SNOHOMISH BASIN PROTECTION PLAN

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Prepared by

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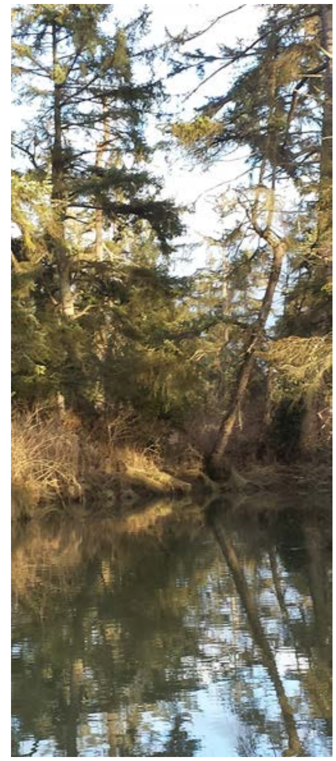
EXECUTIVE SUMMARY

The primary goal of this 2015 *Snohomish Basin Protection Plan* (SBPP) is to identify protection strategies that prevent the degradation of hydrologic processes that support salmon or salmon habitat. In 2005, the Snohomish Basin Salmon Recovery Forum members approved the Snohomish Basin Salmon Conservation Plan and laid out a 50-year road map for multi-species recovery. The 2005 Plan was based on historical records, the best available science, and social and economic conditions. The Plan recognized that it was critical to use adaptive management to increase the chance of success by incorporating new data, information about successes and failures, and new opportunities provided by changing context in the Snohomish River Basin.



Since 2005, there have been many site-scale successes on restoration projects in the mainstems, estuaries and tributaries. However, many environmental indicators continue to decline, according to local data and the 2009 State of the Sound report (Puget Sound Partnership 2010). The continued decline is likely due to little-understood cumulative effects that need to be addressed through protection at the landscape-scale.

Snohomish Basin Hydrology—Supporting People, Wildlife, and Fish

The Snohomish River Basin contains diverse aquatic resources, a variety of fish and wildlife populations of local and regional significance, and a diverse portfolio of land uses. The Basin and its many natural resources and human communities are inextricably linked to how water moves through space and time, from the smallest headwater streams to mainstem rivers and the groundwater beneath the surface.

Photo credit: Greg Dunlap

Hydrology in the Snohomish, Snoqualmie, and Skykomish rivers and associated tributaries is changing. Historical flow patterns and volumes are shifting as a result of changing land uses and climate change. Human activities—such as impervious surface installation, tree cover removal, traditional stormwater conveyance systems, and water withdrawals—are contributing to altered watershed processes, degraded water quality, loss of wetlands and riparian forests, and degraded shoreline conditions.

Investigating Protection of Snohomish Basin Hydrology

The continued degradation of hydrology in the Basin, rapid urbanization, and threats from climate change motivated a new effort focused on the protection of the water resources in the Basin and the watershed processes that support them. This SBPP identifies areas that are important to the goal of protecting hydrology, and examines new and existing tools to help support that goal. Through the protection of hydrology, the SBPP aims to ultimately protect habitat quality, quantity, and heterogeneity for fish and wildlife. The protection of hydrology will also support a continued high quality of life for those who live and work in the Basin, help ameliorate flood risks, and ensure the availability of water for multiple uses into the future.

To best characterize the different challenges, hydrological importance, and opportunities in each area, an approach was developed that incorporates information on land use, expected climate change impacts, services provided by hydrology, salmon use, existing protection measures, and possible improvements to policies, programs, and projects. The Puget Sound Watershed Characterization model was used to understand the importance of different components of hydrology at various scales and to describe the level of hydrological degradation. Assessment of the components of hydrology resulted in the development of

basic protection strategies and aided in the assessment of tools to achieve protective actions.

The Snohomish Basin Protection Plan

The intent of the SBPP is to set a framework for a more complete implementation and accounting of protection efforts by all Basin partners. Section 1 of the SBPP provides the Basin protection context and more details on the intended purposes of this document. Section 2 describes the technical assessment approach and Section 3 summarizes the results of the technical assessment (with additional details provided in Appendix A).

Section 4 of the SBPP provides an overview of protection tools that can be a starting point for planners and others to consider in combination with local hydrology concerns, land use types, fish use, and implementation opportunities. The tools include a range of existing programs in their current form, existing programs with suggestions for improvements, and entirely new tools. Section 5 presents an assessment of current and potential future funding strategies to support SBPP objectives.

Section 6 presents a summary example of how the SBPP can guide the development of protection strategies towards a specific program goal—in this case, salmon recovery—and provides updates on information developed since the 2005 Snohomish Basin Salmon Conservation Plan. Appendix B provides more detailed recommendations for updated salmon recovery protection strategies relative to specific land uses in the Basin. In December 2015, the Snohomish Basin Salmon Recovery Forum adopted Appendix B as the first formal adaptive management action for the 2005 Plan. This protection update does not change existing restoration recommendations and habitat goals from the 2005 Plan.

The consequences of not implementing protective measures for hydrology in the Snohomish Basin include the following:

- *Loss of habitat for salmon and other aquatic species*
- *Continued degradation of water quality*
- *Decreased ability to mitigate drought conditions*
- *Negative impacts on in-stream flows*
- *Risk of loss of life and infrastructure during flood events*
- *Lost opportunity to protect ecosystem function*
- *High future costs of restoration*

Although a lot of good work is being done through existing policy and programs, water quality has continued to degrade and with the challenges of drought and extreme flow events, the Basin's natural hydrologic regime has been significantly altered. It is more cost effective to protect hydrology now than to pay later for restoration actions and projects.

Photo credit: flickr user brewbooks

It has been 10 years since the 2005 Plan was adopted by the Forum, with broad support of jurisdictions operating in the Basin. Much has been accomplished in the realm of habitat restoration, yet landscape-scale indicators—such as total forest cover and water temperature—continue to show degradation. The intent of this SBPP is to provide an update to the 2005 Plan, and to serve as planning guidance to achieve greater protection of hydrology and, in turn, salmon habitat. This SBPP was developed at a time when there is recognition for the need to create watershed and ecosystem resilience in the face of growing populations and changing climatic conditions. Just as restoration relies on partnerships and collaboration, protection of hydrology and habitat cannot be undertaken in isolation, or by one entity, group, or agency. As stated by the original chairs of the Forum, "we know that to recover salmon in Puget Sound, we must succeed in the Snohomish Basin."

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LIST OF ACRONYMS AND ABBREVIATIONS

BMP	best management practice
CAR	critical areas regulation
CFT	Conservation Futures tax
CREP	Conservation Reserve Enhancement Program
CUT	Current Use Taxation
CWA	Clean Water Act
DNR	Washington State Department of Natural Resources
EASC	Ecological Analysis for Salmonid Conservation
Ecology	Washington State Department of Ecology
ESA	Endangered Species Act
FERC	Federal Energy Regulatory Commission
Forum	Snohomish Basin Salmon Recovery Forum
FPP	Farmland Preservation Program
GMA	Growth Management Act
HCP	Habitat Conservation Plan
HPA	Hydraulic Project Approval
HRCD	High Resolution Change Detection
ILP	Integrated Licensing Process
IRPP	Instream Resource Protection Program
LID	Low Impact Development
LiDAR	Light Distance and Ranging
MS4	municipal separate storm sewer system
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resource Conservation Service
NWFP	Northwest Forest Plan
NWPA	Northwest Power Act
PBRS	Public Benefit Rating System

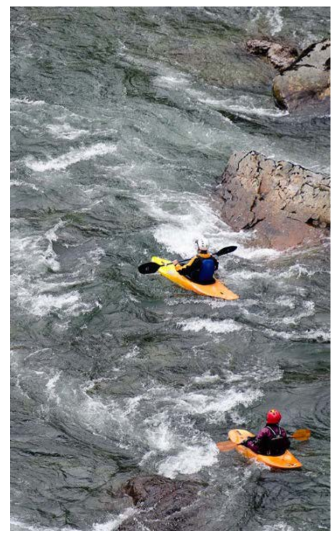
PDR	Purchase of Development Rights
PSWC	Puget Sound Watershed Characterization
RCW	Revised Code of Washington
SBPP	*Snohomish Basin Protection Plan*
SFLO	small forest landowner
TDR	Transfer of Development Rights
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WRIA	Water Resource Inventory Area
WSU	Washington State University

Section 1

INTRODUCTION AND BASIN PROTECTION CONTEXT

The Snohomish River Basin (see Figure 1), the second largest drainage in the Puget Sound, contains diverse aquatic resources. It is home to Endangered Species Act (ESA)-listed Chinook salmon, steelhead trout, and bull trout char populations as well as other fish and wildlife populations of local and regional significance. Among Puget Sound watersheds, it is the largest producer of coho salmon and the second largest producer of Chinook salmon, supporting two spawning populations—the Skykomish and the Snoqualmie.

The Snohomish River Basin is an 1,856 square mile watershed that drains from the Cascade Mountains to Puget Sound. The second largest watershed that drains into Puget Sound, it includes the Skykomish, Snoqualmie, and Snohomish rivers, along with numerous tributaries.



The Basin contains a diverse portfolio of land uses including agriculture, forestry, and urban and rural residential areas. From 2000 to 2010, Snohomish County was the fastest growing county in the Puget Sound region, by percent growth (Earth Economics 2010). The Basin is famous for recreational opportunities for kayaking, fishing, boating, bird watching, and swimming.

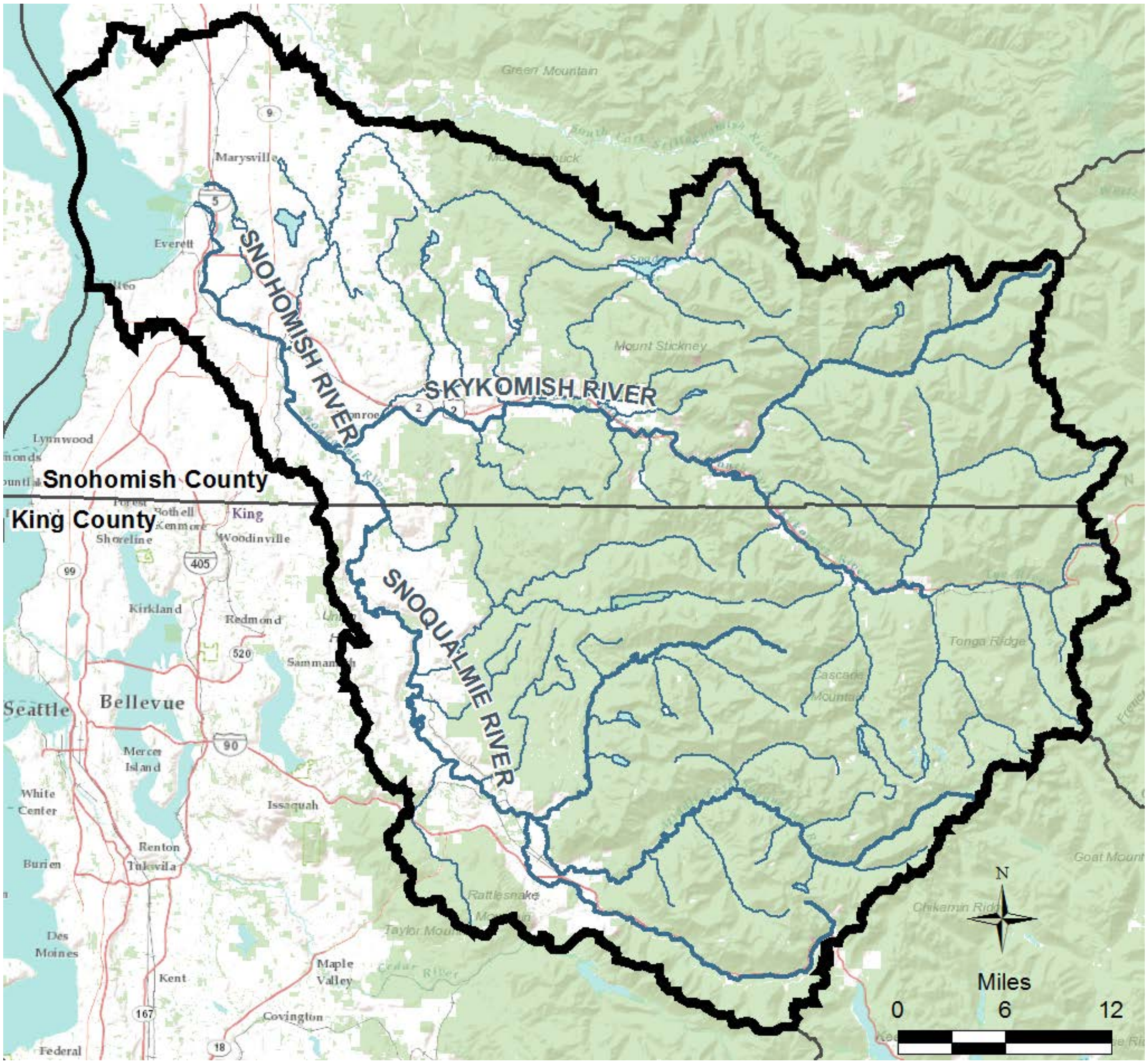


Figure 1: Snohomish River Basin

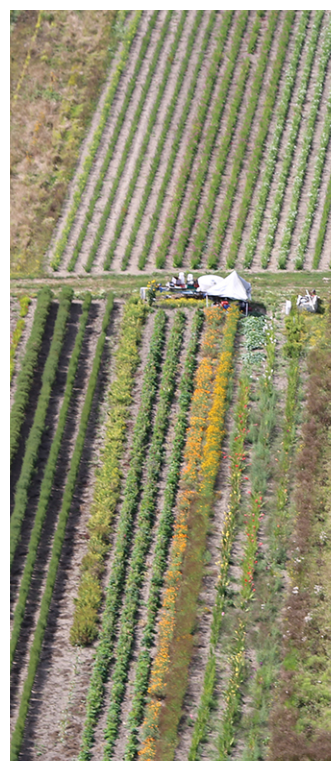
1.1 The Importance of Hydrology in the Basin

The Basin and its many natural resources and human communities are inextricably linked to how water moves through space and time, from the smallest headwater streams to mainstem rivers and the groundwater beneath the surface. Intact hydrology supports people, wildlife, and fish in the Basin. Salmon are dependent on adequate cool, low flows in the summer, the timing of outmigrant peak flows in the spring, and periodic winter flooding to create new habitat. Farmers depend on water for irrigation in summer and can suffer production losses during floods. Communities require drinking water supplies and safe areas to build. Recreational river users depend on clean rivers for swimming and fishing, and flow levels to support boating.

Ecosystem services are benefits that humans derive from the environment, which can include flood control and water quality, water supply, nutrient cycling, and recreation.

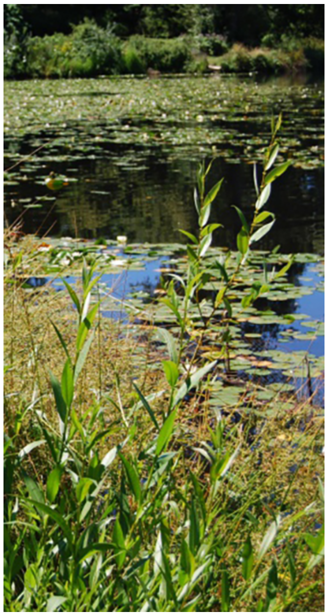
By acknowledging the multiple benefits that intact watershed processes provide, there is opportunity to expand non-traditional partnerships and funding, and improve willingness to protect and improve implementation.

In December 2006 alone, Snohomish County Emergency Management Department estimated $5.3 million dollars damage from floods to farms along the Skykomish and Snohomish Rivers (HeraldNet 2011). In addition, the City of Snoqualmie is one of the most flood-prone cities in Washington and has produced the highest number of flood claims of any city in the state (City of Snoqualmie 2014).



In 2002, Snohomish County farms sold more than $126 million in agriculture products, and King County had comparable sales (USDA 2009). Many of these products depend on the availability of existing water rights. The Washington State Department of Ecology (Ecology) is currently not issuing new irrigation rights in the majority of the Basin's agricultural areas.

The City of Everett depends on the upper Sultan watershed forests to provide natural water purification for their Spada Lake water supply. This source provides clean, safe water for more than 570,000 people and 80% of the businesses and residents of



Wetlands are areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. (40 CFR 230.3)

The riparian zone is the vegetated area bordering a waterbody. Riparian areas help protect aquatic ecosystems and salmon habitat in many ways, including controlling erosion, filtering pollutants, contributing large woody debris, protecting microclimate, and providing shade to moderate stream temperature.

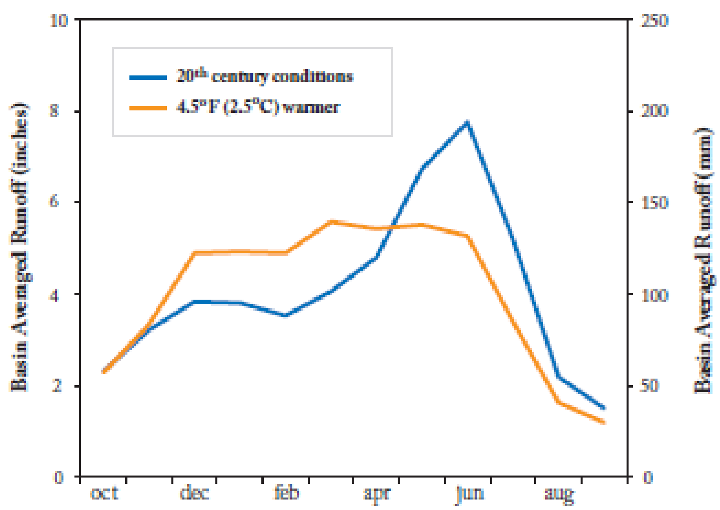
Snohomish County through a network of local water providers (https://everettwa.gov/444/Water-System). Snohomish County residents receive water captured and largely filtered by natural systems. When the City's filter system was compromised, the U.S. Environmental Protection Agency (USEPA) allowed the City to continue providing drinking water because the forest-filtered water met clarity parameters and there was no threat to public safety (Earth Economics 2010). The City of Seattle maintains a similar system in the Cedar River Watershed and estimates that management of their forests has avoided construction of a water filtration plant and the estimated cost of $200 million (Earth Economics 2010).

Recreation provides a boost to the entire Puget Sound economy. Nearly 80% of the state's revenue from tourism occurs in Puget Sound, with Snohomish and King Counties within the top four counties (OFM 2007). According to the recreation surveys and public records used in a recent Earth Economics study, there were a total of about 446 million participant days per year spent on outdoor recreation in Washington, resulting in $21.6 billion dollars in annual expenditures. Expenditures were highest for recreation associated with public waters (Briceno and Shundeler 2015).

According to the Washington State Office of Financial Management, King and Snohomish counties are two of the three counties in Washington with the greatest growth (OFM 2015). Between 2010 and 2014, Snohomish County grew by more than 6.5% and King County grew by more than 7.7%. By 2035, Snohomish County is projected to grow to a population greater than 955,000 (an increase of approximately 15% from 2000) and by 2030 King County is projected to exceed 2.1 million (an increase of 18% from 2000).

Hydrology in the Snohomish, Snoqualmie, and Skykomish rivers and associated tributaries is changing. Historical flow patterns and volumes are shifting as a result of changing land uses and climate change. Human activities—such as impervious surface installation, tree cover removal, traditional stormwater conveyance systems, and water withdrawals—are contributing to altered watershed processes, degraded water quality, loss of wetlands and riparian forests, and degraded shoreline conditions.

Climate change in the Basin has been modeled extensively by the University of Washington Climate Impact Group and Battelle (CIG and NWFSC 2005; PNNL 2015). Predicted effects include increases in the magnitude of peak flows, changes in the timing of seasonal flow peaks, prolonged and persistent low flows, reductions in summer flows, and increased stream temperatures. These effects would place even greater strain on water quality, threatened salmon populations, drinking water supplies, flood-prone areas, and working farms and forests.



Climate change models show that river discharge is predicted to change with more flow in the winter, less in the summer, and the loss of the spring peak floods.

Source: Snover et al. 2005

In order to prioritize actions in the Basin, we need to understand how different hydrologic functions are distributed throughout the watershed and its many sub-basins. Ecology recently developed the Puget Sound Watershed Characterization (PSWC) model (Hume et al. 2015). This model

The protection of hydrology will improve the overall resiliency of the ecosystem in the Basin. Resiliency is the ability of the ecological system to withstand perturbations and other stressors while still maintaining its structure and function. When resiliency is improved, a system is more likely to tolerate disturbances, such as population growth and climate change, without collapsing.

A watershed is the geographic area that drains into a particular river system or other body of water.

Watershed processes refers to the natural physical, chemical, and biological interactions that form the ecosystem of a watershed.

describes the importance of different components of hydrology at the sub-basin scale, regardless of current land use, and also provides information on the level of hydrological degradation. The information derived from the PSWC model is an important new tool to be considered in the face of development and climate change impacts.

The continued degradation of hydrology in the Basin, rapid urbanization, and threats from climate change have motivated a new effort focused on the protection of the water resources in the Basin and the watershed processes that support them.

1.2 Snohomish Basin Protection Plan Purpose

This *Snohomish Basin Protection Plan* (SBPP) identifies areas that are important to the goal of protecting hydrology, and examines new and existing tools to help support that goal. Through the protection of hydrology, the SBPP aims to ultimately protect habitat quality, quantity, and heterogeneity for fish and wildlife. The protection of hydrology will also support a continued high quality of life for those who live and work in the Basin, help ameliorate flood risks, and ensure the availability of water for multiple uses into the future.

This document is intended to be used by cities, counties, state and federal agencies, tribes, non-profit organizations, and other planning entities working in the Basin. The primary audience is land use planners, who will make recommendations to decision-makers about how to direct land use changes in the Basin, and resource managers and program staff who make decisions on how and where to apply programs and projects on the ground. The overview of protection tools in Section 4 can provide a starting point for planners and others to consider in combination with local hydrology concerns, land use types, fish

use, and implementation opportunities. Tools can be packaged to develop protection strategies appropriate to particular geographic areas to achieve the entities' goals.

Though protection and restoration are both essential to improving hydrologic process, this SBPP is focused on actions that do not directly involve restoration. The Basin has a focused and strategic approach for restoration needed to recover salmon populations and there was no attempt in this plan to change or update the restoration targets or emphasis areas. Although there is overlap between protection and restoration actions and they are often done in tandem, for the SBPP, protection tools were defined as those that do not "use a shovel or move dirt."

The tools for habitat protection are implemented by a broad spectrum of public and private entities within the Basin and there are many efforts underway that fall under the category of protection. Protection efforts range from regulations at the local government scale to acquisitions by land conservancies to incentive programs offered for specific resource industries.

The SBPP outlines many of the protection tools that have been used but that have not typically been implemented or tracked at a Basin-wide scale. The SBPP builds on information recognized at the time of the *Snohomish River Basin Conservation Plan* (Forum 2005; referred to as the 2005 Plan in this document) and integrates new tools, political context, and lessons learned from 10 years of implementation. The tools include a range of existing programs in their current form, existing programs with suggestions for improvements, and entirely new tools. The intent of this document is to set a framework for a more complete implementation and accounting of protection efforts by all Basin partners.

The definition of protection for the purpose of this document is inclusive of all areas in the Basin, regardless of their current levels of degradation. This definition was created to recognize that even degraded areas in the Basin have hydrological value and should be protected against further damage.

Habitat protection definitions traditionally only focus on pristine habitat areas. The definition of protection in the SBPP shifts attention from strictly intact opportunistic areas to a more comprehensive approach that takes into account the function and services each area in the watershed provides.

Basin partners include area state, local, and tribal governments, as well as non profit organizations

Additionally, the SBPP goals, if implemented, would further portions of the *2014/2015 Action Agenda for Puget Sound* (Puget Sound Partnership 2014). Implementing tools in this plan will directly lead to improvements in several Puget Sound Partnership vital signs (Figure 2) including, but not limited to, summer stream flows, water quality, shoreline armoring, Chinook salmon, floodplains, and land development and cover. Improving hydrologic function in the basin makes a positive contribution to the six goals outlined in the Action Agenda: healthy human population, vibrant quality of life, thriving species and food web, protected and restored habitat, abundant water quantity, and healthy water quality.

Figure 2: Puget Sound Vital Signs

From Puget Sound Partnership

Vital signs of Puget Sound's health were identified in 2011 by the Puget Sound Partnership as indicators to track progress. Current information is provided at: http://www.psp.wa.gov/vitalsigns/

1.3 Snohomish Basin Protection Plan Organization

Section 2 of this document describes the technical assessment approach and Section 3 summarizes the results of the technical assessment (with additional details provided in Appendix A). Section 4 examines new and existing tools to support the goal of protecting hydrology. Section 5 presents current and potential future funding strategies to support SBPP objectives. Section 6 summarizes protection strategies that specifically benefit ESA-listed Chinook salmon, with additional details provided in Appendix B.

The SBPP process was motivated by an understanding by recovery partners that protection can and must be done better to protect hydrology for enhancement of both salmon habitat and human uses. Information on the progress of recovery—restoration gains and protection losses—is also included in this document.

Section 2

TECHNICAL ASSESSMENT APPROACH

The SBPP process was driven by the understanding that hydrology is changing in the face of increasing pressures in the Basin. To best characterize the different challenges, hydrological importance, and opportunities in each area, an approach was developed that incorporates information on land use, expected climate change impacts, services provided by hydrology, salmon use, existing protection measures, and possible improvements to policies, programs, and projects. This will allow land managers and decision-makers to best align their particular physical and political context with the available protection tools.

2.1 Geographic Scales of Analysis

The SBPP technical approach sought to balance many different considerations throughout the basin, including land use and associated jurisdictions, salmon habitat, local opportunities, and important areas for hydrological protection based on existing geologies and precipitation regimes. All of the information considered has different meanings at basin-wide and local scales. The watershed characterization provided the ability to zoom in and out of areas, highlighting different relative importance values, which led the project team to analyze information in a similar manner. Three different scales were selected that gave a continuum of landscape-scale to practitioner-scale with different resolutions of information (Figure 3):

- **Scale 1 – Snohomish Basin Scale:** This broadest scale allowed a general understanding of hydrologic importance in the entire Snohomish River Basin. It also allowed the consideration of tools that can be applied to general land use

An example of how the SBPP approach and protection tools can be used at a locally relevant scale is provided by the City of Duvall 2014 comprehensive watershed planning process. Duvall was among the first communities in the Basin to incorporate a watershed planning effort into a Comprehensive Plan Update.

