Appendices

WRIA 14 Kennedy - Goldsborough Watershed

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Appendix B – Glossary

Acronym	Definition
AE	Application Efficiency
AFY	Acre-Feet per Year
CFS	Cubic Feet per Second
CU	Consumptive Use
CUF	Consumptive Use Factor
GPD	Gallons per Day
GIS	Geographic Information System
IR	Irrigation Requirements
LID	Low Impact Development
LIO	Local Integrating Organization
MAR	Managed Aquifer Recharge
NEB	Net Ecological Benefit
PE	Permit-Exempt
RCW	Revised Code of Washington
WDFW	Washington Department of Fish and Wildlife
WRIA	Water Resource Inventory Areas

Acre-feet (AF): A unit of volume equal to the volume of a sheet of water one acre in area and one foot in depth. (USGS)

Adaptive Management: An iterative and systematic decision-making process that aims to reduce uncertainty over time and help meet project, action, and plan performance goals by learning from the implementation and outcomes of projects and actions. (NEB)

Annual Average Withdrawal: RCW 90.94.030 (4)(a)(vi)(B) refers to the amount of water allowed for withdrawal per connection as the annual average withdrawal. As an example, a homeowner could withdraw 4,000 gallons on a summer day, so long as they did not do so often enough that their annual average exceeds the 950 gpd.

Beaver Dam Analogue (BDA): BDAs are man-made structures designed to mimic the form and function of a natural beaver dam. They can be used to increase the probability of successful beaver translocation and function as a simple, cost-effective, non-intrusive approach to stream restoration. (From Anabranch Solutions)

Critical Flow Period: The time period of low streamflow (generally described in bi-monthly or monthly time steps) that has the greatest likelihood to negatively impact the survival and recovery of threatened or endangered salmonids or other fish species targeted by the planning group. The planning group should discuss with Ecology, local tribal and WDFW biologists to determine the critical flow period in those reaches under the planning group's evaluation. (NEB)

Cubic feet per second (CFS): 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 (about the size of one archive file box or a basketball). (USGS)

Domestic Use: In the context of Chapter 90.94 RCW, "domestic use" and the withdrawal limits from permit-exempt domestic wells include both indoor and outdoor household uses, and watering of a lawn and noncommercial garden. (NEB)

ESSB 6091: In January 2018, the Legislature passed Engrossed Substitute Senate Bill (ESSB) 6091 in response to the Hirst decision. In the Whatcom County vs. Hirst, Futurewise, et al. decision (often referred to as the "Hirst decision"), the court ruled that the county failed to comply with the Growth Management Act requirements to protect water resources. The ruling required the county to make an independent decision about legal water availability. ESSB 6091 addresses the court's decision by allowing landowners to obtain a building permit for a new home relying on a permit-exempt well. ESSB 6091 is codified as Chapter 90.94 RCW. (ECY)

Evolutionarily Significant Unit (ESU): A population of organisms that is considered distinct for purposes of conservation. For Puget Sound Chinook, the ESU includes naturally spawned Chinook Salmon originating from rivers flowing into Puget Sound from the Elwha River (inclusive) eastward, including rivers in Hood Canal, South Sound, North Sound and the Strait of Georgia. Also, Chinook Salmon from 26 artificial propagation programs. (NOAA)

Foster Pilots and Foster Task Force: To address the impacts of the 2015 Foster decision, Chapter 90.94 RCW established a Task Force on Water Resource Mitigation and authorized the Department

of Ecology to issue permit decisions for up to five water mitigation pilot projects. These pilot projects will address issues such as the treatment of surface water and groundwater appropriations and include management strategies to monitor how these appropriations affect instream flows and fish habitats. The joint legislative Task Force will (1) review the treatment of surface water and groundwater appropriations as they relate to instream flows and fish habitat, (2) develop and recommend a mitigation sequencing process and scoring system to address such appropriations, and (3) review the Washington Supreme Court decision in Foster v. Department of Ecology. The Task Force is responsible for overseeing the five pilot projects. (ECY)

Four Year Work Plans: Four year plans are developed by salmon recovery lead entities in Puget Sound to describe each lead entity's accomplishments during the previous year, to identify the current status of recovery actions, any changes in recovery strategies, and to propose future actions anticipated over the next four years. Regional experts conduct technical and policy reviews of each watershed's four year work plan update to evaluate the consistency and appropriate sequencing of actions with the Puget Sound Salmon Recovery Plan. (Partnership)

Gallons per day (GPD): An expression of the average rate of domestic and commercial water use. 1 million gallons per day is equivalent to 1.547 cubic feet per second.

Group A public water systems: Group A water systems have 15 or more service connections or serve 25 or more people per day. Chapter 246-290 WAC (Group A Public Water Supplies), outlines the purpose, applicability, enforcement, and other policies related to Group A water systems. (WAC)

Group B public water systems: Group B public water systems serve fewer than 15 connections **and** fewer than 25 people per day. Chapter 246-291 WAC (Group B Public Water Systems), outlines the purpose, applicability, enforcement, and other policies related to Group B water systems.(WAC)

Growth Management Act (GMA): Passed by the Washington Legislature and enacted in 1990, this act guides planning for growth and development in Washington State. The act requires local governments in fast growing and densely populated counties to develop, adopt, and periodically update comprehensive plans.

Home: A general term referring to any house, household, or other Equivalent Residential Unit. (Policy and Interpretive Statement)

Hydrologic Unit Code (HUC): Hydrologic unit codes refer to the USGS's division and sub-division of the watersheds into successively smaller hydrologic units. The units are classified into four levels: regions, sub-regions, accounting units, and cataloging units, and are arranged within each other from the largest geographic area to the smallest. Each unit is classified by a unit code (HUC) composed of two to eight digits based on the four levels of the classification in the hydrologic unit system (two digit units are largest and eight digits are smallest). (USGS)

Impact: For the purpose of streamflow restoration planning, impact is the same as new consumptive water use (see definition below). As provided in Ecology WR POL 2094 "Though the statute requires the offset of 'consumptive impacts to instream flows associated with permit-

exempt domestic water use' (RCW 90.94.020(4)(b)) and 90.94.030(3)(b)), watershed plans should address the consumptive use of new permit-exempt domestic well withdrawals. Ecology recommends consumptive use as a surrogate for consumptive impact to eliminate the need for detailed hydrogeologic modeling, which is costly and unlikely feasible to complete within the limited planning timeframes provided in chapter 90.94 RCW. " (NEB)

Instream Flow Rule (IFR): An administrative rule that establishes Instream Flows.

Instream Resources Protection Program (IRPP): The IRPP was initiated by the Department of Ecology in September 1978 with the purpose of developing and adopting instream resource protection measures for Water Resource Inventory Areas (WRIAs) (see definition below) in Western Washington as authorized in the Water Resources Act of 1971 (RCW 90.54), and in accordance with the Water Resources Management Program (WAC 175-500).

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Instream Resources: Fish and related aquatic resources. (NEB)

Large woody debris (LWD): LWD refers to the fallen trees, logs and stumps, root wads, and piles of branches along the edges of streams, rivers, lakes and Puget Sound. Wood helps stabilize shorelines and provides vital habitat for salmon and other aquatic life. Preserving the debris along shorelines is important for keeping aquatic ecosystems healthy and improving the survival of native salmon. (King County)

Lead Entities (LE): Lead Entities are local, citizen-based organizations in Puget Sound that coordinate salmon recovery strategies in their local watershed. Lead entities work with local and state agencies, tribes, citizens, and other community groups to adaptively manage their local salmon recovery chapters and ensure recovery actions are implemented. (Partnership)

Listed Species: Before a species can receive the protection provided by the Endangered Species Act (ESA), it must first be added to the federal lists of endangered and threatened wildlife and plants. The List of Endangered and Threatened Wildlife (50 CFR 17.11) and the List of Endangered and Threatened Plants (50 CFR 17.12) contain the names of all species that have been determined by the U.S. Fish and Wildlife Service (Service) or the National Marine Fisheries Service (for most marine life) to be in the greatest need of federal protection. A species is added to the list when it is determined to be endangered or threatened because of any of the following factors: the present or threatened destruction, modification, or curtailment of its habitat or range; overutilization for commercial, recreational, scientific, or educational purposes; disease or predation; the inadequacy of existing regulatory mechanisms; or other natural or manmade factors affecting its survival. (USFWS)

Local Integrating Organizations (LIO): Local Integrating Organizations are local forums in Puget Sound that collaboratively work to develop, coordinate, and implement strategies and actions that contribute to the protection and recovery of the local ecosystem. Funded and supported by the Puget Sound Partnership, the LIOs are recognized as the local expert bodies for ecosystem recovery in nine unique ecosystems across Puget Sound. (Partnership)

Low Impact Development (LID): Low Impact Development (LID) is a stormwater and land-use management strategy that tries to mimic natural hydrologic conditions by emphasizing techniques including conservation, use of on-site natural features, site planning, and distributed stormwater best management practices (BMPs) integrated into a project design. (ECY)

Managed Aquifer Recharge (MAR): Managed aquifer recharge projects involve the addition of water to an aquifer through infiltration basins, injection wells, or other methods. The stored water can then be used to benefit stream flows, especially during critical flow periods. (NEB)

National Pollutant Discharge Elimination System (NPDES): The NPDES permit program addresses water pollution by regulating point sources that discharge pollutants to waters of the United States. Created by the Clean Water Act in 1972, the EPA authorizes state governments to perform many permitting, administrative, and enforcement aspects of the program. (EPA)

Net Ecological Benefit (NEB): Net Ecological Benefit is a term used in ESSB 6091 as a standard that watershed plans (see below for definition) must meet. 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. See *Final Guidance for Determining Net Ecological Benefit - Guid-2094 Water Resources Program Guidance.* (NEB)

Net Ecological Benefit Determination: Occurs solely upon Ecology's conclusion after its review of a watershed plan submitted to Ecology by appropriate procedures, that the plan does or does not achieves a NEB as defined in the Net Ecological Benefit guidance. The Director of Ecology will issue the results of that review and the NEB determination in the form of an order. (NEB)

Net Ecological Benefit Evaluation: A planning group's demonstration, using NEB Guidance and as reflected in their watershed plan, that their plan has or has not achieved a NEB. (NEB)

New Consumptive Water Use: The consumptive water use from the permit-exempt domestic groundwater withdrawals estimated to be initiated within the planning horizon. For the purpose of RCW 90.94, consumptive water use is considered water that is evaporated, transpired, consumed by humans, or otherwise removed from an immediate water environment due to the use of new permit-exempt domestic wells. (NEB)

Office of Financial Management (OFM): OFM is a Washington state agency that develops official state and local population estimates and projections for use in local growth management planning. (OFM)

Offset: The anticipated ability of a project or action to counterbalance some amount of the new consumptive water use over the planning horizon. Offsets need to continue beyond the planning horizon for as long as new well pumping continues. (NEB)

Permit exempt wells: The Groundwater Code (RCW 90.44), identified four "small withdrawals" of groundwater as exempt from the permitting process. Permit-exempt groundwater wells often provide water where a community supply is not available, serving single homes, small developments, irrigation of small lawns and gardens, industry, and stock watering.

Permit-exempt uses: Groundwater permit exemptions allow four small uses of groundwater without a water right permit: domestic uses of less than 5,000 gallons per day, industrial uses of less than 5,000 gallons per day, irrigation of a lawn or non-commercial garden, a half-acre or less in size, or stock water. Although exempt groundwater withdrawals don't require a water right permit, they are always subject to state water law. (ECY)

Planning groups: A general term that refers to either initiating governments, in consultation with the planning unit, preparing a watershed plan update required by Chapter 90.94.020 RCW, or a watershed restoration and enhancement committee preparing a plan required by Chapter 90.94.030 RCW. (NEB)

Planning Horizon: 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, based on the requirements set forth in Chapter 90.94 RCW. (NEB)

Projects and Actions: General terms describing any activities in watershed plans to offset impacts from new consumptive water use and/or contribute to NEB. (NEB)

Puget Sound Acquisition and Restoration (PSAR) fund: This fund supports projects that recover salmon and protect and recover salmon habitat in Puget Sound. The state legislature appropriates money for PSAR every 2 years in the Capital Budget. PSAR is co-managed by the Puget Sound Partnership and the Recreation and Conservation Office, and local entities identify and propose PSAR projects. (Partnership)

Puget Sound Partnership (Partnership): The Puget Sound Partnership is the state agency leading the region's collective effort to restore and protect Puget Sound and its watersheds. The organization brings together hundreds of partners to mobilize partner action around a common agenda, advance Sound investments, and advance priority actions by supporting partners. (Partnership)

Puget Sound Regional Council (PSRC): PSRC develops policies and coordinates decisions about regional growth, transportation and economic development planning within King, Pierce, Snohomish and Kitsap counties. (PSRC)

RCW 90.03 **(Water Code)**: This chapter outlines the role of the Department of Ecology in regulating and controlling the waters within the state. The code describes policies surrounding surface water and groundwater uses, the process of determining water rights, compliance measures and civil penalties, and various legal procedures.

RCW 90.44 **(Groundwater Regulations)**: RCW 90.44 details regulations and policies concerning groundwater use in Washington State, and declares that public groundwaters belong to the public

and are subject to appropriation for beneficial use under the terms of the chapter. The rights to appropriate surface waters of the state are not affected by the provisions of this chapter.

RCW 90.44.050 **(Groundwater permit exemption)**: This code states that any withdrawal of public groundwaters after June 6, 1945 must have an associated water right from the Department of Ecology. However, any withdrawal of public groundwaters for stock-watering purposes, or for the watering of a lawn or of a noncommercial garden not exceeding one-half acre in area, or for single or group domestic uses in an amount not exceeding five thousand gallons a day, or for an industrial purpose in an amount not exceeding five thousand gallons a day, is exempt from the provisions of this section and does not need a water right.

RCW 90.54 (**Water Resources Act of 1971**): This act set the stage for the series of rules that set instream flow levels as water rights, as well as a compliance effort to protect those flows.

RCW 90.82 **(Watershed Planning)**: Watershed Planning was passed in 1997 with the purpose of developing a more thorough and cooperative method of determining what the current water resource situation is in each water resource inventory area of the state and to provide local citizens with the maximum possible input concerning their goals and objectives for water resource management and development.

RCW 90.94 **(Streamflow Restoration)**: This chapter of the Revised Code of Washington codifies ESSB 6091, including watershed planning efforts, streamflow restoration funding program and the joint legislative task force on water resource mitigation and mitigation pilot projects (Foster task force and pilot projects).

Reasonable Assurance: Explicit statement(s) in a watershed plan that the plan's content is realistic regarding the outcomes anticipated by the plan, and that the plan content is supported with scientifically rigorous documentation of the methods, assumptions, data, and implementation considerations used by the planning group. (NEB)

Revised Code of Washington (RCW**)**: The revised code is a compilation of all permanent laws now in force for the state of Washington. The RCWs are organized by subject area into Titles, Chapters, and Sections.

Salmon Recovery Funding Board (SRFB): Pronounced "surf board", this state and federal board provides grants to protect and restore salmon habitat. Administered by a 10-member State Board that includes five governor-appointed citizens and five natural resource agency directors, the board brings together the experiences and viewpoints of citizens and the major state natural resource agencies. For watersheds planning under Section 203, the Department of Ecology will submit final draft WRE Plans not adopted by the prescribed deadline to SRFB for a technical review (RCO and Policy and Interpretive Statement).

Section 202 or Section 020: Refers to Section 202 of ESSB 6091 or Section 020 of RCW 90.94 respectively. The code provides policies and requirements for new domestic groundwater withdrawals exempt from permitting with a potential impact on a closed water body and potential impairment to an instream flow. This section includes WRIAs 1, 11, 22, 23, 49, 59 and 55, are

required to update watershed plans completed under RCW 90.82 and to limit new permit-exempt withdrawals to 3000 gpd annual average.

Section 203 or Section 030: Refers to Section 203 of ESSB 6091 or Section 030 of RCW 90.94 respectively. The section details the role of WRE committees and WRE plans (see definitions below) in ensuring the protection and enhancement of instream resources and watershed functions. This section includes WRIAs 7, 8, 9, 10, 12, 13, 14 and 15. New permit-exempt withdrawals are limited to 950 gpd annual average.

SEPA and SEPA Review: SEPA is the State Environmental Policy Act. SEPA identifies and analyzes environmental impacts associated with governmental decisions. These decisions may be related to issuing permits for private projects, constructing public facilitates, or adopting regulations, policies, and plans. SEPA review is a process which helps agency decision-makers, applications, and the public understand how the entire proposal will affect the environment. These reviews are necessary prior to Ecology adopting a plan or plan update and may be completed by Ecology or by a local government. (Ecology)

Stream Flow: A specific flow level measured at a specific location in a given stream, usually described as a rate, such as cfs. Stream flow is the actual amount of real water at a specific place and at a given moment. Stream flows can change from moment to moment.

Subbasins: A geographic subarea within a WRIA, equivalent to the words "same basin or tributary" as used in RCW 90.94.020(4)(b) and RCW 90.94.030 (3)(b). In some instances, subbasins may not correspond with hydrologic or geologic basin delineations (e.g. watershed divides). (NEB)

Trust Water Right Program: The program allows the Department of Ecology to hold water rights for future uses without the risk of relinquishment. Water rights held in trust contribute to streamflows and groundwater recharge, while retaining their original priority date. Ecology uses the Trust Water Right Program to manage acquisitions and accept temporary donations. The program provides flexibility to enhance flows, bank or temporarily donate water rights. (ECY)

Urban Growth Area (UGA): UGAs are unincorporated areas outside of city limits where urban growth is encouraged. Each city that is located in a GMA fully-planning county includes an urban growth area where the city can grow into through annexation. An urban growth area may include more than a single city. An urban growth area may include territory that is located outside of a city in some cases. Urban growth areas are under county jurisdiction until they are annexed or incorporated as a city. Zoning in UGAs generally reflect the city zoning, and public utilities and roads are generally built to city standards with the expectation that when annexed, the UGA will transition seamlessly into the urban fabric. Areas outside of the UGA are generally considered rural. UGA boundaries are reviewed and sometimes adjusted during periodic comprehensive plan updates. UGAs are further defined in RCW 36.70.

WAC 173-566 **(Streamflow Restoration Funding Rule)**: On June 25, 2019 the Department of Ecology adopted this rule for funding projects under RCW 90.94. This rule establishes processes and criteria

for prioritizing and approving grants consistent with legislative intent, thus making Ecology's funding decision and contracting more transparent, consistent, and defensible.

Washington Administrative Code (WAC): The WAC contains the current and permanent rules and regulations of state agencies. It is arranged by agency and new editions are published every two years. (Washington State Legislature)

Washington Department of Ecology (DOE/ECY): The Washington State Department of Ecology is an environmental regulatory agency for the State of Washington. The department administers laws and regulations pertaining to the areas of water quality, water rights and water resources, shoreline management, toxics clean-up, nuclear and hazardous waste, and air quality.

Washington Department of Fish and Wildlife (WDFW): An agency dedicated to preserving, protecting, and perpetuating the state's fish, wildlife, and ecosystems while providing sustainable fish and wildlife recreational and commercial opportunities. Headquartered in Olympia, the department maintains six regional offices and manages dozens of wildlife areas around the state, offering fishing, hunting, wildlife viewing, and other recreational opportunities for the residents of Washington. With the tribes, WDFW is a co-manager of the state salmon fishery. (WDFW)

Washington Department of Natural Resources (WADNR or DNR): The department manages over 3,000,000 acres of forest, range, agricultural, and commercial lands in the U.S. state of Washington. The DNR also manages 2,600,000 acres of aquatic areas which include shorelines, tidelands, lands under Puget Sound and the coast, and navigable lakes and rivers. Part of the DNR's management responsibility includes monitoring of mining cleanup, environmental restoration, providing scientific information about earthquakes, landslides, and ecologically sensitive areas. (WADNR)

Water Resources (WR): The Water Resources program at Department of Ecology supports sustainable water resources management to meet the present and future water needs of people and the natural environment, in partnership with Washington communities. (ECY)

Water Resources Advisory Committee (WRAC): Established in 1996, the Water Resources Advisory Committee is a forum for issues related to water resource management in Washington State. This stakeholder group is comprised of 40 people representing state agencies, local governments, water utilities, tribes, environmental groups, consultants, law firms, and other water stakeholders. (ECY)

Watershed Plan: A general term that refers to either: a watershed plan update prepared by a WRIA's initiating governments, in collaboration with the WRIA's planning unit, per RCW 90.94.020; or a watershed restoration and enhancement plan prepared by a watershed restoration and enhancement committee, per RCW 90.94.030. This term does not refer to RCW 90.82.020(6). (NEB)

Watershed Restoration and Enhancement Plan (WRE Plan): The Watershed Restoration and Enhancement Plan is directed by Section 203 of ESSB 6091 and requires that by June 30, 2021, the Department of Ecology will prepare and adopt a watershed restoration and enhancement plan for WRIAs 7, 8, 9, 10, 12, 13, 14 and 15, in collaboration with the watershed restoration and enhancement committee. The plan should, at a minimum, offset the consumptive impact of new permit-exempt domestic water use, but may also include recommendations for projects and actions

that will measure, protect, and enhance instream resources that support the recovery of threatened and endangered salmonids. Prior to adoption of an updated plan, Department of Ecology must determine that the actions in the plan will result in a "net ecological benefit" to instream resources in the WRIA. The planning group may recommend out-of-kind projects to help achieve this standard.

WRIA: Water Resource Inventory Area. WRIAs are also called basins or watersheds. There are 62 across the state and each are assigned a number and name. They were defined in 1979 for the purpose of monitoring water availability. A complete map is available here: https://ecology.wa.gov/Water-Shorelines/Water-supply/Water-availability/Watershed-look-up

Appendix C – Committee Roster

WRIA 14 Committee Members – Primary Representatives and Alternates[1]

Commissioner Kevin Shutty, Mason County

Commissioner Randy Neatherlin, Mason County

David Windom, Mason County

Joshua Cummings, Thurston County

Kaitlynn Nelson, Thurston County

Brad Murphy, Thurston County

Ken Gill, City of Shelton

Craig Gregory[1], City of Shelton

Jason Dose, City of Shelton

Brent Armstrong, City of Shelton

Mark Ziegler, City of Shelton

Alex Gouley, Skokomish Indian Tribe

Seth Book, Skokomish Indian Tribe

Dana Sarff, Skokomish Indian Tribe

Jeff Dickison, Squaxin Island Tribe

Tristan Weiss, Department of Fish and Wildlife

Megan Kernan, Department of Fish and Wildlife

Josie Cummings, Building Industry Association of Washington

Erin Hall[1], Olympia Master Builders[3]

John Bolender, Mason Conservation District, (ex officio)

Barbara Adkins, Mason Conservation District (ex officio)

Fern Schultz, Department of Health (ex officio)

Patti Case, Green Diamond (ex officio)

Paul Pickett, Squaxin Island Tribe

Commissioner Ron Gold, Mason County PUD #1

Darin Hall[1], Mason County PUD #1

Brandy Milroy, Mason County PUD #1

Kristen Masteller, Mason County PUD #1

James Reyes, Mason County PUD #1

Elaine Packard, Washington State Chapter Sierra Club

Lois Ward, Washington State Chapter Sierra Club

Shelley Spalding[2], Washington State Chapter Sierra Club

Marilyn Vogler[2], Washington State Chapter Sierra Club

Larry Boltz, Mason-Kitsap Farm Bureau

Paul Miller, Skokomish Valley Farms

Allison Cook, Department of Fish and Wildlife

Darrin Masters, Department of Fish and Wildlife

[1] [1]No longer with entity [2]Withdrew from Committee prior to final vote [3]Entity withdrew from Committee prior to final vote

Technical and Project Workgroup[2]

Angela Johnson, Department of Ecology

Tom Culhane, Department of Ecology

Jim Pacheco, Department of Ecology

Chad Wiseman, HDR

Peter Schwartzman, PGG

David Windom, Mason County

Kell Rowen, Mason County

Kaitlynn Nelson, Thurston County

Brad Murphy, Thurston County

Kevin Hansen, Thurston County

Ken Gill, City of Shelton

Craig Gregory[1], City of Shelton

Seth Book, Skokomish Indian Tribe

Dana Sarff, Skokomish Indian Tribe

Jon Turk, Aspect Consulting, representing Skokomish Indian Tribe

Paul Pickett, Squaxin Island Tribe

Erica Marbet, Squaxin Island Tribe

Darin Hall, Mason County PUD #1

James Reyes, Mason County PUD #1

Lois Ward, Washington Chapter Sierra Club

Shelley Spalding[2], Washington State Chapter Sierra Club

Marilyn Vogler[2], Washington State Chapter Sierra Club

Larry Boltz, Mason-Kitsap Farm Bureau

Allison Cook, Department of Fish and Wildlife

Darrin Masters, Department of Fish and Wildlife

Tristan Weiss, Department of Fish and Wildlife

Megan Kernan, Department of Fish and Wildlife

Erin Hall[1], Olympia Master Builders[2]

Barbara Adkins, Mason Conservation District (ex officio)

Steve Hagerty, WRIA 14 Lead Entity Coordinator, Mason Conservation District (ex officio)

Evan Bauder, Mason Conservation District (ex officio)

Fern Schultz, Department of Health (ex officio)

Patti Case, Green Diamond (ex officio)

[2] [1]No longer with entity [2]Withdrew from Committee prior to final vote [3]Entity withdrew from Committee prior to final vote

Appendix D – Final Meeting Summary of the WRIA 14 Watershed Restoration and Enhancement Committee

MEETING SUMMARY

WRIA 14 Watershed Restoration and Enhancement Committee

April 21st, 2021 | 9:00 a.m. – 11:30 a.m. | committee website

Location	Committee Chair	Handouts
WebEx	Angela Johnson angela.johnson@ecy.wa.gov	Plan Adoption Pathways Final Plan Plan Compendium

Attendance

*Attendance is based on WebEx participation

Committee Representatives and Alternates

Angela Johnson (*Ecology*)

Jeff Dickison (*Squaxin Island Tribe*)

Paul Pickett (*Squaxin Island Tribe*)

Seth Book (*Skokomish Tribe*)

Dana Sarff (*Skokomish Tribe*)

Kaitlynn Nelson (*Thurston County*)

Kevin Shutty (*Mason County*)

Dave Windom (*Mason County*)

Ken Gill (*City of Shelton*)

Allison Cook (*WDFW*)

Larry Boltz (*Mason Kitsap Farm Bureau*)

Lois Ward (*WA State Chapter Sierra Club*)

Barbara Adkins (*Mason Conservation District, ex officio)*

Patti Case (*Green Diamond, ex officio)*

Committee Representatives Not in Attendance*

Other Attendees*

Susan Gulick *(Facilitator, Sound Resolutions)*

Jimmy Kralj (*ESA*)

Chad Wiseman (*HDR*)

Tom Culhane (*Ecology*)

Mike Noone (*Ecology*)

Stacy Vynne McKinstry (*Ecology)*

Rebecca Brown (*Ecology)*

Elena Hernandez (*Thurston County Public Works*)

Jason Gano (*Olympia Master Builders*)

Welcome

Angela and Susan kicked off the meeting and took roll call. The group reviewed the meeting agenda. Susan and Angela notified the Committee that there was a request for the meeting to be recorded. The meeting recording is available through WebEx and is posted on the Committee's EZ View website.

Updates and Announcements

- The January 2021 meeting summaries were approved over email, no action is needed today.
    - We will have the same approval process for the meeting summary for this meeting.
- Angela provided updates regarding plan approval in the 90.94.020 and 90.94.030 processes.
- Ecology will finalize the timing of the next round of the Streamflow Restoration Grant program once funding is confirmed by the legislature.
- Angela provided a short summary of corrections and additions made to the plan since it was distributed for local review. Angela noted that the Committee had received notice that several entities intended to disapprove the plan today, but their decisions to do so were not based on any of the proposed changes; as such, Angela noted that she was not going to review the proposed changes in detail but that they were distributed with the meeting packet.

Steps to Plan Adoption

- Angela provided an overview of the two pathways to plan adoption, as stated in the handout distributed with meeting materials: plans approved by the Committee, and plans not approved by the Committee or not adopted by Ecology by June 30, 2021.
- The Squaxin Island Tribe asked about the SEPA process for non-Committee approved plans.
    - Ecology responded that a SEPA process would occur but did not have further information at this time. Information will be shared with the Committee when it is available.

Public Comment

- No public comment was provided.

Committee Member Vote and Statements

- **Ecology**
    - Approve
    - Thanked the Committee for their hard work in the process.
- **Squaxin Island Tribe**
    - Disapprove
    - The tribe has submitted a letter to Ecology to document its intention to disapprove the WRIA 14 plan. The letter is signed by Andy Whitener who is a member of the Tribal Council. This decision was made and supported by the Council. While there are some positive aspects of the plan, the plan's inadequacies outweigh the positive

elements. There are insufficient projects in locations where there are likely to be increased exempt wells with an impact to salmon streams. The tribe offered several policy and regulatory proposals that were rejected and the plan contains no provisions for rulemaking.

- **Skokomish Tribe**
  - Disapprove
  - The Tribe will continue to work in partnership with other tribes and stakeholders to advance habitat and salmon recovery efforts.
- **WDFW**
  - Disapprove
  - The plan was reviewed by the Water Policy Team and the WDFW Director was briefed. WDFW has concerns about consumptive use estimates, streamflow benefits, uncertainty with implementation, and projects related to achieving NEB. WDFW submitted a letter to Ecology that further outlines their concerns.
- **Thurston County**
  - Approve
  - Supported by Board of County Commissioners
- **Mason County**
  - Approve
  - Expressed gratitude to the facilitation team, Ecology, and Mason County staff for their work. Mason County looks forward to continuing to work with partners to develop and advance work contained in the plan.
- **City of Shelton**
  - Approve
  - Expressed gratitude to the facilitation team, Ecology, and Shelton City Council Members.
- **Mason PUD 1**
  - Approve
  - Expressed concerns related to the plan. They felt that there was not enough time to review documents and models that were submitted to the Plan Compendium near the end of the review process.
- **Building Industry Association of Washington**
  - Disapprove
  - Believes that the plan falls outside the scope of the legislation. More detailed comments are included in a letter that they submitted to Ecology.
- **Sierra Club**
  - Approve
- **Mason Kitsap Farm Bureau**
  - Approve
  - Stated their frustration on the collaboration of the Committee. Expressed concerns about late additions to the Plan Compendium, and expressed hope that farming can be viable and continue to exist in the watershed.
- Ex-Officio Comments

- Green Diamond Resource Company: Expressed hope that some of the work identified in the plan can advance and that partners can collaborate and work together.

- **The plan was not approved, with 4 entities voting to disapprove, and 7 entities voting to approve. The tally of the votes given by the Committee is presented below.**

Entity	Committee Member	Vote
Ecology	Angela Johnson	Approve
Squaxin Island Tribe	Jeff Dickison	Disapprove
Skokomish Tribe	Dana Sarff	Disapprove
Department of Fish and Wildlife	Allison Cook	Disapprove
Thurston County	Kaitlynn Nelson	Approve
Mason County	Kevin Shutty	Approve
City of Shelton	Ken Gill	Approve
Mason PUD 1	Ron Gold	Approve
BIAW	Josie Cummings	Disapprove
WA Sierra Club	Lois Ward	Approve
Mason Kitsap Farm Bureau	Larry Boltz	Approve

Post-Vote Discussion

Angela and Susan confirmed with the Committee that the plan was not approved, and asked the Committee if there was any discussion on the outcome of the vote or how the Committee would like to proceed.

- Susan noted that the Committee, if they chose to, still had the opportunity to work together to reach consensus and vote again on the plan. However, based on the statements made during the vote, there did not appear to be a path to consensus given the range of disagreements as well as the constraints of the June 30, 2021 deadline.
    - There were no comments from the Committee in response to this statement.
- WDFW expressed concerns about the future of partnerships between entities on the Committee given the outcome of the final plan. Allison stated that she would be

disappointed to see the disagreement on this plan bleed into the existing collaboration between salmon recovery partners in the field. She stated that relationships are so important to salmon recovery, and that she would encourage there to not be a breakdown of those relationships as a result of the outcome of this process.

- Angela and Susan thanked the Committee for this discussion and indicated they would be moving on to the next steps to wrap-up the meeting. They confirmed that the plan was not approved, and that based on the Committee's discussion there would be no further action to make changes to the plan. If Committee members see a path forward that could lead to consensus, they should contact Angela or Susan.

Next Steps

- Angela will notify Ecology management that the WRIA 14 Watershed Restoration and Enhancement Plan is not approved, and will send the final draft plan along with any signing statements submitted by entities to confirm their vote. Angela noted that aside from the signing statements, this would not include documents submitted for the Plan Compendium. Committee members can submit letters to Ecology for their consideration at any time.
    - Angela noted that the timeline for Ecology moving forward on preparing the final plan under RCW 90.94.030(3)(h) has not been completely determined, but Ecology will not start on their plan adoption process until after June 30th. Angela will continue to be in touch with Committee members as information becomes available.
    - Ecology is prioritizing their review for approved plans. The timing of Ecology preparing plans that are not approved by Committees will be dependent upon work and demands from other plans and Committees – Ecology will be evaluating this over the next couple of months.
- The meeting summary will be approved over email.

  Angela and Susan thanked the Committee members and their entities, consultants, Ecology technical team, and all workgroup members for their time, hard work, and participation over the last 2.5 years.

Appendix E – Regional Aquifer Units within WRIA 14

Aquifer	Description	Typical Thickness
AA – Alluvial Aquifer	Composed of recent alluvium (Qa), this aquifer consists of clay, silt, sand, and gravel deposits. This aquifer is laterally discontinuous and limited to stream valleys.	A few feet up to about 50 feet thick, where present. Where saturated, the unit is often in direct continuity with surface-water bodies.
UA – Upper Aquifer	This aquifer is mainly composed of deposits from the Vashon recessional outwash (Qgo). The deposits are usually poorly- to moderately-sorted sand or sand and gravel, sometimes with lenses of silt or clay. The unit is generally unconfined.	The thickness varies from 5 feet up to about 250 feet.
UC – Upper Confining Unit	This confining unit is composed primarily of Vashon till (Qgt) and consists of unsorted and compacted clay, silt, sand, and gravel. This unit separates the Upper Aquifer and Middle Aquifer.	The thickness ranges from 5 feet up to about 360 feet.
MA – Middle Aquifer	This aquifer is mainly composed of deposits from the Vashon advance outwash (Qga). The deposits are usually moderately- to well-sorted sand, gravel, and silt with occasional lenses of silt or clay. Although laterally extensive, this aquifer is discontinuous where surface water drainages have incised through the overlying till and into the outwash. This aquifer is generally confined, but locally unconfined conditions may occur where the aquifer is not fully saturated, or where it is exposed at land surface.	The thickness ranges from a few feet to about 150 feet.

Aquifer	Description	Typical Thickness
LC – Lower Confining Unit	This confining unit is primarily composed of pre-Vashon glaciolacustrine and interglacial sediments and consists of clay and silt, with some till and occasional deposits of peat and wood. This unit is laterally extensive and separates the Middle Aquifer and Lower Aquifer.	The thickness ranges from several tens of feet to about 350 feet.
LA – Lower Aquifer	Sometimes also called the "sea-level aquifer" due its coincident elevation, this unit is primarily composed of pre-Vashon outwash deposits consisting of sand and gravel, with some lower-permeability deposits of silt, clay, or till. This aquifer is confined by the overlying Middle Confining Unit. This aquifer is present throughout most of the WRIA, except the southeast portion where bedrock is at or near ground surface.	The thickness ranges from 5 feet to about 200 feet.

Appendix F - Policy, Regulatory, and Adaptive Management Recommendations Proposed by the WRIA 14 Committee

The WRIA 14 Committee spent several months preparing recommendations for policy and regulatory change, as well as plan implementation tracking and adaptive management. While Ecology is not putting forward these recommendations as part of our plan, we want to preserve the work of the committee and present the recommendations for WRIA 14 partners that may choose to move these recommendations forward.

This language is taken directly from the Committee's WRIA 14 draft plan (version February 3, 2021) with only minor revisions to remove references to appendices.

6.1 Policy and Regulatory Recommendations

The Streamflow Restoration law lists optional elements committees may consider including in the plan to manage water resources for the WRIA or a portion of the WRIA (RCW 90.94.030(3)(f)). The WRIA 14 Committee included "policy and regulatory recommendations" in the watershed plan to show support for programs, policies, and regulatory actions that would contribute to the goal of streamflow restoration. When similar concepts arose from multiple Watershed Restoration and Enhancement Committees, the WRIA 14 Committee coordinated with those other committees to put forward common language for inclusion in the watershed plans, when appropriate. Coordination also occurred for jurisdictions that cross multiple watersheds. All projects and actions the WRIA 14 Committee intended to count toward the required consumptive use offset or NEB are included in Chapter 5: Projects and Actions.

As recommended by the NEB Guidance, the WRIA 14 Committee prepared the plan with implementation in mind. However, as articulated in the Streamflow Restoration Policy and Interpretive Statement (POL-2094), "RCW 90.94.020 and 90.94.030 do not create an obligation on any party to ensure that plans, or projects and actions in those plans or associated with rulemaking, are implemented" (Ecology 2019a).

The WRIA 14 Committee initially identified a list of potential recommendations based on proposals brought forward by members of the Committee. After iterative rounds of discussion and feedback during Committee meetings, in one on one conversations, and using a survey tool, the Committee narrowed the recommendations to those presented below. Unless otherwise specified, the proposed implementing entity is not obligated by this plan to implement the recommendation; however, the WRIA 14 Committee requests consideration of each recommendation by the identified implementing entity. Additional information on assurance of implementation has been provided by many entities in section 6.3.2. The identification and listing of these policy and regulatory recommendations is directly from the WRIA 14 Committee members and is not endorsed or opposed by Ecology.

The WRIA 14 Committee provides the following recommendations. Please note that these are not listed in order of priority:

1. Track the number and location of permit-exempt wells

Proposed implementing entity: Department of Ecology

Recommendation: Update Department of Ecology's well tracking system to better track the number and location of permit-exempt wells in use. This update would include the following:

- Collect latitude and longitude of wells on well report forms;
- Identify permit-exempt wells on well log form; and
- Provide electronic Well ID Tag numbers to older wells, and associate well decommissioning, replacement, or other well activities with the Well ID Tag.

Purpose: Accurate tracking of the locations and features of permit-exempt wells will support the WRIA 14 Committee's desire to engage in monitoring and adaptive management after plan adoption.

Funding source: If Ecology does not have capacity do this work with existing staffing and resources, the Committee recommends the legislature provide additional funding.

Additional Resources: The full proposal for this recommendation is included in Appendix M

2. Monitoring and Research

Proposed implementing entity: Multiple agencies would likely be involved in monitoring. Ecology would coordinate the development of the strategy.

Recommendation: Develop and implement a research and monitoring strategy for WRIA 14 that may include the following:

- Streamflow monitoring
- Groundwater monitoring
- Groundwater modeling
- Precipitation and drought conditions
- Land use changes
- Water consumption and water supply data

Purpose: The WRIA 14 Committee desires comprehensive monitoring data on the overall health of the watershed, including status and trends.

Funding source: Funding is needed either through legislative appropriations, grants, pooling of resources by Committee members and other stakeholders, or other means.

3. Revolving Loan and Grant Fund for Community Water Systems

Proposed implementing entity: Thurston and Mason Counties

Recommendation: Investigate the feasibility of establishing and operating a revolving loan/grant fund to offset the costs of connecting to Group A public water systems. Funding would be available when the cost of connecting to a Group A system is higher than creating a new permit-exempt well, creating an economic barrier for applicants. Feasibility would be determined by criteria set for the provider and applicant (such as the availability of a sufficient water right; consistency with the relevant Water System Plan).

Purpose: This would reduce barriers to connecting to Group A systems, thereby reducing the number of projected new permit-exempt wells and reducing groundwater consumptive use.

Funding source: Funding would be needed to develop and manage the program and to provide seed money to the revolving fund. Potential funding sources have not been identified.

4. Mason County-Wide Conservation Outreach Program

Proposed implementing entity: Mason Conservation District and Mason County, with support from the Squaxin Island Tribe

Recommendation: Develop a program for all water users in Mason County to provide water conservation education incentives (mailers, websites, special events, tables at community events, free low flow indoor and outdoor fixtures, rain barrels, xeriscapes, etc.) Measurements of success could be included, such as a certification program, use of signage, the number of conservation items installed, or other methods.

Purpose: This benefits the watershed in creating awareness for water conservation and providing a cumulative reduction in groundwater use. An effective conservation program also supports drought response and climate change resilience. Overall, the program would support NEB and the Plan's goal of streamflow restoration.

Funding source: Funding would be needed to support the program. Potential sources include state or local appropriations, grants, pooling of resources by Committee members and other stakeholders, or other means.

5. Water Supply Data for Comprehensive Water Planning

Proposed implementing entity: Ecology with support from counties, Department of Health, local jurisdictions and potentially consultants.

Recommendation: By September of 2026, collect, estimate, and/or project the following data and include in a report to the WRIA 14 Committee members and the group established in section 6.2 to address Adaptive Management:

- Number of existing permit exempt domestic water wells and their water use.

- All projected water usage for the next 20 years (permit-exempt wells, inchoate rights, and new water rights).
- Number of municipal water supply connections expected in the next 20 years, by subbasin.
- Total number of existing permit-exempt wells by county.
- Total existing (2018 and earlier) connections in service using (1) unmitigated inchoate water rights; (2) mitigated inchoate water rights; or (3) permit-exempt wells.
- Total connections expected to be put into service in the next 20 years using (1) unmitigated inchoate water rights; (2) mitigated inchoate water rights; or (3) permit-exempt wells.
- An evaluation of the costs of offsetting all new domestic water uses over the next 20 years, as described in RCW 90.94.030(3)(d). The initiation of adjudication would be considered an acceptable substitute for this study.

Purpose: This would provide a robust information base for comprehensive water planning and would provide context for the Plan and its goals. This also supports tribal desire for a comprehensive water use estimate.

Funding source: Grant funding or a legislative appropriation will be necessary to hire consultant assistance to Ecology for this effort.

6. Sports Field Irrigation Conservation

Proposed implementing entity: City of Shelton. Other sports field owners, such as Shelton School District, Mason County Parks and Rec, South Mason Youth Soccer Association, YMCA. Support from Squaxin Island Tribe.

Recommendation: Increase conservation at outdoor sports fields by assessing and improving current practices through the following steps:

- Review current irrigation practices of sports ball fields.
- Develop short conservation plans for each entity.
- Develop contingency plans for reclaimed water and use reclaimed water when it becomes available.
- Install water-saving infrastructure at sports fields.
- Use existing metering to demonstrate savings from new infrastructure.
- Consider rainwater capture potential from buildings at outdoor sports fields.

Purpose: This would reduce groundwater use, increase use of reclaimed water, and provides resilience to drought and climate change.
Funding source: Funding would be needed to prepare plans, install water saving infrastructure, and to evaluate program. Funding sources are undetermined.

7. Group A Water System Conservation through Infrastructure Improvements

Proposed implementing entity: City of Shelton and Mason Public Utility District 1

Recommendation: Replace leaking household water distribution pipes to greatly reduce unaccounted for water (distribution system leakage). Start by identifying systems with high distribution system leakage and prioritize them based on quantity of water that can be conserved with infrastructure improvements.

Purpose: Group A water systems are currently required by WA Department of Health to bring distribution system leakage below 10%; the objective of this recommendation is to bring distribution systems below this threshold. By reducing system leakage, group A water systems could expand service territory from the additional connections gained. Expanding service territory decreases the likelihood of nearby installation of permit exempt wells.

Funding source: Grant funding to Group A water system purveyors.

8. Funding for Plan Implementation

Proposed implementing entity: Legislature and/or Committee Members or other stakeholders

Recommendation: The WRIA 14 Committee recommends the Legislature provide funding for plan implementation, monitoring and adaptive management of the plan, including:

- Annual tracking of new PE wells and project implementation by subbasin.
- Staffing for the ongoing Committee.
- Ongoing Committee member participation.
- Developing a process to adaptively manage implementation if NEB is not being met as envisioned by the watershed plan (e.g. identification and development of alternative projects, etc.).
- Ongoing monitoring within the basin (see recommendation 6.1.2).
- Plan implementation.

If necessary, the Committee may also recommend additional funding, including grants, fees, shared contributions from members and other stakeholders, and other sources that may emerge.

Purpose: Plan implementation is key to success and it will take ongoing funding.

Funding source: Legislature or others.

9. Waterwise Landscaping

Proposed implementing entity: Mason County, Mason Conservation District, Squaxin Island Tribe, and/or Committee Members or other stakeholders.

Recommendation: The WRIA 14 Committee recommends the Legislature provide funding for a technical and financial support program for voluntarily participating landowners (~100) who are developing their property and installing permit-exempt domestic wells to do the following:

- Around a newly built home site, create waterwise landscaping which includes native plants or retains the existing native vegetation on the site.
- After the completion of home landscaping, monitor daily outdoor water consumption for landscaping purposes only for three years.
- Changes in landscaping water use per household resulting from this program will be summarized and reported by a participating implementing entity.

Purpose: This would generate a new model in waterwise and native landscaping that provides wildlife habitat, and decreases water use which could be quantified and used for planning of future incentive programs.

Funding source: Legislature or others.

6.2 Plan Implementation and Adaptive Management

6.2.1 Project, Policy, and Permit-Exempt Well Tracking

The WRIA 14 Committee recommends tracking the growth of permit-exempt (PE) wells in the watershed as well as the projects and policies that were planned to offset the impacts of these PE wells. This data will allow the Committee to determine whether planning assumptions were accurate and whether adjustments to plan implementation are needed. Recommended funding for plan implementation is described in detail in section 6.1.8.

A. The WRIA 14 Committee recommends tracking the following information on an ongoing basis:

   - New building permits issued that include permit-exempt wells, as well as the number of building permits requiring water connections.
   - Status of implementation for each project included in the plan.
   - Status of policy recommendations included in the plan.
   - An ongoing list of new PE wells in the WRIA since the enactment of RCW 90.94.
     - The lists of building permits and projects will be organized by subbasin, and if feasible represented on a map that includes subbasin delineations. Counties are encouraged to provide parcel or other geographic information in their reports to Ecology to support mapping by subbasin.

B. To assess the status of project implementation, the Committee recommends using the Salmon Recovery Portal (https://srp.rco.wa.gov/about), managed by the Washington State Recreation and Conservation Office (RCO), to support project tracking.

- The Washington Department of Fish & Wildlife (WDFW), in collaboration with the Washington Department of Ecology and RCO, will coordinate the implementation of project tracking through the Salmon Recovery Portal.
- Project sponsors are expected to support project tracking efforts and data sharing.
- Local salmon recovery Lead Entity Coordinators will not be expected to provide ongoing support for project entry, maintenance, or reporting. To improve harmonization of streamflow restoration with ongoing salmon recovery efforts, local salmon recovery Lead Entity Coordinators will be consulted prior to initial data uploads.
- University of Washington data stewards, contracted by WDFW, will conduct data entry, quality assurance, and quality control. If this approach changes, WDFW will propose an alternative method for completing this task.
- Entities with representation in the WRIA 14 Committee (or an implementation group, if created) are encouraged to assist as needed with coordination, data gathering and input, and tracking.

Table 10 summarizes the entities recommended as being responsible for implementing the tracking and monitoring recommendation and associated funding needs.

Table F-1: Implementation of Tracking and Monitoring Recommendation

Action	Entity or Entities Responsible	Funding Considerations
Track building permits issued with PE wells (including new connections).	Ecology (via reporting from counties and cities).	The number of building permits and associated fees are transmitted to Ecology annually. No additional funding is needed.
Maintain an ongoing list and map of new PE wells within each sub-basin.	Ecology	Information is included with data on new PE wells, provided by local governments. No additional funding is needed.
Maintain a summary of the status of implementation for each project.	Ecology via the Salmon Recovery Portal, with support from WDFW, RCO, and project sponsors	WDFW may need additional funding to support maintaining the Salmon Recovery Portal.
Maintain a summary of the status of each policy recommendation.	*Implementation group and proposed implementing entities listed in 6.1 Policy and Regulatory Recommendations*	Additional funding may be needed to gather status updates.

6.2.2 Reporting and Adaptation

The Committee recommends that Ecology provides the data collected above to all entities represented on the Committee and other interested parties through annual reporting and a self-assessment as described below. These reports and assessments will help determine whether the plan's recommendations are being implemented and whether they are having the intended impacts. Recommended funding for plan implementation is described in detail in section 6.1.8.

A. The WRIA 14 Committee recommends **annual reporting** as follows:
    - By September of each year, **Ecology** will prepare an annual report that includes:
        - A list of total building permits issued in the prior calendar year along with the total number of associated new domestic PE wells, using the information provided to Ecology by the local jurisdictions.
        - A brief description of the status of WRIA 14 projects and actions included in this plan (descriptions may be drawn from the Salmon Recovery Portal, if available).

        - If the project as implemented differs significantly from the original description and assumptions included in the plan, the annual report will also include an estimate of changes to the offset benefit.
    - Other implementation actions to date, including any changes in approach since the last report and any challenges identified that may require adaptation in plan implementation.
    - The lists of building permits and projects will be organized by subbasin, and if feasible represented on a map that includes subbasin delineations. Counties are encouraged to provide parcel or other geographic information in their reports to Ecology to support mapping by subbasin.
- The first annual report should include an estimate of expenses necessary for plan implementation and associated funding options. Funding options could include:
    - Local or state fees, including PE well fees
    - Grants
    - State funding
    - Other options
- Ecology will share the report with Committee members and other interested parties.

