesses, and citizens focused on protecting and enhancing wild salmon populations. The Salmon Recovery Council formed in 2000 and developed the *Lake Washington/Cedar/Sammamish Watershed (WRIA 8) Chinook Salmon Conservation Plan* in 2005. Since 2005, the WRIA 8 Salmon Recovery Council has worked to implement the *Salmon Conservation Plan* and updated the plan in 2017 (WRIA 8 Salmon Recovery Council 2017).

The South Central LIO and WRIA 8 Salmon Recovery Council include many of the same organizations and individuals that participated in the WRIA 8 Watershed Restoration and Enhancement Committee.

Priority Actions from Salmon Recovery Plan

The *Lake Washington/Cedar/Sammamish Watershed Chinook Salmon Conservation Plan Update* (WRIA 8 Salmon Recovery Council 2017) recommends a combination of projects and programs to protect, restore, and enhance salmonid habitat and watershed ecosystem processes. Projects include:

- Removing or setting back flood control levees and revetments.
- Installing large wood.
- Planting native vegetation and removing invasive weeds in riparian areas throughout the watershed.
- Replacing lakeshore armoring with natural shoreline or soft-shore alternatives.
- Replacing fish passage barriers.
- Property acquisition to protect high functioning habitat.

The plan identifies high priority habitat protection and restoration projects on the following water bodies: Cedar River, Bear/Cottage Lake Creek, Issaquah Creek, Sammamish River, Lake Washington shoreline, Lake Sammamish shoreline, Lake Union/Ship Canal, Puget Sound nearshore, North Creek, Little Bear Creek, Evans Creek, and Kelsey Creek. The *WRIA 8 Salmon Conservation Plan* also recommends land use actions that support habitat protection and restoration by addressing impacts from development, stormwater, increased impervious surface, etc.

Coordinated Water System Planning

Coordinated Water System Plans (CWSPs) are mandated by the Public Water System Coordination Act of 1977. King County passed ordinances ratifying four CWSPs (East King County, Skyway, South King County, and Vashon). Snohomish County updated their CWSP in 2010. These plans ensure that water system service areas are consistent with local growth management plans and development policies. The location of new homes in relation to and within designated retail water system service areas and related policies determine if homes connect to a water system, or rely on a PE well. Within their designated retail service area(s), water purveyors are given first right of refusal for new connections. The purveyor may decline to provide service if water cannot be made available in a 'reasonable and timely' manner. However, it can be the case that a new permit-exempt well is drilled without making any inquiries with the county or with the local water system.

Watershed Characterization and Planning

The Puget Sound Watershed Characterization Project is a tool used in Puget Sound by planners and resource managers to identify areas to prioritize for habitat protection and restoration, and areas more suitable for development.[12] The project covers the entire Puget Sound drainage area — from the Olympic Mountains to the Cascades.

The characterization results may help:

- Achieve a more functional and resilient natural watershed ecosystem.
- Identify and resolve areas of conflict between proposed land use actions and protection of watershed resources.
- Identify the root cause of watershed issues and develop appropriate solutions.

For the purpose of this watershed plan, the characterization tool can help Ecology understand if identified projects are likely to achieve an ecological benefit. A component of the characterization project is a study by WDFW of the relative conservation value of freshwater habitat conducted at the small drainage area Assessment Unit (AU) scale (Wilhere et. Al. 2013). This freshwater habitat index has three components: the density of hydro-geomorphic features, local salmonid habitats, and the accumulative downstream habitats. Quantity and quality of habitats were assessed for eight salmonid species. The index is the relative value of the freshwater habitat in an Assessment Unit based on an average of:

- The density of wetlands and undeveloped floodplains inside the AU.
- The quantity and quality of salmonid habitats inside the AU.
- The quantity and quality of salmonid habitats outside and downstream of the AU.

An analysis of projects in this plan in relation to the freshwater habitat index is presented in Chapter 6.

2.2.2 Coordination with Related Plans

Throughout the development of this watershed plan, Ecology streamflow restoration staff engaged with staff from the WRIA 8 Salmon Recovery Council, South Central LIO, and the Puget Sound Partnership, providing briefings on the streamflow restoration law, scope of the watershed plan, and plan development status updates. Throughout the committee phase of the planning process, the WRIA 8 Committee coordinated closely with the WRIA 8 Salmon Recovery Council, including inviting lead entity staff to join the WRIA 8 Committee as an ex-officio member. Many of the habitat projects are included in this watershed plan based on information from the Salmon Conservation Plan.

Snohomish County and King County planning staff contributed to the plan development to ensure consistency with the counties' Comprehensive Plans. The Comprehensive Plans set policy for development, housing, public services and facilities, and environmentally sensitive

[12] For more information, visit the Puget Sound Watershed Characterization Project website.

areas, among other topics. The Comprehensive Plans identify Snohomish and King Counties' urban growth areas, set forth standards for urban and rural development, and provide the basis for zoning districts.

2.3 WRIA 8 Geology, Hydrogeology, Hydrology, and Streamflow

2.3.1 Geologic Setting

Understanding the geologic setting of WRIA 8 helps to characterize surface and groundwater flow through the watershed. The relationships between surface water flow and deeper groundwater are important to understanding how to manage surface water resources and can be helpful in identifying strategies to offset the impacts of pumping from permit-exempt wells.

Within WRIA 8, bedrock forms mountain ranges and uplands and generally consists of igneous and sedimentary rocks. Within drainages and lowland areas, glacial and alluvial sediments overlay the bedrock (Washington State Department of Natural Resources 2020). At least four major glaciations covered the lower portion of the watershed during the Pleistocene Epoch (about 11,700 years to 2.6 million years ago), the most recent glacier being the Vashon ice sheet (Jones 1998; Vaccaro et al. 1998; Booth et al. 2003). The advance and retreat of the Vashon ice sheet shaped the present topography and drainage network in WRIA 8 (Evans 1996). These processes created ridges and lakes linked by drainage channels (Booth and Goldstein 1994; Evans 1996) and deposited and left behind glacial till, recessional and advance outwash, and glaciolacustrine deposits in lowland areas. Glacial till deposits generally consist of dense, silty sand with gravel and silt lenses. Outwash deposits generally consist of sand and gravel with locally abundant wood debris and peat. Glaciolacustrine deposits generally consist of silt and clay. These glacial deposits can be over 1,500 feet thick within the lower portions of the watershed (Jones 1996; Vaccaro et al. 1998).

Recent alluvial deposits are generally associated with channel and overbank deposits from the modern Cedar and Sammamish Rivers and their tributaries. These sediments generally consist of stratified silt, sand, gravel, with minor amounts of clay.

2.3.2 Hydrogeologic Setting

The U.S. Geological Survey identified six hydrogeologic units within the sequence of Puget Sound glacial and alluvial sediments within WRIA 8 (Vaccaro 1998). The hydrogeologic units typically alternate between aquifer units and semi-confining to confining layers (non-water-bearing units) which lack sufficient permeability to form aquifers.

Within the upper portion of the watershed, glacial and alluvial sediments occur within the Cedar River valley and drainages associated with area tributaries. Shallow glacial and alluvial sediments are widespread within the lower portion of the watershed. Glacial and alluvial aquifers are generally unconfined (under water-table conditions) except where overlain by low permeability confining layers (generally till or glaciolacustrine deposits). Transmissivity (a hydraulic property related to the rate of groundwater flow through an aquifer) and storativity (a hydraulic property related to the capacity of an aquifer to store/release water) of these aquifers vary significantly with depositional environment and are generally the highest in outwash sands and gravels and lowest in fine-grained alluvial deposits. Glacial and alluvial aquifers are characterized by a shallow depth to the groundwater table and, where applicable, a direct hydraulic connection with adjacent surface water.

Bedrock aquifers underlay the entire watershed. However, within the lower portions of the watershed, glacial and alluvial sediments are hundreds to thousands of feet thick (Jones 1996; Vaccaro et al. 1998). Water supply wells seldom target the bedrock aquifers. The glacial and alluvial layers generally become thinner to the east within WRIA 8. Relatively shallow and frequently outcropping bedrock underlies much of the watershed southeast of Bellevue.

Bedrock aquifers are generally of relatively low transmissivity and storativity: they do not allow for much groundwater flow or storage. Wells completed within bedrock aquifers typically do not have high enough capacity for municipal use. However, they can be valuable aquifers for residential water uses, and in specific areas are an important target aquifer for permit-exempt wells.

Recharge to glacial, alluvial, and bedrock aquifers within WRIA 8 is primarily associated with precipitation, applied irrigation, septic systems, leakage from surface water within losing reaches (where streamflow infiltrates to groundwater), and through leakage from adjacent aquifers. An important component of recharge, particularly to the deep aquifers, occurs through mountain-front recharge. In WRIA 8, this includes recharge to shallower aquifers surrounding the Issaquah Alps and to aquifers adjacent to the Cascade Range in the southeastern part of the WRIA (Rock Creek/Ravensdale area). The WRIA 8 watershed's aquifers discharge to water supply wells, adjacent aquifers, gaining reaches of streams, and Puget Sound. Summer base flows in WRIA 8 rivers and tributaries are sustained by groundwater (baseflow) on most of the lower-elevation tributaries.

Regionally, groundwater flow direction within the watershed's aquifers generally is perpendicular to the westerly slope of the Cascade Range, although groundwater flow in shallow aquifers is more influenced by surface topography and streamflow within the watershed and is directed to the northwest. This groundwater flow paradigm is complicated throughout the watershed by aquifer boundaries, aquifer heterogeneities, topography, the influence of gaining and losing stream reaches, well pumping, and other factors.

2.3.3 Hydrology and Streamflow

The Cedar River and its headwaters are located in a snowmelt transition region where the rivers are fed by both snowmelt and rainfall. Within low elevation portions of the watershed, mean annual precipitation ranges from about 30 to 40 inches per year. Mean annual precipitation increases with topographic elevation and can exceed 120 inches within the Cascade Range (MGS Engineering Service and Oregon Climate Service 2006). Most precipitation occurs during the late fall and winter. Precipitation is lowest during the summer when water demands are highest. During these low precipitation periods, streamflow is highly dependent upon groundwater inflow (baseflow).

Washington Administrative Code (WAC) 173-508 set minimum instream flows for the Cedar River and closed lakes and streams contributing to the Lake Washington drainage above the Hiram M. Chittenden Locks to further consumptive appropriations.

In the vicinity of Chester Morse Lake and the Masonry Pool, the stage of the Cedar River is controlled for municipal supply and hydroelectric power generation by Masonry Dam and associated secondary control structures. The Instream Flow Commission, which includes City of Seattle, Muckleshoot Indian Tribe, National Marine Fisheries Service, Washington Department of Ecology, Washington Department of Fish and Wildlife, King County, and the U.S. Army Corps of Engineers (Army Corps), meets regularly to review current hydrologic conditions and help guide real-time instream flow management for the Cedar River, pursuant to the Cedar River Watershed Habitat Conservation Plan (City of Seattle 2020b). The Muckleshoot Indian Tribe also has a 2006 Agreement with the City of Seattle.

The Sammamish River has been extensively channelized during the 20th century and is controlled by an outlet weir installed in 1964. The Army Corps of Engineers controls the lake levels in Lake Washington through operation of the Chittenden Locks.

Cedar River and Sammamish River streamflow conditions are summarized by the following:

<u>USGS stream gage 12116500 (Cedar River at Cedar Falls)</u>: At this upper watershed location, mean daily discharge ranges from 100 cfs in September to 512 cfs in December (U.S. Geological Survey 2020) for the period of record from April 1914 to June 2020. This gage is the farthest upstream station on the Cedar River.

<u>USGS stream gage 12119000 (Cedar River at Renton)</u>: Near its discharge location in Renton, Washington, mean daily discharge ranges from 187 cfs in August to 1,140 cfs in January (U.S. Geological Survey 2020) for the consistent record from August 1945 to June 2020. This gage is also a compliance station for instream flows in chapter 173-508 WAC.

<u>USGS stream gage 12125200 (Sammamish River near Woodinville)</u>: Near Woodinville, Washington, mean daily discharge of the Sammamish River ranges from 72 cfs in August to 624 cfs in January (U.S. Geological Survey 2020) for February 1965 to June 2006. King County took over gaging from the USGS.

<u>USGS stream gage 12121600 (Issaquah Creek near mouth</u>): Mean daily discharge is 30 cfs in August and 270 cfs in January for the period of record from October 1963 through March 2020.

King County also gages Bear Creek near the mouth (gage 02A), and other tributaries.

Anticipated future climate impacts will result in continued loss of snow in the Cascade Range, combined with rising temperatures and changes in precipitation. Earlier spring snowmelt, lower snowpack, increased evaporative losses, and warmer and drier summer conditions will intensify summer drought conditions and low flow issues in WRIA 8. These climate impacts are expected to drive changes in seasonal streamflows, increasing winter flooding while intensifying summer low flow conditions. For the Cedar River, climate modeling predicts average minimum flows to be 25 percent lower (range: -32 to -13 percent) by the 2080s for a moderate warming scenario, relative to 1970 to 1999 (Mauger et al. 2015).

Several factors contribute to streamflow: snowpack and rate of melt, rainfall, surface water runoff, and groundwater discharge. In addition to environmental factors, surface water withdrawals and groundwater pumping from wells in hydraulic continuity with surface water affect streamflow.

This plan addresses impacts on groundwater discharge to streams due to withdrawals from permit-exempt wells for domestic use. Pumping from wells can reduce groundwater discharge to springs and streams by capturing water that would otherwise have discharged naturally. Groundwater pumping may diminish surface water flows. Consumptive water use (that portion not returned to the immediate water environment) potentially reduces streamflow, both seasonally and as average annual recharge. A well drawing from an aquifer connected to a surface water body either directly or through an overlying aquifer can either reduce baseflow or increase the quantity of water leaking out of the river (Ecology 1995). Water use from new permit-exempt domestic wells represents only a portion of all water use and factors affecting streamflow in the watershed.

Chapter Three: Subbasin Delineation

3.1 Introduction to Subbasins

Water Resource Inventory Areas are large watershed areas formalized under Washington Administrative Code for the purpose of administrative water management and planning. WRIAs encompass multiple landscapes, hydrogeologic regimes, levels of development, and variable natural resources. To allow for meaningful analysis of the relationship between new consumptive water use (consumptive use) and offsets per Ecology's Final NEB Guidance,[13] the plan divides WRIA 8 into subbasins. Subbasins help describe the location and timing of projected new consumptive water use, the location and timing of impacts to instream resources, and the necessary scope, scale, and anticipated benefits of projects. In some instances, subbasins did not correspond with hydrologic or geologic basin delineations (e.g. watershed divides).[14]

3.2 Approach to Develop Subbasins

The plan divides WRIA 8 into 12 subbasins for purposes of assessing consumptive use and project offsets. Ecology concurs with the subbasin delineations developed by the WRIA 8 Committee. The WRIA 8 Committee based the subbasin delineations on existing subwatershed units, interim growth projections developed by Snohomish County and King County, and the following guiding principles:

Use USGS hydrologic unit code subwatershed (HUC-12) boundaries in the Snohomish County portion of the watershed (USGS 2013; USGS 2016).

Use King County drainage basin boundaries in the King County portion of the watershed (King County 2018).

Combine HUC-12s (Snohomish County) and drainage basins (King County) in areas of the watershed that are urbanized and have existing water service and are therefore unlikely to have new homes using PE wells.