Duvall coupled the PSWC model with their exising information, such as zoning and critical area regulations, to identify opportunities to allow growth while ensuring protection and restoration of critical hydrologic areas.

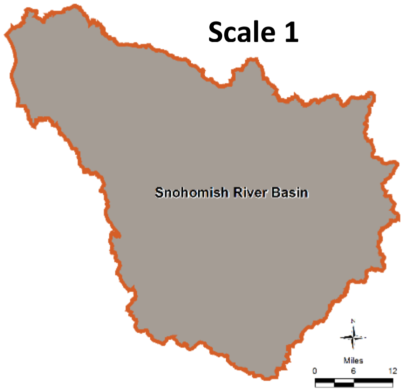
The goal of the effort was to develop tools for the city to continue to grow and develop while trying to protect important resources. The process of examining the tools shed light on shortcomings of existing protection and allowed review of resources in the face of decisions related to growth and zoning. Although some of the solutions are long-term for development and adoption, there were also tools identified that can be implemented on a much shorter time line.

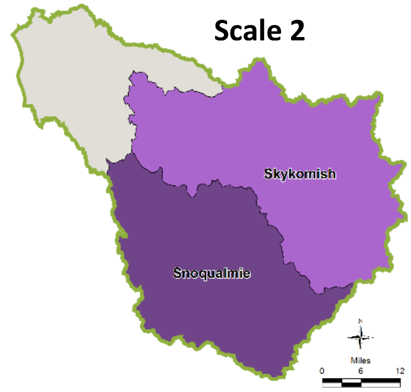
Duvall serves as a model for how the information in the SBPP can be used to inform real changes.

categories, rather than considering the nuances of each jurisdiction.

- **Scale 2 – Mainstem Scale:** The decision to look at each of the mainstem basins was driven by the fact that the Skykomish, Snoqualmie, and Snohomish rivers are very different from each other physically, especially in the lowlands. Additionally, the Skykomish and Snoqualmie rivers have unique Chinook salmon populations that are dependent on the watershed-scale hydrology of the mainstems and major tributaries. Finally, there is a fairly clear geographic division between King County (Snoqualmie) and Snohomish County (Snohomish and Skykomish), with the exception of the South Fork Skykomish. The physical differences between the basins and the jurisdictional uniqueness drives how certain salmon plan goals are allocated.
- **Scale 3 – Planning Unit Scale:** This smallest scale highlights fine-scale conditions such as hydrology, habitat, and ownership. It was organized around combined sub-watershed drainages (hereafter referred to as planning units) and smaller watersheds were grouped by similarity of location, fish use, and land use. At this local scale, jurisdictions are ultimately the major drivers of tools, though watershed characterization still aids understand of the relative hydrologic importance. Scale 3 was also advantageous for identifying unique opportunities for protection strategy implementation.

Maps of the three scales are provided in Figure 3. The white planning units shown at Scale 3 are mainstem floodplains that are better described in Scale 2.





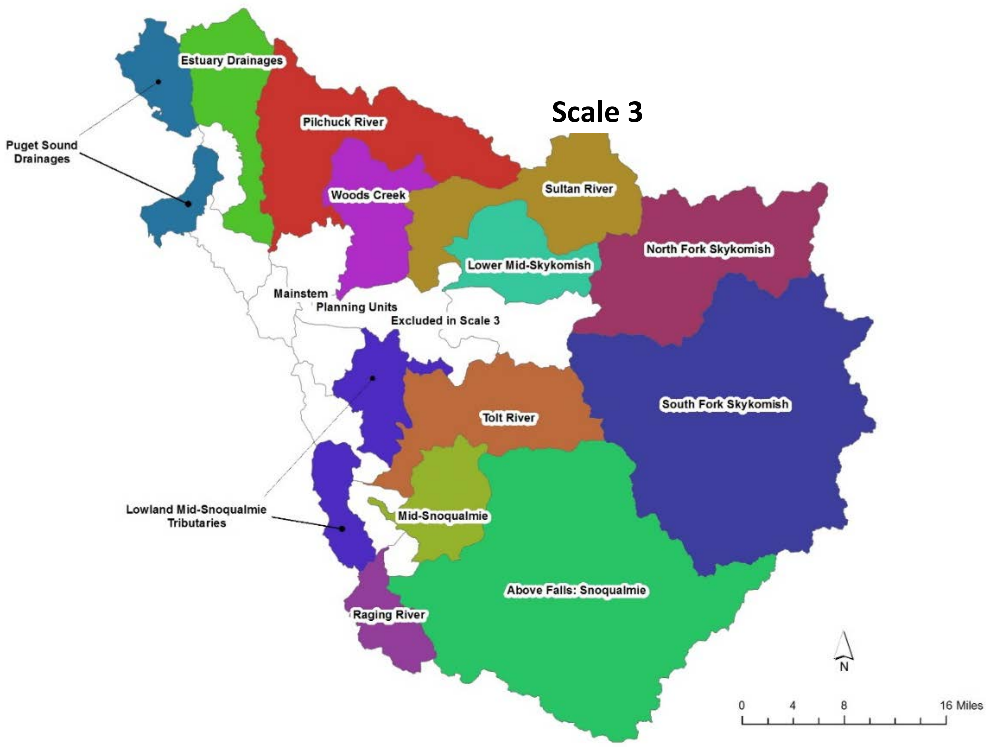


Figure 3: Scales Examined in the SBPP Technical Assessment

Note the white planning units shown at Scale 3 are mainstem floodplains that are better described in Scale 2.

The Scale 3 planning units were determined based on the following criteria: 1) contributing basins, which flow into critical/priority Chinook salmon areas and focal reaches; 2) sub-watersheds with relatively similar hydrology; and 3) sub-watersheds with potentially similar protection strategies due to comparable land uses.

Assessment at all three scales focused on the overlap of hydrology, anadromous salmon use, and landscape pressures. Resulting protection strategies relevant to Scales 1 and 2 focused on land use type. Protection strategies relevant to Scale 3 are geographically specific and account for the results of the hydrologic importance model. Scale 3 strategies were identified where possible and presented in Appendix A. These designations were chosen to best align the suites of strategies with the appropriate scales for implementation.

2.2 Building a Layered Technical Approach

Various layers of information, or lenses, were available for the planning units (Figure 4).

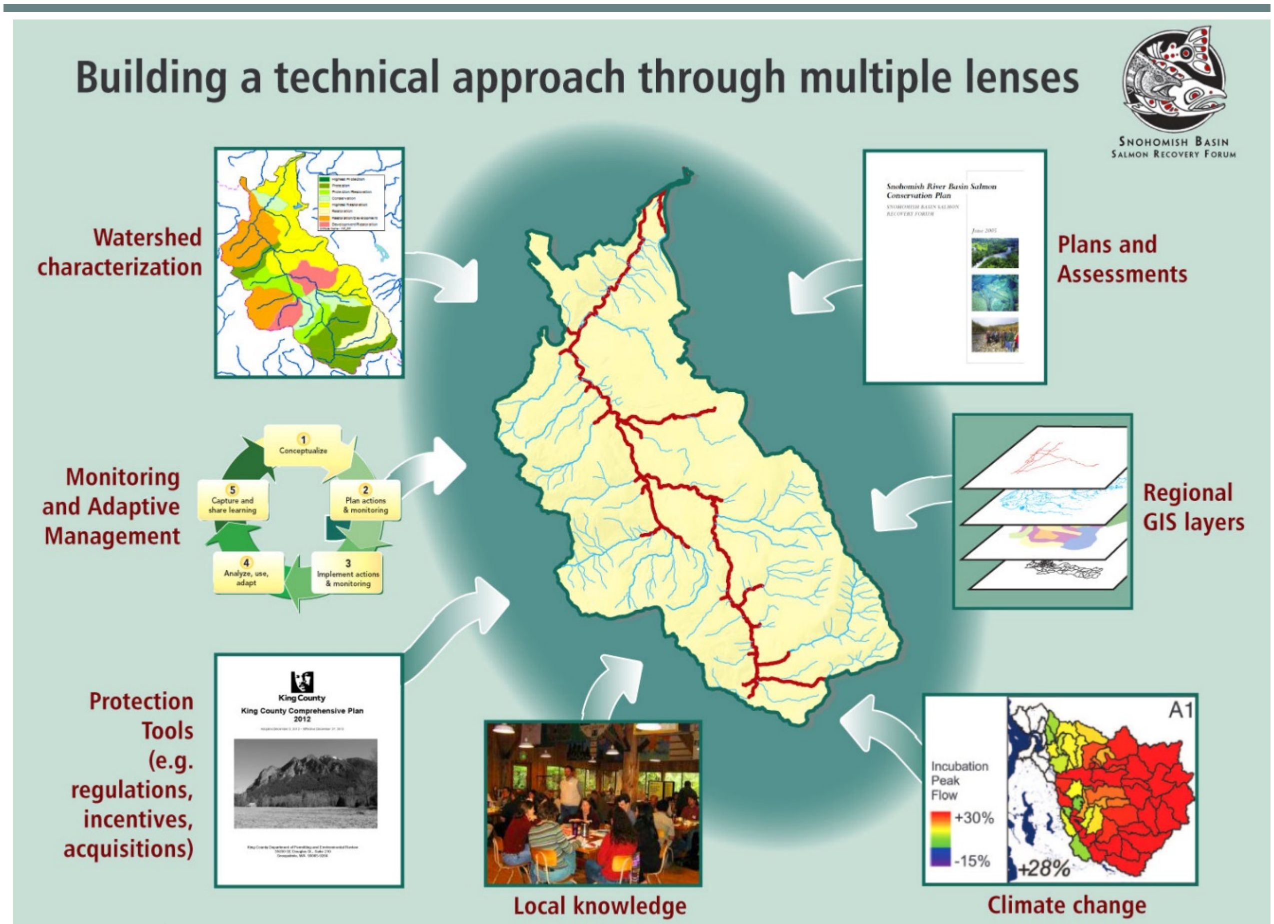


Figure 4: Building a Technical Approach through Multiple Lenses

Assessment at Scales 1 through 3 relied heavily on the PSWC models to provide hydrologic context and an evaluation of key hydrologic components (see Section 2.5). However, because Scale 3 provides analysis at the planning unit scale, watershed characterization was one of several lenses used to determine areas for protection and strategy development; this scale included a supplemental multi-facetted technical approach focused on integrating additional information sources to better assess the overlap of hydrology, anadromous salmon use, and landscape pressures. This included primary anadromous fish use, information on habitat changes, precipitation regime, primary land use and activities, modeled hydrologic and habitat conditions, limiting factors related to hydrology, ecosystem services, potential climate change impacts, and current and future pressures. This technical approach helped to determine the overlap of hydrologic importance, threats of continued degradation, and opportunities for protection. The Scale 3 technical approach primarily focused on evaluating previously available information and data sets with the exception of an updated hydrologic and habitat conditions assessment.

Anadromous species hatch in freshwater, mature in saltwater, and return to freshwater to reproduce.

2.3 Identifying Land Uses

Land use information can change quickly in urban-rural fringe areas, and land use maps can only provide information relative to a particular snapshot in time. Current aerial images can be used to determine more current land uses in an area, but land use maps can give context for development and open space patterns and help shape opportunities for protection.

Figure 5 shows the land use designations for the Basin, based on the Comprehensive Plans of Snohomish and King Counties. While this does not show the current on-the-ground land use, it maps the potential growth and conservation areas. When

coupled with a current aerial image, the map can be used to identify the potential land use of the area, show opportunity, and help refine the appropriate suite of tools.

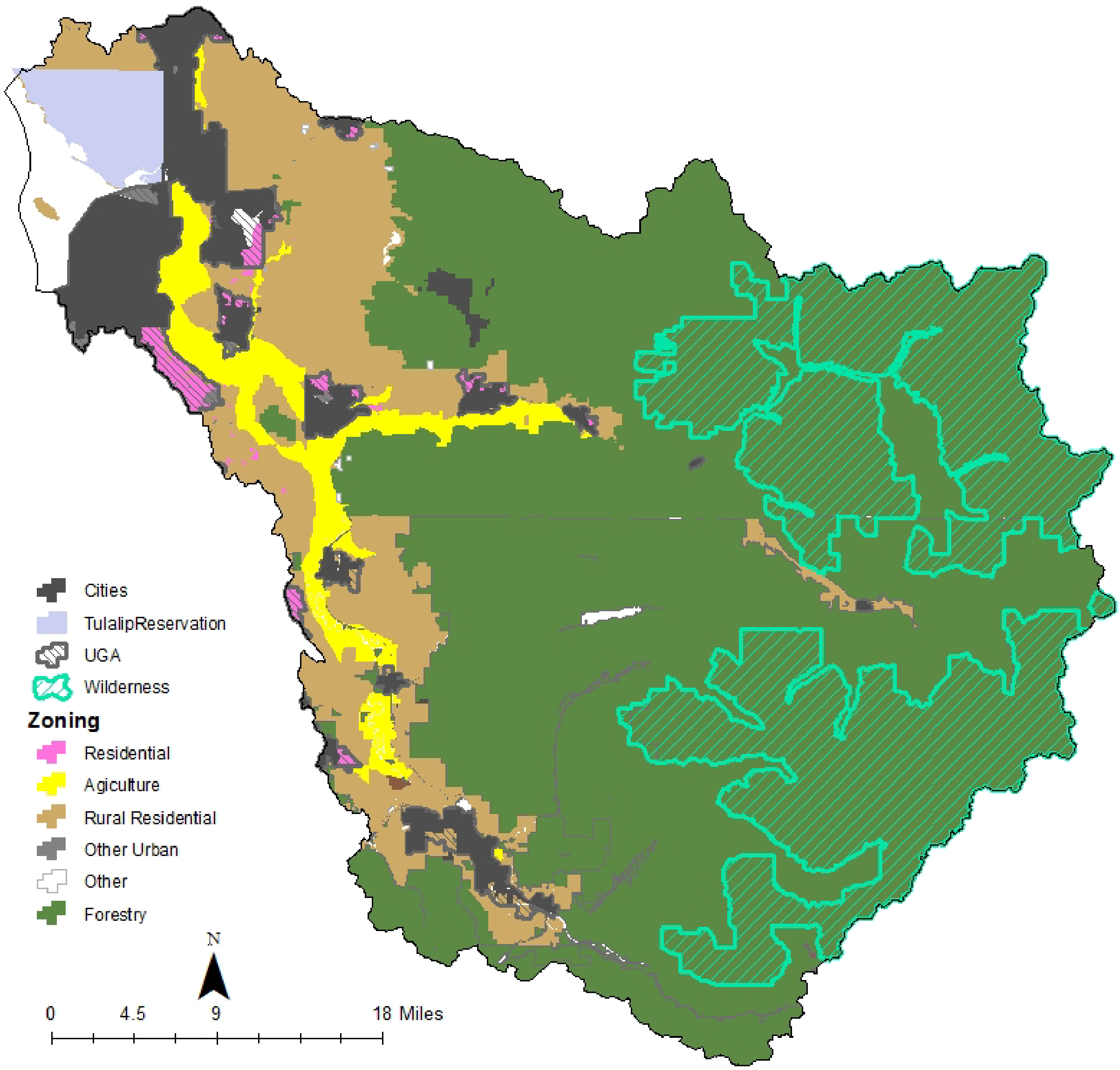


Figure 5: Land Use Designations for WRIA 7

2.4 Identifying Current and Existing Protection

In addition to the land use identification, it is important to explore the existing protection methods that are already applied in the area of interest (Figure 6). Protection maps were used to help identify tools that could complement work being done in the area and show where existing protection tools could be expanded or strengthened.

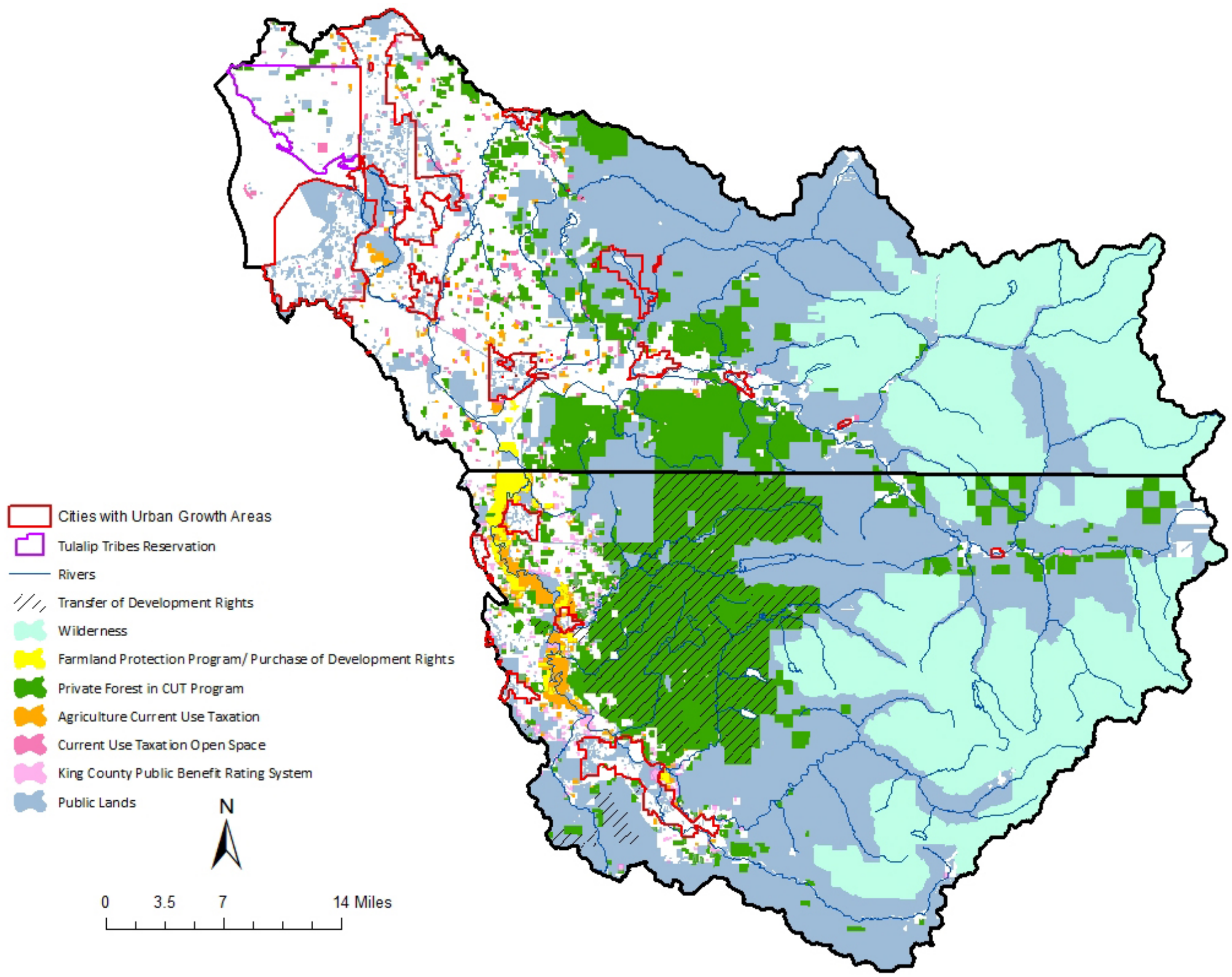


Figure 6: Current Protection Tools in WRIA 7

2.5 Puget Sound Watershed Characterization Models

Across all spatial scales, the project team evaluated hydrology using Ecology's PSWC models (Stanley et al. 2012; Wilhere et al. 2013). PSWC examined the four key components of hydrology—delivery, surface storage, recharge, and discharge (see Section 3)—as well as overall hydrologic importance.

The four water-flow processes used in this sub-model included delivery, surface storage, and movement (separated into recharge and discharge). The following attributes determined the level of importance assigned to each component:

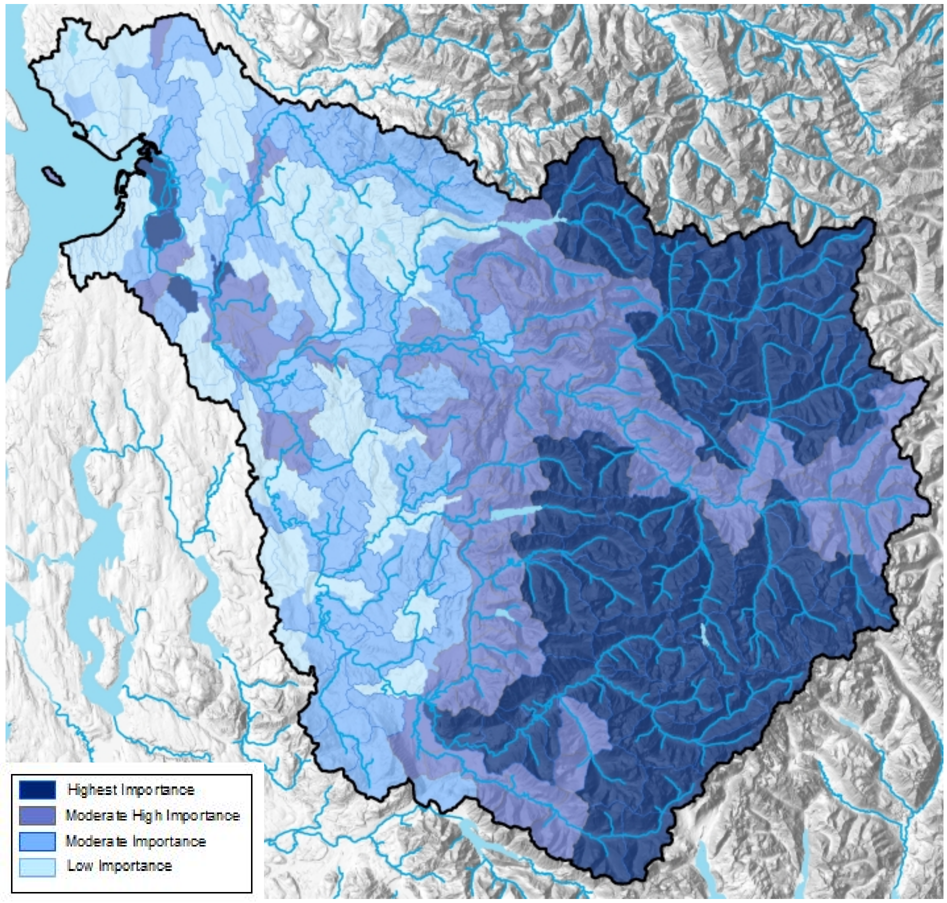
- *Delivery: precipitation regime*
- *Surface storage: depressional wetlands, lakes, and stream floodplains*
- *Recharge and discharge: precipitation, soil composition, slope wetlands, alluvial floodplains*

Since the SBPP is focused on assessing areas of hydrologic importance, regardless of condition (i.e., degradation), the technical approach focused on evaluating results from the hydrologic flow importance sub-model. The flow importance sub-model evaluated hydrology based on physical attributes of topography, soils, geology, and hydrology. This sub-model evaluated water-flow processes in an "unaltered" state, without consideration of land-use changes or human modifications, providing a detailed spatial assessment of hydrologic importance across the Basin.

The model highlighted the areas that were important for all four hydrologic components as well as areas important for each of the individual hydrologic components. The model provides a relative comparison between watersheds in an unaltered state. These results inform decisions about the most important opportunities to protect specific components of hydrology at each scale.

The hydrological importance of the area of interest was identified using watershed characterization maps (Figure 7). These maps establish hydrologic areas of interests and important areas within the Basin (or sub-basin or planning unit). Note the importance rating changes relative to scale, but the prioritization can be used at any scale. An example of a detailed map at a smaller scale is provided in Figure 8. Additional detailed maps at smaller scales are provided in Appendix A.

Figure 7:
Ecology Watershed Characterization Model for Hydrologic Importance in WRIA 7



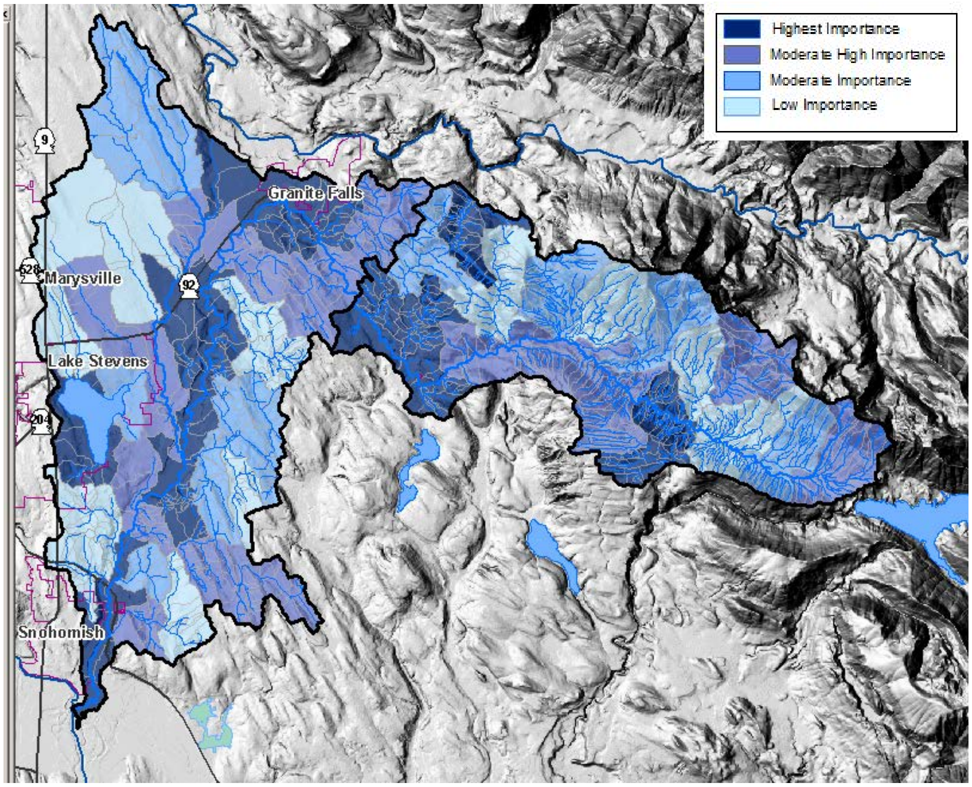


Figure 8: Example of a Smaller-Scale Watershed Characterization Model for Hydrologic Importance

Section 3

TECHNICAL ASSESSMENT RESULTS

Assessment of the four key components of hydrology—delivery, surface storage, recharge, and discharge—using the PSWC models resulted in basic protection strategies, detailed in Section 3.1. Section 3.2 summarizes the overall watershed characterization hydrologic importance assessment results at Scales 1 through 3, and provides information regarding locations in the Basin where the particular components are most important.