B. The WRIA 14 Committee recommends preparing a **self-assessment every five years** as follows:
    - By September of 2026, and every five years thereafter during the planning horizon period, Ecology will compile and report based on available information from previous reports and partners:
        - All cumulative information required in the annual report.
        - Estimated water offset quantities, consumptive use, and instream flow benefits, realized through implementation of projects and actions identified in this plan.
        - A comparison of each item above to the original assumptions included in the plan and a summation of overall ecological benefit (i.e., greater than expected, less than expected, or about the same as expected).

C. The WRIA 14 Committee recommends that the WRIA 14 Committee members continue to meet to allow continued collaboration on plan implementation.
    - Interested WRIA 14 Committee members, or a new implementation group if established, will meet regularly to:
        - Review and discuss the annual report.
        - Share updates on project and policy implementation.
        - Discuss or develop recommendations for revisions, additions, or deletions to planned projects or actions.

- Every five years interested WRIA 14 Committee members, or a new implementation group if established, will hold a series of meetings to conduct the self-assessment, which includes:
    - Reviewing the five-year assessment report from Ecology.
    - Developing recommendations to adapt projects and actions to meet NEB.
    - Updating data and assumptions.
    - Other items identified by Committee members.
- Additional meetings may be scheduled as needed.
- Mason County has offered to play the role of coordinating an implementation group for WRIA 14. Mason County will use existing capacity as well as seek funding opportunities to support their role. Mason County will convene interested member entities of the WRIA 14 Committee to form the implementation group in the summer of 2021. This group will consider the following activities related to plan implementation:
    - Redefining the WRIA 14 Committee, which could include a new name, charter, and supporting interlocal agreement.
    - Identifying project development lead(s) and supporting project development.
    - Identifying triggers for adaptive management and develop responses to emerging challenges.
    - Coordinating monitoring and research.
    - Coordinating reporting.
    - Identifying funding mechanisms to provide capacity for the Committee members and facilitator.
    - Other tasks as needed.

Table F-2 summarizes the entities responsible for carrying out the reporting and adaptation recommendation and associated funding needs.

Table F-2: Implementation of Reporting and Adaptation Recommendation

Action	Entity or Entities Responsible	Funding Considerations
Annual Reports	• Local jurisdictions provide building permit information to Ecology. • Ecology compiles information on project status, drawn from the Salmon Recovery Portal. • Entities provide monitoring data to Ecology for inclusion in reports.	• Local jurisdictions are already required to provide building permit information to Ecology (no additional funding needed). • Ecology staff would compile reports using existing resources. • WDFW may need additional funds to manage the Salmon Recovery Portal.

Action	Entity or Entities Responsible	Funding Considerations
	• Ecology combines monitoring data from within the agency with data provided by other entities. • Ecology compiles information into a single report for distribution to the Committee and other interested parties.	
Five-Year Self-Assessment:	• Local jurisdictions provide building permit information to Ecology. • Ecology compiles information on project status, drawn from the Salmon Recovery Portal. • Entities provide monitoring data to Ecology for inclusion in reports. • Ecology combines monitoring data from within the agency with data provided by other entities. • Ecology prepares estimates of the quantity of water, instream flow, and habitat benefits realized through implementation of projects and actions identified in this plan. • Ecology compiles information into a single report for distribution to Committee and other interested parties. • Mason County convenes interested members of the WRIA 14 Committee to review progress and recommend adaptations as needed.	• Local jurisdictions are already required to provide building permit information to Ecology (no additional funding needed). • Ecology may need funding to complete the estimate of realized benefits. • State funding or staff support will be needed to reconvene a group to prepare recommendations. • Committee members who cannot participate in meetings using existing resources will need additional funding. • Mason County may need additional funding to support their role in convening the implementation group.

6.3 Other Issues

6.3.1 Summary of Legislative requests

Legislative funding is requested for recommendations 6.1.1, 6.1.2, 6.1.5, 6.1.8, and 6.1.9

6.3.2 Assurance of Plan implementation

The WRIA 14 Committee prepared the WRIA 14 watershed plan with the intent that the plan is fully implemented Members of the Committee provided the following statements of assurance of their commitment to plan implementation.

- **Department of Ecology**
    - Ecology follows NEB Guidance and RCW 90.94.030 provisions in reviewing the watershed plan and considering plan adoption.
    - Ecology administers the 90.94 Grant Program, giving priority evaluation points to projects included in WRIA plans, and updating grant guidance as needed to better support plan implementation.
    - Ecology considers watershed plan recommendations and investigates the feasibility of actions and recommendations where Ecology is identified as the lead.
    - Ecology reports to the legislature on the status of the watershed plan implementation in 2020 and 2027.
- **Squaxin Island Tribe**
    - The Squaxin Island Tribe supports and participates in implementation activities as staff capacity allows, including:
        - Participating in implementation group meetings.
        - Coordination between meetings, including:
            - Supporting project development and seek project opportunities
            - Seeking and supporting funding opportunities to achieve implementation
            - Tracking implementation and identifying areas for improvement
- **Skokomish Indian Tribe**
    - The Skokomish Tribe supports and participates in implementation activities as staff capacity allows, including:
        - As directed by Skokomish management, participating in implementation group meetings.
        - As directed by Skokomish management, coordination between meetings:
            - Assist in research and identify project opportunities

        - Assist in the identification of funding opportunities to achieve implementation
        - Identify areas for improvement

- **Thurston County**

    - Thurston County will adopt this watershed plan by resolution, formalizing our support of the plan contents once the plan has been approved by Ecology.
    - This watershed plan will become one of the guiding documents for Thurston County community planning work, including implementation of the Comprehensive Plan and related plans.
    - Thurston County will evaluate the relationship of identified projects within the watershed plan with the Thurston County Capital Improvement Program, seeking potential for overlap in funding opportunities.
    - Thurston County supports and participates in implementation activities as staff capacity allows, including:
        - Participating in implementation group meetings.
        - Coordination between meetings, including:
            - Supporting project development and seeking project opportunities
            - Seeking and supporting funding opportunities to achieve implementation
            - Tracking implementation and identifying areas for improvement

- **Mason County**

    - Mason County adopts this watershed plan by resolution, formalizing our support of the plan contents once the plan has been approved by Ecology.
    - Mason County supports and participates in implementation activities as staff capacity and funding allows, including:
        - Participating in implementation group meetings.
        - Coordination between meetings, including:
            - Supporting project development and seeking project opportunities
            - Seeking and supporting funding opportunities to achieve implementation
            - Tracking implementation and identifying areas for improvement

- **City of Shelton**

    - The City of Shelton supports and participates in implementation activities as staff capacity allows, including:
        - Participating in implementation group meetings.
        - Coordination between meetings, including:
            - Supporting project development and seek project opportunities
            - Seeking and supporting funding opportunities to achieve implementation
            - Tracking implementation and identifying areas for improvement

- **Mason County PUD No. 1**

    - Mason County PUD 1 supports collaboration among WRIA 14 members to implement a comprehensive strategy for balancing competing demands for water, while at the same time preserving and enhancing the future integrity of the WRIA 14 watershed basin.

    - Mason County PUD 1 evaluates and prioritizes capital projects included in this plan for placement into the Capital Improvement Program.

    - Mason County PUD 1 supports and participates in implementation activities as staff capacity allows, including:

        - Participating in implementation group meetings.
        - Coordination between meetings, including:
            - Supporting project development and seek project opportunities
            - Seeking and supporting funding opportunities to achieve implementation
            - Tracking implementation and identifying areas for improvement

- **Building Industry Association of Washington (BIAW)**

    - BIAW supports and participates in implementation activities as staff capacity allows, including:
        - Participating in implementation group meetings.
        - Coordination between meetings, including:
            - Supporting project development and seek project opportunities
            - Seeking and supporting funding opportunities to achieve implementation
            - Tracking implementation and identifying areas for improvement

- **Washington State Chapter Sierra Club**

    - The Sierra Club will support and participate in implementation activities as Sierra Club volunteer representative capacity allows, including:
        - Participating in implementation group meetings.
        - Coordination between meetings, including:
            - Supporting project development and seek project opportunities
            - Seeking and supporting funding opportunities to achieve implementation
            - Tracking implementation and identifying areas for improvement

- **Mason Kitsap Farm Bureau**

    - The Mason Kitsap Farm Bureau supports and participates in implementation activities as staff capacity allows, including:
        i. Participating in implementation group meetings.
        ii. Coordination between meetings, including:
            1. Supporting project development and seeking project opportunities
            2. Tracking implementation and identify areas for improvement
            3. Providing information and support from the perspective of agriculture

- **Mason Conservation District - Salmon Recovery Lead Entity (Ex-Officio Member)**

    - Mason Conservation District supports and participates in implementation activities as staff capacity and funding resources allow, including:
        - Participating in implementation group meetings.
        - Coordination between meetings, including:
            - Supporting project development and seek project opportunities
            - Seeking and supporting funding opportunities to achieve implementation
            - Tracking implementation and identifying areas for improvement

- **Washington State Department of Health (Ex-Officio Member)**

    - WA State Department of Health supports and participates in implementation activities as staff capacity allows, including:

        - Participating in implementation group meetings.

        - Prior to approving a Water System Plan for a municipal water supplier (or other planning document with a water right place of use expansion), the Office of Drinking Water will ensure that new water service provided under the water system plan is consistent with relevant provisions of adopted local plans and development regulations. The Office of Drinking Water will ensure consistency through local government review of water system plans against relevant provisions of adopted local plans and development regulations.

        - Office of Drinking Water commits to coordinate with Department of Ecology through the agencies' Joint Memorandum of Understanding. This MOU states that the Department of Ecology will make a determination that the water system's service area and the submitted Water System Plan is not-inconsistent with any county-approved watershed plans.

- **Green Diamond (Ex-Officio Member)**

    - Green Diamond supports and participates in implementation activities as appropriate, including:
        - Partnership in implementations activities with nexus to Green Diamond forest lands, including:
            - Supporting project development where consistent with Green Diamond's operations
            - ii. Supporting funding and in-kind opportunities to achieve implementation
            - iii. Tracking implementation and identifying areas for improvement

Appendix G – Subbasin Delineation Memo

The following technical memo was developed for the WRIA 14 Committee process. Therefore, final conclusions as presented in this plan may not align with the technical memo.

To:	Angela Johnson, Washington State Department of Ecology
From:	Chad Wiseman, HDR
Copy:	
Date:	June 26, 2019
Subject:	WRIA 14 Draft Subbasin Delineation (Work Assignment WA-01, Task 2)

1.0 Introduction

HDR is providing technical support to the Washington State Department of Ecology and the Watershed Restoration and Enhancement (WRE) committee for Water Resource Inventory Area (WRIA) 14. The Streamflow Restoration law (Revised Code of Washington [RCW] Chapter 90.94) requires that WRE plans include actions to offset new consumptive-use impacts associated with permit-exempt domestic water use. RCW 90.94.030(3)(b) states, "The highest priority recommendations must include replacing the quantity of consumptive water use during the same time as the impact and in the same basin or tributary." Therefore, delineations must be developed for the subbasins in WRIA 14 that will be used as a spatial framework for growth projections, consumptive-use estimates, and priority offset projects. The Net Ecological Benefit (NEB) evaluation will also be based on this framework. This technical memorandum addresses the basis for subbasin delineation in WRIA 14 (Kennedy-Goldsborough).

2.0 Subbasin Delineation

This section explains the initial and draft delineations for WRIA 14.

2.1 Initial Delineation

The WRIA 14 workgroup (a subcommittee of the WRE committee) was tasked to delineate subbasin boundaries for discussion at WRE committee meetings. The WRIA 14 workgroup started with the subbasins used in the draft WRIA 14 watershed management plan that was pursuant to Chapter 90.82 RCW (Plateau 2006). These subbasins were organized based on the receiving saltwater body. During this watershed planning process, the subbasin discharging to Hood Canal was co-opted by the WRIA 16 watershed plan. This subbasin is part of WRIA 14 and was included for the purposes of this Chapter 90.94 RCW planning process.
The following subbasins were defined in the initial delineation:

- Hood: includes multiple small drainages discharging directly to the Hood Canal
- Case: includes Sherwood Creek and multiple small drainages that discharge to Case Inlet, including Harstine Island and Squaxin Island
- Goldsborough: includes all drainages discharging to Oakland Bay, including Deer Creek, Cranberry Creek, Johns Creek, Goldsborough Creek, Mill Creek, and other small drainages
- Skookum: includes all drainages discharging to Little Skookum Inlet, including Skookum and other small drainages
- Kennedy: includes all drainages discharging to Totten and Eld inlets, including Kennedy Creek, Perry Creek, and other small drainages

The workgroup requested that an alternative delineation be developed that had smaller drainage granularity. Twelfth-field hydrologic unit codes (HUCs) (USGS 2013) were applied to WRIA 14 as an alternative. The comparison of the 12th-field HUCs delineation with 12th-field hydrologic units resulted in 16 subbasins and, in some cases, subbasins were viewed as too small (e.g., Snodgrass Creek, discharging to Totten Inlet).

2.2 Draft Delineation

During the May 9, 2019, WRIA 14 WRE committee meeting, HDR presented a comparison between the initial subbasin delineation (based on the draft Watershed Management Plan and the south shore of Hood Canal) with the 12th-field HUCs. The comparison included stream distribution, fisheries resources, and stream management units (i.e., streams with closures and minimum flows) associated with the WRIA 14 instream flow rule (Washington Administrative Code [WAC] Chapter 173-514).

During the June 7, 2019, WRIA 14 workgroup meeting, HDR presented the same comparison as

during the May 9, 2019, WRE committee meeting. The Squaxin Island Tribe made recommendations for a draft delineation premised with the understanding that there would be an opportunity for revision after the growth projections and consumptive-use estimates were completed and compared to the draft delineation. The recommendations included separating Harstine, Squaxin, and Hope islands from the rest of the initial "Case" subbasin. The recommendations also included breaking up the initial "Goldsborough" subbasin into three separate subbasins (Oakland, Goldsborough, and Mill). The Goldsborough Creek and Mill Creek watersheds would be their own respective subbasins.

The remainder of the initial "Goldsborough" subbasin (including Deer Creek, Cranberry Creek, and Johns Creek) would compose the Oakland subbasin. The draft subbasin delineation is depicted in Figure 1. The following subbasins were defined in the draft delineation:

- Hood: includes multiple small drainages discharging directly to Hood Canal
- Case: includes Sherwood Creek and multiple small drainages that discharge to Case Inlet
- Harstine: includes Harstine, Squaxin, and Hope islands
- Oakland: includes Deer Creek, Cranberry Creek, Johns Creek, and other small drainages discharging to Oakland Bay
- Goldsborough: includes the Goldsborough Creek watershed
- Mill: includes the Mill Creek watershed and small drainages discharging to the south shore of Hammersley Inlet
- Skookum: includes all drainages discharging to Little Skookum Inlet, including Skookum and other small drainages

• Kennedy: includes all drainages discharging to Totten and Eld inlets, including Kennedy

Creek, Perry Creek, and other small drainages

The WRIA 14 workgroup recommended that this draft subbasin delineation be approved by the WRIA 14 WRE committee on June 13 2019.

3.0 Conclusion

The WRIA 14 workgroup draft subbasin delineation will be used as an organizational framework for growth projection and consumptive-use scenarios, pending approval by the WRIA 14 WRE committee. The current draft subbasin delineation is currently only a recommendation by the WRIA 14 workgroup. Furthermore, the draft subbasin delineation is subject to change after evaluation with the growth projection and consumptive-use scenarios. The final subbasin delineation will be used as a framework for consumptive-use impacts and offset benefit accounting and for the NEB evaluation.

4.0 References

Plateau Technical Communication Services (Plateau). 2006. WRIA 14 Watershed Management Plan: Kennedy–Goldsborough Watershed, Final Draft.

Revised Code of Washington (RCW). 2019. Watershed Planning, Chapter 90.82 RCW. Accessed on June 23, 2019, at https://app.leg.wa.gov/rcw/default.aspx?cite=90.82.

RCW. 2019. Streamflow Restoration, Chapter 90.94 RCW. Accessed on June 23, 2019, at https://app.leg.wa.gov/RCW/default.aspx?cite=90.94.

U.S. Geological Survey and U.S. Department of Agriculture, Natural Resources Conservation Service (USGS). 2013. Federal Standards and Procedures for the National Watershed Boundary Dataset (WBD) (4 ed.): Techniques and Methods 11–A3, 63 p., https://pubs.usgs.gov/tm/11/a3/.

Appendix H – Permit-Exempt Growth and Consumptive Use Summary Technical Memo

The following technical memo was developed for the WRIA 14 Committee process. Therefore, final conclusions as presented in this plan may not align with the technical memo.

To:	Angela Johnson, Washington State Department of Ecology
From:	Chad Wiseman, HDR, Malia Bassett, HDR
Copy:	
Date:	July 6, 2020
Subject:	WRIA 14 Permit-Exempt Growth and Consumptive Use Summary (Work Assignment 2, Tasks 2 and 3)

Introduction

HDR is providing technical support to the Washington State Department of Ecology (Ecology) and the Watershed Restoration and Enhancement (WRE) committees for Water Resource Inventory Area 14. This memorandum provides a summary of the analytical methods used for Work Assignment 2 Task 2: Consumptive Use (CU) Estimates, and the final estimates of consumptive use per WRIA.

Under Revised Code of Washington (RCW) 90.94, consumptive water use by permit-exempt connections occurring over the planning horizon must be estimated to establish the water use that watershed restoration plans and plan updates are required to address and offset. This memorandum summarizes permit-exempt connections and related consumptive use of groundwater that is projected to impact WRIA 14 over the planning horizon.

This memorandum includes:

- A summary of WRIA 14 initial permit-exempt growth and an alternative scenario of permit-exempt growth.
- A summary of WRIA 14 initial and alternative scenario consumptive use using two different methods.

WRIA 14 Permit-Exempt Growth Projection Methods

Permit-exempt growth over the planning horizon was projected using methods at the county scale and then combined at the WRIA scale. HDR worked directly with Mason County to develop and implement growth projection methods. Thurston County (working with the Thurston Regional Planning Council) provided methods and results for Thurston County.

HDR worked with the WRIA 14 workgroup and Committee to define one alternative growth scenario that allowed for some permit-exempt growth in water system boundaries based on the proportion of parcels not currently served by their respective water systems.

Mason County

The Mason County initial permit-exempt growth projections were developed using the following methods:

1. Develop growth projections based on the Mason County Comprehensive Plan (the comprehensive plan is based on Office of Financial Management (OFM) medium

population growth estimates, and conversion to dwelling units based on assumed people per dwelling unit).

2. Determine available land for single family domestic units and determine proportion of build-out capacity by county Urban Growth Areas (UGAs) and rural lands.
3. Apply growth projections to buildable lands.
4. Overlay subbasins to determine new permit-exempt connections in each subbasin.

Initial growth projections for Mason County have increased, based on updating parcel data for the application of growth projections to buildable lands (i.e., parcels that were streets or waterbodies). The results were organized by subbasin. The distribution of projected permit-exempt growth within subbasins was reported with a heat map.

An alternative permit-exempt growth projection scenario was developed by assuming that some permit-exempt growth will occur in water system areas. It was assumed that growth in each respective water system will be proportional to buildable parcels without water system hookups relative to parcels with water system hookups. The following methods were applied on top of the initial methods:

1. Define total buildable parcels in GIS, using Department of Health (DOH) service area polygons and county parcel data.
2. Define total approved water system connections (built out + available) and active water system connections (built out) using the DOH Sentry database (DOH 2019).
3. Buildable parcels with water system hookup = total approved minus active water system connections.
4. Buildable parcels without water system hookup = total buildable parcels minus total approved water system connections.
5. Define proportion of permit-exempt growth within each water system by dividing number of buildable parcels without water system hookups by total number of buildable parcels.
6. Multiply proportion of permit-exempt growth within each respective water system by total growth projected to occur in that water system.
7. Sum additional permit-exempt growth by subbasin and add to initial permit-exempt growth projection.

Thurston County Methods

The Thurston County initial permit-exempt growth projections were developed using the following methods:

1. Develop 20-year growth projections based on OFM medium population growth estimates, and conversion to dwelling units based on assumed people per dwelling unit
2. Develop residential capacity estimates.
3. Allocate growth to parcels based on recent residential development and permit trends, where capacity is available.
4. Estimate the amount of development on permit-exempt connections based on the following criteria provided by Thurston County:
    a) Located outside incorporated cities; growth in incorporated cities is assumed to connect to a municipal water system.
    b) Water systems within UGAs; permit-exempt growth is assumed to occur on parcels with no sewer service.
    c) Rural water systems; assumed no permit-exempt growth.

These Thurston County growth projection methods and results have not changed since the original estimate was provided to Ecology and the WRIA 14 WRE Committee (HDR 2019; Appendix B). The results were calculated for the Thurston County portion of the Kennedy subbasin. The distribution of projected permit-exempt growth within subbasins was further defined using a buildable lands analysis and was reported with a heat map (Appendix B).

An alternative permit-exempt growth projection scenario was developed by assuming that some permit-exempt growth will occur in the rural water system areas. It was assumed growth in each respective water system will be proportional to buildable parcels without water system hookups relative to parcels with water system hookups. The methods defined for the Mason County alternative growth scenario (see Mason County above) were used to define permit-exempt growth in these rural water systems.

WRIA 14 Consumptive Use Methods

Under RCW 90.94, consumptive water use (consumptive use) by permit-exempt connections that are forecast to be installed over the planning horizon to service rural growth must be estimated to establish the water offsets required under the Streamflow Restoration law. The following definitions from the *Final Guidance for Determining Net Ecological Benefit - ESSB 6091 - Recommendations for Water Use Estimates* (Ecology's Final NEB Guidance) are used in this memorandum as a guide to estimate consumptive water use by permit-exempt connections (Ecology 2019).

- Consumptive Use: water that evaporates, transpires, is consumed by humans, or is otherwise removed from an immediate water environment.

- Domestic Use: includes both indoor and outdoor household uses, and watering of a lawn and noncommercial garden.
- New Consumptive Water Use: The consumptive water use from the permit-exempt domestic groundwater withdrawals estimated to be initiated within the 20-year planning horizon (2020–2040; planning horizon). The required water offset is equal to new consumptive water use.
- Net Ecological Benefit: 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.
- Water Offsets: Projects that put water back into aquifers or streams that offset new consumptive water use.

Ecology has provided guidance for estimating indoor and outdoor consumptive water use in Ecology's Final NEB Guidance (Ecology 2019).

Consumptive use estimates are divided into two components: the indoor and outdoor portions of use. The use patterns and consumptive portions of indoor versus outdoor use associated with permit-exempt connections are different; therefore, separate approaches within each method that account for these differences are used to estimate consumptive use.

Ecology's indoor consumptive water use guidance includes literature-based assumptions on per-capita indoor water use and the consumptive proportion. Outdoor consumptive water use guidance includes methods for the estimation of irrigated area, assumed irrigation requirements, irrigation efficiency, and the consumptive proportion. Ecology's guidance also recommends local corroboration using water system meter data for both indoor and outdoor estimates (Ecology 2018, 2019). For purposes of this technical memorandum, Ecology's method for estimating consumptive use is called the Irrigated Area method, and estimation of consumptive use using local water system meter data is called the Water System Data method.

Consistent with the Final NEB guidance, the Committee assumed that impacts from consumptive use on surface water are steady-state, meaning that impacts to the stream from pumping do not change over time. This assumption is based on the wide distribution of future well locations and depths across varying hydrogeological conditions.

Irrigated Area Method

Based on Ecology's Final NEB Guidance (Ecology 2019), estimating indoor and outdoor consumptive water use included literature-based assumptions for both the per capita indoor water use and indoor and outdoor use proportions.

Indoor Consumptive Use – Irrigated Area Method

The following assumptions were used to estimate indoor consumptive water use by occupants of a dwelling unit (Ecology 2018, 2019):

- 60 gallons per day (gpd) per person within a household

- 2.5 persons per household (or as otherwise defined by the Counties)
- 10 percent of indoor use is consumptively used

Most homes served by a permit-exempt connection use septic systems for wastewater (Ecology 2019). This method assumes that 10 percent of water entering the septic system will evaporate out of the septic drain field and the rest will be returned to the groundwater system.

Assuming that there is one permit-exempt connection per dwelling unit, a "per permit-exempt connection" consumptive use factor was applied to the growth projections forecast in each subbasin to determine total indoor consumptive use per subbasin. This method is summarized by the following equation:

$$HCIWU\ (gpd) = 60\ gpd\ x\ 2.5\ people\ per\ household\ x\ 10\%\ CUF$$

or

$$HCIWU\ (afy) = 60 gpd * 2.5\ people\ per\ house * 365\ days * 0.00000307\ AF/gallon * 10\%\ CUF$$

Where:

HCIWU = Household Consumptive Indoor Water Use (gpd)

afy = acre-feet per year

CUF = Consumptive use factor

This estimate of indoor consumptive water use per household is 15 gpd and can be annualized and converted to acre-feet per year (AFY) or cubic feet per second (cfs).

Outdoor Consumptive Use – Irrigated Area Method

Ecology (2018, 2019) recommends estimating future outdoor water use based on an evaluation of the average outdoor irrigated area for existing dwelling units served by permit-exempt connections. To calculate the consumptive portion of total outdoor water required per connection, Ecology recommends:

- Estimating the average irrigated lawn area (pasture/turf grass) per parcel;
- Applying crop irrigation requirements;
- Correcting for application efficiency (75 percent efficiency recommended by Ecology Guidance) to determine the total outdoor water required over a single growing season; and
- Applying a percentage of outdoor water that is assumed to be consumptive. This method assumes that 80 percent of outdoor domestic water use is consumed by evaporation and transpiration.

Future outdoor water use may be based, in part, on an estimate of the average outdoor irrigated area for existing homes served by permit-exempt domestic wells (Ecology 2018, 2019).

HDR estimated the average irrigated lawn area for WRIA 14 by delineating the apparent irrigated area in 80 parcels identified as containing a dwelling unit served by a permit-exempt well in WRIA 14, and averaging them (Attachment A). The irrigated areas were delineated using one technician and a standard method. The average irrigated area per permit-exempt connection in WRIA 14 was estimated to be 0.07 acre. The majority of the parcels evaluated did not have an apparent irrigated area (i.e., most parcels had no irrigated area).

Bias in the irrigated area delineation methods was evaluated by doing a side-by-side comparison study with another consulting form that was providing similar technical support for the WRIA 7, 8, and 9 WRE plans. This comparability study concluded that there was no inherent bias in the methods. Overall method bias was also evaluated by comparing the CU calculated with the Irrigated Area method to specific parcels with meter records (Attachment B). The Irrigated Area method overestimated overall water use, relative to the actual metered use.

Because of the high proportion of zero irrigated acreage measurements contributing to the 0.07-acre irrigated acreage average, and because of the large variability in the results (i.e., large standard deviation), HDR proposed a range of alternatives to mitigate that uncertainty:

- To account for the uncertainty of detecting small areas of irrigation, the Committee could impute the zero values with a "minimum detection" irrigated area of 0.05 acre, which would result in a 0.10-acre average irrigated area size.
- HDR completed an irrigated area comparability study for the irrigated area parcel analysis, and determined that an additional way to account for uncertainty in "human error" could be done using a "correction factor," which would result in a 0.11-acre average irrigated area size.
- HDR has completed a statistical analysis of their data, and has determined that using the 95 percent Upper Confidence Limit of the data (based on initial analysis with 0 values) could be an additional way to account for uncertainty, which would result in a 0.14-acre average irrigated area size.

Initially, the WRIA 14 Committee decided to move forward with a "primary working number" and a "working number for comparison." The primary working number is an average irrigated acreage of 0.10 acre (average value with imputed minimum detection values of 0.05 acre). The working number for comparison is 0.14 acre, which is the non-parametric 95th Upper Confidence Limit of the mean. Consumptive use based on both acreages were evaluated and compared to the consumptive use calculated from the Water System Data Method. The Committee later agreed by consensus to include the consumptive use estimate based on the 0.10 acre average irrigated area as the "most likely" estimate in the plan, and the consumptive use estimate based on the 0.14 acre average irrigated area as a higher goal to achieve through adaptive management.

Crop irrigation requirements, irrigation efficiency and outdoor use assumptions were also made to estimate outdoor consumptive use. An average crop irrigation requirement of 18 inches per year was estimated for pasture/turf grass from nearby stations as provided in the Washington

Irrigation Guide (NRCS-USDA 1997). Irrigation application efficiency (i.e., the percent of water used that actually reaches the turf) was assumed to be 75 percent, consistent with Ecology (2018, 2019) recommendations. Finally, the consumptive portion of total amount of water used for outdoor use was assumed to be 80 percent. The WRIA 14 Committee chose not to modify the irrigation efficiency or indoor and outdoor consumptive factors used in the Irrigation Area method.

This method is summarized in the following equation:

$$HCOWU\ (afy) = A\ (acres) * IR(feet) * AE * CUF$$

Where:

HCOWU = Household Consumptive Outdoor Water Use (gpd)

afy = acre-feet per year

A = Irrigated Area (acres)

IR = Irrigation Requirement over one irrigation season (feet)

AE = Application Efficiency; assumed to be 75 percent (factor expressed as 1/0.75)

CUF = Consumptive Use Factor; assumed to be 80 percent (factor expressed as 0.80)

This estimate of outdoor consumptive water use per household per day can be annualized and converted to gallons per day or cubic feet per second.

Conversion Factors:

gpd = afy * 0.001120

cfs = afy * 723.97

This estimate of outdoor consumptive use per household per day is 143 gpd (assuming average irrigated area of 0.10 acre) and 200 gpd (assuming average irrigated area of 0.14 acre) and can be annualized and converted to acre-feet per year of cubic feet per second.

Seasonal consumptive use was estimated on a monthly basis by allocating total outdoor consumptive use proportional to the monthly irrigation requirement. The monthly irrigation requirement was defined by the Washington Irrigation Guidance.

Water System Data Method

Consumptive use by permit-exempt connections may also be estimated using metered connections from water systems. Water systems required to plan per Washington Administrative Code 246–290 must install meters on all customer connections. Smaller water systems that do not have state planning requirements may choose to meter their customer connections if the system billing is based on a tiered rate structure (i.e., increasing costs per unit of water consumed coincident with higher total use in the billing period).

Some systems bill customers a flat rate (i.e., same bill every month regardless of consumption). The lack of a tiered rate structure reduces the financial incentive to conserve water, which may

result in consumption patterns more similar to those observed on a permit-exempt connection. These systems may or may not choose to meter their customers if meters are not required by law.

No water use meter data were available for systems that uses a flat rate structure. The Cherry Park, Union, and Harstine Island water systems operate under a tiered rate structure in WRIA 14 and were utilized for this analysis.

In most instances pumping impacts associated with new permit-exempt domestic withdrawals will be quite small, well dispersed, and nearly steady-state with respect to streams, as stated in Ecology's final NEB Guidance Appendix B (Ecology, 2019).

Indoor Use

Average daily use in December, January, and February is representative of year-round daily indoor use. Average daily system-wide use is divided by the number of permit-exempt connections (assuming all connections are residential) to determine average daily indoor use per permit-exempt connection. Similar to that used in the Ecology Irrigated Area method, a 10 percent consumptive use factor was applied to the average daily use in the winter months to determine the consumptive portion of indoor water use per connection.

Annual Outdoor Water Use

Average daily indoor use was multiplied by the number of days in a year to estimate total annual indoor use. Total annual indoor use was then subtracted from total annual use by a water system to estimate total annual outdoor use. Similar to the calculation used in the Ecology Irrigated Area Method, an 80 percent consumptive factor was applied to determine the consumptive portion of outdoor use.

Seasonal Outdoor Water Use

Outdoor consumptive use was also estimated on a seasonal basis. The Washington Irrigation Guide reports irrigation requirements between the months of April and September for representative weather stations in WRIA 14; therefore, seasonal outdoor water use was assumed to occur over a period of 6 months (April through September). Average daily indoor use was multiplied by the number of days in the irrigation season to calculate total indoor use for the irrigation season. Total irrigation season indoor use was then subtracted from total season use to determine total outdoor use for the irrigation season. The value was proportionally allocated to each month in the irrigation season using the requirements from the Washington Irrigation Guide. An 80 percent consumptive factor was applied to determine the consumptive portion of outdoor use.

Results

Permit-Exempt Connection Growth

Initial permit-exempt connection growth is projected to be 4,006 connections (Table 1). The alternative revised permit-exempt connection growth scenario is projected to have 288 additional connections, for a total of 4,294 permit-exempt connections. The WRIA 14 Committee has not selected one projection over the other for consumptive use estimation. Permit-exempt connection growth is expected to be greatest in the Oakland Bay subbasin.

Table H-1: WRIA 14 Alternative Growth Projection Scenarios

Number of Permit-Exempt Wells Added between 2018 and 2038

Subbasin	Initial	Revised
Case	418	512
Goldsborough	509	546
Harstine	143	143
Hood	74	117
Kennedy	556	588
Mill	462	466
Oakland	1,481	1559
Skookum	363	363
Totals	**4,006**	**4,294**

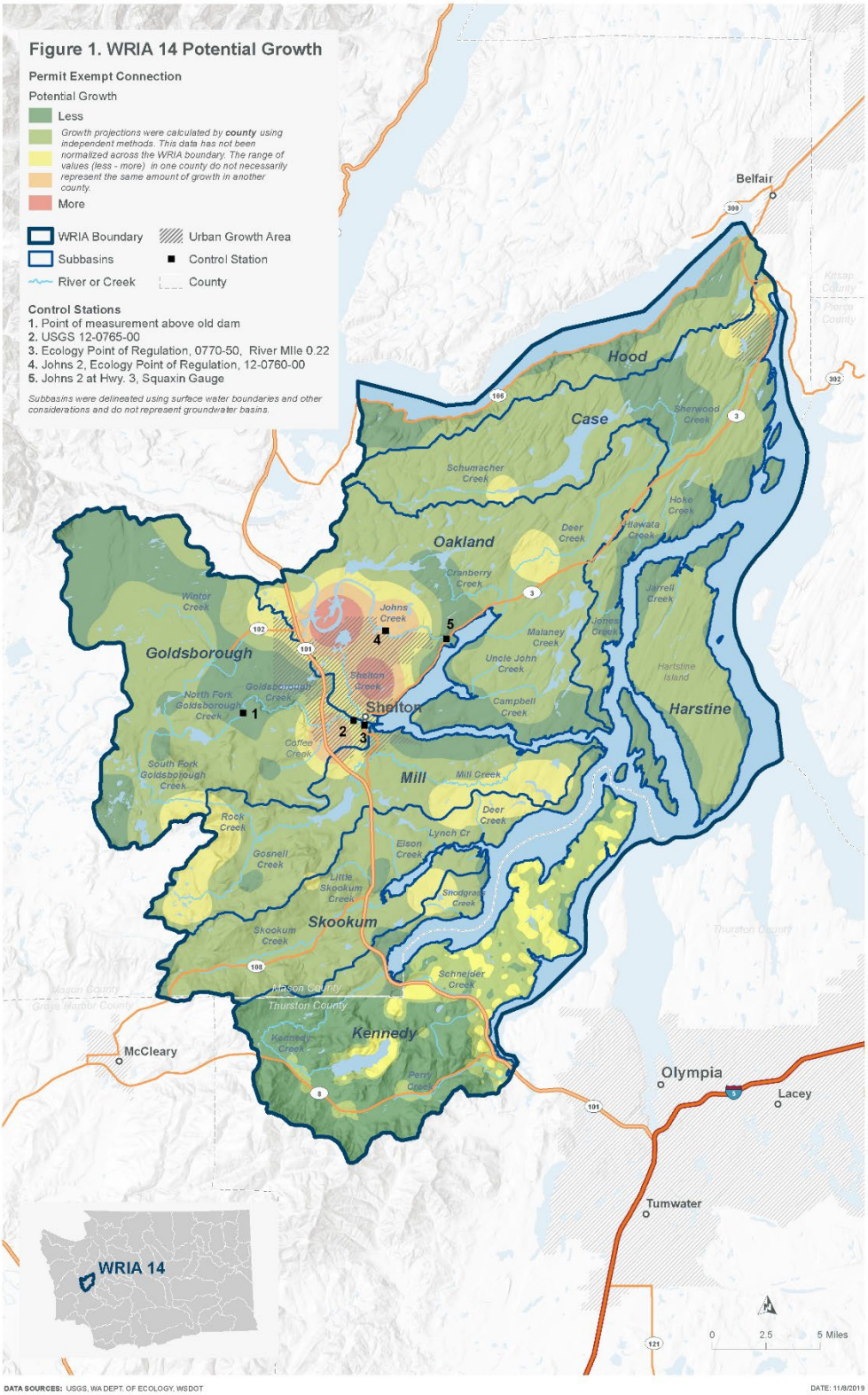


Figure H-1. WRIA 14 Projected Permit-Exempt Connection Growth

Consumptive Use

The WRIA-wide consumptive use estimates used the Irrigated Area method range from 0.98 cfs (initial, average irrigated area of 0.10 acre) to 1.05 cfs (revised growth, average irrigated area of 0.10 acre) (Table 2 and Table 3). When an average irrigated area of 0.14 acre (95 percent Upper Confidence Limit [UCL] average irrigated area) was assumed, the consumptive use estimates ranged from 1.33 cfs (initial) to 1.43 cfs (revised growth).

The water system data analysis in WRIA 14 was conducted using averages of three systems managed by the Mason Public Utility District: Cherry Park, Union, and Harstine Retreat. The WRIA-wide consumptive use estimate calculated using the Water System Data method ranged from 0.48 cfs (initial) to 0.51 cfs (revised growth) (Table 2 and Table 3).

The WRIA 14 Committee selected the Irrigated Area method, using an average irrigated area of 0.10 acre as the "working" consumptive use estimate. The consumptive use estimates using a 95 percent UCL of the average irrigated area (0.14 acre) and the water system data method are for comparative purposes only.

Estimates of consumptive use using the Irrigated Area method are approximately two times greater than the Water System Data estimates.

Seasonal Use

Monthly outdoor water use was calculated as part of the consumptive use analysis for the Irrigated Area method. Seasonal water use by month is reported by subbasin and scenario (Table 4 and Table 5). The month of July has the highest irrigation requirement, resulting in the highest monthly consumptive use impact. This information may be used during evaluation of projects designed to offset subbasin- and season-specific impacts.

Sources

Ecology. 2018. *Recommendations for Water Use Estimates*. Washington State Department of Ecology, Publication 18-11-007.

Ecology. 2019. Final Guidance for Determining Net Ecological Benefit. Washington State Department of Ecology, Publication 19-11-079.

Natural Resource Conservation Service. 1997. Washington Irrigation Guide (WAIG). U.S. Department of Agriculture.

Table H-2a: Annualized Average Consumptive Use Estimates for WRIA 14 (2020–2040) – Initial Growth: Water System Estimate

Subbasin	Projected No. Permit-Exempt Wells	AFY	GPM	AFY
Case	418	36.2	22.4	0.05
Goldsborough	509	44.0	27.3	0.06
Harstine	143	12.4	7.7	0.02
Hood	74	6.4	4.0	0.01
Kennedy	556	48.1	29.8	0.07
Mill	462	40.0	24.8	0.06
Oakland	1,481	128.2	79.4	0.18
Skookum	363	31.4	19.5	0.04
Totals	**4,006**	**346.7**	**214.9**	**0.48**

Table H-2b: Annualized Average Consumptive Use Estimates for WRIA 14 (2020–2040) – Initial Growth: Irrigated Area Estimate (0.10 acre average irrigated area)

Subbasin	Projected No. Permit-Exempt Wells	AFY	GPM	AFY
Case	418	73.9	45.8	0.10
Goldsborough	509	90.0	55.8	0.12
Harstine	143	25.3	15.7	0.03
Hood	74	13.1	8.1	0.02
Kennedy	556	98.3	60.9	0.14
Mill	462	81.7	50.6	0.11
Oakland	1,481	261.8	162.3	0.36
Skookum	363	64.2	39.8	0.09
Totals	**4,006**	**708.3**	**439.1**	**0.98**

Table H-2c: Annualized Average Consumptive Use Estimates for WRIA 14 (2020–2040) – Initial Growth: Irrigated Area Estimate (0.14 acre average irrigated area)

Subbasin	Projected No. Permit-Exempt Wells	AFY	GPM	AFY
Case	418	100.7	62.4	0.14
Goldsborough	509	122.6	76.0	0.17
Harstine	143	34.4	21.3	0.05
Hood	74	17.8	11.0	0.02
Kennedy	556	133.9	83.0	0.19
Mill	462	111.3	69.0	0.15
Oakland	1,481	356.6	221.1	0.49
Skookum	363	87.4	54.2	0.12
Totals	**4,006**	**964.7**	**598.0**	**1.33**

Table H-3a: Annualized Average Consumptive Use Estimates for WRIA 14 (2020–2040) – Revised Permit-exempt Connection Growth: Water System Estimate

Subbasin	Projected No. Permit-Exempt Wells	AFY	GPM	AFY
Case	512	44.3	27.5	0.06
Goldsborough	546	47.2	29.3	0.07
Harstine	143	12.4	7.7	0.02
Hood	117	10.1	6.3	0.01
Kennedy	588	50.9	31.5	0.07
Mill	466	40.3	25.0	0.06
Oakland	1559	134.9	83.6	0.19
Skookum	363	31.4	19.5	0.04
Totals	**4,294**	**371.6**	**230.4**	**0.51**

Table H-3b: Annualized Average Consumptive Use Estimates for WRIA 14 (2020–2040) – Revised Permit-exempt Connection Growth: Irrigated Area Estimate (0.10 acre average irrigated area)

Subbasin	Projected No. Permit-Exempt Wells	AFY	GPM	AFY
Case	512	90.5	56.1	0.13
Goldsborough	546	96.5	59.8	0.13
Harstine	143	25.3	15.7	0.04
Hood	117	20.7	12.8	0.03
Kennedy	588	103.9	64.4	0.14
Mill	466	82.4	51.1	0.11
Oakland	1559	275.6	170.9	0.38
Skookum	363	64.2	39.8	0.09
Totals	**4,294**	759.2	470.6	1.05

Table H-3c: Annualized Average Consumptive Use Estimates for WRIA 14 (2020–2040) – Revised Permit-exempt Connection Growth: Irrigated Area Estimate (0.14 acre average irrigated area)

Subbasin	Projected No. Permit-Exempt Wells	AFY	GPM	AFY
Case	512	123.3	76.4	0.17
Goldsborough	546	131.5	81.5	0.18
Harstine	143	34.5	21.4	0.05
Hood	117	28.2	17.5	0.04
Kennedy	588	141.5	87.7	0.20
Mill	466	112.2	69.6	0.16
Oakland	1559	375.4	232.7	0.52
Skookum	363	87.4	54.2	0.12
Totals	**4,294**	1,034.0	641.0	1.43

Table H-4a: WRIA 14 Monthly Consumptive Water Use (Irrigated Area method; assumed irrigated area of 0.10 acres) - Initial

Subbasin	Projected No. Permit-exempt Connections	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Case	418	0.00	0.00	0.00	0.02	0.18	0.24	0.33	0.25	0.10	0.00	0.00	0.00
Goldsborough	509	0.00	0.00	0.00	0.03	0.21	0.29	0.40	0.31	0.12	0.00	0.00	0.00
Harstine	143	0.00	0.00	0.00	0.01	0.06	0.08	0.11	0.09	0.03	0.00	0.00	0.00
Hood	74	0.00	0.00	0.00	0.00	0.03	0.04	0.06	0.04	0.02	0.00	0.00	0.00
Kennedy	556	0.01	0.01	0.01	0.03	0.23	0.32	0.44	0.34	0.14	0.01	0.01	0.01
Mill	462	0.00	0.00	0.00	0.03	0.19	0.27	0.36	0.28	0.11	0.00	0.00	0.00
Oakland	1,481	0.01	0.01	0.01	0.08	0.62	0.85	1.17	0.90	0.36	0.01	0.01	0.01
Skookum	363	0.00	0.00	0.00	0.02	0.15	0.21	0.29	0.22	0.09	0.00	0.00	0.00
Totals	**4,006**	0.04	0.04	0.04	0.22	1.69	2.31	3.15	2.43	0.97	0.04	0.04	0.04

Table H-4b: WRIA 14 Monthly Consumptive Water Use (Irrigated Area method; assumed irrigated area of 0.10 acres) - Higher Permit-Exempt Connection Growth

Subbasin	Projected No. Permit-exempt Connections	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Case	512	0.00	0.00	0.00	0.03	0.22	0.29	0.40	0.31	0.12	0.00	0.00	0.00
Goldsborough	546	0.01	0.01	0.01	0.03	0.23	0.31	0.43	0.33	0.13	0.01	0.01	0.01
Harstine	143	0.00	0.00	0.00	0.01	0.06	0.08	0.11	0.09	0.03	0.00	0.00	0.00
Hood	117	0.00	0.00	0.00	0.01	0.05	0.07	0.09	0.07	0.03	0.00	0.00	0.00
Kennedy	588	0.01	0.01	0.01	0.03	0.25	0.34	0.46	0.36	0.14	0.01	0.01	0.01
Mill	466	0.00	0.00	0.00	0.03	0.20	0.27	0.37	0.28	0.11	0.00	0.00	0.00
Oakland	1,559	0.01	0.01	0.01	0.09	0.66	0.90	1.23	0.95	0.38	0.01	0.01	0.01
Skookum	363	0.00	0.00	0.00	0.02	0.15	0.21	0.29	0.22	0.09	0.00	0.00	0.00
Totals	**4,294**	0.04	0.04	0.04	0.24	1.81	2.47	3.38	2.61	1.04	0.04	0.04	0.04

Note: WRIA 14 did not consider a low-growth scenario.

Table H-5a: WRIA 14 Monthly Consumptive Water Use (Irrigated Area method; assumed irrigated area of 0.14 acres) - Initial

Subbasin	Projected No. Permit-exempt Connections	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Case	418	0.00	0.00	0.00	0.03	0.25	0.34	0.46	0.35	0.14	0.00	0.00	0.00
Goldsborough	509	0.00	0.00	0.00	0.04	0.30	0.41	0.56	0.43	0.17	0.00	0.00	0.00
Harstine	143	0.00	0.00	0.00	0.01	0.08	0.11	0.16	0.12	0.05	0.00	0.00	0.00
Hood	74	0.00	0.00	0.00	0.01	0.04	0.06	0.08	0.06	0.02	0.00	0.00	0.00
Kennedy	556	0.01	0.01	0.01	0.04	0.33	0.45	0.61	0.47	0.19	0.01	0.01	0.01
Mill	462	0.00	0.00	0.00	0.03	0.27	0.37	0.51	0.39	0.16	0.00	0.00	0.00
Oakland	1,481	0.01	0.01	0.01	0.11	0.87	1.19	1.63	1.25	0.50	0.01	0.01	0.01
Skookum	363	0.00	0.00	0.00	0.03	0.21	0.29	0.40	0.31	0.12	0.00	0.00	0.00
Totals	**4,006**	0.04	0.04	0.04	0.30	2.35	3.21	4.40	3.39	1.35	0.04	0.04	0.04

Table H-5b: WRIA 14 Monthly Consumptive Water Use (Irrigated Area method; assumed irrigated area of 0.14 acres) - Higher Permit-Exempt Connection Growth

Subbasin	Projected No. Permit-exempt Connections	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Case	512	0.00	0.00	0.00	0.04	0.30	0.41	0.56	0.43	0.17	0.00	0.00	0.00
Goldsborough	546	0.01	0.01	0.01	0.04	0.32	0.44	0.60	0.46	0.18	0.01	0.01	0.01
Harstine	143	0.00	0.00	0.00	0.01	0.08	0.11	0.16	0.12	0.05	0.00	0.00	0.00
Hood	117	0.00	0.00	0.00	0.01	0.07	0.09	0.13	0.10	0.04	0.00	0.00	0.00
Kennedy	588	0.01	0.01	0.01	0.04	0.34	0.47	0.65	0.50	0.20	0.01	0.01	0.01
Mill	466	0.00	0.00	0.00	0.03	0.27	0.37	0.51	0.39	0.16	0.00	0.00	0.00
Oakland	1,559	0.01	0.01	0.01	0.12	0.91	1.25	1.71	1.32	0.53	0.01	0.01	0.01
Skookum	363	0.00	0.00	0.00	0.03	0.21	0.29	0.40	0.31	0.12	0.00	0.00	0.00
Totals	**4,294**	0.04	0.04	0.04	0.32	2.52	3.44	4.71	3.63	1.45	0.04	0.04	0.04

Note: WRIA 14 did not consider a low-growth scenario.