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[13] "Planning groups must divide the WRIA into suitably sized subbasins to allow meaningful analysis of the relationship between new consumptive use and offsets. Subbasins will help the planning groups understand and describe location and timing of projected new consumptive water use, location and timing of impacts to instream resources, and the necessary scope, scale, and anticipated benefits of projects. Planning at the subbasin scale will also allow planning groups to consider specific reaches in terms of documented presence (e.g., spawning and rearing) of salmonid species listed under the federal Endangered Species Act." Final NEB Guidance p. 7.

[14] This is consistent with Final NEB Guidance that defines subbasins as a geographic subarea within a WRIA. A subbasin is equivalent to the words "same basin or tributary" as used in RCW 90.94.030(3)(b).

Keep distinct subbasins for HUC-12s and drainage basins with higher projected growth of new homes using PE wells.

The WRIA 8 subbasin delineations are shown on Figure 3.1 and summarized below in Table 3.1. A more detailed description of the subbasin delineation is in the technical memo available in Appendix D.

Table 3.1: WRIA 8 Subbasins

Subbasin Name	**Primary Rivers and Tributaries**	**County**
Seattle/Lake Union	Elliott Bay and Lake Union	King County
Puget Sound Shorelines	Streams draining directly to Puget Sound between the City of Mukilteo and the City of Seattle, including Pipers Creek, Boeing Creek, and Shell Creek	Snohomish County and King County
Swamp/North	Swamp Creek and North Creek	Snohomish County and King County
Little Bear	Little Bear Creek	Snohomish County and King County
Sammamish River Valley	Sammamish River	Snohomish County and King County
Bear/Evans	Bear Creek and Evans Creek	Snohomish County and King County
Greater Lake Washington	Streams draining to Lake Washington, including Lyon Creek, McAleer Creek, Thornton Creek, Juanita Creek, Forbes Creek, and Kelsey Creek	Snohomish County and King County
May/Coal	Coal Creek and May Creek	King County
Lake Sammamish Creeks	Streams draining to Lake Sammamish, including Tibbets Creek	King County
Issaquah	Issaquah Creek	King County
Lower Cedar	Cedar River below the Landsburg diversion dam	King County
Upper Cedar	Cedar River above the Landsburg diversion dam	King County

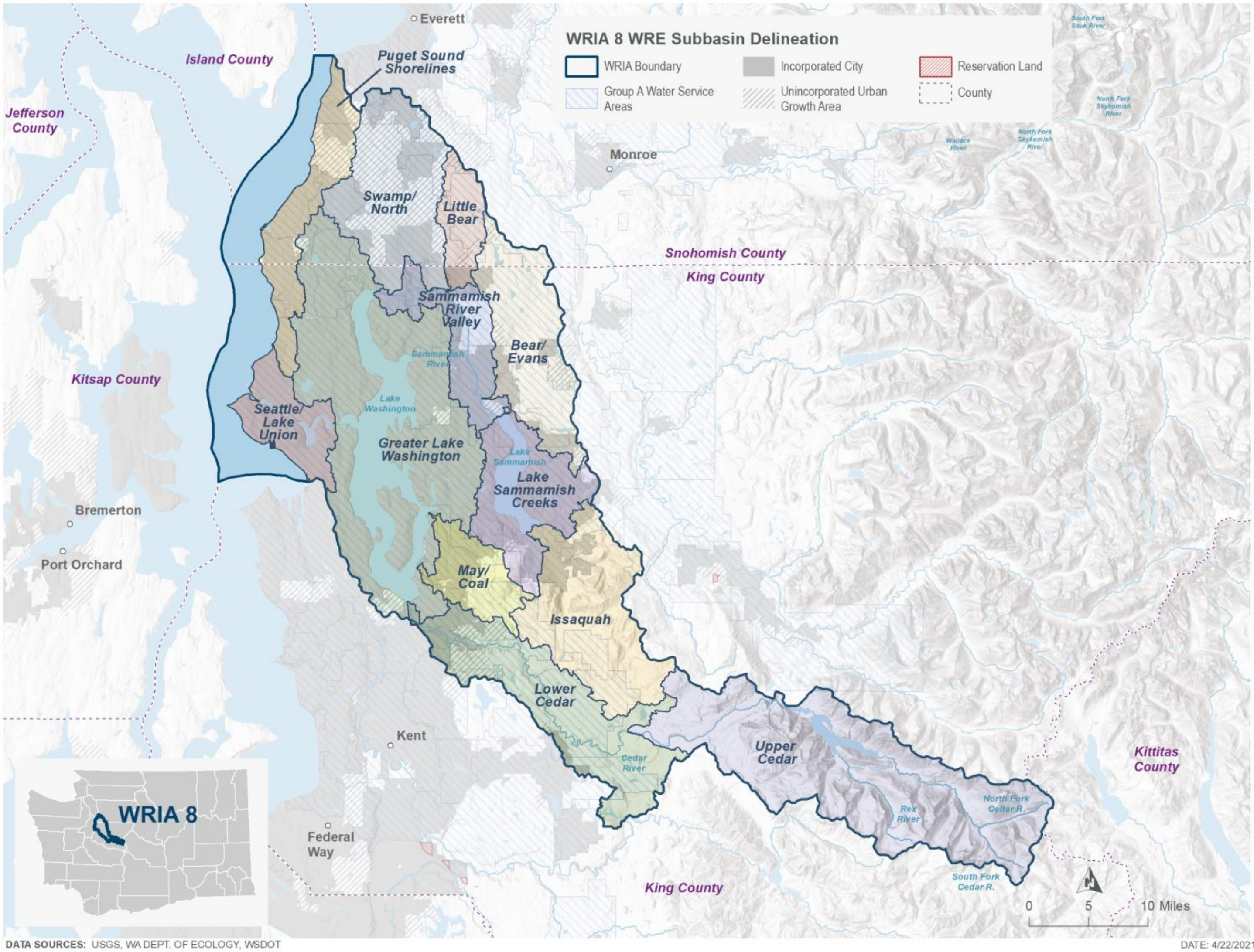

Figure 3.1: WRIA 8 Subbasin Delineation

Chapter Four: New Consumptive Water Use Impacts

4.1 Introduction to Consumptive Use

The Streamflow Restoration law requires watershed plans to include "estimates of the cumulative consumptive water use impacts over the subsequent twenty years" for "new domestic groundwater withdrawals exempt from permitting under RCW 90.44.050" (RCW 90.94.030(3)(e) and RCW 90.94.030(6)).The Final NEB Guidance states that, "Watershed plans must include a new consumptive water use estimate for each subbasin, and the technical basis for such estimate" (pg. 7). This chapter provides the projections of new permit-exempt domestic well connections (PE wells) and their associated consumptive use[15] for the planning horizon.

Ecology concurs with the analysis completed by the technical consultants for the WRIA 8 Committee and the results are consistent with the WRIA 8 Committee's draft watershed plan. Additional information on the methods and results used to project new PE wells and consumptive use is available in the technical memos in Appendix D.

Addressing Uncertainties, Assumptions, and Limitations Associated with Projections for PE Wells and Consumptive Use. Uncertainties and limitations are inherent with any planning process. Appropriate data are not always available, so analyses rely on the best available information and often require assumptions to fill the gaps. Ecology based the PE well projections and consumptive use estimates in this chapter on the best information available at the time and presents assumptions associated with the projections. The technical memos in Appendix D provide more detail on the assumptions that Ecology used in this plan.

4.2 Projection of New Permit-Exempt Well Connections (2018 - 2038)

The plan projects 967 new PE wells over the planning horizon.[16] Most of these wells are likely to be installed in the following subbasins outside of city limits and the Urban Growth Areas (UGAs): Lower Cedar, Issaquah, Bear/Evans, and Little Bear.

[15] New consumptive water use in this document is from projected new homes connected to permit-exempt domestic wells associated with building permits issued during the planning horizon. Generally, new homes will be associated with wells drilled during the planning horizon. However, new uses could occur where new homes are added to existing wells serving group systems under RCW 90.44.050. In this document, the well use discussed refers to both these types of new well use. PE wells may be used to supply houses, and in some cases other Equivalent Residential Units (ERUs) such as small apartments. For the purposes of this document, the terms "house" or "home" refer to any permit-exempt domestic groundwater use, including other ERUs.

[16] Ecology concurs with the PE well projection methods and results from the WRIA 8 Committee's draft plan. The PE well projection in this plan (967 new PE wells) is consistent with the PE well projection in the WRIA 8 Committee's draft plan.

The method used to project the number of new PE wells over the planning horizon, referred to as the PE well projection method, is based on recommendations from Appendix A of Ecology's Final NEB Guidance (Ecology 2019a). The following sections provide the 20-year projections of new PE wells for each subbasin within WRIA 8, the methods used to develop the projections (PE well projection method), and uncertainties associated with the projections.

4.2.1 PE Well Connections Projection by Subbasin

This WRIA 8 watershed plan uses the Snohomish County and King County PE well projection data at both the WRIA scale and by subbasin. The projection for new PE wells in WRIA 8 by subbasin is shown in Table 4.1 and Figure 4.1.

Table 4.1: Number of PE Wells Projected between 2018 and 2038 for the WRIA 8 Subbasins

Subbasins	King County	Snohomish County	Cities and Urban Growth Areas	Total PE Wells per Subbasin
Seattle/Lake Union	0	--	0	0
Puget Sound Shorelines	0	--	2	2
Swamp/North	0	0	5	5
Little Bear	0	118	0	118
Sammamish River Valley	8	--	0	8
Bear/Evans	138	92	4	234
Greater Lake Washington	0	--	4	4
May/Coal	15	--	0	15
Lake Sammamish Creeks	6	--	0	6
Issaquah	235	--	0	235
Lower Cedar	338	--	2	340
Upper Cedar	0	--	0	0
Totals	740	210	17	967

The total projection for WRIA 8 is 967 new PE wells over the planning horizon. King County projects approximately 740 new PE wells within WRIA 8 portions of unincorporated King County. Snohomish County projects approximately 210 new PE wells within WRIA 8 portions of unincorporated Snohomish County. The King and Snohomish County methods do not account for potential PE wells in cities or UGAs. The plan includes a projection of 17 new PE wells within cities and UGAs based on an analysis the technical consultants completed (UGA Well Log Spot Check).

4.2.2 Methodology

King and Snohomish Counties used historical building data to project new potential PE wells, assuming the rate and general location of past growth will continue over the planning horizon. Using past building permits to predict future growth is one of the recommended methods in the Final NEB Guidance (Ecology 2019a). In this final plan, Ecology deferred to and incorporated the information provided by King and Snohomish Counties to determine PE well growth estimates.

Due to data availability, which differed for the two counties, King and Snohomish County used different methods to estimate the number of homes that would be served by community water systems and municipalities, and removed those homes from the PE well projection. Snohomish County considered distance to existing water lines, whereas King County considered historical rates of connection to water service within water service area boundaries.[17] King and Snohomish Counties completed their analyses internally and their methods are described in detail in Appendix D.

The plan also uses the technical consultant's evaluation of potential PE wells within city limits and UGAs using data from Ecology's Well Report Viewer database.

King County completed a PE Well Potential Assessment which identified potential parcels where development could occur within rural King County. Snohomish County completed a similar assessment which they have referred to as a Rural Capacity Analysis. The PE Well Potential Assessment and Rural Capacity Analysis results were used to assess whether a subbasin has the capacity to accommodate the number of PE wells projected over the planning horizon.

The sections below summarize the growth projection methods. The WRIA 8 Growth Projections Technical Memorandum provides a more detailed description of the analysis and methods (Appendix D).

King County PE Well Projection Methodology

King County used historical residential building permit and parcel data from 2000 through 2017 to project the number of new PE wells for the planning horizon in unincorporated King County (referred to as the past trends analysis). This data set considers economic and building trends over an 18-year period and the method assumes that past trends will continue.

King County projected the number of new PE wells over the planning horizon using the following steps:

[17] Water service area boundaries include areas currently served by existing water lines and may also include areas not yet served by water lines. King County used historic rates of connection to water service to predict future rates of connection because King County does not have County-wide information on the location of water lines.

Gather historical building permit and parcel data (2000–2017) for new residential structures.[18]

Assess the total number of permits and average number of permits per year for WRIA 8.

Link building permit and parcel data to determine water source for each building permit/parcel and separate into public, private, and other water source categories. Consider a building permit with water source listed as "private" as a PE well.

Calculate the number and percentage of building permits for each type of water source (public, private, or other) inside and outside water services areas by subbasin, and for the WRIA overall.

Then the technical consultants used the King County past trends analysis to develop PE well projections by subbasin using the following steps:

Calculate the projected number of PE wells per year for each subbasin by multiplying the average number of building permits per year by the percentage of building permits per subbasin, and percentage of building permits using a private water source (well) per subbasin.

Multiply the projected number of PE wells per year per subbasin by 20 to calculate the total of PE wells projected over the planning horizon for each subbasin.

Add 6% to the 20-year PE well projection per subbasin to account for gaps in the building permit and parcel data (6% error is based on the percentage of building permits with "other" as the water source).

Tabulate the total PE wells projected over the planning horizon, including the 6% error, for each subbasin and sum to get the total of PE wells projected over the 20-year planning horizon in rural unincorporated King County.

Snohomish County PE Well Projection Methodology

Snohomish County developed three PE well projection scenarios based on development trends and population projections, which are described in Appendix D. This plan uses the scenario that reviewed past development trends within WRIA 8 to estimate the number and location of potential new homes over the planning horizon (referred to as the past trends analysis).[19]

Snohomish County used a different method than King County for their past trends analysis. They used a geographic information system (GIS) model to identify areas where homes are

[18] King County used the time period 2000 through 2017 because that data was available. The building permit data for 2000 through 2017 includes both periods of high growth and periods of low growth. King County compared these data with information from the Vision 2040 regional plan and population data and is confident in using the average of this time period to project into the future.
[19] Ecology concurs with the WRIA 8 Committee's decision to use the past trends analysis method for the Snohomish County PE well projection.

likely to connect to water service, based on proximity to existing water distribution lines (referred to as public water service areas). Areas that were not proximal to existing water distribution lines were assumed to be served by a PE well (referred to as PE well areas).[20] Snohomish County used this spatial model, in combination with analysis of year-built data from 2008-2018 for recently built single-family residences, to develop PE well projections. The method assumes that past trends will continue, that water lines now are representative of water lines in the future, and that homes built close to water lines as they exist now will connect to public water service and not to PE wells.

Snohomish County projected the number of new PE wells over the planning horizon using the following steps:

Gather year-built data for single-family residences (i.e. housing units or HUs) built between 2008–2018.

Assign HUs to “public water service areas” or “PE well areas” based on the distance to existing water mains. Assume HUs in “PE well areas” will use a PE well for the water source.

Estimate the number of HUs per subbasin for each type of water source (public water service or PE well) and calculate the percentage of HUs per subbasin for each type of water source.

Calculate the average number of HUs per year (2008-2018) and multiply by 20 to calculate the estimated total of HUs projected over the planning horizon for rural unincorporated Snohomish County.

Apply HU projections to WRIA 8 subbasins based on the past percentage of growth per subbasin and past percentage of HU for each type of water source per subbasin.

Tabulate the total PE wells projected over the planning horizon for each subbasin and sum to get the total of PE wells projected over the planning horizon in rural unincorporated Snohomish County.