Section 4 provides recommendations related to tools to achieve these protective actions.

3.1 Watershed Characterization Hydrology Components and Protection Strategies

Each of the four key components of hydrology has basic protection strategies, detailed in Sections 3.1.1 through 3.1.4.

3.1.1 Delivery

Delivery is a mechanism of water flow processes that has to do with the quantity and timing of water available for surface waters and groundwater.

The PSWC model (Hume et al. 2015) indicates that delivery is most important in the forested areas. These areas are typically dominated by forest cover, and characteristic of rain-on-snow and snow-dominated precipitation zones. Delivery is critical to maintain water in rivers and streams. Protection of delivery functions is imperative to ensure water is available throughout the year, particularly in low flow conditions. Spatial orientation of delivery across the three scales is shown in Table 1. Delivery functions are degraded through loss of forest cover and increases in impervious surface. In order to protect areas important to

delivery, strategies will have to focus on protecting forest cover, especially in rain-on-snow and snow-dominated zones.
The following are examples of strategies to protect delivery:

- Preserving tree cover (conifers in particular) to allow for infiltration and prolonged delivery of water to the Basin
- Protecting snow-dominant and rain-on-snow areas to maintain appropriate delivery
- Ensuring zoning is in line with long term protection of resources
- Increasing the size of protected areas around streams and wetlands

3.1.2 Storage

Storage is a mechanism of water flow processes where surface runoff accumulates during storm events, desynchronizing flows to downstream areas.

The storage of water is a key process in lowland and transition zones between mountainous areas and the lowlands. Areas that are important to storage generally have a high proportion of wetlands, lakes, and floodplains. Spatial orientation of storage across the three scales is shown in Table 1. The storage process is degraded through the loss of wetlands, increased channelization, and disconnection of streams from floodplains.

The following are examples of strategies to protect storage:

- Limiting stream and wetland crossings by roads
- Maintaining beaver ponds to increase surface storage
- Limiting road building in forested areas
- Reducing the density of artificial channels (interception of shallow groundwater in channels and road ditches)
- Reducing channelization and, where appropriate, finding ways to combine drainage systems for better hydrologic benefit
- Reducing opportunities for development in the floodplain, encouraging abandonment of floodplain development, and purchasing floodplain development rights

- Ensuring zoning, critical areas regulations, shoreline regulations, and other pertinent regulations are consistent with protection of wetlands, lakes, and floodplains
- Increasing the size of protected areas around streams and wetlands

3.1.3 Recharge

Recharge is a key hydrologic process in areas with permeable outwash and alluvial deposits, particularly in glacial terraces and floodplains because these areas allow for higher infiltration. The importance of groundwater and interactions with recharge and water flow are clearly important; however, groundwater dynamics are not addressed in the SBPP. Spatial orientation of recharge across the three scales is shown in Table 1. Areas with high infiltration that also experience high precipitation rates are critical for recharge, which is degraded by impervious surface.

Recharge is a mechanism of water flow processes where water moves downward from surface water to groundwater and is dependent on the infiltration rate associated with soils and underlying geology.

The following are examples of strategies to protect recharge:

- Reducing groundwater withdrawals
- Capturing runoff in a manner that allows for greater infiltration, such as rain gardens or use of pervious pavement, especially in developed areas
- Limiting development and logging in areas with permeable soils, in particular, when soils are in high-precipitation areas
- Retaining large parcels in recharge areas and limiting certain extraction activities in recharge areas
- Increasing the size of protected areas around streams and wetlands
- Ensuring zoning is consistent with protection of resources
- Reducing the density of artificial channels (interception of shallow groundwater in channels and road ditches)

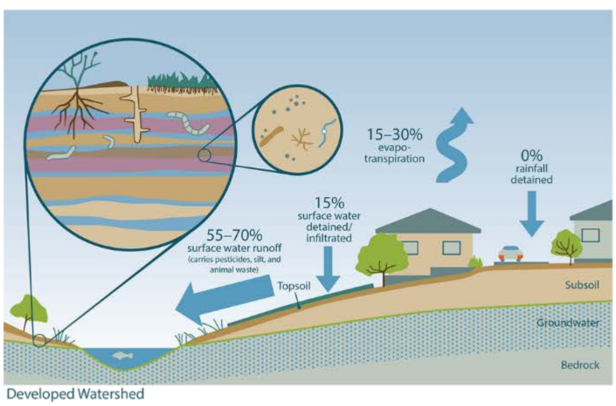
3.1.4 Discharge

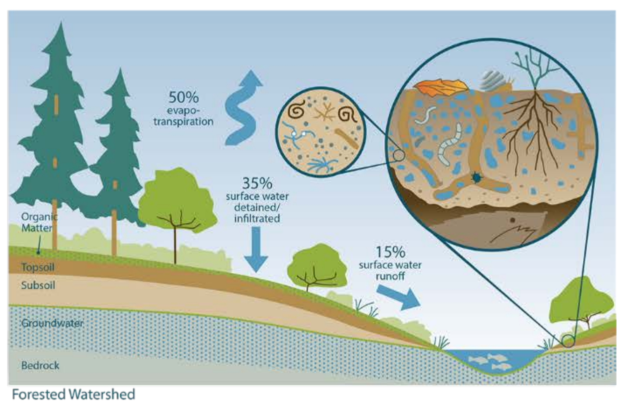
Discharge is a mechanism of water flow processes where groundwater seeps out to surface water features as springs or shallow groundwater seeps.

Areas important to discharge processes are concentrated in large floodplain areas where the floodplain intersects permeable soils, and slope wetlands adjacent to rivers. These areas are critical in maintaining low flows. Spatial orientation of discharge across the three scales is shown in Table 1. Discharge is affected by development adjacent to slope wetlands, high density of roads, ditches, and groundwater withdrawals.

The following are examples of strategies to protect discharge:

- Reducing interception of shallow groundwater in channels and road and agricultural ditches
- Protecting wetlands
- Developing regulations that are protective of slope wetlands
- Increasing the size of protected areas around streams and wetlands
- Reducing groundwater withdrawals





Adapted from King County

Figure 9: Movement of Precipitation in Developed and Forested Watersheds

3.2 Scales 1 through 3 Results Summary

Results from the watershed characterization importance model for the different components of hydrology at Scale 1 (across the entire basin) show patterns that should allow managers to plan targeted protection of different kinds of hydrology in appropriate locations. Figure 10 shows the importance maps for each of the four key components of hydrology at Scale 1.

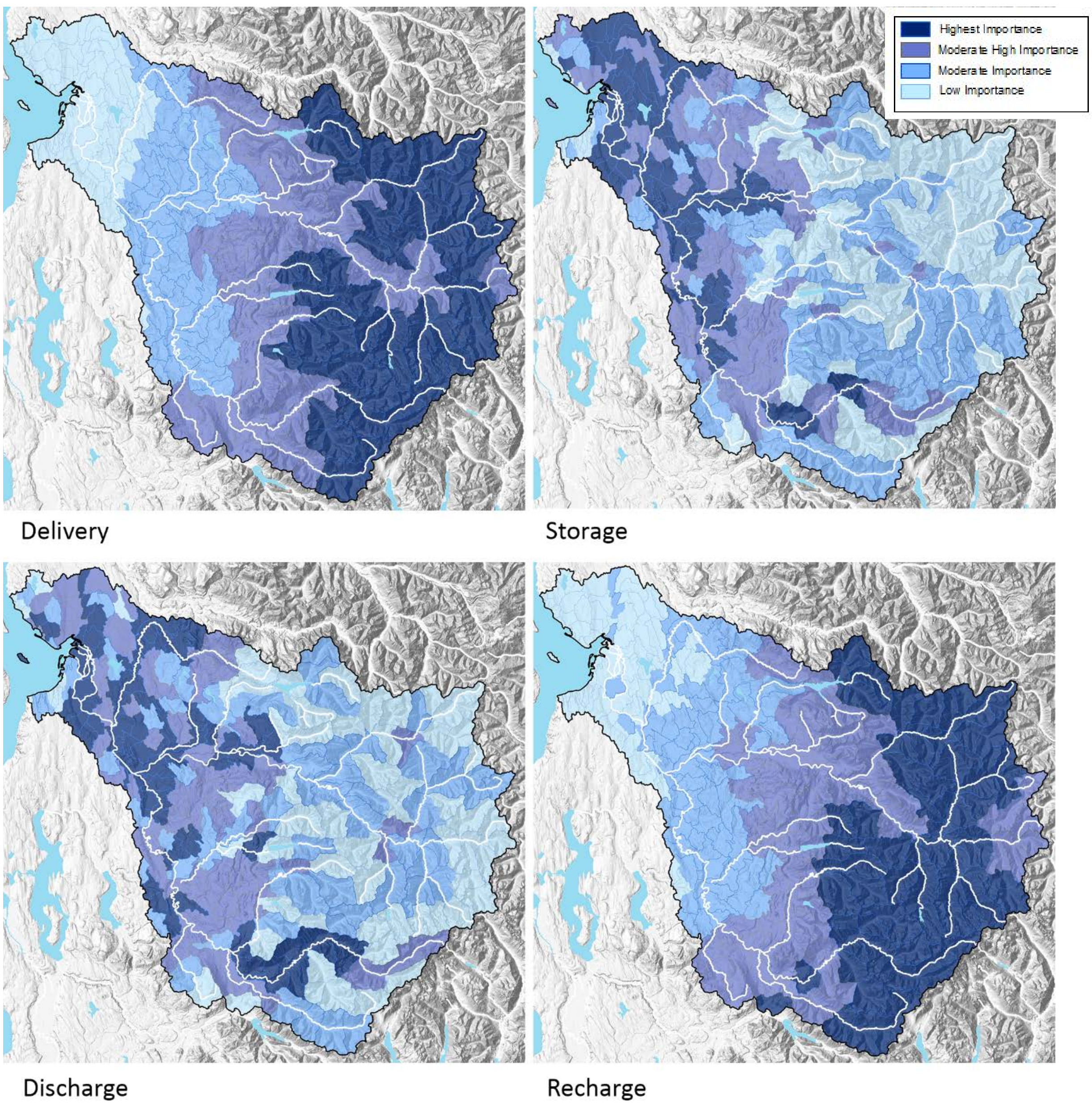


Figure 10: Scale 1 Hydrologic Components Importance Maps

Interpretation of the results patterns reveal that in the upper watershed, forested headwaters with high precipitation are critical in maintaining delivery. Where these areas lose forest cover, delivery will be impacted. Many of the same areas with appropriate geology also maintain recharge for the movement of water through the slope down-watershed. These areas would be affected by compaction and impervious surface.

In the lower watershed, discharge is related to valley-bottom coarse sediment floodplains. These areas could be affected by anything that intercepted the movement of water throughout the floodplains and into channels such as wells or revetments. Storage in the lowlands is identified as important where there are depressional features. Regrading or filling these surfaces could result in a loss of function.

In Tables 1 through 3, results are color-coded to indicate applicable Puget Sound Watershed Characterization scales:

Scale 1

Scale 2

Scale 3

The patterns across the landscape remain consistent as the analysis zooms in from Scale 1 to more the more refined Scale 3. In order to facilitate quick reference of results, Table 1 shows a summary of the importance of the watershed characterization hydrology components at the three scales and information regarding locations in the Basin where the particular components are most important. Table 2 presents the results of the habitat model and assessment of protection considerations at a planning unit scale (Scale 3). Table 3 presents a summary of the information gathered in the technical assessment for each Scale 3 planning unit. More detailed technical assessment results—including lenses such as expected hydrological change due to climate change, current fish use, and local opportunities—are provided by planning unit in Appendix A.

Table 1: Highest Importance Watershed Characterization Model Outputs for Scales 1 through 3

Geographic Extent (Scale)	Overall Flow Importance Model	Delivery Importance Model	Surface Storage Importance Model	Recharge Importance Model	Discharge Importance Model
Scale 1					
Snohomish River Basin	• Upper watersheds of Snoqualmie and Skykomish basins • In particular, Upper Snoqualmie, Upper South Fork Skykomish, and Upper North Fork Skykomish planning units contain significant proportions of AUs ranked highest or moderate-high for importance to overall water flow processes	• North Fork Skykomish, Upper South Fork Skykomish, and Upper Snoqualmie • To a lesser extent, Sultan, Tolt, and Upper Pilchuck rivers	• Lower Snohomish mainstem near estuary and lower portions of Pilchuck River • Areas of the lower portion of Skykomish mainstem, Woods Creek, and Sultan River • Snoqualmie mainstem, Cherry Creek, and Upper Snoqualmie are of moderate importance	• Snoqualmie River basin • Skykomish River basin	• Snohomish and Snoqualmie rivers • Lower Pilchuck and estuary drainages • To a lesser degree, Upper Snoqualmie, Skykomish mainstem, and lower middle Skykomish
Scale 2					
Snohomish Mainstem	• Pilchuck and Snohomish rivers mainstem planning units • Estuary drainage also contain some moderate-high to high ranked AUs	• Upper Pilchuck • Eastern drainage of Snohomish mainstem	• Snohomish mainstem • Snohomish estuary • Lower Pilchuck (at a moderate-high degree)	• Upper Pilchuck • Eastern portion of Snohomish mainstem • Quilceda Creek	• Pilchuck mainstem • Allen Creek • Snohomish mainstem
Snoqualmie Mainstem	• Upper Snoqualmie planning unit, though some areas of highest and moderate-high-ranked AUs can be found in North and South Forks Tolt River, as well as lower Snoqualmie mainstem • Generally, Upper Snoqualmie ranks highest for overall importance, followed by Tolt and Raging rivers planning units	• Upper Snoqualmie (all three forks) • North and South Forks Tolt River	• Snoqualmie mainstem • Patterson and Cherry creeks • Middle Fork Upper Snoqualmie	• Upper Snoqualmie • Tolt • To a lesser degree, Raging River and Snoqualmie mainstem	• Snoqualmie mainstem • Cherry and Patterson Creek • Middle Fork Upper Snoqualmie
Skykomish Mainstem	• Upper reaches of South Fork Skykomish, Upper North Fork Skykomish, and Sultan River planning units • Skykomish mainstem • Upper North Fork Skykomish and Upper South Fork Skykomish rank highest in Skykomish basin for overall importance to water flow process	• Upper portions of North and South Forks are the most important to delivery • Sultan River is of moderate importance	• Woods Creek • Skykomish mainstem • Lower Sultan • Lower middle Skykomish	• North and South Forks Skykomish River • Upper Sultan River	• Skykomish mainstem • Woods Creek • Lower Sultan River • Olney Creek
Scale 3					
Above the Snoqualmie Falls	• Entire Middle Fork Snoqualmie • Taylor River • Tate Creek	• Headwaters • Eastern extents of Upper North Fork • Middle Fork Snoqualmie	• Lower-mid Middle Fork Snoqualmie • Coal Creek • Tate Creek (around North Bend and Snoqualmie)	• Taylor River • Eastern headwaters • Upper portions of North and Middle Forks	• Middle Fork Snoqualmie • Tate Creek • Coal Creek • Northern tributaries of North Fork Snoqualmie

Geographic Extent (Scale)	Overall Flow Importance Model	Delivery Importance Model	Surface Storage Importance Model	Recharge Importance Model	Discharge Importance Model
Snohomish Estuary Drainages	• East Fork Quilceda Creek • Allen Creek drainage	• Upper portion of Quilceda Creek (specifically, East Fork south of Arlington)	• Areas near confluence of West and East Forks Quilceda • Allen Creek drainage	• Primarily, East and West Forks Quilceda Creek (excluding headwaters of East Fork)	• Lower East Fork Quilceda • Allen Creek drainage
Lower Mid Skykomish	• Lower middle Skykomish	• Upper Wallace River • May Creek • Lower reaches of Olney Creek	• Headwaters in Upper Wallace Creek • Upper Olney Creek • Upper May Creek	• Mid-lower Olney Creek • Upper Bear Creek • Lower May Creek (around Gold Bar) • Confluence of Wallace River with May and Olney creeks	• Upper Olney Creek • Upper Wallace River • Upper May Creek • Lower May Creek
Lowland Snoqualmie Tributaries	• Mid-lower Patterson Creek • Eastern headwaters of Cherry Creek • Lower Cherry Creek near confluence with Snoqualmie River (near Duvall) • Mid-upper portion of Harris Creek	• Headwaters of Patterson Creek • Eastern headwaters of Cherry Creek	• Northern headwaters of Patterson Creek • Lower Patterson near confluence with Snoqualmie River • Harris Creek • Lower Cherry Creek near confluence with Snoqualmie (near Duvall)	• Mid-lower Patterson Creek • Cherry Creek	• Mid-lower Patterson Creek • Mid-lower Harris Creek • Lower Cherry Creek
Mid Snoqualmie Tributaries	• Headwaters of Tokul Creek (Canyon Creek, Beaver Creek, and Ten Creek drainages) • Western portions of Griffin Creek drainage	• Eastern portion of Tokul Creek drainage (including Beaver Creek and Ten Creek drainages)	• Western drainage of Griffin Creek • Southern drainage of Tokul Creek	• Eastern portion of Tokul Creek drainage (including Beaver Creek and Ten Creek drainages)	• Griffin Creek drainage • Beaver and Ten Creek drainages
North Fork Skykomish	• Lower North Fork Skykomish (around Index and up to Bitter Creek) • Mid North Fork (from Silver Creek to Goblin Creek)	• Upper North Fork Skykomish • West Cady Creek	• North Fork Skykomish from Bear Creek down to confluence with South Fork Skykomish (around Index)	• Upper North Fork Skykomish including west Cady Creek, Goblin Creek, and Troublesome Creek drainages	• Lower-mid North Fork Skykomish
Pilchuck	• Upper headwaters of Pilchuck • Portions of middle Pilchuck between Granite Falls and Lake Stevens • Mouth of Pilchuck near Snohomish	• Headwaters in Upper Pilchuck down to Granite Falls	• Areas around Lake Stevens • Catherine Creek • Little Pilchuck • Portions of middle Pilchuck • Mouth of Pilchuck near Snohomish	• Headwaters of Upper Pilchuck • Tributaries near Granite Falls • Mouth of Pilchuck near Snohomish	• Areas around Granite Falls down to confluence of Dubuque and Little Pilchuck • Worthy Creek • Upper Panther Creek • Lower Pilchuck near confluence of Snohomish
Puget Sound Drainages	• Tulalip Creek and Mission Creek drainages (on Tulalip reservation)	• Drainages around Port Gardner • Japanese Gulch Creek • Merrill Creek • Ring Creek • Pigeon Creek drainage	• Tulalip Creek • Mission Creek drainage	• Tulalip Creek • Mission Creek • Japanese Gulch • Merrill Creek • Ring Creek	• Tulalip Creek • Mission Creek
Raging River	• Headwaters rank moderately high in importance to basin hydrology	• Headwaters (near Tiger Mountain)	• Mouth of Raging River near Preston and Fall City	• Headwaters (near Tiger Mountain) • Middle portion of basin	• Mouth of Raging River near Preston and Fall City

<table>
<tr><th>Geographic Extent (Scale)</th><th>Overall Flow Importance Model</th><th>Delivery Importance Model</th><th>Surface Storage Importance Model</th><th>Recharge Importance Model</th><th>Discharge Importance Model</th></tr>
<tr><td>South Fork Skykomish</td><td>• Lower South Fork Skykomish drainage from confluence with North Fork up to confluence with Miller River (excluding Index Creek, Barclay Creek, and Money Creek drainages)
• East Fork Miller River drainage
• West Fork Foss drainage
• Lower Tye River drainage</td><td>• Rapid River
• Miller River
• Foss River
• Deception Creek drainage</td><td>• South Fork Skykomish mainstem
• Upper Miller River
• West Fork Foss River
• Alpine Creek drainage</td><td>• Miller River
• Foss River
• Rapid River
• Johnson Creek drainage</td><td>• South Fork Skykomish mainstem from confluence with North Fork up to confluences with Beckler/Rapid, Tye, Foss, and Miller rivers</td></tr>
<tr><td>Sultan</td><td>• Upper Sultan River (upstream of Spada Lake)
• Lower Sultan (up to Woods Creek)</td><td>• Headwaters and upper portions of Sultan River</td><td>• Lower Sultan
• Spada Lake</td><td>• Upper Sultan (upstream of Spada Lake)</td><td>• Lower Sultan (near Sultan and up to Woods Creek)</td></tr>
<tr><td>Tolt</td><td>• Lower Tolt River (near Carnation)
• Upper South Fork Tolt</td><td>• Upper portions of North and South Forks Tolt</td><td>• South Fork Tolt (below South Fork reservoir)
• Drainage below confluence of North and South Forks Tolt</td><td>• Eastern headwaters of North and South Forks Tolt
• Areas directly below South Fork reservoir</td><td>• North Fork Creek drainage
• Areas directly below South Fork reservoir
• Lower Tolt near Carnation</td></tr>
<tr><td>Woods</td><td>• Primarily, East Fork from confluence with Rosinger Creek down to confluence with West Fork
• Richardson Creek drainage</td><td>• East Fork Woods Creek</td><td>• Lower East Fork
• Richardson Creek
• Below confluence of East and West Forks</td><td>• East Fork from confluence with Rosinger Creek down to confluence with West Fork
• Richardson Creek</td><td>• East Fork from confluence with Rosinger Creek down to confluence with West Fork
• Richardson Creek</td></tr>
</table>

Notes:
AUs = Assessment Unit (a smaller basins broken out within a planning unit that allowed the Watershed Characterization Model to be run at a more refined scale)

Table 2: Habitat Model Outputs and Assessment of Protection Considerations for Scale 3 (Planning Units)

Planning Unit	Habitat Model	Protection Consideration
Scale 3		
Above the Snoqualmie Falls	• Generally, North and Middle Forks Snoqualmie have higher watershed habitat indices than South Fork Snoqualmie and western drainages • Upper portions of North and Middle Forks, in addition to Taylor River, displayed the highest watershed habitat values • While habitat potential is good, Snoqualmie Falls is a natural barrier that prevents anadromous fish from being able to access this habitat	• North Fork: protection of delivery and recharge; restoration of delivery and recharge processes in mid reaches • Middle Fork: restoration of storage and protection of delivery and recharge • South Fork: protection of delivery and recharge processes
Snohomish Estuary Drainages	• West Fork Quilceda Creek • Allen Creek drainage • Majority of eastern drainages into Ebey Slough	• Restoration of surface storage • Protection of recharge and delivery
Lower Mid Skykomish	• Mid-lower Olney Creek • Mid-lower May Creek	• Wallace River • Lower Olney Creek • Lower May Creek (around Gold Bar)
Lowland Snoqualmie Tributaries	• Generally, Cherry and Harris creeks have higher watershed habitat values than Patterson and Ames creeks • Within Cherry-Harris Creek area, mid-lower Cherry Creek near Duvall and northern tributaries of middle Cherry Creek have high watershed habitat values	• Cherry Creek: restoration of discharge and surfaces storage processes • Patterson Creek: restoration of discharge and surface storage processes
Mid Snoqualmie Tributaries	• Griffin Creek • Tokul Creek	• Protection and restoration of surface storage and discharge
North Fork Skykomish	• Lower North Fork Skykomish (near Index) • Areas around Bear and San Juan creeks	• Protection of delivery • Protection and restoration of recharge
Pilchuck	• Specifically, from confluence of Little Pilchuck and middle Pilchuck up to Purdy Creek • Upper portion of Dubuque Creek • Upper portion of Little Pilchuck Creek	• Highest protection in upper watershed • Protection of recharge and delivery in upper watershed • Restoration of discharge and surface storage in lower watershed
Puget Sound Drainages	• Lower Tulalip Creek and lower Mission Creek drainages have the highest watershed index values • Among those, lower Mission Creek drainage has the highest watershed habitat indices	• Northern drainages around Tulalip Creek: protection of surface storage and recharge and discharge • Restoration of discharge, delivery, and recharge in southern drainages
Raging River	• Best habitat is in lower portions of Raging River • Upper reaches of Raging are considered moderate quality or importance	• Protect delivery and recharge in upper watershed
South Fork Skykomish	• Lower portions of South Fork Skykomish mainstem drainages (downstream of Index Creek confluence), areas around confluence of Miller River, and areas around confluence of Foss with Tye rivers have the highest watershed index values • Deception Creek drainage in Tye River drainage was also characterized as having high watershed habitat indices	• Northern tributaries: restore recharge and protect and restore delivery • Southern tributaries: protect recharge and delivery • South Fork mainstem: restore surface storage
Sultan	• Much of Sultan has high watershed habitat value; however, lower portions near Sultan, areas below Spada Lake, and Elk Creek drainage have the highest habitat values because above Spada Lake reservoir there is no passage for anadromous fish at the Jackson Dam	• Upper watershed: protection of surface storage and recharge • Lower watershed: restoration of discharge and surface storage
Tolt	• All of drainages below confluence of North and South Forks Tolt have high watershed habitat values. Specifically, the areas directly below South Fork reservoir and lower Tolt near Carnation have the highest habitat values. • Only spawning reach for summer steelhead in South Fork Tolt is below dam, which is highlighted as a unique population in the distinct population segment	• North Fork: restoration of delivery and protection of recharge • South Fork: protection and restoration of delivery and recharge • Mainstem: protection and restoration of surface storage
Woods	• Much of Woods Creek has high watershed habitat value, with the Richardson Creek drainage, Upper West and East Forks drainages (area at top of the East Fork is not accessible to anadromy), and areas near the confluence of the West and East Forks having the highest habitat values	• Restoration of surface storage and discharge

Table 3: Information Sources included in Scale 3 (Planning Units) for the SBPP Technical Approach