Attachment A

Estimation of Average Irrigated Area

Methods

1. 80 parcels representing an existing dwelling served by a permit-exempt well or connection was defined.
    a. A pool of parcels with an existing dwelling served by a permit-exempt well or connection was defined.
    b. The selection pool was classified by property value. The classes were (1) Under $350,000, (2) $350,000–$600,000, and (3) more than $600,000.
    c. 80 parcels were randomly drawn from the selection pool, weighted by the proportion of property value class membership.
    d. Additional parcels were randomly selected as alternates, in case any of the primary (80) samples were able to be interpreted to irrigated area.
    e. All parcels were provided in a GoogleEarth .kmz file.
2. The irrigated area in each parcel was delineated according to the following procedure:
    a. Used a single technician to minimize operator variability.
    b. Irrigated area delineations were made using GoogleEarth aerial imagery taken during drier summer months (i.e., July and August). Unirrigated lawns (pasture/turf) go dormant in the dry summer months and turn brown. As such, areas that remain green in the summer imagery were considered irrigated.
    c. Aerial imagery from winter months was reviewed alongside summer imagery to reveal which lawn areas change from green to brown. Those areas that do not change color, or moderately change color but remain green, were considered irrigated.
    d. If available, multiple years of aerial imagery were used to corroborate the irrigated area delineation.
    e. Landscaped shrub/flower bed areas within a larger irrigated footprint were included. Shrub and flower bed areas outside of the irrigated footprint were excluded.
    f. If the irrigated area extended beyond the parcel boundary, those areas were included.
    g. Parcels with no visible signs of irrigation were assumed to have zero irrigated acres.
    h. Areas that appeared to be native forest or unmaintained grass were not included in the irrigated footprint.

i. Parcels with homes or accessory dwelling units (ADUs) under construction in the most recent GoogleEarth imagery were excluded from the analysis, and an alternate parcel was evaluated.

- Figures H-2 through H-5 illustrate some example delineations.

Figure H-2. No irrigated areas visible in most recent GoogleEarth aerial imagery.

Figure H-3. Area in white includes maintained grass. Residence constructed between June 2017 and July 2018. Therefore, historical irrigation of property is unavailable in GoogleEarth imagery.

Figure H-4. Irrigated area includes landscaped area in driveway, maintained yard around residence, garden area, and maintained grass near garden area.

Figure H-5. No irrigated area. Assumption that green vegeation on southern portion of parcel is due to proximity to Spurgeon Creek since clear delineation of irrigated area is not present on aerial. Green area near residence appears to be tree and shrubs, not maintained landscaping and is excluded.

Results

Eighty parcels were evaluated for irrigated acreage (Figure B-5). The average irrigated acreage was 0.07 acre (Table B-1). In all WRIAs evaluated, most parcels had zero irrigated acres (Figure B-6). The distribution of irrigated acreages for all WRIAs were skewed because of the large percentage of parcels that had zero irrigated acres. Some parcels had an irrigated area nearly an order of magnitude larger than the mean, resulting in a large standard deviation. The 95 percent upper confidence limit of the mean could be fit only with a non-parametric distribution and was about twice the quantity of the calculated arithmetic mean. When a minimum irrigated acreage of 0.05 acre was imputed for the parcels with zero irrigated acres observed, the average acreage increased to 0.10 acre.

Figure H-6. Parcels selected in WRIA 14 with existing permit-exempt connections that were delineated for apparent irrigated areas.

Table B-1. Irrigated acreage delineation results

Statistic	WRIA 14
Permit-exempt Parcel Sample Pool	5,091
Sample Size	80
Mean (acres)	0.07
Mean, with 0.05-acre minimum (acres)	0.10
Standard Deviation (acres)	0.15
95% UCL (acres)	0.14

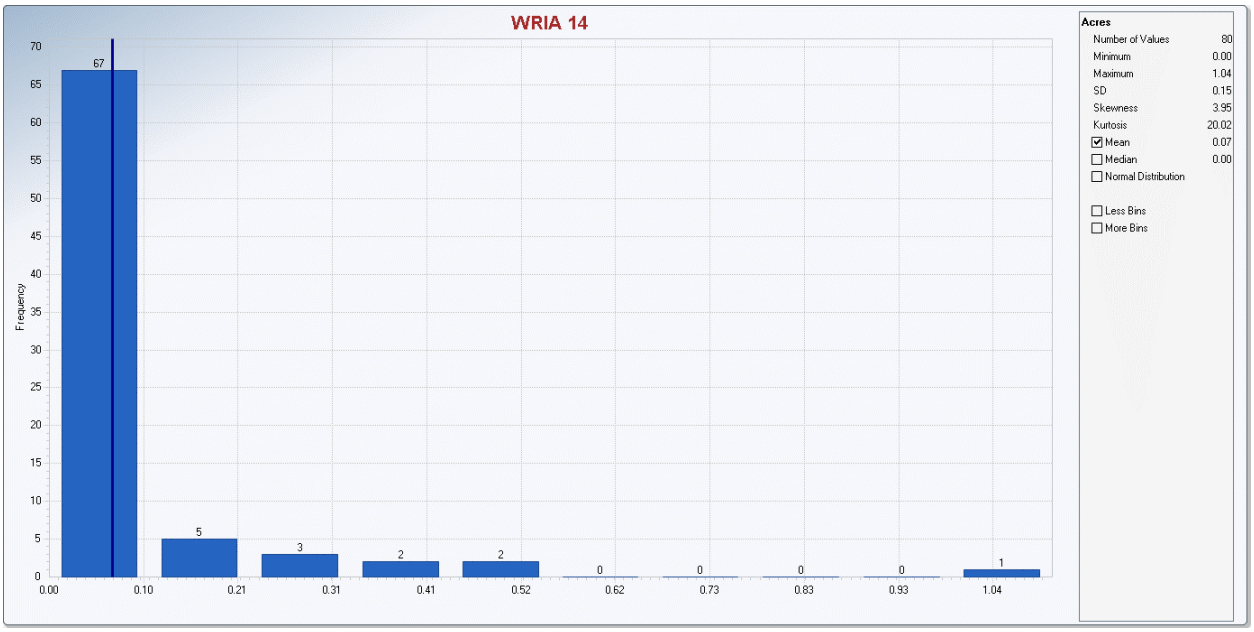


Figure H-7. Histogram of WRIA 14 irrigated acreage delineation results.

Because of the large proportion of parcels with zero acres observed, and the large variability in the results (i.e., large standard deviation), HDR proposed a range of alternatives to mitigate that uncertainty:

- To account for uncertainty of detecting small areas of irrigation, the Committee could impute the zero values with a "minimum detection" irrigated area of 0.05 acre, which would result in a 0.10-acre average irrigated area size.
- HDR completed an irrigated area comparability study for the irrigated area parcel analysis, and determined that an additional way to account for uncertainty in "human error" could be done using a "correction factor," which would result in a 0.11-acre average irrigated area size.

- HDR has completed a statistical analysis of their data, and has determined that using the 95 percent Upper Confidence Limit of the data (based on initial analysis with 0 values) could be an additional way to account for uncertainty, which would result in a 0.14-acre average irrigated area size.

The WRIA 14 Committee decided to move forward with a "primary working number" and a "working number for comparison." The primary working number is an average irrigated acreage of 0.10 acre (average value with imputed minimum detection values of 0.05 acre). The working number for comparison is 0.14 acre, which is the non-parametric 95th Upper Confidence Limit of the mean. Consumptive use based on both acreages will be evaluated and compared to the consumptive use calculated from the Water System Data method.

Attachment B

Consumptive Use Corroboration Analysis

Thurston, Mason, and Kitsap PUDs provided water consumption data for several systems with a small number of connections. These systems were analyzed using both consumptive use estimation methods. All parcels in each system were analyzed for irrigated area, providing a direct comparison between the water estimated using the Irrigated Area method and the actual measured consumption by the water system. Tables H-6a-d contain the results of the corroboration analysis.

Tables H-6a-d: Annual and Seasonal Consumptive Use Corroboration Analysis

WRIA 12 Whiskey Hollow	Water System Data	Irrigated Area Method	% Difference
Annual Consumptive Use	53.6	181.1	238
Summer Consumptive Use	85.8	346.3	304
Winter Consumptive Use	11.2	15.0	34

WRIA 14 Canyonwood Beach	Water System Data	Irrigated Area Method	% Difference
Annual Consumptive Use	29.3	86.4	195
Summer Consumptive Use	51.2	157.4	207
Winter Consumptive Use	7.2	15.0	107

WRIA 13 Rich Road	Water System Data	Irrigated Area Method	% Difference
Annual Consumptive Use	52.6	113.2	115
Summer Consumptive Use	86.8	210.8	143
Winter Consumptive Use	7.3	15.0	107

WRIA 13 Echo Valley	Water System Data	Irrigated Area Method	% Difference
Annual Consumptive Use	76.7	75.5	-2
Summer Consumptive Use	137.9	135.7	-2
Winter Consumptive Use	15.2	15.0	-1

[1]Change in consumptive use from the Water System Data method to the Irrigated Area method.

The Irrigated Area method estimated consumptive use values at least double those estimated from the Water System Data method in WRIAs 12, 13, and 14. This is true for both indoor and outdoor use. The exception is winter consumptive use in the Whiskey Hollow system, which suggests that customers purchasing water from Whiskey Hollow use indoor water at a rate similar to that assumed in the Irrigated Area method (i.e., 60 gpd per person). The Echo Valley

system in WRIA 15 has a slight decrease in estimated consumptive use in the Irrigated Area method compared to the Water System Data method. Customers in this system may heavily irrigate their lawns, or the estimate of total irrigated area in the system may be biased low. No small water system data were provided in WRIA 10.

Appendix I – Detailed Project Descriptions

The following project descriptions were developed based on information provided to Ecology prior to December 2021.

City of Shelton Reclaimed Water Project

Project Name
City of Shelton Reclaimed Water Project

WRIA 14 WRE Subbasin
North Fork Goldsborough Subbasin

Water Offset
459 acre-feet (AF) per year

Project Status
Through the City of Shelton Reclaimed Water Project, the City of Shelton (City) proposes to increase the quantity and rate of reclaimed water infiltration into the shallow aquifer system underlying the North Fork Goldsborough subbasin. The project centers around increasing production of Class A reclaimed water (RW) and infiltrating to groundwater at the City reclaimed water spray field, near the Washington Corrections Center (WCC). RW also will be used for irrigation at the WCC. This project is currently in the design phase and is supported by the City, the WCC, and the Squaxin Island Tribe.

This project is also described in a Project Summary by HDR (2020), which is available in Appendix J, however, the analysis and results presented here differs somewhat from the HDR analysis. Original development of this project was conducted under the direction of the WRIA 14 Watershed Restoration and Enhancement Committee, which is reflected in the HDR memo.

Narrative Description
The City of Shelton Reclaimed Water Project will redirect an annual average of 0.5 million gallons per day (mgd) of the City's wastewater from the Felton Wastewater Treatment Plant (WWTP) to the City's Water Reclamation Plant (WRP). The redirected wastewater will be treated to produce 0.5 mgd of RW for subsequent conveyance to the existing City spray field where a portion will infiltrate to recharge shallow groundwater. The following infrastructure improvements are required to facilitate this project:
Conveyance of North Shelton wastewater to the WRP.

- A 0.750 million-gallon-capacity storage tank to store RW at the WRP.

Conveyance of redirected wastewater to the WRP is currently in its design phase. The conveyance design is likely to include a sewage lift station and an 18-inch sewer main approximately 9,000 feet in length running from West Birch Street to a reclaimed water satellite plant. The RW storage tank serves to buffer variable production and use of RW. RW produced from City wastewater could be used for firefighting and it allows strategic timing of application of RW to the ground to benefit aquifers and streams and wetlands. Streamflow restoration

funds are currently being used to support design for the lift station, sewer main, storage tank, and cost estimates.

This project also proposes to convey RW to WCC for irrigation to replace (source exchange) current groundwater use. The WCC proposes to use RW to irrigate their outdoor lawn areas, instead of water that they currently pump from their groundwater supply well. Pumping from the WCC well currently impacts instream flows in the North Fork Goldsborough Creek.

Quantitative or qualitative assessment of how the project will function, including anticipated offset benefits, if applicable. Show how offset volume(s) were estimated.

Wastewater in the Shelton area is currently treated by the City at the Shelton WWTP and the WRP. Approximately 1.3 million gallons per day (about 1,490 AF per year) of treated effluent from the WWTP is discharged directly to Oakland Bay. Approximately 0.213 million gallons per day (about 239 acre-feet/year) of RW is currently produced at the WRP and is conveyed to a wooded area near the WCC and overland sprayed. This overland spraying area is adjacent to the North Fork Goldsborough Creek, and it is likely that RW infiltrating to shallow groundwater is hydraulically connected with North Fork Goldsborough Creek.

The water offset benefit from the City of Shelton Reclaimed Water Project will derive from two components:

1. The first water offset component will result from infiltrating RW that currently is discharged to Oakland Bay. Under this project, 560 AF per year of water in the North Shelton waste stream will be treated to Class A RW standards. Assuming an infiltration efficiency of 80 percent, that would result in approximately 448 AF per year of RW infiltration to shallow groundwater (if all treated water is infiltrated).

2. The second water offset component is related to the use of RW for irrigation at WCC. This RW use will reduce consumptive use (CU) associated with WCC's production well pumping. WCC is currently pumping approximately 67 AF per year of groundwater for irrigation. Approximately 80 percent of the irrigation water is lost to evapotranspiration, which equates a CU of 53.6 AF per year. Under this project, RW will replace groundwater for outdoor irrigation so that, as the WCC population grows, 67 AF of groundwater formerly used for irrigation can be used indoors. However, very little of that water will be consumptively used, because the wastewater will be conveyed to the WRP, treated to RW standards, then pumped to the City spray field and land applied. Assuming an infiltration efficiency of 80 percent, that would result in approximately 13.4 AF per year of additional RW infiltration to shallow groundwater (if all treated water is infiltrated).

The balance of water offset benefits from both these components will provide a total water offset of 459 AF per year (Table 1). That evaluation assumes future indoor water use at the WCC will lead to a 5 percent evaporative loss. Although it is not reflected in the table, the immediate

benefits of this project would be larger, because the growth of indoor use would be gradual, and immediately after the switch to RW for irrigation, the WCC would pump 67 AF per year less from their local well.

Tables I-1a-d. Estimated additional groundwater recharge as result of Shelton Reclaimed Water Project

WCC well water use	**Water Quantity (AF per year)**
Water quantity withdrawn from WCC well	67
Evaporative water loss associated with WCC indoor use (67 x 5%)	-3.4
Wastewater provided to Shelton WWTP (67 x 95%)	63.7

WCC irrigation	**Water Quantity (AF per year)**
RW shipped from Shelton WRP to WCC for irrigation use	67.0
Portion of irrigation water infiltrated into ground (67 x 20%)	13.4

Shelton WRP water use	**Water Quantity (AF per year)**
RW produced by Shelton WRP	560.0
Water shipped to WCC for irrigation use	-67.0
Wastewater provided by WCC back to Shelton WRP	63.7
Total RW available for infiltration at Shelton WRP	556.7
RW infiltrated into the ground from Shelton WRP (556.7 x 80%)	445.3

North Fork Goldsborough Creek benefit	**Water Quantity (AF per year)**
Shelton WRP RW infiltration (445.3) + WCC irrigation infiltration (13.4)	**458.7**

Conceptual-level map and drawings of the project and location.

Figure I-1 shows the locations of components of the City of Shelton Reclaimed Water Project.

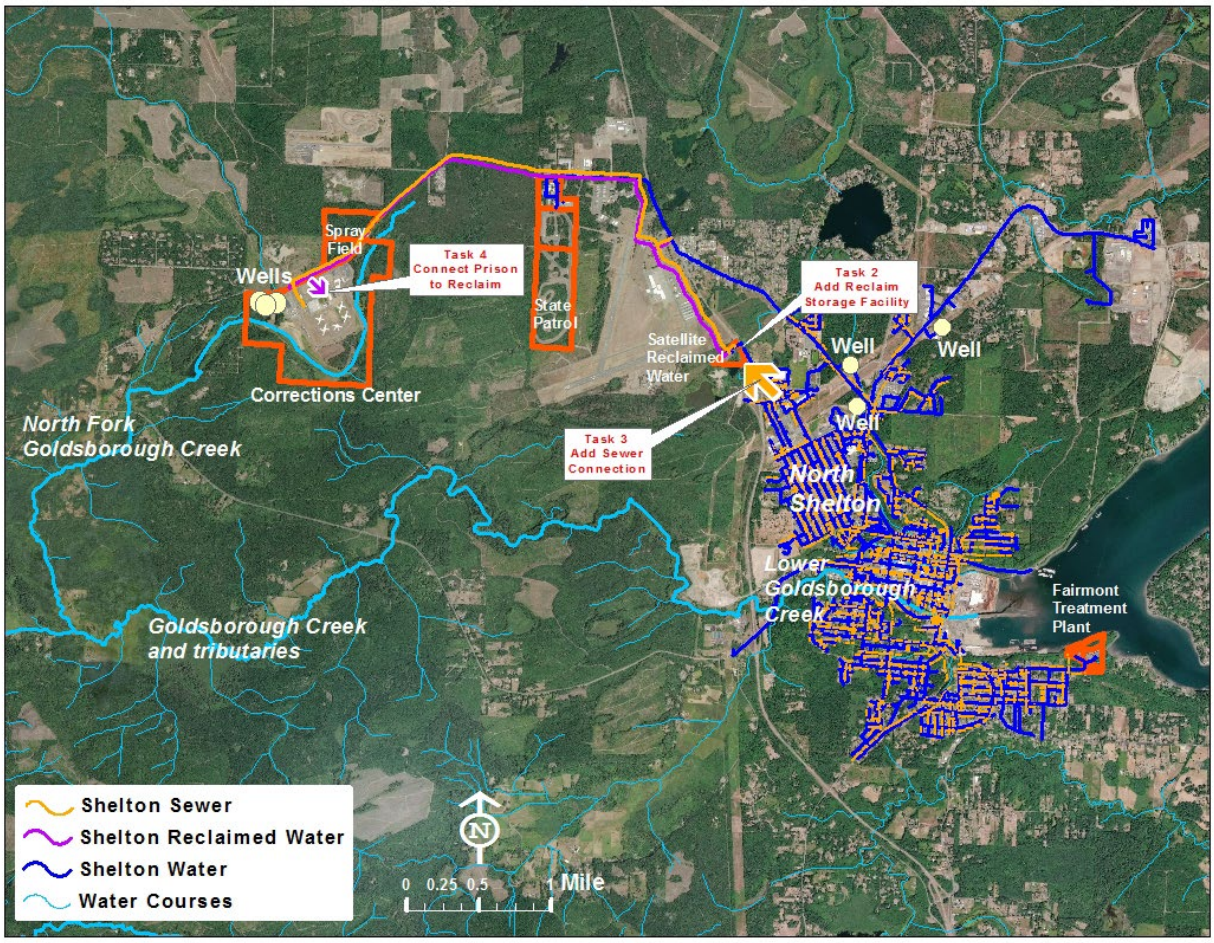


Figure I-1. City of Shelton wastewater collection network, wastewater treatment plants, and reclaimed water use at the WCC.

Description of the anticipated spatial distribution of likely benefits.

The spray field is underlain by relatively permeable glacial outwash deposits, as indicated by monitoring wells associated with Reclaimed Water Permit ST6216 (Ecology 2009; 2016). The spray field also is situated upgradient of North Fork Goldsborough Creek to the west and south. Therefore, RW infiltration associated with the City of Shelton Reclaimed Water Project will benefit stream flows in North Fork Goldsborough Creek.

Performance goals and measures.

The performance goals of the City of Shelton Reclaimed Water Project are to reduce RW discharge to Oakland Bay through RW infiltration and to reduce WCC's production well pumping through RW irrigation. Specific measures will be the volume of RW infiltrated and used for irrigation, as well as the increase in shallow groundwater storage.

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.

The City of Shelton Reclaimed Water Project will benefit North Fork Goldsborough Creek and, ultimately, Goldsborough Creek. Goldsborough Creek is designated habitat for ESA-listed winter steelhead. It is also home to populations of Chum Salmon, Coho Salmon, and anadromous cutthroat trout (WDFW, 2020).

Increased baseflow and reduced surface water temperatures would primarily benefit juvenile salmonid rearing habitats by providing increased area and quality of summer stream rearing habitat. This would improve both productivity and survival of juveniles. The alteration of natural stream hydrology has been identified as a high priority limiting factor in WRIA 14 (NOAA, 2007) and streamflow is important for supporting riparian vegetation and wetlands that provide shading, food web support, and flood and sediment attenuation functions.

Identification of anticipated support and barriers to completion.

This project aligns with the goals of the Streamflow Restoration Act. Managed aquifer recharge and source exchanges are identified project types that could address the new consumptive water use and achievement of net ecological benefit (NEB).

This project is supported by the City, the WCC, and the Squaxin Island Tribe. No barriers to completion are currently foreseen.

Potential budget and O&M costs.

The current project cost estimate is $1,673,000, based on similar work from an existing project grant associated with the Squaxin Island Tribe. The City and the Squaxin Island Tribe are currently completing a feasibility study that will refine this estimate through development of specific capital and O&M costs.

Anticipated durability and resiliency.

In this context, durability refers to the capacity of the City of Shelton Reclaimed Water Project to maintain the estimated water offset over time despite changing external conditions (which could include seasonal variation in hydrologic conditions, seasonal and/or long-term fluctuation in regional groundwater elevation, population change, adjacent land use changes, and/or other factors). We anticipate that the planned project will be durable, based on the following:

- The water source will be controlled by the City and should be reliable, even during low water years. The water source might increase with the forecasted increase in associated population.
- Reclaimed water delivery would be precisely maintained through engineering controls and conveyed with minimal loss to the use/recharge location.
- Groundwater recharge rate presumably would be maintained through a program of periodic rehabilitation of the infiltration facility.

- Land use changes external to the project site likely would have negligible impact on project function.
- O&M presumably would be funded through ratepayers.

Herein, resiliency refers to the capacity of the project to maintain the estimated water offset despite the impacts of climate change. Within the watershed, climate change could result in an increase in seasonal temperature, a decrease in summer precipitation, an increase in winter rainfall, a decrease in winter snowfall and/or spring snowpack, an increase in the frequency and/or intensity of storm events, an increase in wildfires, an increase in sea level, and/or other impacts. We anticipate that the planned project would be resilient to the potential impacts of climate change based on the following:

- The water source is not limited by seasonal or longer-term low streamflow conditions.
- Project function would not be impacted by summer drought conditions.
- Project engineering elements can be engineered and constructed in a manner that is resilient to flood events.
- Wildfire damage to the project site and surrounding area would not impact project function and the anticipated water offset.

Project sponsor(s) (if identified) and readiness to proceed/implement.

The project sponsor is the City of Shelton, supported by the Squaxin Island Tribe. The WCC is a project stakeholder. The project sponsor is currently proceeding with a feasibility study and these entities are ready to implement the project pending study results.

Documentation of sources, methods, and assumptions.

Ecology (Washington State Department of Ecology). 2009. Fact Sheet for Reclaimed Water Permit Number ST 6216.

Ecology (Washington State Department of Ecology). 2016. Reclaimed Water Permit Number ST 6216.

HDR. 2020. City of Shelton Reclaimed Water. Project description prepared by HDR for the Washington State Department of Ecology. 6 p.

NOAA (National Oceanic and Atmospheric Administration, National Marine Fisheries Service). 2007. Puget Sound Salmon Recovery Plan. Volume I. Adopted by the National Marine Fisheries Service, January 19, 2007.

WDFW (Washington Department of Fish and Wildlife). 2020. Salmonscape mapping of fish distribution. Available at: http://apps.wdfw.wa.gov/salmonscape/

Evergreen Mobile Home Estates Water System Consolidation Project

Project Name
Evergreen Mobile Home Estates Water System Consolidation Project

WRIA 14 WRE Subbasin
Oakland subbasin

Water Offset
7.2 acre-feet (AF) per year

Project Status
The City of Shelton, Washington (City) has conducted a study of the feasibility of the Evergreen Mobile Home Estates Water System Consolidation Project. Feasibility study details are provided by Carollo (2020).

This project is also described in a Project Summary by HDR (2020), which is available in Appendix J and has been excerpted to form portions of this project description.

Narrative Description
Evergreen Mobile Home Estates (Evergreen Estates) Group A water system (Water System No. 24154) was issued a compliance order to install CT6 disinfection (i.e., chlorination) to address failing on-site wastewater systems in close proximity to its wells. As an alternative to CT6 treatment, Evergreen Estates is considering consolidation with the City of Shelton's (City's) water system and decommissioning its existing wells. The City has been pursuing consolidating the Evergreen Estates with the City drinking water system, and conducted a feasibility study to identify necessary infrastructure improvements to connect Evergreen Mobile Estates to its water system (Carollo, 2020).

In response to the compliance order, Evergreen Estates installed five new sewer septic systems and a chlorination system at the wells. The property owner indicated that the State has accepted their plan for onsite septic and chlorination improvements and that no further action on their part is required (Carollo, 2020). However, the Evergreen Estates owner also indicated that they would be interested in water system consolidation if their costs were covered by others or with grant funding (HDR 2020).

Water system consolidation will result in the water right(s) associated with the Evergreen Mobile Estates Group A system not being used. A water offset benefit will occur if that water

Quantitative or qualitative assessment of how the project will function, including anticipated offset benefits, if applicable. Show how offset volume(s) were estimated.

The City of Shelton recently completed a feasibility study for the consolidation of Evergreen Estates with the City water system (Carollo, 2020). The study identified the infrastructure that would need to be built by the City and by Evergreen Estates, respectively. The City would provide water service to the Evergreen Estates by providing an 8-inch water main for domestic supply and fire flows. Evergreen Estates would need to install a pressure reducing valve, a backflow prevention device, and potentially private fire hydrants.

Evergreen Estates' available Water Use Efficiency reports indicate that their annual water production is equal to their total annual water right allocation of 26.9 AF per year. However, Carollo (2020) estimated their likely annual water use is approximately 7.2 AF per year. Therefore, if the City provided water to Evergreen Estates and the existing water right were to be put into permanent trust, the water offset value would be 7.2 AF per year.

Conceptual-level map and drawings of the project and location.

The approximate boundaries of Evergreen Estates is shown in Figure I-2.

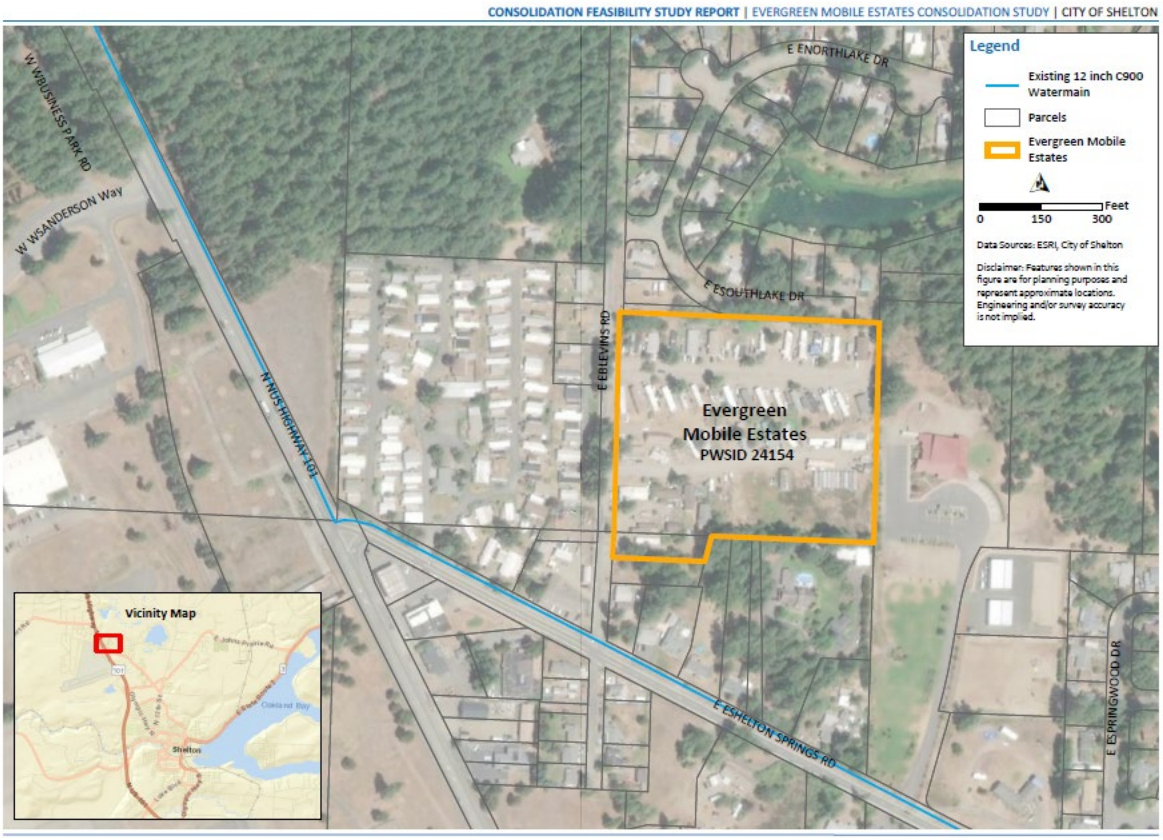


Figure I-2. Evergreen Estates Site Location (from Carollo, 2020).

Description of the anticipated spatial distribution of likely benefits.

Elimination of groundwater pumping by the Evergreen Estates water system will increase groundwater storage in the aquifer system in the vicinity of Evergreen Estate's existing wells. It is also anticipated to benefit baseflow discharge to John's Creek, which is situated less than half a mile away from Evergreen Estates.

Performance goals and measures.

The performance goals would be elimination of groundwater withdrawal associated with the Evergreen Estates water system and placement of the Evergreen Estates water right into permanent trust. Project performance will be measured by the water use eliminated by water system consolidation.

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.

John's Creek supports Coho Salmon, Summer Chum Salmon, Fall Chum Salmon, and winter steelhead (WDFW, 2020). Increased summer low flows will support juvenile Coho Salmon and winter steelhead juveniles. Chum Salmon species would benefit from continued groundwater connectivity during spawning and early rearing during the winter and early spring.

Increased base streamflow and riparian and wetland restoration would contribute to reducing water temperatures that would benefit both adult migrants to spawning grounds and juvenile salmonid rearing habitats by providing increased area and quality of summer stream rearing habitat. This would improve survival of adults and both productivity and survival of juveniles. The alteration of natural stream hydrology has been identified as a high priority limiting factor in WRIA 14 (NOAA, 2007) and streamflow is important for supporting riparian vegetation and wetlands that provide shading, food web support, and flood and sediment attenuation functions.

Identification of anticipated support and barriers to completion.

This project aligns with the goals of the Streamflow Restoration Act. Water right acquisition is an identified project type that could achieve net ecological benefit (NEB).

The project is supported by the City and Evergreen Estates has expressed interest in consolidation. The primary barrier to this project is securing funding for project implementation.

Potential budget and O&M costs.

The cost of project implementation is estimated at $474,000. Specific improvements and costs are currently being developed in a feasibility study that is being funded through a grant between the Washington State Department of Health (DOH) and the City (DOH Contract Number GVL24700).

No ongoing O&M costs associated with water system consolidation other than those associated with typical water system operation are anticipated. We assume that ongoing water system operational costs will be funded by City ratepayers.

Anticipated durability and resiliency.

In this context, durability refers to the capacity of the Evergreen Mobile Estates Water System Consolidation Project to maintain benefit to watershed streams over time despite changing external conditions (which could include seasonal variation in hydrologic conditions, seasonal and/or long-term fluctuation in regional groundwater elevation, population change, adjacent land use changes, and/or other factors). We anticipate that the planned project will be durable, based on the following:

- Water system consolidation is anticipated to provide water offset over a range of hydrologic conditions.
- Acquired water rights will be controlled by the Trust Water Rights Program.
- Land use changes external to the project site likely would have negligible impact on project function.

Herein, resiliency refers to the capacity of the project to maintain the benefit to watershed streams despite the impacts of climate change. Within the watershed, climate change could result in an increase in seasonal temperature, a decrease in summer precipitation, an increase in winter rainfall, a decrease in winter snowfall and/or spring snowpack, an increase in the frequency and/or intensity of storm events, an increase in wildfires, an increase in sea level, and/or other impacts. We anticipate that the planned project would be resilient to the potential impacts of climate change based on the following:

- Water system consolidation is anticipated to provide water offset over a range of climatic conditions.
- Wildfire damage to the project site and surrounding area would not impact project function.

Project sponsor(s) (if identified) and readiness to proceed/implement.

The City is the project sponsor and is ready to proceed once Evergreen Estates concurs and project funding is secured.

Documentation of sources, methods, and assumptions.

Carollo. 2020. City of Shelton, Evergreen Mobile Estates Consolidation Study. Consolidation Feasibility Study Report. Final. September 2020.

HDR. 2020. Evergreen Mobile Home Estates Water Rights Acquisition. Project description prepared by HDR for the Washington State Department of Ecology. 3 p.

WDFW (Washington Department of Fish and Wildlife). 2020. Salmonscape mapping of fish distribution. Available at: http://apps.wdfw.wa.gov/salmonscape/

Managed Aquifer Recharge Projects in WRIA 14

Project Name
Managed Aquifer Recharge (MAR) Projects in WRIA 14

WRIA 14 WRE Subbasin
Kennedy, Skookum, Mill, Goldsborough, Oakland, and Case subbasins.

Water Offset
910 to 1,377 acre-feet (AF) per year

Project Status
MAR projects in WRIA 14 would take peak seasonal streamflow from select streams, and infiltrate this at engineered facilities that are hydraulically connected with shallow aquifer systems and source streams. Seven potential MAR sites in 6 subbasins have been identified in WRIA 14 and are included herein. These locations were developed based on a site suitability analysis conducted by Pacific Groundwater Group (PGG), and a source water availability and MAR facility sizing analyses was conducted by HDR, with site selection criteria based on direction from the WRIA 14 Watershed Restoration and Enhancement (WRE) committee (the committee) and subsequent adoption by the Department of Ecology (Ecology).

This project is described in detail in a Technical Memorandum by PGG (2020) and a Project Summary by HDR (2020), which are available in Appendix J and have been excerpted to form portions of this project description.

Narrative Description
General

MAR projects can derive water from a variety of sources, including stormwater, Class A reclaimed water, and peak flows in rivers and streams. This project is specific to MAR projects that divert, convey, and infiltrate peak seasonal streamflow in engineered MAR facilities that are in hydraulic connection with the shallow aquifer system and the source stream. Flows will be diverted from the source stream in quantities that will not reduce habitat suitability for salmonids and that do not reduce habitat forming processes. Water infiltrated at the MAR facilities will be transported downgradient through the shallow aquifer system and emerge as baseflow in one or more area stream(s). Enhanced conditions will occur across a broad time period, including the late summer and early fall, when flows are typically the lowest, and water demand for consumptive use is the highest.

This project description describes candidate MAR locations, potential methods for diversion and conveyance, potential diversion and infiltration quantities, and the associated potential water offset benefits. Detailed feasibility analyses are not included in this project description and will occur during plan implementation for each specific location. Potential project components are described below:

Diversion

Capture and recovery methods will vary by source stream but will likely include a combination of a screened gravity diversion/bypass systems, screened water lift and/or pump systems, and/or a series of below ground infiltration galleries/collector pipes (e.g., Raney wells) adjacent to source streams. Prior to selection, these capture and recovery methods will need to be evaluated within the context of operation and maintenance (O&M), fish passage performance, permitting, reliability, public safety, construction and lifecycle cost, and available funding mechanisms in order to determine the best fit for the specific water sources.

Conveyance

After capture and recovery, water will be transported to the respective MAR sites through conveyance systems that could consist of canals, ditches, trenches, closed surface piping, and/or closed subsurface piping/tunnels. Conveyance can be accomplished using gravity fed structures or pumping, depending on elevations along the conveyance route. Ideally, source streams and MAR sites would be in close proximity to minimize the complexity and associated expense of the conveyance system.

Storage and Infiltration

Diverted water will be infiltrated to the shallow aquifer system at MAR facilities. Depending on diversion and infiltration rates, MAR facility design could include a storage component consisting of one or more small storage reservoirs. After water is captured during periods of excessive river flow, water will be conveyed to the MAR facility and allowed to infiltrate into the subsurface. MAR sites will be chosen carefully and evaluated for potential infiltration rates and volumes as well as anticipated hydrologic and water quality effects resulting from the project. Suitable sites will have permeable material at or near ground surface and a water table deep enough to support infiltration and associated groundwater mounding.

Feasibility Study

It is assumed that, for each project component that is implemented, an MAR feasibility study will be conducted. This will be consistent with Appendix B of Ecology's Net Ecological Benefit (NEB) guidance (Ecology 2019a) and Appendix D of the Streamflow Restoration Grant application requirements assuming funding from Ecology is provided subsequent to a future grant round (Ecology 2021). All values presented in this project description are for planning purposes and may not represent actual site conditions.

Quantitative or qualitative assessment of how the project will function, including anticipated offset benefits, if applicable. Show how offset volume(s) were estimated.

Methodology

Potential MAR locations were determined based on a screening process conducted by Pacific Groundwater Group (PGG, 2020), which is provided in Appendix J. Areas in WRIA 14 with the following features were considered for inclusion:

- Favorable soils and geology
    - Surficial geologic units consisting primarily of sand and/or gravel (for example, alluvium and glacial outwash) were considered favorable.
    - Areas with outcropping glacial till and/or underlying glacial till in excess of 10 feet in thickness were excluded.
    - Areas underlain by surficial soils with high runoff potential were excluded.
    - Wetlands, lakes, and/or high groundwater areas were excluded.
- Favorable Land Use
    - Land uses designated as commercial lumber and wood, governmental services, educational services, parks, and designated forest land were considered favorable.
- Proximity to potential water source
    - Potential water sources included peak flows from Schumacher Creek, Sherwood Creek, Deer Creek, Cranberry Creek, Johns Creek, Goldsborough Creek, Mill Creek, Skookum Creek, Kennedy Creek, and Perry Creek.
    - Areas within ½ mile of potential source water were included.

This screening resulted in general areas that appear favorable for MAR project implementation; these locations are shown in Figure 1. Additional candidate areas might be identified and proposed during plan implementation.

Once potential sites were selected, source water availability and MAR facility sizing analyses were conducted by HDR (2020). Streams that can demonstrably support MAR projects are those that have a flow record adequate for an assessment of flow diversion quantities and infiltration facility design. Diversion flows are based on maintaining minimum instream flows and habitat forming processes (i.e. ecological flows).

For this project, diversion flows were assumed to equal 2 percent of wet season (November through April) minimum flows. Diversion of flow to an MAR facility can occur during days when flows exceed minimum instream flows. These days were tallied for each day in the flow record and summed by month, as shown in Table 1. These “diversion days” were averaged across all water years in the flow record and those averages were summed during the wet season months. Therefore, the number of “diversion days” for each site provided in Table 1 represents the average number of diversion days per wet season.

A more conservative approach, summarized in Table 2, was also employed that summed the number of "diversion days" for the wet season (November through April) for each water year. Then, the smallest number of "diversion days" among the years in the flow record was selected (Table 2).

The average diversion days (Table 1) and minimum diversion days (Table 2) were used to develop water offset estimates in Table 3. The minimum and average volumes of water that could be diverted to one or more MAR facilities in each stream were estimated by multiplying the diversion flow by the number of diversion days, and converting the volume to AF per year (Table 3).

Kennedy Subbasin

Kennedy Creek could have an MAR site(s) near the outlet of Summit Lake or at approximately River Mile (RM) 5. Both of these areas are forested and appear to have suitable geology and soils for infiltration. Average monthly flows near the mouth of Kennedy Creek range between 92 and 119 cubic feet per second (cfs) between November and March (Table 1). Because no minimum instream flows are assigned to Kennedy Creek, the average flows were used as a basis for setting diversion flow quantities. An MAR diversion of 1 cfs is proposed over this period, which would be less than 2 percent of average wet season flows. Flows during a period of 40 days are estimated to be above average while still accommodating a 1 cfs diversion (Tables 1 and 3). This yields a potential water offset of 79 AF per year.

Skookum Subbasin

Mapping suggests that Skookum Creek is underlain by unfavorable soils for MAR infiltration along much of its stream alignment (Figure 1). However, there appears to be small areas of suitable surficial soil and geologic conditions in the headwaters and near the confluence with Kamilche Creek. Average monthly flows at Highway 101 range between 57 and 140 cfs between November and April (Table 1). Assuming that flows are similar downstream of Kamilche Creek, an MAR diversion of 0.5 cfs (less than 2 percent of the lowest minimum instream flows) is proposed over this period. Between 84 and 131 days were above minimum instream flows at this location while still accommodating a 0.5 cfs diversion (Tables 1 and 2). This yields a potential water offset of 83 to 130 AF per year (Table 3).

Mill Subbasin

Surficial soil and geologic conditions appear favorable for MAR immediately downstream of Isabella Lake (Figure 1. Average monthly flows for Mill Creek at Highway 3 range between 81 and 153 cfs between November and April (Table 1). An MAR diversion of 1 cfs (less than 2 percent of the lowest minimum instream flows) is proposed over this period. Between 86 and 128 days were above minimum instream flows at this location while still accommodating a 1 cfs diversion (Tables 1 and 2). This yields a potential water offset of 171 to 254 AF per year (Table 3).

Goldsborough Subbasin

Surficial soil and geologic conditions appear favorable for MAR sites near Goldsborough Creek at multiple locations (Figure 1). Average monthly flows for Goldsborough Creek at S. 7th Street (U.S. Geological Survey Gage No. 12076800) range between 196 and 341 cfs between November and April (Table 1). An MAR diversion of 1 cfs (less than 2 percent of the lowest minimum instream flows) is proposed over this period.

Between 166 and 177 days were above minimum instream flows at this location while still accommodating a 1 cfs diversion (Tables 1 and 2). This yields a potential water offset of 329 to 351 AF per year (Table 3).

Oakland Subbasin

Several streams are located in the Oakland subbasin with available flow records. These include Johns Creek and Cranberry Creek. Average monthly flows for Johns Creek at Hwy 3 range between 81 and 153 cfs between November and April (Table 1). An MAR diversion of 0.5 cfs (less than 2 percent of the lowest minimum instream flows) is proposed over this period. Between 36 and 117 days were above minimum instream flows at this location while still accommodating a 1 cfs diversion (Tables 1 and 2). This yields a potential water offset of 36 to 116 AF per year (Table 3).

Average monthly flows for Cranberry Creek at Highway 3 range between 48 and 99 cfs between November and April (Table 1). An MAR diversion of 1 cfs (less than 2 percent of the lowest minimum instream flows) is proposed over this period. Between 35 and 92 days were above minimum instream flows at this location while still accommodating a 1 cfs diversion (Tables 1 and 2). This yields a potential water offset of 69 to 182 AF per year (Table 3).

Case Subbasin

The primary streams in the Case subbasin include Schumacher Creek and Sherwood Creek. The two creeks are part of the same drainage, with Schumacher Creek flowing into Mason Lake, and Sherwood Creek flowing from Mason Lake (Figure 1). Average monthly flows for Sherwood Creek at Sherwood Cr Rd. range between 79 and 144 cfs between November and April (Table 1). Water could be diverted from the downstream end of Mason Lake and conveyed to an MAR facility directly downstream of the lake outlet (Figure 1). An MAR diversion of 1 cfs (less than 2 percent of the lowest minimum instream flows) is proposed over this period. Between 72 and 133 days were above minimum instream flows at this location while still accommodating a 1 cfs diversion (Tables 1 and 2). This yields a potential water offset of 143 to 264 AF per year (Table 3).

Hood Subbasin

Several small streams drain directly to Hood Canal. Mapping suggests that the unnamed stream that drains Devereaux Lake has suitable soils for an MAR site. However, this stream does not have flow data. Therefore, no MAR diversion scenario is currently proposed.

Harstine Subbasin

The only stream large enough to accommodate a small MAR project within Harstine subbasin is Jarrell Creek. However, soils are generally unsuitable near the stream and on most of Harstine Island (Figure 1). Therefore, no candidate locations are proposed for the Harstine subbasin.

Total Potential Water Offset

The total potential MAR diversion quantities for all streams proposed herein range between 910 and 1,377 AF per year (Table 3). For the purpose of assigning a projected water offset for MAR projects in WRIA 14, Ecology conservatively selected the water offset associated with the minimum number of diversion days for each of the projects indicated in Table 3. The subsequent total estimated potential water offset for this project claimed in the plan is 910 AF per year.

Table I-2. The average measured monthly flow (Avg.) in cfs, minimum monthly instream flows (Min. Inst.) in cfs, and the average number of days each month where flows exceed minimum flows (Days). The total number of days where flows exceed minimum flows during the wet season (November through April) are summed in the bottom row. Cells outside of the wet season are shaded.

-	Kennedy Creek			Goldsborough (USGS) at S 7th St.			Johns 1 at Hwy. 3			Johns 2 at Johns Cr Rd.			Skookum at Hwy. 101			Mill at Hwy. 3			Cranberry at Hwy. 3			Sherwood at E Sherwood Cr Rd		
Month	**Avg.**	**Min. Inst.**	**Days**	**Avg.**	**Min. Inst.**	**Days**	**Avg.**	**Min. Inst.**	**Days**	**Avg.**	**Min. Inst.**	**Days**	**Avg.**	**Min. Inst.**	**Days**	**Avg**	**Min. Inst**	**Days**	**Avg.**	**Min. Inst.**	**Days**	**Avg.**	**Min. Inst.**	**Days**
Jan	119	NA	10	341	50	31	97	45	20	63	45	9	140	40	27	153	65	27	99	50	21	140	60	28
Feb	92	NA	10	250	85	28	69	45	12	47	45	13	87	40	19	116	65	21	66	50	16	106	60	22
Mar	100	NA	10	258	85	30	72	45	12	50	45	19	100	40	24	121	65	23	72	50	15	128	60	23
Apr	56	NA	0	196	85	29	54	45	7	38	45	9	57	40	17	81	65	16	48	50	12	79	60	19
May	38	NA	0	119	85	21	34	34	4	24	34	2	29	26	13	49	55	9	29	31	8	50	48	11
June	17	NA	0	75	85	7	21	20	3	15	20	0	13	11	13	29	40	3	17	18	10	32	29	15
July	8	NA	0	51	55	8	14	12	6	9	12	6	5	5	10	18	28	0	10	11	9	19	18	17
Aug	6	NA	0	41	48	2	11	7	13	7	7	11	2	3	5	13	20	0	7	8	6	14	11	15
Sept	5	NA	0	45	45	6	10	7	12	7	7	6	4	3	9	14	20	2	9	8	13	16	11	14
Oct	11	NA	0	82	50	16	17	7	19	12	7	7	22	6	17	32	20	14	18	15	11	34	19	19
Nov	57	NA	0	221	50	29	52	45	9	36	45	3	114	40	21	114	65	19	61	50	12	100	60	19
Dec	99	NA	10	274	50	31	78	45	15	50	45	5	114	40	23	124	65	22	80	50	17	144	60	22
Total			**40**			**177**			**75**			**58**			**131**			**128**			**92**			**133**

Table I-3. The number of days that flows at specific flow stations exceed minimum instream flows during the wet season (November through April) for the years 2005 through 2018 and the minimum number of days (Minimum) among all years for each flow station.

Flow Station	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Minimum
Skookum at Hwy. 101	84	113	117	104	122	158	133	165	104	146	129	157	164		84
Goldsborough (USGS) at S 7th St.	-	179	172	177	166	181	176	182	180	178	181	182	181	181	166
Johns 1 at Hwy. 3	-	91	159	87	36	123	151	132	110	74	106	149	181	128	36
Johns 2	14	104	80	38	41	74	82	111	25	64	75	143	113		14
Mill at Hwy. 3	-	116	127	86	89	145	139	164	89	134	129	159	157		86
Cranberry at Hwy. 3	-	111	106	50	45	106	87	135	35	87	86	143	118		35
Sherwood at E Sherwood Cr Rd	-			72	85	172	137	179	90	127	131	169	165		72

Table I-4. Potential MAR site locations, facility sizes, and estimated water offsets for the minimum diversion days and average diversion days scenarios.

Stream	Location	Facility Size (square feet)	Diversion Flow (cfs)	Minimum Days Exceeding Minimum Flows (Nov through Apr)	Total Water Per Year (cubic feet per year)	Total Water Per Year (AF per year)	Average Days Exceeding Minimum Flows (Nov - Apr)	Total Water Per Year (cubic feet per year)	Total Water Per Year (AF per year)
Kennedy Creek	Summit Lake outlet or RM 5	6,200	1	40	3,456,000	79	40	3,456,000	79
Skookum Creek	Downstream of Kamilche Cr; headwaters	3,100	0.5	84	3,628,800	83	131	5,659,200	130
Mill	Downstream of Lake Isabella	6,200	1	86	7,430,400	171	128	11,059,200	254
Goldsborough Creek	~River Mile 7	6,200	1	166	14,342,400	329	177	15,292,800	351
Johns Creek	Downstream of Johns Cr Rd	3,100	0.5	36	1,555,200	36	117	5,054,400	116
Cranberry Creek	~ RM3	6,200	1	35	3,024,000	69	92	7,948,800	182
Sherwood Creek	DS of Mason Lake	6,200	1	72	6,220,800	143	133	11,491,200	264
					Total	**910**		**Total**	**1,377**

Conceptual-level map and drawings of the project and location.

Results of the screening process conducted by PGG (2020), including identification of general areas that could be favorable for MAR, are presented in Figure I-3.