Urban Growth Area PE Well Projection Methodology

The King County and Snohomish County PE well projection methods do not account for potential PE wells within cities or UGAs. The technical consultants completed an analysis of potential PE well growth within the city limits and UGAs using data from Ecology’s Well Report Viewer database (referred to as the UGA well log spot check).

[20] PE well areas are more than 100’ from a water main for homes that are not part of a subdivision and more than ¼ mile from a water main for homes that are part of a subdivision. See Snohomish County Growth Projections and Rural Capacity Analysis Methods in Appendix D for additional information.

The general method included using Ecology's Well Report Viewer database (1998–2018) to query water wells with characteristics of a domestic well[21] within city limits and UGAs. The technical consultants randomly reviewed a subset of the water well reports and calculated the number and percentage of each type of well (domestic, irrigation, other and incorrect) located within the cities and UGAs. They multiplied the percentage of wells identified as domestic (assumed to be PE wells) by the total number of wells located within cities and UGAs to estimate the number of PE wells installed in the cities and UGAs over the past 20-year period. The technical consultants also verified the physical address of the wells with the city and UGA boundaries to determine which subbasin the domestic wells were located in. The technical consultants used the total number of domestic wells per subbasin over the past 20 years to project the number of PE wells located within the cities and UGAs over the planning horizon for each WRIA 8 subbasin. A more detailed methodology is included in Appendix D.

King County PE Well Potential Assessment

King County completed an assessment of parcels available for future residential development in unincorporated King County (referred to as the PE well potential assessment). The plan uses the PE Well Potential Assessment to assess whether a subbasin has the capacity to accommodate the number of PE wells projected over the planning horizon.

King County screened parcels with potential for future residential development by subbasin using criteria such as parcel size, zoning district, and appraised improvements. The County determined the total number of parcels and dwelling units[22] (DUs) per subbasin and labeled them as either inside or outside the water district service boundaries. King County then projected the water source for each parcel or DU (public water or PE well) based on historic rates of connection to water service inside water district service boundaries. King County used historic rates of connection to water service because the County does not have County-wide information on the location of water lines. The technical consultants compared the 20-year PE well projection to the PE well potential assessment. In areas where the number of projected PE wells exceeded the potential parcels available, they reallocated those PE wells to the nearest subbasin with parcel capacity and similar growth patterns. The result is one well was redistributed from the Upper Cedar subbasin to the Lower Cedar subbasin in the King County portion of WRIA 8. A more detailed methodology and list of assumptions is included in Appendix D.

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[21] Ecology's complete Well Report Viewer database was filtered for water wells 6 to 8 inches in diameter and greater than 30 feet deep, which are typical dimensions and depths for domestic wells. The Ecology Well Report Viewer database does not have the ability to filter for permit-exempt domestic wells.

[22] A dwelling unit is a rough estimate of subdivision potential based on parcel size and zoning (e.g. a 22-acre parcel zoned RA-5 is assumed to allow 4 dwelling units). King County's dwelling unit is comparable to Snohomish County's housing unit.

Snohomish County Rural Capacity Analysis

Snohomish County completed a Rural Capacity Analysis in 2011 that resulted in an assigned future residential development capacity for each parcel in the rural area. Snohomish County updated their 2011 analysis to determine capacity to accommodate the 20-year PE well projection at the WRIA and subbasin level.

Snohomish County identified parcels with potential for future residential development by subbasin using screening criteria. For each parcel, Snohomish County calculated residential development capacity based on development status, parcel size, density, and other attributes. The County assigned parcels to "public water service areas" or "PE well areas" per the past trends analysis method and aggregated the residential development capacity by subbasin and water source. Snohomish County compared the 20-year PE well projection with the rural capacity analysis and calculated the shortfall or surplus of available parcels to be sourced by PE wells. In areas where the number of projected PE wells exceeded the potential parcels available, the technical consultants reallocated those PE wells to the nearest subbasin with parcel capacity and similar growth patterns. Fifty-nine wells were reallocated from the Little Bear subbasin to the Bear/Evans subbasin in the Snohomish County portion of WRIA 8. A more detailed methodology and list of assumptions is included in Appendix D.

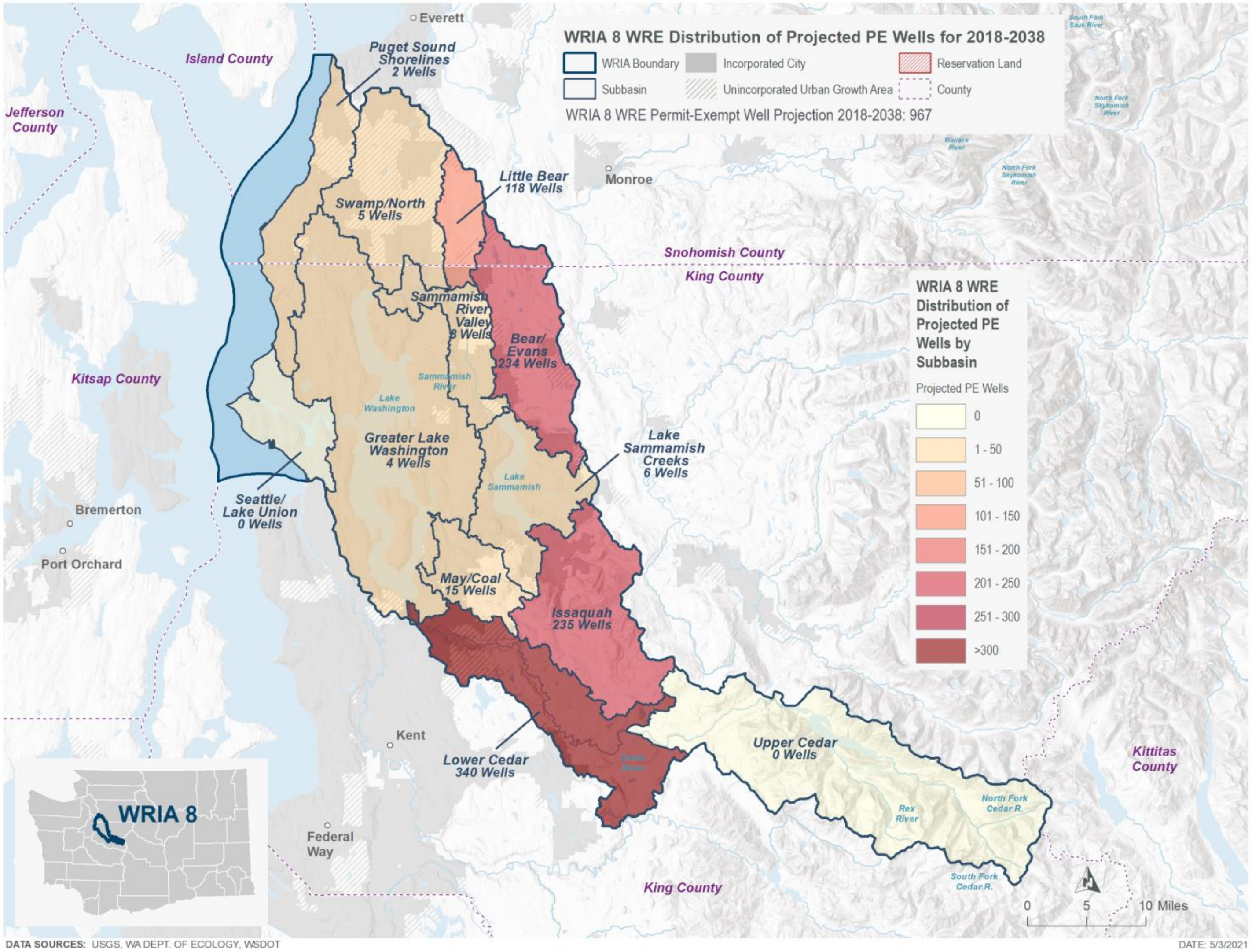


Figure 4.1: WRIA 8 Distribution of Projected PE Wells for 2018-2038

4.3 Impacts of New Consumptive Water Use

The plan uses the 20-year projection of new wells for WRIA 8 (967) to estimate the new consumptive water use that this watershed plan must address and offset. The plan estimates 425.4 acre-feet per year (AFY) (0.59 cfs) of new consumptive water use in WRIA 8.[23]

This section includes an overview of the methods used to estimate new consumptive water use and an overview of the anticipated impacts of new consumptive use in WRIA 8 over the planning horizon. The WRIA 8 Consumptive Use Estimates Technical Memorandum provides a more detailed description of the analysis and alternative scenarios considered (Appendix D).

4.3.1 Methods to Estimate Indoor and Outdoor Consumptive Water Use

Indoor water use patterns differ from outdoor water use. Indoor use is generally constant throughout the year, while outdoor use occurs primarily in the summer months. The portion of water that is consumptive varies for indoor and outdoor water use. Appendix A of the Final NEB Guidance (Ecology 2019a) describes a method (referred to as the Irrigated Area Method) which assumes average indoor use per person per day, and reviews aerial imagery to provide a basis to estimate irrigated area of outdoor lawn and garden areas. The Irrigated Area Method accounts for indoor and outdoor consumptive use variances by using separate approaches to estimate indoor and outdoor consumptive use.

To develop the consumptive use estimate, the plan used the Irrigated Area Method and relied on assumptions for indoor use and outdoor use from Appendix A of the Final NEB Guidance. This chapter provides a summary of the technical memo, which is available in Appendix D.

Consistent with the Final NEB guidance (Appendix B, pg. 25), the plan assumes impacts from consumptive use on surface water are steady-state, meaning impacts to the stream from pumping do not change over time. Household water use will likely vary seasonally, with higher water use and well pumping during the summer months. However, this plan assumes impacts are steady-state based on the wide distribution of future well locations and depths across varying hydrogeological conditions, and because empirical data to support the assumption is not locally available. While consumptive use impacts will essentially be steady-state, they

[23] Ecology concurs with the consumptive use methods and results from the WRIA 8 Committee's draft plan. The consumptive use estimate in this plan (425.4 AFY) is consistent with the consumptive use estimate in the WRIA 8 Committee's draft plan. The WRIA 8 Committee added a margin of safety to the consumptive use estimate to account for uncertainties in the PE well projections and consumptive use estimate. The WRIA 8 Committee sought projects to offset at least 698.9 AFY (referred to as the offset target). The offset target was based on the consumptive use scenario that assumes each home uses 950 gallons of water per day for indoor and outdoor household use (the legal annualized withdrawal limit per PE well connection), described in the consumptive use technical memo in Appendix D. Ecology does not include a margin of safety or offset target in this plan because Ecology considers 425.4 AFY a conservative estimate of consumptive use. See the WRIA 8 Consumptive Use Estimates Technical Memorandum in Appendix D for more information.

represent the greatest percentage of surface flow during the low flow periods of late summer and early fall.

New Indoor Consumptive Water Use

Indoor water use refers to the water that households use in kitchens, bathrooms, and laundry (Ely and Kahle 2012). The plan used the Irrigated Area Method and the following assumptions, recommended in Appendix A of the Final NEB Guidance, to estimate household consumptive indoor water use:

- 60 gallons per day (gpd) per person of indoor daily water use.
- 2.73 and 2.75 persons per household assumed for rural portions of King and Snohomish Counties, respectively.[24] For areas spanning both counties, a weighted value was estimated based on the number of projected PE wells in each county.
- 10% of indoor use is consumptively used (or a consumptive use factor (CUF) of 0.10), based on the assumption that homes on PE wells are served by onsite sewage systems (septic). Onsite sewage systems return most wastewater back to the immediate water environment; a fraction of that water is lost to the atmosphere through evaporation in the drainfield.

The equation used to estimate household consumptive indoor water use is:

60 gpd x 2.73 to 2.75 people per house x 365 days x .10 CUF

This results in an annual aggregated average of 0.0184 AF[25] (16.4 gpd or 0.000025 cfs[26]) indoor consumptive water use per day per well.

New Outdoor Consumptive Water Uses

Most outdoor water use is for irrigating lawns, gardens, and landscaping. To a lesser extent, households use outdoor water for car and pet washing, exterior home maintenance, pools, and other water-based activities. Water from outdoor use does not enter onsite sewage systems, but instead typically infiltrates into the ground or is lost to the atmosphere through evapotranspiration (Ecology 2019a).

[24] Data on average household size was provided by King County and Snohomish County.

[25] Acre-foot is a unit of volume for water equal to a sheet of water one acre in area and one foot in depth. It is equal to 325,851 gallons of water. 1 acre-foot per year is equal to 893 gallons per day.

[26] Cubic feet per second (CFS) is a rate of the flow in streams and rivers. It is equal to a volume of water one foot high and one foot wide flowing a distance of one foot in one second. 1 cubic foot per second is equal to 646,317 gallons per day.

The technical consultants used aerial imagery to measure the irrigated areas of 153 randomly selected parcels in seven[27] subbasins with projected PE wells to develop an average outdoor irrigated area per subbasin. The technical consultants selected the parcels from a pool of over 400 recent (2006-2017) building permits for new single-family residential homes not served by public water. For subbasins with more than 20 applicable building permits, a statistically representative sample size was identified to ensure that the sample mean is representative over the WRIA. The average irrigated area for the 153 randomly selected parcels, when aggregated across subbasins, was 0.32 acres per parcel.

The plan used the following assumptions, recommended in Appendix A of the Final NEB Guidance, to estimate household outdoor consumptive water use:

- The amount of water needed to maintain a lawn varies by subbasin due to varying temperature and precipitation across the watershed. The technical consultants used the Washington Irrigation Guide (WAIG) (NRCS-USDA 1997) Seattle-UW station and surrounding stations to develop a weighted average crop irrigation requirement (IR) for commercial turf grass in each subbasin (the WRIA average IR is 15.66 inches). This value represents the amount of water needed to maintain a green lawn.
- Irrigation application efficiency (AE) of 75% to account for water that does not reach the turf. This increases the amount of water used to meet the crop's irrigation requirement.
- Consumptive use factor (CUF) of 0.8, reflecting 80% consumption for outdoor use. This means 20% of outdoor water is returned to the immediate water environment.
- Outdoor irrigated area per subbasin based on the irrigated footprint analysis (the WRIA average irrigated area size is 0.32 acres per PE well).

The equation used to estimate outdoor consumptive indoor water use is:

IR by subbasin (inches) ÷ 0.75 AE x average irrigated area by subbasin (acres) x 0.80 CUF

First, water loss is accounted for by dividing the crop irrigation requirement (total water depth used to maintain turf) by the application efficiency. Next, that number is multiplied by the area

[27] The analysis covered seven of the ten subbasins in WRIA 8 with projected PE well connections. Due to small sample sizes, the subbasin-level results for Lake Sammamish Creeks, Sammamish River Valley, and May/Coal subbasins are not considered representative. Parcels in these subbasins were included in the overall average, but average irrigated areas from similar adjacent subbasins (Bear/Evans, Little Bear, and Lower Cedar, respectively) were used for the purpose of subbasin-scale consumptive use estimates. The Puget Sound Shorelines, Greater Lake Washington, and Swamp/North subbasins (with two, four, and five projected PE well connections, respectively) did not have any recent building permits for sites without purveyor-provided water service from which to estimate subbasin-specific irrigated area. The average irrigated area for the Little Bear subbasin was applied for purposes of subbasin-scale consumptive use estimates. Puget Sound Shorelines, Greater Lake Washington, and Swamp/North subbasins are almost entirely within the Urban Growth Area (UGA) and may have homes on smaller lots with smaller lawns than homes in Little Bear subbasin, which is mostly outside the UGA.

which is irrigated. Finally, the volume of water is multiplied by 80 percent to produce the outdoor consumptive water use. To convert the equation from inches to acre-feet, divide the result by 12.