Planning Unit	Salmonid Use[1, 2]	Precipitation Regime	Primary Land Uses	Life Cycle Limiting Factors	Current and Future Pressures	Ecosystem Services	Climate Change Impacts	Existing Protection Strategies in Unit	Opportunities
Scale 3									
Above the Snoqualmie Falls	No anadromous fish use (assumed bull trout presence)	• Highland (30%) • Snow Dominant (26%) • Rain on Snow (21%) • Rain Dominant (18%)	• Forestry (91%) • Rural Residential (6%) • Cities (3%)	NA; anadromous fish not present in this planning unit	• City growth and rural residential development • Forestry practices • Water withdrawals • High water temperatures • Revetments/levees disconnect river from floodplain • Limited large wood recruitment from logging and development	• Flood regulation • Water quality regulation • Drinking water provisioning • Recreation • Energy production • Spawning • Water storage • Disturbance prevention	• Minimal increase for pre-spawning temperature (Battin et al. 2007) • Shift to earlier runoff timing and increases in magnitude of extreme precipitation and discharge events (King County 2010)	• PBRS 0.3% • Forestland 16.1% • Agriculture 0.1% • FPP 0.1% • Public 77.2% (12.6% of basin in TDR and 30.8% of basin in wilderness protection)	• Decrease private inholdings surrounded by public land • Study impacts of groundwater withdrawals on instream flows and groundwater • Acquire TDRs in key areas of hydrologic importance • Ensure timber harvest methods are protective of hydrology
Estuary Drainages	• Chinook salmon/bull trout use = low • Bull trout = presumed presence • Coho salmon use = low to moderate • Steelhead = present	• Lowland (100%)	• Rural Residential (34.7%) • City (45%)	• Upriver migration • Spawning • Egg deposition • Egg development • Freshwater rearing • Estuarine rearing • River outmigration	• Continued expansion of UGAs • Industrial development along mainstem	• Recreation • Irrigation	No data for spawning and incubation	• Public Lands (11.3%) • Agriculture (0.9%) • Timber (2.0%) • Open Space (1.0%)	• Implement LID for future development • Protect lands in floodplains for future levee setbacks • Protect urban trees • Protect open space and agriculture in estuary areas under the Comprehensive Plan
Lower Middle Skykomish	• Wallace River = Chinook = moderate; coho/bull trout = low use; steelhead = present • Olney Creek = no Chinook salmon use; bull trout/coho presumed use; steelhead = present • Bear Creek = no Chinook salmon use; bull trout/coho = low; steelhead = modeled presence • May Creek = moderate Chinook use; bull trout/coho = low use; steelhead = present	• Rain Dominant (39.1%) • Rain on Snow (22.9%) • Snow Dominant (20.4%) • Highland (10.7%) • Lowland (7%)	• Forestry (88.6%) • Rural Residential (7.7%)	• Upriver migration • Spawning • Egg deposition • Egg development • Freshwater rearing • River outmigration	• Most important areas for hydrology are in and near cities; future development will have impacts on hydrology • Conversion of forest land to rural residential • Dredge mining in upper areas of lower middle Skykomish • Areas of agriculture that correspond to key areas of surface storage will need to be maintained	• Flood regulation • Water quality regulation • Recreation • Hatchery water supply • Storage • Water quantity regulation	• Small to significant increase in incubation peak flow • Minimal to moderate decrease (Upper Wallace) in minimum spawning flow • Minimal change to moderate increase (Olney) in pre-spawning temperature • Change in average number of adult Chinook spawners: slight decrease in one of six scenarios in May Creek • No change or slight increase in others	• Public Lands (65.7%) • Timberlands (22.4%) • Open Space (0.2%)	• Protect forestlands from conversion • Ensure protective timber harvest methods and allow for adaptive management in the face of climate change • Work on acquiring TDRs in key areas of hydrologic importance • Decrease private inholdings surrounded by public lands • Protect floodplain areas between Highway 2 and Snohomish River, upstream of Start Up levee; area is important for surface storage and discharge • Use LID in cities and UGA • Use inventive programs in residential areas

Planning Unit	Salmonid Use[1, 2]	Precipitation Regime	Primary Land Uses	Life Cycle Limiting Factors	Current and Future Pressures	Ecosystem Services	Climate Change Impacts	Existing Protection Strategies in Unit	Opportunities
Lowland Snoqualmie Tributaries	• Cherry Creek: - Chinook salmon/ bull trout use = low - Coho = high - Steelhead = present • Harris Creek: - Chinook salmon/ bull trout use = low - Coho = moderate - Steelhead = present • Ames Creek: - Chinook salmon = none - Coho/bull trout = low - Steelhead = presumed presence • Patterson Creek: - Chinook salmon/ bull trout use = low - Coho = moderate - Steelhead = present	• Lowland (74%) • Rain Dominant (25%) • Rain on Snow (1%)	• Rural Residential (60.2%) • Forestry (27.9%) • Agriculture (8%)	• Upriver migration • Spawning • Egg deposition • Egg development • Freshwater rearing • River outmigration	• Conversion of forestry lands to rural residential development • Growth of cities and UGAs • Increase of water withdrawals in rural residential areas (Cherry)	• Flood regulation • Water quality regulation • Recreation • Irrigation • Storage • Water quantity regulation	• Moderate increase in incubation peak flow • Minimal decrease in minimum spawning flow • No change to minimal increase in pre-spawning temperature • Change in average number of adult Chinook spawners: - Cherry/Harris creeks: increase in all scenarios - Patterson/Ames: assumed decrease in all scenarios (Battin et al. 2007)	• Public Lands (21%) • Forestlands (13%) • Agriculture Lands (8%) • PBRS (7%)	• Implement stormwater regulations as cities grow • Ensure that timber harvest methods are protective of hydrology and can adaptively manage with climate change • Acquire TDRs in key areas of hydrologic importance • Continue to enhance open spaces—limit conversions • Enroll rural residential properties into appropriate CUT • Decrease number of private inholdings surrounded by public lands • Study groundwater withdrawals to understand impacts on instream flows and groundwater recharge
Mid Snoqualmie Tributaries	• Chinook salmon = low use • Coho = high use (Griffin) and low use (Tokul) • Bull trout = presumed presence) • Steelhead = present	• Rain Dominant (89%) • Rain on Snow (2%) • Lowland (9%)	• Forestry (96.1%) • Rural Residential (2.8%)	• Upriver migration • Spawning • Egg deposition • Egg development • Freshwater rearing • River outmigration	• Biological resource use—in particular, timber harvest • Natural system modification • Human intrusions and disturbance • Development • Invasive and problematic species	• Flood regulation • Water quality regulation • Recreation • Irrigation • Storage • Water quantity regulation	• Moderate increase in incubation peak flow • Minimal decrease in minimum spawning flow • Moderate increase in pre-spawning temperature • Moderate decrease in average number of adult Chinook spawners in four of six scenarios (Battin et al. 2007)	• Forestland (95%) • PBRS 0.3% • Agriculture CUT 1% • Public Lands 1% • 0.3% of Agriculture Land is in FPP • 92% of forestlands in TDR	• Place non-protected parcels into appropriate CUT programs, particularly in hydrologically important areas • Ensure timber harvest methods are protective of hydrology

Planning Unit	Salmonid Use[1, 2]	Precipitation Regime	Primary Land Uses	Life Cycle Limiting Factors	Current and Future Pressures	Ecosystem Services	Climate Change Impacts	Existing Protection Strategies in Unit	Opportunities
North Fork Skykomish	• Chinook Salmon = low • Bull trout = known presence to high • Coho = high use (known use in upper reaches) • Steelhead = present	• Highlands (46.4%) • Snow Dominant (27.4%) • Rain on Snow (18.8%) • Rain Dominant (7.4%)	• Forestry (99.9%) • City (0.1%)	None identified	• New roads • Bank hardening for road protection • Geothermal/hydropower exploration	• Recreation	• Incubation peak flow: moderate to major increase • Minimum spawning flow: moderate to major decrease • Pre-spawning temperature: minimal to moderate increase • Change in average number of adult Chinook spawners: moderate decrease	• Public Lands (84.1%) • Timberlands (0.5%) • Open Space (0.1%)	• Educate the population in this basin and recreational users about the importance of leaving wood in the river system and not harvesting it for firewood • Use LID techniques in and around the Town of Skykomish • Protect hydrology as exploration of geothermal and hydropower increase in the area • Encourage acquisition of private inholdings in and around public lands
Pilchuck	• Chinook salmon = low • Bull trout = presumed presence • Coho = known presence to moderate • Steelhead = present	• Rain on Snow (33.1%) • Lowland (56.7%)	• Rural Residential (51.1%) • Forestry (37.9%)	• Upriver migration • Spawning • Egg development • Freshwater rearing • River outmigration	• Conversion of forest land and farmland to rural residential • Additional bank armoring • Loss of critical areas • Increased flooding and diking with climate change • Loss of wood in river due to firewood	• Flood regulation • Water quality regulation • Drinking water provisioning • Recreation • Water quantity regulation	• Incubation peak flow: moderate increase • Minimal decrease in pre-spawning minimum spawning flow • No change to minimal increase in temperature	• Public Lands (35.2%) • Timberlands (6.7%) • Agriculture (2.3%) • Open Space (1.8%)	• Protect forestry and agricultural lands from conversion • Use PDR/TDR to purchase development rights in agricultural land • Buy development rights in areas currently forested that are zoned rural residential • Study impacts of exempt wells on basin hydrology and find ways to minimize those impacts
Puget Sound Drainages	• Tulalip/Battle Creek: - Chinook salmon = none - Bull trout = none - Coho = none - Steelhead = present • Everett Coastal: - Chinook salmon = none - Bull trout = low - Coho= low - Steelhead = present	• Lowland (100%)	• Cities (39.4%) • Rural Residential (32.1%) • Tribal Land (27.1%)	Freshwater rearing	• Transportation infrastructure	• Recreation • Water storage (artificial)	None listed	• Public Lands (9.7%) • Timberlands (2.2%) • Open Space (1.2%)	• Use acquisitions to acquire key areas such as wetlands • Cities should use best management practices when it comes to LID • Snohomish County could adopt a PBRS (very similar to Open Space CUT program) that could potentially allow more urban property owners to take advantage of a CUT program

Planning Unit	Salmonid Use[1, 2]	Precipitation Regime	Primary Land Uses	Life Cycle Limiting Factors	Current and Future Pressures	Ecosystem Services	Climate Change Impacts	Existing Protection Strategies in Unit	Opportunities
Raging River	• Chinook salmon = high use • Coho = moderate • Bull trout = presumed presence • Steelhead = present	• Rain Dominant (63.1%) • Rain on Snow (27.9%) • Lowland (4.5%) • Snow Dominant (4.4%)	• Forestry (72.6%) • Rural Residential (24.6%)	• Upriver migration • Spawning • Egg deposition • Egg development • Freshwater rearing • River outmigration	• Biological resource use—in particular, timber harvest • Natural system modification • Human intrusions and disturbance • Development • Invasive and problematic species	• Flood regulation • Water quality regulation • Recreation • Storage • Water quantity regulation	• Slight decrease in incubation peak flow • Minimal decrease in minimum spawning flow • Moderate increase in pre-spawning temperature • Decrease in average number of adult Chinook spawners in five of six scenarios (Battin et al. 2007)	• Public Lands (79.2%) • TDR (20%) • Forestlands (3.6%) • PBRS (2.2%) • Agriculture (0.3%)	• Try to capture any DNR Public Trust lands to avoid being put into private ownership • Ensure timber methods are protective of hydrology • Enroll private properties into CUT programs • Decrease private inholdings surrounded by public land
South Fork Skykomish	• Chinook = high use (Upper South Fork) and low use (South Fork) • Coho = known presence • Bull trout = known presence) • Steelhead = present	• Highland (47.9%) • Snow Dominant (24.1%) • Rain on Snow (19.1%) • Rain Dominant (8.9%)	• Forestry (98.1%) • Rural Residential (1.8%) • Cities (0.1%)	• Upriver migration • Spawning • Egg deposition • Egg development • Freshwater rearing • River outmigration	• Timber harvest • Removal of large woody debris • Natural system modification • Human intrusions and disturbance • Development • Geothermal energy, oil, gas, and mineral • Hydropower	• Flood regulation • Water quality regulation • Recreation • Storage • Water quantity regulation • Disturbance prevention	• Moderate increase in incubation peak flow • Moderate decrease in minimum spawning flow • Minimal increase in pre-spawning temperature • Decrease in average number of adult Chinook spawners	• Public Lands (94.2%) • Forestlands (5.76%)	• Acquire key parcels to protect hydrology in the face of development • Explore beaver reintroduction to improve hydrologic conditions • Continue to use current minimum road strategy implemented by USFS • Improve and relocate bridges, roads, and railways to improve hydrologic conditions • Engage in planning processes for hydropower development, geothermal energy development, and oil, gas, and mineral resource development proposals to ensure hydrology is not further degraded • Decrease number of private inholdings in public areas • Ensure timber harvest methods are protective of hydrology

Planning Unit	Salmonid Use[1, 2]	Precipitation Regime	Primary Land Uses	Life Cycle Limiting Factors	Current and Future Pressures	Ecosystem Services	Climate Change Impacts	Existing Protection Strategies in Unit	Opportunities
Sultan	• Chinook = high use (in the river downstream of the City of Everett Diversion Dam) • Coho = known presence • Bull trout = presumed presence • Steelhead = present	• Rain Dominant (27.9%) • Rain on Snow (25.9%) • Snow Dominant (22.7%) • Highland (15.7%) • Lowland (7.2%)	• Forestry (90.4%) • City (5.6%)	• Freshwater rearing (currently debatable)	• Timber harvest • Natural system modification (bank hardening) in lower watershed • Development in lower watershed • Invasive species	• Flood regulation • Water quality regulation • Drinking water provisioning • Recreation • Energy production • Storage • Water quantity regulation	Hydrology largely regulated by Culmback Dam for next 45 years	• Public Lands (89.6%) • Timberlands (3.2%)	• Enroll lands into CUT programs • Reduce number of private inholdings in public lands through targeted acquisitions • Ensure that forestry practices are using best available management practices for harvesting • Use LID practices • Focus education programs on importance of stream buffers
Tolt	• Chinook salmon = high use below forks and low use above forks • Coho = high use below forks and low use above forks • Bull trout = presumed presence • Steelhead = present	• Rain Dominant (35.4%) • Rain on Snow (24.2%) • Snow Dominant (21.8%) • Lowland (10.1%)	• Forestry (92.7%) • Rural Residential (3.83%)	• Upriver migration • Spawning • Egg deposition • Egg development • Freshwater rearing • River outmigration	• Floodplain disconnection • Lack of natural cover leading to a lack of habitat in Lower Tolt • Sediment impacts from historic gravel removal • Residential development • Invasive and problematic species	• Flood regulation • Water quality regulation • Drinking water provisioning • Recreation • Energy production • Storage • Water quantity regulation	• Significant increase in incubation peak flow • Minimal decrease in minimum spawning flow • Moderate increase in pre-spawning temperature • Decrease in average number of adult Chinook spawners in five of six scenarios • Hydrology will be largely regulated by South Fork Tolt dam (Battin et al. 2007) • Some models predicting decreased low flows, higher frequency of high flow events, and increased annual peak flow (King County 2010)	• Forestlands (72.9%) • TDR (65.2%) • Public Lands (40.1%) • PBRS (0.6%) • Agriculture (0.3%) • FPP (0.2%)	• Continue acquisitions and levee setbacks • Decrease private inholdings surrounded by public lands • Ensure timber harvest methods are protective of hydrology • Support and improve small forestry owner-harvest methods • Participate in South Fork project relicensing to ensure protection of hydrology

Planning Unit	Salmonid Use[1, 2]	Precipitation Regime	Primary Land Uses	Life Cycle Limiting Factors	Current and Future Pressures	Ecosystem Services	Climate Change Impacts	Existing Protection Strategies in Unit	Opportunities
Woods	• Chinook = low use • Bull trout = presumed presence • Coho = moderate use • Steelhead = present	• Rain Dominant (51.5%) • Lowland (48.5%)	• Rural Residential (51.3%) • Forestry (42.1%)	• Upriver migration • Spawning • Egg deposition • Egg development • Freshwater rearing • Hydrology: frequency	• Conversion of open space to residential development • UGA expansion – City of Monroe • Loss of critical areas • Loss of beaver ponds/wetlands	• Flood regulation • Water quality regulation • Drinking water provisioning (exempt wells) • Recreation • Energy production • Irrigation • Hatchery water supply	• No increase to moderate increase in incubation peak flow • Minimal decrease in minimum spawning flow • Minimal increase in pre-spawning temperature • Decrease or little change in average number of adult Chinook spawners in four of six scenarios	• Public Lands (43.9%) • Timberlands (10.8%) • Agriculture (0.8%) • Open Space (1.6%)	• Decrease number of private inholdings surrounded by public lands • Work on acquiring TDRs in key areas of hydrologic importance • Enroll properties in CUT Program • Implement LID in cities and rural residential areas • Increase education with homeowners on importance of stream buffers

Notes:
1 Chinook salmon, bull trout, and coho salmon data from the Ecological Analysis for Salmonid Conservation
2 Steelhead data from Washington Department of Fish and Wildlife Salmonscape
CUT = Current Use Taxation
DNR = Washington State Department of Natural Resources
FPP = Farmland Preservation Program
LID = Low Impact Development
NA = not applicable
PBRS = Public Benefit Rating System
PDR = Purchase of Development Rights
TDR = Transfer of Development Rights
UGA = Urban Growth Area
USFS = U.S. Forest Service

Section 4

PROTECTION TOOLS

This section provides descriptions of a wide range of protection tools—both those in existence and potential tools—and presents assessments of the tools in relation to Basin hydrology. Readers should consider the relative hydrological importance in their areas of interest, the current and potential land uses, and other pertinent information (such as expected hydrological change or fish considerations) to determine which protection tool opportunities are available in their area of interest and what they have the ability to govern (e.g., via regulation) or implement through other programs, such as voluntary measures.

*For purposes of the SBPP, a **protection tool** is any action that prevents the degradation of hydrologic processes that support salmon or salmon habitat, regardless of how degraded those processes currently are. In this context, protection tools are different from **restoration** or **mitigation approaches**, which refer to actions resulting in physical alterations that improve hydrologic processes.*

4.1 Overview

4.1.1 Purpose

Basin partners have made significant investments to develop strategies and tools within the Basin that meet the definition of protection tools in the SBPP. Some of the tools were specifically developed to protect hydrologic function, while others were developed to achieve different objectives. For this chapter of the SBPP, the project team identified, categorized, and conducted assessments of these existing tools, as well as new and emerging tools. The purpose of these assessments is to inform planning and decision-making as relates to protecting hydrologic function in the Basin.

4.1.2 Approach

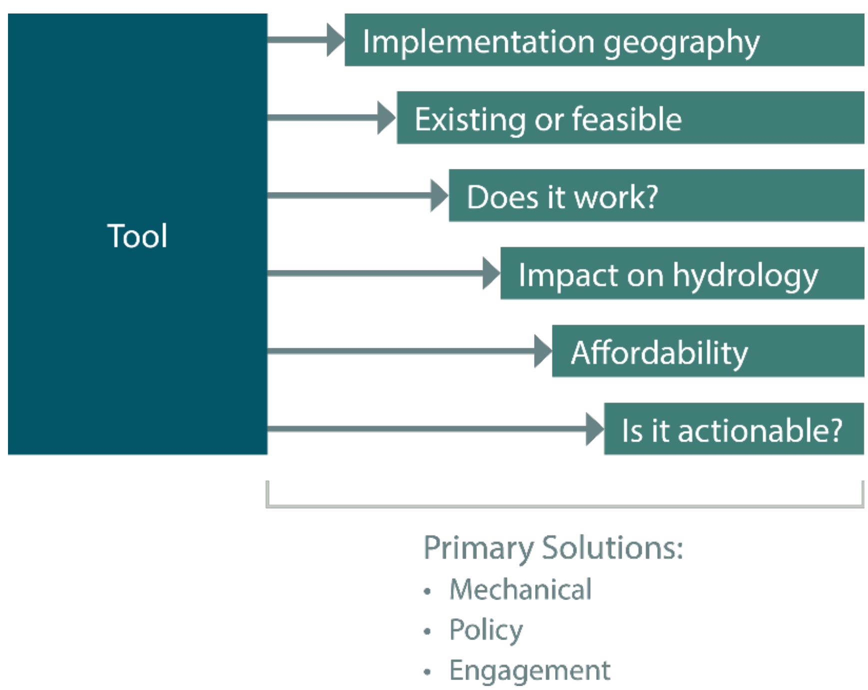
The protection tools included in Sections 4.2 through 4.6 range from those that are in use across the Basin, to those that have been implemented in certain jurisdictions, to conceptual tools that have not yet been tested. These tools were assessed at a high level, with the objective of helping decision-makers

understand the range of tools available to them as they develop viable near-term actions to help implement the SBPP. To accomplish this objective, the project team assessed each protection tool based on the following criteria:

- *Geographical scale* – Is the tool implemented Basin-wide, by jurisdiction, or at the individual project/property scale?
- *Existence and feasibility* – Is the tool in use? Is the tool technically feasible?
- *Effectiveness* – From a general qualitative standpoint, does the tool achieve protection?
- *Hydrological benefits* – How does the tool affect the hydrology of the Basin? To what degree does use of the tool result in desired hydrological outcomes?
- *Affordability* – Is the tool economically feasible? Are there any public costs, and are they reasonable?
- *Actionable* – Can the tool be used now or in the near future?

Figure 11 illustrates how these six criteria informed the assessment and recommendations of the project team.

Figure 11: Protection Tools Assessment Flow Chart



The assessments presented in Sections 4.2 through 4.6 suggest where existing tools could be improved, introduce appropriate tools that are being implemented elsewhere in the region, and identify new and innovative tools that would be appropriate for the Basin.

4.1.3 Considerations

In its assessments of protection tools, the project team considered the geographic scales at which the tools are primarily applied. For the purposes of this section, protection tools are considered to be implemented at the following levels:

- *Basin-wide* – available uniformly throughout the Basin regardless of jurisdiction
- *Jurisdictional level (city or county)* – may be used by all of the jurisdictions within the Basin, although the way in which it is implemented likely varies across jurisdictions
- *Individual properties or projects* – may be implemented without the involvement of a jurisdiction

For those tools not available Basin-wide, opportunities for alignment between jurisdictions and between agencies within a jurisdiction were considered in the assessments. It is important to recognize the role of the Tulalip Tribes in the Basin, as their involvement in advancing and implementing protection efforts spans all levels listed above. The Tulalip Tribes manage protection strategies within the extent of their reservation and participate in a wide range of projects, fora, initiatives, and partnerships that use many of the land protection tools described in this chapter. Protection efforts in which the Tulalip Tribes participate largely overlap with existing Basin-wide tools, strategies, and assessments.

4.1.4 Recommendations

The expansion of engagement efforts is applicable to all protection tools and is a universal opportunity for improving the effectiveness of tools included in the SBPP.

For some tools, engagement is one of the most promising opportunities, and is specifically noted in the recommendations where applicable.

Following the assessment of each protection tool in Sections 4.2 through 4.6 are recommendations that focus on areas of opportunity to best implement the tool. These recommendations are grouped into three categories:

- *Engagement* – characterized by education, outreach, recruitment, or other approaches to interacting with a target group (to improve protection outcomes through increased participation in a program, for example)
- *Mechanical* – characterized by specific actions to enable or improve functioning of a protection tool (creation of a market for an incentive, for example)
- *Policy* – characterized by a legislative action to create direction and regulatory framework that would enable or improve a protection tool (adoption of state legislation allowing value capture financing, for example)

Recognizing that there is a range of improvements possible for each tool, the recommendations presented in these sections emphasize actions that would have the most meaningful impact on achieving land protection and, by extension, hydrologic processes in the Basin.

4.1.5 Organization

For a summary of the protection tools, refer to Table 8 in Section 4.7.

The protection tools identified and assessed by the project team are organized in Sections 4.2 through 4.6 in the following five categories:

1. *Regulatory mechanisms* – protection tools or processes that are required by law
2. *Incentives* – measures that give individuals financial benefits for voluntarily protecting private property
3. *Acquisitions* – permanent protection tools that involve the purchase of all or a portion of an individual's property rights

4. *New models and assessments* – models or assessments that have been developed or changed since 2005 that could help focus or improve protection efforts
5. *Other tools/strategies* – protection tools or processes that do not clearly fit into the other categories

4.2 Category 1: Regulatory Mechanisms

A key component in the protection of natural resources is regulation of human activity on the landscape. In Washington State, land use regulations focus on local control rather than centralized planning and decision-making at the state level. The primary source for local regulatory authority is the Growth Management Act (GMA), under which 29 counties must prepare comprehensive plans and implement them through land use regulations. Other sources of local regulatory authority include the Shoreline Management Act, which requires local jurisdictions to regulate development on shorelines of the state, and the Planning Enabling Act, which allows cities, counties, or public regional planning organizations to regulate development through mechanisms such as zoning.

While many local regulations provide some degree of protection for hydrologic processes (either directly or indirectly), they do not align well across jurisdictions. It has therefore been difficult to achieve efficient implementation and enforcement at the Basin scale. One major challenge is that the current overarching regulatory structure is characterized by conflicting priorities (e.g., the recovery of endangered salmon versus the goals of the agricultural community). Some of these conflicts are addressed specifically in Sections 4.2.1 through 4.2.11; however, a few broad suggestions for improving regulatory alignment are also included in the recommendations for this section.

Recommendations across all Regulatory Mechanism Tools

- Pursue opportunities at the policy level for achieving greater alignment across jurisdictions, advisory and planning entities, and management regimes.
- Work to align the language and definitions used in regulations and policies.
- Use the federal definition of wetlands in local regulations, as it affords the most protection.
- Ensure that funding is provided to appropriately implement and enforce regulations.
- Increase coordination between local governments and groups pursuing Basin-wide land protection to identify opportunities for sharing information and collaborating on regulatory updates.