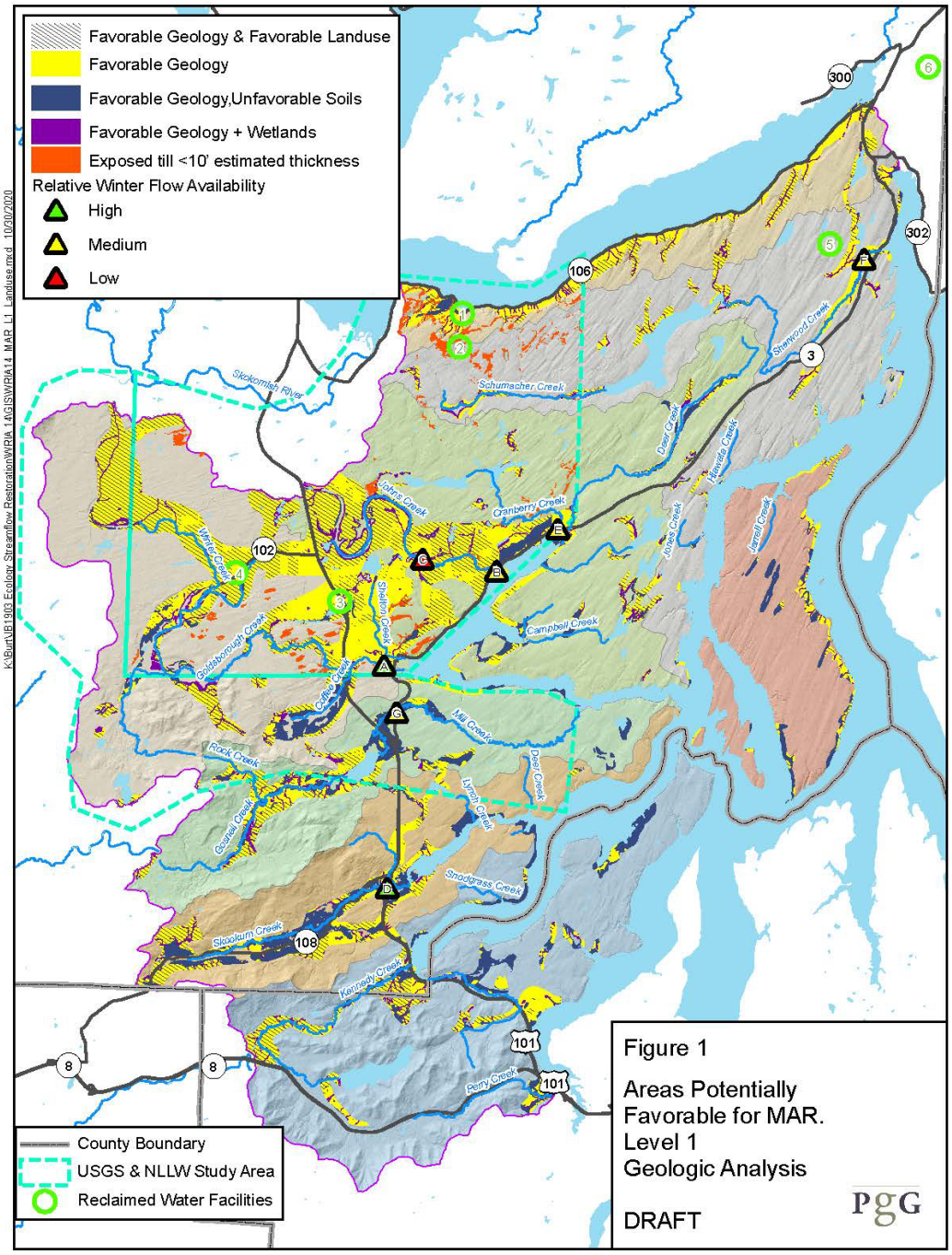


Figure I-3. Areas potentially favorable for MAR project development.

Description of the anticipated spatial distribution of likely benefits.

The proposed MAR projects will increase streamflow in target streams during the summer and early fall, and also will increase usable aquatic habitat. Project implementation will benefit rearing for yearling salmonids such as Coho Salmon, steelhead, and Coastal Cutthroat Trout.

Performance goals and measures.

The performance goals are to increase water storage in the shallow aquifer system adjacent to WRIA 14 streams by infiltrating water through MAR facilities to augment baseflow. The performance measures will be the volume of water infiltrated at MAR facilities and, by extension, the increase in streamflow in targeted streams. Specific quantities and timing for surface water diversion will be determined during a feasibility study.

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.

Streams within the WRIA 14 subbasins listed in Table 1 are inhabited by numerous fish species tracked by the Washington State Department of Fish and Wildlife (WDFW 2021), which could include Chum Salmon, Chinook Salmon, Coho Salmon, Pink Salmon, steelhead, Bull Trout, kokanee, Rainbow Trout, and resident Coastal Cutthroat Trout.

In the Puget Sound Salmon Recovery Plan, NOAA identifies the alteration of natural stream hydrology as a high priority limiting factor in WRIA 14 (NOAA 2007), and streamflow is important for supporting riparian vegetation and wetlands that provide shading, wildfire breaks, food web support, and flood and sediment attenuation functions.

Increased streamflow and reduced water temperatures will primarily benefit juvenile salmonid rearing habitats by providing increased area and quality of summer stream rearing habitat. This will improve the survival of juveniles. Addressing the streamflow limiting factor and improving habitat conditions will help support salmonids at various life stages and increase presence, recruitment, and survival in the area of the project.

Identification of anticipated support and barriers to completion.

This project aligns with the goals of the Streamflow Restoration Act. MAR is an identified project type that could address the new consumptive water use and achievement of NEB. Thurston County, Mason County, and Mason Public Utility District (PUD) 1 are candidates to support and implement these projects, with potential support from the Squaxin Island Tribe and/or other partners.

The barriers to completion include evaluation of MAR feasibility, obtaining funding for construction and O&M costs, and obtaining necessary permitting from the Washington State Department of Ecology, which could include water right permitting depending on project design. Streamflow mitigation could be required, consistent with the Foster Decision, if the projects cause transient impairment of minimum instream flows.

Potential budget and O&M costs.

The potential budget for WRIA 14 MAR projects is based on estimates compiled by Ecology from similar projects, resulting in an estimate of about $3,400 per AF. For the total water offset estimate of 910 to 1,377 AF per year, this equates to a total cost of approximately $3.1 million to $4.7 million.

Anticipated durability and resiliency.

In this context, durability refers to the capacity of the potential MAR projects to maintain the estimated water offset over time despite changing external conditions (which could include seasonal variation in streamflow, seasonal and/or long-term fluctuation in regional groundwater elevation, adjacent land use changes, and/or other factors). We anticipate that the planned projects will be moderately durable, based on the following:

- The reliability of the water source decreases during low water years.
- The feasibility of MAR has not been evaluated.
- The rate of diversion will be precisely maintained through engineering controls and conveyed with minimal loss to the recharge location.
- Groundwater recharge rate will be maintained through a program of periodic rehabilitation of the infiltration structure(s).
- Land use changes external to the project sites likely will have negligible impact on project function.

Herein, resiliency refers to the capacity of the projects to maintain the estimated water offset despite the impacts of climate change. Within the watershed, climate change could result in an increase in seasonal temperature, a decrease in summer precipitation, an increase in winter rainfall, a decrease in winter snowfall and/or spring snowpack, an increase in the frequency and/or intensity of storm events, an increase in wildfires, an increase in sea level, and/or other impacts. We anticipate that the planned project will be resilient to the potential impacts of climate change based on the following:

- Diversion typically will occur during late fall through spring, which generally does not coincide with anticipated (post-climate change) low-streamflow conditions.
- Project function will not be impacted by summer drought conditions.
- Project engineering elements can be engineered and constructed in a manner that is resilient to flood events.
- Wildfire damage to the project site and surrounding area will not impact project function and the anticipated water offset.

Project sponsor(s) (if identified) and readiness to proceed/implement.

Thurston County, Mason County, and Mason PUD 1 have indicated that they would be likely project sponsors, depending on site locations and further review.

Documentation of sources, methods, and assumptions.

Ecology (Washington State Department of Ecology). 2019a. Final Guidance for Determining Net Ecological Benefit. GUID-2094 Water Resources Program Guidance. Publication 19-11-079. July 2019.

Ecology (Washington State Department of Ecology). 2021. Streamflow Restoration Competitive Grants, 2022: Guidance for project applicants. Publication 21-11-019. Revised September 2021. Streamflow Restoration Competitive Grants, 2022: Guidance for project applicants (wa.gov)

HDR. 2020. Managed Aquifer Recharge Projects in WRIA 14. Project Summary prepared by HDR for the Washington State Department of Ecology. 14 p.

NOAA (National Oceanic and Atmospheric Administration, National Marine Fisheries Service). 2007. Puget Sound Salmon Recovery Plan. Volume I. Adopted by the National Marine Fisheries Service, January 19, 2007.

PGG (Pacific Groundwater Group). 2020. Technical Memorandum, WRIA 14 Managed Aquifer Recharge Assessment Methodology. Technical Memorandum prepared by PGG for the Department of Ecology WRIA 14 Watershed Restoration and Enhancement Committee. December 18, 5 p.

WDFW (Washington State Department of Fish and Wildlife). 2021. Salmonscape Mapping of Fish Distribution. http://apps.wdfw.wa.gov/salmonscape/

Mason County Rooftop Runoff

WRIA 14 WRE Subbasin
Case, Goldsborough, Harstine, Hood, Kennedy, Mill, Oakland, and Skookum subbasins

Conversions
1 acre-foot (AF) = 325,851 gallons = 43,560 cubic feet
1 AF per year = 893 gallons per day (gpd) = 0.0014 cubic feet per second (cfs)

Water Offset
224 AF per year

Project Status
Mason County has proposed a possible modification to the Mason County building code to require conveyance and infiltration of rooftop runoff from new rural residential development. This project is summarized in a Technical Memorandum by HDR (2021) provided in Appendix J, which has been excerpted to form portions of this project description.

Narrative Description
Mason County's proposed Rooftop Runoff project recommends a possible modification of the Mason County building code to require capture of roof runoff from new rural residential (RR) development, typically on 5-acre parcels or greater, with direct connection to home site infiltration facilities. Home site infiltration facilities could consist of dry wells, infiltration trenches, infiltration galleries, rain gardens, or other approved infiltration structure. This proposed code revision would typically require conveyance and infiltration facilities that infiltrate a minimum of 85 percent of the annual average rooftop runoff for new rural residential development, with a reduced percentage possible (69 percent) in less permeable soils. The infiltrated runoff will recharge the shallow aquifer system, with an assumed downgradient surface water benefit to the baseflow of receiving streams.

Rooftop runoff capture is not specifically required within Mason County at the current time since the County is not a NPDES MS4 Phase II community. Therefore, this water offset is only possible with Mason County's actions to create this requirement as an offset for consumptive water use from rural residential growth.

Mason County encompasses portions of both WRIA 14 and WRIA 15. Those portions of Mason County within WRIA 14 are the subject of the analyses summarized in this project description.

Quantitative or qualitative assessment of how the project will function, including anticipated offset benefits, if applicable. Show how offset volume(s) were estimated.
HDR used MGSFlood (a Washington State Department of Ecology-approved continuous simulation hydrologic model) to simulate the infiltration potential associated with new rural residential development. The model was used to simulate basin-scale infiltration characteristics

under existing (baseline) development requirements and under the Rooftop Runoff project to estimate the water offset associated with implementation of this project. The analysis and underlying assumptions are described in detail in a technical memorandum (memo) produced by HDR (2021). For WRIA 14, HDR estimates that the projected water offset for 2,766 new PE wells will be approximately 248 AF per year, which is equivalent to about 221,500 gpd. The distribution of the projected water offset within WRIA 14 subbasins is presented in Table I-5 (HDR, 2021).[3]

Table I-5. Estimated water offset volumes by subbasin above the baseline condition that results from the project activities within WRIA 14 (adapted from Table 4 from HDR [2021] memo).

Subbasin¤	Projected·No.·of·PE·Wells¤	Soil·Type·Proportion¤			Well·Proportion¤			Projected·Offset¶(AF·per·year)¤			Subbasin·Offset¶(AF·per·year)¤
		A¤	B¤	C¤	A¤	B¤	C¤	A¤	B¤	C¤	
Case¤	396¤	0.11¤	0.88¤	0.02¤	42¤	347¤	7¤	2¤	34¤	1¤	37¤
Goldsborough¤	338¤	0.82¤	0.08¤	0.11¤	276¤	26¤	37¤	11¤	3¤	5¤	19¤
Harstine¤	143¤	0.14¤	0.18¤	0.69¤	20¤	25¤	98¤	1¤	2¤	14¤	17¤
Hood¤	78¤	0.09¤	0.91¤	0.01¤	7¤	71¤	0¤	0¤	7¤	0¤	7¤
Kennedy¤	59¤	0.61¤	0.05¤	0.34¤	36¤	3¤	20¤	1¤	0¤	3¤	4¤
Mill¤	434¤	0.30¤	0.19¤	0.51¤	132¤	80¤	221¤	5¤	8¤	31¤	44¤
Oakland¤	955¤	0.24¤	0.67¤	0.10¤	226¤	636¤	93¤	9¤	63¤	13¤	85¤
Skookum¤	363¤	0.39¤	0.14¤	0.47¤	141¤	51¤	172¤	6¤	5¤	24¤	35¤
Total¤	**2,766¤**	¤	¤	¤	¤	¤	¤	**35¤**	**122¤**	**91¤**	**248¤**

[3] Quantities obtained from HDR (2021) Table 4 for WRIA 14 subbasins

Ecology considers it likely that some small number of parcels associated with new permit-exempt domestic wells will not support roof runoff infiltration facilities due to limiting site conditions. As such, Ecology directed HDR to reduce the projected water offset estimates for each of the subbasins by 10 percent. This reduction is to account for the fact that the county's new modified building code (if adopted) will likely allow exceptions due to limitations involving depth to groundwater, steep slopes, property setbacks, etc. It is anticipated that such exempted properties will be few, since the footprints of the infiltration facilities will be relatively small (0.005 to 0.014 acre on 5-acre sites) and parcels that are suitable for building construction generally should accommodate infiltration facilities as well. Factoring in this 10% reduction, the project offset will be 224 AF per year, which is equivalent to about 199,100 gpd. Estimated water offsets within individual subbasins ranged from approximately 4 AF per year in the Kennedy subbasin to approximately 77 AF per year in the Oakland subbasin, as summarized in Table 2 (HDR, 2021).[4]

Table I-6. Projected water offsets with a 10% reduction (adapted from Table 5 from HDR [2021] memo).

Subbasin	Offset (AF per year)	Offset with 10% Reduction (AF per year)
Case	37	33
Goldsborough	19	17
Harstine	17	15
Hood	7	7
Kennedy	4	4
Mill	44	40
Oakland	85	77
Skookum	35	31
Total	**248**	**224**

Conceptual-level map and drawings of the project and location.

The portion of Mason County included within WRIA 14 is shown in Figure I-4.

[4] Quantities obtained from HDR (2021) Table 5 for WRIA 14 subbasins

Figure I-4. WRIA 14 boundaries within Mason County (Figure 1 from HDR [2021] memo).

WRIA 14 subbasin distribution within Mason County is shown in Figure I-5.

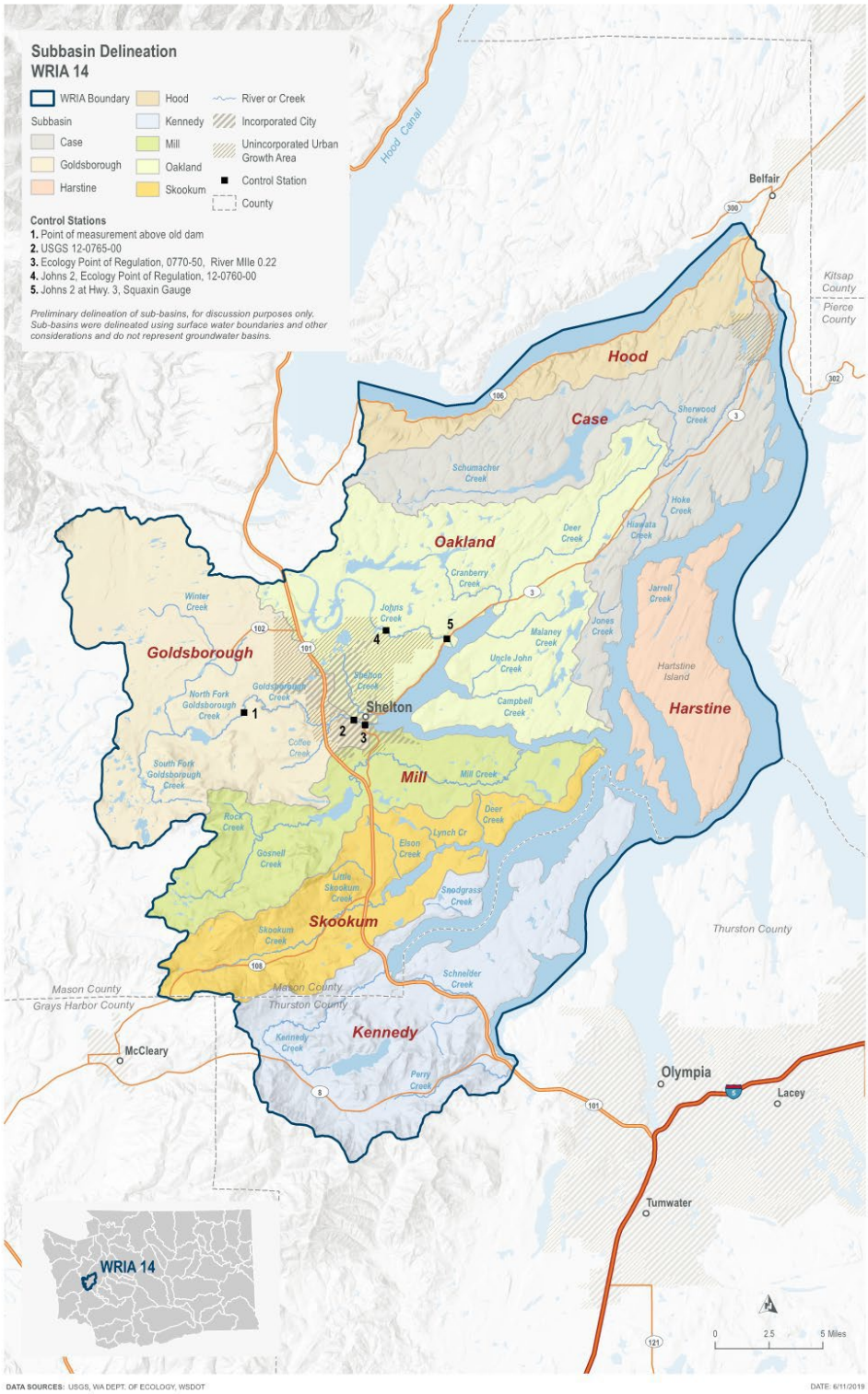


Figure I-5. WRIA 14 subbasins (Figure 2 from HDR [2021] memo).

Description of the anticipated spatial distribution of likely benefits.

Groundwater recharge associated with infiltration of rooftop runoff will increase: (1) groundwater storage in the shallow aquifer system underlying WRIA 14; and (2) associated groundwater discharge to streams in hydraulic connection with the shallow aquifer system. This increased shallow aquifer recharge (and subsequent increased baseflow discharge) will occur on the same parcels where the new consumptive uses will arise as new rural development takes place throughout the subbasins.

Performance goals and measures.

The project's performance goal is to increase streamflow in streams within WRIA 14 subbasins.

A project performance measure will be the number of new homes within WRIA 14 that are equipped with rooftop runoff capture and infiltration infrastructure because of Mason County's Rooftop Runoff project. HDR (2021) estimates the number of homes within WRIA 14 will be approximately 2,766.

A second performance measure will be an increase in streamflow in WRIA 14 streams. Specific quantities and timing for the streamflow increase will vary by stream and location as a function of new home density and local hydrologic characteristics.

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.

Streams within WRIA 14 subbasins are inhabited by Fall Chum Salmon, Summer Chum Salmon, Fall Chinook Salmon, Coho Salmon, Pink Salmon, winter steelhead, Rainbow Trout, and resident Coastal Cutthroat Trout (WDFW, 2021).

In the Puget Sound Salmon Recovery Plan, NOAA identifies the alteration of natural stream hydrology as a high priority limiting factor in WRIA 14 (NOAA, 2007), and streamflow is important for supporting riparian vegetation and wetlands that provide shading, wildfire breaks, food web support, and flood and sediment attenuation functions.

Increased streamflow and reduced water temperatures would primarily benefit juvenile salmonid rearing habitats by providing increased area and quality of summer stream rearing habitat. This would improve the survival of juveniles. Addressing the streamflow limiting factor and improving habitat conditions would help support salmonids at various life stages and increase presence, recruitment, and survival in the area of the project.

Identification of anticipated support and barriers to completion.

This project, as proposed by Mason County, aligns with the goals of the Streamflow Restoration Act. Shallow aquifer recharge is identified as a project type that potentially could address new consumptive water use and help achieve a net ecological benefit (NEB).

Barriers to implementation could include applicability of roof runoff infiltration to areas with poor infiltration characteristics and resistance from prospective homeowners and/or the home construction community.

Potential budget and O&M costs.

HDR (2021) provided estimates for implementation of Mason County's Rooftop Runoff project. HDR assumed that all project costs will be associated with the initial cost of construction for new homes and that construction cost will vary as a function of hydrologic soil group. Assuming that an infiltration facility costs $15 per square foot (sf) to construct, implementation costs could range from $3,780 to $9,300 per home depending on hydrologic soil group, as summarized below:

- Homes with Group A Soils = 252 sf x $15/sf = $3,780
- Homes with Group B Soils = 420 sf x $15/sf = $6,300
- Homes with Group C Soils = 620 sf x $15/sf = $9,330

The estimated cost to implement the Rooftop Runoff Infiltration Program in WRIA 14 is $17,211,543, as summarized in Table 3.

Table I-7: Estimated cost of project implementation within WRIA 14 (Table 6 from HDR [2021] memo).

Hydrologic Soil Group	Num. of Rural Permit-Exempt Wells	Unit Cost Per Home	Costs
Group A	879	$3,780	$3,320,836
Group B	1,240	$6,330	$7,847,947
Group C	648	$9,330	$6,042,760
Total	**2,766**		**$17,211,543**

Anticipated durability and resiliency.

In this context, durability refers to the capacity of the Mason County Rooftop Runoff Project to maintain the estimated water offset over time despite changing external conditions (which could include seasonal variation in hydrologic conditions, seasonal and/or long-term fluctuation in regional groundwater elevation, population change, adjacent land use changes, and/or other factors). We anticipate that the planned project will be moderately durable, based on the following:

- Rooftop runoff would be conveyed from rooftop to infiltration structure with minimal loss to the recharge location.
- Land use changes external to the project sites likely would have negligible impact on project function.

- The quantity of infiltrated water will fluctuate as a function of short-and long-term trends in precipitation.

- Groundwater recharge rate can be maintained through a program of periodic rehabilitation of the infiltration structure(s). However, long-term infiltration capacity will depend on the homeowner's commitment to maintaining the infiltration structures over the lifespan of the home.

Herein, resiliency refers to the capacity of the project to maintain the estimated water offset despite the impacts of climate change. Within the watershed, climate change could result in an increase in seasonal temperature, a decrease in summer precipitation, an increase in winter rainfall, a decrease in winter snowfall and/or spring snowpack, an increase in the frequency and/or intensity of storm events, an increase in wildfires, an increase in sea level, and/or other impacts. We anticipate that the planned project would be moderately resilient to the potential impacts of climate change based on the following:

- Project engineering elements can be engineered and constructed in a manner that is resilient to flood events.

- Wildfire damage to the project sites could impact project function.

- Project function could be impacted by a decrease in seasonal and/or annual precipitation.

Project sponsor(s) (if identified) and readiness to proceed/implement.

The project will be implemented by individual homeowners. However, Mason County will administer rooftop runoff requirements as a component of the Mason County building code.

Documentation of sources, methods, and assumptions.

HDR. 2021. Technical Memorandum, Mason County WRIA 14 and 15 Rooftop Runoff Infiltration Recharge Analysis for Streamflow Augmentation of Net Benefits. Technical Memorandum prepared by HDR for the Washington State Department of Ecology. September 21. 12 p.

NOAA (National Oceanic and Atmospheric Administration, National Marine Fisheries Service). 2007. Puget Sound Salmon Recovery Plan. Volume I. Adopted by the National Marine Fisheries Service, January 19, 2007.

WDFW (Washington Department of Fish and Wildlife). 2020. Salmonscape mapping of fish distribution. Accessed at: http://apps.wdfw.wa.gov/salmonscape/

Steamboat Middle Storage Enhancement and Habitat Improvements

Project Name
Steamboat Middle Storage Enhancement and Habitat Improvements

WRIA 14 WRE Subbasin
Kennedy subbasin

Water Offset
14 acre-feet (AF) per year

Project Status
The Steamboat Middle Storage Enhancement and Habitat Improvements project is located on the Steamboat Island peninsula, northwest of the City of Olympia, Washington. The site is situated north of US Highway 101 and just south of Steamboat Island Road NW. This project is in the conceptual stage.

This project is also described in a Project Information Sheet by Thurston County (2020), which is available in Appendix J and has been excerpted to form portions of this project description.

Narrative Description
The Steamboat Middle Storage Enhancement and Habitat Improvements project increases water storage in an existing forested/non-forested wetland. The project would expand water storage in a low-lying area between 114 feet and 118 feet in topographic elevation relative to the North American Vertical Datum of 1988 (NAVD 88). Conceptual project design envisions the use of a dike and gate/outfall structure to retain an additional 28 to 121 AF of wet season runoff, of which approximately half (14 to 61 AF) is anticipated to provide a water offset benefit. The remainder would primarily be lost to evapotranspiration. The water offset benefit will occur through infiltration of retained runoff and reemergence as baseflow within the unnamed tributaries feeding Young Cove.

Quantitative or qualitative assessment of how the project will function, including anticipated offset benefits, if applicable. Show how offset volume(s) were estimated.
The project area contains a north basin and south basin. Assuming installation of a dike and gate/outfall structure to retain runoff, two water storage scenarios have been preliminarily assessed, as presented in Tables 1 and 2 and described below:

1. At a “Low Water Stand,” the northern basin will retain about one additional foot of water depth within the existing ponded area, for about 28 AF of additional storage. Assuming half of this storage emerges in adjacent stream(s) each year, the associated water offset will be approximately 14 AF per year.

2. At a "High Water Stand," the southern basin will fill to a depth of 1.11 feet and the northern basin depth will increase by a depth of 2.35 feet, on average. Combined, this yields approximately 121 AF of additional storage. Assuming half of this storage emerges in adjacent stream(s) each year, the associated water offset will be approximately 61 AF per year.

Because this project is still in the conceptual phase, the Washington State Department of Ecology (Ecology) is conservatively claiming 14 AF per year of offset benefit (the Low Water Stand) for this project.

Table I-8. Basin characteristics.

Location	Flooded Area (acres)	Average Water Depth – Low Water Stand (feet)	Average Water Depth - High Water Stand (feet)
Northern Basin	28	1	2.35
Southern Basin	50	0	1.11

Table I-9. Water offset summary.

Location	Storage (AF)	Water Offset Benefit (AF per year)
Low Water Stand	28	14
High Water Stand	121	61

Conceptual-level map and drawings of the project and location.
Not available.

Description of the anticipated spatial distribution of likely benefits.
The proposed project will increase streamflow in the unnamed streams that discharge to Young Cove during the summer and early fall and will also increase usable aquatic habitat. Project implementation will benefit rearing for yearling salmonids including Coho Salmon and resident Coastal Cutthroat Trout.

Performance goals and measures.
The performance goals are to increase water storage in the shallow aquifer system beneath the project site and augmenting baseflow in adjacent streams by retaining and infiltrating runoff. The performance measures will be the amount of additional water stored by project facilities and, by extension, the associated increase in infiltration and streamflow in the unnamed streams that discharge to Young Cove.

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.
The unnamed streams that discharge to Young Cove are inhabited by fish species tracked by the Washington State Department of Fish and Wildlife (WDFW, 2021), which include Coho Salmon and resident Coastal Cutthroat Trout. In the Puget Sound Salmon Recovery Plan, NOAA identifies the alteration of natural stream hydrology as a high priority limiting factor in WRIA 14 (NOAA, 2007), and streamflow is important for supporting riparian vegetation and wetlands that provide shading, wildfire breaks, food web support, and flood and sediment attenuation functions.

Increased streamflow and reduced water temperatures will primarily benefit juvenile salmonid rearing habitats by providing increased area and quality of summer stream rearing habitat. This will improve the survival of juveniles. Addressing the streamflow limiting factor and improving habitat conditions will help support salmonids at various life stages and increase presence, recruitment, and survival in the area of the project.

Identification of anticipated support and barriers to completion.
This project aligns with the goals of the Streamflow Restoration Act. This project has elements of surface storage and managed aquifer recharge (MAR), both of which are identified project types that could address the new consumptive water use and achievement of NEB.

A project sponsor has not yet been identified. Rights to inundate lands adjacent to the project would need to be obtained and landowner willingness to allow such inundation could reduce the feasible water offset quantity. Barriers to completion also include evaluation of infiltration feasibility, obtaining funding for construction and O&M costs, and obtaining necessary permitting from Ecology, depending on project design.

Potential budget and O&M costs.

Feasibility study costs are estimated to be approximately $250,000. Capital project costs are expected to be on the order of several hundred thousand dollars for civil works and land access/acquisition. O&M costs are anticipated but have not been evaluated at this time.

Anticipated durability and resiliency.

In this context, durability refers to the capacity of the project to maintain the estimated water offset over time despite changing external conditions (which could include seasonal variation in streamflow, seasonal and/or long-term fluctuation in regional groundwater elevation, adjacent land use changes, and/or other factors). We anticipate that the planned projects will be moderately durable, based on the following:

- The volume of surface storage will be precisely maintained through engineering controls.
- Land use changes external to the project sites likely will have negligible impact on project function.
- The reliability of the water source decreases during periods of drought.
- The feasibility of infiltration and baseflow augmentation has not been evaluated.

Herein, resiliency refers to the capacity of the projects to maintain the estimated water offset despite the impacts of climate change. Within the watershed, climate change could result in an increase in seasonal temperature, a decrease in summer precipitation, an increase in winter rainfall, a decrease in winter snowfall and/or spring snowpack, an increase in the frequency and/or intensity of storm events, an increase in wildfires, an increase in sea level, and/or other impacts. We anticipate that the planned project will be moderately resilient to the potential impacts of climate change based on the following:

- Project engineering elements can be engineered and constructed in a manner that is resilient to flood events.
- Sea level increase, on the order of several feet or less, will not impact project function.
- Project function could be impacted by drought conditions.
- Wildfire damage to the project site and/or surrounding area could impact project function.

Project sponsor(s) (if identified) and readiness to proceed/implement.

A sponsor has not yet been identified for this project.

Documentation of sources, methods, and assumptions.

NOAA (National Oceanic and Atmospheric Administration, National Marine Fisheries Service). 2007. Puget Sound Salmon Recovery Plan. Volume I. Adopted by the National Marine Fisheries Service, January 19, 2007.

Thurston County. 2020. Steamboat Middle Storage Enhancement and Habitat Improvements (Thurston County ID 110). Project Information Sheet prepared by Thurston County. 3p.

WDFW (Washington State Department of Fish and Wildlife). 2021. Salmonscape Mapping of Fish Distribution. http://apps.wdfw.wa.gov/salmonscape/

Summit Lake Alternative Water Supply Project

Project Name
Summit Lake Alternative Water Supply

WRIA 14 WRE Subbasin
Kennedy subbasin

Water Offset
None claimed

Project Status
The Summit Lake Alternative Water Supply Project seeks an alternative solution for safe water supply to the Summit Lake community in Thurston County, Washington. The project will reduce the Summit Lake community's impact on groundwater storage and associated baseflow to area surface water. This project is in the conceptual stage.

This project is described in detail in a Project Information Sheet by Thurston County (2020), which is available in Appendix J and has been excerpted to form portions of this project description.

Narrative Description
The Summit Lake Alternative Water Supply Project will develop an alternative water supply for residents who currently use surface water from Summit Lake for residential water supply. The outlet at the west end of the lake is controlled by a dam with overflow flash boards, regulated under a superior court order issued under Chapter 90.24 RCW, which allows lake overflow to feed Kennedy Creek.

An alternative water supply could potentially eliminate the use of Summit Lake water by approximately 235 homes and could result in the retirement of associated surface water withdrawal permits.

Developing an alternative water supply also could reduce public health risk related to surface water quality concerns and clarify uncertain permitting, including those undeveloped lots surrounding Summit Lake that are currently without access to water.

Two potential alternative water sources have previously been identified and are summarized below:

1. One or more new groundwater production wells could be installed near the Boy Scouts of America's Camp Thunderbird, which is located near the west end of Summit Lake. Well yields of 10 to 30 gallons per minute (gpm) have been identified in at least five existing nearby wells; this includes the Camp Thunderbird production well which was rated by the Washington State Department of Health (DOH) as capable of serving 9,000 gallons per day (gpd). This alternative source might require obtaining a new water right

in compliance with Chapter 173-514 WAC, which could be challenging give current instream flow rules for Kennedy Creek and the Washington State Supreme Court's Foster Decision.

2. Water delivery from a public water system located outside the Summit Lake drainage could be pursued. This option would provide reliable water source to the Summit Lake community and a reliable streamflow benefit to Kennedy Creek but could be costly depending on the required conveyance length and route.

Primary project elements are anticipated to consist of the following:

- One or more feasibility studies to determine preferred alternative water sources, assess associated water quantity and quality, and develop cost estimates for alternative water supply development.
- Community outreach to assess and increase resident acceptance of the new water source
- Regulatory coordination, including water right and/or other permitting.
- Identification and procurement of a suitable funding mechanism(s).
- Identification/communication of financial impacts to residents.
- Project implementation.

A net water offset benefit could occur in two ways: 1) by limiting irrigation for homes newly connected to a new water supply, and 2) by retiring some non-certificated permits and purchase/retirement of some certificated water rights.

Quantitative or qualitative assessment of how the project will function, including anticipated offset benefits, if applicable. Show how offset volume(s) were estimated.

The Summit Lake Alternative Water Supply Project could result in water offset related to retirement of surface water withdrawal permits associated with homes and/or restriction of outdoor water use. According to Thurston County (2020) and depending on the assessment assumptions and methodology, the water savings associated with restricting some types of outdoor water use could yield a water offset of 16.8 to 52.6 AF per year, while retirement of permitted surface water rights could yield a water offset of 26 AF per year. However, because of uncertainties associated with this project and the need for feasibility and community outreach to occur, Ecology has chosen not to claim a water offset benefit for this project at this time.

Conceptual-level map and drawings of the project and location.

The location of Summit Lake, Kennedy Creek, and the Boy Scouts of America's Camp Thunderbird is shown in Figure I-6.

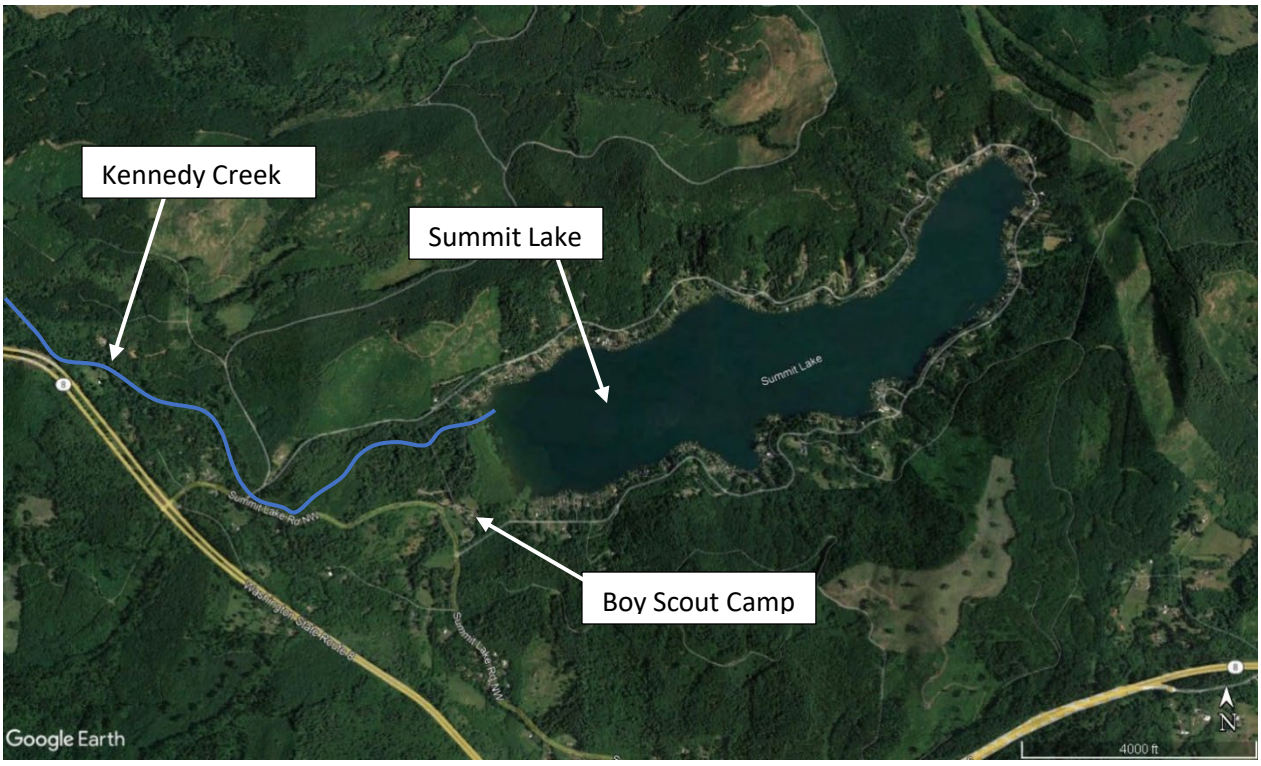


Figure I-6. Summit Lake Alternative Water Supply project site.

Description of the anticipated spatial distribution of likely benefits.

Potential benefits from the Summit Lake Alternative Water Supply project include the following:

1. Water offset to Summit Lake and Kennedy Creek related to retirement of surface water use by homes and/or restriction of outdoor water use.
2. Health risk reduction associated with surface water quality concerns with surface water from Summit Lake.

Performance goals and measures.

The project performance goal is the elimination of surface water withdrawal associated with the Summit Lakes community homeowners. Project performance will be measured by the number of Summit Lake surface water users converted to an alternative water supply through implementation of this project.

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.

Kennedy Creek supports Fall Chinook Salmon, Coho Salmon, Fall Chum Salmon, winter steelhead, and resident Coastal Cutthroat Trout (WDFW, 2021). Increased base streamflow would contribute to reducing water temperatures that would benefit both adult migrants to spawning grounds and juvenile salmonid rearing habitats by providing increased area and quality of summer stream rearing habitat. This would improve survival of adults and both productivity and survival of juveniles. The alteration of natural stream hydrology has been

identified as a high priority limiting factor in WRIA 14 (NOAA, 2007) and streamflow is important for supporting riparian vegetation and wetlands that provide shading, food web support, and flood and sediment attenuation functions.

Identification of anticipated support and barriers to completion.

This project aligns with the goals of the Streamflow Restoration Act. Source exchanges and water right acquisition are identified project types that could achieve net ecological benefit (NEB).

Thurston County might sponsor this project, depending upon the outcome of feasibility study. The Squaxin Island Tribe has indicated that it might support this project.

The primary barriers to this project are securing funding for project implementation and homeowner cooperation. Based on resident comments received in connection with similar proposals in the 1990s and again in 2018-2019, incentives and educational outreach could be required for residents to be supportive of alternative water supply solutions.

Potential budget and O&M costs.

A specific cost estimate has not been developed for this project. If a new groundwater supply is pursued, the cost of new production well(s), engineering, permitting, conveyance, and other infrastructure will require several millions of dollars, at a minimum.

Anticipated durability and resiliency.

In this context, durability refers to the capacity of the Summit Lake Alternative Water Supply Project to maintain benefit to watershed streams over time despite changing external conditions (which could include seasonal variation in hydrologic conditions, seasonal and/or long-term fluctuation in regional groundwater elevation, population change, adjacent land use changes, and/or other factors). Durability will depend on the specific alternative water source that is selected. However, we anticipate that the planned project will be durable, based on the following:

- The new source, whether it be groundwater or an existing water purveyor, is anticipated to provide water offset over a range of hydrologic conditions.
- Acquired water rights, if applicable, will be controlled by the Trust Water Rights Program.
- Land use changes external to the project sites likely would have negligible impact on project function.

Herein, resiliency refers to the capacity of the project to maintain the benefit to watershed streams despite the impacts of climate change. Within the watershed, climate change could result in an increase in seasonal temperature, a decrease in summer precipitation, an increase in winter rainfall, a decrease in winter snowfall and/or spring snowpack, an increase in the

frequency and/or intensity of storm events, an increase in wildfires, an increase in sea level, and/or other impacts. We anticipate that the planned project would be resilient to the potential impacts of climate change based on the following:

- The new source is anticipated to provide water offset over a range of climatic conditions.
- Wildfire damage to the project site and surrounding area likely would not impact project function.

Project sponsor(s) (if identified) and readiness to proceed/implement.

Thurston County might sponsor this project, depending upon the outcome of feasibility study.

Documentation of sources, methods, and assumptions.

NOAA (National Oceanic and Atmospheric Administration, National Marine Fisheries Service). 2007. Puget Sound Salmon Recovery Plan. Volume I. Adopted by the National Marine Fisheries Service, January 19, 2007.

Thurston County. 2020. Summit Lake Alternative Water Supply Use (TC Project #76). Project Information Sheet prepared by Thurston County. 6p.

WDFW (Washington State Department of Fish and Wildlife). 2021. Salmonscape Mapping of Fish Distribution. http://apps.wdfw.wa.gov/salmonscape/

Water Right Opportunities in WRIA 14

Project Name
Water Right Opportunities in WRIA 14

WRIA 14 WRE Subbasin
Goldsborough, Hood, Mill, and Oakland subbasins

Water Offset
111 acre-feet (AF) per year

Project Status
Pacific Groundwater Group (PGG) conducted an investigation to identify potential water right acquisition opportunities in WRIA 14. PGG's methodology and results were summarized in their Technical Memorandum dated December 22, 2020, which is available in Appendix J and has been excerpted to form portions of this project description. PGG's investigation was guided by criteria established by the WRIA 14 Watershed Restoration and Enhancement Committee (committee). These criteria included considerations for priority subbasins, preferred sources, and preferred purposes of use, as well as information provided by some committee members on known water rights.

Although Ecology identified a focused list of water rights for potential future investigation, this proposal is general in nature and no specific water rights are identified for acquisition herein.

Narrative Description
Potential opportunities exist within WRIA 14 for the acquisition of water rights to offset future PE water use. The Water Right Opportunities in WRIA 14 project will benefit instream flows in priority streams by acquiring all or a portion of a selected water right and, if applicable, placing it into Ecology's Trust Water Rights Program (TWRP). Quantitative benefits to instream flow will depend on the current use of the specific water right. For example, a domestic water right that diverts from a stream for indoor uses only, might have a consumptive use (CU) of about 10 percent of total use. If the return flows from this use return to the same stream from which the water was diverted, placing this water right into the TWRP would have only limited benefit to instream flows. Conversely, an irrigation water right may have a CU of about 80 percent of total use (assuming reasonably efficient irrigation practices) and placing this water right into the TWRP would result in greater benefits. Additionally, the period of use, or seasonality, will affect the portion of the year that instream flow benefits occur.

Quantitative or qualitative assessment of how the project will function, including anticipated offset benefits, if applicable. Show how offset volume(s) were estimated.
Direct benefits to instream flow in a priority stream will be realized through an interruption or retirement of the use of the acquired water rights. Depending on the specific opportunity, the eliminated water use could be supported by fallowing of irrigated fields, reducing hay harvest,

changing to an alternate crop that does not require irrigation, removing livestock, or providing an alternate source of supply. The acquired water right could be placed into the TWRP and dedicated to instream flow purposes. By placing it into the TWRP, increases in instream flows realized by a project would be protected from future appropriation.

Based on the methods described in the PGG memorandum (2020), focused potential water right opportunities were identified for the Goldsborough, Hood, Mill, and Oakland subbasins. The cumulative annual water right allocation (Qa) volumes for those water rights were subsequently totaled by subbasin, then reduced by 90 percent in order to account for uncertainty in ability to acquire water rights. That reduction factor was selected by the committee during its planning process, and was retained by Ecology. The resulting amounts of potential offset benefits by subbasin are as follows:

- Goldsborough: 34 AF per year.
- Hood: 31 AF per year.
- Mill: 30 AF per year.
- Oakland: 16 AF per year.

Based on the focused list of water rights, Ecology estimates that future feasibility studies or acquisition and efficiency opportunities may lead to a total estimated water offset of 111 AF per year.

Conceptual-level map and drawings of the project and location.

No specific project locations are included herein.

Description of the anticipated spatial distribution of likely benefits.

The Water Right Opportunities in WRIA 14 project will increase streamflow in target streams during periods tied to the permitted water rights, which typically include greatest water use during the summer and early fall, and therefore provide the greatest aquatic habitat benefits.

Performance goals and measures.

The performance goal is to increase streamflow in targeted streams by terminating water use associated with specific water rights. Project performance will be measured by the CU retired by the water rights acquired by the project.

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.

Streams within WRIA 14 are inhabited by numerous fish species tracked by the Washington State Department of Fish and Wildlife (WDFW, 2021), which could include Chum Salmon, Chinook Salmon, Coho Salmon, Pink Salmon, steelhead, Bull Trout, kokanee, Rainbow Trout, and resident Coastal Cutthroat Trout.

In the Puget Sound Salmon Recovery Plan, NOAA identifies the alteration of natural stream hydrology as a high priority limiting factor in WRIA 14 (NOAA, 2007), and streamflow is

important for supporting riparian vegetation and wetlands that provide shading, wildfire breaks, food web support, and flood and sediment attenuation functions.

Increased streamflow and reduced water temperatures will primarily benefit juvenile salmonid rearing habitats by providing increased area and quality of summer stream rearing habitat. This will improve the survival of juveniles. Addressing the streamflow limiting factor and improving habitat conditions will help support salmonids at various life stages and increase presence, recruitment, and survival in the area of the project.

Identification of anticipated support and barriers to completion.

This project aligns with the goals of the Streamflow Restoration Act. Water right acquisition is an identified project type that could achieve net ecological benefit (NEB).

This project is anticipated to have broad support among Ecology and WRIA 14 stakeholders. Barriers to project implementation could be the availability of project funding and the willingness of existing water right holders/property owners to sell their water rights.

Potential budget and O&M costs.

Water right acquisition costs are location and market specific. For a planning-level estimate, costs per consumptive acre-foot of water can be assumed to be in the range of $1,500 to $6,500 (WestWater Research, 2019). Assuming a CU of 100 AF, this equates to a total project cost of $150,000 to $650,000.

Anticipated durability and resiliency.

In this context, durability refers to the capacity of the Water Right Opportunities in WRIA 14 project to maintain benefit to watershed streams over time despite changing external conditions (which could include seasonal variation in hydrologic conditions, seasonal and/or long-term fluctuation in regional groundwater elevation, population change, adjacent land use changes, and/or other factors). We anticipate that the planned project will be durable, based on the following:

- Water right acquisition is anticipated to provide water offset over a range of hydrologic conditions.
- Acquired water rights will be controlled by the TWRP or purchasing entity.
- Land use changes external to the project site likely would have negligible impact on project function.

Herein, resiliency refers to the capacity of the project to maintain the benefit to watershed streams despite the impacts of climate change. Within the watershed, climate change could result in an increase in seasonal temperature, a decrease in summer precipitation, an increase in winter rainfall, a decrease in winter snowfall and/or spring snowpack, an increase in the frequency and/or intensity of storm events, an increase in wildfires, an increase in sea level,

and/or other impacts. We anticipate that the planned project would be resilient to the potential impacts of climate change based on the following:

- Water right acquisition is anticipated to provide water offset over a range of climatic conditions.
- Wildfire damage to the project site and surrounding area would not impact project function.

Project sponsor(s) (if identified) and readiness to proceed/implement.

Project sponsor(s) have not been identified for this project.

Documentation of sources, methods, and assumptions.

NOAA (National Oceanic and Atmospheric Administration, National Marine Fisheries Service). 2007. Puget Sound Salmon Recovery Plan. Volume I. Adopted by the National Marine Fisheries Service, January 19, 2007.

PGG (Pacific Groundwater Group). 2020. Technical Memorandum, Water Right Screening Methodology. Technical Memorandum prepared by PGG for the Department of Ecology WRIA 14 Watershed Restoration and Enhancement Committee. December 20, 7p.

DFW (Washington State Department of Fish and Wildlife). 2021. Salmonscape Mapping of Fish Distribution. http://apps.wdfw.wa.gov/salmonscape/

WestWater Research, LLC. 2019. Valuation of a Proposed Water Release Agreement, Final Report. Report prepared by WestWater Research of Boise, Idaho for the Washington State Department of Ecology and Seattle City Light. January 26. 29 p.