The result is total outdoor consumptive water use per PE well per subbasin ranging from 0.36 AFY in the Little Bear subbasin to 0.47 AFY in the May/Coal and Issaquah Creek subbasins. The outdoor consumptive use varies by subbasin due to differences in average outdoor irrigated area size and irrigation requirements across the watershed. This estimate is the total annual outdoor consumptive use; the expectation is that more outdoor water use will occur in the summer than in the other months.

4.3.2 Consumptive Use Estimate for WRIA 8 and by Subbasin

The total consumptive use estimate for WRIA 8 is 425.4 AFY. The total consumptive use estimate for WRIA 8 is the PE well projection (see section 4.2) multiplied by the total indoor and outdoor consumptive use per PE well.

Table 4.2 summarizes the estimated indoor and outdoor consumptive use by subbasin. The highest consumptive use is expected in the subbasin with the largest irrigated area per PE well and the most anticipated new PE wells, as presented in Figure 4.2.

Table 4.2: Consumptive Use (CU) Estimate Based on Irrigated Area Method

Subbasin	Projected PE wells	Average Lawn Size (Acres)	Indoor CU per Well (AFY)	Outdoor CU per Well (AFY)	Total CU/Year per Well (AFY)	Total CU 2018-2038 (AFY)
Seattle/Lake Union	0	-	-	-	-	0
Puget Sound Shorelines	2	0.28	0.0185	0.42	0.44	0.9
Swamp/North	5	0.28	0.0185	0.38	0.40	2.0
Little Bear	118	0.28	0.0185	0.36	0.38	44.3
Sammamish River Valley	8	0.28	0.0183	0.39	0.41	3.2
Bear/Evans	234	0.31	0.0184	0.39	0.41	96.7
Greater Lake Washington	4	0.28	0.0183	0.43	0.45	1.8
May/Coal	15	0.33	0.0183	0.47	0.49	7.4
Lake Sammamish Creeks	6	0.31	0.0183	0.43	0.44	2.7
Issaquah	235	0.37	0.0183	0.47	0.49	115.3
Lower Cedar	340	0.33	0.0183	0.43	0.44	151.2
Upper Cedar	0	-	-	-	-	0
Totals	967	0.33	0.0184	0.42	0.43	425.4

Note: Values in table have been rounded.

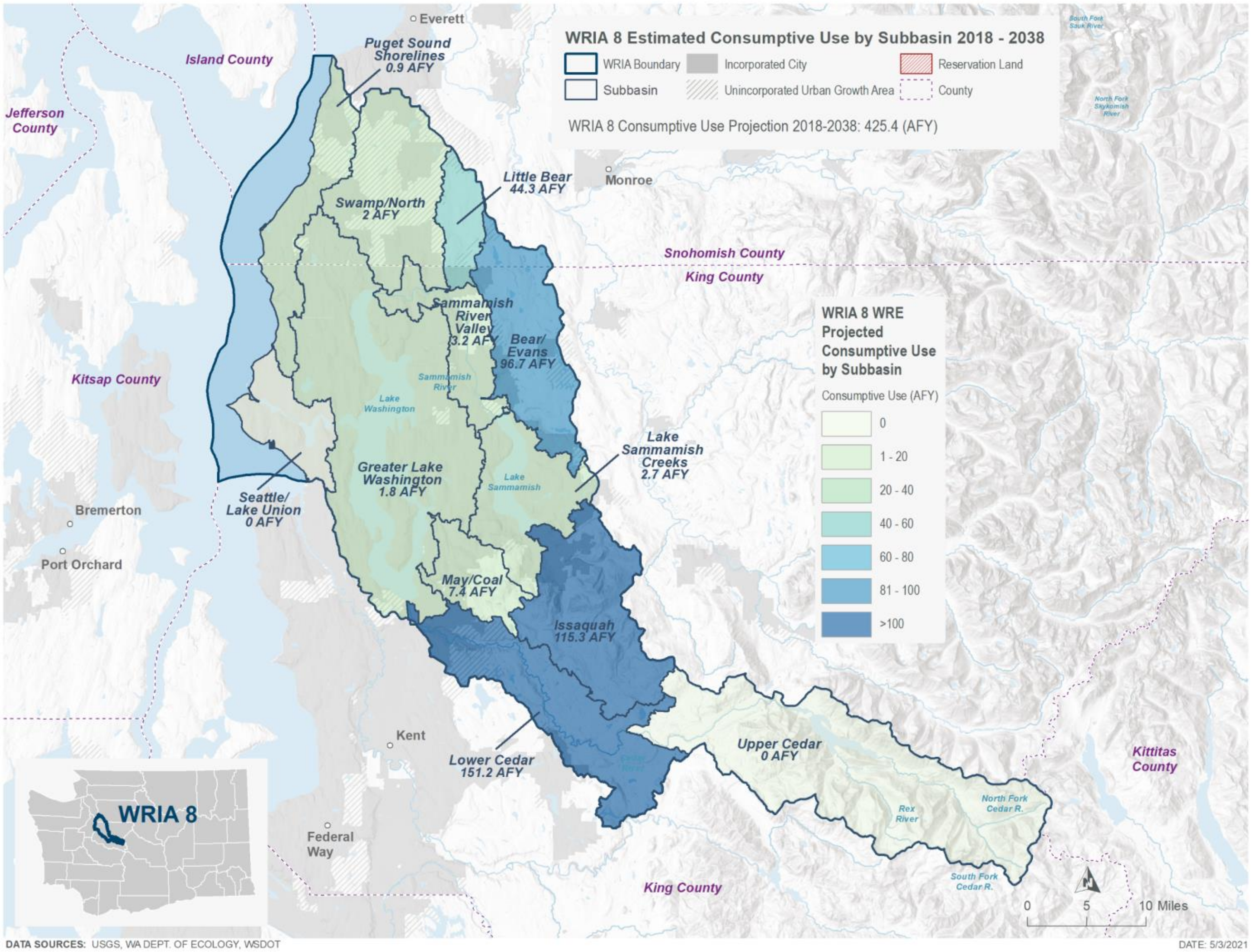


Figure 4.2: WRIA 8 Estimated Consumptive Use by Subbasin 2018-2038

Chapter Five: Projects and Actions

5.1 Introduction to Projects and Actions

Watershed plans must identify projects that offset the potential impacts future PE wells have on streamflows and provide a net ecological benefit to the WRIA. RCW 90.94.030(3)(b) requires the plan to offset consumptive use at the watershed scale.

The approach to identifying and selecting projects is described in Section 5.1.1. Ecology considered the WRIA 8 Committee's project list as a starting point in order to develop the final list of projects and actions that, once implemented, achieve the water offset and meet the NEB criteria outlined in RCW 90.94.030. Ecology revised the WRIA 8 Committee's project list to focus on projects with identified project sponsors and reflect new information available prior to the adoption of the plan. Ecology included 33 projects in the plan with an estimated offset of 1,805.1 AFY. The 10 water offset projects are described in section 5.2.1 and the 23 habitat projects are described in section 5.2.2. Detailed project descriptions are included in Appendix E.

5.1.1 Approach to Identify and Select Projects

This plan categorizes projects as water offset projects and habitat projects. Water offset projects have a quantified streamflow benefit and contribute to offsetting consumptive use. Habitat projects contribute toward achieving NEB by focusing on actions that improve the ecosystem function and resilience of aquatic systems, support the recovery of threatened or endangered salmonids, and protect instream resources including important native aquatic species. Habitat projects may also result in an increase in streamflow, but the water offset benefits for these projects is difficult to quantify with a high degree of certainty. Therefore, the plan does not rely on habitat projects to contribute toward offsetting consumptive use.

Ecology relied on much of the project information generated during the WRIA 8 Committee planning process. Technical consultants researched project concepts, analyzed estimated water offset for projects, contacted project sponsors, and developed project descriptions. Ecology also solicited project ideas from WRIA 8 Committee members and local partners. The technical consultants worked with the WRIA 8 Committee to develop new water offset project concepts with quantifiable streamflow benefits. Through this effort, two reclaimed water managed aquifer recharge projects are included in the plan.

In a separate effort, Ecology contracted with Washington Water Trust (WWT) to identify opportunities for water right acquisition water offset projects within WRIA 8, including source switches to municipal water and reclaimed water. WWT developed water right selection criteria based on the unique local nature of water rights and water use in WRIA 8. The water rights assessment consisted of four categories of potential projects: irrigation water rights in priority subbasins, irrigation water rights near existing reclaimed water infrastructure, water rights in the Trust Water Rights Program as a temporary donation, and specific water right acquisition opportunities identified by the WRIA 8 Committee. WWT developed water right acquisition project opportunity profiles, which included an estimate of the consumptively used portion of water. Eight water rights acquisitions projects are included in the plan.

The list of habitat projects was developed by reviewing projects recommended by WRIA 8 Committee members, projects submitted by local project sponsors, and projects identified by technical workgroup members based on the WRIA 8 Committee's priorities for project types and locations (projects in priority subbasins that are likely to have streamflow benefits). Ecology retained the WRIA 8 Committee's prioritization of subbasins for habitat projects: Sammamish River Valley, Bear/Evans, Lake Sammamish Creeks, Issaquah, and Lower Cedar. Twenty-three habitat projects are included in the plan.

In finalizing this plan, Ecology evaluated projects based on their feasibility and likelihood of implementation. This plan contains projects that Ecology has identified as having a high likelihood of implementation based on their technical merit and project sponsor support.

5.2 Projects and Actions

The projects presented below have water offset and/or ecological benefits. Ecology identified these projects as contributing toward offsetting consumptive use and achieving NEB.

All project sponsors agreed to have their projects listed here. Although project sponsors noted a willingness to proceed, the listing of a project in this plan does not obligate Ecology to fund a project or the project sponsor to carry out the project (see Ecology's POL-2094). Therefore, this plan does not guarantee that sponsors will complete these projects or that expected benefits will occur. Ecology encourages project sponsors to complete the projects, and provides incentives through the streamflow restoration grant program.

5.2.1 Water Offset Projects

Table 5.1 provides a summary of the 10 water offset projects included in the plan to offset consumptive use and contribute toward NEB. The total offset potential of these 10 projects for WRIA 8 is 1,805.1 acre-feet per year. Offset benefits are anticipated in the subbasins listed in Table 5.1 as well as downstream of the respective project locations. Figure 5.1 is a map of the watershed that shows the location of the projects listed in Table 5.1.

For the water right acquisition projects included in this watershed plan, Ecology relied on the WWT evaluations to estimate water offsets shown in Table 5.1. WWT estimated the consumptively used portion of the water right. Ecology will conduct a full extent and validity analysis to determine the actual quantity available for acquisition and the consumptively used portion before water rights are transferred to the Trust Water Rights Program. This analysis generally happens after the water right holder has agreed to sell. See Section 5.3.2 for more detail on cost estimates.

In addition to the water right acquisition projects summarized in this section, Ecology supports further development of projects that acquire water rights from willing sellers to increase streamflows and offset the impacts of PE wells. Water rights should be permanently transferred to the Trust Water Rights Program to ensure that the benefits to instream resources are permanent.

The Managed Aquifer Recharge (MAR) projects presented in this watershed plan are the known opportunities at the time of publication, and calculations are based on the best available site information. These projects represent well-formed project concepts, but they do not provide design or feasibility study elements. WRIA 8 partners may identify future MAR projects that use recycled water or surface water and which will support offset benefits. Ecology encourages project partners to undergo a feasibility study for all MAR projects to identify any water quality, permitting, and design requirements. MAR projects funded through Streamflow Restoration grant funding are required to complete a feasibility study prior to any other phases of the MAR project being eligible for funding.

Water offset amounts for each project identified in this plan are based on calculations developed by project sponsors and technical consultants. In finalizing this plan, Ecology deferred to projects developed by the WRIA 8 committee, and provided further evaluation to include projects that have a high certainty of providing the estimated water offset. More information on the certainty of project implementation is described in Section 5.3.3 below. A summary description for each project is provided below. More detailed water offset project descriptions, including water offset calculations and assumptions, are provided in Appendix E.

Table 5.1: WRIA 8 Water Offset Projects

Project Number	Project Name	Project type	Subbasin(s)	Water Offset (AFY)	Project Sponsor	Estimated Project Cost
8-LB-W1	Snohomish County Recycled Water Managed Aquifer Recharge	Water storage and retiming - MAR	Little Bear	181	Washington Water Trust	$623,000
Little Bear Subbasin Subtotal				**181 AFY**		

Project Number	Project Name	Project type	Subbasin(s)	Water Offset (AFY)	Project Sponsor	Estimated Project Cost
8-SRV-W2	Wayne Golf Course Water Right Acquisition (Pre-Identified No. 7)	Water right acquisition	Sammamish River Valley	3.54	City of Bothell	$9,101
8-SRV-W3	Sixty Acres Park Water right Acquisition	Water right acquisition	Sammamish River Valley	126	King County	$323,900
8-SRV-W4	Pre-Identified No. 8 Water Right Acquisition	Water right acquisition	Sammamish River Valley	23.43	Washington Water Trust	$60,200
8-SRV-W5	Sammamish River Valley Irrigation Water Rights Acquisitions	Water right acquisition	Sammamish River Valley	551.83	Washington Water Trust	$1,428,755
8-SRV-W6	Sammamish River Valley Recycled Water Managed Aquifer Recharge	Water storage and retiming - MAR	Sammamish River Valley	181	Washington Water Trust	$623,000
Sammamish River Valley Subbasin Subtotal				**885.8 AFY**		

Project Number	Project Name	Project type	Subbasin(s)	Water Offset (AFY)	Project Sponsor	Estimated Project Cost
8-BE-W7	Pre-Identified No. 1 Water Right Acquisition[1]	Water right acquisition	Bear/Evans	346.8	Washington Water Trust	$891,600

Bear/Evans Subbasin Subtotal **346.8 AFY**

Project Number	Project Name	Project type	Subbasin(s)	Water Offset (AFY)	Project Sponsor	Estimated Project Cost
8-I-W9	Pre-Identified No. 4 Water Right Acquisition	Water right acquisition	Issaquah	286	Washington Water Trust	$735,300

Issaquah Subbasin Subtotal **286 AFY**

Project Number	Project Name	Project type	Subbasin(s)	Water Offset (AFY)	Project Sponsor	Estimated Project Cost
8-LC-W10	Riverbend Mobile Home Park Water Right Acquisition (Pre-Identified No. 9)	Water right acquisition	Lower Cedar	20.1	King County	$51,700
8-LC-W11	Pre-Identified No. 5 Water Right Acquisition[1]	Water right acquisition	Lower Cedar	85.4	Washington Water Trust	$219,600

Lower Cedar Subbasin Subtotal **105.5 AFY**

WRIA 8 Total Water Offset (Cumulative from above)	**1,805.1 AFY**
WRIA 8 Consumptive Use Estimate	**425.4 AFY**

Notes:
Project 8-I-W8: Pre-Identified No. 2 Water Right Acquisition was included in the WRIA 8 Committee's draft plan. This project is not included in this plan because of new information regarding likelihood of implementation.
[1] These water right acquisition projects do not have detailed project descriptions in Appendix E.