4.2.1 Growth Management Act

In 1990 the Washington State Legislature adopted the GMA (Revised Code of Washington [RCW] 36.70A) based on its finding that unplanned, uncoordinated growth poses a threat to sustainable economic development, quality of life, and the environment. The GMA, which has been amended annually since its adoption, requires the state's most rapidly growing counties and the cities within them to adopt comprehensive plans and development regulations that address future population growth and its impacts. These plans and regulations must be consistent with GMA goals for the following:

- Sprawl reduction
- Urban growth
- Open space and recreation
- Natural resource industries
- Environmental protection
- Shoreline management
- Public facilities and services
- Affordable housing
- Economic development
- Transportation
- Historic lands and buildings
- Permit processing
- Public participation and coordination
- Private property rights

Counties planning under the GMA must designate and direct growth to Urban Growth Areas, where public facilities and services can be provided most efficiently. In addition, all counties and cities, including those not planning under the GMA, are required to periodically review and, if necessary, revise their designations and development regulations for natural resource lands and critical areas.

An Urban Growth Area is the area of a county, as designated in a County Comprehensive Plan, where most future urban growth and development is designated to occur.

GMA Implementation

The GMA is implemented at the Basin scale. King and Snohomish Counties, as well as all cities contained therein, are required to engage in comprehensive planning under the GMA.

Assessment

The GMA provides local jurisdictions with a framework to plan for future population growth and requires them to adopt development regulations for natural resource lands and critical areas. The GMA has additional significance in that it serves as the legal foundation for some of the other protection tools. The GMA does not have direct public costs like those associated with some protection tools; however, it does have indirect costs associated with compliance. Costs related to implementing specific elements of the GMA are discussed below. Political sensitivities around implementation of the GMA vary; however, proposed changes to the act have historically been controversial.

The GMA has had a substantial impact on land use and development patterns in the Basin, but incremental growth in rural areas continues to exert conversion pressures on the resource land base and, by extension, hydrologic processes.

Recommendations

Policy

- Strengthen protection policies and regulations to reduce the fragmentation and loss of resource lands.
- Encourage the Washington State Department of Natural Resources (DNR) to retain ownership of properties that provide hydrologic benefits, especially within Urban Growth Areas.
- Protect the boundaries between Urban Growth Areas and rural areas by focusing more effort on the retention of forest cover.

Mechanical

- Limit the exceptions, exemptions, and variances that can result in decreased function of hydrologically sensitive areas such as shorelines, wetlands, forest cover, and riparian zones.
- Increase flexibility in local permitting processes to facilitate actions that protect hydrology to a greater degree than required under regulations.

4.2.1.1 Comprehensive Plans

The first and most important step in local planning under the GMA is the development of comprehensive plans. These plans, which must be updated periodically, outline policies, goals, and implementation strategies for managing population growth and its impacts over the next 20 years. Comprehensive plans must include, at a minimum, the following elements: land use, housing, capital facilities, utilities, transportation, economic development, and parks and recreation. County plans must also include a rural element. Comprehensive plans provide key guidance to cities and counties as they consider how to best accommodate different land uses and meet multiple goals for growth and natural resource protection. The plans also play an essential role in shaping local development regulations, since the GMA requires consistency between comprehensive plans and implementing regulations.

Comprehensive Plans

Implementation

The comprehensive planning process is implemented at the city and county level, in alignment with the regional growth strategy set by the Puget Sound Regional Council. Cities and counties planning under the GMA must periodically conduct an extensive review of their comprehensive plans and development regulations and update them based on land use changes, projected population growth, and any relevant amendments to the GMA. This "periodic update" is required at least once every 8 years for most cities and counties; however, certain small, slow-growing communities are given an additional 2 years to complete their updates. In addition to conducting major updates of their comprehensive plans, many cities and counties choose to adopt minor amendments to their plans annually and regularly adopt changes to development regulations that implement the plans, including zoning regulations.

Assessment

The GMA establishes the comprehensive plan as the primary instrument for local planning. Under these plans, cities and counties designate lands for specific uses such as agriculture, timber harvesting, and rural residential development. While not strictly a regulatory mechanism, comprehensive plans articulate policy direction, objectives, and priorities for natural resource protection, and as such, are influential tools for guiding land use patterns and protecting hydrology in the Basin.

Comprehensive planning is both affordable and actionable insofar as it is a locally funded state mandate within the Basin. Political sensitivity surrounding comprehensive plan updates varies. In cases where

minor or routine revisions are made to the plans, political sensitivity is typically low. In cases involving policy shifts or substantial revisions, however, political sensitivity can be high.

Recommendations

Policy

- Fund watershed planning as part of comprehensive plan updates.
- Manage to maximize multiple objectives through the Counties' comprehensive planning processes.
- Support the development of watershed characterization information (see Section 4.5.6) at a scale relevant to every local jurisdiction in the Basin and encourage its use in comprehensive planning.

4.2.1.2 Critical Areas Regulations

The GMA requires every city and county in Washington State to adopt and regularly update critical areas regulations (CARs) to protect the functions and values of wetlands, aquifer recharge areas, fish and wildlife habitat conservation areas, frequently flooded areas, and geologically hazardous areas (RCW 36.70A.030(5)). During CAR updates, local jurisdictions must use the best available science to review and revise their policies and regulations for critical areas, in accordance with Chapter 365-195 Washington Administrative Code (WAC). They must also "give special consideration to conservation and protection measures necessary to preserve or enhance anadromous fisheries" (RCW 36.70A.172(1)).

CARs

Implementation

CARs are implemented at the city and county level. King County adopted major updates to its CAR in 2004; Snohomish County did so in 2015. Due to controversy surrounding the application of CAR updates to agricultural activities, the state legislature enacted a moratorium that prevented local jurisdictions from implementing new CAR provisions on agricultural lands between 2007 and 2011. (King and Snohomish Counties adopted new provisions for agricultural areas after the moratorium was lifted.) Since 2007, King and Snohomish Counties have conducted assessments on the environmental effectiveness of CAR permitting and enforcement. Both counties issued CAR monitoring reports in 2014.

Assessment

CARs are affordable and actionable, as they are required by law. These regulations play a key role in the protection of hydrology by restricting development in and around ecologically sensitive areas. For

example, they require buffers, setbacks, or other mitigation measures for development activities near wetlands and streams. CARs can be politically sensitive, as they are often viewed by landowners as placing unreasonable restrictions on their property rights or land use options.

Recommendations

Policy

- Manage for multiple benefits and include consideration of watershed characterizations in regulatory updates.

Mechanical

- Provide the latest updates regarding best available science to planners to inform regulatory updates (near-term opportunity).
- Ensure that funding is provided to appropriately enforce and implement these rules and regulations.

4.2.1.3 Zoning Regulations

The Planning Enabling Act (RCW 36.70) authorizes cities, counties, and certain regional planning commissions to regulate development through mechanisms such as zoning. Zoning regulations specify the type and density of residential, commercial, or industrial development that is allowable for a given category of land as well as what uses are permitted in different geographical areas. These regulations are updated, as needed, through the comprehensive planning process.

Zoning Regulations

Implementation

Zoning regulations are implemented at the city and county level.

Assessment

Zoning regulations are generally considered to be effective protection tools because they provide clear guidelines, standards, and permitting requirements for development and land use activities. However, any protection they provide can be described as impermanent, because they can be revised by legislative action. Nevertheless, these regulations do confer numerous benefits to hydrology, including limiting impacts on the landscape, limiting runoff potential, and limiting development in floodplains. They are affordable and actionable, as they are required by law. Political sensitivities around zoning regulations vary. Routine or technical changes may not draw attention; however, substantial changes may be controversial.

Recommendations

Policy

- Manage for multiple benefits and include consideration of protections (such as expanding use of Transfer of Development Rights [TDR] programs, using watershed characterizations to inform land use decisions) during rezoning processes.
- Create a new Snohomish County TDR receiving area as part of the County's area-wide rezone of Multifamily Residential (near-term opportunity).
- Explore opportunities for jurisdictions that are planning rezones to include incentive zoning tools (such as TDR or in-lieu fees) to support Basin-wide protection outcomes while advancing growth, economic development, and infill objectives. Such consideration could include a market-based understanding of demand for growth to best align rezones with economic opportunities.
- Allow for exploration of opportunities to reduce the potential for future build-out, particularly in areas of hydrological importance.

4.2.1.4 Minimized Impact Rural Development

The GMA recognizes rural character and establishes guidelines for growth in rural areas based on density of development. An approach to reducing the impact of rural growth on the landscape and hydrology of the Basin is to change the focus from rural density to impervious surface or impact on hydrology. This would result in more compact land uses tied to the permanent conservation of surrounding open space. Some options for achieving this exist on a limited basis (e.g., rural cluster plat) and on the state level (e.g., Master Planned Resorts). Other options that could achieve protection on a broader scale would require state legislation.

Minimized Impact Rural Development

Implementation

Minimized impact rural development strategies are primarily implemented on the county level.

Assessment

Within the potential range of approaches to minimizing rural development impacts, some exist while others are conceptual. Clustering and rural-to-rural development right transfers are available on a limited basis in Snohomish County; neither Snohomish County nor King County have provisions for more coordinated approaches.

The effectiveness of this group of strategies is largely untested in the Basin. Snohomish County recognizes the public benefit of retaining open space in rural cluster developments; however, the utilization of these provisions has been limited. Larger-scale options do not yet exist in the Basin and are untested. Hydrologic benefits of these approaches in general result from reduced impervious surfaces in the rural landscape relative to traditional development patterns.

These approaches have a low public cost, as they are generally regulatory in nature. Some variations are actionable (although only in Snohomish County) while others are not yet available in the Basin. Political issues surrounding these approaches are contentious, as they may be perceived as encouraging residential growth in rural areas.

Recommendations

Policy

- Encourage state legislation to permit the use of large-scale, compact development.
- Consider expanded rural applications of TDR for King County.

4.2.2 Shoreline Management Act

The Shoreline Management Act (RCW 90.58) requires local jurisdictions to develop and update programs to regulate uses of the shorelines of the state (Chapter 173-26 WAC Part III). These programs must be based on guidelines and standards issued and updated by Ecology. A central goal of the Shoreline Management Act is to prevent uncoordinated development on Puget Sound shorelines, rivers, large lakes, and associated wetlands.

Shoreline Management Act

Implementation

The Shoreline Management Act is implemented at the city and county level. King County adopted a Shoreline Master Program in 1975 and most recently updated the program in 2013. Similarly, Snohomish County adopted a Shoreline Management Master Program in 1974 and completed a comprehensive update in 2012. The purpose of these updates was to ensure that the county programs are consistent with state Shoreline Master Program Guidelines, county comprehensive plans and implementing zoning, CARs, and other county development regulations.

Assessment

The Shoreline Management Act protects hydrology by requiring local jurisdictions to regulate structures and uses along state-designated waterbodies and to address the cumulative impacts of shoreline development.

Shoreline Master Programs can be politically sensitive, as they may be viewed by landowners as placing unreasonable restrictions on their property rights or land use options.

Recommendations

Policy	**Mechanical**
• Manage for multiple objectives and use watershed characterization to inform program updates.	• Convene planners from jurisdictions across the Basin to identify, discuss, and coordinate hydrologic and land protection priorities in the next round of plan updates (near-term opportunity). • Ensure that funding is provided to appropriately enforce and implement these rules and regulations.

4.2.3 Forest Regulations

In Washington State a substantial framework of state and federal laws and land management plans has been developed to help limit the environmental impacts of forest practices on private and public forestlands. The framework has two main relevant components administered by DNR: the Forest Practices Rules, and other federally approved Habitat Conservation Plans (HCPs). The U.S. Forest Service (USFS) manages the Northwest Forest Plan (NWFP) on federally owned forestlands. One overarching objective of these regulatory components is to protect the hydrologic processes that support salmon or salmon habitat, as well as other species.

4.2.3.1 Forest Practices Rules

In 1974, the Washington State Legislature adopted the Forest Practices Act (RCW 76.09) to regulate forestry activities on all private, state, and local government lands. The Forest Practices Act broadly defines forest practices as "any activity conducted on or directly pertaining to forest land and relating to growing, harvesting or processing timber..."

The act is implemented through the Forest Practices Rules (WAC 222), which divide forest practices into four classes based on their potential impacts to public resources. Classes I through III are administered by DNR and have limited concerns that there may be damage to public resources, though in some cases additional permits may be required.

Class IV permits are split into two categories: Class IV-Special and Class IV-General. Class IV-Special forest practices have the potential to cause a substantial impact on the environment. They include certain aerial applications of pesticides, forestry activities on lands designated as critical habitat for threatened or endangered species, or certain harvest activities within geologically unstable areas. Class IV-Special permits are processed and approved by DNR.

Class IV-General forest practices are forest practices on lands that have been or are being converted to another use incompatible with forestry or on lands that are likely to be converted to urban development in the future. Class IV-General permits are managed through the relevant local jurisdictions (e.g., county or city).

In 1999, a group of public and private sector stakeholders published the *Forests and Fish Report*, which presented a comprehensive set of recommendations for improving the regulation of forest practices (USFWS et al. 1999). Two years later, the Forest Practices Rules were amended to include more stringent environmental standards and guidelines for riparian buffers and forest roads maintenance, and are referred to as the Forests and Fish Rules.

Forest Practices Rules

Implementation

The Forest Practices Rules are implemented across Washington State broadly and are applied individually to each HCP or Forest Practices Application. Until recently, DNR regulated all forest practices on non-federal lands. Snohomish and King Counties, as well as several cities, now administer and enforce Class IV-General permits in unincorporated county areas (on lands that have been or are being converted to another use or on lands that are likely to be converted to urban development in the future).

Assessment

The Forest Practices Rules establish standards for forest practices such as timber harvest, pre-commercial thinning, road construction, fertilization, and forest chemical application (Title 222 WAC). They give direction on how to implement the Forest Practices Act (RCW 76.09) and Stewardship of Non-industrial Forests and Woodlands (chapter 76.13 RCW). The rules are designed to protect public resources such as water quality and fish habitat while maintaining a viable timber industry. They are under constant review through the adaptive management program, otherwise known as CMER (Cooperative Monitoring, Evaluation, and Research). Rule changes and updates, if needed are promulgated by the Forest Practices Board.

Recommendations

Policy

- Maintain funding for the adaptive management process.
- Work closely with the Counties' and Cities' strategies for implementing rules associated with Class IV-General.
- Update best available science to incorporate the current landscape regulatory framework (e.g., water quality, sediment from roads, riparian protection).

4.2.3.2 Other Federally Approved Habitat Conservation Plans

Section 10 of the ESA authorizes landowners to negotiate conservation plans with the federal government in order to minimize and mitigate impacts to threatened and endangered species while carrying out lawful activities. In 1997, DNR State Lands signed an agreement with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service (NMFS) for the implementation of a long-term, multiple-species HCP on state-owned and regulated forestlands within the range of the northern spotted owl. In addition to the State Lands HCP, several large private timber companies have negotiated HCPs on their properties. With the approval of a HCP, the federal

agencies issued an incidental take permit to the landowner for a period of 70 years. Under the provisions of this permit, the landowner may carry out timber harvesting and other forest management activities as long as the agency complies with the HCP implementation agreement.

The State Trust Lands HCP alone covers approximately 1.6 million acres of state-managed forestlands, including those within the Basin. The plan includes a riparian conservation strategy for DNR planning units in western Washington. This strategy is the primary mechanism by which the HCP minimizes forestry impacts on salmon habitat, as it limits timber harvesting and road building on unstable slopes or in riparian zones, rain-on-snow zones, and wetlands. All HCPs also include a requirement for annual implementation, effectiveness, and validation monitoring and periodic comprehensive reviews. The results of these monitoring and review processes feed into DNR's adaptive management cycle.

Other Federally-Approved HCPs

Implementation

In the Snohomish Basin, there is a HCP that applies to all state lands but is implemented at the site scale with site-specific prescriptions. Additional federally approved HCPs in the Snohomish Basin may be pursued by landowners at any time in the future.

Assessment

HCPs include four detailed conservation strategies: marbled murrelets; northern spotted owls; riparian areas, wetlands, and salmon; and other species of concern and uncommon habitats. Through these conservation strategies, protection is provided for the following:

- Habitat for northern spotted owls, marbled murrelets, and riparian-dependent species such as salmon
- Habitat for other animal and plant species that are federally listed as threatened or endangered
- Habitat for state-listed threatened or endangered species
- Uncommon habitats and habitat elements (e.g., talus fields, caves, cliffs, oak woodlands, large snags, balds, mineral springs, and large, structurally unique trees), that support the various species that depend on them
- Old-growth forests in the five Westside HCP planning units
- Unstable slopes

- Habitat for unlisted plant or animal species that might be declining in numbers or that could be listed in the future

Recommendations

Engagement

- Maintain funding for the adaptive management process.
- Update best available science to incorporate the current landscape regulatory framework (e.g., water quality, sediment from roads, riparian protection).

Mechanical

- Ensure that adequate funding is provided to monitor and adaptively manage implementation of the HCPs.

4.2.3.3 Northwest Forest Plan

In 1994, the USFS and the Bureau of Land Management jointly adopted the NWFP. This plan amended existing USFS and Bureau of Land Management land and resource management plans throughout the range of the northern spotted owl, including western Washington. The NWFP established standards and guidelines for implementing a science-based ecosystem management strategy on federal forestlands. It also created a network of old-growth and riparian reserves, as well as adaptive management areas. The goals of the NWFP are to protect and restore critical forest habitat, watershed health and function, and a sustainable supply of forest products to help support local and regional economies.

A central component of the NWFP is the Aquatic Conservation Strategy, which provides guidance for the management of aquatic and riparian habitats on federal lands covered by the plan. Objectives of the Aquatic Conservation Strategy focus on the protection of habitat-forming processes, water quality, instream flows, and the physical integrity of aquatic systems. Under the NWFP, land managers must evaluate proposed projects and management activities for consistency with these objectives. In doing so, they must employ tools such as

watershed analysis, which provides baseline information on geomorphic and ecological processes in specific watersheds and guides monitoring and restoration efforts.

NWFP

Implementation

The NWFP amended a total of 26 land and resource management plans, and was implemented on federal lands stretching from northern California to western Washington. Federal lands falling under the purview of the NWFP are predominantly national forests; however, Bureau of Land Management lands, national parks, national wildlife refuges, and military bases are also covered by the plan. In 2015, the USFS initiated a public outreach process to gather input on how to revise management plans for forestlands that are currently managed under the NWFP.

Assessment

The NWFP was envisioned to protect late-successional and old-growth forests, but it also provides protection for younger forests. The NWFP significantly reduced harvest levels in old-growth areas and aimed to create sustainable harvest cycles. Since the adoption of the NWFP, a regional interagency effectiveness monitoring framework has been implemented to track the status and trends of watershed condition, late-successional and old-growth forests, population and habitat for marbled murrelets and northern spotted owls, and socioeconomic conditions.

In 2008, a federal NWFP status review, called the 15-year Report, was completed (Grinspoon and Phillips 2008). That report stated that late-successional and old-growth forest acreage had remained relatively constant in areas covered by the NWFP. A small amount of old-growth loss occurred, but this was attributed mainly to natural disturbance regimes such as forest fires. The 15-year Report also stated that the majority of watersheds (69%) had a positive change in condition scores. Most of the larger positive changes were driven by improvements in road (decommissioning) and vegetation (natural growth) scores. Overall, the report indicated that the NWFP had resulted in the successful protection of forest cover on federal lands, and the associated protection or improvement of hydrologic processes.

Recommendations

Mechanical

- Increase monitoring funding so that local Basin information can be gathered and analyzed to address forest management issues locally.
- Encourage and fund ongoing USFS forest management planning to manage forests for hydrologic benefits to salmon and other species.
- Increase funding for acquisitions within the USFS district boundaries to secure inholdings and ecologically sensitive areas.
- Provide input to USFS as it initiates the process to update management plans for forestlands that are currently managed under the NWFP.

4.2.4 Federal Land Designations

4.2.4.1 Wilderness Act Designation

Federal lands can be designated as "Wilderness Areas" by an act of Congress. Wilderness Areas are defined as "...lands designated for preservation and protection in their natural condition" (1964 Wilderness Act Section 2(a)). A Wilderness designation generally prohibits motorized use, mechanical transport, timber harvest, and new mining claims. Most types of outdoor recreation are allowed in Wilderness Areas, including hunting and fishing, except those needing mechanical transport or motorized equipment, such as motorboats, cars, trucks, off-road vehicles, bicycles, and snowmobiles. The Wilderness Act of 1964 is one of the most successful environmental laws in the United States, standing for almost 50 years without a substantial amendment.

Wilderness Act Designation

Implementation

There are currently three designated wilderness areas that are either completely within or partially within the Basin: The Wild Sky Wilderness (2008), The Henry M. Jackson Wilderness (1984), and the Alpine Lakes Wilderness (1976). The Wild Sky Wilderness is the most recently designated wilderness area and includes more than 106,000 acres in the North Fork Skykomish and Beckler River basins. There are additional areas of roadless forests managed by the Mt. Baker Snoqualmie National Forest in the Skykomish and Snoqualmie River basins that may merit designation as Wilderness. For example, legislation in 2014 added 22,000 acres to the Alpine Lakes Wilderness near Snoqualmie Pass.

Assessment

The Wilderness Act provides the highest level of federal protection and is considered one of America's greatest conservation achievements. However, the local support necessary and the congressional approval required often necessitate 3 to 10 years to achieve a designation. Many groups whose members enjoy recreating are hesitant to support new Wilderness designation because it will limit activities they are currently able to do in the area (e.g., bike, snowmobile, use off-road vehicles). Additionally, though tribes are offered consultation and review during the process, there are concerns that treaty right activities are not given due consideration. Current Wilderness Areas do not allow for active management, such as burning for berry production, that is important to maintaining tribal resources. The areas considered for Wilderness designation are chosen as a result of ecological value, suitability, and political considerations.

Recommendations

Engagement

- USFS and tribes work to identify how to design Wilderness Area boundaries to support the highest degree of tribal use.

Policy

- Review potential wilderness areas for hydrologic value to ensure inclusion.

4.2.4.2 National Wild and Scenic River Designation

Reaches of free-flowing rivers or streams can be designated as Wild and Scenic Rivers under the Wild and Scenic River Act of 1968. The designation, which generally requires an act of Congress, preserves certain rivers with outstanding natural, cultural, and recreational values in a free-flowing condition for the enjoyment of present and future generations (Wild & Scenic Rivers Council 2015). A designation prohibits federal support for actions such as the construction of dams or other instream activities that would harm the river's free-flowing condition, water quality, or outstanding resource values. The designation creates a federal reserved water right to protect flow-dependent values but does not affect existing water rights or the existing jurisdiction of states and the federal government over waters as determined by established principles of law.

National Wild and Scenic River Designation

Implementation

In 1990, USFS, as a part of its land management planning, evaluated all rivers and streams originating on National Forest Lands within the Mt. Baker-Snoqualmie National Forest to determine their eligibility and suitability for designation under the federal Wild and Scenic Rivers Act (USFS 1990). Many rivers in the Basin (see recommendations below) have been found eligible for Wild and Scenic designation, and some have been found suitable for recommendation to Congress. In December 2014, the Middle Fork Snoqualmie and Pratt Rivers were designated as Wild and Scenic.

The Skykomish River is part of the separate Washington State Scenic River system, the legislative purpose of which is to “protect and preserve the natural character of such rivers and fulfill other conservation purposes.” Rivers in the system “shall be preserved in as natural a condition as practical” and “overuse of such rivers, which tends to downgrade their natural condition, shall be discouraged.”

Assessment

Identifying rivers that are eligible or suitable for Wild and Scenic designation is important because they are then afforded administrative protection. The USFS, for example, states in their management manual that "rivers found to be eligible and suitable must be protected as far as possible to the same extent as a designated study river" (Forest Service Manual 2354.62). These eligible rivers must therefore be managed "to protect existing characteristics" and "resource management activities may be carried out provided they do not cause a negative or reduced classification recommendation" (Forest Service Manual 2354.21). While the administrative protections for eligible rivers are not as strong as Congressional (Wild and Scenic) designation, they do provide important protection. Proponents of non-motorized river recreation are often effective in making the case for eligibility determinations during agency planning efforts.

Recommendations

Future priorities for Wild and Scenic designation in the Basin include the following: North Fork and South Fork Skykomish, Troublesome Creek, West Cady Creek, Tye River, Miller River, West Fork and East Fork Miller, Foss River, West Fork and East Fork Foss, Beckler River, Rapid River, South Fork Tolt, North Fork Snoqualmie, Lennox Creek, and Taylor River.

4.2.5 Water Rights and Instream Flow Protection

The state of Washington regulates groundwater and surface water withdrawals through a system of water allocations, or "water rights." Ecology is the regulatory agency that tracks, administers, and issues water rights in Washington State. There are several different types of water rights—surface water rights focused on withdrawals typically from lakes, streams, and rivers; groundwater rights, which withdraw from subsurface water such as aquifers; and water storage rights, which allow for the impoundment of water on a property.

Washington water rights are steeped in legal history and are based on a doctrine of prior appropriation, meaning "first in time, first in right" (i.e., priority water rights are given to those who had them first). While it is true that the majority of permits are assigned to a specific piece of property, one very important water right was issued for the Basin in 1979 that established instream flows for the Basin.

4.2.5.1 Instream Flow Rule Making

The Instream Resource Protection Program (IRPP) for the Snohomish River Basin (Chapter 173-507 WAC) was enacted in 1979. The intent was to retain base flows in perennial streams, rivers, and lakes at levels necessary to protect a wide range of benefits including wildlife, fish, scenic, aesthetic, recreational, environmental, and navigational values. The IRPP established instream flow rules at ten control points on the Snohomish, Skykomish, Snoqualmie, Sultan, Tolt, and Pilchuck rivers within the Basin. The IRPP also identified 30 streams and lakes subject to conditional and unconditional closure when flows drop below specified levels. Ecology can initiate a review of the IRPP whenever new information, changing conditions, or statutory modifications make it necessary to consider revisions.

The IRPP states that from the date of establishment forward, all consumptive water rights shall be subject to the instream flow rules and no surface water right granted afterward shall be in conflict with the rules or with closures. Because instream flows do not meet the required levels at all times in the Basin, new water rights cannot be obtained without performing mitigation. In the Basin, several creeks have been determined to be flow-limited and are closed to new water rights. However, even in these sub-basins new groundwater withdrawals exempt from permitting are allowed. These withdrawals—from what are termed "permit exempt wells"—are subject to the following limits:

- Withdrawal for domestic use is limited to 5,000 gallons of water per day.
- Water use for lawns or non-commercial gardens is limited to "reasonable use" on an outdoor area up to 0.5 acre in size with no quantity restriction.