WRIA 14 General Floodplain Restoration Project (14-WRIA-H1)

WRIA 14 WRE Subbasin

Hood, Case, Oakland, Goldsborough, Harstine, Mill, Skookum, and Kennedy Subbasins

Project Status

The WRIA 14 General Floodplain Restoration Project is currently in the conceptual stage. A mapping exercise was conducted as part of the WRIA 14 planning process that identified the potential floodplain restoration project locations shown in Figure 1.

This proposal is described in a Project Summary by HDR (2020), which is available in Appendix J and has been excerpted to form portions of this project description.

Narrative Description

The Kennedy-Goldsborough Watershed (WRIA 14) is within Mason and Thurston counties and includes an extensive network of independent streams that issue from springs, wetlands, small lakes, and surface water drainages. The Kennedy-Goldsborough Watershed has no major river system. These multiple small streams originate from the Black Hills and lower foothills of the Olympic Mountains, emptying into several shallow bays and inlets in South Puget Sound, including Eld, Totten, Skookum, Hammersley, and Case inlets. Principal drainages include (from north to south) Sherwood, Campbell, Deer, Cranberry, Johns, Goldsborough, Mill, Skookum, Schneider, Kennedy, and Perry Creeks. The geomorphology of WRIA 14 is strongly influenced by coarse glacial sediments that promote connectivity between surface and groundwaters and the headwaters of many of the stream systems are (or were) dominated by wetlands.

Limiting factors for salmon species in WRIA 14 have been identified by Kuttel (2002) and Mason Conservation District (2004), and are briefly summarized below:

- Fish barriers such as dams, culverts, and grade control structures have inhibited fish passage in WRIA 14.
- Removal of native riparian vegetation and channel modifications have led to deteriorated streambank conditions and reduced quantity and quality of instream habitat.
- Reduced levels of large wood, particularly key pieces that promote the long-term formation of instream and off-channel habitats.
- Groundwater and surface water withdrawals, loss of forest canopy and impervious surfaces have increases in water temperature, reduced dissolved oxygen levels, and very low flows during summer and early fall.

WRIA 14 floodplain restoration projects would address loss of groundwater storage, low flows and water quality conditions. The specific actions proposed for any given project would be specific to the restoration opportunity and habitat capacity of that location. The goal of any given project would be to rehabilitate natural hydrologic and geomorphic processes that are

provided by floodplain connectivity. More detailed objectives pursuant to this goal would be specific to each respective project.

Quantitative or qualitative assessment of how the project will function, including water offset benefits, if applicable.

Individual WRIA 14 General Floodplain Restoration projects will vary in form and function depending on the stream setting, habitat capacity, the impact that is being remediated, and the corresponding opportunities for restoration. Potential floodplain restoration actions include the following:

- Channel re-alignment (for example, remeander projects).
- Removing bank protection.
- Installation of LWD to promote hyporheic and floodplain water storage.
- Removal of fill or creation of inset floodplain (for example, excavation of terraces).
- Side channel and off-channel feature reconnection, creation, or enhancement
.

This habitat project could potentially produce a water offset benefit, however, the size of that benefit would be small, so the Washington Department of Ecology did not estimate the specific quantity.

A map and drawings of the project location.

As part of the planning process, recommendations for specific locations for the WRIA 14 General Floodplain Restoration Project were reviewed from the WRIA 14 Watershed Restoration and Enhancement Committee. The following process was used to identify the candidate sites:

- Identified reaches that are unconfined using a hillshade surface built from LiDAR coverages. Unconfined reaches were defined as those with relatively wide valleys and floodplains.
- Identified reaches within floodplains.
- Identified land that is vacant, and therefore potentially available for acquisition and restoration.
- Identified land that is public and potentially easier to acquire for restoration.
- Identified areas of tributary inflow, because these areas are often areas of biological importance, habitat complexity, and in many cases intermittent flooding.

Figure I-7 presents the project locations identified during the planning process, which include the following general locations:

- Schumacher - Beaver
- Deer Creek - Beaver
- Johns Creek - Beaver
- Campbell Creek, Upper
- Jarrell Creek

- Mill Creek above BNSF tracks
- Gosnell
- Skookum at Duck Pond
- Skookum, Eich Road
- Skookum, Upper
- Kennedy Creek flats
- Upper Schneider
- Perry Creek.

All project locations will be subject to feasibility evaluation during plan implementation. Also, other locations not shown on Figure 1 might be identified by project sponsors during plan implementation.

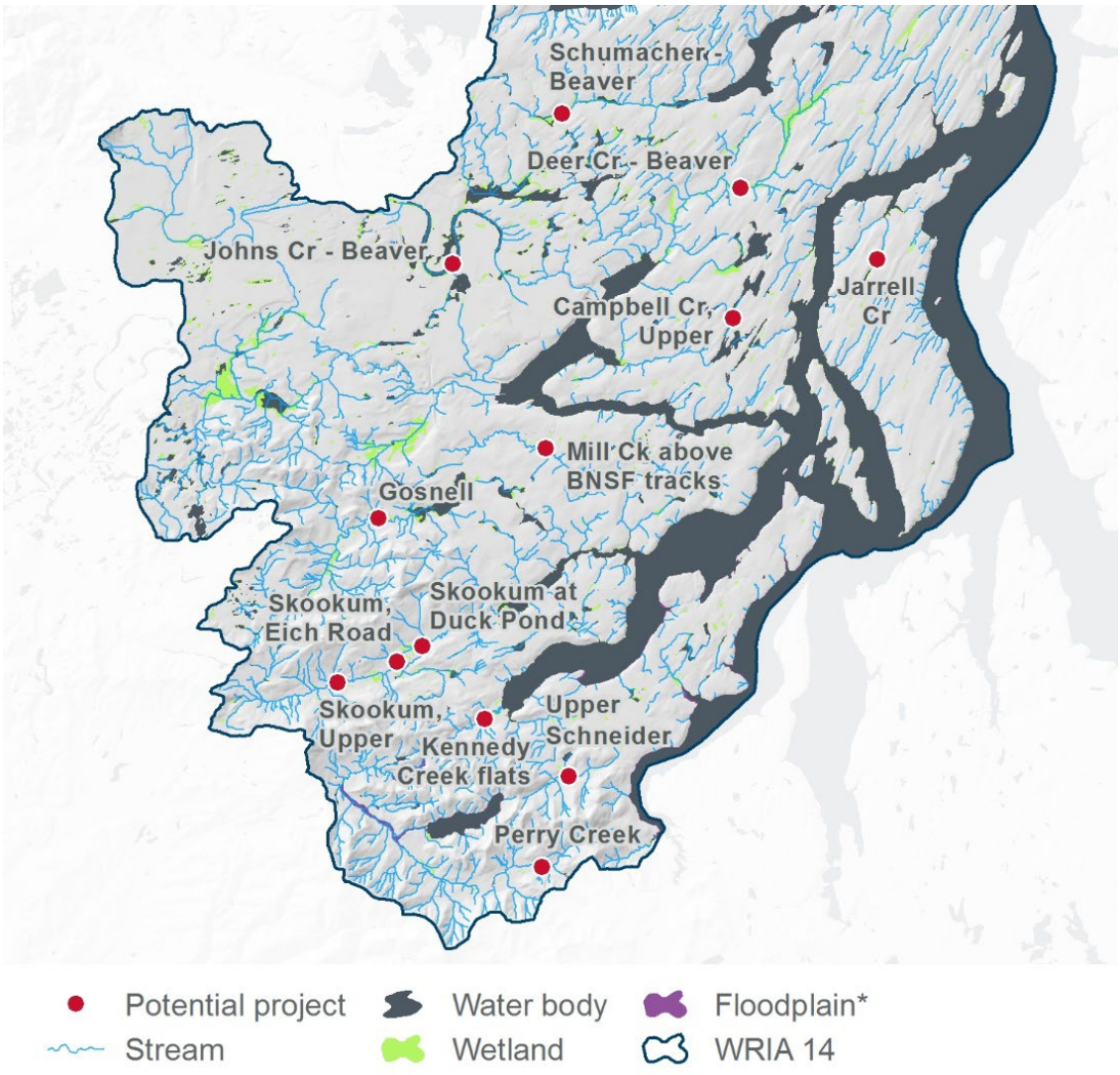


Figure I-7. Potential floodplain restoration project locations.

Description of the anticipated spatial distribution of likely benefits.

Potential floodplain restoration projects have been identified in suitable floodplain areas of Schumacher, Deer, Johns, Campbell, Jarrell, Mill, Gosnell, Skookum, Kennedy, Schneider, and Perry Creeks. Restoring floodplain connectivity, along with riparian and wetland habitats could benefit between 2 and 6 miles of these tributaries by storing direct precipitation and floodwaters in these floodplain areas, contributing additional flows during low flow periods.

These streams have been noted for low summer/fall flows for decades (WDF 1975) and improvements to flows and temperatures, as well as floodplain and instream habitats, could provide substantially improved summer rearing habitat for juvenile Coho Salmon, steelhead and Cutthroat Trout. Improved flow conditions would also benefit upstream migration of adult Chinook, Chum Salmon, and Coho Salmon.

Performance goals and measures.

Performance goals and measures will vary depending on the project. In general, the goals will be to implement specific restoration actions with their intended quantity and purpose. Depending on the project, directly measurable restoration elements could include acres of floodplain; acres of wetland and/or riparian habitats restored; stream-miles enhanced; predicted quantity of baseflow volume restored; predicted reduction in stream temperature; and potentially other metrics.

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed. Note if threatened and endangered fish species would benefit.

The Washington Department of Fish and Wildlife (WDFW, 2020a) has identified that Coho Salmon, Fall Chum Salmon, and winter steelhead trout are present in all the identified primary drainages in WRIA 14. Fall Chinook Salmon are present in Sherwood/Schumacher, Deer, Cranberry, Goldsborough, and Mill Creeks and Summer Chum Salmon are present in Sherwood/Schumacher, Deer, and Cranberry Creeks. Most salmon species are of wild origin, although some mixed stocks are present from prior hatchery Chum Salmon and Coho Salmon releases (WDFW, 2020b). Chinook are priority species, protected under the U.S. Endangered Species Act (ESA).

Increased floodplain habitats and improved riparian and instream habitat conditions would primarily benefit juvenile salmonid rearing habitats by providing increased area and quality of summer rearing habitats. This would improve both productivity and survival of juveniles, particularly Coho Salmon and steelhead. The restoration of floodplain processes and functions could also improve summer/fall base flows and reduce water temperatures. This would improve both juvenile and adult migration conditions. Low flows have been identified as a high priority limiting factor in WRIA 14 (Kuttel, 2002) and the restoration and reconnection of floodplain habitats and riparian enhancements provide shading, food web support, and flood and sediment attenuation functions.

Identification of anticipated support and barriers to completion.

This project aligns with the goals of the Streamflow Restoration Act. Riparian and fish habitat improvement projects are identified project types that could achieve net ecological benefit (NEB). We anticipate that individual projects could receive support from area conservation groups, municipalities, and regulators.

Barriers to completion could include funding acquisition, property acquisition, and/or opposition from neighboring landowners.

Estimate of capital costs and reoccurring O&M costs.

Capital and O&M costs for specific projects have not yet been evaluated.

Project durability and resiliency.

In this context, durability refers to the capacity of the WRIA 14 General Floodplain Restoration Project to maintain benefit to watershed streams over time despite changing external conditions (which could include seasonal variation in hydrologic conditions, seasonal and/or long-term fluctuation in regional groundwater elevation, population change, adjacent land use changes, and/or other factors). We anticipate that the planned projects will be durable, based on the following:

- The projects will be actively managed by the project sponsors.
- The restored stream sections will be designed to mimic natural fluvial and ecological processes and be self-sustaining.
- Land use changes external to the project sites likely would have negligible impact on project function.

Herein, resiliency refers to the capacity of the projects to maintain the benefit to watershed streams despite the impacts of climate change. Within the watershed, climate change could result in an increase in seasonal temperature, a decrease in summer precipitation, an increase in winter rainfall, a decrease in winter snowfall and/or spring snowpack, an increase in the frequency and/or intensity of storm events, an increase in wildfires, an increase in sea level, and/or other impacts. We anticipate that the planned project would be moderately resilient to the potential impacts of climate change based on the following:

- The projects will be designed to be resilient to perturbations in climate.
- Sea level increase, on the order of several feet or less, likely would not impact project function.
- A climate-related decrease in summer streamflow could impact the ability of the project sites to support fish populations.
- Wildfire damage to the project site and surrounding area would impact project function.

Project sponsor(s) (if identified) and readiness to proceed/implement.

No specific project sponsors have been identified.

Documentation of sources.

Kuttel, M. 2002. *Salmonid Habitat Limiting Factors Water Resource Inventory Area 14, Kennedy-Goldsborough Basin*. Washington State Conservation Commission. November 2002.

Mason CD (Mason Conservation District Lead Entity). 2004. *Salmon Habitat Protection and Restoration Plan, Water Resource Inventory Area 14, Kennedy-Goldsborough*.

WDF (Washington Department of Fisheries). 1975. *A Catalog of Washington Streams and Salmon Utilization*, WRIA 14. Available at: https://www.streamnetlibrary.org/?page_id=95

WDFW (Washington Department of Fish and Wildlife). 2020a. Salmonscape. Available at: http://apps.wdfw.wa.gov/salmonscape/map.html

WDFW (Washington Department of Fish and Wildlife). 2020b. Salmon Conservation and Reporting Engine. Available at: https://fortress.wa.gov/dfw/score/score/maps/map_details.jsp?geocode=wria&geoarea=WRIA14_Kennedy_Goldsborough

Goldsborough Hilburn Restoration Project (14-G-H1)

WRIA 14 WRE Subbasin
Goldsborough Subbasin

Project Status
The Goldsborough Hilburn Restoration Project is sponsored by the South Puget Sound Salmon Enhancement Group and Tribe and proposes to restore a section of Goldsborough Creek that has been impacted by the placement of fill and bank armoring. A preliminary design for the project has been developed and is summarized in Figure I-8.

Narrative Description
The Goldsborough Hilburn Restoration Project is located along Goldsborough Creek approximately 500 feet upstream of Highway 101 near Shelton, Washington. Within the project site, Goldsborough Creek has been impacted by the placement of fill and armoring in the floodplain and immediate stream channel, resulting in a homogenous channel form that is mostly a riffle-glide complex. The project involves removal of up to 7,800 cubic yards of artificial fill that is constricting Goldsborough Creek. The constriction is presumably causing higher-than-normal flow velocities during flood events, exacerbating the lack of flood refuge for salmonids, a problem also seen in other portions of Goldsborough Creek, and possibly causing channel incision. Additionally, the project will widen the floodplain from 58 feet to approximately 200 feet and add large woody debris (LWD) and riparian vegetation, both of which are lacking in the project area.

Quantitative or qualitative assessment of how the project will function, including water offset benefits, if applicable.
Stream conditions at this site and reach provide little salmonid rearing habitat, holding water, covered pools, or floodplain off-channel areas. The Goldsborough Hilburn Restoration Project will restore natural processes and augment the habitat with in-stream woody elements (Fox and Bolton, 2007).

The Washington Department of Ecology elected not to assign water offsets to habitat projects in this plan, therefore, a specific water offset for this habitat project has not been developed.

A map and drawings of the project location.
Figure I-8 presents the project site plan and a preliminary project design.

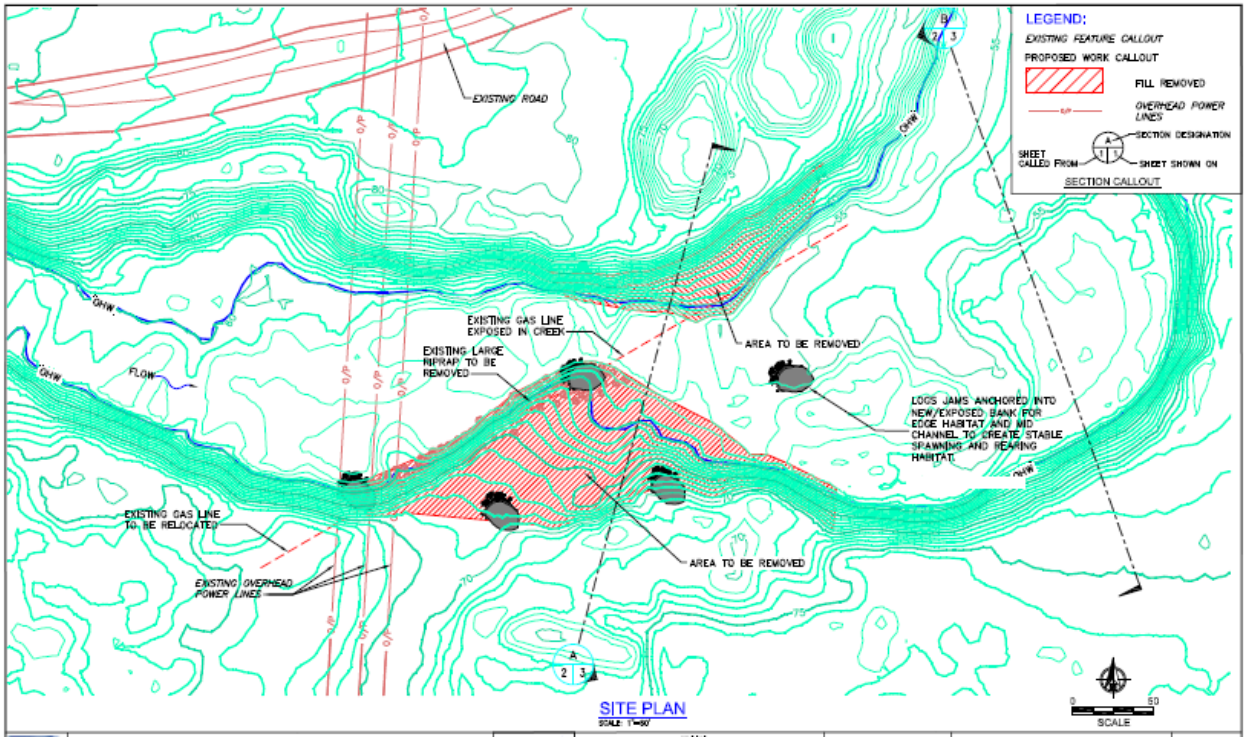


Figure I-8. Goldsborough Hilburn Restoration Project site plan.

Description of the anticipated spatial distribution of likely benefits.

The Goldsborough Hilburn Restoration Project will restore up to 500 feet of Goldsborough Creek. The restored channel alignment will improve instream habitat, improve floodplain connectivity, and increase groundwater storage in shallow soil underlying the project area.

Performance goals and measures.

The project's performance goal is to improve/restore habitat conditions within Goldsborough Creek and install in-stream woody elements. The performance measure is the length of creek that is restored and the amount of LWD that is installed. Specific metrics will be defined based on the restoration design.

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed. Note if threatened and endangered fish species would benefit.

The Washington Department of Fish and Wildlife has identified that Fall Chinook Salmon (presence), Coho Salmon (presence), resident coastal cutthroat trout (presence), Fall Chum Salmon (spawning), and winter steelhead trout (spawning) inhabit Goldsborough Creek (WDFW, 2020). Chinook are priority species, protected under the U.S. Endangered Species Act (ESA). Fill removal and LWD will increase habitat quantity and quality for pre-spawn holding in pools. The project will also provide variable current velocities, depths, and substrate composition that will be suitable spawning and rearing habitat for multiple species.

Identification of anticipated support and barriers to completion.

This project aligns with the goals of the Streamflow Restoration Act. Channel habitat improvement projects are an identified project type that could achieve net ecological benefit (NEB).

This project is supported by the South Puget Sound Salmon Enhancement Group. No barriers to completion have currently been identified.

Estimate of capital costs and reoccurring O&M costs.

The total costs of construction, engineering, permitting, and cultural assessments are estimated to be less than $1 million, based on an order of magnitude estimate. No estimate of O&M costs is currently available.

Project durability and resiliency.

In this context, durability refers to the capacity of the Goldsborough Hilburn Restoration Project to maintain benefit to watershed streams over time despite changing external conditions (which could include seasonal variation in hydrologic conditions, seasonal and/or long-term fluctuation in regional groundwater elevation, population change, adjacent land use changes, and/or other factors). We anticipate that the planned project will be durable, based on the following:

- The project will be actively managed by the South Puget Sound Salmon Enhancement Group or their future project partner(s).
- The restored stream section will be designed to mimic natural fluvial and ecological processes and be self-sustaining.
- Land use changes external to the project site likely would have negligible impact on project function.

Herein, resiliency refers to the capacity of the project to maintain the benefit to watershed streams despite the impacts of climate change. Within the watershed, climate change could result in an increase in seasonal temperature, a decrease in summer precipitation, an increase in winter rainfall, a decrease in winter snowfall and/or spring snowpack, an increase in the frequency and/or intensity of storm events, an increase in wildfires, an increase in sea level, and/or other impacts. We anticipate that the planned project would be moderately resilient to the potential impacts of climate change based on the following:

- The project will be designed to be resilient to perturbations in climate.
- Sea level increase, on the order of several feet or less, likely would not impact project function.
- A climate-related decrease in summer streamflow would impact the ability of the project site to support fish populations.

- Wildfire damage to the project site and surrounding area would impact project function.

Project sponsor(s) (if identified) and readiness to proceed/implement.

The project sponsor is the South Puget Sound Salmon Enhancement Group.

Documentation of sources.

Fox, M. and S. Bolton. 2007. A regional and Geomorphic Reference for Quantities and Volumes of Instream Wood in Unmanaged Forested Basins for Washington State. North American Journal of Fisheries Management. Volume 27 (1): 342 – 359.

SPSSEG (South Puget Sound Salmon Enhancement Group). 2010. Goldsborough Creek Constriction Removal Project. Salmonid Habitat Project Development. December 2010.

WDFW (Washington Department of Fish and Wildlife). 2020. Salmonscape mapping of fish distribution. Available at: http://apps.wdfw.wa.gov/salmonscape/

Skookum Valley Ag Project (14-S-H1)

WRIA 14 WRE Subbasin
Skookum Subbasin

Project Status
The Skookum Valley Ag Project is sponsored by the Squaxin Island Tribe and proposes to restore a section of Skookum Creek that has been altered from its historic alignment. The project is currently in a conceptual phase and project implementation will initiate with a feasibility and design study.

Narrative Description
Skookum Creek flows directly to Little Skookum Inlet and supports Coho Salmon, Chum Salmon, winter steelhead, and Coastal Cutthroat Trout. Habitat in Skookum Creek has been simplified, in part, from agricultural land use within the Skookum Valley floodplain. Some reaches of Skookum Creek have been moved to the edge of the valley wall to maximize agricultural production, and not allowed to meander through the creek's natural channel migration zone. This has resulted in channel incision (streambed downcutting), loss of side channels, loss of off-channel habitat, and reduced floodplain connectivity.

The proposed Skookum Valley Ag Project will restore a reach of the stream channel that is currently confined to the valley wall back into its historical alignment and natural meander pattern. The project is intended to be the first step in larger-scale restoration program for Skookum Creek.

Quantitative or qualitative assessment of how the project will function, including water offset benefits, if applicable.
As currently envisioned, the Skookum Valley Ag Project will increase the length of Skookum Creek within the project site from 920 feet to 1,530 feet, an increase of 610 feet. The re-alignment will include instream structures (for example, large woody debris [LWD] and engineered log jams) that will increase habitat complexity. These structures will contribute to bedload retention and reduction of channel incision, in combination with other future projects. Riparian vegetation will be established around the new stream alignment.

The Washington Department of Ecology elected not to assign water offsets to habitat projects in this plan, therefore, a specific water offset for this habitat project has not been developed.

A map and drawings of the project location.
Figure I-9 presents the project location and approximate location of the re-aligned reach of Skookum Creek.

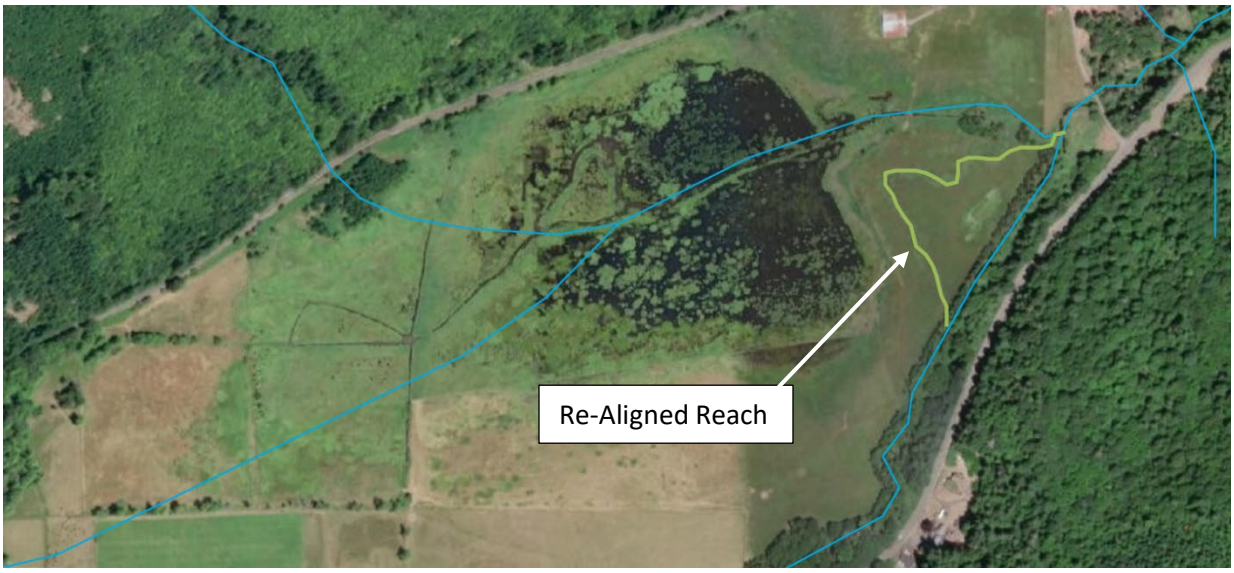


Figure I-9. Skookum Valley Ag Project relocation of Skookum Creek.

Description of the anticipated spatial distribution of likely benefits.

The Skookum Valley Ag Project will increase channel length in Skookum Creek by approximately 610 feet. The restored channel alignment will improve instream habitat, improve floodplain connectivity, and increase groundwater storage in shallow soil underlying the project area.

Performance goals and measures.

The project's performance goal is to improve/restore habitat conditions within Skookum Creek. The performance measure is to increase stream length by 610 feet with an appropriate channel geometry, LWD density, pool density and residual depth, stable banks, and riparian zone establishment. Specific metrics for these attributes will be defined based on the restoration design.

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed. Note if threatened and endangered fish species would benefit.

The Washington Department of Fish and Wildlife has identified that Coho Salmon, Chum Salmon, steelhead trout, and Coastal Cutthroat Trout have spawning populations in Skookum Creek (WDFW, 2020).

Skookum Creek has several habitat factors that are limiting to fish productivity, including low summer baseflow, high summer water temperature, suboptimal LWD and pool density, and poor spawning gravel quality. This project will address these factors at the reach scale. The increased channel length and re-alignment likely will increase groundwater levels and associated baseflow. The installation of LWD and establishment of riparian vegetation will contribute to optimal LWD density, pool density, and will create the hydraulic complexity to sort sediments, leading to pockets of suitable spawning gravels.

Identification of anticipated support and barriers to completion.

This project aligns with the goals of the Streamflow Restoration Act. Channel habitat improvement projects are an identified project type that could achieve net ecological benefit (NEB).

The project is located on land previously acquired by the Squaxin Island Tribe, who is supportive of this project.

Estimate of capital costs and reoccurring O&M costs.

The total costs of construction, engineering, permitting, and cultural assessments are estimated to be less than $1 million, based on an order of magnitude estimate. No estimate of O&M costs is currently available.

Project durability and resiliency.

In this context, durability refers to the capacity of the Skookum Valley Ag Project to maintain benefit to watershed streams over time despite changing external conditions (which could include seasonal variation in hydrologic conditions, seasonal and/or long-term fluctuation in regional groundwater elevation, population change, adjacent land use changes, and/or other factors). We anticipate that the planned project will be durable, based on the following:

- The project will be actively managed by the Squaxin Island Tribe or their future project partner(s).
- The restored stream section will be designed to mimic natural fluvial and ecological processes and be self-sustaining.
- Land use changes external to the project site likely would have negligible impact on project function.

Herein, resiliency refers to the capacity of the project to maintain the benefit to watershed streams despite the impacts of climate change. Within the watershed, climate change could result in an increase in seasonal temperature, a decrease in summer precipitation, an increase in winter rainfall, a decrease in winter snowfall and/or spring snowpack, an increase in the frequency and/or intensity of storm events, an increase in wildfires, an increase in sea level, and/or other impacts. We anticipate that the planned project would be moderately resilient to the potential impacts of climate change based on the following:

- The project will be designed to be resilient to perturbations in climate.
- A climate-related decrease in summer streamflow would impact the ability of the project site to support fish populations.
- Wildfire damage to the project site and surrounding area would impact project function.

Project sponsor(s) (if identified) and readiness to proceed/implement.

The project sponsor is the Squaxin Island Tribe. An initial step in implementation will be an evaluation of project feasibility and project design development.

Documentation of sources.

WDFW (Washington Department of Fish and Wildlife). 2020. Salmonscape mapping of fish distribution. Available at: http://apps.wdfw.wa.gov/salmonscape/

Skookum Valley Railroad Culvert Blockages (14-S-H2)

WRIA 14 WRE Subbasin
Skookum Subbasin

Project Status
The Skookum Valley Railroad Culvert Blockages Project is sponsored by the Squaxin Island Tribe and proposes to replace culverts that are blocking fish passage within tributaries to Skookum Creek. The project is currently in a conceptual phase and project implementation will initiate with a feasibility and design study.

Narrative Description
Skookum Creek is a tributary that flows into Little Skookum Inlet in South Puget Sound. Multiple tributaries to Skookum Creek are blocked by culverts that run under the Puget Sound and Pacific (PSAP) Railroad located on the north side of the valley. The PSAP is owned by Genesee and Wyoming of Darien, Connecticut. Replacing those culverts could open as much as 5 miles of spawning and rearing habitat in the Skookum watershed to migrating fish populations.

Quantitative or qualitative assessment of how the project will function, including water offset benefits, if applicable.
As currently envisioned, this project replaces 8 to 15 culverts along the PSAP railroad that are full or partial barriers to upstream fish passage. Anticipated project tasks include the following:

- Survey the length of PSAP Railroad through Skookum Valley to fully inventory blocking culverts.
- Field verify the amount of available fish habitat upstream of blocking culverts.
- Conduct outreach to Genesee and Wyoming to request their cooperation in culvert replacement.
- Develop a culvert replacement schedule and plan with Genesee and Wyoming.
- Implement culvert replacement projects.

The attached map, obtained from the Washington Department of Fish and Wildlife (WDFW, 2020b), and annotated for this project description, shows potential fish passage barriers within and surrounding the project area. The annotations point out eight culverts that could potentially be addressed with this project. These associated culvert identification numbers and an estimate of the approximate length of stream that can be opened through culvert replacement are provided below.

- MC263- 2,400 feet
- MC264- 12,000 feet
- MC265- 1,200 feet
- MC266- 4,000 feet
- 132051653- Unknown
- 602175- 3,200 feet
- 602172- 3,000 feet

- MC267- 1,800 feet

For these eight culverts, replacement could make approximately 27,600 feet (about 5.2 miles) of fish habitat accessible.

The Washington Department of Ecology elected not to assign water offsets to habitat projects in this plan, therefore, a specific water offset for this habitat project has not been developed.

A map and drawings of the project location.

The attached figure presents a map, obtained from WDFW (2020b), showing fish passage barriers in the project area, as well as the approximate locations of the eight culverts specified above.

Description of the anticipated spatial distribution of likely benefits.

The Skookum Valley Railroad Culvert Blockages Project will provide access to tributaries on the north side of Skookum Valley, from the headwaters to Little Skookum Inlet on Puget Sound.

Performance goals and measures.

The project's performance goal is to restore fish passage to Skookum Creek tributaries on the north side of Skookum Valley. The project's performance measure is the length of habitat made accessible to anadromous fish, as each culvert is removed.

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed. Note if threatened and endangered fish species would benefit.

WDFW has identified that Coho Salmon, Chum Salmon, steelhead trout, and Coastal Cutthroat Trout have spawning populations in Skookum Creek (WDFW, 2020a).

Identification of anticipated support and barriers to completion.

This project aligns with the goals of the Streamflow Restoration Act. Fish passage projects are an identified project type that could achieve net ecological benefit (NEB).

Broad support for this project is anticipated. A barrier to completion could be acquiring the cooperation of Genesee and Wyoming.

Estimate of capital costs and reoccurring O&M costs.

Costs are estimated to be between $1 million and $5 million, depending on project design. No estimate of O&M costs is currently available.

Project durability and resiliency.

In this context, durability refers to the capacity of the Skookum Valley Culvert Blockages Project to maintain benefit to watershed streams over time despite changing external conditions (which could include seasonal variation in hydrologic conditions, seasonal and/or long-term fluctuation in regional groundwater elevation, population change, adjacent land use changes,

and/or other factors). We anticipate that the planned project will be durable, based on the following:

- The project will be actively managed by the Squaxin Island Tribe or their future project partner(s).
- The replaced culverts will be designed and installed to function within a range of streamflow conditions.
- Groundwater level fluctuation is not likely to impact project function.
- Land use changes external to the project site likely would have negligible impact on project function.

Herein, resiliency refers to the capacity of the project to maintain the benefit to watershed streams despite the impacts of climate change. Within the watershed, climate change could result in an increase in seasonal temperature, a decrease in summer precipitation, an increase in winter rainfall, a decrease in winter snowfall and/or spring snowpack, an increase in the frequency and/or intensity of storm events, an increase in wildfires, an increase in sea level, and/or other impacts. We anticipate that the planned project would be resilient to the potential impacts of climate change based on the following:

- The project will be designed to be resilient to perturbations in climate.
- Sea level increase, on the order of several feet or less, likely would not impact project function.
- Wildfire damage to the project site and surrounding area would not impact project function.

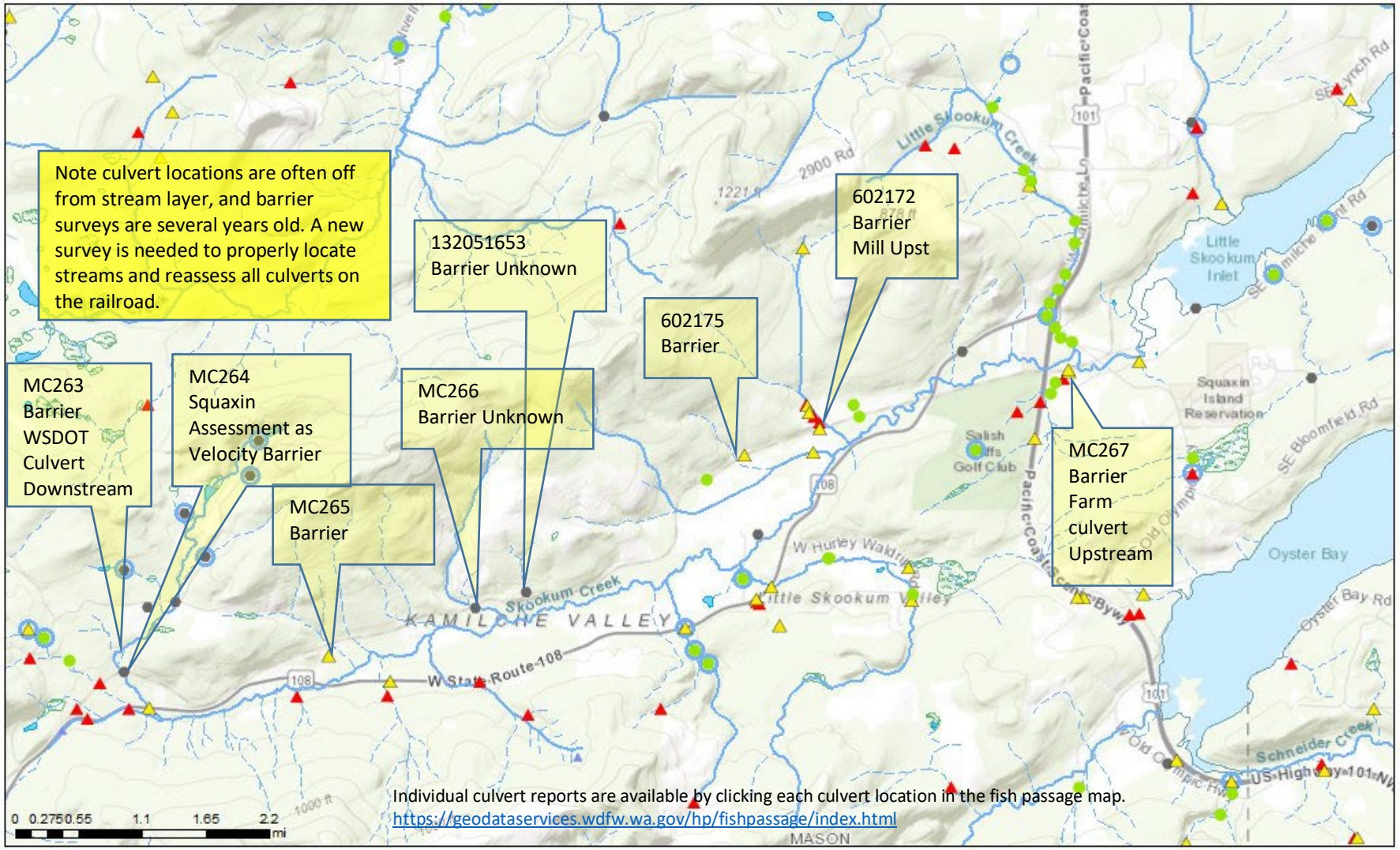
Project sponsor(s) (if identified) and readiness to proceed/implement.

The project sponsor is the Squaxin Island Tribe. An initial step in implementation will be an evaluation of project feasibility and project design development.

Documentation of sources.

WDFW (Washington Department of Fish and Wildlife). 2020a. Salmonscape mapping of fish distribution. Available at: http://apps.wdfw.wa.gov/salmonscape/

WDFW (Washington Department of Fish and Wildlife). 2020b. Fish passage map. https://geodataservices.wdfw.wa.gov/hp/fishpassage/index.html



Washington State Fish Passage

Washington Department of FISH and WILDLIFE

- Not a barrier
- Partial Fish Passage Blockage
- Total Fish Passage Blockage
- Barrier, Unknown Percent Passable
- Diversion
- Natural Barrier - Verified
- Unknown
- Corrected Barriers
- NHD Coastline

NHD Rivers
- Stream / Perennial
- Intermittent / Ephemeral
- Canal, Ditch

- Pipeline
- Connector

NHD Waterbody
- Lake, Pond, Reservoir
- Swamp, Marsh
- Ice Mass

http://apps.wdfw.wa.gov/fishpassage/?extent=-123.2305,47.0853,-123.0566,47.1571

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Appendix J – HDR Project Technical Memos

The following technical memos were developed for the WRIA 14 Committee process. Therefore, final conclusions as presented in this plan may not align with these technical memos, but are provided as a supplement for project descriptions in Appendix I.

City of Shelton Reclaimed water

PROJECT DESCRIPTION

Description

The City of Shelton (City) proposes to increase the quantity and rate of reclaimed water infiltration into the North Fork Goldsborough subbasin by increasing production of Class A reclaimed water (RW) and infiltrating to groundwater at the City RW spray field, near the Washington Corrections Center (WCC). This project will re-direct an annual average of 0.5 mgd of the City's wastewater in North Shelton from the WWTP to the Water Reclamation Plant (WRP). The additional flow will be treated to produce 0.5 mgd of RW for subsequent conveyance to the existing City spray field. The following infrastructure improvements must occur to facilitate this project:

- Conveyance of North Shelton wastewater to the WRP.
- A storage tank (0.750 mg) to store RW at the WRP.

The conveyance of North Shelton wastewater to the WRP is currently in its design phase is likely to include a sewage lift station, and 18 inch sewer main and would run from West Birch Street to reclaimed water satellite plant (approximately 9,000 linear feet). The RW storage tank serves to buffer variable production and use of RW. Reclaimed water produced from City wastewater may be used for City uses, including a backup for firefighting, and it allows strategic timing of application of reclaimed water to the ground to benefit aquifers and streams and wetlands. Streamflow restoration funds are currently supporting design options for the lift station, sewer main, storage tank, and cost estimates. The additional reclaimed water will be conveyed to the City's existing spray field near the WCC with and infiltrated to local groundwater.

The second component of this project is RW use at the WCC. The WCC proposes to use reclaimed water to irrigate their outdoor lawn, instead of water that they currently pump from their local well. Pumping from their local well has been shown to impact instream flows in the North Fork Goldsborough Creek.

Quantitative or qualitative assessment of how the project will function, including anticipated offset benefits, if applicable. Show how offset volume(s) were estimated.

Wastewater in the Shelton area is currently treated by the City at the Fairmont wastewater treatment plant (WWTP) and the Water Reclamation Plant (WRP). Approximately 1.3 million gallons per day (1,490 acre-feet/year) of treated effluent from the WWTP is discharged directly to Oakland Bay. Approximately 0.213 million gallons per day (239 acre-feet/year) of RW is currently produced at the WRP and is conveyed to a wooded area near the WCC and overland sprayed. This overland spraying area is adjacent to the North Fork Goldsborough Creek, and it is likely that water infiltrating to the local aquifer is in connection with North Fork Goldsborough Creek flows.

The water offset benefit from the North Shelton wastewater re-direct to the WRP, would be the result of infiltrating the reclaimed water produced from that waste stream. The North Shelton wastewater is currently treated at the WWTP and discharged to Oakland Bay. All 560 acre-feet/ year of reclaimed water produced from the North Shelton waste stream would be infiltrated into the proposed infiltration facility. Assuming an infiltration efficiency of 80%, this would result in between 448 afy infiltrated to the local aquifer (Table 1).

The use of RW for irrigation by the WCC will result in a water offset, because of reduced consumptive use of their locally pumped water. The WCC is currently pumping 67 acre-feet/yr of local groundwater for irrigation. Eighty percent of the water used for irrigation will be lost to evapotranspiration (Table 2). However, if RW was used for outdoor irrigation, it's assumed that as the WCC population grows, the same quantity of water will be used for indoor use. However, very little of that water will be consumptively used, because the wastewater will be conveyed to the WRP, treated to Class A RW, pumped to the City spray field and land applied at rates that result in 80% infiltration efficiency. The resulting quantity of locally pumped water that would be infiltrated because of the change to indoor use would be 38 acre-feet/yr (Table 2). The immediate benefit would be larger, because the growth of indoor use would be gradual, and immediately after the switch to RW for irrigation, the WCC would pump 67 acre-feet/yr less from their local well. Future WCC expansion include new buildings (i.e. health care building and Program building) where grey water piping will be incorporated. These and other potential expansions may increase RW use to approximately 134 acre-feet/year. If outdoor water use (i.e. irrigation) used the entire 134 acre-feet/year in the future, then that would result in a net savings of 75 acre-feet/yr (Table 3).

Table 1. Estimated quantity of infiltrated reclaimed water from North Shelton, Basin 7.

New North Shelton Reclaimed Water	Water Quantity (af/yr)
RW Quantity	560
RW Infiltration (80%)	448

Table 2. WCC consumptive use savings from using RW for immediate irrigation needs.

Outdoor Use	**Water Quantity (af/yr)**
Irrigation Quantity	67
Irrigation CU	53.6
Indoor Use	
Future Indoor Use	60
Future Indoor CU	6
CU Savings	
CU Savings	47.6
RW Infiltration (80% Efficiency)	38

Table 3. WCC consumptive use savings from using RW for future potential irrigation needs.

Outdoor Use	**Water Quantity (af/yr)**
Irrigation Quantity	134
Irrigation CU	107
Indoor Use	
Future Indoor Use	134
Future Indoor CU	13
CU Savings	
CU Savings	94
RW Infiltration (80% Efficiency)	75

Conceptual-level map and drawings of the project and location.

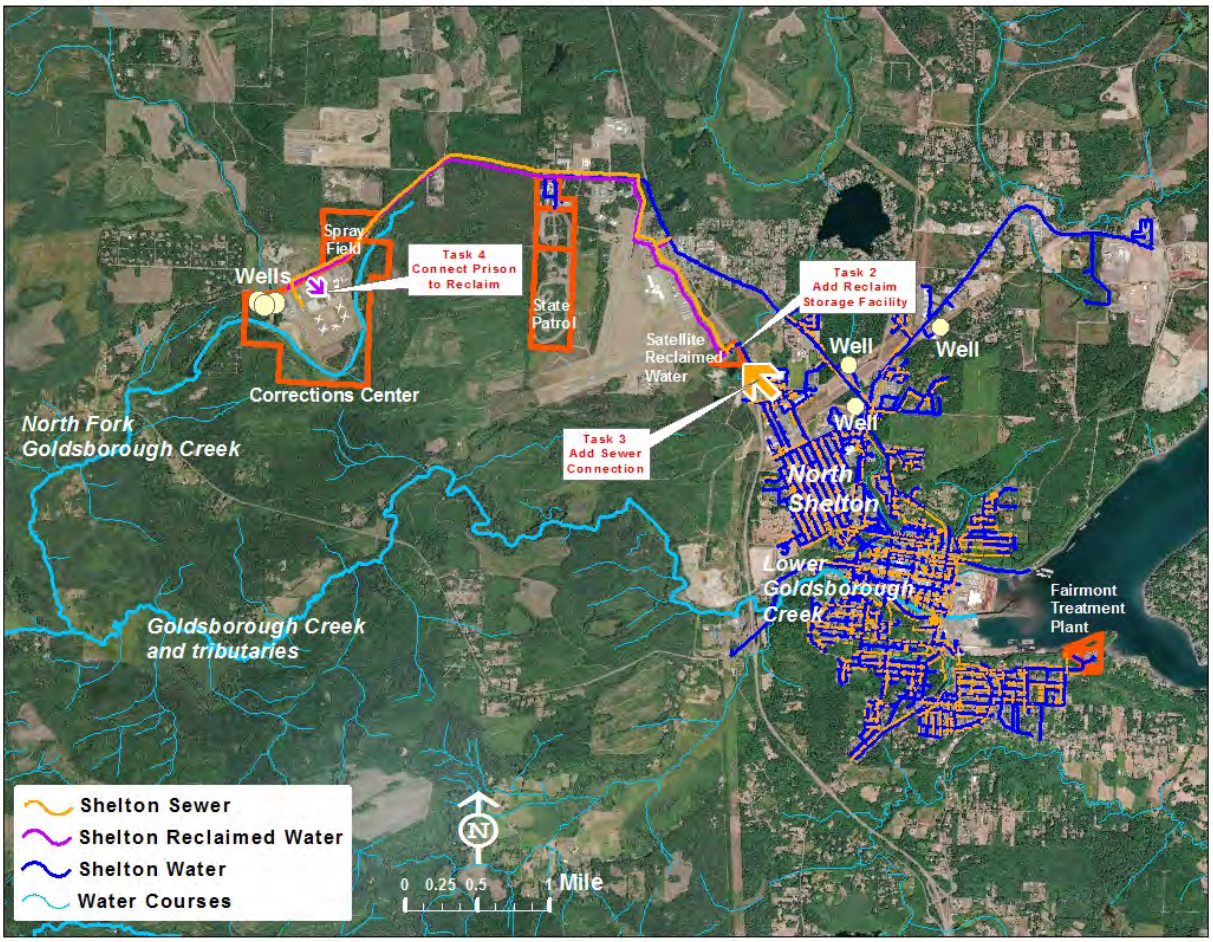

Figure 1. City of Shelton wastewaster collection network, wastewater treatment plants, and reclaimed water use at the WCC.

Description of the anticipated spatial distribution of likely benefits

RW infiltration will likely benefit stream flows in the North Fork Goldsborough Creek. The spray field is underlain by Vashon Recessional Outwash, as indicated by monitoring wells associated with reclaimed water permit ST6216 fact sheet. The spray field is up-gradient from the North Fork Goldsborough Creek to the west and south. On-site observations indicated significant swelling of the North Fork of Goldsborough Creek during rainfalls, suggesting that much of the water infiltrating in the immediate area discharges to the North Fork of Goldsborough Creek (Permit ST6216 fact sheet).

Performance goals and measures.

The following performance goals and measures will determine the success of this project:

- Annual average wastewater flow from the North Shelton neighborhood is 0.5 mgd (560 acre-feet/yr)

- Annual average RW production and conveyance to the infiltration facility is equal to the North Shelton and WCC input sources. Alternative uses of the reclaimed water originating from the WCC wastewater may be deducted from the total (i.e. separate accounting).

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.

Goldsborough Creek is designated habitat for ESA-listed winter steelhead. It is also home to populations of chum and coho salmon and anadromous cutthroat trout (WDFW 2020). This project will benefit North Fork Goldsborough Creek and Goldsborough Creek. Increased flow will increase usable aquatic habitat, and would have the greatest benefit during summer low flows.

Identification of anticipated support and barriers to completion.

This project is supported by the City, the WCC, and the Squaxin Island Tribe. No barriers to completion are currently foreseen.

Potential budget and O&M costs.

The City and the Squaxin Island Tribe are currently undergoing a feasibility study that includes capital and O&M costs. The current cost estimate is $1,673,000, based on similar work from an existing project grant from the Squaxin Island Tribe.

Anticipated durability and resiliency.