Little Bear Subbasin

Project Name: Snohomish County Recycled Water Managed Aquifer Recharge (8-LB-W1)
Project Description: The Snohomish County Recycled Water MAR project proposes to divert reclaimed water from the Brightwater treatment plant to a constructed MAR facility between May and October, when reclaimed water is expected to be available. This diverted water infiltrates into the shallow aquifer, is transported down-gradient, and ultimately discharges to one or more adjacent streams as re-timed groundwater baseflow. The goal of the project is to increase baseflow to the subject stream(s), especially during the critical flow period when surface flows are lowest, by recharging the aquifer adjacent to the stream(s) and providing additional groundwater discharge to the river through MAR. As of 2021, reclaimed water is only available via King County's recycled water pipeline within the Sammamish River Valley. However, King County is in the process of designing and constructing additional storage capacity at Brightwater, which would allow for distribution of reclaimed water to areas proximal to the plant and eventually to other portions of Snohomish County as reclaimed water infrastructure expands to meet future demand.

Initial calculations indicate the Snohomish County Recycled Water MAR project could infiltrate approximately 181 acre-feet annually. Additional information is included in the project description in Appendix E.

Sammamish River Valley Subbasin

Project Name: Wayne Golf Course Water Right Acquisition (Pre-Identified Water Right No. 7) (8-SRV-W2)
Project Description: The Wayne Golf Course Water Right Acquisition project proposes to permanently acquire two groundwater rights in the Sammamish River Valley subbasin for an estimated 3.54 acre-feet annually of consumptively used water. The land, and a portion of the underlying water right, was previously used as a golf course. The other active irrigation within the water rights place of use occurred on a city park. The property is located within the City of Bothell. The City of Bothell purchased the property in 2017 with assistance from King County, which now holds a conservation easement over the property.

The City of Bothell temporarily donated the water right to the Trust Water Rights Program until March 31, 2026. The offset estimate is based on information provided by the City of Bothell to Ecology for the donation. An extent and validity determination by Ecology would be required to determine the actual quantity available for acquisition. Additional information is included in the project profile in Appendix E.

Project Name: Sixty Acres Park Water Right Acquisition (8-SRV-W3)
Project Description: The Sixty Acres Park Water Right Acquisition project proposes to acquire an estimated 126 acre-feet annually of consumptively used water. There are two surface water rights associated with the property, one associated with the North Park property and one associated with the South Park property.

The total irrigated land attributed to the two surfaces water rights is 100 acres. While the sum of the irrigable acres authorized by these water rights documents is 100 acres, the irrigation delineation suggests as much as 59.5 irrigated acres in the most recent 5-year period. Ecology utilized irrigation delineation analysis to estimate consumptive use of 126 AFY. This is an estimate of consumptive use quantity. An extent and validity determination by Ecology would be required to determine the actual quantity available for acquisition.

Initial conversations have occurred between Ecology and King County regarding a transfer of this water right into the Trust Water Rights Program for permanent streamflow benefit. King County plans to continue to seasonally transfer some portion of this right downstream until recycled water or another feasible water source is available at the Sammamish Farm. Additional information is included in the project profile in Appendix E.

Project Name: Pre-Identified No. 8 Water Right Acquisition (8-SRV-W4)
Project Description: The Pre-Identified Water Right No. 8 Water Right Acquisition project proposes to acquire three groundwater rights in the Sammamish River Valley subbasin for an estimated 23.43 acre-feet annually of consumptively used water. The land under common management for this project opportunity is comprised of five parcels totaling 92.93 acres. Online sources indicate these parcels were purchased by the current owners and developed into a winery and vineyard in 1976.

WWT utilized irrigation delineation analysis to estimate consumptive use of 23.43 AFY. This is an estimate of consumptive use quantity. An extent and validity determination by Ecology would be required to determine the actual quantity available for acquisition.

Initial conversations have occurred between King County and the landowner regarding extending reclaimed water to the property, which could make the water rights available for transfer into the Trust Water Rights Program for permanent streamflow benefit. Additional information is included in the project profile in Appendix E.

Project Name: Sammamish River Valley Irrigation Water Rights Acquisitions (8-SRV-W5)
Project Description: The project proposes to acquire irrigation water rights within or upstream of the Sammamish River Valley Agricultural Production District from willing sellers. Water rights would be permanently and legally held by Ecology in the Trust Water Rights Program to ensure that the benefits to instream resources are permanent.

The offset estimate is based on the Sammamish River Valley No. 3 water right acquisition project. This project includes at least three surface water rights that are currently used to irrigate a turf farm. WWT developed a consumptive water use estimate of 551.83 AFY based on the three water rights documents which authorize or assert 292 acres of irrigation, and assuming turf/pasture, and sprinkler irrigation. Additional information is included in the project profile for Sammamish River Valley No. 3 Water Right Acquisition in Appendix E.

Initial outreach to the water right holder for Sammamish River Valley water right No. 3 was completed by Washington Water Trust and the water right holder is open to further discussions. Washington Water Trust is continuing to conduct outreach to water right holders in the Sammamish River Valley as part of a separate outreach and education effort related to reclaimed water.

Project Name: Sammamish River Valley Recycled Water Managed Aquifer Recharge (8-SRV-W6)
Project Description: This Recycled Water MAR project proposes to divert reclaimed water from the existing King County Brightwater Wastewater Treatment Plant (Brightwater) recycled water pipeline to a constructed Managed Aquifer Recharged (MAR) facility between May and October, when reclaimed water is available. This diverted water infiltrates into the shallow aquifer, is transported down-gradient, and ultimately discharges to the Sammamish River as re-timed groundwater baseflow. The goal of the project is to increase baseflow to the Sammamish River, especially during the critical flow period when surface flows are lowest, by recharging the aquifer adjacent to the river and providing additional groundwater discharge to the river through MAR. A specific project location has not yet been identified.

Initial calculations indicate the Sammamish River Valley Recycled Water MAR project could infiltrate approximately 181 acre-feet annually. Additional information is included in the project description in Appendix E.

Bear/Evans subbasin

Project Name: Pre-Identified No. 1 Water Right Acquisition (8-BE-W7)
Project Description: The Pre-identified Water Right No. 1 Water Right Acquisition project proposes to acquire two groundwater rights in the Bear/Evans subbasin for an estimated 346.8 acre-feet annually of consumptively used water. The land, and underlying water right, currently support single-family residences and a country club with three 9-hole golf courses. According to online sources, these facilities were constructed during 1967 and have been operated continuously since that time.

WWT utilized irrigation delineation analysis to estimate a consumptive use of 346.8 AFY. This is an estimate of consumptive use quantity. An extent and validity determination by Ecology would be required to determine the actual quantity available for acquisition.

WWT initiated outreach to this water right holder and, as of the time of publication, did not receive a response.

Issaquah Creek Subbasin

Project Name: Pre-Identified No. 4 Water Right Acquisition (8-I-W9)
Project Description: The Pre-identified Water Right No. 4 Water Right Acquisition project proposes to acquire one water right in the Issaquah subbasin with approximately 286 acre-feet annually of consumptively used water. The land, and underlying water right, currently support commercial production of dairy products. According to online sources, the facility, located in the City of Issaquah's Cultural Business District, has been continuously operated since 1909. As of July 30, 2018, a portion of the annual quantity of the subject water right was temporarily

donated to the Trust Water Rights Program. WWT identified that the water right appears to have been put to continuous beneficial use.

Initial outreach was completed by Washington Water Trust and the water right holder is open to further discussions.

Additional information is included in the project profile in Appendix E.

Lower Cedar subbasin

Project Name: Riverbend Mobile Home Park Water Right Acquisition (Pre-Identified Water Right No. 9) (8-LC-W10)
Project Description: The Riverbend Mobile Home Park Water Right Acquisition project proposes to acquire one groundwater right in the Lower Cedar subbasin for an estimated 20.079 acre-feet annually of consumptively used water. The land, and underlying water right, previously were used to support a mobile home park. According to Ecology and online sources, the property and water right were purchased by King County in 2013 as acquisitions that formed part of a levee setback and floodplain restoration project.

WWT utilized irrigation delineation analysis to estimate a consumptive use of 20.079 AFY available for trust water transaction. This is an estimate of consumptive use quantity. An extent and validity determination by Ecology would be required to determine the actual quantity available for acquisition.

Initial conversations have occurred between Ecology and King County regarding a transfer of this water right into the Trust Water Rights Program for permanent streamflow benefit. Additional information is included in the project profile in Appendix E.

Project Name: Pre-identified No. 5 Water Right Acquisition (8-LC-W11)
Project Description: The Pre-identified Water Right No. 5 Water Right Acquisition project proposes to acquire one groundwater right in the Lower Cedar subbasin for an estimated 85.4 acre-feet annually of consumptively used water. The land, and underlying water right, is currently used as a golf course, which, according to Ecology documents, has been in operation since the early 1930s.

WWT utilized irrigation delineation analysis to estimate consumptive use of 85.4 AFY available for trust water transaction. This is an estimate of consumptive use quantity. An extent and validity determination by Ecology would be required to determine the actual quantity available for acquisition.

As of the time of this plan, no outreach related to this project had been conducted.

5.2.2 Habitat Projects

Table 5.2 provides a summary of 23 habitat projects included in the plan to provide ecological benefits to WRIA 8. This list also includes projects that are expected to have ecological benefits from improvements to stormwater management and infiltration. More detailed habitat project descriptions are provided in Appendix E.

Although many of these projects have potential streamflow benefits, Ecology did not to quantify water offsets from habitat projects due to the uncertainty regarding magnitude, reliability, and timing of streamflow benefits.

Table 5.2: WRIA 8 Habitat Projects

Project Number	Project Name	Project Description	Subbasin(s)	Anticipated Ecological Benefits	Project Sponsor	Estimated Cost
8-SN-H12	North Creek Beaver Dam Analog and Log Jam Installation	Install 16 beaver analogs/logjams at three locations in the upper 2.5 miles of North Creek.	Swamp/North	Reduction of peak flow during storm events, increase in groundwater levels and recharge, increase channel complexity, increase species diversity, and increase salmonid habitat.	Adopt a Stream Foundation	$94,193
8-SN-H13	Canyon Park Business Park Redevelopment (stormwater)	Reduce overall impervious surface area, stormwater improvements and restoration and/or wetland enhancement along North Creek.	Swamp/North	Recharge to underlying aquifers, restore degraded channel and habitat structure.	City of Bothell	$150,000 for feasibility
8-LB-H14	Cutthroat Creek Restoration at Carousel Ranch	Stream, riparian, and upland restoration on Cutthroat Creek, including wood placement.	Little Bear	Increase hydraulic diversity, restore native vegetation, restore water temperature, and provide erosion abatement.	Snohomish County	$499,500
8-LB-H15	Little Bear Instream Projects	Instream restoration projects along Little Bear Creek, including wood placement.	Little Bear	Improve cover and hydraulic diversity in riparian buffer zone, floodplain reconnection.	Snohomish County	$741,000

Project Number	Project Name	Project Description	Subbasin(s)	Anticipated Ecological Benefits	Project Sponsor	Estimated Cost
8-LB-H16	Silver Firs Stormwater Pond Retrofits (stormwater)	Retrofit two existing stormwater ponds to increase infiltration capacity.	Little Bear	Improve stormwater management.	Snohomish County	$1,400,000
8-SRV-H17	East Side Wayne Sammamish/ Waynita Restoration	Restore the eastside of the former Wayne Golf Course property, including the south bank of the Sammamish River and the mouth and lower reach of Waynita Creek.	Sammamish River Valley	Floodplain restoration.	City of Bothell	$7,000,000
8-SRV-H18	Reconnection of Wetland 38	Reconnect Wetland 38 to the Sammamish River	Sammamish River Valley	Wetland reconnection.	Mid Sound Fisheries Enhancement Group	Unknown
8-BE-H20	Seawest Granston/ Middle Bear Creek Natural Area Restoration	Restoration of up to 3,300 lineal feet of stream and approximately 32 acres of wetland and riparian areas.	Bear/Evans	Increase baseflow and groundwater levels, increase storage capacity. May augment streamflow and moderate stream temperature.	King County	$1,400,000
8-BE-H21	Little Bit Restoration	Addition of woody debris, excavation of off-channel habitats, and revegetation of the floodplain and riparian areas along 650 feet of Bear Creek.	Bear/Evans	Increase the volume and availability of off-channel habitat for juvenile salmonids and increase overall channel complexity and habitat quality.	King County	$1,000,000

Project Number	Project Name	Project Description	Subbasin(s)	Anticipated Ecological Benefits	Project Sponsor	Estimated Cost
8-BE-H22	Bear Creek Water Quality Enhancement Projects (stormwater)	Identification of stormwater retrofit projects in the Bear Creek basin.	Bear/Evans	Future projects will target water quality treatment, stream shading/temperature reduction, and/or enhanced flow control of storm runoff.	King County	Unknown
8-GLW-H23	Lake Washington Institute of Technology (LWIT) Infiltration Vault (stormwater)	The LWIT Infiltration Vault would provide water quality treatment and subsequent infiltration of stormwater for 23.4 acres of contributing area.	Greater Lake Washington	Infiltrate stormwater before it reaches Totem Lake and subsequently Lake and subsequently Juanita Creek, a salmon bearing stream in Kirkland.	City of Kirkland	$2,700,000
8-GLW-H24	Juanita/ Cedar Creek Stormwater Retrofit Planning (stormwater)	Conduct stormwater design permitting and construction of three water quality treatment and/or flow control facilities for Cedar Creek	Greater Lake Washington	Stormwater retrofit facilities will contribute to stream restoration efforts that include installation of a fish passable culvert.	City of Kirkland	$6,000,000
8-GLW-H25	Forbes/ North Rose Hill Stormwater Retrofit (stormwater)	Implementation of stormwater projects in the North Rose Hill and Forbes Creek stormwater retrofit plans.	Greater Lake Washington	Stormwater management will support summer streamflows and control winter peak flows.	City of Kirkland	$5,000,000