- Withdrawal for industrial use, which includes agricultural irrigation, has no acreage restriction but is limited to 5,000 gallons of water per day.
- Stock watering is allowed and has no daily quantity limit or acreage restriction.

The IRPP is aimed at protecting current instream flows, not restoring pre-development flows. Although the IRPP also states that any future groundwater permitting actions must consider the interrelationship of surface and groundwater to ensure compliance with the IRPP, permit exempt wells continue to be allowed throughout the Basin, mostly in rural areas not served by utilities. Newer instream flow rules utilize a "reservation" system for further water withdrawals, including limits on the number of exempt wells allowed in a basin or sub-basin. These rules are being legally challenged at the state level.

4.2.5.2 Water Rights Market Tools

Ecology has three major tools that protect instream flows by allowing the acquisition and redistribution of water rights. These tools—Trust Water Rights, Water Banking, and Water Acquisition programs—are designed to help water right holders use their permits efficiently. Descriptions of the three tools are as follows:

- Trust Water Rights: The Trust for Water Rights Program is the legal process for holding water rights for future uses. By allowing water right owners to put their water right into the program, they avoid the "use it or lose it" scenario. Water right owners can bank these rights temporarily or permanently. The benefit of this tool is that even temporary rights in the trust can be used to protect instream water flows.
- Water Banking: This particular program works at a regional/watershed level. A water bank is an institutional

mechanism used to facilitate the legal transfer and market exchange of various types of surface, groundwater, and storage rights. The exchange purchases water from willing sellers and then holds, transfers, and exchanges water rights on behalf of willing buyers. The seller can be anyone who holds a water right and the buyer can be anyone who needs to mitigate for a new water use or restore instream flows.

- Water Acquisition: Water Acquisition programs buy existing water rights for stream flow enhancement. Acquired water rights can be temporarily leased or permanently purchased. Water rights use the Trust Water Rights Program to legally protect the water rights and make sure no one else uses the water. The Washington State legislature has allotted money to Ecology to purchase water rights. Also, private money can be used to purchase water rights. There are two non-profit stream flow organizations that actively use Water Acquisitions as a restoration tool; these purchases are prioritized to be used in 16 basins in the state that have vulnerable salmon or trout populations, due to critically low flows. However, purchases can be made anywhere in the state. The Pilchuck sub-basin within the Snohomish River Basin is one of these 16 rivers.

Water Rights and Instream Flow

Implementation

Water rights are implemented at a Basin-wide scale, although maintenance of instream flows via the IRPP is implemented at the sub-basin scale. Water uses in the upper Basin will affect downstream flows.

Assessment

Water marketing tools are intended to allow for water right flexibility in a changing landscape.

The instream flow standards established for the Pilchuck, Skykomish, Snohomish, Snoqualmie, Sultan, and Tolt rivers will affect any newer water rights that could be interrupted if the instream flows are not met. Obtaining a new, year-round water right is very difficult and applicants will have to mitigate if they need a year-round water supply.

In addition to meeting the instream flows, there are several sub-basins that are currently closed year-

round to any new water withdrawals unless they are mitigated. These sub-basins include: Griffin Creek, Harris Creek, Little Pilchuck Creek, May Creek, Patterson Creek, Quilceda Creek, Raging River, and Bodell Creek.

All of these sub-basins require some form of mitigation and using a water bank or the Trust for Water Rights Program could help manage water rights better within any of these sub-basins.

Recommendations

Mechanical

- Conduct a survey of the validity of water rights in order to understand rights holders, quantity, and types of water use relative to water rights permit information.
- Conduct a water supply/demand study for Water Resource Inventory Area (WRIA) 7 and determine if it is necessary to initiate new rules or revise the instream flow rule in the Basin. For basins in WRIA 7 that are determined to have a water supply issue and a demand for new water rights, establish a water bank.
- Work with public entities and non-profits that are engaged in land acquisition and restoration to survey their properties for water rights (previous 5 years). If water rights are still active, work to get water rights banked and/or notify Ecology of the desire to relinquish rights if they have not been used in 5 or more years.
- Continue long-term streamflow monitoring at existing gages and consider more monitoring of low flows.
- Initiate more detailed hydrologic (streamflow) analysis in areas specifically affected by low flows and habitats critical to fish.
- Consider conducting studies of hydraulic conductivity in areas where development relies on groundwater.
- Explore closing sub-basins for groundwater withdrawals as well as surface water withdrawals.

Engagement

- Develop an education program encouraging landowners on exempt wells to conserve water.
- Launch education campaigns to educate water right holders how they could use Trust Water Rights and Water Banking to help manage their water rights and protect instream flows.
- Work with irrigation districts to upgrade their irrigation efficiency and bank the saved rights into the Trust for Water Rights Program.
- Encourage Public Utility Districts, cities, and private water purveyors that deal with exempt wells and water rights to launch water conservation education campaigns.

Policy

- Set a limit (number of gallons per day) for domestic outdoor water use.
- Set a limit (number of gallons per day) for stock watering use.
- Close critical basins to all water withdrawals, even exempt domestic wells, based on analysis determining flow impairment.
- Find ways to store more water in valley aquifers to provide flows for the environment.
- Encourage Ecology to eliminate illegal surface water diversions and expire water rights if they are not used in 5 years. Protect existing wetlands in the landscape and aquifer recharge areas.

4.2.5.3 Reclaimed Water

Reclaimed water is a newer technology that is gaining interest in water conservation. The approach uses treated waters from wastewater treatment plants for industrial uses, irrigation, wetland and stream flow enhancement, and other non-potable water uses.

Reclaimed Water

Implementation

Reclaimed water is implemented at a jurisdictional level.

Assessment

Reclaimed water is a new approach to managing water resources and the technologies required for water reuse and recycling are not currently being widely used. It provides some interesting opportunities for a different source of water so some new water rights applications may be postponed or eliminated; this is of particular importance in closed basins. The approach would also leave water in the systems to support instream flow requirements and reduce energy demand in the wastewater treatment process. Care should be given to concerns that reclamation may reduce the amount of water in the system and impact current water rights holders.

Recommendations

Mechanical

- Explore tertiary treatment at wastewater treatment plants to improve any impairment (nutrients) in the discharge water.
- Explore new wastewater facility technologies that discharge drinking water standard flow into reaches with low flow issues, at times when old infrastructure has to be replaced.

Engagement

- Educate people on the benefits and uses of reclaimed water and encourage it as an option for water needs where the focus is on matching quality to use.

Policy

- Secure funding to explore options for using reclaimed water.
- Allow for flexibility in the use of reclaimed water.
- Examine the ability to produce and use reclaimed water as wastewater facility permits come up for renewal.
- Align with public health policies and ensure compliance with plumbing codes or address existing codes and revise to ensure cross connections are not an implementation issue.

4.2.6 Beaver Management

4.2.6.1 Living with Beavers

Beavers are native to the Basin and were once ubiquitous around the region. Populations plummeted when trapping of beavers for pelts was prevalent. In the last century, beaver populations have rebounded and now beaver are seen even in the Basin's most urbanized aquatic settings. Beavers are one of the key animals that can affect the quantity and quality of water in an aquatic system. In unpopulated places, their manipulation of the landscape is appropriate and welcomed but in populated and agricultural areas, that manipulation can create challenges. However, the beavers' ability to create water storage helps protect hydrology.

Living with Beavers

Implementation

The trapping and movement of beavers is regulated through the Washington Department of Fish and Wildlife (WDFW). Removing or altering beaver dams in any way requires an HPA, also within the purview of WDFW. Currently, King and Snohomish Counties, conservation districts, WDFW, and a number of non-profit organizations offer site visits and limited technical support to landowners with concerns about beavers and related flooding.

Assessment

Beavers benefit hydrology by building ponds that store runoff water and allow water to slowly enter neighboring streams and other waterbodies. These ponds can help regulate flood flows by storing and gradually releasing flood waters during storm events while also increasing flows during the dry season. Beavers also benefit hydrology by creating wetlands that can purify water and recharge groundwater.

Recommendations

Engagement

- Increase outreach to landowners to address questions and concerns about beaver management.
- Distribute information about water level management devices to landowners prior to dam removal.

Policy

- Increase access to beaver management resources through public agencies, special purpose districts, and non-profit organizations.
- Streamline HPA permits for pond levelers and beaver deceivers.
- Encourage local jurisdictions to incentivize living with beavers by amending CAR buffer requirements for beaver-formed wetlands , shoreline and other land use requirements

	similar to the way the existing statutes, WACs and local government regulation that exempt enhancement and restoration projects.

4.2.6.2 Beaver Relocation

The Tulalip Tribes are working to improve water storage in the headwaters of the Basin in order to ameliorate the hydrologic shifts caused by climate change. This effort involves trapping beavers and releasing them in appropriate areas on USFS land. Once released, the beavers will create a complex series of dams that will store runoff and/or snow melt in the upper watershed and moderate flows during high-flow and flood events.

Beaver Relocation

Implementation

The Tulalip Tribes, in partnership with the University of Washington, are relocating nuisance beavers from the lowlands to headwater systems on federal lands as part of a pilot program.

Assessment

The goal of the pilot beaver relocation program is to introduce viable populations of beavers into the federal forestlands of the Basin. Based on studies conducted by Tulalip Tribes and the University of Washington, there is moderate amount of suitable habitat on USFS lands for beavers, which could result in beaver pond complexes.

Recommendations

Mechanical

- Identify and study land suitable for beaver relocation in USFS areas across the Basin.
- Model impacts from beavers on the hydrology of the Basin.
- Evaluate how to preserve beaver habitat and encourage the acceptance of beaver presence while protecting development and landowners from property damage.

Policy

- Work with WDFW to allow the relocation of beavers between watersheds on the west side of the Cascade Mountains.

4.2.7 Hydroelectric Facility Licensing

The Federal Energy Regulatory Commission (FERC) licenses hydroelectric facilities under the Federal Power Act. In 2005,

FERC implemented the Integrated Licensing Process (ILP) with the goal of streamlining the licensing and relicensing processes while ensuring adequate resource protections. The ILP requires an applicant to provide detailed information on the proposed hydroelectric project at the beginning of the licensing process, or during relicensing, and to submit study plans for assessing the impacts of the project on environmental, cultural, and socioeconomic resources. The ILP also requires an applicant to consult with tribes, agencies, nongovernmental organizations, and public stakeholders early in the process so that the parties can identify key issues and resolve disputes over project design, studies, and alternatives. Dispute resolution may include the development of a settlement agreement under which the applicant agrees to implement resource protection, mitigation, and enhancement measures before or after FERC issues a license; FERC is not obligated to grant a license to projects or to relicense existing projects.

The Northwest Power Act of 1980 (NWPA) authorized Washington, Idaho, and Oregon to create a regional power plan and prioritize protections for fish and wildlife habitats from hydroelectric development. The Northwest Power and Conservation Council studied and identified areas of critical importance to the region where mitigation techniques could not ensure all adverse impacts of hydroelectric development to fisheries and wildlife could be reversed. The council designated river reaches throughout the Northwest as protected areas where "unacceptable risks of loss to fish and wildlife species of concern, their productive capacity or their habitat" would occur under hydroelectric development. Under the NWPA and the Federal Power Act, federal entities must consider Protected Area status and restrictions when making decisions regarding hydroelectric facility permits and access to electricity from those facilities. Inclusion in a Protected Area does not prohibit

Locations of Protected Areas can be found through the StreamNet Protected Areas Mapper, available from: http://psmfc.maps.arcgis.com/apps/webappviewer/index.html?id=f4a9bf13f2014b259d63c8eb03e1f7af.

hydroelectric development at a site; however, the council calls on FERC to not license a new hydroelectric development in a Protected Area, and Bonneville Power Administration to not acquire the power from such a project should one be licensed by FERC (nor to allow access to the power grid in a way that would undermine the protected areas policy).

Most of the 44,000 miles of stream designated as Protected Areas are located within the Columbia Basin, although protected areas are located throughout the Bonneville Power Administration service territory, including several reaches within the Snohomish Basin. Two proposed projects within designated Protected Areas are currently moving through the ILP in the Snohomish Basin: the Sunset Falls project on the mainstem Skykomish River, and the Black Canyon project on the North Fork Snoqualmie River.

Hydroelectric Facility Licensing

Implementation

The licensing and relicensing of hydroelectric facilities can be viewed as being implemented at the Basin scale.

Within the Basin, there are several existing licensed hydroelectric facilities with varying license periods. Salmon recovery interests, jurisdictions, and other interested parties have engaged to varying levels in licensing processes, depending on project location, potential impacts, and capacity to participate. Tables 4 through 7 provide information on existing projects, pending licenses, and preliminary permits.

Assessment

License articles in the FERC-issued licenses for hydroelectric projects may contain immediate and future operational and management actions to attempt to mitigate for aquatic and wildlife impacts identified in the ILP. License articles are prescriptive and therefore do not allow for adaptive management in the implementation phase. Adaptive management is not typically addressed in license articles. Settlement agreements contain provisions for addressing issues important to stakeholders and co-managers (Washington State and Treaty Tribes) in the ILP, yet action was not considered necessary by FERC for licensing. Settlement agreements can include a monetary fund to help address unforeseen issues, studies, and land acquisition. Depending on the language in the settlement agreement, the funds may be used for adaptive management.

The designations under the NWPA of Protected Areas of fish and wildlife habitat from future

hydroelectric development are intended to provide hydrologic protections by ensuring that streamflow is not appropriated for out-of-stream uses and adjacent wildlife habitat is not altered by a project area or project operations. The amendment process allows for petitioning to remove the Protected Area designation provided by the NWPA. Any party may recommend an amendment to change the designation of a river reach as protected or unprotected. The amendment process requires notification of state and federal fish and wildlife agencies and Indian tribes. There is a process to petition for an exception of the Protected Area designation for proposed projects that will provide exceptional benefits to fish and wildlife. Black Canyon Hydro filed a petition in 2013 to try to remove a reach of the North Fork Snoqualmie from the list of Protected Areas. To date, that petition has not been successful, but the company's efforts to secure a FERC license in the reach continue. The Sunset Falls Fish Passage and Energy Project is a likely candidate for an exception from the list of Protected Areas for providing exceptional benefits to fish and wildlife by funding the reconstruction and operation of the salmon trap-and-haul operation at Sunset Falls.

Recommendations

Through participation in an ILP, parties should advocate for maintaining hydrographs in project reaches that closely follow the natural, pre-project condition.

Participation in ILP processes by multiple levels of government, fish and wildlife agencies, tribes, nongovernmental organizations, and other stakeholders is recommended. The accelerated rate of the process makes it difficult to track the process and ensure appropriate studies are designed. Groups participating in the ILP process could petition for an adaptive management component within the license articles, which may help to ensure the correct actions are taken to protect hydrology over the course of the license.

While much of the Basin has Protected Area status, new hydropower facilities continue to be proposed in such areas and it may be necessary to monitor the petitioning process in order to ensure key areas remain protected.

Table 4: Existing Licensed Projects

Project No.	Project Name	Expiration Date	Issue Date	Authorized (MW)	Licensee	Waterway
02959	Tolt River – South Fork	07/19/29	03/29/84	16.7	Seattle, City of (WA)	South Fork Tolt River
07563	Weeks Falls	03/31/35	04/25/85	4.8	South Fork II Associates (WA	South Fork Snoqualmie River
04885	Twin Falls	04/30/35	05/06/85	24	Twin Falls Hydro Associates LP (CT)	South Fork Snoqualmie River
06221	Black Creek	06/30/38	07/29/88	3.7	Black Creek Hydro Inc. (WA)	Black Creek
10359	Youngs Creek	04/30/42	05/05/92	7.5	PUD No 1 of Snohomish County (WA)	Youngs Creek
02493	Snoqualmie Falls	05/31/44	06/29/04	54.4	Puget Sound Energy, Inc. (WA)	Snoqualmie River
02157	Henry M Jackson (Sultan)	08/31/56	09/02/11	111.8	PUD No 1 of Snohomish County (WA)	Sultan River

Table 5: Existing Exempt-from-License Projects

Project No.	Project Name	Issue Date	Authorized (MW)	Licensee	Waterway	Description
3602	Woods Creek	02/03/82	.65	PUD No 1 of Snohomish County (WA)	Woods Creek	Exemption – Non Conduit

Table 6: Licensed but Not Yet Constructed Projects

Project No.	Project Name	Expiration Date	Issue Date	Authorized (MW)	Licensee	Application Type
13948	Calligan Creek	05/31/65	06/23/15	6	Snohomish County PUD No. 1	Original License
13994	Hancock Creek	05/31/65	06/19/15	6	Snohomish County PUD No. 1	Original License

Table 7: Issued Preliminary Permits (Working Toward Application)

Project No.	Project Name	Expiration Date	Issue Date	Authorized (MW)	Licensee	Waterway	Description
14110	Black Canyon	09/30/16	10/14/11	25	Black Canyon Hydro, LLC	North Fork Snoqualmie River	Conventional Permit
14295	Sunset Falls	02/28/17	03/02/12	30	PUD No 1 of Snohomish County (WA)	South Fork Skykomish River	Conventional Permit

4.2.8 WDFW Hydraulic Project Approval

WDFW is responsible for preserving, protecting, and perpetuating fish and shellfish resources of the state. In 1943, the state Legislature passed the Hydraulic Code (Chapter 77.55 RCW) that requires any person, organization, or government agency wishing to conduct any construction activity that will use, divert, obstruct, or change the natural flow or bed of state waters to do so under the terms of a permit (the HPA) issued by WDFW. The law's purpose is to ensure that work does not damage the state's fish and shellfish, and their habitats.

Activities in freshwater that require an HPA include, but are not limited to: stream bank protection; construction or repair of bridges, piers, and docks; pile driving; channel change or realignment; conduit (pipeline) crossing; culvert installation; dredging; gravel removal; pond construction; placement of outfall structures; log, log jam, or debris removal; installation or maintenance of water diversions; and mineral prospecting. Activities in saltwater that require an HPA include, but are not limited to: construction of bulkheads, fills, boat launches, piers, dry docks, artificial reefs, dock floats, and marinas; placement of utility lines; pile driving; and dredging.

WDFW HPA Implementation

The RCW directs WDFW to "preserve, protect, perpetuate, and manage" the fish and wildlife species of the state as its paramount responsibility (RCW 77.55.021). To help achieve that goal, the state Legislature passed the Hydraulic Code (chapter 77.55 RCW) in 1943. This law was designed to protect public fish resources by requiring a Hydraulic Project Approval before conducting activities in fresh and salt waters of the state. Specifically, WDFW, who administers the Hydraulic Code, regulates work that "uses, obstructs, diverts or changes the natural flow or bed of state waters for the protection of fish life."

WDFW reviews and issues approximately 5,000 HPA permits per year covering a wide range of activities. All HPA permits are issued with provisions to protect public resources. These provisions are consistent with best available science as informed by comprehensive literature reviews and by experience gained by WDFW employees during the course of providing technical assistance, particularly in the area of culvert

design. In 2013, WDFW published the Water Crossing Design Guidelines to help applicants better design and install culverts and bridges for fish passage. Goals of the Habitat Program include improving fish passage as well sediment distribution, flow, and large woody debris movement in streams. Hydrology can be improved by addressing undersized barriers.

Effective July 2015, the Hydraulic Code Rules, Chapter 220-660 was re-written to update construction specifications for all freshwater and marine projects.

Assessment

To help ensure that work permitted under the terms of HPAs sufficiently preserves, protects, and perpetuates the fish and shellfish resources of the state, WDFW conducts research to address specific areas where the effectiveness of HPAs is uncertain. WDFW results suggest that it is possible to make immediate improvements to the HPA program by ensuring that all pertinent provisions are included on each permit. This has been accomplished through the July 2015 WAC revision. Assessing levels of success in achieving “no net loss” is complex. Notwithstanding issues of different baseline conditions or subjectivity in effectiveness ratings, it appears that projects can and do meet a high standard of resource protection.

Recommendations

Mechanical

- Ensure all pertinent provisions are included on each permit.
- Secure funding to increase enforcement of proper HPA implementation. Work with Habitat and Enforcement Programs to improve coordination and communication on hydraulic violations or unpermitted activities.
- Continue monitoring and mitigation of culvert replacement projects to ensure compliance.

Policy

- Secure funding to redevelop the HPA application process to be more streamlined.

4.2.9 Gold Mining and Fish Hydraulic Project Approval

Prospecting and mining by individuals are currently allowed in the freshwater basins of Washington State. In WRIA 7, these activities primarily occur in the North Fork of Skykomish, but also in smaller tributaries such as the Raging River and Olney Creek. Individuals are allowed to mine/prospect in the area by obtaining the 2015 Gold and Fish Pamphlet. This pamphlet describes when prospecting or mining are allowed and specifies the equipment that is allowed. The main elements of this

pamphlet HPA are the “fish window,” a list of dates by river section that determines when actions in the water will not detrimentally affect fish and the tools that can be used at particular times. Most often, the HPA dictates when mechanized mining equipment, such as suction dredges, can be used in any particular stream. If individuals follow the fish window and equipment requirements, WDFW (the enforcing agency) generally is not alerted to where the mining is occurring. The only HPAs that require permission from WDFW are for prospectors who are looking to use mechanical equipment or timing extensions beyond the allowed fish window. Fish window or in-water work dates are available on the WDFW website.

Gold Mining and Fish HPA

Implementation

This permit is applied at a Basin-wide scale.

Assessment

As increasing numbers of people are interested in mining and prospecting in Basin streams, it is difficult to assess the impacts, given that the pamphlet allows for a variety of actions, including power and suction dredging. There is also limited information on the number of individuals mining and whether they are following the rules from the pamphlet. However, it is known that using mechanical mining equipment in the streams and rivers of WRIA 7 can have hydrologic impacts including changing hydraulic patterns, possibly dewatering areas. It is also possible that excavation of flood terraces and riverbanks could increase their instability and enhance the likelihood of increased flood scouring.

One of the major issues in the small mining operations in WRIA 7 is the practice of “high banking,” which deposits sediment in piles along the channel edges, creating new flow patterns or increases in sedimentation. Curtailing the use of mechanical equipment, in particular those that allow high banking, through legislative action would offer hydrologic protection.

Current hydraulic law is criminal, creating an environment with a high burden of proof for WDFW officers. This is expensive and time consuming for staff, and difficult to prosecute. By changing the enforcement to be civil penalties, it is more likely that violations will be caught, protecting the critical hydrology in these basin streams. A change in low would allow WDFW to charge violators with infractions and require violators to fix the damage; if they do not, WDFW could conduct repairs and charge the violator for the cost plus a penalty.

Recommendations

Policy

- Limit use of mechanical tools allowed in small-scale mining based on impacts to stream or fish life.
- Prohibit the practice of high banking in streams with unstable banks or endangered fish use.
- Improve WDFW's ability to enforce the Gold and Fish Pamphlet by changing enforcement to a civil penalty.

4.2.10 National Pollutant Discharge Elimination System

The National Pollutant Discharge Elimination System (NPDES) Program was established by Congress in 1972 and incorporated into the federal Clean Water Act (CWA) in 1977. Under this program, any facility that discharges pollutants from a point source into waters of the United States is required to obtain an NPDES permit. The NPDES permit system regulates wastewater discharges from industries and municipal wastewater systems as well as stormwater discharges from industries, construction sites, and municipal separate storm sewer systems (MS4s).

With the exception of the municipal stormwater permit, NPDES permits are issued to a specific discharge and location, set forth numeric effluent limits for specific parameters, and in some cases set forth required actions to prevent or minimize pollution. Many urban areas that collect stormwater runoff in MS4s are required to have an NPDES municipal stormwater permit. USEPA established two phases under which states issue these permits: Phase I for medium and large MS4s, and Phase II for smaller MS4s. As of 2015, municipal stormwater permits do not contain numeric effluent limits. Rather, they require implementation of a set of programs or actions associated with Total Maximum Daily Load requirements affecting municipal operations such as storm sewer operation and maintenance,

water pollution investigations, municipal property management, and standards for construction and land development affecting both private and public construction. Municipalities covered by an NPDES municipal stormwater permit in western Washington are also required to participate in watershed-scale stormwater planning. This effort involves the development of a stormwater management strategy that is intended to result in hydraulic and water quality conditions that fully support existing and designated uses.

The NPDES municipal stormwater permit was issued in 1995 to six Phase I jurisdictions, and when reissued in 2007, more than 100 additional cities and counties within Washington were issued Phase II permits. These permits contain requirements for construction and land development affecting both private and public construction. Permitees are required to adopt land development regulations that contain the equivalent of those directly set forth in the NPDES permit plus those incorporated by reference in the appropriate Ecology Stormwater Management Manual (either Eastern Washington or Western Washington).

NPDES

Implementation

The CWA allows USEPA to delegate NPDES permitting authority to individual states. In Washington State, the NPDES permit system is administered by Ecology, with the exception of permits required for federal agencies and tribes, in which cases the permits are administered directly by USEPA. All of the NPDES permit types cited above are in effect within the Basin, including Phase I and II municipal stormwater permits. Those who may need to obtain coverage under one or more NPDES permits includes individual citizens, corporations, special districts, cities and counties, the state of Washington, federal agencies, and tribes.

Assessment

NPDES permits regulate discharges of pollutants in stormwater or wastewater discharges, within the scope of the CWA. This scope is fairly broad, and within that scope, the permits allow extensive ability to regulate. However, the scope of the CWA has limits. For example, the CWA overall is aimed at

achievement of water quality standards as established by USEPA. This is a different goal than, for example, recovery of species listed as endangered under the ESA. One can determine or infer connections between levels of specific pollutants in water and the potential to endanger a species, but the CWA does not directly protect endangered species or directly regulate "harm" to them as "harm" is defined in the ESA. Further, the scope of each type of NPDES permit is limited. For example, the municipal stormwater permit specifically regulates discharges to and from municipal storm sewers. That permit does not regulate discharges of polluted stormwater that never enter a municipal storm sewer. Thus, there are many polluted stormwater discharges that are outside the scope of the NPDES municipal stormwater permit, and in fact are outside the scope of the entire NPDES permit system.