This project is expected to be durable, because the upgrades and RW quantities will be reflected by NPDES wastewater permit requirements that are designed to avoid and minimize treatment failure. Treatment upsets are generally avoided with design redundancy and safeguards, as defined in the reclaimed water permit ST6216.

Project sponsor(s) (if identified) and readiness to proceed/implement.

The project sponsor is the City of Shelton with the Squaxin Island Tribe as supporter. The WCC is a project stakeholder. All parties are currently proceeding with a feasibility study and are ready to implement the project, according to the results of the feasibility study.

References

Ecology (Washington State Department of Ecology). 2009. Fact Sheet for Reclaimed Water Permit Number ST 6216.

Ecology (Washington State Department of Ecology). 2016. Reclaimed Water Permit Number ST 6216.

WDFW (Washington Department of Fish and Wildlife), 2020. Salmonscape mapping of fish distribution. Available at: http://apps.wdfw.wa.gov/salmonscape/

Evergreen Mobile Home Estates Water Rights Acquisition

PROJECT DESCRIPTION

Description

Evergreen Mobile Home Estates (Evergreen Estates) Group A water system (PWSID# 24154) has been issued a compliance order to install CT6 disinfection (i.e. chlorination) to address failing on-site wastewater systems in close proximity to its wells. As an alternative to CT6 treatment, Evergreen Estates is considering connection to the City of Shelton's (City's) water system and abandoning its existing wells. The City has been pursuing consolidating the Evergreen Estates with the City drinking water system, and conducted a feasibility study to identify necessary infrastructure improvements to connect Evergreen Mobile Estates to its water system.

The Evergreen Estates installed five new sewer septic systems and a chlorination system at the wells. The property owner has indicated that the State has accepted their plan for onsite septic and chlorination improvements and that no further action on their part is needed (Carollo 2020). However, the Evergreen Estates owner did indicate that they would be amenable to water system consolidation if their costs were covered by others or with grant funding (HDR 2020).

The water system consolidation would result in the water rights of the Evergreen Mobile Estates Group A system to be unused. A water offset benefit would occur if that water right were to be put into permanent trust, per RCW 90.42.

Quantitative or qualitative assessment of how the project will function, including anticipated offset benefits, if applicable. Show how offset volume(s) were estimated.

The City of Shelton recently completed a consolidation feasibility study for the Evergreen Estates (Carollo 2020). The study identified the infrastructure that would need to be built by the City and by Evergreen Estates, respectively. The City would provide water service to the Evergreen Estates by providing an 8-inch water main for domestic supply and fire flows. Evergreen Estates would need to install a pressure reducing valve, a backflow prevention device, and potentially private fire hydrants.

The Evergreen Estates' available Water Use Efficiency reports indicated annual water production at the total authorized annual consumption of 26.9 acre-feet per year. However, the feasibility study estimated their likely annual water use to be 7.2 acre-feet per year. Therefore, if the City provided water to the Evergreen Estates, and the existing water right were to be put into permanent trust, the water offset value would be 7.2 acre-feet per year.

Conceptual-level map and drawings of the project and location.

The Evergreen Estates and water offset benefits would occur in the North Shelton area, in the Oakland subbasin (Figure 1).

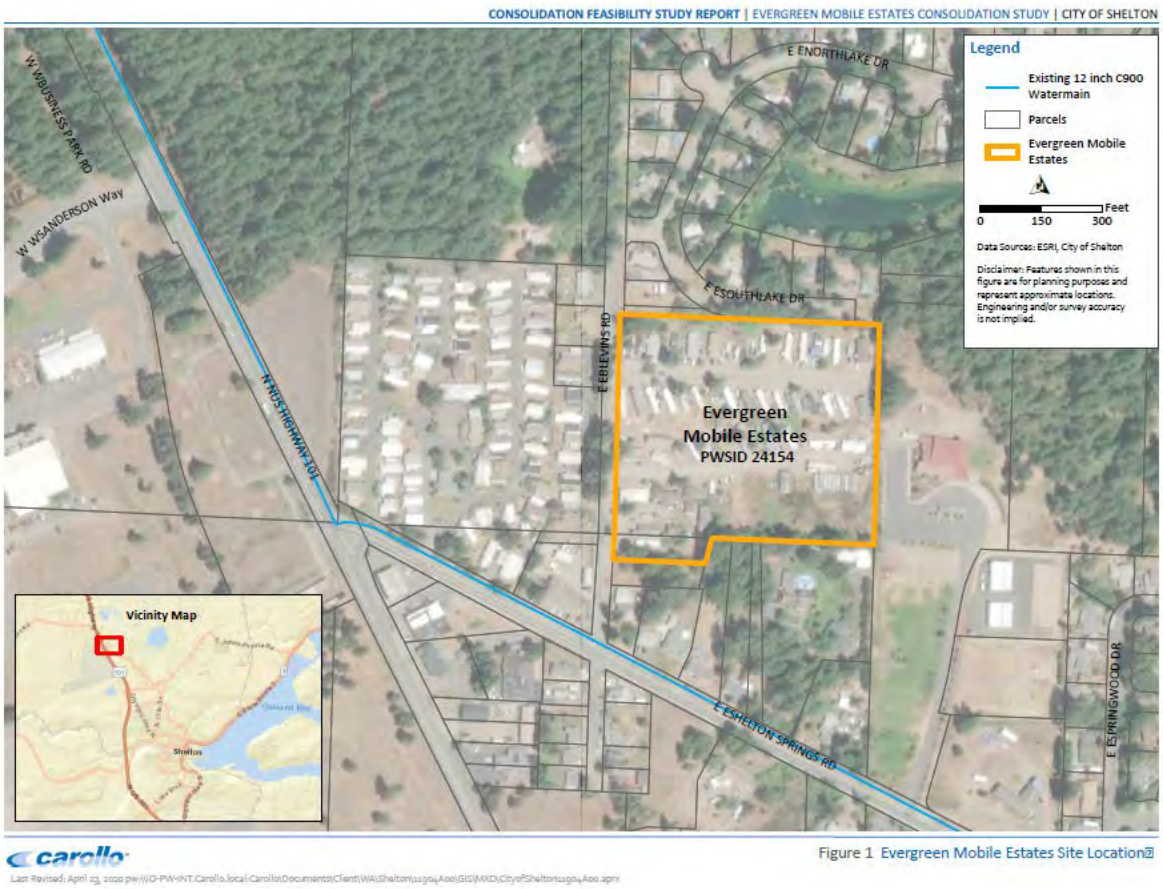

Figure 1. Evergreen Estates Site Location (from Carollo 2020).

Description of the anticipated spatial distribution of likely benefits

Elimination of pumping and consumptive use at the Evergreen Estates may benefit flow in John's Creek, in the Oakland subbasin. John's Creek is less than half a mile away from Evergreen Estates.

Performance goals and measures.

The performance goals would include completion of the legal mechanism of putting the Evergreen Estates water right into permanent trust, and permanent well closure.

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.

John's Creek supports coho, summer chum, fall chum, and winter steelhead (WDFW 2020). Increased summer low flows would support juvenile coho and winter steelhead juveniles. Chum species would

benefit from continued groundwater connectivity during spawning and early rearing during the winter and early spring.

Identification of anticipated support and barriers to completion.

The primary barrier to this project is funding. Evergreen Estates has already invested in new septic systems and chlorination at their well. Consolidation may need to be fully funded by a grant(s).

Potential budget and O&M costs.

Costs are estimated at $474,000. Specific improvements and costs are currently being developed in a feasibility study that is being funded through a grant between the Department of Health (DOH) and the City (DOH Contract Number GVL24700).

Anticipated durability and resiliency.

The water rights acquisition would be a durable benefit, because it would be put into permanent trust. Although the City would need to pump more groundwater to provide water to the evergreen Estates, the City would still have the same maximum allowable use and number of connections, since they would not obtain the Evergreen Estates water right as part of their consolidation.

Project sponsor(s) (if identified) and readiness to proceed/implement.

The City is ready to proceed, if and when Evergreen Estates is ready. Evergreen Estates readiness is currently unclear and subject to future agreement.

References

Carollo. 2020. City of Shelton, Evergreen Mobile Estates Consolidation Study. Consolidation Feasibility Study Report. Final. September 2020.

WDFW (Washington Department of Fish and Wildlife), 2020. Salmonscape mapping of fish distribution. Available at: http://apps.wdfw.wa.gov/salmonscape/

General Floodplain Restoration

PROJECT DESCRIPTION

Narrative description, including goals and objectives.

The Kennedy-Goldsborough Watershed (WRIA 14) is within Mason and Thurston counties and includes an extensive network of independent streams that issue from springs, wetlands, small lakes, and surface water drainages. The Kennedy-Goldsborough Watershed has no major river system. These multiple small streams originate from the Black Hills and lower foothills of the Olympic Mountains, emptying into several shallow bays and inlets in South Puget Sound, including Eld, Totten, Skookum, Hammersley, and Case inlets. Principal drainages include (from north to south) Sherwood, Campbell, Deer, Cranberry, Johns, Goldsborough, Mill, Skookum, Schneider, Kennedy, and Perry creeks. The geomorphology of WRIA 14 is strongly influenced by glacial deposits of coarse materials that promote connectivity between surface and groundwaters and the headwaters of many of the stream systems are (or were) dominated by wetlands.

Limiting factors for salmon species in WRIA 14 have been identified by Kuttel (2002) and Mason CD (2004), and are briefly summarized below:

- Fish barriers such as dams, culverts, and grade control structures have inhibited fish passage in WRIA 14.
- Removal of native riparian vegetation and channel modifications have led to deteriorated streambank conditions and reduced quantity and quality of instream habitat.
- Reduced levels of large wood, particularly key pieces that promote the long-term formation of instream and off-channel habitats.
- Groundwater and surface water withdrawals, loss of forest canopy and impervious surfaces have increases in water temperature, reduced dissolved oxygen levels, and very low flows during summer and early fall.

WRIA 14 floodplain restoration projects would address loss of groundwater storage, low flows and water quality conditions. The specific actions proposed for any given project would be specific to the restoration opportunity and habitat capacity of that location. The goal of any given project would be to rehabilitate natural hydrologic and geomorphic processes that are provided by floodplain connectivity. More detailed objectives pursuant to this goal would be specific to each respective project.

Qualitative assessment of how the project will function.

Projects will vary depending on the stream setting, habitat capacity, the impact that has occurred, and the corresponding opportunities for restoration. Potential floodplain restoration actions include the following:

- Channel re-alignment (i.e. re-meander),
- Removing bank protection,
- Installation of large wood to promote hyporheic and floodplain water storage
- Removal of fill or creation of inset floodplain (i.e. excavation of terraces),
- Side channel and off-channel feature reconnections, creation or enhancement.

Conceptual-level map of the project and location.

A mapping utility was used to solicit WRIA 14 floodplain project recommendations from the WRIA 14 Committee. The following data and reasoning was used to select candidate sites in WRIA 14:

- Identify reaches that are unconfined with Lidar hillshade. Unconfined reaches have wider valleys and floodplains.
- Identify reaches in flood zones
- Identify land that is vacant, and therefore potentially available for acquisition and restoration.
- Identify land that is public and potentially easier to acquire for restoration.
- Identify areas of tributary inflow, because they are often areas of biological importance and habitat complexity. They may also be areas more prone to intermittent flooding.

Project locations identified by the Committee are shown in Figure 1 include the following:

- Schumacher – Beaver
- Deer Creek - Beaver
- Johns Creek – Beaver
- Campbell Creek, Upper
- Jarrell Creek
- Mill Creek above BNSF tracks

- Gosnell
- Skookum at Duck Pond
- Skookum, Eich Road
- Skookum, Upper
- Kennedy Creek flats
- Upper Schneider
- Perry Creek

All project locations would be subject to evaluation of feasibility during plan implementation. Other locations may be identified by Committee members or other project sponsors during plan implementation.

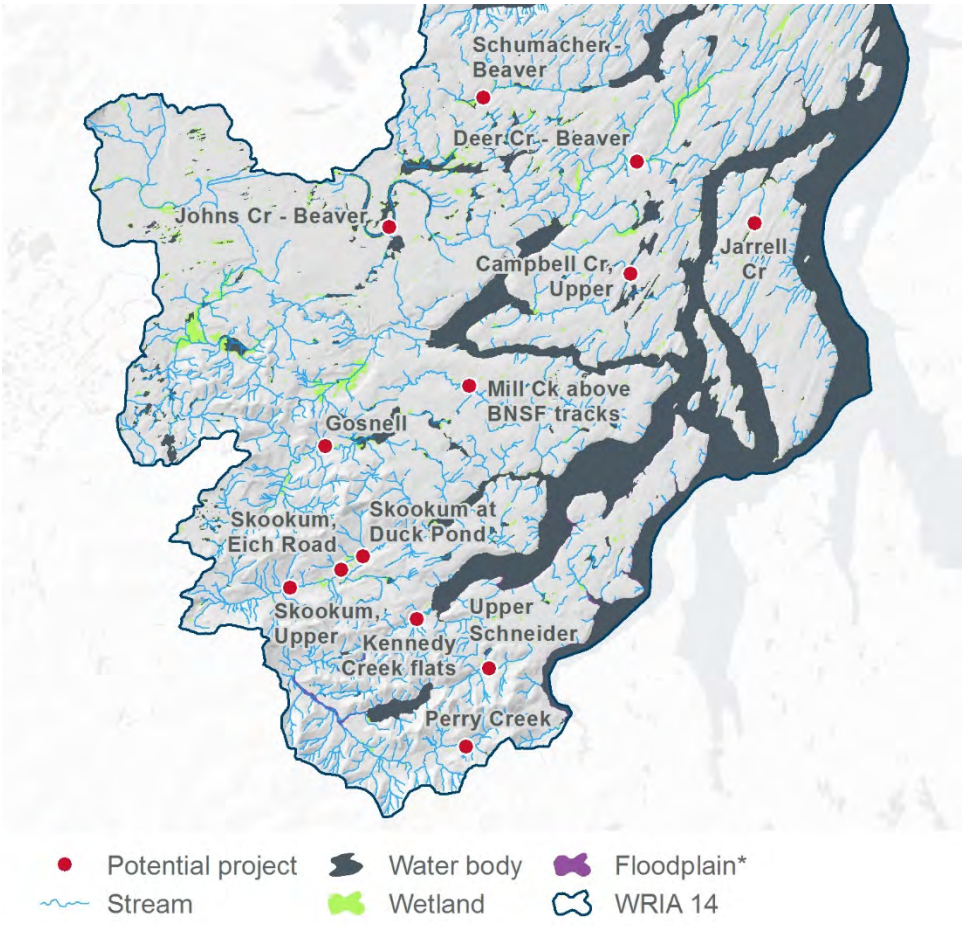

Figure 1. Potential floodplain restoration project locations.
**Floodplain data only available for southern areas in WRIA 14.*

Performance goals and measures.

Performance goals and measures will vary depending on the project. In general, the goals will be to implement the restoration actions with their intended quantity and purpose. The measures will be directly measurable elements such as acres of floodplain, wetland, or riparian habitats restored, stream-miles enhanced, predicted quantity of baseflow volume restored, predicted reduction of temperature, etc.

Description of the anticipated spatial distribution of likely benefits.

Potential floodplain restoration projects have been identified in suitable floodplain areas of Schumacher, Deer, Johns, Campbell, Jarrell, Mill, Gosnell, Skookum, Kennedy, Schneider, and Perry creeks. Restoring floodplain connectivity, along with riparian and wetland habitats could benefit between 2 and 6 miles of these tributaries by storing direct precipitation and floodwaters in these floodplain areas, contributing additional flows during low flow periods.

These streams have been noted for low summer/fall flows for decades (WDF 1975) and improvements to flows and temperatures, as well as floodplain and instream habitats, could provide substantially improved summer rearing habitat for juvenile coho salmon, steelhead and cutthroat trout. Improved flow conditions would also benefit upstream migration of adult Chinook, chum, and coho salmon.

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.

The Washington Department of Fish and Wildlife (WDFW 2020a) has identified that coho, and fall chum salmon, and winter steelhead trout are present in all the identified primary drainages in WRIA 14. Fall Chinook salmon are present in Sherwood/Schumacher, Deer, Cranberry, Goldsborough, and Mill creeks and summer chum are present in Sherwood/Schumacher, Deer, and Cranberry creeks. Most salmon species are of wild origin, although some mixed stocks are present from prior hatchery chum and coho releases (WDFW 2020b).

Increased floodplain habitats and improved riparian and instream habitat conditions would primarily benefit juvenile salmonid rearing habitats by providing increased area and quality of summer rearing habitats. This would improve both productivity and survival of juveniles, particularly coho and steelhead. The restoration of floodplain processes and functions could also improve summer/fall base flows and reduce water temperatures. This would improve both juvenile and adult migration conditions. Low flows have been identified as a high priority limiting factor in WRIA 14 (Kuttle 2002) and the restoration and reconnection of floodplain habitats and riparian enhancements provide shading, food web support, and flood and sediment attenuation functions.

Identification of anticipated support and barriers to completion.

No specific projects have been identified.

Potential budget and O&M costs (order of magnitude costs).

No specific projects have been identified.

Anticipated durability and resiliency.

Floodplain reconnection projects are durable as they restore natural processes to a reach of the river, allowing flooding and channel migration to occur unimpeded. Floodplain reconnection projects that provide the river with more room to meander and more ways to hold water for longer are important solutions to implement to restore watershed processes and to provide resiliency from a changing climate.

Project sponsor(s) (if identified) and readiness to proceed/implement.

No specific projects have been identified.

Documentation of sources, methods, and assumptions.

The following references were used:

Kuttel, M, 2002. *Salmonid Habitat Limiting Factors Water Resource Inventory Area 14, Kennedy-Goldsborough Basin*. Washington State Conservation Commission. November 2002.

Mason CD (Mason Conservation District Lead Entity), 2004. *Salmon Habitat Protection and Restoration Plan, Water Resource Inventory Area 14, Kennedy-Goldsborough*.

WDF (Washington Department of Fisheries), 1975. *A Catalog of Washington Streams and Salmon Utilization*, WRIA 14. Available at: https://www.streamnetlibrary.org/?page_id=95

WDFW, 2020a. Salmonscape. Available at: http://apps.wdfw.wa.gov/salmonscape/map.html

WDFW, 2020b. Salmon Conservation and Reporting Engine. Available at: https://fortress.wa.gov/dfw/score/score/maps/map_details.jsp?geocode=wria&geoarea=WRIA14_Kennedy_Goldsborough

Goldsborough Hilburn Restoration Project

PROJECT DESCRIPTION

Description

The Goldsborough Hilburn Restoration Project (Project) site is located approximately 500 feet upstream of Highway 101 near Shelton, WA, has been impacted by the placement of fill and armoring in the floodplain and immediate stream channel, resulting in a homogenous channel form that is mostly a riffle-glide complex.

The project involves removal of up to 7,800 cubic yards (CY) of artificial fill that is constricting Goldsborough Creek. The constriction is presumably causing higher-than-normal flow velocities during flood events, exacerbating the lack of flood refuge for salmonids, a problem also seen in other areas of Middle Goldsborough, and possibly causing channel incision (e.g. an existing, underground gas-line has been exposed, indicating active incising). Additionally, the project would widen the floodplain from 58 feet to 200 feet and add large wood and riparian vegetation, both of which are lacking in the project area.

Qualitative assessment of how the project will function.

Stream conditions at this site and reach provide little salmonid rearing habitat, holding water, covered pools, or floodplain off-channel areas. The site has a high potential for restoring natural processes and augmenting the habitat with in-stream woody elements, relative to reference quantities (Fox and Bolton 2007).

Conceptual-level map and drawings of the project and location.

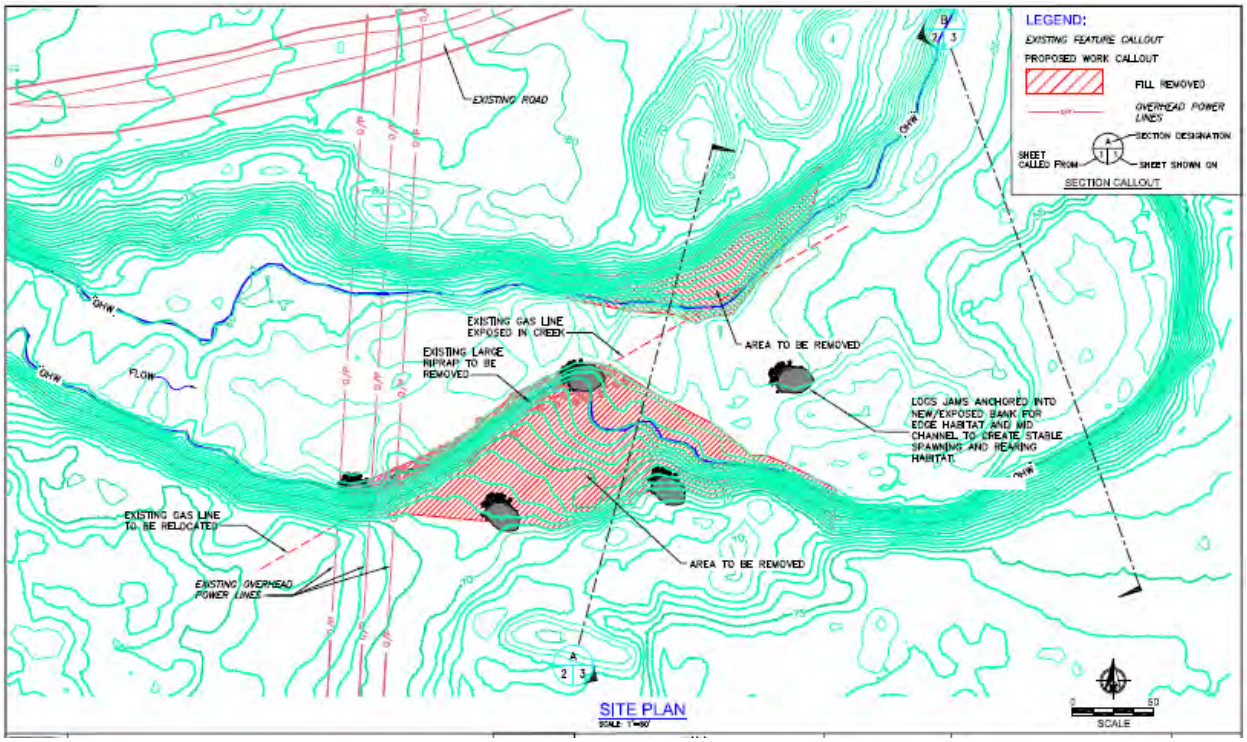

Figure 1. Goldsborough Creek Watershed Fish Habitat Enhancement Site Plan.

Description of the anticipated spatial distribution of likely benefit

The project would restore up to 500 feet of the Middle Goldsborough Segment. This will increase usable aquatic habitat.

Performance goals and measures.

The performance goals are to restore the natural processes and augment the habitat with in-stream woody elements, a need for this reach according. Specific metrics for these attributes will be defined based on the restoration design.

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.

This site and reach is used by multiple salmonid species including fall Chinook salmon (presence), coho salmon (spawning), fall chum salmon (spawning), and winter steelhead trout (spawning). Increasing hydraulic and habitat complexity with fill removal and LWD additions would increase habitat quantity and quality for pre-spawn holding in pools, variable current velocities, depths, and substrate composition that would be suitable spawning and rearing habitat for multiple species.

Identification of anticipated support and barriers to completion.

This project is supported by the South Puget Sound Salmon Enhancement Group and the WRIA 14 Lead Entity, but has not been developed enough to identify barriers to completion.

Potential budget and O&M costs.

The total costs of construction, engineering, permitting, and cultural assessments are estimated to be less than $1,000,000 (includes engineering and construction costs).

Anticipated durability and resiliency.

The project would have lasting benefits and would not require operation and maintenance, once it is established.

Project sponsor(s) (if identified) and readiness to proceed/implement.

The project sponsor would be South Puget Sound Salmon Enhancement Group.

References

Fox, M. and S. Bolton. 2007. A reginal and Geomorphic Reference for Quantities and Volumes of Instream Wood in Unmanaged Forested Basins for Washington state. North American Journal of Fisheries Management. Volume 27 (1): 342 – 359.

SPSSEG. 2010. Goldsborough Creek Constriction Removal Project. Salmonid Habitat Project Development. December 2010.

Managed Aquifer Recharge Projects in WRIA 14

PROJECT DESCRIPTION

Description

The WRIA 14 WRE Committee has identified managed aquifer recharge (MAR) projects as a viable approach to offsetting the consumptive use associated with permit exempt well growth. MAR projects may include many water sources, such as stormwater, Class A reclaimed water, and peak flows in rivers and streams. This general project is limited to MAR projects that divert, convey, and infiltrate peak seasonal river flows in engineered facilities that are in connection with the local alluvial aquifer that the donor stream or river is also in connection. Flows would be diverted in quantities that would not reduce habitat suitability for salmonids and that do not reduce habitat forming processes. Seepage back into the river would result in attenuation of these flows, increasing base flows across a broader time period, including the late summer and early fall, when flows are typically the lowest, and water demand for consumptive use is the highest.

This project description describes candidate MAR locations, potential methods for diversion and conveyance, potential diversion quantities, typical infiltration basins that would infiltrate those diversion quantities, and the associated offset benefits. Detailed feasibility analysis is not included in this project description and would occur during plan implementation for each specific location.

Quantitative or qualitative assessment of how the project will function, including anticipated offset benefits, if applicable. Show how offset volume(s) were estimated.

Potential MAR locations were determined based on a screening process (Attachment A). Areas in WRIA 14 with the following features were considered for candidate locations:

- Favorable soils and geology-
    - No wetlands, lakes, or high groundwater areas
    - Exposed till less than 10 feet estimated thickness
- Favorable Land Use
    - Undeveloped or Forestry
- Proximity to potential water source
    - Potential water sources included peak flows from Schumacher Creek, Sherwood Creek, Deer Creek, Cranberry Creek, Johns Creek, Goldsborough Creek, Mill Creek, Skookum Creek, Kennedy Creek, and Perry Creek
    - ½ mile from potential donor waterbody
- Land ownership

This screening resulted in favorable areas and specific locations for consideration during WRE Plan

implementation (Figure 1). Additional candidate locations may be proposed during plan implementation. Additional candidate locations are likely to be within these favorable areas but may also be demonstrated as suitable for MAR based on an independent site-specific analysis.

Potential streams that could be part of MAR projects are those that have a flow record adequate for an assessment of flow diversion quantities and infiltration facility design. Diversion flows could be proposed based on maintaining minimum instream flows and habitat forming processes (i.e. ecological flows). Diversion flows were set at 2 percent of wet season (November – April) minimum flows. Diversion of flow to an MAR facility could occur during days when flows exceed minimum instream flows. These days were tallied for each day in the flow record and summed by month (Table 1). These "diversion days" were averaged across all water years in the flow record. Then those averages were summed during the wet season months. This number of "diversion days" for each site, represents the average number of diversion days.

A more conservative approach was also employed that summed the number of "diversion days" for the wet season (November – April) for each water year. Then, the smallest number of "diversion days" among the years in the flow record was selected (Table 2).

The minimum and average volume of water that could be diverted to one or more MAR facilities in each stream was calculated by multiplying the diversion flow by the number of diversion days, and transforming the volume to acre-feet/ year (Table 3).

Diversion

Typical capture and recovery methods vary by water source but include some combination of a screened gravity diversion/bypass, a screened water lift and/or pump system, or a series of below ground infiltration galleries/collector pipes (e.g. Raney wells) adjacent to source streams. All of these methods would need to be evaluated based on a number of factors including operation and maintenance, fish passage performance, permitting, reliability, public safety, construction and lifecycle cost, and available funding mechanisms (HDR 2017) in order to determine the best fit for the water source. Screened water gravity diversions require the most extensive infrastructure but would need the least amount of effort to get water into conveyance structures. Screened water lift and/or pump systems would require less infrastructure than a screened water gravity diversion however the risk of damage would be greater.

The WRIA 14 Committee acknowledges that some diversion methods including in-channel structures may pose an impact to fish habitat, and strongly advocates for the use of diversion methods that do not include in-channel structures. For example, diverted water could be conveyed through a collector well adjacent to the river (e.g. Ranney Collector well). The WRIA 14 Committee suggests that projects should be specifically designed to enhance streamflows and to avoid a negative impact to ecological functions and/or critical habitat needed to sustain threatened or endangered salmonids.

Conveyance

After capture and recovery, water would be transported to the MAR site through a conveyance system which would be some combination of open canals/ditches, surface and subsurface closed piping, tunnels, and trenches (e.g. lined and unlined). Conveyance can be facilitated through gravity fed structures or strategic pumping throughout the system. Once constructed or modified, maintenance – including repair, leakage control, preventing recontamination, and the operation of pumping stations where gravity pressure is not enough– has to be ensured. Ideally, source streams and MAR sites would be in close proximity to minimize the complexity of the conveyance system.

Storage and Infiltration

MAR sites (e.g. shallow aquifer recharge sites) are expected to consist of one or more small storage reservoirs (ideally less than 10 AF in volume or less than 6 feet in height). After water is captured during periods of excessive river flow, water will be conveyed into storage reservoirs and allowed to infiltrate into the local water table over time. Infiltration sites must be chosen carefully and evaluated for potential infiltration rates and volumes as well as anticipated hydrologic and water quality effects resulting from the project. Suitable sites would have permeable material at the surface and a water-table deep enough to allow levels to rise without causing problems, such as flooding.

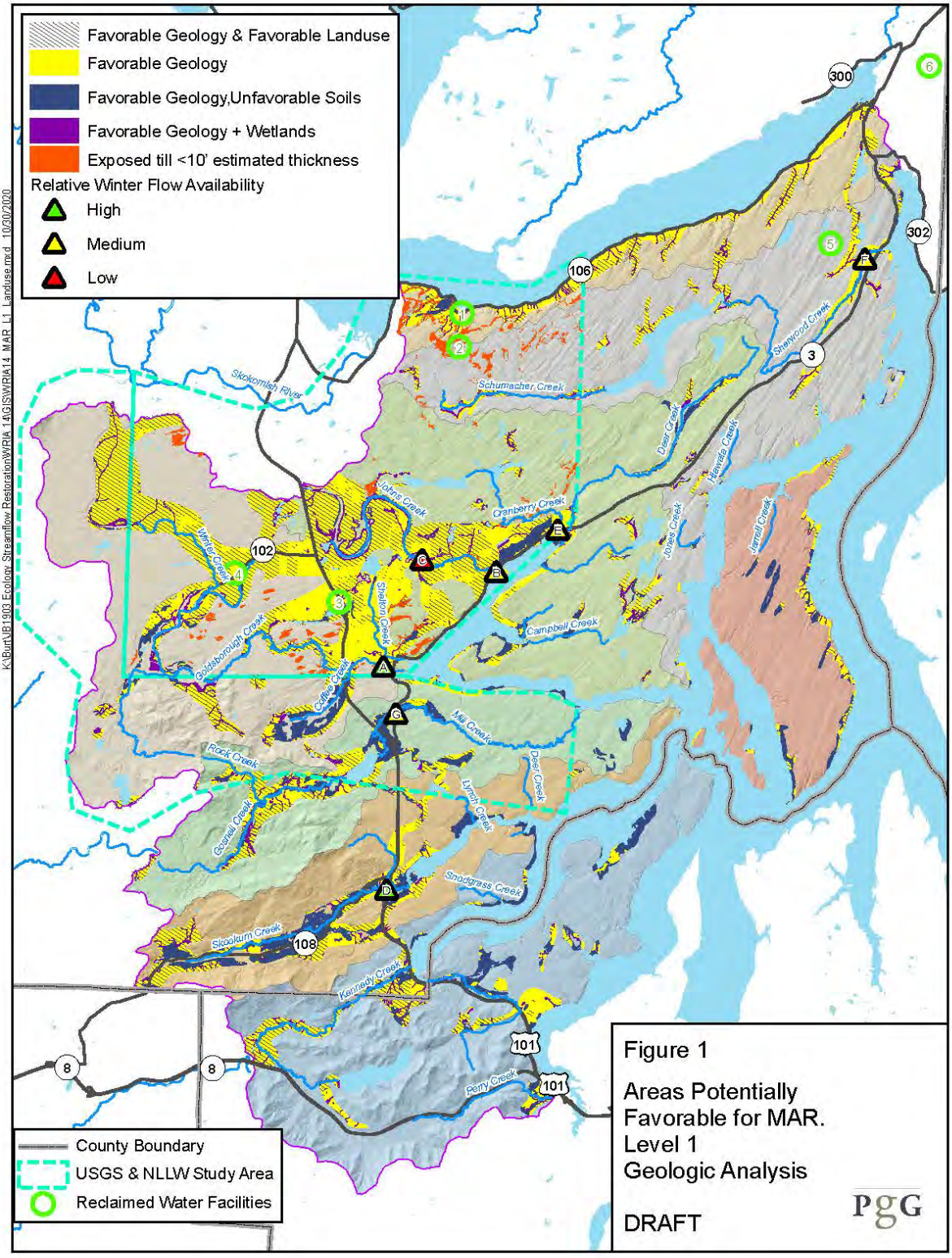

Figure 1. Favorable areas for MAR for feasibility analysis during plan implementation.

Table 1. Average measured monthly flow, minimum monthly instream flow, and the average number of days each month, where flows exceed minimum flows. Total number of days where flows exceed minimum flows during the wet season (November – April) are summed at the bottom. All flow values are in cubic feet per second.

	Kennedy Creek			Goldsborough (USGS) at S 7th St.			Johns 1 at Hwy. 3			Johns 2 at Johns Cr Rd.			Skookum at Hwy. 101			Mill at Hwy. 3			Cranberry at Hwy. 3			Sherwood at E Sherwood Cr Rd		
Month	Avg	Min. Inst	Days	Avg	Min. Inst	Days	Avg	Min. Inst	Days	Avg	Min. Inst	Days	Avg	Min. Inst	Days	Avg	Min. Inst	Days	Avg	Min. Inst	Days	Avg	Min. Inst	Days
Jan	119	NA	10	341	50	31	97	45	20	63	45	9	140	40	27	153	65	27	99	50	21	140	60	28
Feb	92	NA	10	250	85	28	69	45	12	47	45	13	87	40	19	116	65	21	66	50	16	106	60	22
Mar	100	NA	10	258	85	30	72	45	12	50	45	19	100	40	24	121	65	23	72	50	15	128	60	23
Apr	56	NA	0	196	85	29	54	45	7	38	45	9	57	40	17	81	65	16	48	50	12	79	60	19
May	38	NA	0	119	85	21	34	34	4	24	34	2	29	26	13	49	55	9	29	31	8	50	48	11
June	17	NA	0	75	85	7	21	20	3	15	20	0	13	11	13	29	40	3	17	18	10	32	29	15
July	8	NA	0	51	55	8	14	12	6	9	12	6	5	5	10	18	28	0	10	11	9	19	18	17
Aug	6	NA	0	41	48	2	11	7	13	7	7	11	2	3	5	13	20	0	7	8	6	14	11	15
Sept	5	NA	0	45	45	6	10	7	12	7	7	6	4	3	9	14	20	2	9	8	13	16	11	14
Oct	11	NA	0	82	50	16	17	7	19	12	7	7	22	6	17	32	20	14	18	15	11	34	19	19
Nov	57	NA	0	221	50	29	52	45	9	36	45	3	114	40	21	114	65	19	61	50	12	100	60	19
Dec	99	NA	10	274	50	31	78	45	15	50	45	5	114	40	23	124	65	22	80	50	17	144	60	22
Total			40			177			75			58			131			128			92			133

Table 2. Number of days that flows exceed minimum instream flows during the wet season (November – April) and the minimum number of days among all years for each flow station.

Flow Station	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Minimum
Skookum at Hwy. 101	84	113	117	104	122	158	133	165	104	146	129	157	164		84
Goldsborough (USGS) at S 7th St.		179	172	177	166	181	176	182	180	178	181	182	181	181	166
Johns 1 at Hwy. 3		91	159	87	36	123	151	132	110	74	106	149	181	128	36
Johns 2	14	104	80	38	41	74	82	111	25	64	75	143	113		14
Mill at Hwy. 3		116	127	86	89	145	139	164	89	134	129	159	157		86
Cranberry at Hwy. 3		111	106	50	45	106	87	135	35	87	86	143	118		35
Sherwood at E Sherwood Cr Rd				72	85	172	137	179	90	127	131	169	165		72

Table 3. Potential MAR site locations, facility sizes, and water offsets

Stream	Location	Facility Size (sq ft)	Diverstion Flow (cfs)	Minimum Days Exceeding Minimum Flows (Nov - Apr)			Average Days Exceeding Minimum Flows (Nov - Apr)		
				Total Days of Diversion	Total Water Per Year (cfy)	Total Water Per Year (afy)	Total Days of Diversion	Total Water Per Year (cfy)	Total Water Per Year (afy)
Kennedy Creek	Summit Lake outlet or RM 5	6,200	1	40	3,456,000	79	40	3,456,000	79
Skookum Creek	Downstream of Kamilche Cr; headwaters	3,100	0.5	84	3,628,800	83	131	5,659,200	130
Mill	Downstream of Lake Isabella	6,200	1	86	7,430,400	171	128	11,059,200	254
Goldsborough Creek	~River Mile 7	6,200	1	166	14,342,400	329	177	15,292,800	351
Johns Creek	Downstream of Johns Cr Rd	3,100	0.5	36	1,555,200	36	117	5,054,400	116
Cranberry Creek	~ RM3	6,200	1	35	3,024,000	69	92	7,948,800	182
Sherwood Creek	DS of Mason Lake	6,200	1	72	6,220,800	143	133	11,491,200	264
					Total	910			1,377

Potential streams for MAR diversion, infiltration, and low-flow return in WRIA 14 vary in terms of the quantity of available flows, the seasonality of available flows, and the suitability of soils for MAR sites.

Kennedy Subbasin

Kennedy Creek could have an MAR site(s) at near the outlet of Summit Lake or at approximately River Mile (RM) 5. Both of these areas are forested and have suitable geology and soils for infiltration. Average monthly flows near the mouth range between 92 – 119 cfs between November and March (Table 1). Since no minimum flows are set for Kennedy Creek, the average flows were used as a basis for setting diversion flow quantities. An MAR diversion of 1 cfs during period is proposed over this period, which would be less than 2% of average wet season flows. A conservative estimate of 40 days (a third of the time) is estimated to be above these average flows, while still accommodating a 1 cfs diversion. (Tables 1 and 3).

Skookum Subbasin

Skookum Creek has unfavorable soils for MAR infiltration along much of its stream alignment (Figure 1). However, there are some small areas of suitable geology and soils in the headwaters and near the confluence with Kamilche Creek. Average monthly flows at Highway 101 range between 57 – 140 cfs between November and April (Table 1). Assuming that flows are similar downstream of Kamilche Creek, an MAR diversion of 0.5 cfs (less than 2% of the lowest minimum instream flows) during period is proposed over this period. Between 84 - 131 days were above minimum instream flows, while still accommodating a 0.5 cfs diversion (Table 1 and 2), resulting a potential water offset of 83 – 130 acre-feet/year (Table 3).

Mill Subbasin

Soils and geology are favorable for MAR sites immediately downstream of Isabella Lake (Figure 1). This location would be useful, in terms of providing cool groundwater recharge downstream of the lake. Average monthly flows for Mill creek at Highway 3 range between 81 -153 cfs between November and April (Table 1). An MAR diversion of 1 cfs (less than 2% of the lowest minimum instream flows) during period is proposed over this period. Between 86 - 128 days were above minimum instream flows, while still accommodating a 1 cfs diversion (Table 1 and 2), resulting a potential water offset of 171 – 254 acre-feet/year (Table 3).

Goldsborough Subbasin

Soils and geology are favorable for MAR sites near Goldsborough Creek at multiple locations (Figure 1). Average monthly flows for Goldsborough Creek at S. 7th Street (USGS gage 12076800) range between 196 – 341 cfs between November and April (Table 1). An MAR diversion of 1 cfs (less than 2% of the lowest minimum instream flows) during period is proposed over this period. Between 166 - 177 days were above minimum instream flows, while still accommodating a 1 cfs

diversion (Table 1 and 2), resulting a potential water offset of 329 – 351 acre-feet/year (Table 3).

Oakland Subbasin

Several streams are located in the Oakland Streams with available flow record include Johns Creek and Cranberry Creek. Average monthly flows for Johns Creek at Hwy 3 range between 81 – 153 cfs between November and April (Table 1). An MAR diversion of 0.5 cfs (less than 2% of the lowest minimum instream flows) during period is proposed over this period. Between 36 - 117 days were above minimum instream flows, while still accommodating a 1 cfs diversion (Table 1 and 2), resulting a potential water offset of 36 – 116 acre-feet/year (Table 3).

Average monthly flows for Cranberry Creek at Highway 3 range between 48 - 99 cfs between November and April (Table 1). An MAR diversion of 1 cfs (less than 2% of the lowest minimum instream flows) during period is proposed over this period. Between 35- 92 days were above minimum instream flows, while still accommodating a 1 cfs diversion (Table 1 and 2), resulting a potential water offset of 69 – 182 acre-feet/year (Table 3).

Case Subbasin

The primary streams in the Case subbasin include Schumacher Creek and Sherwood Creek. The two creeks are part of the same drainage, with Schumacher Creek flowing into Mason Lake, and Sherwood Creek flowing from Mason Lake (Figure 1). Average monthly flows for Sherwood Creek at Sherwood Cr Rd. range between 79 - 144 cfs between November and April (Table 1). Water could be diverted from the downstream end of Mason Lake and conveyed to an MAR site directly downstream of the lake outlet (Figure 1). An MAR diversion of 1 cfs (less than 2% of the lowest minimum instream flows) during period is proposed over this period. Between 72- 133 days were above minimum instream flows, while still accommodating a 1 cfs diversion (Table 1 and 2), resulting a potential water offset of 143 – 264 acre-feet/year (Table 3).

Hood Subbasin

Several small streams drain directly to Hood Canal. The unnamed stream that drains Devereaux Lake has suitable soils for an MAR site. This stream does not have flow data. Therefore, no MAR diversion scenario is currently proposed.

Harstine Subbasin

No candidate locations are proposed for the Harstine Subbasin. The only stream large enough to accommodate a small MAR project is Jarrell Creek. However, soils are generally unsuitable near the stream and on most of Harstine Island (Figure 1).

The total potential MAR diversion quantities for all streams proposed herein range between 910 – 1,377 acre-feet/year (Table 3).

Description of the anticipated spatial distribution of likely benefits

The benefits will vary depending on the Creek, fish use. MAR seepage back to any of the proposed creeks would target benefits to the low-flow summer and early fall period. This would benefit rearing for yearling salmonids such as coho, steelhead, and coastal cutthroat trout.

Performance goals and measures.

Performance goals would be the quantity of water diverted and infiltrated. This goal could be measured by metering the conveyance pipe flow and the water depth of the MAR infiltration basin. Secondarily, water table elevations between the MAR and receiving waters, flow in the receiving waters, and seepage observations could be done, as an indication of flow benefits.

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.

These MAR projects would increase flow during the summer and early fall periods, increasing usable aquatic habitat, overall.

Identification of anticipated support and barriers to completion.

Mason County may support and implement these projects, with potential support from the Squaxin Island Tribe.

Potential budget and O&M costs.

The estimated costs for MAR projects are based on an assumption of ~$3,443/acre-foot of estimated offset. For the total 910 AFY estimated as potential offset for WRIA 14, this would equate to ~$3 million.

Anticipated durability and resiliency.

The project would require regular operation and maintenance.

Project sponsor(s) (if identified) and readiness to proceed/implement.

Thurston County, Mason County, and Mason County PUD #1 have indicated that they would be likely project sponsors, depending on site locations and further review.

Sources of Information

WDFW (Washington Department of Fish and Wildlife), 2020. Salmonscape mapping of fish distribution. Available at: http://apps.wdfw.wa.gov/salmonscape/

Attachment A

Managed Aquifer Recharge Assessment Methodology

Technical Memorandum

To: Department of Ecology WRIA 14 Watershed Restoration and Enhancement Committee

From: Peter Schwartzman, LHG

Re: WRIA 14 Managed Aquifer Recharge Assessment Methodology

Date: December 18, 2020

This technical memorandum documents the methodology used to identify properties that appear to have characteristics favorable for Managed Aquifer Recharge (MAR) in Kennedy-Goldsborough Basin, Water Resources Inventory Area (WRIA) 14. This work was completed by Pacific Groundwater Group (PGG) on behalf of the WRIA 14 Watershed Restoration and Enhancement (WRE) Committee (Committee) and the Department of Ecology (Ecology). This work was performed under Ecology Contract Number C1700029, Work Assignment PGG104.

Under RCW 90.94.030, Ecology has the responsibility to convene WRE committees and prepare WRE plans for eight WRIAs in the Puget Sound and Hood Canal areas. The general purpose of the plans is to document potential offsets to projected depletion of instream flows resulting from new, permit-exempt domestic well uses in the WRIAs over the next 20 years.

MAR project sites potentially can support watershed restoration and enhancement projects within the WRIA by potentially offsetting the impacts of permit exempt wells on WRIA streams. For this evaluation, MAR was defined as recharge via infiltration of source water at or near the land surface. A portion of recharged water is expected to follow subsurface pathways and return to hydraulically connected streams. To support development of the WRE plan for WRIA 14, PGG used regional data to assist the Committee in selecting properties within WRIA 14 that appear to have favorable infiltration characteristics and a close enough proximity to source water so that MAR may occur with reasonable economic efficiency. This memorandum outlines the methodology used to identify potentially favorable MAR project sites.

PROCEDURE

Regional soils, geologic, wetlands and land-use coverages were compiled for WRIA 14 using Geographic Information System (GIS) software. A series of screening criteria were then applied to identify sites that appear most favorable.

Screening Level 1- Surficial Geology, Soils, Wetlands and Groundwater Flooding

The initial screen focused on areas where regionally mapped soil and geologic units appear favorable for infiltration. The following criteria were applied:

1. Surficial geologic maps were reviewed and geologic units primarily composed of sand

and/or gravel were identified as favorable for infiltration, while low permeability units (with higher silt and/or clay contents or bedrock) were excluded. Surficial geology was based on regional (1:100,000-scale mapping) by DNR (Schasse, 1987). Favorable geologic units were associated with alluvium, recessional glacial outwash and advance glacial outwash.

2. Areas with unfavorable geology (glacial till exposed at the land surface) were generally excluded; however, PGG identified areas where hydrogeologic characterization performed by the USGS (REF) suggested that the till may be sufficiently thin (<10 feet) that excavation could provide an infiltration pathway to underlying materials (typically advance glacial outwash). This approach differs from infiltration at the land surface in that recharge occurs deeper in the groundwater flow system. Additional hydrogeologic characterization would be required to assess the value of recharge the advance outwash. Although few streams are mapped as penetrating advance outwash, model simulations may suggest reasonable hydraulic connectivity between streams and advance outwash (Massman, 2020).
3. Soils types mapped by the Natural Resources Conservation Service[57] were reviewed and those classified in "Hydrologic Soil Groups[58]" (HSG's) with high runoff potential (low infiltration potential) were excluded from the areas of favorable surficial geology. Unfavorable soils were classified for HSG's "C" and "D", along with "dual hydrologic soil groups" associated with poorly-drained soils exhibiting a shallow water table (e.g. "A/D", "B/D"). Whereas "A" and "B" HSG's indicate low and moderately-low runoff potential, "C" and "D" HSG's indicate moderately-high and high runoff potential (NRCS, 2007).
4. Wetlands, lakes, and high groundwater areas (as mapped within and by Thurston County) were excluded from the favorable infiltration areas defined based on criteria in bullets #1 and #3 (above).

Hydrogeologically favorable areas that meet the Level 1 screening criteria are shown in **Figure 1**.

Screening Level 2 – Favorable Land Use for MAR

PGG obtained GIS coverages of land use from Thurston and Mason counties and identified those land uses that might be most amenable to installation of an infiltration facility where infiltration potential is favorable. Land use data were available for the entire WRIA, of which 15% was listed as "water". Out of the terrestrial portion of the WRIA, land uses deemed potentially favorable for MAR included: commercial lumber and wood (<0.1%), governmental services (2%), educational

[57] https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm
[58] https://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=22526.wba

services (0.15%), parks (1%) and designated forest land (56%). The remaining land use were deemed 41% of the terrestrial WRIA) were deemed likely unfavorable for MAR. PGG added diagonal hatches to the hydrogeologically favorable areas identified in Screening Level 1 (**Figure 1**).

Screening Level 3- Potential Source Water Considerations

Figure 1 also illustrates potential water sources for MAR. HDR assessed selected streams within WRIA 14 for flow availability by calculating the difference between monthly average flow and the minimum instream flow requirement (HDR, 2020). PGG used the magnitude of these monthly values for the months of November through April to classify steams as having relatively high, medium and low availabilities. Flow availability was evaluated at specific gaging stations within the WRIA, shown as triangles on **Figure 1**. The triangles were colored to indicate high, medium and low relative flow availability, and labeled to correspond to the table below.