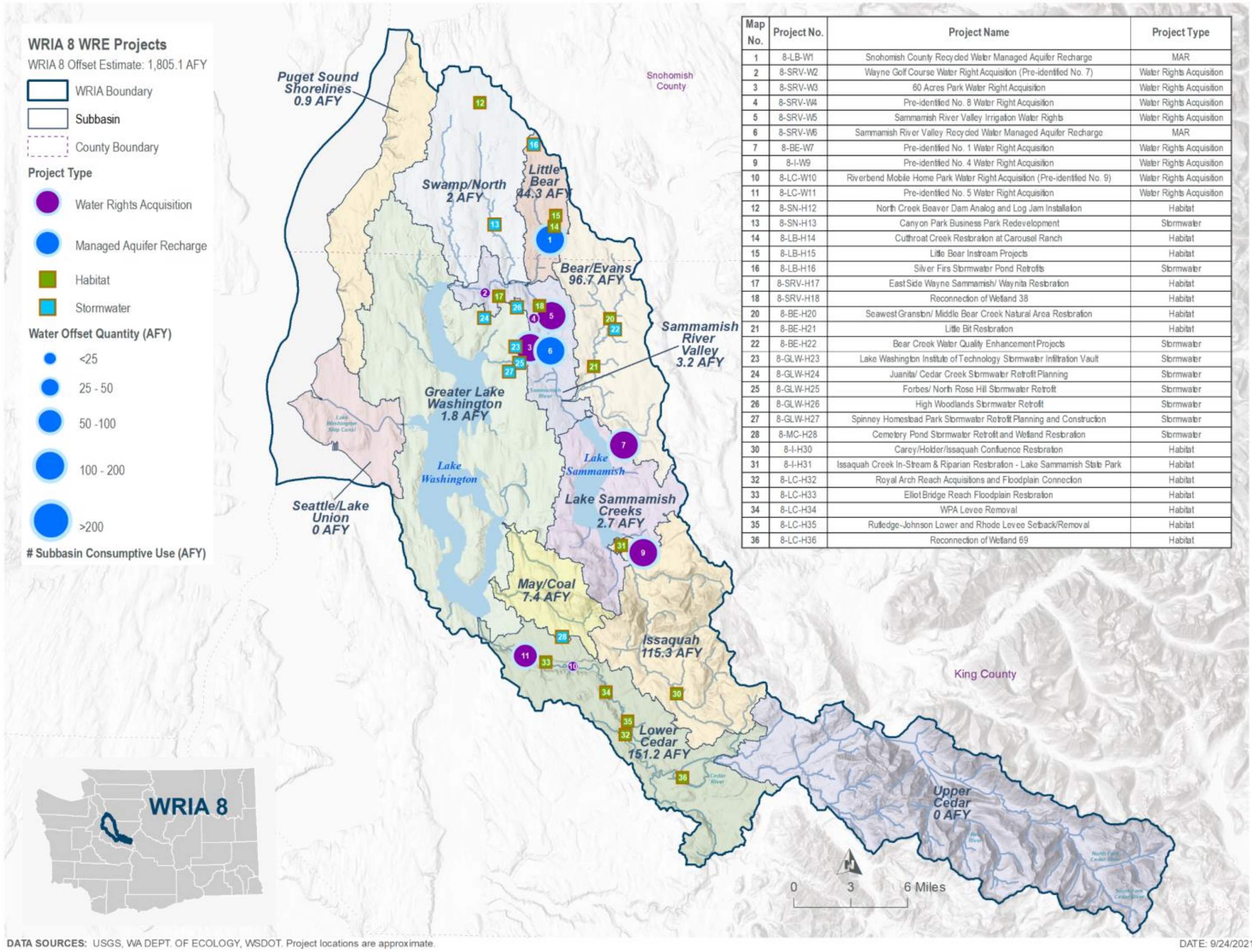
Project Number	Project Name	Project Description	Subbasin(s)	Anticipated Ecological Benefits	Project Sponsor	Estimated Cost
8-GLW-H26	High Woodlands Stormwater Retrofit (stormwater)	Site and size stormwater retrofit facilities within the High Woodlands subbasin of Juanita Creek.	Greater Lake Washington	Contribute to improved flows and water quality.	City of Kirkland	$6,000,000
8-GLW-H27	Spinney Homestead Park Stormwater Retrofit Planning and Construction (stormwater)	Conduct stormwater retrofit planning, design development, and facility construction at Spinney Homestead Park.	Greater Lake Washington	Stormwater management will support summer streamflows and control winter peak flows.	City of Kirkland	$5,200,000
8-MC-H28	Cemetery Pond Stormwater Retrofit and Wetland Restoration (stormwater)	Improve the water quality in May Creek through the retrofit design of an existing stormwater detention pond.	May/Coal	Support summer streamflows and control winter peak flows to May Creek by providing stormwater detention.	King County	Unknown
8-I-H30	Carey/ Holder/ Issaquah Confluence Restoration	Restore riparian vegetation, add livestock fencing, implement other best management practices for livestock on a 120-acre site, and potentially install large woody debris.	Issaquah	Increase the volume and availability of off-channel habitat for juvenile salmonids and increase overall channel complexity and habitat quality.	King County	Unknown

Project Number	Project Name	Project Description	Subbasin(s)	Anticipated Ecological Benefits	Project Sponsor	Estimated Cost
8-I-H31	Issaquah Creek In-Stream & Riparian Restoration - Lake Sammamish State Park	Complete in-stream restoration and riparian buffer restoration along Issaquah Creek within Lake Sammamish State Park.	Issaquah	Enhance the quality and quantity of key, strategically located salmonid habitat, particularly for juvenile Chinook rearing and adult Chinook holding in Issaquah Creek.	Mountains to Sound Greenway Trust	$4,500,000
8-LC-H32	Royal Arch Reach Acquisitions and Floodplain Connection	Acquire floodplain properties for future floodplain reconnection and restoration.	Lower Cedar	Restore the floodplain connectivity, improving the aquatic habitats associated with the Cedar River.	Seattle Public Utilities	$7,000,000
8-LC-H33	Elliot Bridge Floodplain Restoration	Acquire parcels near the former Elliot Bridge site to enable floodplain restoration.	Lower Cedar	Floodplain restoration, enhance habitat conditions in Madsen creek.	King County	Unknown
8-LC-H34	WPA Levee Removal	Acquire remaining parcel not in public ownership and setback or remove the WPA levee.	Lower Cedar	Restore the floodplain connectivity, improving the aquatic habitats along the Cedar River.	King County	Unknown
8-LC-H35	Rutledge-Johnson Lower and Rhode Levee Setback/ Removal	Acquire necessary property, remove/setback levees, and restore reconnected floodplain along the Rutledge-Johnson levee (a) and the Rhode and Rutledge-Johnson Levees.	Lower Cedar	Restore the floodplain connectivity, improving the aquatic habitats along the Cedar River.	King County	Unknown

Project Number	Project Name	Project Description	Subbasin(s)	Anticipated Ecological Benefits	Project Sponsor	Estimated Cost
8-LC-H36	Reconnection of Wetland 69	Acquire necessary property to reconnect Wetland 69 to the Cedar River and remove a revetment.	Lower Cedar	Reconnect a wetland feature, known as Wetland 69, with the Cedar River, which will provide refugia for fish and vegetation and nutrients for insects and invertebrates, which are a prey source for fish.	King County	Unknown

Notes:

[1] The following two projects were included in the WRIA 8 Committee's draft plan, but were not included in this plan because they are conceptual and do not have a detailed project description or project sponsor: 8-SRV-H19 Sammamish River floodplain restoration project and 8-LSC-H29 Lake Sammamish Creeks habitat restoration projects.



Map No.	Project No.	Project Name	Project Type
1	8-LB-W1	Snohomish County Recycled Water Managed Aquifer Recharge	MAR
2	8-SRV-W2	Wayne Golf Course Water Right Acquisition (Pre-identified No. 7)	Water Rights Acquisition
3	8-SRV-W3	60 Acres Park Water Right Acquisition	Water Rights Acquisition
4	8-SRV-W4	Pre-identified No. 8 Water Right Acquisition	Water Rights Acquisition
5	8-SRV-W5	Sammamish River Valley Irrigation Water Rights	Water Rights Acquisition
6	8-SRV-W6	Sammamish River Valley Recycled Water Managed Aquifer Recharge	MAR
7	8-BE-W7	Pre-identified No. 1 Water Right Acquisition	Water Rights Acquisition
9	8-I-W9	Pre-identified No. 4 Water Right Acquisition	Water Rights Acquisition
10	8-LC-W10	Riverbend Mobile Home Park Water Right Acquisition (Pre-identified No. 9)	Water Rights Acquisition
11	8-LC-W11	Pre-identified No. 5 Water Right Acquisition	Water Rights Acquisition
12	8-SN-H12	North Creek Beaver Dam Analog and Log Jam Installation	Habitat
13	8-SN-H13	Canyon Park Business Park Redevelopment	Stormwater
14	8-LB-H14	Cutthroat Creek Restoration at Carousel Ranch	Habitat
15	8-LB-H15	Little Bear Instream Projects	Habitat
16	8-LB-H16	Silver Firs Stormwater Pond Retrofits	Stormwater
17	8-SRV-H17	East Side Wayne Sammamish/ Waynita Restoration	Habitat
18	8-SRV-H18	Reconnection of Wetland 38	Habitat
20	8-BE-H20	Seawest Granston/ Middle Bear Creek Natural Area Restoration	Habitat
21	8-BE-H21	Little Bit Restoration	Habitat
22	8-BE-H22	Bear Creek Water Quality Enhancement Projects	Stormwater
23	8-GLW-H23	Lake Washington Institute of Technology Stormwater Infiltration Vault	Stormwater
24	8-GLW-H24	Juanita/ Cedar Creek Stormwater Retrofit Planning	Stormwater
25	8-GLW-H25	Forbes/ North Rose Hill Stormwater Retrofit	Stormwater
26	8-GLW-H26	High Woodlands Stormwater Retrofit	Stormwater
27	8-GLW-H27	Spinney Homestead Park Stormwater Retrofit Planning and Construction	Stormwater
28	8-MC-H28	Cemetery Pond Stormwater Retrofit and Wetland Restoration	Stormwater
30	8-I-H30	Carey/Holder/Issaquah Confluence Restoration	Habitat
31	8-I-H31	Issaquah Creek In-Stream & Riparian Restoration - Lake Sammamish State Park	Habitat
32	8-LC-H32	Royal Arch Reach Acquisitions and Floodplain Connection	Habitat
33	8-LC-H33	Elliot Bridge Reach Floodplain Restoration	Habitat
34	8-LC-H34	WPA Levee Removal	Habitat
35	8-LC-H35	Rutledge-Johnson Lower and Rhode Levee Setback/Removal	Habitat
36	8-LC-H36	Reconnection of Wetland 69	Habitat

Figure 5.1: WRIA 8 Projects

5.3 Project Implementation Summary

5.3.1 Summary of Projects and Benefits

Per RCW 90.94.030(3), this watershed plan must include actions necessary to offset potential impacts to instream flows associated with new PE well water use and result in a net ecological benefit to instream resources within the WRIA.

As specified in Chapter 4, the plan estimates 425.4 AFY of consumptive use from new PE wells over the planning horizon. The plan includes eight water right acquisitions projects and two reclaimed water managed aquifer recharge projects to offset consumptive use. These water offset projects included in Table 5.1 provide an estimated offset of 1,805.1 AFY and exceed the estimated consumptive use.

This plan includes 23 habitat projects shown in Table 5.2. Ecological benefits associated with these projects vary and include floodplain restoration, wetland reconnection, availability of off-channel habitat for juvenile salmonids, reduction of peak flow during storm events, increase in groundwater levels and baseflow, and increase in channel complexity. While many of these projects have potential streamflow benefits, this plan does not account for water offset from habitat projects. The ecological and streamflow benefits from habitat projects are supplemental to the quantified water offsets and contribute to achieving a net ecological benefit.

5.3.2 Cost Estimate for Offsetting New Domestic Water Use Over 20 Year Planning Horizon

Per RCW 90.94.030(3)(d), this watershed plan must include an evaluation or estimation of the cost of offsetting new domestic water uses over the subsequent twenty years. To satisfy this requirement, Ecology developed planning-level cost estimates for each of the water offset projects listed in Table 5.1. The plan also included cost estimates for habitat projects in Table 5.2, when the project sponsor provided that information.

Cost estimates for water offset projects included in the plan are planning level cost estimates only. Ecology developed the cost estimates by reviewing recent streamflow restoration grant program applications for similar project types and recently completed water right acquisitions. For all water right acquisitions, an extent and validity determination will need to be completed to establish the quantity of water that can be permanently protected through transfer to Ecology's Trust Water Rights program. The price for these water rights will be negotiated between the willing seller and the willing buyer. The total estimated cost for implementing the water offset projects listed and described in this chapter is $4,956,156. Project sponsors will further refine project costs during their project scoping and development processes.

The estimated cost for implementing individual habitat projects range from $94,193 to $7 million, with several of the project costs unknown.

5.3.3 Certainty of Implementation

Certainty of implementation depends on many factors, including identification and support of project sponsors, readiness to proceed and implement the project, and identification of potential barriers to completion.

Two types of water offset projects are included in this plan: water rights acquisitions and managed aquifer recharge. These types of projects have been successfully implemented within Washington and the technology to implement these types of projects is proven. Each of the water offset projects listed in Table 5.1. have project sponsors who have experience implementing these types of projects and are ready to proceed with project development. The water offset projects included in the plan are likely to be implemented and provide benefits during the planning horizon.

For six of the water rights acquisitions projects, initial outreach to water right holders has occurred and those water right holders indicated interest in further discussions. Two water right acquisition projects (Pre-Identified Water Right No. 1 and Pre-Identified Water Right No. 5), have greater uncertainty because at the time of this plan, the water right holder has not expressed interest in an acquisition. This plan also encourages additional water right acquisitions when the opportunity arises.

The habitat projects included in the plan, if funded, are expected to be implemented within the planning horizon. All of the habitat projects have project sponsors with experience implementing habitat restoration and stormwater projects.

The total offset benefits surpass the consumptive use estimate, which provides a reasonable assurance that the plan will offset the estimated consumptive use from new PE wells and achieve NEB. Ecology encourages project sponsors to complete the projects, and provides incentives through the streamflow restoration grant program.

Chapter Six: Net Ecological Benefit Determination

6.1 Overview

Watershed Restoration and Enhancement Plans must identify projects and actions to offset the potential consumptive impacts of new permit-exempt domestic groundwater withdrawals on instream flows over the planning horizon and provide a net ecological benefit to the WRIA. The Final NEB Guidance establishes Ecology's interpretation of the term "net ecological benefit" as "the outcome that is anticipated to occur through implementation of projects and actions in a plan to yield offsets that exceed impacts within: a) the planning horizon; and, b) the relevant WRIA boundary" (Ecology 2019a). This chapter provides Ecology's analysis of the WRIA 8 watershed plan's reasonable assurance in meeting NEB.

6.2 Net Ecological Benefit Analysis

The WRIA 8 watershed plan provides a path forward for offsetting an estimated 425.4 AFY of new consumptive water use in WRIA 8. The plan primarily achieves this offset through ten water offset projects with a total estimated offset of 1,805.1 AFY. This total offset yields a surplus offset of 1,379.7 AFY above the 425.4 AFY consumptive use estimate. This plan also includes 23 habitat projects, which provide numerous additional benefits to aquatic and riparian habitat. The ecological and streamflow benefits from these habitat projects are supplemental to the quantified water offset project benefits and will contribute to achieving a NEB.

6.2.1 Review of PE Well Projection and Consumptive Water Use Estimate

This plan divides WRIA 8 into 12 subbasins (see Figure 3.1), then distributes the number of projected PE wells across the subbasins based on historic building trends.

This plan projects 967 new PE wells installed in WRIA 8 over the planning horizon. Based on this projection, the plan estimates 425.4 AFY of new consumptive water use from new PE wells in WRIA 8.

The method for estimating outdoor water use (outlined in Ecology's NEB Guidance) was designed to be protective of instream resources. The outdoor water use component was based on the assumption that every new PE well homeowner will water their lawn at rates equal to those of commercial turf grass in the Washington Irrigation Guide (NRCS-USDA 1997). Commercial turf grass irrigation rates are much higher than typical domestic applications. Therefore, Ecology considers 425.4 AFY a conservative estimate of consumptive water use.

6.2.2 Quantity and Spatial Distribution of Water Offset Project Benefits

Table 6.1 provides a summary of the ten water offset projects listed in the plan to offset consumptive use and contribute toward achieving a NEB in WRIA 8. The potential water offset of these ten projects is 1,805.1 AFY, a surplus of 1,379.7 AFY above the consumptive use estimate. Therefore, the plan succeeds in offsetting consumptive use impacts at the WRIA scale. Water offset benefits are anticipated in the subbasins listed in Table 6.2 as well as downstream of the respective project locations.