The NPDES permit system is, in itself, quite robust and effective, within the context of its underlying statutory basis. Many of the perceived "problems" with it are, in fact, a perceptual problem stemming from an imperfect understanding of the permit system and its underlying statutory basis, in the larger context of other regulations underlain by the CWA (such as the Total Maximum Daily Load program related to Section 303 of the CWA), and other federal laws such as the ESA and the Safe Drinking Water Act. In short, because the NPDES system is one of the most robust regulatory systems in effect, the last 2 decades have seen numerous attempts to contort various NPDES permits into doing things for which there is no statutory basis, or for which the permit system is an inefficient or ineffective tool.

Recommendations

- Regionalize NPDES-driven program requirements where it makes sense.
- Consider alternative management models based on drainage basins rather than jurisdictions.
- Provide better collaboration between regulatory programs such as Total Maximum Daily Load, the Model Toxics Control Act, NPDES, etc. and the relevant regulatory agencies.
- Collaborate with other efforts such as salmon recovery, floodplain reconnectivity, and habitat restoration.
- Provide additional funding sources from the regional, state, and national levels.

4.2.11 Low Impact Development

Low Impact Development (LID) is an approach to land use and stormwater management that aims to preserve or mimic natural, pre-disturbance hydrologic processes. Key tenets of LID include minimizing site disturbance, conserving native vegetation, reducing impervious surface, and controlling stormwater at or near its source through the use of best management practices (BMPs). Stormwater BMPs, which are commonly referred to as green stormwater infrastructure, are small, distributed facilities that manage water through infiltration, filtration, storage,

Best management practices (BMPs) are structural and procedural measures applied to control the adverse impacts of development and redevelopment.

evaporation, and transpiration. Specific BMPs include rain gardens, permeable pavement, and vegetated roofs and will be primarily located on private properties and maintained by homeowners and businesses.

In western Washington, jurisdictions covered by a Phase I or II NPDES municipal stormwater permit must adopt development regulations that require LID BMPs to be used whenever feasible at development sites. In addition, between 2015 and 2018, these jurisdictions must incorporate specific LID requirements into local codes, ordinances, and standards. They must also evaluate their development codes, using a process established in the NPDES permit, to determine whether barriers to LID exist and revise the codes to remove or reduce identified barriers and make LID the preferred and commonly used approach to site development.

LID Implementation

In Washington State, the NPDES permit system is administered in most cases by Ecology. Between 2015 and 2018, Ecology will require all western Washington jurisdictions covered by an NPDES municipal stormwater permit to integrate LID requirements into their stormwater and development codes. To facilitate compliance with this requirement, Ecology has established a Stormwater Retrofit and LID grant program to assist Phase I and II municipal stormwater permittees with funding for the design and construction of stormwater capital retrofit projects, with an emphasis on LID facilities. The Puget Sound Region has yet to fully understand how to implement and maintain LID features in the most effective way.

Assessment

LID has been implemented throughout the Puget Sound region. In some cases, LID has been shown to reduce the costs of storm sewer construction and maintenance and/or to provide environmental benefits, such as reduced stormwater runoff. However, in other cases, LID features have produced little or no measurable benefit, have resulted in unforeseen problems, or have increased long-term operation and maintenance costs for storm sewers. The most recent NPDES Phase I and II municipal stormwater permits include revised LID facility design and construction standards aimed at maximizing the benefits of the LID, as well as infeasibility criteria intended to prevent construction of LID facilities that would have no benefit or cause unanticipated issues.

Recommendations

- Provide programmatic support for LID implementation in stormwater planning and projects.
- Perform further study of LID facility function and assess the effectiveness of new NPDES infeasibility criteria, especially in the urbanized environment.
- Provide training for design, construction, operation, and maintenance. Develop and implement inspection and maintenance protocols. Develop methods for transfer of responsibilities when properties with LID change ownership.
- Use catchment scale assessments to identify areas in which LID facilities could yield desired environmental benefits.
- Apply total life cycle cost-benefit research on LID facilities to improve understanding of the situations in which such facilities are the best approach for achieving desired environmental benefits.

4.3 Category 2: Incentives

Incentive programs are intended to encourage voluntary protection. These tools reward positive actions through tax and fee reductions, streamlined permitting, recognition, and financial compensation. The success of these tools is often dependent on market conditions.

4.3.1 Property Tax Reduction

4.3.1.1 Current Use Taxation Program

In 1970, the Washington State Legislature enacted the Open Space Taxation Act (RCW 84.34) for the purpose of preserving adequate open space lands for the production of food, fiber, and forest products as well as for recreational use and scenic beauty. The act established the Current Use Taxation (CUT) Program, a voluntary program under which property owners can reduce the amount they pay in property taxes by having their open space or natural resource lands valued at their current use, rather than at their highest and best use.

A property owner who wishes to participate in the CUT Program submits an application to the local granting authority requesting one of four land classifications: farm and agricultural land, open space land (which includes farm and agricultural conservation land), timber land, or designated forest land. If the application is approved, the county assessor must calculate annual taxes based on the current use value of the property. In addition, the landowner must maintain the property as presented for classification for as long as the property remains in the program.

Once a property is classified under the CUT Program, the property remains in that classification until a request for removal is made by the owner, land use changes disqualify the property, or the property is sold or transferred to a new owner who doesn't continue enrollment in the program (or who causes the land to be tax-exempt). Additional tax, interest, and penalties—based on the difference between the current use value and the market value of the property—may become payable upon disqualification or removal from classification.

CUT Program Implementation

The CUT Program is mostly implemented at the county level. Both King and Snohomish Counties have implemented programs that offer property tax reductions for properties successfully enrolled in the CUT program. In Snohomish County, CUT applications are processed through two programs: the Open Space Program or the Designated Forest Land Program. In King County, applications are processed through four programs—one for each of the CUT land classifications established by the Open Space Taxation Act. These programs are Timber Land, Forestland, Farm and Agricultural Land, and Open Space, which is also referred to as the Public Benefit Rating System (PBRS). (See Section 4.3.1.2 for additional information on PBRS.) If a property owner submits a CUT application for land located in an unincorporated area, the county legislative authority is the granting authority on the application. If, however, a property owner submits an application for land located within an incorporated area, the county and city legislative authorities act jointly on the application.

Assessment

The CUT Program is enabled by state law and is implemented by local jurisdictions across the Basin. The main hydrologic benefit of this tool involves the protection of pervious land surfaces in the Basin. This protection can be viewed as temporary in nature, however, because landowners can opt out of the program whenever they wish, as long as they pay any required fees or penalties.

The CUT Program is actionable, as it has been successfully used for decades and enjoys broad support. The program is also affordable. In implementing the CUT program, counties do not lose tax revenue. Instead, they shift the overall public tax burden by reducing the amount of property tax they collect from property owners participating in the program while slightly increasing the amount of tax they collect from non-participants.

Recommendations

As a general recommendation, one approach that would increase value to landowners (and potentially increase participation) is the "stacking" of incentives whereby individuals enroll in multiple conservation incentive programs simultaneously. For example, a landowner could achieve greater compensation by selling development rights and participating in Conservation Reserve Enhancement Program (CREP; see Section 4.3.3) and pursuing added-value products.

Mechanical

- Target outreach of CUT programs to areas of hydrologic importance.

Engagement

- Expand engagement efforts; although the CUT program is already widely used, the primary opportunity for expanding use of this tool is increased participation.

4.3.1.2 Public Benefit Ratings System

Under the Open Space Taxation Act, counties may choose to adopt a PBRS (RCW 84.34.055) to establish more specific criteria used to evaluate or rate open space resource value on properties. PBRS offers property owners an incentive (a property tax reduction) to protect or restore open space resources on their land. A PBRS program identifies open space resources and assigns a rating or score to determine the level of property tax savings participating properties are eligible for. Properties with the highest scores, and therefore the greatest conservation values, are eligible for the greatest tax reduction.

PBRS

Implementation

PBRS enrollment is based on a point system. Points are awarded for each PBRS resource category a property qualifies for (such as protecting stream and wetland buffers, preserving significant wildlife habitat, and conserving native forestland). In King County, the total points awarded for a property's PBRS resources translate into a 50% to 90% reduction in the taxable land value for the portion of the property enrolled. Over the past 15 years, King County has enrolled an average of 60 to 80 properties and 500 to 600 acres annually.

Snohomish County has considered the merits of a PBRS several times in recent years, as the adoption of a rating system has the potential to make implementation of the 'open space' current use assessment (CUT) classification more effective and equitable. However, the county has been reluctant to develop and adopt a PBRS due to staff capacity issues and budget constraints. For now, Snohomish County evaluates open space applications based on 19 designation criteria, including criteria that qualify properties based on the presence of wetlands, undeveloped natural areas, sensitive wildlife habitat, or unstable slopes. The county assessor hopes to get a PBRS program in place for a subset of open space properties (farm and agricultural conservation land) sometime in 2016.

Assessment

King County has protected a significant amount of open space using a PBRS (more than 11,000 acres); however, as mentioned previously, enrollment in a CUT program may confer only temporary protection. One potential benefit of adopting a PBRS program is that it can be used to complement more permanent protection tools, such as TDR or Purchase of Development Rights (PDR) programs, which are described in Sections 4.4.3 and 4.4.4. Landowners who may be eligible to participate in PDR or TDR programs but may not be willing to accept permanent conservation easements on their properties could protect natural resources on their properties by enrolling in the CUT Program.

Recommendations

Policy

- Pursue the creation of a PBRS program in Snohomish County with an award structure informed by watershed characterization, comprehensive planning policies, and conservation priorities as identified in existing incentive programs.

Mechanical

- Improve the local benefits of PBRS within King County that are informed by watershed characterization (near-term opportunity).

4.3.2 In-Lieu Fee

Also known as a density fee, an in-lieu fee is an alternative to other density incentives (e.g., affordable housing bonuses) whereby developers pay a fee to a public entity instead of providing a specified public benefit. The public entity then uses

the fee revenue to achieve the public benefit (in this context, protection).

In-Lieu Fee

Implementation

An in-lieu fee would be implemented at the county or city level.

Assessment

The in-lieu fee has been used by local jurisdictions around the Puget Sound region but it has not been tested in King or Snohomish Counties. As with other incentives, the main hydrologic benefit of this tool involves the protection of pervious surfaces (non-developed land) in the Basin.

Like TDR programs with which it is often associated, the success of the in-lieu fee depends on market conditions. When there is demand for growth, developers will use the fee to achieve higher densities. By creating an in-lieu fee option now (or in the near term), jurisdictions will be prepared to make use of the tool when the market for growth reaches a level at which this tool becomes attractive.

Public costs are relatively low because fees are paid into a fund by private developers. Local jurisdictions are responsible for administering the fund and using its proceeds for acquisitions. An in-lieu fee is not currently actionable in the Basin but could become actionable in the near term if Snohomish County creates the mechanism pursuant to policy updates adopted as part of its 2015 Comprehensive Plan. Potential political sensitivities include prioritizing how fee revenue is spent and the view that this fee adds to the cost of growth. Other considerations include how a fee structure should be priced and how to integrate it with other incentive programs.

Recommendations

Policy

- Explore the potential of having cities in the Basin adopt an in-lieu fee program individually or in partnership with other jurisdictions.

Mechanical

- Pursue the modification of the existing County TDR programs to create a fee option that developers can pay to the county as an alternative to purchasing TDR credits on the private market. The Counties could manage revenues from this fee (or delegate the role to an external partner with experience in conservation land transactions) and use proceeds to acquire development rights from lands whose protection would be important to hydrologic processes in the Basin.
- Pursue this option for cities within the Basin, either by creating a new fee program or by updating existing TDR programs to include an in-lieu fee.

4.3.3 Conservation Reserve Enhancement Program

CREP is a voluntary program in which a local organization, typically a conservation district, uses federal funds to pay landowners for maintaining or installing and improving natural riparian buffers on farmland. The goal is to provide financial compensation to landowners for the reduction in productive land and to pay for enhancement of buffers.

CREP
Implementation
CREP is available on agricultural land Basin-wide, though the application varies by county.
Assessment
CREP, while arguably a restoration tool, is included in this category because it has a conservation component and offers financial compensation to participating landowners. The program is available and in use. The program achieves land protection on a small scale and participation is limited by multiple factors. The hydrologic benefits of the tool in the Basin derive from improved riparian buffers on agricultural land. The public cost of this program is relatively low. In the context of local governments implementing the SBPP, CREP is cost-effective because funding is federal and local conservation districts conduct projects. CREP is actionable and fully functional. A political consideration of the program is the reduction in area of land available for agricultural production, which may be a concern to proponents of "no net loss" of farmland. A consideration for CREP is the value of the financial incentive. For some landowners, the compensation the program provides is insufficient to motivate participation. Surveys of landowners suggest that participation could potentially increase if the program offered greater compensation. CREP contracts have a specific time period for lease payments. Funding would be required to secure permanent easements. CREP buffer easements that have reached their maturity may be cut down, depending on the application of local regulations.
Recommendations
Mechanical • Identify local funding opportunities that augment the value offered by the federal program. • Secure funding for permanent riparian buffer easements.

4.3.4 *Forestry Riparian Easement Program*

DNR compensates small forestry landowners in exchange for a 50-year easement on "qualifying timber." Qualifying timber includes areas that have trees that would have resulted in economic gain if harvested and are adjacent to streams, wetlands, seeps, unstable slopes, or channel migration zones. The small landowner cannot cut or remove the qualifying timber during the easement period. The voluntary program reimburses landowners for a minimum of 50% of the value of the trees that they are required to leave by regulation.

Forestry Riparian Easement Program

Implementation

Forestry riparian easements are implemented Basin-wide.

Assessment

This approach, which involves applying the same easement concepts and mechanics to forested properties as those that are applied to agricultural lands, exists in the Basin. The hydrologic benefits of the tool derive from improved riparian, channel migration zone, and unstable slope buffers on forested land that has already been harvested.

Recommendations

Mechanical

- Continue funding for the program.
- Ensure proper funding for enforcement of easements.

Engagement

- Target outreach to small forested landowners in high-priority areas for hydrologic protection.

4.3.5 *Four-to-One Program*

This program allows developers to cluster and achieve a development bonus on land along urban growth boundaries, provided that for each acre developed, four are retained as open space. The program is administered through the comprehensive plan amendment process.

4:1 Program

Implementation

The 4:1 program is implemented at the county level.

Assessment

The 4:1 program exists in the Basin but it is currently actionable only in King County. The program has been used successfully in the past and its hydrologic benefits include reduction of impervious areas associated with residential development projects near the urban-rural fringe.

The 4:1 program has a low public cost, as the responsibility for implementation rests with private developers who propose projects under the program. The program is actionable and functional; however, program applications are complex and King County only considers them as part of the annual comprehensive planning cycle. Considerations for 4:1 include program extent. Use of the program is constrained by geography, raising the question of whether the program is scalable in a meaningful way.

Recommendations

Policy

- Consider a similar program in Snohomish County.
- Reduce the minimum property size requirement for the King County program to create more opportunities for participation.
- Review which uses are allowed and restricted within the retained open space in the King County program to more closely support protection goals.

4.3.6 Added Value Products

This approach involves landowners capturing additional value from their property by selling products or by-products as raw material for other industries. In the Basin, this concept is often referred to as "working buffers." An example of how this could improve hydrologic function is raising woody crops for biofuels on lands otherwise used for traditional farming that have no riparian forests. The potential hydrologic gain comes from creating temporary riparian zones or tree cover where there is none.

Added Value Products

Implementation

Projects and programs focused on developing added value products on existing resource land would be

implemented at the Basin level.

Assessment

This approach does not yet exist at scale as a protection tool. Recent feasibility studies conducted by the Snohomish Conservation District have shown that it is feasible although untested in the Basin. Changes in regulatory structure are untested and identified funding sources have not been used. The approach of using existing resource land more efficiently to expand production for new markets has been successful in the past in Europe and the eastern United States.

The affordability of this protection strategy is unknown. Given the market-based nature of the mechanism, the public costs would likely be relatively low. This strategy is not yet actionable at scale in the Basin. Likewise, political issues are also unknown. Additional effects of planting new species should be considered.

Recommendations

Mechanical

- Create or identify markets for the added value products.
- Identify and partner with landowners and potential customers for added value products to explore the feasibility of a pilot program that could be scalable (near-term opportunity).

4.3.7 Cost Share Programs

Both King and Snohomish Conservation Districts offer cost share opportunities for landowners that can reduce project costs from 50% to 100%. This incentive helps landowners be able to implement BMPs that are recommended through farm plans or site visits.

To be eligible for cost share funds, the landowner must complete a cost share application and arrange a site visit. Qualifying BMPs include projects such as buffer fencing, heavy use area protection, stream crossing improvement, and gutter and downspout piping. The availability of cost-share, however, is limited based on how the projects ranks and the availability of funding. Once landowners have received approval, they have a limited window to implement the BMPs and submit receipts for reimbursement.

Cost Share Products

Implementation

In areas served by King and Snohomish Conservation Districts, cost share funding is fully allocated every year.

Assessment

The funding for cost share programs comes from a variety of federal, state, and local sources, including the Natural Resource Conservation Service, the Washington State Conservation Commission, and Conservation Districts' assessment fees. However, the application process is limited by the capacity of staff to review cost share applications and the availability of cost-share funding and landowner match. As a result, there is a backlog of applications, resulting in a loss of interest from landowners.

Recommendations

Mechanical

- Increase funding and capacity to process cost share applications.

4.4 Category 3: Acquisitions

Acquisition provides permanent protection tools that involve the purchase of existing property rights. Land acquisition is typically prioritized by habitat value, threats, and opportunities to protect functioning habitat and key hydrologic areas, but is always conducted with willing landowners.

4.4.1 Outright Purchase

Public or private entities may protect land by purchasing it outright (also referred to as "in fee"). This is an appropriate mechanism for when a landowner has no further interest in a property that may otherwise face conversion pressure or if conservation of a property creates a compelling public benefit. An example of this could be purchase of land for a public park. Depending on the ultimate use of land protected through outright purchase, monitoring and stewardship may be part of the long-term management plan and will require funding.

Outright Purchase

Implementation

The ability to purchase properties outright is implemented at the jurisdictional and individual project levels.

Assessment

Outright purchase as a protection strategy is available for use in both King and Snohomish Counties. This strategy has been successfully used in a variety of applications and is a proven, permanent protection mechanism. Hydrologic benefits include maintaining pervious areas in a multitude of locations across the Basin.

The cost of outright purchase varies; it can be high if public, and is lower if private. Prices are limited to fair market value as determined by appraisal. Outright purchases are an actionable protection strategy. Political sensitivities include issues such as cost and value to the public, as well as changes in use (farm to recreation). Outright purchase is often the most expensive means by which to protect land, as the costs include not only the acquisition but also stewardship and other aspects of management. Another consideration is ownership – whether it makes sense for a county, city, or private partners to hold and manage protected property.

Recommendations

Policy

- Prioritize and select properties for purchase based on hydrological importance.

Engagement

- Encourage collaboration among stakeholder groups and public entities, prioritizing purchases based on watershed characterization and other criteria.

4.4.2 Conservation Easement

A conservation easement allows a qualified private land conservation organization or government to constrain land uses on private or public properties to achieve certain conservation or preservation purposes. Landowners can sell conservation easements or donate them for tax benefits. They are typically permanent, though the landowner may still own the land. Some involve restoration of portions of the protected property and all involve monitoring to enforce easement terms.

Conservation Easement

Implementation

Conservation easement acquisition is implemented at the county and individual project levels.

Assessment

Conservation easement acquisition is available for use in both King and Snohomish Counties. This strategy has been successfully used in a variety of applications and is a proven, permanent protection mechanism. Hydrologic benefits include maintaining pervious areas in a multitude of locations across the Basin. The public cost of acquisitions can be high, although this depends on funding sources: some are available through federal and state programs, others can be private. Transactions are required to be at or below fair market value as determined by appraisal. Acquisitions are an actionable protection strategy. Political sensitivity is generally low; landowners participate on a voluntary basis, properties are determined to be of high conservation value, and a transparent process determines compensation. Other considerations include limited availability of funding, complexity of the acquisition process, and responsibility for stewardship and monitoring of conservation easements. Counties and nonprofit organizations may accept donations of easements from landowners seeking to permanently protect their properties. While the donation incurs no acquisition costs, the county or land trust bears the long-term cost of monitoring and enforcing easements.

Recommendations

Policy

- Increase existing funding sources or create new ones.
- Examine the conversion of trust lands to natural lands.
- Prioritize and select properties for conservation easements based on hydrological importance.

Mechanical

- Work with private entities (potentially tribes as well) to prioritize acquisitions.
- Find ways to get easements on DNR trust lands so they are not converted.

4.4.3 Transfer of Development Rights

TDR is a voluntary, market-based real estate tool that gives landowners the option to sell development potential in the form of credits, to buyers who may in turn use the credits to build to higher intensities in designated “receiving areas” than zoning otherwise allows. Land protection at “sending areas” resulting from the TDR credits is permanent and enforced through a conservation easement, which entails monitoring and enforcement. Both King and Snohomish Counties have county-wide programs and several cities in each county have programs with inter-jurisdictional transfer agreements (such as the

Landscape Conservation and Local Infrastructure Program). A regional program also allows for transfers across county boundaries and provides financial benefits for certain cities to participate.

TDR

Implementation

For the purposes of the SBPP, TDR is implemented at the county level.

Assessment

Both counties have used TDR to varying degrees as a means to permanently protect rural residential and resource lands. As a market-based program, TDR use is driven by development and the extent to which it is used varies according to real estate market trends. The hydrologic benefits of lands protected via TDR involve maintaining existing levels of pervious surfaces in perpetuity at TDR sending sites, which can be in rural-zoned land (including forest and agricultural zones) from the urban-rural fringe to the headwaters.

Administrative costs of the program vary between King and Snohomish Counties, as have the respective returns on public investment in TDR credit acquisitions. TDR is fully actionable: owners of designated resource lands across the Basin are eligible to participate, as are some owners of rural residential lands. Political issues around the use of TDR vary. While the voluntary and market-based aspects of the program respect property rights and thus are broadly consistent with landowner interests, expanded use of TDR at the regional scale has introduced political sensitivities. In cities, TDR may compete with other incentives like affordable housing. More broadly, use of the tool is perceived as an additional cost imposed on growth. Considerations influencing more extensive use of TDR in the Basin include greater incentives for jurisdictions to use TDR, the dependency of local programs on market conditions, and the breadth of program adoption and credit absorption. As more cities participate in the regional program, they will absorb more credits and, by extension, permanently conserve more land.

Recommendations

Policy

Snohomish County near-term opportunities:

- Ensure that upcoming area-wide rezones in urban areas become TDR receiving areas in accordance with comprehensive plan policies.
- Partner with eligible cities to implement the regional TDR tool, the Landscape Conservation and Local Infrastructure Program.
- Market the TDR credits that the county currently holds (at prevailing market rates) and revolve the initial public investment made in the TDR pilot program into more conservation (i.e., purchases of additional TDRs).

King County near-term opportunities:

- Support the work of additional cities to implement the regional TDR tool, the Landscape Conservation and Local Infrastructure Program.
- Support adoption of TDR agreements between cities and counties to ensure continued demand for TDRs; update existing programs periodically to reflect changing conditions in local real estate markets.

- Support adoption of TDR agreements between cities and counties to ensure continued demand for TDRs; update existing programs periodically to reflect changing conditions in local real estate markets.

4.4.4 Purchase of Development Rights

PDR is a voluntary market-based tool in which landowners may sell or donate the development potential from their natural resource lands, typically by encumbering those lands with a conservation easement. The chief distinctions from TDR are that PDR is publicly funded, development potential is permanently extinguished (rather than transferred), and easements are typically more restrictive. As with TDR, conservation easements acquired through PDR require regular monitoring and enforcement. PDR can operate as a standalone program or can be modified to work in conjunction with TDR.

PDR

Implementation

For the purposes of the SBPP, PDR is implemented at the county level.

King County initiated its PDR program, called the Farmland Preservation Program (FPP), in 1979 after county voters approved an initiative that authorized the county to protect increasingly scarce farmland by purchasing the rights to develop it. Landowners who sell their development rights to the county under the FPP allow restrictive covenants to be placed on their properties, which greatly limit non-agricultural uses and development. Since 1979, King County has used the FPP to acquire the development rights on 13,200 acres of high-quality agricultural land within its boundaries.

Snohomish County carried out its first acquisition of development rights in 2005 and formally established its PDR program via ordinance in 2006. Under this program, the county preserves valuable farmland by purchasing development rights from landowners and placing conservation easements on their properties that prohibit most non-agricultural uses. Between 2005 and 2012, Snohomish County protected nearly 500 acres of agricultural land in a pilot area in the southern portion of the county. The program has been on hold in recent years.

Assessment

PDR is actionable, as both King and Snohomish Counties have adopted PDR programs and used them to

permanently protect agricultural lands. However, PDR can be a relatively expensive protection tool. PDR acquisitions within the Basin have been funded by a combination of local Conservation Futures tax (CFT) funds and state/federal matching funds; the long-term availability of these matching funds is uncertain.

PDR is also limited in terms of the amount of protection it can provide. The main hydrologic benefit of PDR is the protection of pervious land surfaces in the Basin. The conservation easements used in local PDR programs prohibit most non-agricultural activities, thereby limiting opportunities for ecological restoration. In King County, new FPP easements now allow for greater restoration opportunities (older FPP easements still allow only minimal restoration).

Recommendations

Policy

- Expand the PDR program area in Snohomish County to include all designated resource lands and integrate the program with TDR, allowing the county to sell publicly acquired credits and revolve funding.
- Adapt the funding structure for PDR to increase local flexibility in program implementation.

4.4.5 Reverse Purchase of Development Rights Auction

A reverse PDR auction is a conservation mechanism based on a transaction model used in agricultural commodity markets. A public entity raises funds, announces a PDR, and accepts bids from landowners who declare the price at which they are willing to sell. The public entity reviews the bids, prioritizes them, and purchases development rights from interested parties until funds are expended or all properties have been protected. Participating landowners accept conservation easements on their properties. The purchased rights may either be extinguished or re-sold through a TDR program. This process can be repeated according to the availability of resources and the level of interest.

Reverse PDR Auction

Implementation

A reverse PDR auction would be implemented at the county level.