Stream/Location	Winter (Nov-Apr) Availability	Map Symbol
Goldsborough (USGS) at S 7th St.	High	A
Johns 1 at Hwy. 3	Med	B
Johns 2 at Johns Cr Rd.	Low	C
Skookum at Hwy. 101	High	D
Mill at Hwy. 3	Med	G
Cranberry at Hwy. 3	Med	E
Sherwood at E Sherwood Cr Rd	Med	F

Figure 1 also includes the locations of reclaimed water facilities (provided to PGG by the Squaxin Tribe) as potential MAR, indexed using the ID numbers below:

ID	Name
1	Alderbrook Wastewater Plant
2	Alderbrook Golf Course
3	Shelton Reclaimed Water Plant
4	Shelton Reclaimed Water Sprayfield
5	Allyn Reclaimed Water Plant, Basins, Sprayfield
6	Belfair Reclaimed Water Plant, Basins, and sprayfield

ADDITIONAL CONSIDERATIONS

As noted above, MAR was defined herein as infiltration of source water at or near the land surface. Another mechanism for MAR would be injection of source waters to deeper portions of the groundwater flow system, most realistically the Vashon advance outwash that occurs beneath Vashon glacial till (hardpan). Recharge to the advance outwash via infiltration is mentioned above, but where the till is thicker, injection wells would need to be constructed to fully penetrate the till and deliver source water to the advance outwash. In some cases, the upper portion of the outwash may be unsaturated, and injection into this unsaturated zone would provide some level of treatment (similar to typical surface infiltration project designs). In some cases, the advance outwash will be fully saturated below the till. Injection directly into saturated advance outwash may require additional levels of pre-treatment. Although WRIA streams typically occur above the till, groundwater modeling has suggested a reasonable degree of hydraulic connection between the advance outwash aquifer and surficial streams (Massmann, 2020). Should MAR by injection be considered, additional modeling work would be needed to better understand the pathways, proportions and timing by which water injected into the advance outwash would return to streams.

Another factor worth considering is the distance between MAR sites and source waters. Close distances reduce the cost of conveyance between the source (stream, reclaimed water facility, etc.) and the MAR site, making MAR projects more economically appealing. However, based on distance and geologic conditions, MAR sites too close to streams may not provide the timing of subsurface return flow desired to enhance streamflow. For instance, if streamflow is available as an MARE source between November and April, one would want a substantial portion of subsurface return flow to reach the stream during alternate months (May thru October, with additional preference for the low-flow months in late-summer and fall). Where proximity and hydrogeologic conditions support quick return flows from the MAR site to the stream (e.g. days to weeks), flow benefit during the desired season is reduced. Effectiveness is improved where

return flow timing is on the order of months or is more even year-round. Year-round availability is an express advantage of reclaimed water sources.

FUTURE STEPS

PGG recommends that individual properties within the areas of identified favorable geology *and* favorable land be identified, prioritized and selected for site specific feasibility analyses. Sponsors for planning, designing, constructing and maintaining MAR projects will also need to be identified and paired with individual projects. Initial project feasibility considerations will include site ownership (and if the owners would consider selling, leasing, or permitting easements on their property to allow MAR) and the relative cost and complexity of providing source water to the site. Different sites will likely have different conveyance requirements that could include pumps, pipelines with significant elevation gain, long-distance subsurface pipelines, and pipeline easements for each property crossed by the conveyance line. For sites that remain favorable following initial owner outreach and conveyance considerations, a site specific hydrogeologic evaluation should be performed to identify local soil and aquifer hydrologic properties, depth to groundwater, and groundwater flow direction and gradient. Groundwater mound height and return flow travel time estimates would be included in this evaluation, as well as potential water quality or treatment concerns (such as the removal of particulate matter) prior to infiltration.

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Mason County Rooftop Runoff

INFILTRATION RECHARGE ANALYSIS FOR STREAMFLOW AUGMENTATION NET BENEFITS

TECHNICAL MEMORANDUM

Date:	Tuesday, December 01, 2020
Project:	Watershed Restoration & Enhancement Committees Technical Support
To:	Angela Johnson (Ecology) and David Windom (Mason County)
From:	Chad Wiseman, Jerry Bibee, PE, and Grace Doran, EIT (HDR)
Subject:	Mason County WRIA 14 and 15 Rooftop Runoff Infiltration Recharge Analysis for Streamflow Augmentation Net Benefits

Background

This memorandum describes the evaluation of net water offset recharge benefit associated with Mason County's proposed Rooftop Runoff Infiltration Program requirement for new rural development. Mason County has proposed a possible modification of the County building code to require capture of roof runoff from new rural residential (RR) development, typically on 5 acre parcels or greater, with direct connection to home site infiltration facilities (i.e., parcel dry wells, infiltration trenches, infiltration galleries, or rain gardens). This proposed code revision would typically require infiltration facilities that achieve recharge of 85 percent of the annual average rooftop runoff for new RR parcel development roof, with some reduction possible in less permeable soils to limit infiltration facility sizes. Similar to assumptions regarding permit exempt well consumptive use withdrawals, the infiltrated runoff is assumed to result in shallow groundwater recharge to interflow, with an assumed down-gradient surface water benefit to receiving waters base flow augmentation.

RR growth outside of urban growth areas (UGAs) within Mason County has been projected by the Mason County Comprehensive Plan and for the development of the Watershed Resource Inventory (WRIA) 14 and 15 Watershed Restoration and Enhancement (WRE) Plans (HDR 2020a and 2020b). HDR modeled hydrologic response and infiltration potential for new RR parcel development under existing (baseline) development requirements and under the proposed infiltration program, and in variable soil types, to estimate water offsets to be gained through this low-impact development (LID) best management practice (BMP). The typical infiltration quantities per RR parcel for each respective soil type were then applied to the projected RR growth in rural Mason County and associated hydrologic soil group (HSG) types. The resulting net increases in recharge benefits (proposed minus baseline) were applied to projected RR growth in Mason County at the WRIA and subbasin scales. Mason County encompasses portions of WRIA 14 and WRIA 15, respectively (Figure 1). The WRIAs have nested subbasins (Figures 2 and 3).

The application of LID BMPs within the County are not specifically required at the current time since the County is not a NPDES MS4 Phase II community tied to onsite stormwater

management practices otherwise required in the 2019 Ecology Stormwater Management Manual for Western Washington (SWMMWW). Therefore, this water offset would not have occurred, if it were not for Mason County's proposal to create this requirement as a contribution to offsetting consumptive water use from rural residential growth. For the purposes of the WRIA 14 and 15 Watershed Restoration and Enhancement (WRE) Plans, the net infiltration recharge of rooftop runoff is equivalent to a water offset per RCW 90.94. The water offset benefits could be credited incrementally with continued RR growth under the current Mason County NPDES program status and implemented Rooftop Runoff Infiltration Program.

Figure 6: WRIA and Washington Counties within Project area

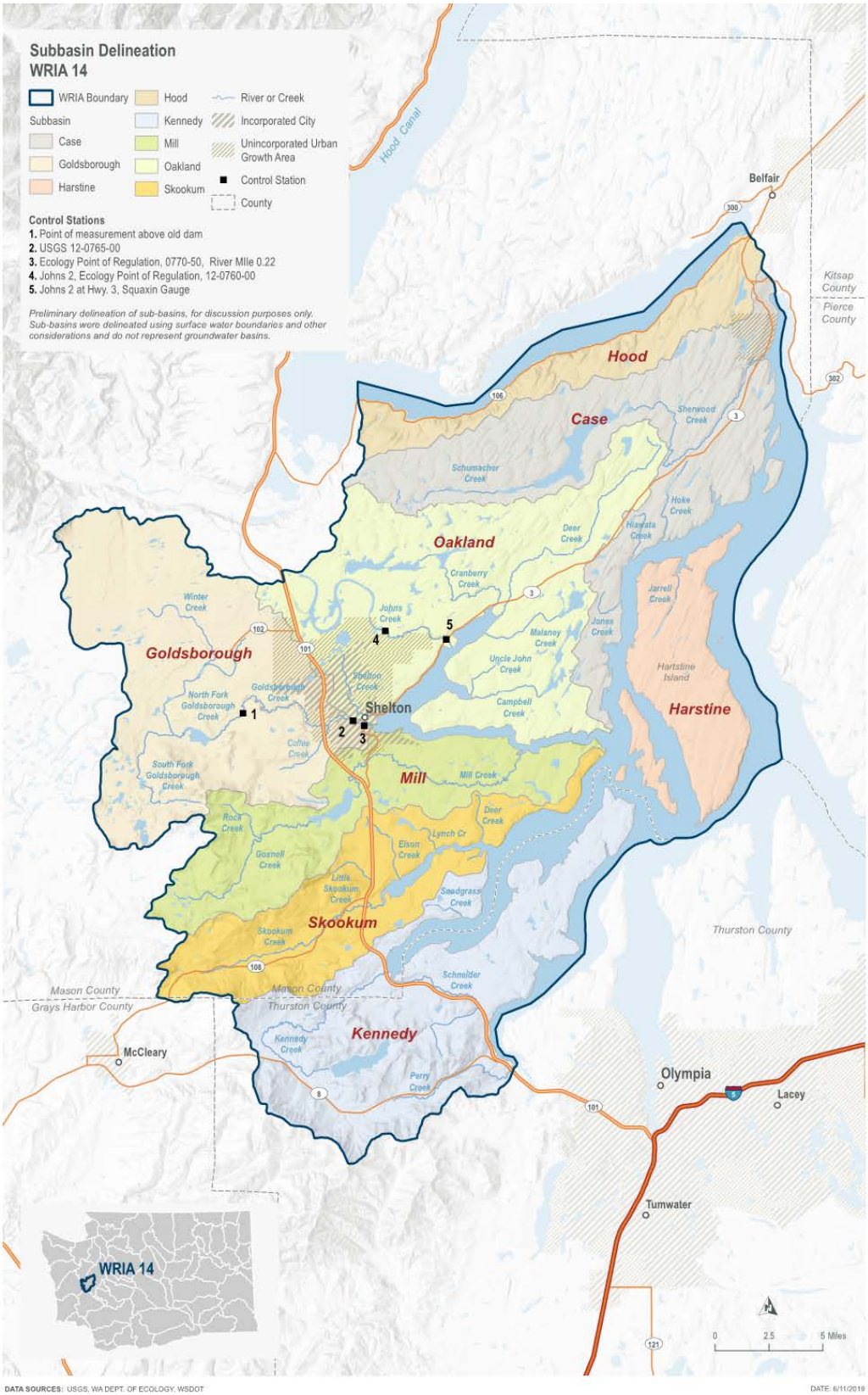


Figure 7: WRIA 14 subbasins

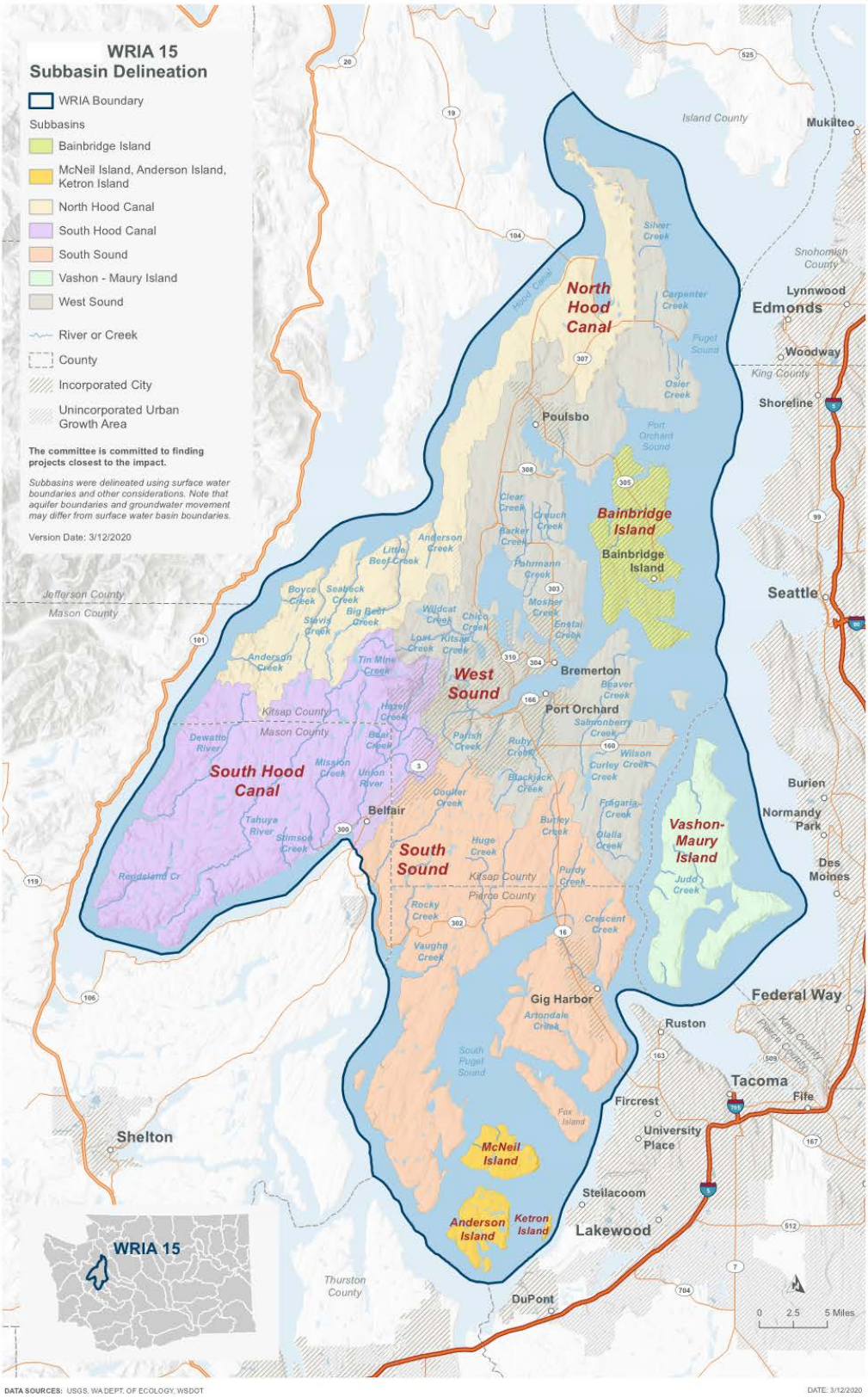


Figure 8: WRIA 15 subbasins

Analysis Methods and Assumptions

The following subsections describe the methods, conditions, and key assumptions underlying the Mason County Rooftop Runoff Infiltration Program analysis.

Analysis Approach Overview

Infiltration recharge volume estimates have been made for existing baseline conditions and standards, and for a proposal by Mason County to modify development standards to require direct infiltration of roof runoff. The analysis was conducted under an assumed set of typical parcel development conditions and under variable soil types. The resulting infiltration recharge volumes for each analysis condition were compared to establish the potential water offset net recharge benefit per RR development parcel under the evaluated soil types. Those parcel-level analysis results were then expanded to the WRIA 14 and 15 subbasins for characterization of the potential cumulative water offset benefits associated with this Mason County program proposal.

Characterization of Rural Residential Growth and Buildable Lands

The Mason County requirement to infiltrate rooftop runoff applies to buildable RR zoned lands, typically 5 acre and greater in parcel size (Figure 4). That collective land use totals approximately 186,000 acres of rural residential developable lands (Table 1), and with a total of 3,692 wells projected to service that area between 2018 and 2038. The projected 3,692 wells do not include the permit exempt wells that are anticipated to go into urban growth areas over that same period. The quantity of rural residences projected to be built in 2018 – 2038 in each subbasin were defined in the WRE Plan permit-exempt well and connection growth and consumptive use analysis (HDR 2020). The composition of HSG types (SWMMWW, Volume III-2.2) within the buildable lands were characterized within each subbasin (Figure 4). Group A, B, and C soils were evaluated, where Group A are outwash soils, Group B soils are transitional outwash to till soils, Group C are till soils. The transition in soils permeability from outwash to till soils ranges from high level to low level, with factored design infiltration rates ranging from 6.0 to 0.5 inches per hour evaluated. Group D soils are saturated/wetland soils and were not evaluated since achieving significant infiltration through them is not technically feasible.

Table 15: Total WRIA 14 and 15 RR developable area summarized by Hydrologic Soil Group

Hydrologic Soil Group	Cumulative Area of Soil Group (acres)
Group A	60,158
Group B	96,746
Group C	26,781
Group D	2,138
Total	**185,823**

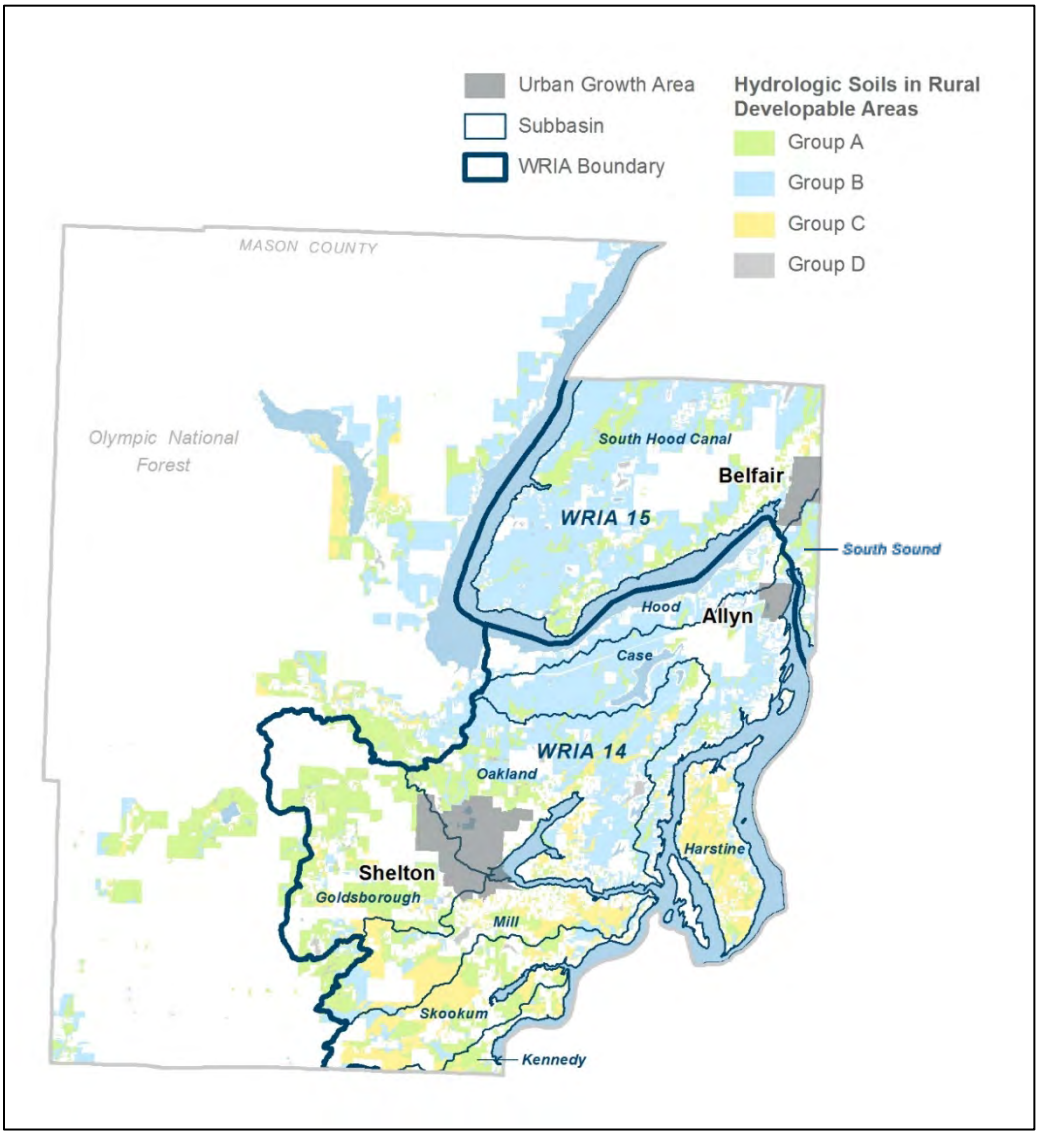


Figure 4: Rural residential buildable lands classified by hydrologic soil type.

Hydrologic Modeling Analysis Methods and Assumptions

MGSFlood, an Ecology-approved continuous simulation hydrologic model, was used to simulate RR parcel development area runoff and recharge through permeable surfaces in estimating the annual water balance to be applied to the WRIA subbasins rural residential developable lands. The analysis was conducted for a typical 5-acre developed parcel with typical land surface cover conversions as shown below. The analysis was conducted for the Group A, B, and C hydrologic soil classes, respectively, and using pervious land vegetation classes noted below. The following key assumptions were made for the MGSFlood hydrologic modeling analysis:

- Mean Annual Precipitation (MAP) is 70 inches (5.83 ft/yr)
- Individual parcel size is 5 acres
    - Cleared area of parcel is 1 acre (ac)
    - Typical house non-pollution generating impervious surface (NPGIS) area is 2,200 sf (0.05 ac)
    - Typical garage NPGIS roof area is 600 sf (0.014 ac)
    - Typical driveway pollution generating impervious surface (PGIS) is 1,200 sf (0.028 ac) (driveways were not considered for direct runoff recharge since they are pollution-generating surfaces)
    - Remainder of cleared site is grass
    - Remaining 4 acres is forested with native soil type
- Group A, B and C soils were evaluated with this analysis. For parcel runoff and infiltration simulation from pervious surfaces beyond roof runoff separately analyzed, Group B soils were proportionally split between outwash and till soils (the MGSFlood model does not include a Group B soil class)
- Group D soils were not included
- Soil permeability factored design rates for rooftop runoff infiltration trench analysis:
    - Group A = 4, 5, and 6 inches/hour (in/hr)
    - Group B = 1, 2, and 3 in/hr
    - Group C = 0.5 in/hr
- Infiltration facility depth of 2 feet
- The depth to water table beneath the infiltration facility is 5 feet or greater
- Filter strip soil permeability was assumed to be 3 in/hr to simulate a typical lawn topsoil or amended native soil, unless underlying native soil permeability was lower, in which case, it was set equivalent to that lower value

Parcel rooftop runoff was simulated using the MGSFlood model to evaluate rooftop runoff targeted for infiltration in each HSG, both under existing baseline condition development standards, and under the Mason County's proposed rooftop runoff modified development standard condition. The difference in recharge between those two conditions was used to assess the net increased benefit in recharge achieved. Separately, runoff from other parcel development area surfaces was evaluated as described in the following section, but since the infiltration characteristics of those surfaces under the two development standard conditions would not change, that analysis does not enter into the net recharge benefit evaluation.

Parcel Hydrologic Modeling Analysis (Beyond Roof)

To determine runoff and recharge for the entire 5-acre parcel, an MGSFlood model simulation was run to analyze the full recharge potential of the parcel. The roof infiltration changes from the baseline to proposed conditions was analyzed in a separate model simulation and was therefore not included in the full parcel analysis. Beyond the roof area, the analysis did not change between the baseline and proposed conditions. The land cover breakdown of a typical 5 acre parcel used for the MGSFlood analysis, excluding the 0.064 acres of roof area (house area, 0.050 ac, plus garage area, 0.014 ac), is shown in Table 2. Assuming 1 acre of the parcel would be developed, the soil group types of the remaining 4 acres of forested land was determined

based on GIS analysis. As stated in the assumptions, Group B soil type was portioned out between Group A (outwash) and Group C (till) soils.

Table 16: MGSFlood Soils-Land Cover Input for typical 5-acre parcel development without roof area

MGSFlood Input	Area (ac)
Till Forest	1.232
Till Grass	0.230
Till Pasture	0.678
Outwash Forest	2.768
Impervious (beyond roof)	0.028
Total	**4.936**

Rooftop Runoff Baseline Condition Analysis

To complete the roof runoff recharge analysis for the assumed 0.064 acre roof area, a baseline analysis was completed to estimate how much runoff would infiltrate using existing Mason County development standards (Mason County Code, Title 14, Chapter 14.48). The Downspout Dispersion System BMP from the SWMMWW (BMP T5.10B) was considered the most representative for comparative analysis of infiltration recharge potential. This BMP for a single roof down-drain is applicable for 700 square foot (sf) of roof and requires a minimum 20 sf infiltration trench area. The developed parcel roof area was assumed to be 0.064 acres (2,800 sf), so 80 sf of infiltration trench area (2-foot width by 40-foot length) was modeled for the entire roof for baseline conditions applicable to all soil groups. For the baseline analysis, a filter strip (SWMMWW BMP T9.40) was linked downstream of the infiltration trench to route overflow runoff from the trench across it as sheet flow. As a linked element in MGSFlood, the filter strip only receives excess flow that is not infiltrated within the infiltration trench. The filter strip was conservatively assumed to have an area of 4,000 sf, 40 ft in width by 100 ft in length, and was intended to mimic a typical developed lawn surface (with topsoil or compost-amended native soil).

The infiltration recharge analysis was completed for each soil group, using the assumed design permeability rates applied to the infiltration trench area. The filter strip was analyzed with a typical topsoil infiltration rate of 3 in/hr. However, where the underlying native soils have a lower infiltration rate than 3 in/hr, the permeability of the filter strip was set to the limiting subgrade soils value.

Rooftop Runoff Proposed Condition Analysis

The proposed analysis was conducted under Mason County's proposed modified development standard requiring increased rooftop runoff infiltration. For this analysis, it was also assumed that a 0.064 acre roof is connected to an infiltration trench that would accommodate the majority of the roof annual runoff volume.. This was analyzed using the MGSFlood model infiltration trench BMP element without consideration of a filter strip downgradient of the infiltration trench for supplemental overflow infiltration benefit. The recharge analysis was completed for each soil group applying assumed design permeability rates.

The proposed condition infiltration analysis was initially conducted for a range of roof runoff values, ranging from 85 percent to 100 percent annual average infiltration volume in 5 percent increments to determine the required area of the infiltration trench or equivalent infiltration gallery area. Based on the analysis findings, Ecology staff consulted with Mason County staff on the desired target annual recharge value, and direction was subsequently provided by Ecology to HDR to use an 85% annual roof runoff infiltration target value. An exception to that was requested by Mason County for Group C soils, where annual recharge is limited by a maximum requested infiltration facility area footprint of 620 square feet.

Analysis Results

Parcel Runoff Analysis Findings

For the typical developed 5-acre parcel under the modeling assumptions listed above, it was estimated that the annual recharge volume over pervious surfaces, without including roof infiltration, is approximately 14.2 ac-ft/yr. This represents about 50 percent of the annual precipitation volume over the parcel area. This component of the analysis results remains the same between baseline and proposed development conditions. This analysis was completed to show that the change in rooftop runoff recharge is a smaller component of the overall typical 5-acre parcel infiltration recharge volume.

Rooftop Runoff Analysis Findings

For typical developed parcel roof recharge analysis, soil infiltration rates were the key factor in estimating infiltration trench BMP size needs and the net recharge gain. As the soil infiltration rate decreases, the size of the infiltration facility increases. As stated previously, the Group C soil infiltration facility was sized at 620 sf, equivalent to the 1 in/hr infiltration rate facility size, resulting in 69 percent average annual infiltration volume (versus the standard 85 percent). The net average annual recharge gain compared to baseline was greatest for soils with the lowest infiltration rates (Table 3 and Figure 4).

Table 17: Baseline and proposed (85 percent infiltration) roof recharge

Per Parcel Roof 85% Proposed Recharge*												
Hydrologic Soil Group	Baseline							Proposed		Net Average Annual Recharge Gain		
	Infiltration Facility		Filter Strip			Total						
	Area (SF)	Average Annual Recharge (ac-ft/yr)	Infiltration Rate (in/hr)	Area (SF)	Average Annual Recharge (ac-ft/yr)	Average Annual Recharge (ac-ft/yr)	Percent Recharge	Infiltration Facility Area (SF)	Average Annual Recharge (ac-ft/yr)	ac-ft/yr	cfs	gpm
Group A - 6 in/hr	80	0.219	3.0	4,000	0.037	0.256	76%	227	0.285	0.030	4.1E-05	0.018
Group A - 5 in/hr		0.204			0.041	0.245	73%	252	0.285	0.040	5.5E-05	0.025
Group A - 4 in/hr		0.188			0.046	0.234	70%	294	0.285	0.052	7.1E-05	0.032
Group B - 3 in/hr		0.167			0.053	0.220	66%	337	0.285	0.065	9.0E-05	0.041
Group B - 2 in/hr		0.140	2.0		0.046	0.186	56%	420	0.285	0.099	1.4E-04	0.061
Group B - 1 in/hr		0.102	1.0		0.031	0.133	40%	620	0.285	0.152	2.1E-04	0.094
Group C - 0.5 in/hr*		0.072	0.5		0.019	0.090	27%	620	0.230	0.140	1.9E-04	0.087
*Proposed C soils infiltrate 69%												

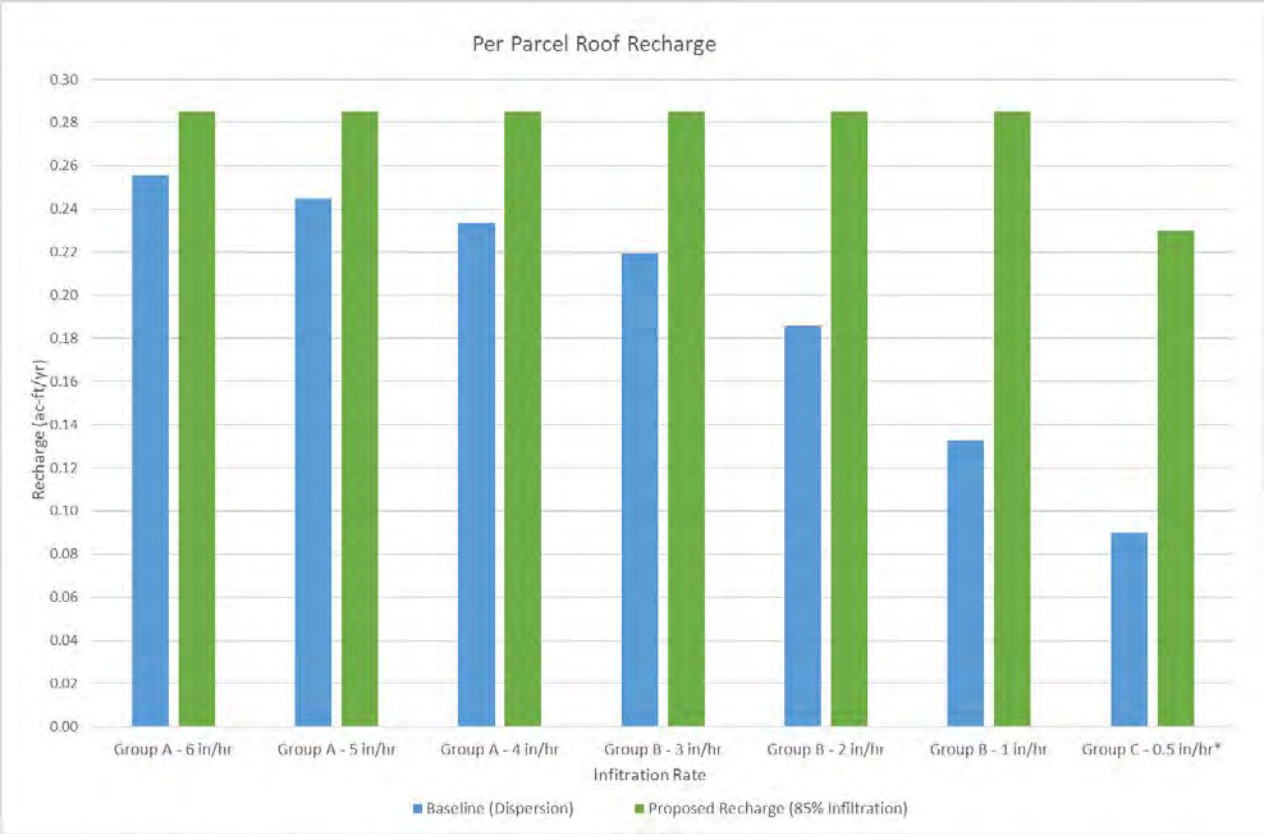


Figure 9: Parcel roof recharge comparison by soil group

Based on the parcel level analysis results, the typical net recharge gain for collective parcels in each soil group were extrapolated to the projected RR growth areas in the Mason County portions of WRIAs 14 and 15. The net recharge gain for proposed conditions infiltration capture compared to baseline conditions was used to estimate the projected offset for each soil group within each subbasin. For that evaluation, and the total potential offset for collective parcels

apportioned to the estimated number of wells were estimated in accordance with the analysis assumptions. The average of each soil group infiltration rate was used to complete this analysis, with 5 in/hr for Group A soils, 2 in/hr for Group B soils, and 0.5 in/hr for Group C soils being applied.

Based on 2,766 wells apportioned to assumed full parcel buildout within the WRIA 14 Project area, this yielded a total potential projected water recharge offset of 249 ac-ft/yr, at 85 percent recharge on an average annual basis. (Table 5).

Based on 926 wells apportioned to assumed full parcel buildout within the WRIA 15 Project area, this yielded a total potential projected water recharge offset of 79 ac-ft/yr, at 85 percent recharge on an average annual basis. (Table 5).

Table 5: WRIA 14 and 15 project area roof 85 percent estimated recharge and projected water offset from baseline by subbasin

85% Infiltration*											
WRIA	Subbasin	Mason County Rural Projected No. Permit-Exempt Wells	Soil Type Proportion			Well Proportion			Projected Offset (ac-ft/yr)		
			A	B	C	A	B	C	A	B	C*
14	Case	396	0.11	0.88	0.02	42	347	7	2	34	1
14	Goldsborough	338	0.82	0.08	0.11	276	26	37	11	3	5
14	Harstine	143	0.14	0.18	0.69	20	25	98	1	2	14
14	Hood	78	0.09	0.91	0.01	7	71	0	0	7	0
14	Kennedy	59	0.61	0.05	0.34	36	3	20	1	0	3
14	Mill	434	0.30	0.19	0.51	132	80	221	5	8	31
14	Oakland	955	0.24	0.67	0.10	226	636	93	9	63	13
14	Skookum	363	0.39	0.14	0.47	141	51	172	6	5	24
	Totals	**2766**								**249**	
15	Sough Hood Canal	834	0.22	0.76	0.01	186	637	11	7	63	2
15	South Sound	92	0.46	0.52	0.02	42	48	2	2	5	0
	Totals	**926**								**79**	

*Proposed C soils only infiltrate 69%

Project Costs

At this time, all estimated project costs are expected to be included in costs of construction for new homes, which could range from $3,780-$9,300 per home. For WRIA 14, this results in a total of ~$17 million for the total project (based on total projected PE well growth).

Response to WRIA 14 and 15 Committee Comments on Draft Analysis Memorandum

Ecology provided HDR comments from various committee participants based on the HDR Draft Technical Memorandum summarizing this analysis, dated September 4, 2020. Those comments consider committee feedback received from presentation of this analysis at prior committee meetings. HDR's response to those comments is included as Appendix A.

Mason County Rooftop Runoff Appendix A - HDR Response to Committee Comments on Draft Technical Memorandum

Mason County Rooftop Runoff Project

Comments Received as of 10/5/2020

Paul Pickett (Squaxin Island Tribe) Comments sent to Angela Johnson 9/23/2020

- A factor should be included to reduce total offsets to account for properties where the facility cannot be installed (site limitations like wetlands, slope, other setbacks)

  HDR Response: We did exclude all parcels with Type D hydrologic soil group (HSG) (typically wetland soils where roof infiltration (and parcel development) would typically not be allowed or feasible. We did not consider steep slopes and other setbacks, but the assumption is that some portion of 5 ac parcels may still be developable. There are more existing parcels than PE Wells, so we factored back the number of parcels to match the # of PE Wells to evaluate on a consistent basis with consumptive use, allocated by the various HSG areas.

- Soils should be assessed in PE growth hot spots within subbasins, not the entire subbasin, because those are the areas that facilities would be installed.

  HDR Response: This evaluation addresses potential incremental benefits per parcel as development occurs in the various subbasins, so the net benefits would accrue with parcel development wherever it occurs as PEWs are installed to serve those parcels. This evaluation was intended to be high level for project screening evaluation of potential cumulative benefits over time, and was not intended to be parcel location specific.

  The proportion of HSG types used in this analysis are based on the same buildable lands analysis that was used to spatially allocate PE Well growth for the consumptive use analysis.

- Where did the infiltration value come from? No citation was provided.

  HDR Response: The citation will be added. They were assumed from expected average long-term design infiltration rates for the various HSGs (Type A = 4 in/hr; Type B = 2 in/hr, Type C = 0.5 in/hr). Design infiltration rates under Ecology SWMMWW guidance are factored values from field measured values, typically established from a Pilot Infiltration Test (PIT). Typically cumulative factoring back of measured rates for long-term design infiltration rates ranges from about 0.2 to 0.4. So for example, for Type A soils, measured PIT infiltration rates would need to be in the 10-20 in/hr range for a 4 in/hr factored design infiltration rate, which would be typical of Type A soils. The typical long-term, factored infiltration rate in a Type C soil is normally around 0.5 in/hr, but can

be lower. Type B soils would fall in between, and can be highly variable, so 2 in/hr was assumed as a design infiltration rate for analysis. Therefore, the reference for this information is the Ecology SWMMWW (2019).

- How was the depth to water table determined? No citation was provided. Type C soils are likely to have shallow winter water tables. This is another factor that may make some parcels poor candidates for the facility.

  HDR Response: It was not determined at this screening level of analysis, but assumed to be of adequate depth (5 ft or greater from existing grade) to allow an infiltration trench BMP to be installed. This assumption can be added. Depth to water table would be variable depend on the depth of overburden soils (which may be more permeable) to underlying till. If adequate depth to shallow groundwater does not exist on a particular parcel, then those parcels may not be viable for this type of roof runoff infiltration BMP. Again, recharge benefits are incremental with parcel development, and associated only with parcels where the proposed County roof runoff development standard are technically feasible to implement.

- Average rainfall was used, but rainfall varies with time, and during wet spells soils may become saturated. Some analysis is needed for the amount of rainfall that would be in excess of infiltration capacity, based on patterns of rainfall in infiltration and soil saturation capacity. A factor should be applied for the reduction in potential infiltration.

  HDR Response: Rainfall variability is accounted for in the MGSFlood modeling analysis that is conducted using a long-term continuous time-series precipitation record and runoff simulation and recharge response to it. We're assuming a constant infiltration rate for subgrade soils based on soil type, even though some variability would likely exist over time. Generally, infiltration facilities tend to start with higher infiltration rates and performance, and can degrade over time with partial occlusion of subgrade soils. That effect is generically accounted for in the factored infiltration design rate.

- In Tables 3 and 4:

  - Only 15% of rainfall infiltrates in Group C soils. This suggests that 85% of the rainfall occurs at times when the soils are at capacity. Should the analysis assume that, if the soils can only infiltrate 15% of rainfall, it will also only infiltrate 15% of rooftop runoff?

    HDR Response: These values come from the MGSFlood continuous simulation modeling results. They suggest that under infiltration rates assumed for Type C (till) subgrade soils (0.5 in/hr design rate) that only 15% of the roof runoff volume would infiltrate in the infiltration trench area on an annual basis, under existing

development standards (min trench area per standards), and that 85% would result in overflow. Additional incidental infiltration down-gradient of the infiltration trench BMP could result in additional infiltration (not modeled), but for Type C soils, that would likely be limited, and result primarily in surface runoff to collection systems.

- What does "Net Average Annual Recharge Volume Gain" mean, and why does it get larger with less porous soils? I would expect the less infiltration capacity, the less recharge volume would result.

  HDR Response: It is the difference in roof runoff recharge volume per parcel on an annual average basis between baseline conditions (infiltration BMPs following existing development standards) and parcel developed conditions (larger infiltration facilities with sizes targeted to achieve either 95% or 100% infiltration). We analyzed the infiltration facility area that is required to achieve those post-developed infiltration volumes, which of course gets significantly larger in tighter soils. Since there is more change from baseline infiltration for Type C soils compared to Type A soils, the net recharge volume increases. I would expect that if we consider incidental infiltration beyond the infiltration BMP, that for Type A soils, the baseline would come up significantly in value, but for Type C soils, I would expect very little increase in baseline infiltration, so the net benefit in those tighter soils per parcel should remain relatively consistent with reported values. Type B soils would fall in between. Based on the GIS analysis conducted, the largest number of PE Wells were shown to be in Type B soils.

- If infiltration decreases with the Soil Group, the amount of offset benefit should decrease by soil group. Nowhere in the memo is this relationship shown.

  HDR Response: It is accounted for in the design infiltration rate, which under baseline conditions, results in less annual volume of infiltration progressing from Type A to Type C soils. In the parcel developed condition, we are adding to the infiltration BMP surface area to with tighter soils to achieve either the 95% or 100% average annual volume of infiltration. Therefore, the incremental net recharge benefit increases from Type A to Type C soils, as is demonstrated with the reported modeling results.

WDFW Comments sent to Angela Johnson 10/5/2020

- This approach proposes increasing the rate of infiltration of roof-top intercepted rainwater; therefore, any benefits would accrue within a short time period of the rainfall. The impacts of permit exempt wells are presumed continuous across the year and are likely to increase during dry periods. This makes it unlikely that any benefits accrued

from increased infiltration, would match the seasonal impacts of well withdrawals during critical flow periods.

HDR Response: Benefits from added recharge at parcels would primarily be seasonal (fall-spring) as noted, but the timing of those benefits to receiving water stream flow augmentation would be variable and extend over longer durations depending on hydrogeology/shallow groundwater interflow characteristics and travel paths to receiving waters. Agree that less recharge and stream flow augmentation benefit would be expected to occur in summer months. But the assumptions used in evaluation for annual volumes in water balance are the same as used in the for PE wells consumptive use evaluation for consistency.

- There are major assumptions imbedded throughout the technical memo including:
    - The analysis appears to only consider changes in infiltration based on soil type and roof/infiltration trench area. It is unclear whether the consumptive losses of evapotranspiration (ET) are considered in this analysis or accounted for in the MGSFlood model. ET losses could be significant but are not mentioned in the report.

      HDR Response: For the analysis, the estimated change in recharge compared to baseline applies only to the directly connected roof area. For the continuous simulation MGSFlood analysis, ET losses are built into the MGSFlood model runoff analysis, although I expect limited to evaporation that would be small for the impervious roof areas. For other parcel areas considered in a separate baseline analysis, ET losses are also evaluated in the runoff analysis from the various pervious area PERLND (soil type, veg cover) surfaces evaluated. That analysis doesn't enter into the net benefits evaluation.

    - It is unclear how the difference between pre-development infiltration and post-development infiltration is accounted for. The analysis appears to assume that nearly all water (95-100%) routed to the infiltration trench would contribute towards the estimated benefit.

      HDR Response: It is accounted for in the increased area of the infiltration trench BMP being used to simulate rooftop runoff infiltration characteristics and recharge quantities. For baseline conditions (existing County development standards), we set the roof infiltration trench length/area equal to the minimum development standard for that BMP type (20 sf per 700 sf of roof area) and evaluated for the various HSGs. For parcel developed conditions, we analyzed the required length/area of trench required to achieve annual infiltration volume of 95% and 100% of the annual roof runoff volume for the various HSGs based on assumed design infiltration rates (considered typical factored design values). There is a significant increase in infiltration facility size to go from 95% (approximately 2-yr event) to 100% full infiltration, so a slightly lower target (95%) makes more sense in setting a reasonable modified development standard for parcels infiltration facility sizing.

- Among other modelled assumptions, it is unclear how assumptions of average water table depth and average 1-acre clearing sizes were determined. Depth to water table and the effects of canopy interception from overhanging trees could significantly impact the estimated benefits.

  HDR Response: At this screening level of analysis, the assumption is that adequate depth to water table exists to apply a parcel development roof runoff infiltration BMP (typically 3 ft min from infiltration area subgrade, so 5 feet total including 2 ft depth of infiltration trench). The size of the cleared parcel is based on our understanding of what the County typically allows on a 5 ac parcel. We have not accounted for changes in recharge associated with the cleared area land cover area conversion at this level of analysis. Also, to our understanding, the County is not proposing a change in that criterion with the development standard change, which is focused on requiring only enhanced rooftop runoff infiltration) So that doesn't enter into the net benefits evaluation results as shown.

- There is no references section and the author of the memo is not listed.

  HDR Response: These will be added.

MEMO From Skokomish Tribe and Aspect Consulting with HDR Responses

Project No.: 190315

October 28, 2020

To: Dana Sarff, Skokomish DNR

cc: Seth Book, Skokomish DNR

From: Jonathan Turk, LHG; Jay Pietraszek, LHG

Re: **Technical Review of "Mason County WRIA 14 and 15 Rooftop Runoff Infiltration Recharge Analysis for Streamflow Augmentation Net Benefits"**

This memorandum presents Aspect's review of HDR's Technical Memorandum (Memo) "Mason County WRIA 14 and 15 Rooftop Runoff Infiltration Recharge Analysis for Streamflow Augmentation Net Benefits" (HDR 2020). The Memo was produced for the WRIA 14 and 15 Watershed Restoration & Enhancement Committees and documents the predicted benefits of capturing and infiltrating rooftop runoff for future rural residential (RR) development in Mason County. Aspect's review focused on the assumptions and methodology used by HDR. The model results and outputs presented in the Memo were not checked in detail.

Background

The Memo presents the predicted benefits to infiltration and recharge volumes from using rooftop collection and infiltration systems at future RR developments. Infiltration volumes were predicted for two conditions: a roof-down drain system (baseline) and infiltration trenches designed to capture all roof runoff (proposed) using MGSFlood, an Ecology-approved continuous simulation hydrologic model. The infiltration trenches under the proposed condition were varied in size based on soil hydrologic classifications. The increase in infiltration volumes under the proposed condition were extrapolated to represent the net-gain in recharge based on the proposed parcel buildouts in WRIA 14 and 15.

General Comments

We agree with the key principle behind the project: increasing infiltration of rooftop runoff will have a net benefit on groundwater recharge and streamflows and creates the potential for offset credits. We acknowledge that accurately quantifying the benefits is difficult. HDRs assumptions and methods produced results that may represent a best-case scenario but could be deemed unrealistic.

The simplified approach of extrapolating unit infiltration trench simulations to the watershed scale has inherent spatial and temporal limitations. Consideration of a more conservative approach and/or the use of a range of input values to account for uncertainties and unknown variability may be warranted. We recommend conditioning the interpretation of the results from the rooftop runoff analysis to consider:

- ***Water losses under the baseline condition:*** In the current model runoff that doesn't infiltrate into the roof-down drain system does not reinfiltrate and is considered lost (i.e., consumptive). In reality, at least a portion of this "overflow" could pond or disperse and eventually re-infiltrate. Some of the overflow may run onto an impervious surface and/or be lost to evapotranspiration. Differentiating between these portions may be needed to accurately assess the offset quantities

  HDR response: The analysis has been updated to estimate the extent of baseline conditions infiltration beyond the infiltration trench using a filter strip BMP (simulating an improved lawn area), conservatively sized, and analyzed within MGSFlood to estimate residual infiltration beyond the infiltration trench. Also note that a wider range of infiltration rates have been evaluated, and a slightly higher average infiltration rate (5 in/hr) has been applied for baseline analysis in Group A soils for the net recharge benefit analysis (Group B and C soils average infiltration rates remain the same).

- ***Differentiate between infiltration and recharge:*** The proposed modifications will increase the amount of roof runoff that will infiltrate into the soil. The infiltrated water will either remain in the soil, discharge to surface water as subsurface stormflow (i.e., interflow) or percolate and recharge shallow groundwater. Soil water may eventually be lost to evapotranspiration. Both the stormflow and groundwater recharge volumes may discharge to surface water (with variable time lags) or exit the basin as groundwater flow. Increasing the amount of infiltration will have a net benefit surface water but the timing and magnitude of the surface water benefits, and benefits to baseflows, are dependent on numerous factors. The implication in the Memo is that 100 percent of the infiltration will eventually report to surface water, which is not necessarily certain.

  HDR response: Comment acknowledged, but the scope of the analysis doesn't include more advanced hydrolgeologic analysis, and the database at this higher level of evaluation doesn't support that analysis. Evapotranspiration losses are considered in the MGSFlood model runoff analysis, but for runoff generated by rooftop surfaces, that component is minimized (it is a larger component of vegetated pervious areas runoff generation). Also, the assumptions pertaining to the timing of recharge are consistent with the consumptive use assumptions on PE well withdrawals.

Specific Questions/Comments and Recommendations

Background Section

1. Some terminology is presented in this section and used in later sections should be clarified. Specifically, the terms 'recharge', 'infiltration', 'infiltration recharge', 'roof infiltration', and 'groundwater recharge' are used somewhat interchangeably and should be defined in this section.

- Recommendation: Revise text to provide clarification to the terminology, particularly with the last sentence in the first paragraph.

  HDR response: The terminology regarding infiltration and recharge has been clarified as appropriate with revisions to the technical memorandum.

2. Is there anything that can be identified with respect to the design of a typical infiltration trenches (construction details, completion depths, etc.) to indicate that infiltration into a trench will be more efficient than a typical downspout dispersion system beyond simply the size?

   - Recommendation: Provide clarification and details in the text, if possible.

     HDR response: Mason County standards provide typical sections of infiltration trenches and other infiltration BMPs for rooftop runoff downspout infiltration. Infiltration through an infiltration trench sited appropriately on subgrade soils are typically more efficient than dispersion onto surficial soils with the same area footprint for the following reasons 1) an infiltration trench is a gravel lined facility intended to intersect more permeable subgrade soils, 2) it will allow up to 2 feet depth (per Mason County standards), increasing the hydraulic gradient and infiltration discharge for a given soil permeability value on the infiltrating surface, and 3) Surficial soils typically have more fines, which tend to limit the their permeability and infiltration rates through them. The filter strip analyzed in the revised analysis demonstrates that for limited infiltration volumes for a much larger area compared to the modeled infiltration trench larger infiltration volumes.