All of the water offset projects have identified project sponsors. If funded, Ecology expects projects will be implemented within the planning horizon and provide benefits beyond the planning horizon and as long as new PE well use continues. Ecology finds that the offset amounts are reasonable, and that these projects, once implemented, will meet the requirements of RCW 90.94.030.

Table 6.1: Summary of WRIA 8 Water Offset Projects included in NEB analysis

Project Number	Project Name	Project Short Description	Subbasin	Estimated Water Offset Benefits (AFY)
8-LB-W1	Snohomish County Recycled Water Managed Aquifer Recharge	Diversion of reclaimed water from the Brightwater treatment plant for infiltration at a constructed MAR facility	Little Bear	181
8-SRV-W2	Wayne Golf Course Water Right Acquisition (Pre-Identified No. 7)	Acquisition of two water rights previously used for golf course irrigation	Sammamish River Valley	3.54
8-SRV-W3	Sixty Acres Park Water Right Acquisition	Acquisition of two surface water rights used for irrigation of a park	Sammamish River Valley	126
8-SRV-W4	Pre-Identified No. 8 Water Right Acquisition	Acquisition of three water rights used at a winery/vineyard	Sammamish River Valley	23.43
8-SRV-W5	Sammamish River Valley Irrigation Water Rights Acquisitions	Acquisition of irrigation water rights within or upstream of the Sammamish River Valley Agricultural Production District from willing sellers with access to an alternative water source, such as reclaimed water	Sammamish River Valley	551.83

Project Number	Project Name	Project Short Description	Subbasin	Estimated Water Offset Benefits (AFY)
8-SRV-W6	Sammamish River Valley Recycled Water Managed Aquifer Recharge	Diversion of reclaimed water from the existing Brightwater Wastewater Treatment Plant recycled water pipeline to a constructed MAR facility	Sammamish River Valley	181
8-BE-W7	Pre-Identified No. 1 Water Right Acquisition	Acquisition of two water rights used for golf course irrigation and residential water supply	Bear/Evans	346.8
8-I-W9	Pre-Identified No. 4 Water Right Acquisition	Acquisition of one water right previously used to support commercial production of dairy products	Issaquah	286
8-LC-W10	Riverbend Mobile Home Park Water Right Acquisition (Pre-Identified No. 9)	Acquisition of one water right previously used for water supply at a mobile home park	Lower Cedar	20.1
8-LC-W11	Pre-Identified No. 5 Water Right Acquisition	Acquisition of one water right used for golf course irrigation	Lower Cedar	85.4
Total Estimated Water Offset Benefits				1,805.1 AFY

Table 6.2 provides a summary of estimated water offset and consumptive use by subbasin, including surplus or deficit. Ten water offset projects will be developed in five subbasins, including the four subbasins where 96% of new PE wells will be constructed. Seven subbasins do not contain offset projects. The plan does not anticipate any new PE wells in two of those seven subbasins. WRIA-wide, the plan anticipates six subbasins will experience water offset deficits that total -60.5 AFY (see Table 6.2). Seventy-six percent of that deficit will occur in the Lower Cedar subbasin. The plan lists five habitat projects in that subbasin. WRIA-wide, the net surplus is 1,379.7 AFY.

Table 6.2: Subbasin Water Offset Totals compared to Subbasin Consumptive Use Estimate

Subbasin	Offset Project Totals (AFY)	Consumptive Use (AFY)[1]	Surplus/Deficit (AFY)[2]
Seattle/Lake Union	0	0	0
Puget Sound Shorelines	0	0.9	-0.9
Swamp/North	0	2.0	-2
Little Bear	181	44.3	+136.7
Sammamish River Valley	885.8	3.2	+882.6
Bear/Evans	346.8	96.7	+250.1
Greater Lake Washington	0	1.8	-1.8
May/Coal	0	7.4	-7.4
Lake Sammamish Creeks	0	2.7	-2.7
Issaquah	286	115.3	+170.7
Lower Cedar	105.5	151.2	-45.7
Upper Cedar	0	0	0
WRIA 8 Total	1,805.1	425.4	+1,379.7

Notes:
[1] Values in table have been rounded, which is why totals may differ.
[2] Surplus water offset is associated with a positive value and a deficit in water offset is associated with a negative value. Note that RCW 90.94.030 requires that offsets be met at the WRIA level, and not at the subbasin level.

The water offset projects listed in Table 6.1 provide additional benefits to instream resources beyond those necessary to offset the impacts from new consumptive water use within the WRIA. These additional benefits for the project types planned in WRIA 8 include the following:

- Water right acquisition projects: Aquatic habitat improvements during key seasonal periods; reduction in groundwater withdrawals and associated benefit to aquifer resources; and/or beneficial use of reclaimed water (if applicable).
- MAR projects: Aquatic habitat improvements during key seasonal periods; increased groundwater recharge; reduction in summer/fall stream temperature; increased groundwater availability to riparian and near-shore plants; and beneficial use of reclaimed water.

6.2.3 Quantity and Spatial Distribution of Habitat Project Benefits

The watershed plan presents a suite of 23 habitat projects that will provide ecological benefits to the watershed beyond those necessary to offset the impacts from new consumptive water use. Habitat improvement tactics associated with these projects include a combination of aquatic habitat restoration, riparian vegetation plantings, land acquisition, levee removal, large woody debris installation, beaver colonization, and stormwater management. Many of the habitat projects include more than one of these elements. Project descriptions are summarized in Table 6.3.

These projects target the salmonid habitat limiting factors identified for this watershed. Benefits include increased hydraulic/aquatic habitat diversity, restored native vegetation, restored water temperature, improved sediment processes, improved spawning and rearing habitat, and water quality benefits, among other benefits (see Table 6.3). Some of these habitat projects have potential streamflow benefits, but those quantities were not estimated due to uncertainties regarding magnitude, reliability, and timing of streamflow benefits.

All 23 of the habitat projects have identified project sponsors, and if funded, are expected to be implemented within the planning horizon.

Table 6.3: Summary of WRIA 8 Habitat Projects included in NEB Analysis

Project Number	Project Name	Project Short Description	Subbasin	River Miles Benefitted	Other Benefits with Quantifiable Metric (e.g. structures per mile)	Habitat Limiting Factor(s) Addressed[1,2]
8-SN-H12	North Creek Beaver Dam Analog and Log Jam Installation	Installation of 16 beaver analogs/ logjams at three locations in North Creek.	Swamp/ North	Upper 2.5 miles of North Creek	-Installation of beaver dam analogs (16 structures) -Reduction of peak flow during storm events (monitoring) -Increase in recharge/ groundwater levels (monitoring) -Increase in channel complexity (mapping) -Increase in species diversity (monitoring) -Increase in salmonid habitat (acres)	-Altered sediment transport processes -Loss of channel and shoreline complexity and connectivity -Altered hydrology -Water quality issues -Loss of floodplain connectivity
8-SN-H13	Canyon Park Business Park Redevelopment (stormwater)	Reduction in impervious surface area, stormwater improvements and restoration and/or wetland enhancement along North Creek.	Swamp/ North	North Creek at and downstream of Canyon Park	-Increase in recharge/ groundwater levels (monitoring) -Restoration of aquatic habitat and wetlands (acres) -Stormwater retrofit area treated (acres)	-Degradation or lack of riparian conditions -Altered hydrology -Loss of floodplain connectivity -Water quality issues

Project Number	Project Name	Project Short Description	Subbasin	River Miles Benefitted	Other Benefits with Quantifiable Metric (e.g. structures per mile)	Habitat Limiting Factor(s) Addressed[1, 2]
8-LB-H14	Cutthroat Creek Restoration at Carousel Ranch	Stream, riparian, and upland restoration on Cutthroat Creek, including wood placement.	Little Bear	870 feet of Cutthroat Creek at Carousel Ranch	-Stream length that is restored (870 feet) -Increase in hydraulic diversity (mapping) -Restoration of native vegetation (acres) -Moderation of water temperature (monitoring) -Erosion abatement (mapping)	-Altered sediment transport processes -Loss of channel and shoreline complexity and connectivity -Altered hydrology -Water quality issues -Loss of floodplain connectivity
8-LB-H15	Little Bear Instream Projects	Instream restoration projects along Little Bear Creek, including wood placement.	Little Bear	Multiple sites along Little Bear Creek in Woodinville	-Number of sites improved (four) -Increase in hydraulic diversity (mapping) -Floodplain reconnection (mapping) -Riparian restoration (acres) -LWD installation (number of structures)	-Increased sedimentation and altered sediment transport processes -Loss of channel and shoreline complexity and connectivity -Altered hydrology -Water quality issues -Loss of floodplain connectivity

Project Number	Project Name	Project Short Description	Subbasin	River Miles Benefitted	Other Benefits with Quantifiable Metric (e.g. structures per mile)	Habitat Limiting Factor(s) Addressed[1, 2]
8-LB-H16	Silver Firs Stormwater Pond Retrofits (stormwater)	Retrofit of two existing stormwater ponds to increase infiltration capacity.	Little Bear	Northern portion of Little Bear Creek	-Increased stormwater pond volume (2.0 AF) -Increased infiltration (45 AFY) -Increase in recharge/ groundwater levels (monitoring) -Stormwater retrofit area treated (acres) -Streamflow maintenance (monitoring)	-Altered hydrology -Water quality issues
8-SRV-H17	East Side Wayne Sammamish/ Waynita Restoration	Restoration of the former Wayne Golf Course property, including the south bank of the Sammamish River and the mouth and lower reach of Waynita Creek.	Sammamish River Valley	1,000 feet along south bank of Sammamish River and lower reach of Waynita Creek	-Floodplain restoration (31.6 acres) -Stream length that is restored (1,000 feet) -LWD installation (number of structures)	-Altered sediment transport processes -Loss of channel and shoreline complexity and connectivity -Altered hydrology -Water quality issues -Loss of floodplain connectivity

Project Number	Project Name	Project Short Description	Subbasin	River Miles Benefitted	Other Benefits with Quantifiable Metric (e.g. structures per mile)	Habitat Limiting Factor(s) Addressed[1, 2]
8-SRV-H18	Reconnection of Wetland 38	Reconnection of Wetland 38 to the Sammamish River.	Sammamish River Valley	Sammamish River at south end of Woodinville	-Wetland reconnection (acres)	-Altered hydrology -Water quality issues -Loss of floodplain connectivity
8-BE-H20	Seawest Granston/ Middle Bear Creek Natural Area Restoration	Restoration of up to 3,300 lineal feet of stream and approximately 32 acres of wetland and riparian areas.	Bear/ Evans	Seawest Granston Reach of Bear Creek	-Riparian and wetland area restoration (32 acres) -Stream length that is restored (3,300 feet) -Increase baseflow and groundwater levels (monitoring) -Moderate stream temperature (monitoring) -LWD installation (number of structures)	-Altered sediment transport processes -Loss of channel and shoreline complexity and connectivity -Altered hydrology -Water quality issues -Loss of floodplain connectivity

Project Number	Project Name	Project Short Description	Subbasin	River Miles Benefitted	Other Benefits with Quantifiable Metric (e.g. structures per mile)	Habitat Limiting Factor(s) Addressed[1, 2]
8-BE-H21	Little Bit Restoration	Addition of woody debris, excavation of off-channel habitats, and revegetation of the floodplain and riparian areas along 650 feet of Bear Creek.	Bear/ Evans	Little Bit Reach of Bear Creek	-Stream length that is restored (650 feet) -Increase the volume and availability of off-channel habitat for juvenile salmonids (acres) -Increase overall channel complexity and habitat quality (acres) -LWD installation (number of structures)	- Altered sediment transport processes -Loss of channel and shoreline complexity and connectivity -Altered hydrology -Water quality issues -Loss of floodplain connectivity
8-BE-H22	Bear Creek Water Quality Enhancement Projects (stormwater)	Identification of stormwater retrofit projects in the Bear Creek basin.	Bear/ Evans	Bear Creek	-Water quality treatment (monitoring) -Moderation of water temperature (monitoring) -Enhanced flow control of storm runoff (monitoring)	-Altered hydrology -Water quality issues

Project Number	Project Name	Project Short Description	Subbasin	River Miles Benefitted	Other Benefits with Quantifiable Metric (e.g. structures per mile)	Habitat Limiting Factor(s) Addressed[1, 2]
8-GLW-H23	Lake Washington Institute of Technology (LWIT) Infiltration Vault (stormwater)	Water quality treatment and subsequent infiltration of stormwater for 23.4 acres of contributing area.	Greater Lake Washington	Totem Lake and Juanita Creek	-Infiltration vault dimensions (15,000 feet^2 by 10.5 feet in depth) -Increased infiltration (70 AFY) -Increase in recharge/ groundwater levels (monitoring) -Stormwater retrofit area treated (23.4 acres) -Streamflow maintenance (monitoring)	-Altered hydrology -Water quality issues
8-GLW-H24	Juanita/ Cedar Creek Stormwater Retrofit Planning (stormwater)	Stormwater retrofit planning for Cedar Creek, resulting in conceptual design and cost estimates for three facilities and an implementation plan.	Greater Lake Washington	Cedar Creek	-Stormwater retrofit area treated (50 acres) -Increased infiltration (70 AFY) -Increase in recharge/ groundwater levels (monitoring) -Stormwater retrofit area treated (acres) -Streamflow maintenance (monitoring)	-Altered hydrology -Water quality issues

Project Number	Project Name	Project Short Description	Subbasin	River Miles Benefitted	Other Benefits with Quantifiable Metric (e.g. structures per mile)	Habitat Limiting Factor(s) Addressed[1, 2]
8-GLW-H25	Forbes/ North Rose Hill Stormwater Retrofit (stormwater)	Implementation of stormwater projects in the North Rose Hill and Forbes Creek stormwater retrofit plans.	Greater Lake Washington	North Rose Hill basin of Forbes Creek Watershed	-Stormwater retrofit area treated (50 acres) -Increased infiltration (47 AFY) -Increase in recharge/ groundwater levels (monitoring) -Streamflow maintenance (monitoring)	-Altered hydrology -Water quality issues
8-GLW-H26	High Woodlands Stormwater Retrofit (stormwater)	Site and size stormwater retrofit facilities within the High Woodlands subbasin of Juanita Creek.	Greater Lake Washington	High Woodlands basin of Juanita Creek Watershed	-Stormwater retrofit area treated (approximately 48.5 acres) -Increased infiltration (70 AFY) -Increase in recharge/ groundwater levels (monitoring) -Streamflow maintenance (monitoring)	-Altered hydrology -Water quality issues

Project Number	Project Name	Project Short Description	Subbasin	River Miles Benefitted	Other Benefits with Quantifiable Metric (e.g. structures per mile)	Habitat Limiting Factor(s) Addressed[1, 2]
8-GLW-H27	Spinney Homestead Park Stormwater Retrofit Planning and Construction (stormwater)	Stormwater retrofit planning, design development, and facility construction at Spinney Homestead Park.	Greater Lake Washington	Forbes Creek near Spinney Homestead Park	-Stormwater retrofit area treated (approximately 48.5 acres) -Infiltration structure volume (2.1 to 7.8 AF) -Increased infiltration (76.5 AFY) -Increase in recharge/ groundwater levels (monitoring) -Streamflow maintenance (monitoring)	-Altered hydrology -Water quality issues

Project Number	Project Name	Project Short Description	Subbasin	River Miles Benefitted	Other Benefits with Quantifiable Metric (e.g. structures per mile)	Habitat Limiting Factor(s) Addressed[1, 2]
8-MC-H28	Cemetery Pond Stormwater Retrofit and Wetland Restoration (stormwater)	Water quality improvement in May Creek through the retrofit design of an existing stormwater detention pond.	May/Coal	May Creek near Renton	-Stormwater retrofit area treated (acres) -Increased infiltration (AFY) -Increase in recharge/ groundwater levels (monitoring) -Streamflow maintenance (monitoring) -Control winter peak flows to May Creek by providing stormwater detention (monitoring)	-Altered hydrology -Water quality issues

Project Number	Project Name	Project Short Description	Subbasin	River Miles Benefitted	Other Benefits with Quantifiable Metric (e.g. structures per mile)	Habitat Limiting Factor(s) Addressed[1, 2]
8-I-H30	Carey/Holder/ Issaquah Confluence Restoration	Riparian vegetation restoration, livestock fencing, and other best management practices for livestock on a 120-acre site, and potentially installation of large woody debris.	Issaquah	Confluence of Carey/ Holder/ Issaquah Creeks	-Increase in volume and availability of off-channel habitat for juvenile salmonids (acres) -Increase overall channel complexity and habitat quality (acres)	-Altered sediment transport processes -Loss of channel and shoreline complexity and connectivity -Altered hydrology -Water quality issues -Loss of floodplain connectivity

Project Number	Project Name	Project Short Description	Subbasin	River Miles Benefitted	Other Benefits with Quantifiable Metric (e.g. structures per mile)	Habitat Limiting Factor(s) Addressed[1, 2]
8-I-H31	Issaquah Creek In-Stream & Riparian Restoration - Lake Sammamish State Park	In-stream restoration and riparian buffer restoration along Issaquah Creek within Lake Sammamish State Park.	Issaquah	6000 feet of Issaquah Creek within Lake Sammamish Park	-Enhance the quality and quantity of key, strategically located salmonid habitat (acres) -Riparian restoration (40 acres) -Native trees planted (9,000) -Stream length that is restored (6,000 feet) -LWD installation (number of structures) -Apex jam installation (3) -Large spur jam installation (17) -Log installation (32) -Log jack installation (16) -Small spur jam installation (1)	-Altered sediment transport processes -Loss of channel and shoreline complexity and connectivity -Altered hydrology -Water quality issues -Loss of floodplain connectivity

Project Number	Project Name	Project Short Description	Subbasin	River Miles Benefitted	Other Benefits with Quantifiable Metric (e.g. structures per mile)	Habitat Limiting Factor(s) Addressed[1, 2]
8-LC-H32	Royal Arch Reach Acquisitions and Floodplain Connection	Acquisition of floodplain properties for future floodplain reconnection and restoration.	Lower Cedar	Royal Arch Reach of Cedar River	-Restore floodplain connectivity (mapping) -Property acquired (acres) -Restore aquatic habitats (acres)	-Altered sediment transport processes -Loss of channel and shoreline complexity and connectivity -Altered hydrology -Water quality issues -Loss of floodplain connectivity
8-LC-H33	Elliot Bridge Floodplain Restoration	Acquisition of parcels near the former Elliot Bridge site to enable floodplain restoration	Lower Cedar	Elliot Bridge portion of Cedar River in Renton	-Property acquired (acres) -Floodplain restoration (acres) -Levee removal (feet) -Enhance habitat conditions in Madsen creek (mapping/number of structures)	-Altered sediment transport processes -Loss of channel and shoreline complexity and connectivity -Altered hydrology -Water quality issues -Loss of floodplain connectivity

Project Number	Project Name	Project Short Description	Subbasin	River Miles Benefitted	Other Benefits with Quantifiable Metric (e.g. structures per mile)	Habitat Limiting Factor(s) Addressed[1, 2]
8-LC-H34	WPA Levee Removal	Acquisition of remaining parcel not in public ownership and setback or remove the WPA levee.	Lower Cedar	Cedar River adjacent to East Renton Highlands	-Levee removal (feet) -Floodplain restoration (acres) -Restore aquatic habitats (acres)	-Altered sediment transport processes -Loss of channel and shoreline complexity and connectivity -Altered hydrology -Water quality issues -Loss of floodplain connectivity
8-LC-H35	Rutledge-Johnson Lower and Rhode Levee Setback/ Removal	Property acquisition, remove/setback levees, and restore reconnected floodplain along the Rutledge-Johnson levee (a) and the Rhode and Rutledge-Johnson Levees (b).	Lower Cedar	Cedar River in Maple Valley	-Floodplain restoration (16 acres) -Levee removal/ setback (600 feet) -Floodplain restoration (acres) -Restore aquatic habitats (acres)	-Altered sediment transport processes -Loss of channel and shoreline complexity and connectivity -Altered hydrology -Water quality issues -Loss of floodplain connectivity

Project Number	Project Name	Project Short Description	Subbasin	River Miles Benefitted	Other Benefits with Quantifiable Metric (e.g. structures per mile)	Habitat Limiting Factor(s) Addressed[1, 2]
8-LC-H36	Reconnection of Wetland 69	Property acquisition to reconnect Wetland 69 to the Cedar River and remove a revetment.	Lower Cedar	Cedar River in Hobart	-Wetland reconnection (acres)	-Altered hydrology -Water quality issues -Loss of floodplain connectivity

Notes:

[1] Habitat limiting factors are described in Section 2.1.3 Salmonids in WRIA 8.

[2] Altered hydrology includes both high flows and low flows. Decreased water quality includes elevated water temperatures.

Projects H12, H14, H20, H21, H31, H32 and H35 will provide a combined total of approximately 2.35 miles of stream restoration and channel reconnection, 41 acres of riparian and wetland restoration, and 86 acres of floodplain reconnection. These benefits will contribute to improving habitat for multiple salmonid species. Most of the habitat projects are in the middle to upper portions of subbasins, so downstream benefits are likely. The exception, H13, is near the mouth of Issaquah Creek, which provides important habitat benefits at a primary rearing and migration corridor. The habitat benefits from the remaining projects, while not quantifiable at this time, will also contribute to NEB.

Habitat projects are distributed across eight of the twelve subbasins, including all four of the subbasins with the highest estimated consumptive use (see Table 5.1 and Table 6.4). Five of the habitat projects are located within the Lower Cedar subbasin that will experience the largest water offset deficit. Four subbasins (Seattle/Lake Union, Puget Sound Shorelines, Lake Sammamish Creeks, and Upper Cedar) have no habitat projects.

Table 6.4: Summary of Habitat Projects by Subbasin

Subbasin	**Habitat Projects**	**Benefiting Stream**
Seattle/Lake Union	No projects	
Puget Sound Shorelines	No projects	
Swamp/North	2 projects: 8-SN-H12 and 8-SN-H13	North Creek
Little Bear	3 projects: 8-LB-H14, 8-LB-H15, and 8-LB-H16	Cutthroat Creek and Little Bear Creek
Sammamish River Valley	2 projects: 8-SRV-H17 and 8-SRV-H18	Sammamish River
Bear/Evans	3 projects: 8-BE-H20, 8-BE-H21, and 8-BE-H22	Bear Creek
Greater Lake Washington	5 projects: 8-GLW-H23, 8-GLW-H24, 8-GLW-H25, 8-GLW-H26, 8 and 8-GLW-H27	Various creeks
May/Coal	1 project: 8-MC-H28	May Creek
Lake Sammamish Creeks	No projects	NA
Issaquah	2 projects: 8-I-H30 and 8-I-H31	Issaquah Creek and its tributaries
Lower Cedar	5 projects: 8-LC-H32, 8-LC-H33, 8-LC-H34, 8-LC-H35, 8-LC-H36	Cedar River
Upper Cedar	No projects	

6.2.4 Watershed Characterization Analysis

Ecology compared the spatial distribution of the watershed plan's water offset and habitat projects against the freshwater habitat index from the Puget Sound Watershed Characterization Project (Wilhere et. al. 2013), which is discussed in Chapter 2.2.1.

This comparison shows the relationship between projects in the watershed plan and the general state of salmon habitat in the watershed. Figure 6.1 shows the project locations with respect to the freshwater habitat index in WRIA 8. Red on the map indicates lower-valued habitat, yellow for moderate-valued habitat, and green for higher-valued habitat. The project map symbols correspond with those in Figure 5.1, with circles indicating water offset projects listed in Table 5.1 and squares indicating habitat projects listed in Table 5.2.

As is evident on Figure 6.1, the watershed plan's water offset and habitat projects are located in areas with relatively higher-valued habitat (green and yellow), which means that projects are more likely to benefit fish and other instream resources. This provides added assurance that the watershed plan will result in a NEB.

6.3 Uncertainty and Adaptive Management

There is uncertainty associated with all of the analyses presented in the plan – including the projected number of new PE wells, the consumptive use estimates, the water offset benefits from the proposed projects, and the likelihood that all projects will be implemented and maintained. In addition, external factors like climate change and human migration patterns could influence the projections and estimates in this plan. Ecology relied on data available at the time of writing this plan and is transparent in the assumptions used in the analyses. Because of the large surplus in water offset, if some offset projects are not developed or benefits are less than expected, a subset of projects can still provide sufficient water to offset the estimated new consumptive use.

Ecology and the state of Washington are invested in the implementation of this watershed plan, including periodically assessing plan and project implementation and issuing competitive grants to local projects that demonstrably implement this plan while benefiting streamflows and aquatic habitat. As required by RCW 90.94.050, Ecology will also prepare and deliver a report to the legislature in 2027 that includes:

- Watershed planning progress under this law.
- A description of current and potential program projects, costs, and expenditures.
- An assessment of the benefits from projects.
- A listing of other directly related effort.
- The total number of, and estimates of consumptive water use impacts associated with, new withdrawals exempt from permitting under each WRIA by this law.

Ecology also acknowledges and supports the importance of adaptively managing the implementation of any plan that covers a 20-year planning horizon. Ecology's periodic plan and project implementation assessments coupled with the availability of hundreds of millions of state appropriated dollars in competitive grant funding provide important catalysts for the necessary local action needed to coordinate project implementation and any associated adaptive management necessary as new information or changed circumstances arise. During the WRIA 8 Committee planning process, the Committee proposed a number of recommendations for adaptive management, which are provided for reference purposes in Appendix F.

6.4 NEB Determination

This watershed plan identifies 33 projects to offset 425.4 AFY of potential consumptive impacts from new permit-exempt domestic groundwater withdrawals on instream flows over 20 years (2018 – 2038), and provide a net ecological benefit to the watershed. The watershed plan provides a surplus of 1,379.7 AFY in water offset benefits from ten water offset projects. Twenty-three habitat projects provide additional ecological and streamflow benefits that contribute to achieving a net ecological benefit at the WRIA scale. The surplus water offset and habitat projects provide reasonable assurance that the plan will adequately offset new consumptive use from PE wells anticipated during the planning horizon and achieve a net ecological benefit.

Based on the information and analyses summarized in this plan, Ecology finds that this plan, if implemented, would achieve a net ecological benefit, as required by RCW 90.94.030 and defined by the Final NEB Guidance (Ecology 2019a).

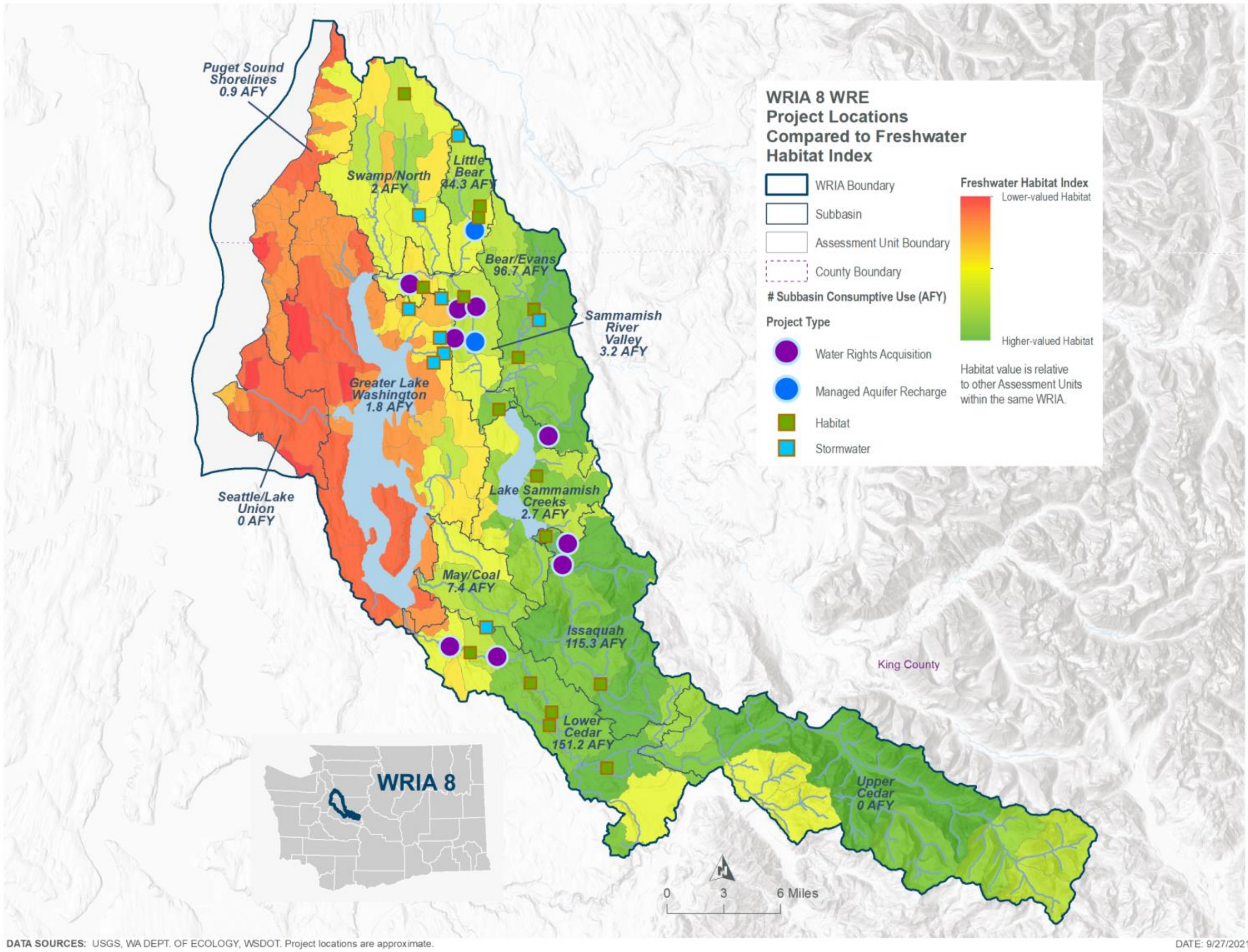


Figure 6.1: WRIA 8 Project Locations Compared to Freshwater Habitat Index

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Appendix

WRIA 8 Cedar – Sammamish Watershed

The following appendices are linked to this report as an Appendices file at:

https://apps.ecology.wa.gov/publications/SummaryPages/2211014.html

Appendix A – Glossary

Appendix B – WRIA 8 Committee Members, Facilitation Team, and Support Staff

Appendix C – Final WRIA 8 Committee Meeting Summary

Appendix D – Technical Memorandums

Appendix E – Project Descriptions

Appendix F – WRIA 8 Committee's Adaptive Management, Implementation, and Policy Recommendations