Methods Section

1. A single soil permeability rate (infiltration rate) for each soil type was used in the analyses. It would be helpful to provide a reference for these values. Further, there is considerable variability in infiltration rates and a single value may not be a representative of actual conditions, for Group C soils in particular. The infiltration rates for Group C soils may be much lower than the value used in the analyses. For example, the range of infiltration rates for Group C soils with turf vegetation is 0.03 to 0.06 inches per hour in the Western Washington Hydrologic Model (WWHM; Appendix B of the User's Manual)[59]. These rates are much lower than the 0.5 inches per hour used in the analyses.

   - Recommendation: Consider using a range of infiltration rates to illustrate variability. Using lower rates for Group C soils would result in much larger infiltration trenches than those already indicated. Consider the feasibility and practicality of the size requirements for the infiltration trenches in till soils.

     HDR response: The revised analysis does include a larger range of infiltration values, with an average value used for the net benefit analysis. HDR certainly understands

[59] WWHM is referenced in Volume III-2.2 SWMMWW as a recommended hydrologic model.

that infiltration rates can be highly variable in a given soil group, and the range of values applied is typical in western WA for long-term operational design using factored infiltration rates compared to field-measured rates in accordance with the 2019 Ecology SWMMWW. Some classes of till soils can have smaller infiltration rates, but the average value assumed for analysis is within a range of values that can extend up to or above 0.75 in/hr. For soils much less than 0.5 in/hr, infiltration facility sizes to accommodate target infiltration rates for proposed conditions would not be practical, and roof infiltration systems in those tighter soils are acknowledged as likely not feasible.

2. The analyses base the infiltration volumes as either 95 percent or 100 percent of the annual precipitation. This may be an overestimation. Consider, for example, that: (1) rooftop runoff coefficients may range from 0.75 to 0.95 (e.g., Dunne and Leopold 1978), and (2) correction factors are recommended to account for long-term reduction in infiltration system performance (due to clogging, etc.).

    - Recommendation: Consider using reducing the volumes available for infiltration to account for the inefficiencies described above.

      HDR response: The analysis was conducted using the MGSFlood model considering the roof as a non-pollution generating impervious surface. Loss rates are built into the model. Based on the modeling results, a typical 2,800 sf (0.0642 ac) roof generates an average runoff volume of 0.335 ac-ft/yr. Considering the modeling is done for a MAP of 70 inches, the precipitation volume falling on the roof is 0.375 ac-ft/yr, so the modeled roof runoff volume is approximately 89 percent of the precipitation volume, within the range of coefficients noted in the comment. Therefore, the analysis results do account for about 11 percent loss in runoff volume compared to precipitation volume.

Results Section

1. The results that show 50 percent of the annual precipitation is recharged over the pervious portions of the lots needs further clarification. The implication that 50 percent of the total precipitation on undeveloped land is recharged to groundwater is most likely an overestimation. It is understood that the analyses for pervious land infiltration was not used in the offset calculations.

    - Recommendation: Provide clarification.

      HDR response: The analysis results for a typical parcel development (beyond the roof area analyzed separately) are output from the MGSFlood model based on the collective land cover and area assumptions as stated. That result will vary with soil group, with a group A highly pervious soil generating significantly more runoff that a group C till soil. As noted, these results are only provided as background, and would be the same under both analysis scenarios, so they do not affect the net recharge benefit analysis results.

2. The results show that large infiltration trenches are required to infiltrate the full volumes in Group C soil types. Consideration of the practicality of constructing and maintain a large

trench, as well as, the long-term performance of an infiltration trench completed in a Group C (glacial till) soil (particularly with respect to the uncertainty with Group C soil infiltration rates described above).

- Recommendation: Consider the overall impact to the net recharge calculations of either removing the Group C soils from analyses entirely or assuming only a certain percentage of the residences with Group C soils will have functional infiltration trenches.

  HDR response: This has been addressed in the analysis based on discussions between and agreed to resolution between Ecology and Mason County staff. The outcome was to evaluate group C soils under proposed conditions using a maximum area infiltration trench that Mason County is in agreement with (620 sf), and determine the expected infiltration volume where less than the target value agreed to for other soil groups (85% annual infiltration volume typical). Based on the revised modeling at 0.5 in/hr permeability, the maximum volume accommodated by that size trench per parcel is 0.230 ac-ft/yr or 69 percent of the annual roof runoff volume.

Limitations

Work for this project was performed for the Skokomish Tribe (Client), and this memorandum was prepared in accordance with generally accepted professional practices for the nature and conditions of work completed in the same or similar localities, at the time the work was performed. This memorandum does not represent a legal opinion. No other warranty, expressed or implied, is made.

All reports prepared by Aspect Consulting for the Client apply only to the services described in the Agreement(s) with the Client. Any use or reuse by any party other than the Client is at the sole risk of that party, and without liability to Aspect Consulting. Aspect Consulting's original files/reports shall govern in the event of any dispute regarding the content of electronic documents furnished to others.

Skookum Valley Railroad Culvert Blockages

PROJECT DESCRIPTION

Description

Skookum Creek is a tributary that flows into Little Skookum Inlet in South Puget Sound. Skookum Creek and its tributaries support chum and coho salmon, as well as a prolific population of sea run cutthroat trout. Steelhead are present but rare. Multiple tributaries to Skookum Creek are blocked by culverts that run under the railroad on the north side of the valley. This railroad is called the Puget Sound and Pacific Railroad (PSAP), and it is owned by Genesee and Wyoming (Darien, Connecticut). Replacing those culverts could open up as much as 5 miles of spawning and rearing habitat in the Skookum watershed.

Qualitative assessment of how the project will function.

This is a proposal to replace a minimum of 8 culverts, perhaps as many as 15 culverts along the PSAP railroad that are full or partial barriers to upstream fish passage.

Tasks:

- Survey length of railroad through Skookum Valley to fully inventory all culverts.
- Field verify amount of available fish habitat upstream of blocking culverts. This will also involve field verification of stream location and correction on WDFW maps.
- Reach out to Genesee and Wyoming to ask for their cooperation to replace all blocking culverts.
- Set in place a culvert replacement schedule and plan with Genesee and Wyoming (PSAP).
- Work to ensure that the culvert replacement schedule is followed.
- Work with WRIA 14 Lead Entity on prioritization schedule for replacement based on their comprehensive barrier prioritization tool.

Conceptual-level map and drawings of the project and location.

See map on the next page of blocking culverts under the PSAP Railroad. The map was generated from the WDFW fish passage map and then annotated.

Listed below are the culvert ID numbers, as listed on WDFW's fish passage map. The number of miles of fish habitat upstream that would be accessible by fish, if these culverts were open to fish passage, has been estimated. Individual reports for each listed culvert can be accessed by clicking on the culvert location in the fish passage map.

MC263- ~2,400 ft

MC264- ~12,000 ft

MC265- ~1,200 ft

MC266- ~4,000 ft

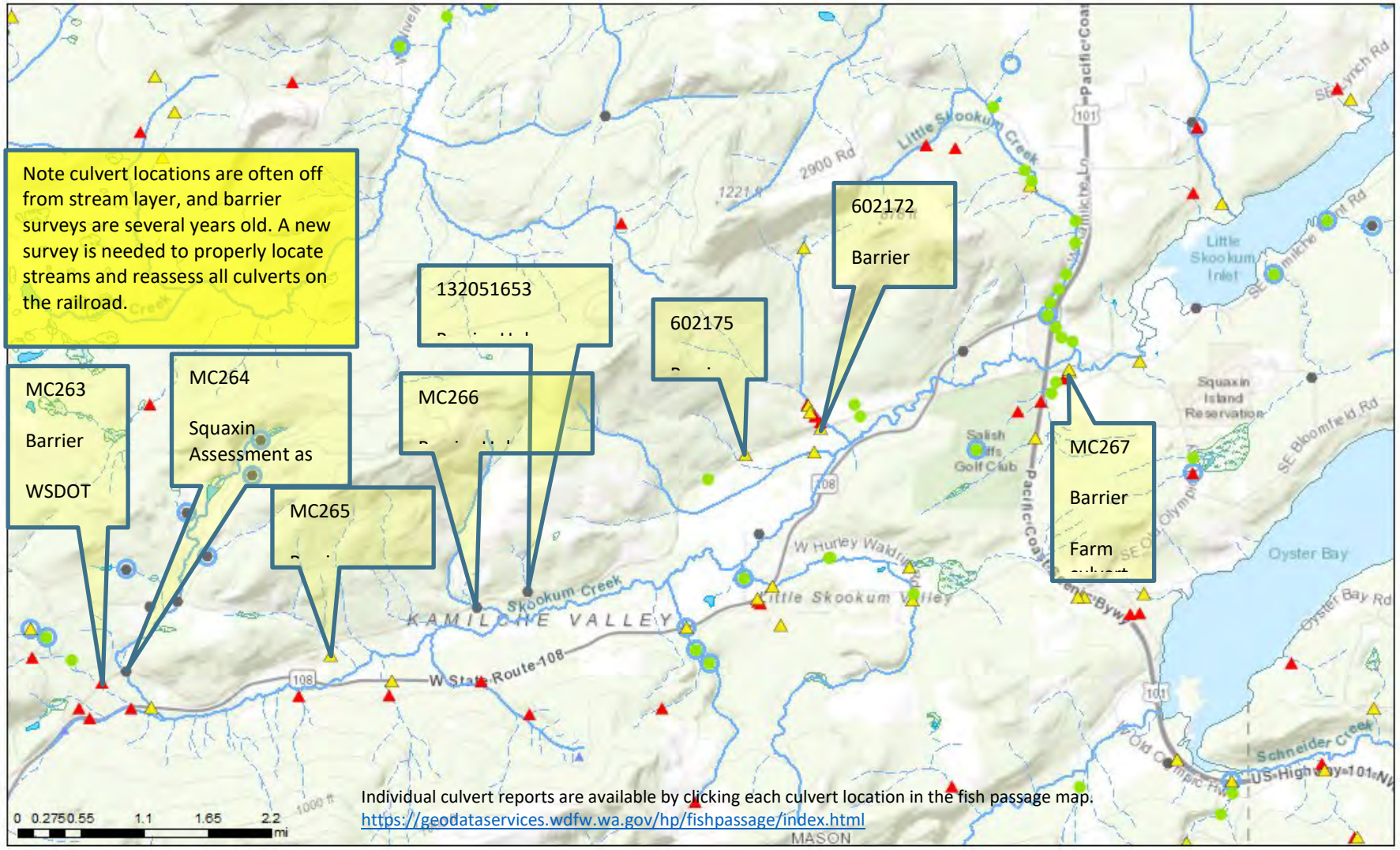
132051653- Unknown

602175- ~3,200 ft

602172- ~3,000 ft

MC267- ~1,800 ft

Total = ~27,600 or 5.2 miles of fish habitat could be made accessible again.


Note culvert locations are often off from stream layer, and barrier surveys are several years old. A new survey is needed to properly locate streams and reassess all culverts on the railroad.
MC263
Barrier
WSDOT
MC264
Squaxin
Assessment as
MC265
MC266
132051653
602175
602172
Barrier
MC267
Barrier
Farm
Skookum Creek
KAMILCHE VALLEY
W State Route 108
Little Skookum Creek
Little Skookum Valley
Pacific Coast Scenic Byway
Squaxin Island Reservation
Salish Cliffs Golf Club
Little Skookum Inlet
Oyster Bay
Oyster Bay Rd
SE Bloomfield Rd
Schneider Creek
2900 Rd
MASON
0 0.275 0.55 1.1 1.65 2.2 mi
Individual culvert reports are available by clicking each culvert location in the fish passage map.
https://geodataservices.wdfw.wa.gov/hp/fishpassage/index.html
Washington State Fish Passage
Washington Department of FISH and WILDLIFE
Not a barrier
Partial Fish Passage Blockage
Total Fish Passage Blockage
Barrier, Unknown Percent Passable
Diversion
Natural Barrier - Verified
Unknown
Corrected Barriers
NHD Coastline
NHD Rivers
Stream / Perennial
Intermittent / Ephemeral
Canal, Ditch
Pipeline
Connector
NHD Waterbody
Lake, Pond, Reservoir
Swamp, Marsh
Ice Mass
http://apps.wdfw.wa.gov/fishpassage/?extent=-123.2305,47.0853,-123.0566,47.1571
Exported: 11/17/2020 2:11:22 PM

Description of the anticipated spatial distribution of likely benefits

Access to tributaries on the north side of Skookum Valley, from headwaters to Little Skookum Inlet on Puget Sound.

Performance goals and measures.

Number of miles of habitat made accessible to anadromous fish, as each culvert is removed.

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.

The Washington Department of Fish and Wildlife has identified that coho salmon, chum salmon, steelhead trout, and coastal cutthroat trout have spawning populations in Skookum Creek (WDFW Salmonscape 2020. Steelhead may be present, but are rare. The extent of fish depicted in Salmonscape is an underestimation.

Identification of anticipated support and barriers to completion.

It is likely that there will be broad support for a project like this in the WRIA 14 WREC Committee, as well as generally. The most difficult challenge in this project would be acquiring the cooperation of the Genesee and Wyoming Railroad Company.

Potential budget and O&M costs.

Costs are estimated to be between $1-5 million, depending on design.

Anticipated durability and resiliency.

Design life of these culverts would probably be at least 50 years.

Project sponsor(s) (if identified) and readiness to proceed/implement.

The project sponsor would be the SIT. The SIT would begin Project implementation with a feasibility and design study.

References

WDFW (Washington Department of Fish and Wildlife), 2020. Salmonscape mapping of fish distribution. Available at: http://apps.wdfw.wa.gov/salmonscape/

WDFW (Washington State Department of Fish and Wildlife). 2020. Fish passage map. https://geodataservices.wdfw.wa.gov/hp/fishpassage/index.html

Skookum Valley Ag Project

PROJECT DESCRIPTION

Description

Skookum Creek is a tributary that flows directly to Little Skookum Inlet and is important for supporting coho salmon, chum salmon, winter steelhead, and coastal cutthroat trout. Habitat in Skookum Creek has been simplified, in part, due to habitat simplification from agricultural land use within the Skookum Valley floodplain. Some reaches of the Creek have been moved to the edge of the valley wall to maximize agricultural production, and not allowed to meander through its channel migration zone. This has resulted in channel incision (streambed downcutting) loss of side channels, loss of off-channel habitat, and reduced floodplain connectivity.

The proposed Skookum Valley Ag Project (Project) will re-align a reach of the stream channel that is currently confined to the valley wall, back into its historical alignment and natural meander pattern. This Project is intended to be the first step in larger scale realignment into historical alignment and allowed to meander through its channel migration zone.

Qualitative assessment of how the project will function.

The proposed project will increase stream length from 920 feet to 1530 feet, an increase of 610 feet (Figure 1). The re-alignment will include instream structures (e.g. large woody debris and engineered log jams) that) that will increase habitat complexity. These structures will contribute to bedload retention and will contribute to reduction of channel incision, in combination with other future projects. Riparian vegetation will be established around the new stream alignment.

Conceptual-level map and drawings of the project and location.

Figure 1. Skookum Valley Ag channel relocation.

Description of the anticipated spatial distribution of likely benefits

The Project will increase channel length in Skookum Creek by 610 feet. This will increase usable aquatic habitat.

Performance goals and measures.

The performance goals are to increase stream length by 610 feet with an appropriate channel geometry, large woody debris density, pool density and residual depth, stable banks, and riparian zone establishment. Specific metrics for these attributes will be defined based on the restoration design.

Descriptions of the species, life stages and specific ecosystem structure, composition, or function addressed.

The Washington Department of Fish and Wildlife has identified that coho salmon, chum salmon, steelhead trout, and coastal cutthroat trout have spawning populations in Skookum Creek (WDFW Salmonscape 2020). WDFW (2020, 1975).

Skookum Creek has several habitat factors that are limiting to fish productivity, including low summer base flow, high summer water temperature, suboptimal large woody debris and pool density, and spawning gravel quality, This Project will contribute to addressing these factors at the reach scale. The increased channel length and re-alignment may allow for more groundwater contribution. The presence of the impoundment directly to the northwest of the proposed alignment would provide a hydraulic gradient to push cool groundwater into this stream alignment. The installation of large woody debris and establishment of riparian vegetation will contribute to optimal

large woody debris density, pool density, and will create the hydraulic complexity to sort sediments, leading to pockets of suitable spawning gravels.

Identification of anticipated support and barriers to completion.

The proposed Project is located on land previously acquired by the Squaxin Island Tribe (SIT). The SIT is supportive of this Project.

Potential budget and O&M costs.

The total costs of construction, engineering, permitting, and cultural assessments are estimated to be <$1.0 million, based on an order of magnitude cost estimate (includes engineering and construction costs).

Anticipated durability and resiliency.

The project would have lasting benefits and would not require operation and maintenance, once it is established.

Project sponsor(s) (if identified) and readiness to proceed/implement.

The project sponsor would be the SIT. Project implementation would begin with a feasibility and design study.

References

WDF (Washington Department of Fisheries), 1975. "A Catalog of Washington Streams and Salmon Utilization, WRIA 15." Accessed at: https://www.streamnetlibrary.org/?page_id=95.

WDFW (Washington Department of Fish and Wildlife), 2020. Salmonscape mapping of fish distribution. Available at: http://apps.wdfw.wa.gov/salmonscape/

Water Right Screening Methodology

TECHNICAL MEMORANDUM

To: Department of Ecology WRIA 14 Watershed Restoration and Enhancement Committee

From: Peter Schwartzman, LHG

Burt Clothier, LHG

Re: Water Right Screening Methodology

Date: December 22, 2020

This technical memorandum documents the methodology used to screen and select water rights for potential use to support watershed restoration and enhancement projects in the Kennedy-Goldsborough Basin, Water Resources Inventory Area (WRIA) 14. This work was completed by Pacific Groundwater Group (PGG) on behalf of the WRIA 14 Watershed Restoration and Enhancement (WRE) Committee (Committee) and the Department of Ecology (Ecology). This work was performed under Ecology Contract Number C1700029, Work Assignment PGG104.

Under RCW 90.94.030, Ecology has the responsibility to convene WRE committees and prepare WRE plans for eight WRIAs in the Puget Sound and Hood Canal areas. The general purpose of the plans is to document potential offsets to projected depletion of instream flows resulting from new, permit-exempt domestic well uses in the WRIAs over the next 20 years.

To support development of the WRE plan for WRIA 14, PGG assisted the Committee in selecting a focused set of water rights for further review to assess potential benefits and their suitability in offsetting impacts from permit-exempt wells on instream flows. This memorandum outlines the methodology used to develop the focused list of water rights.

PROCEDURE

Ecology staff queried their Water Rights Tracking System (WRTS) database and provided tables and associated GIS data of all active water rights within WRIA 14. Inactive water rights (e.g., previously approved changes, cancelled or withdrawn applications) were excluded from the data provided by Ecology. Water right claims and pending applications for new water rights or water right changes were also removed during the screening process.

The provided GIS data included the mapped place of use and point(s) of diversion or withdrawal locations, where available. Where Ecology did not have detailed location information for points of diversion or withdrawal (or such information has not yet been added to their GIS dataset), the default location is generally the nearest quarter or quarter-quarter section, based on the water right file information.

The Committee identified several criteria for identifying potential water-rights where acquisition would have the greatest benefit:

- Surface-water sources were considered to be more useful than groundwater sources, as they provide direct improvement to streams.
- Preferred water-right purposes include irrigation (IR) and commercial/industrial (CI). Later in the process, PGG introduced consideration of domestic multiple (DM) water rights, since nearby municipal water systems (e.g. Shelton) potentially could have capacity to supply smaller Group A or B water systems. All other domestic categories (domestic single and domestic general) and municipal rights were excluded from the analysis based on the expectation that these rights would be unavailable for mitigation or too small (unless otherwise identified by the Committee).
- The Committee identified five priority subbasins (Goldsborough, Mill, Hood Canal, Oakland and Skookum) which include 11 key creeks: (Mill, Gosnell, Sherwood, Schumacher, Skookum, Goldsborough, Cranberry, Johns, Deer, Alderbrook and Twanoh). Prioritization was based on consideration of habitat (Salmon tier "A" and Salmonscape miles) and streamflow regulation (instream flow requirements and closures).

FINDINGS

Approximately 400 active water right files were identified within the five priority subbasins. PGG prepared histograms that sorted IR and CI water rights by quantity towards meeting the desired mitigation offset.

- Surface-water rights were initially sorted by instantaneous quantity (Qi). Among a total of 165 rights representing 672 cfs (159 IR and 6 CI rights), 70 had Qi less than 0.03 cfs and 150 had Qi less than 0.5 cfs. Five water rights were identified with Qi greater than 1 cfs, of which 3 are associated with CI (gravel mining/processing and timber processing) and two are associated with IR.
- Surface-water rights were also sorted by annual quantity (Qa); however, 87 of the 165 surface water rights had no stated Qa, For these cases, PGG estimated Qa based on stated irrigated acreage (77 of 87 rights had irrigated acreage listed) and an assumed irrigation duty of 2 feet. Out of 155 water rights with stated or calculated Qa totaling 4,053 acre-feet/year (af/yr), 96 had Qa less than 10 af/yr and 114 had Qa less than 20 af/yr. Sixteen "large" (>80 af/yr) rights were identified, of which 15 are associated with IR and one is associated with CI.
- Groundwater rights were sorted by annual quantity (Qa). Among 33 IR rights and 16 CI rights (a total of 49 rights representing 24,327 af/yr), 21 had Qa less than 10 af/yr and 30 had Qa less than 20 af/yr. Twelve "large" (>80 af/yr) rights were identified, of which 10 are associated with CI (timber processing, shellfish) and two are associated with irrigation.

In order to identify higher-value water-right acquisition possibilities and provide a more manageably sized list, water rights with a Qa of less than 10 af/yr were removed. This arbitrary cut-off resulted in reducing the list from 400 to 99 water rights with a combined allocated volume of 28,021 af/yr (24,242 from groundwater and 3,778 from surface water).

Table 1 lists the water rights in the five preferred subbasins that could potentially be converted, purchased, or retired as mitigation water, while **Table 2** is a general summary of the focused water right list. **Table 2** provides summed (total) Qa's for the water rights listed in **Table 1** for each priority subbasin, but does not provide summed Qi's because Qi is often not representative of the actual volume of water allocated. Some surface-water rights do not have Qa's listed (**Table 1**); therefore, these rights are not included in the totals on **Table 2**.

These summaries should not preclude the Committee from pursuing specific water rights in other subbasins that could be identified in the future by other means. Therefore, moving forward, the Committee should investigate the availability of rights in the focused study area as well as in the broader WRIA if specific rights are identified. In addition, the Committee may wish to investigate expected Qa for surface-water rights without specific Qa allocations.

It is understood that the offset credit from retiring or increasing the efficiency of IR rights is limited to the associated reduction in *consumptive* use rather than the reduction in *total* use. Similarly, CI water rights were recognized to have both consumptive and non-consumptive portions, of which only consumptive portions could be used for mitigation offsets. Some of the larger water rights listed in the attached tables are for CI purposes associated with timber and sand & gravel operations, and may include a significant portion of non-consumptive use.

The Committee provided input on known water rights. Several IR rights had been acquired by the Squaxin Tribe and were no longer available for mitigation. PGG used satellite imagery to assess evidence of irrigation for the largest 13 IR rights (50-200 irrigated acres) within the five preferred basins, and noted that while most had cleared (or potentially cultivated) land nearby, only four (two golf courses and two agricultural properties) showed observable evidence of irrigation. Committee members agreed that windshield or desktop surveys would better confirm the occurrence of active IR water rights. Thurston County staff performed a limited windshield survey and identified 14 IR rights in Thurston County (Kennedy subbasin) that appear to be in current use. The Squaxin Island Tribe performed additional desktop aerial surveys which resulted in a "targeted" list that the Committee has identified will be a priority for future investigation or acquisition.

Finally, PGG used GIS analysis to identify which smaller DM public water systems are located within or near the Shelton water system service area, with the idea that smaller systems could potentially be sourced from the Shelton system to make their water right available for mitigation offset. PGG identified 27 PWS located within a mile of the Shelton service area. The closest ones have relatively small water rights (Qa <40 af/yr). Larger systems had Qa's of 166 af/yr (2,700 feet away), 160 af/yr (a mile away) and 90 af/yr (4,900 feet away). The Committee considered it unlikely that these water systems would be able to "hook up" to Shelton and operate under their water right.

Source Substitution on Schneider Creek

Project Name:	Source Substitution on Schneider Creek (TC Project #143)
Project Location:	Kennedy Creek management unit in northwestern Thurston County. See Figures 1 and 2. *Lon. -123.05114 Lat. 47.09222*
Project Description:	☑ Water Right Acquisition ☑ Non-Acquisition Water Offset ☐ Habitat/Other **Project Overview** Conceptually this project involves the purchase and retirement of existing irrigation water right certificates, replacement with new irrigation source well(s) under a new water right permit, irrigation efficiency improvements, and ditch removal with stream restoration. See Figures 1 and 2 for maps of project details: • Water right certificates for consideration for possible full/partial retirement as part of a source-substitution project. • Future well location(s). The hypothetical new irrigation source wells would be located near well AKR885 (log attached) to substitute for part of the valid portion of these certificates. • WSDA pasture where irrigation was observed in the field, and where the proposed surface water rights' Place of Use may apply. • MODFLOW groundwater streamlines (steady-state) from the hypothetical well(s) pumping 300gpm. • Potential stream restoration zone along a Schneider Creek tributary. The current ditch draining wetlands could be replaced with a re-meandered stream approximately replicating the historic stream channel. The project involves a cluster of pastures on the north side of US101 along Schneider Creek that collectively appear to be associated with five certificated surface water rights (See Figure 1). The amount of potential water available is sizeable: +1.4cfs irrigation combined, with water rights that appear to be at least

partially active. Field windshield screening indicated they have some visible irrigation works. These five certificates are as follows:

1. **Surface water certificate S2-*10859CWRIS** is the most significant in terms of the water it could provide – namely 1 cfs and enough water to irrigate 100 acres. Part of this use was field-verified in July 2020 by observing irrigation works and apparent be irrigation of 40 acres. The use period for this water right is April 15 through October 1.
2. **Surface water certificate S2-*09745CWRIS** is an irrigation-only water right with an April 15 through October 1 use period.
3. **Surface water certificate S2-*10229CWRIS** has irrigation and domestic purposes of use, and the use period for the irrigation portions end October 1st.
4. **Surface water certificate S2-*02995CWRIS** has irrigation and domestic purposes of use, and the use period for the irrigation portions end October 1st.
5. **Surface water certificate S2-*02996CWRIS** permits domestic water-use only.

The attached copies of water right certificates indicate original authorizations to irrigate up to 150 acres of land. However, in Washington State, water rights are subject to a 5-year relinquishment standard and only remain valid to the extent they are thus put to use. Assuming an irrigation duty of 1.3 feet of water per season (the pasture annual irrigation rate for Shelton listed in the Washington Irrigation Guide), 150 acres of irrigated water use would require about 195 afy (acre-feet per year) of water towards a maximum of approximately 700 afy. However, due to Washington State's water right relinquishment standard, it is quite possible only a portion of that quantity is still valid.

The project element involving ditch removal and stream restoration is highlighted on Figure 2. The ditched part of the wetlands on the north tributary of Schneider Creek is about 3,400 feet long. The current ditch drains wetlands, but that could be replaced with a re-meandered stream approximately replicating the historic stream channel, with significant habitat improvements.

Site Hydrogeology

Hydrogeology in the project vicinity has not been extensively studied. Thurston County has developed a groundwater flow model across the project area based on

	geologic mapping by the WA Geological Survey, and this is generally calibrated to approximate well water levels and streamflows. However, many questions remain. The site-specific hydrogeologic information used in this project summary comes from three main well logs (see attachments): • **Well AGK602 – Holiday Valley Estates (1968).** This older Holiday Valley well produced 233 gpm from torch-cut slots, with about 22 feet of drawdown over 4 hours, from a sand and gravel unit between 116-127 feet below ground surface. The well encountered several layers that appear to be aquitards. Please see the attached well log, and Figure 2 for the well location. • **Holiday Valley Estates (1981).** This 10-inch diameter cased-and-screened production well was drilled to 133.5 feet and terminated at basalt bedrock. From 117 to 133.5 feet below ground, in sand and gravel immediately above bedrock, the well produced 200 gpm with 26 feet of drawdown during a 4-hour test from two 5-foot screened sections. The well encountered several layers that appear to be aquitards. Please see the attached well log, and Figure 2 for the well location. • **Well AKR885 – Vaugh Litchfield (2004).** This 6" ID open pipe domestic well was drilled to 218 feet near Schneider Creek. The well produced 30 gpm during a one-hour open-pipe airlift test (i.e. no well screen, no measured drawdown). The well encountered several layers that appear to be aquitards. Please see the attached well log, and Figure 2 for the well location. In summary, according to testing performed at the time of drilling, yields from two wells were at/over 200 gpm, suggesting very productive rates were possible from the confined aquifer at the Holiday Valley water system wells. Well AKR885 produced at least 30 gpm from a short open section and no screen. These results suggest the following: • Assuming that even higher production rates will be possible with future wells, target irrigation flowrate of 300 gpm may be achievable using one to three new source wells (groundwater flow modeling assumed this rate in Figure 2). • The target aquifer is confined. Long-term well performance should be evaluated, including seawater intrusion and effects on other nearby wells.

	• Induced stream baseflow losses may be reduced near the new irrigation wells because confining layers exist. However, some stream baseflow losses may occur in more distant areas yet to be determined. • Current MODFLOW modeling suggests that source waters feeding the wellfield are from upland areas south of the wells (see Figure 2), but this must be evaluated during the project. • Modeled steady-state groundwater elevations with a pumping rate of 300 gpm are near/below sea level. Although the proposed pumping will be seasonal, induced saltwater intrusion and effects on nearby wells' water levels should be evaluated. **Background** Substituting a deep GW source for the current surface water irrigation will lessen the hydrologic impact to the stream overall (assuming that the deep aquifer primarily discharges to seawater). However, there are legal hurdles associated with this approach. Chapter 173-514 WAC places a seasonal closure on Schneider Creek from May through October. Although it has yet to be evaluated, it is quite possible that groundwater pumping associated with a new irrigation source would impact Schneider Creek baseflow. And, since the effects of seasonal pumping would take some time to work their way through the hydrogeologic system, under that scenario the effects of pumping on Schneider Creek would not cease on October 1st. At least the largest of the 5 subject water rights, S2-*10859CWRIS, has an October 1st cut-off date, so any effects due to groundwater pumping of that water right would spill over past that water right's authorized use period. Some of the other water rights may face similar hurdles, but more research would be needed to make that determination. In years past it might have been possible to mitigate impacts during the month of October more creatively. However, the 2015 Washington State Supreme Court Foster decision has changed the legal framework for source substitution projects. Due to the Foster decision, it is quite possible the only way to deal with the month of October would be to have a situation where there are no adverse impacts due to pumping during that month.

	At least part of the solution to reducing or eliminating potential October impacts could involve relinquishment of the water rights other than S2-*10859CWRIS. More research is needed, but if any of those water rights permit water use throughout October, those rights could be used to cover at least part of the late-season impacts. However, a cursory look at the other water rights suggests that only one, S2-*02996CWRIS, does not have an October 1st cutoff, and the Qi associated with S2-*02996CWRIS is only 0.02 cfs. Another potential option for reducing or eliminating October impacts would involve pairing this source substitution project with some sort of flow augmentation project or perhaps an MAR project that would somehow utilize water that is available at some other times of year to then provide an offset during October. However, this option may be cost prohibitive. Finally, there is the possibility that the Washington State legislature could change the law with a so-called "Foster fix, to allow more latitude with regard to source exchange projects in the future. **Summary of Major Project Elements** • Feasibility Study to determine what type of project is viable, including the following elements: o Assessment of the extent and validity of the 5 certificates. o Determine what fraction of the valid part of these rights can be retired. o Install, aquifer test and model the effects of source substitution well(s). o Determine the irrigated area and the efficiency of the new irrigated area for supply by the new wells. o Negotiate the purchase, new irrigation configuration and partial retirement options for the five water rights. o Determine the impacts to nearby streams and any resulting mitigation requirements. o Evaluate the engineering feasibility and cost options for the project. • Following approval of a feasible option: o Obtain a groundwater withdrawal permit(s) from Ecology o Provide the production wells, irrigation works/modifications, utility connections and permits. o Implement any permit-required mitigation. o Implement the ditch removal and stream restoration elements of the project.

Description of Benefits:	1. **Summary of potential water offset benefits from the project: (**195 afy) x (0.33 irrigation efficiency improvement/retirement fraction) = (64 afy water offset benefit), depending on multiple factors. This assumes the benefit incorporates any mitigation required for the new groundwater permit. Water offset benefits may be smaller if groundwater permit mitigation complexities emerge. 2. **Increased streamflows on Schneider Creek.** 3. **Improvement in stream function for fish habitat.**
Is Water Quantity a Limiting Factor In this Subbasin?	Unknown.
Location & Spatial Extent of Benefits:	Flows could be increased in Schneider Creek from the area of stream restoration, through the area of the five water rights "Points of Diversion", then downstream to its confluence with Totten Inlet.
Anticipated Water Offset (if applicable):	**Summary of total potential water offset benefits** from the project: approximately 64 afy, depending on multiple factors.
Project-Type Specific Information	
Estimated Project Cost:	Several hundred thousand dollars, at minimum, for new source wells, engineering, permitting and new infrastructure.
Performance Goals & Measures:	Weather and water quality monitoring is already performed by Thurston County; however, additional monitoring is likely to be needed. (See: https://www.thurstoncountywa.gov/sw/Pages/monitoring-dashboard.aspx).
Anticipated Local and Partner Support & Barriers to Completion:	1. The Squaxin Island Tribe has indicated that it may support this project. 2. This project depends heavily on achieving sufficient new well yields. Significant questions exist regarding pumping well production. 3. Some form of required mitigation for the new groundwater permit is likely.

	4. Modeled steady-state groundwater elevations with a pumping rate of 300 gpm at the proposed new wellfield are near/below sea level. Although the proposed pumping is expected to be only seasonal, induced saltwater intrusion and effects on nearby wells' water levels should be evaluated.
Project Sponsor, Implementation Start Date and End Date:	Thurston County may sponsor this project, depending upon Feasibility Study outcomes. The project will need a thorough assessment of well yields, a Report of Examination from a CWRE, plus additional hydrogeological, legal, financing and engineering feasibility studies.

Steamboat Middle Storage Enhancement and Habitat Improvements

Project Name:	Steamboat Middle Storage Enhancement and Habitat Improvements (Thurston County ID 110)
Project Location:	Project is in WRIA 14 on the Steamboat Island peninsula, northwest of the City Olympia, north of US 101 and just south of Steamboat Island Road NW (see Figure 1). Kennedy Creek management unit. The project includes unnamed tributary streams feeding Young Cove. *Longitude: -122.9894, Latitude: 47.1208*

Project Description:	☐ Water Right Acquisition ☑ Non-Acquisition Water Offset ☐ Habitat/Other The Steamboat Middle project consists of expanded water storage in an existing forested/non-forested wetland. The project would expand water storage in a low-lying area between elevation 114 and 118 as depicted in Figure 1. Blue shading indicates the potential extent of additional water storage to max. elevation 118 (datum: NAVD88). Some additional habitat may be created during this project. This project concept envisions the retention an additional 28-121 acre-feet of wet season precipitation, of which half (14-61 acre-feet) would likely provide a water-offset benefit by seeping back into the unnamed tributaries feeding Young Cove. We assume that the remainder would be lost to evapotranspiration. The project area is very flat, with two main basins, each with a differing base elevation. The project area has existing wetlands and hydric soils, likely overlying glacial till based on nearby geology (see Attachment A Well Logs). All elevations are referenced herein using the NAVD88 datum and Thurston County's 2011 LiDAR data. Assuming a low dike and gate/outfall to sustain higher water levels up to approximately elevation 118, two configurations of the water storage area can be conceptually evaluated as follows: 1. At a **"Low Water Stand"** the northern basin could retain about one additional foot of water depth within the existing ponded area, for about 28 acre-feet of additional storage.

2. At a **"High Water Stand"** the southern basin would also fill, to a depth of 1.11 feet, on average. At a "High Water Stand," the northern basin depth would increase to a depth of 2.35 feet, on average. Both average depths assume a maximum of 118 feet NAVD88, as controlled by a dike and gate with an outfall structure.

Table 1 Summarizes these features:

	Flooded Acres *	Average Water Depth – Low Water Stand (ft)	Average Water Depth - High Water Stand (ft)
Northern basin	28	1	2.35
Southern basin	50	0	1.11
	Storage acre-feet	28	121.3
	Water Offset Benefit With 50% ET losses	14	60.65

Site hydrogeology

a. **Geology:** probably shallow outwash gravels over glacial till.
b. **Depth to water:** ground surface – wetlands exist.
c. **Stream connection to aquifer:** Partial connection - Project-level calculations required. LiDAR flown in June 2011 did not indicate flow in the two unnamed tributary streams draining the project area. However, DFW modeling indicates fish presence is likely in both small tributaries.
d. **Estimated fraction of recharge that discharges to nearest streams:** Assumed 50% of additional storage reaches the two unnamed tributary streams as new base flow. Project-level calculations required.
e. **Initial estimate of streamflow benefit timing:** Project-level calculations required
f. **Suggested Plan benefit estimate:** 14 to 61 afy, based on 50% of storage reaching both streams.
g. **Probability of benefit:** High (i.e. use 100% of the calculated 14 to 61 afy benefit)
h. **Probability of construction:** Moderate – land access and permit questions will need further feasibility assessment.

	i. **Surface water source evaluation:** None yet - Project-level calculations required j. **Dates when streams are closed:** Discharges to salt water – closure status unknown k. **What type of water rights would need to be acquired to provide water from that source?** Unknown l. **What stream reach likely would benefit from this project?** Unnamed tributaries to Young Cove. m. **What is the anticipated benefit to that reach?** 14 to 61 afy additional streamflow, including flow from groundwater seepage. n. **What fish species will benefit?** WDFW data list fall chum salmon observed and resident coastal cutthroat presumed in the streams feeding Young Cove. MODFLOW groundwater flow modeling exists across this project site and can be used to test project concepts. In addition, significant LiDAR data are available for project assessment (one-foot LiDAR topography).
Description of Benefits:	• Conceptually, this project could provide infiltration of 14 to 61 afy water offset. • These benefits would require quantification as part of a Feasibility Study. • The project would improve streamflow later in the year, i.e. groundwater seepage that would provide stream base flow. • The length of additional wetted channel and volume of water offset would require calculation during the Feasibility Study process, and monitoring during operation. • Habitat could be incrementally improved. • Wetlands may expand as a result of the additional water storage area. • Habitat benefits/protection may be part of the project.
Is Water Quantity a Limiting Factor In this Sub-basin?	Unknown. Habit assessments would be required.
Location & Spatial Extent of Benefits:	Unnamed tributaries to Young Cove.
Anticipated Water Offset (if applicable):	14 to 61 acre-feet per year are anticipated. The WRIA 14 Committee conservatively claimed 14 AFY as a water offset to include in the plan.

Project-Type Specific Information	
Estimated Project Cost:	Feasibility study costs of ~$250,000, plus capital cost of several hundred thousand dollars for civil works, and the costs for land access rights or ownership. Operations & Maintenance costs expected. A cost estimate of $1 million is included in this watershed plan for planning purposes.
Performance Goals & Measures:	Streamflow, habitat or groundwater monitoring would likely be required for this project.
Anticipated Local and Partner Support & Barriers to Completion:	Unknown. Obstacles may include costs for land or rights to inundate lands adjacent to the project; conversely, landowner willingness to allow inundation may reduce the feasible water offset quantity.
Project Sponsor, Implementation Start Date and End Date:	Not yet sponsored.

Summit Lake Alternative Water Supply and Use

Project Name:	Summit Lake Alternative Water Supply and Use (TC Project #76)
Project Location:	Kennedy Creek management unit in northwestern Thurston County. See Figure 1. *Summit Lake Lon. -123.1064 Lat. 47.0538*
Project Description:	☑ Water Right Acquisition ☑ Non-Acquisition Water Offset ☐ Habitat/Other Conceptually this project involves determining alternative solutions for safe water supply to the Summit Lake community. It involves a substantial portion of the lakefront residents of south shore drive along Summit Lake currently using surface water from the lake itself. An alternative water supply could supply water and reduce the use/demand for 235 homes on south Summit Lake Shore Drive South. One potential source of water could include new source wells installed in aquifer material near the Boy Scouts of America Camp Thunderbird. Well yields of 10 gpm to 30 gpm have been identified in at least five existing wells – including the Camp Thunderbird well (rated by WA DOH as capable of serving 9,000 gpd). This could require obtaining a new water right in compliance with Chapter 173-514 WAC, which would be difficult with the current instream flow rules because the location is in direct hydraulic continuity with Kennedy Creek. There may also be conflicting legal concerns with obtaining a water right as a result of the Washington State Supreme Court Foster decision. Another potential source of water could be from piping water from a public water system located outside the Summit Lake drainage. This option could be more expensive but provide a more reliable water source and flow benefit to Kennedy Creek. Other water sources could also be explored, should the opportunity become available. A net water offset benefit could occur in two ways: 1) by limiting irrigation for homes newly connected to a new water supply, and 2) by retiring some non-certificated permits and purchase/retirement of some certificated water rights. Finding an alternative to surface water withdrawals for a portion of the Summit Lake community could result in the retirement of surface water withdrawal permits for homes with newly available supplies. Some of

	these permit revocations may include the 193 temporary withdrawal permits. These permits date to after 1992, when Ecology agreed with Thurston County to temporarily issue new permits for indoor water use only, with the condition that these rights be relinquished when a public water supply became available. Finding an alternative, safe water supply would reduce public health risk for residents and clarify uncertain permitting, including those undeveloped lots surrounding Summit Lake that are currently without access to water. **Background** The approximate altitude of the lake is 460 feet. The drainage is steep and rugged with ridges as high as 1200 feet and slopes up to 80 percent. There are numerous springs and intermittent streams that flow into the lake. The outlet at the west end of the lake is controlled by a dam with overflow flash boards, regulated under a superior court order issued under Chapter 90.24 RCW, which allows lake overflow to feed Kennedy Creek. Summit Lake is one of the deepest lakes in Thurston County, with a maximum depth of 30 meters (100 feet). Groundwater is difficult to find in the thick basalts surrounding the lake, typically requiring homeowners to rely on surface water instead of drilling a permit exempt well. It should also be noted that all Lake area parcels have on-site septic systems that ultimately discharge household wastewater back into the lake via shallow groundwater percolation. Prior to the passage of the Streamflow Restoration Act, significant streamflow concerns existed in the Kennedy Creek basin. For example, the Department of Ecology has noted that each new surface water withdrawal permit adds to ongoing impairment of the Kennedy Creek instream flow right and tribal rights, and the public interest test (RCW Chapter 90) is not met by incrementally diminishing critical instream flows (See Attachment A). Chapter 173-514 WAC, adopted in January 1984, closed Kennedy Creek and its tributaries to new appropriations of water from May 1 through November 15. While there is an exemption in WAC 173-514 for single domestic in-house use if no other source is available, Ecology has determined that the cumulative impact of the existing diversions under the existing water rights is resulting in harmful impacts to Kennedy Creek and its fisheries and the cumulative impact of existing diversions exceeds the available flow in Kennedy Creek during the WAC closure period, preventing any new water allocations from Summit Lake. Parcel owners may elect to install a permit exempt well in an attempt to find a sustainable water source, but that is likely to result in very deep “dry holes” due to inability to access groundwater. In 1992, there were 139 active surface water permits and certificates on Summit Lake, which Ecology agreed to issue as temporary permits with

	the condition that these rights be relinquished when a public water supply became available. Combined with the 193 temporary permits since 1992, there are 332 total known existing diversions of Lake water. Thurston County and Ecology independently determined that the +600 lots surrounding Summit Lake number greater than the permits on record. These include upland lots that require easements from lakefront property owners to install pumps and water lines. Thurston County has also provisionally identified up to 73 lots with possible permit-exempt wells. Note that the Streamflow Restoration Act does not apply to surface water withdrawals where a water right permit is required. Most Summit Lake water use is therefore not permit-exempt. In addition to water offset benefits, an important driver for the project is the toxicity of potential drinking water used by residents of Summit Lake. Water quality advisories have been issued for Summit Lake residents relying on surface water in 2014, 2016, 2017, 2018, 2019 and 2020. The concerns centered around detections of anatoxin-a above public health advisory concentrations. Anatoxin-a is a potent neurotoxin that is fast-acting and can cause serious illness or death. During health advisories issued in the above years, Thurston County Public Health and Social Services recommends that residents do not drink the lake water. The state advisory level for Anatoxin-a is one microgram per liter. These recurring lake advisories associated with detections of anatoxin-a in laboratory-analyzed surface water samples are now nearly annual. They have raised additional concerns about the reliability of Summit Lake as a safe source of drinking water for residents. During health advisories, the Boy Scouts of America have often donated water from their Camp Thunderbird well to supply some resident needs. **Major Project Elements** • **Conduct a feasibility study to determine the best alternative water source.** Pumping tests, sampling, and permitting research. • **Engineering feasibility study of production and water quality for the appropriate water source,** to develop an engineering basis and approximate costs for the alternative water supply. A crucial engineering feasibility cost-tradeoff analysis is required because of known prior limitations on well yield. • **Community outreach** will be an important element of evaluating cost-benefit tradeoffs because resident acceptance rates in the Summit Lake vicinity will likely be less than 100% (based on prior outreach efforts). This could also include educational aspects or working with residents to address their concerns. • **Identification of a process necessary to negotiate required water rights and any associated mitigation requirements** with the

	Department of Ecology. Relinquishment of some water right permits may be a part of this dialog. • **Identification and approval of a suitable funding mechanism(s).** • **Identification of next steps necessary for approvals of alternative water supply plan by local and state authorities.** • **Identification of financial impacts to residents**.
Description of Benefits:	**1. Potential water offset benefits from the project: 96.7 afy to 132.5 afy,** depending on multiple factors. Water offset benefits may be larger if demand reduction measures can be implemented successfully. 2. **Significant health risk reduction** and the improvement of public health outcomes by limiting surface water connections to Summit Lake at 235 homes. **3. Coho, steelhead, and cutthroat would benefit.** **4. Increased streamflows on Kennedy Creek.** 5. **Benefits are potentially scalable:** additional homes might be served if alternative water supply can be established. 6. **Dual permit/exempt benefits:** the proposed source substitution and re-configuration would include co-located benefits from both permit-required and permit exempt mitigation.
Is Water Quantity a Limiting Factor In this Subbasin?	The Department of Ecology has also noted that a water right comment letter dated January 2, 2018, from the Department of Fish and Wildlife (DFW), states that "…any further reduction in [Kennedy Creek] flows will be detrimental to production of coho, steelhead, and cutthroat and the cumulative impact of numerous small diversions from Summit Lake would reduce flow in Kennedy Creek." DFW further requests denial of applications for diversions of surface water from Summit Lake (see Attachment 1).
Location & Spatial Extent of Benefits:	Flows could be increased in Kennedy Creek from Summit Lake downstream to its confluence with Totten Inlet.
Anticipated Water Offset (if applicable):	**Reduction in demand for a water offset of 16.8 afy to 52.6 afy,** depending on the assessment assumptions and methodology (See Table 1), by restricting some types of outdoor water use (e.g. lawn watering). **Retirement of up to about 79.9 afy of permitted surface water rights at approximately 235 homes.** A source substitution would require about 54 afy pumping at a new downstream Group A wellfield, for a net water

	offset benefit of up to about 26 afy: (235 homes) x (0.34 afy/home median permitted water right) = (79.9 afy in estimated total permits). This calculation assumes that some method can be found to incentivize permit retirement. **Summary of total potential water offset benefits** from the project: 96.7 afy to 132.5 afy, depending on multiple factors. Water offset benefits may be larger if demand reduction measures can be implemented successfully.
Project-Type Specific Information	This project depends heavily on achieving sufficient new well yields downstream of Summit Lake or an alternative water source. Significant questions exist regarding pumping well production.
Estimated Project Cost:	Several million dollars, at minimum, for new source wells, engineering, permitting and new infrastructure.
Performance Goals & Measures:	Weather and lake water quality monitoring is already performed by Thurston County; however, additional monitoring is likely to be needed. (See: https://www.thurstoncountywa.gov/sw/Pages/monitoring-dashboard.aspx).
Anticipated Local and Partner Support & Barriers to Completion:	The Squaxin Island Tribe has indicated that it may support this project. Based on resident comments received in connection with similar proposals in the 1990s and again in 2018-2019, incentives and educational outreach may be required for residents to be supportive of alternative water supply solutions.
Project Sponsor, Implementation Start Date and End Date:	Thurston County may sponsor this project, depending upon Feasibility Study outcomes. The project will need a thorough assessment of well yields or other alternative water sources, a Report of Examination from a CWRE, plus additional hydrogeological, legal, financing, and engineering feasibility studies.