Assessment

A reverse PDR auction does not exist in either King or Snohomish Counties. The effectiveness of this approach to watershed protection is untested, although the mechanism is established in agricultural commodity markets. The benefits for hydrology are the same as existing PDR programs.

This protection strategy would involve public funding to pay for acquisitions; however, the design of the auction incentivizes conservation that is more flexible than the existing PDR program, as there would be no appraisal requirements. Potential political issues surrounding this approach could include participant uncertainty and the public's need for assurance that it is not paying above fair market value for development rights.

Recommendations

Mechanical

- Create the mechanism for conducting a reverse auction in King and Snohomish Counties and generate funding to invest in purchases.
- Explore fundraising targets, bond issuance, and assessment of protection goals in King and Snohomish Counties.

4.4.6 Public Corporation/Authority

Washington authorizes the creation of public corporations by local jurisdictions (RCW 35.21.730 through 35.21.755). If chartered accordingly, public corporations can buy, sell, and own property. They can issue revenue-backed debt to finance acquisitions, making them an option for the purchase and ownership of resource lands, such as managed timbered property.

Public Corporation/Authority

Implementation

The establishment of a public authority would be implemented at the county level.

Assessment

Public authorities focused on activities that protect hydrologic functions do not yet exist but could be feasible within the Basin. Effectiveness as a protection strategy is untested. Hydrologic benefits include maintaining pervious areas in the Basin uplands.

A public authority would be chartered for a specific purpose and would be self-sustaining; however, for the model to be viable, it may require authority-issued revenue-backed bonds, guaranteed by the full faith and credit of the hosting county. Authorities are available but not yet actionable given that their

establishment would require additional research into viability. Political issues include a requirement for enabling legislation. Additional considerations are the cost structure of the business model—whether it can deliver a return on investment—and backing the program with the full faith and credit of the public.

Recommendations

Policy

- Evaluate the feasibility of this tool, identify possible funding sources, and explore additional steps toward legislation.

4.5 Category 4: New Models and Assessments

Additional modeling and assessment tools have been developed (or have significantly changed) since the 2005 Plan that could help focus or improve protection efforts in the Basin. These tools allow for better alignment of policies and regulations to protect hydrology and ensure that areas for protection are accurately identified. Some of these tools are focused on informing and prioritizing protection strategies.

4.5.1 Water Typing

Water typing is a process that identifies and classifies streams, lakes, and wetlands into types based on physical, biological, and human-use characteristics. The goal of water typing is to identify waterbodies that are sensitive and important both ecologically and for human use so they can be protected. The original intent of water typing was to regulate forest practices by providing the basis for forestry regulations; to date, forestry practices are still dictated by water typing maps. However, it is also recognized that many local entities use the water typing maps to help identify critical areas in their jurisdictions.

Water Typing

Implementation

Water-typing primarily supports forestry regulations through the Forests and Fish regulations but can also be used in other land use decisions. This tool is implemented at a Basin wide scale.

Assessment

Although water type maps are a protective tool in theory, it is commonly understood that these maps are inaccurate, compromising the effectiveness of planning decisions and regulations intended to protect sensitive, hydrologically important areas. This is true in the higher-elevation forest lands of the Basin, where many forest practice regulations are applied, as well as in the low-elevation forests where water type determines regulatory buffers through local ordinances.

The use of inaccurate maps sets the stage for inappropriate logging and development in potentially sensitive areas. Streams and wetlands that are unmapped or inaccurately mapped may be areas critical to preserving the hydrology of the Basin. In order to ensure the state and local regulations and policies (Forest Practice Rules, HPAs, Critical Areas Ordinances, and Shoreline Master Programs) are appropriately enforced, water typing needs to occur across the Basin, in order to produce a better baseline. Educating partners about the importance of water typing in the Basin will help further the cause and then training those partners in water typing will help cover the Basin.

Recommendations

Mechanical

- Implement water typing efforts in critical basins based on hydrologic importance.
- Establish better enforcement, with meaningful penalties.
- Evaluate compliance, with adaptive management.
- Require better documentation of data collected during field surveys in a standardized format. This would include details on bankfull widths and gradient measurements, e-fishing effort, flow conditions during survey and precipitation preceding survey, and documentation that no constructed barriers (full or partial) exist downstream from the reach in question if fish absence is presented to justify type N.

Engagement

- Increase professional water typing expertise by jurisdictions in the Basin.

Policy

- Develop on-call contracts to provide ground-truthing of water types; make this service available to cities and small forest landowners.
- Establish a certification of water type surveyors, a process that includes mandatory training in water typing to attain professional accountability of consultants who perform the work. Follow state protocols (WAC 222-16-031).
- Re-write WAC 222-16-030 and WAC 222-16-031 to ensure proper classification of stream reaches.

4.5.2 High Resolution Change Detection

The High Resolution Change Detection (HRCD) data set is a land use decision assistance tool developed by WDFW that uses 1-meter National Agricultural Imagery Program ortho-photography to quantify land cover change between different time periods. Each area that is statistically likely to have changed, based on an automated process that evaluates pixel

change, is visually inspected and confirmed by a technician and assigned attributes of initial land class, change percentage, and the change agent. The ability to quantify a variety of land cover change metrics, such as canopy loss and impervious surface increase, can have profound effects on effectiveness assessment of land use decisions like CARs.

HRCD

Implementation

The HRCD dataset currently covers the entire Puget Sound watershed and compares land cover change between 2006, 2009, and 2011. The HRCD pilot study is engaging several localities, including Snohomish County, Pierce County, Whatcom County, Kitsap County, the City of Tacoma, and the Northwest Indian Fisheries Commission.

Assessment

The HRCD dataset is unique in its scale. Covering the entire Puget Sound watershed, the HRCD data currently compare land cover change between 2006, 2009, and 2011, with more iterations set to be developed in the coming years. In order to assess the utility of the HRCD data set, in 2014 WDFW began recruiting local partners to engage in a pilot study to work out a project that addresses a land use issue within a brief (approximately 6-month) time frame. Projects so far include, but are not limited to, canopy loss in riparian areas, evaluation of Shoreline Master Program effectiveness, and (in the case of Snohomish County) evaluation of the permit-based land cover change detection system. Each project will be documented as a case study and compiled to function as both a standardization of use protocol for other localities in the region and to demonstrate support for future iterations of the data. The ultimate goal of the pilot study is to garner support in developing the HRCD project into a self-sustaining land use decision assistance tool that is incorporated into regular operational functions of localities, tribes, and the state.

Recommendations

Policy

- Potentially use HRCD for effectiveness monitoring of Critical Areas Ordinances by quantifying canopy loss and impervious surface increase over time.

Engagement

- Provide technical support/classes to interested parties on how to use the tool.
- Provide a case study on how the tool is used for protection strategies.

Mechanical

- Secure funding to make HRCD a web-based application to be used by nongovernmental organizations, jurisdictions, and agencies in Puget Sound.
- Secure funding to ensure the program is updated on a regular basis.

4.5.3 LiDAR

Light Distance and Ranging (LiDAR) is an airborne laser swath mapping technology that uses a high-frequency pulsed laser (up to 150,000 pulses/sec) typically mounted on a helicopter or fixed-wing aircraft to produce very accurate topographic surveys. Surveys can show tops of structures (like buildings, trees, and stumps) or can be digitally manipulated to show the ground surface in great detail, as though the vegetation has been completely removed.

LiDAR is used to create bare earth models, which can detect geologic faults, unmapped streams, unknown or abandoned roads under a dense forest canopy, unstable slopes features (e.g., inner gorges, deep-seated landslides, steep convergent terrain), wetland features, mapping geomorphic features, flood modeling and forecasting, and other features. Additionally, LiDAR assessments can include tree mapping and species identification, vegetation canopy height, and forest characterization.

LiDAR

Implementation

LiDAR was flown in all of King County, but across several different efforts between 2003 and 2006. In the upper watershed in King County, the quality of the LiDAR was quite low. New Puget Sound protocols have since been developed that will help ensure high quality products.

In Snohomish County, LiDAR has been flown for most of the County with the exception of the USFS ownership on the east side of the County.

Assessment

There are many ways LiDAR information can be used to assist land managers or land use decision-makers in identifying areas of concern or where to focus efforts for more intense scrutiny. Natural resource managers typically use these data to focus on-the-ground evaluation of sensitive resource concerns. For example, unmapped streams, channel migration/erosion zones, unstable slopes, orphaned roads, and fish habitat streams are just a few of the landscape features that were identified for protection for during forest practices review. Many timber and development proposals have been reexamined and resource protection risk reduced over the years due to the ability to use this information, where available. This information is also valuable when designing and scoping restoration projects.

The need for repeating LiDAR flights largely depends on what questions the information is trying to answer. For large swaths of the landscape, the bare earth model does not change much over time. However, in dynamic areas, such as floodplains, managers may want new LiDAR information following large flow events or large restoration projects. For managers in timberlands, where LiDAR can help describe vegetation conditions, LiDAR should be flown more regularly.

Recommendations

Policy

- Work with the USFS to acquire new LiDAR information that will help develop stand management, road, and sensitive feature management approaches that will best protect intact hydrology.

4.5.4 Drainage Classification

King County has an Agriculture Drainage Assistance Program that classifies agricultural waterways according to salmon presence, seasonal stream flow, watershed size, temperature data, and geomorphic characterizations that indicate presence of stream characteristics. The classification is updated periodically when new information is learned about a specific waterway. This classification helps guide decisions on allocation of BMPs for fish protection and restoration of fish habitat and water quality during agricultural waterway maintenance dredging. The County used the classification system as a basis for a streamlined drainage maintenance permitting with WDFW and King County's Department of Permitting and Environmental Review.

Drainage Classification

Implementation

This tool is King County-specific and implemented through the Agriculture Drainage Assistance Program.

Assessment

This classification system has been applied to all waterways (approximately 400 miles) in King County's Agricultural Production Districts, including the Snoqualmie Agricultural Production District, but no similar system has been applied to the Snohomish County portion of the Basin.

Recommendations

Mechanical

- Use method to help determine areas where drainage ditches can be combined to potentially provide greater benefit to hydrology.

Policy

- Consider establishing an agriculture drainage assistance program in Snohomish County and developing a similar stream classification system.
- Use the system to identify which "low" salmonid use streams would have greater juvenile salmon use potential if the fish passage barrier was addressed.
- Use the classification to help pilot installation and evaluation of "controlled drainage" or "drainage water management" systems that can provide greater protection of hydrology than typical drainage systems.

4.5.5 Stream Gauges

A stream gauge, stream gage, or gauging station is a location used by hydrologists or environmental scientists to monitor and test surface water. Hydrometric measurements of water level surface elevation (stage) and/or volumetric discharge (flow) are generally taken and observations of biota and water quality may also be made.

Stream Gauges

Implementation

Stream gauges have been put in place throughout the Basin by federal, state, and county agencies.

Assessment

Stream gauges provide critical information regarding stream flow to environmental scientists, fishery biologists, and planners. This information can help plan for flooding projects, irrigation withdrawals, hydroelectric power production, recreation, infrastructure designs, and habitat conditions. Long-term stability of stream gauging provides consistent, systematically collected information that can be used to track climate and land use changes; improve flood forecasting models; observe flows across jurisdictional and tribal borders; and monitor flows into major river basins that serve heavily populated areas or that sustain vital aquatic communities. Stream flows can inform numerous efforts but, often, long-term stream gauges are lost due to budget cuts.

Recommendations

Policy

- Establish funding source for long-term operation of key stream gauges.

Mechanical

- Determine critical stream gauge stations that will track hydrologic integrity of the Basin and ensure those remain funded.

4.5.6 Watershed Characterization

Ecology was a major partner in the SBPP project by providing technical assistance in running and interpreting the PSWC model. It was a very large undertaking and resulted in the *Watershed Characterization for WRIA 7: Assessment and Recommendations for Protection of Water Flow Processes* (Hume et al. 2016). The following text is from that report.

Watershed processes are defined as the dynamic physical and chemical interactions that form and maintain the landscape and ecosystems on a geographic scale of watershed to basins. This includes the movement of water, sediment, nutrients, pathogens, chemicals and wood. As described by Stanley et al. (2012), the PSWC is built on the basic relationships between ecosystem processes, structure, and function.

Watershed process are controlled and influenced by natural attributes and human actions. Natural controls on watershed processes include physical attributes of the ecosystem such as geomorphology, geology, and soils. Many human actions influence watershed processes. For example, timber harvest may reduce the amount of wood entering streams. Shoreline armoring can reduce sediment input from bluffs and alter the erosion, movement, and deposition of sediments along beaches. Urban development can increase the amount and amplitude of stormwater runoff. PSWC attempts to model these watershed

"Shoreline armoring" refers to the artificial application of materials to protect streambanks from erosion.

processes such that areas of the landscape can be identified that are relatively more important (presence of natural controls) or degraded (due to human impacts).

Watershed Characterization

Implementation

Watershed characterization consists of a series models and indices that evaluate hydrology, water quality, and habitat in watersheds across Puget Sound. The models are run and maintained by Ecology and WDFW. The models are appropriate for comparing the relative value and degradation of processes and habitats in watersheds across Puget Sound. In many cases, with technical assistance from Ecology, the models can be adapted and applied to different watersheds and tailored to inform unique planning scenarios.

Due to the ability to scale the model, watershed characterization results can be applied at all levels (from an individual jurisdiction to Puget Sound-wide).

Assessment

In 2009, Ecology released the first watershed characterization model. This model combines information for assessments from land uses and landforms to present information on the relative importance and degradation of four different components of hydrology: storage, delivery, recharge, and discharge. The model is intended to guide land use planners in identifying areas that are important for restoration and protection. The Project team saw the potential of using the tool to take a landscape-scale approach to new hydrology-focused protection strategies with geographic specificity.

More recently, the completion of PSWC Volume 1 (Stanley et al. 2012) and Volume 2 (Wilhere et al. 2013) provided additional models and assessments of water quality processes (sediment, metals, pathogens, nitrogen, and phosphorus) and fish and wildlife habitats (terrestrial, freshwater, and marine shorelines) for use in planning. Hume et al. 2015 (in review) integrates assessments of water flow processes with those of sediment process degradation and salmonid habitats to help prioritize watersheds of the Basin for protection of hydrologic process, and identify additional benefits for salmonid habitat and potential limiting factors to management actions targeted in those watersheds.

The PSWC project generally prioritizes protection actions in watersheds that are highly important and are relatively less degraded for watershed processes, when resources to enhance or restore these areas are limited. This does not mean that there are not important areas or necessary restoration actions in assessment units that are not highly important and highly degraded. Rather, given limited resources, these might be the first place a planner would want to focus on to increase the likelihood of improving watershed processes in key areas.

Recommendations	
Policy • Incorporate PSWC as a key part in the Comprehensive Plan Updates for local jurisdictions. • Consider PSWC models and indices, or other similar approaches to a comprehensive assessment of watershed processes, as best available science for local planning when relevant.	**Engagement** • Make PSWC training available for planners in the Basin to learn how to best utilize the tool in their jobs. • Highlight local uses of PSWC assessments—for planning projects or Comprehensive Plan updates—in workshops and planning forums to illustrate their utility, increase understanding and acceptance, and continue to refine methods for effective application.

4.6 Category 5: Other Tools/Strategies

This section details other protection tools or processes that do not clearly fit into the other categories.

4.6.1 Snohomish-Stillaguamish Local Integrating Organization

This tool is part of a regional process to assist in local implementation of the *2014/2015 Action Agenda for Puget Sound* (Puget Sound Partnership 2014). A regional group called the Snohomish-Stillaguamish Local Integrating Organization was formed in 2012 to "enable communities to guide the implementation of Action Agenda priorities at an ecosystem scale, and to prioritize local actions for investment" (Puget Sound Partnership 2015).

Snohomish-Stillaguamish Local Integrating Organization
Implementation
Protection actions would be promoted by inclusion as near term actions in the local profile of the Action Agenda.
Assessment
Unlike Lead Entities, the Local Integrating Organizations do not directly control any portion of Puget Sound investment funding.

Recommendations

Engagement

- Seek endorsement from the Local Integrating Organization for proposed protection actions.

4.6.2 Value Capture Financing

This tool, requiring state legislation to create, would create new funding through voluntary property taxes for built and natural infrastructure within a given a watershed. Such infrastructure could include utilities, sidewalks, or other built improvements to support growing urban populations, as well as parks, greenways, or other natural areas that provide hydrologic benefits. A projected outcome of its implementation would be new sources of funding for a variety of incentive and acquisition protection tools that will be eligible for use across the entire Basin.

Value Capture Financing

Implementation

Value capture financing investment in green infrastructure would be implemented at the Basin-wide level.

Assessment

This approach does not yet exist as a protection strategy. In concept, it is feasible although untested. Hydrologic benefits in the Basin derive from permanent protection of pervious areas.

The costs of implementing this strategy are unknown and it is not yet actionable. Political issues include the requirement of state legislation to effect implementation.

Recommendations

Policy

- Adopt legislation to make this tool possible.

4.6.3 Department of Natural Resources Programs

Each of these state-administered programs is implemented on a Basin-wide scale and targets protection of forest lands. Hydrologic benefits are similar to other acquisition tools and mainly involve the retention of pervious land in the Basin. These programs are grouped for analysis because they all operate under the auspices of DNR.

4.6.3.1 Forest Legacy Program

The Forest Legacy Program protects environmentally important forestlands threatened by conversion to development by acquiring conservation easements. Eligible properties must be managed for forest products and to provide public benefits such as healthy riparian areas and scenic, cultural, and recreation resources. Projects are prioritized that demonstrate national significance regarding the impact of forestland on the local or regional economy and on hydrology through water quality and habitat.

Forest Legacy Program

Implementation

The Forest Legacy Program is federally funded, implemented by DNR, and available to be applied statewide. As of 2014, more than 37,000 acres had been entered into the program in seven counties.

Assessment

Appropriations come from the Land and Water Conservation Fund, made up of revenue from offshore drilling for oil and gas. Annual appropriations are usually $50 million, which funds 15 to 20 projects. The grant process is often lengthy; it can be 2 to 3 years from project submittal to receipt of funding.

Recommendations

Mechanical

- Expedite the process for participants to make it more attractive.
- Use watershed characterization results to target outreach to landowners who may be interested in the program.

4.6.3.2 Community Forest Trust

In 2011, the Washington State Legislature worked with DNR to create a new tool for local community partners to participate in protecting working forestlands. This category of working forest will be held by the state, actively and sustainably managed by DNR, and used by the local community. Local communities nominate forest candidates, which are selected by DNR and funded jointly by the community and the legislature. Once acquired, a management plan will be developed for each Community Forest to specify financial, conservation, and recreation objectives. The Community Forests must be financially supported through revenue-generating activities.

Community Forest Trust

Implementation

The establishment of a community forest trust would be implemented at the Basin-wide level.

Assessment

Since adoption of enabling legislation, the program has been used to create the Teanaway Community Forest in Kittitas County. Costs are shared between the state and other parties; the legislature appropriated nearly $100 million for the Teanaway Community Forest. Political sensitivities vary and can include resistance to government acquisition of private land.

Recommendations

Mechanical

- Explore the interest and feasibility of creating a community forest within the Basin.

4.6.3.3 Trust Land Transfer Program

DNR manages more than 3 million acres of state trust forest, agricultural, range, and commercial properties. Income from these trust lands funds public education and other state institutions to provide local services. The Trust Land Transfer Program allows identified trust lands with high ecological value to remain in public ownership while maintaining and improving economic return to trust beneficiaries. Designated

properties are appraised for current market value. DNR uses the land value of the property to acquire replacement property better suited to generating revenue for education. These timbered properties are transferred to another public agency that will manage and protect it for public use and enjoyment. Properties with lower timber-to-land value ratios are often not suitable for this program.

Trust Land Transfer Program

Implementation

The Trust Land Transfer Program is available to public agencies across Washington. The land that DNR acquires to offset the trust land transfer program is often private.

Assessment

The Trust Land Transfer Program is funded by the state legislature.

Recommendations

Mechanical

- Use watershed characterization results to identify public agency property that may be particularly important for maintaining intact hydrological function.
- Use watershed characterization results to target outreach to landowners who may be interested in exchanging land to support the program.

4.6.4 WSU North Puget Sound Extension Forestry and Agriculture Programs

The Washington State University (WSU) Forestry and Agriculture Extension programs provide education and information about forest and agricultural management to private forest landowners and farmers as well as the general public. Local WSU Extension forestry programs include a forest stewardship university; field tours; expert consultations; seminars on topics such as wetlands, ponds, and amphibians; and evaluation of different harvesting techniques to promote woodland health. Local WSU agriculture programs focus on small farm sustainability and entrepreneurship.

WSU North Puget Sound Extension Forestry and Agriculture Programs

Implementation

The WSU North Puget Sound Extension program delivers research-based information and resources to farmers and foresters in King, Snohomish, Island, Skagit, Whatcom, and San Juan Counties.

Assessment

This is a popular, expanding education and outreach program with typical participants being small-scale woodland owners. The overall focus is to provide landowners with the knowledge, tools, connections, and motivation to restore degraded areas of their properties and protect existing intact and functioning systems.

Recommendations

Seek participants—such as professionals, educators, and policymakers—with the goal to reduce the economic pressure on forest owners to convert their forestland to non-forest use.

4.7 Summary of Tools

Table 8 provides a synthesis of the tools discussed in Section 4, including a brief description of the protection tool, the applicable geography and land use type, the affected hydrological component, and details of how the tool can be used to affect hydrology.

Table 8: Synthesis of Tools

Tool	Tool Description	Geography	Implementer	Land Use Type	Hydrology Component	Method of Protecting Hydrology	Notes
Category 1: Regulatory Mechanisms							
Growth Management Act	Plans for growth and land use on a 20-year timeline. State law that lays out 13 broad goals to guide local governments in the planning process including conservation of natural resources and protection and enhancement of the environment.	Basin-wide	State	All land use types	Delivery, storage, recharge, and discharge	Sets aside resource lands and requires the protection of all critical areas. Can help protect sensitive areas by directing development and growth.	
Comprehensive Plans	Goals and policies describing a community's (jurisdiction's) vision and priorities for development and how it plans to achieve them.	Cities and Counties	Cities and Counties	All land use types	Delivery, storage, recharge, and discharge	Through goals and policies for development patterns that emphasize the importance of water and hydrologic processes to the environment and human health.	
Critical Areas Regulations	A code with policies and standards intended to protect critical areas.	Cities and Counties	Cities and Counties	All land use types	Delivery, storage, recharge, and discharge	Requires compliance with policies and standards and protects water resources and hydrologic processes.	
Zoning Regulations	Implements land use designations described in the comprehensive plan (e.g., directs development in certain areas).	Cities and Counties	Cities and Counties	All land use types	Delivery, storage, recharge, and discharge	Policies and standards associated with each zone can protect hydrology	
Minimized Impact Rural Development	Look at rural development from impervious surface or impacts to hydrology lenses vs. density.	Basin-wide	County	Rural	Delivery, storage, recharge, and discharge	Allows development in a manner that is sensitive to hydrology and ecological conditions.	
Shoreline Management Act	Establishes goals and policies for land use and the protection of shorelines and shoreline processes within 200 feet of shorelines of the state.	Cities and Counties	Cities and Counties	Aquatic and upland areas 200 feet from the ordinary high water mark	Delivery, storage, recharge, and discharge	Requires no net loss of ecological function and compliance with policies and standards to protect aquatic habitat and water quality.	
Forest Practices Rules	Regulates logging to protect fish and aquatic resources.	Basin-wide (state, local, and private lands)	State	Forestry	Delivery	Implements forestry practices, which can greatly affect hydrology.	
Other Federally Approved Habitat Conservation Plan	Allows DNR to carry out timber harvesting and other forest management activities on state forestlands	Basin-wide (state, local, and private lands)	State (DNR)	Forestry	Delivery	Provides habitat protection through four detailed conservation strategies.	
Northwest Forest Plan	Regulates logging to protect spotted owl habitat and watershed conditions.	Basin-wide (federal lands)	Federal USFS	Forestry	Delivery, storage, recharge, and discharge	Implements forestry practices, which can greatly affect hydrology.	
Wilderness Act Designation	Sets aside large tracks of forestry land to protect it from development and excessive use.	Basin-wide	Federal USFS	Forestry	Delivery, storage, recharge, and discharge	Protect large tracts of forested lands from manipulation and development.	
National Wild and Scenic Rivers Designation	A designation of rivers that results in banning the licensing of hydropower and creates a federal reserved water right to protect flow-dependent values.	Basin-wide	Federal Government	All land use types	Delivery, storage, recharge, and discharge	Allow rivers to flow unencumbered.	
Instream Flow Rule Making	Regulations for using surface and groundwater for irrigation, livestock, and domestic use.	Basin-wide	State	Rural/Urban	Delivery and storage	Policies protect water in the system and can protect fragile, flow-limited systems.	

Tool	Tool Description	Geography	Implementer	Land Use Type	Hydrology Component	Method of Protecting Hydrology	Notes
Water Rights Market Tools	Trust Water Rights, Water Banking, and Water Acquisition programs designed to help water right holders use their permits efficiently.	Basin-wide	State	Agriculture, Rural, Urban	Delivery and storage	Keeps water in the system for instream uses.	
Reclaimed Water	The use of treated wastewater for non-potable uses.	Local jurisdiction	Cities and Counties	Rural/Urban	Delivery	Keeps water in the system.	
Living with Beavers	Make it easier for land owners to live with beavers on their property.	Local jurisdiction/ Planning Unit	Cities, Counties, and Non-profits	All land use types	Storage and delivery	Improves water storage; moderates delivery by minimizing peak flows.	
Beaver Relocation	Move beavers to forested lands to create wetland complexes.	Basin-wide	Federal Government	Forestry	Storage	Stores runoff in forest lands and creates storage for water delivery.	
Dam Licensing	FERC relicensing can dictate new hydrologic requirements.	Basin-wide/ Planning Unit	Federal Government, State, and Counties	Public lands	Delivery and discharge	Dams can impact delivery and storage. Relicensing can refine how those components are affected.	
WDFW Hydraulic Project Approval	Allows for conducting projects within an aquatic area.	Basin-wide	State	All land use types	Delivery, storage, recharge, and discharge	Can help protect aquatic areas by determining what is allowed and how it is done.	
Gold Mining and Fish Hydraulic Project Approval	Hydraulic Project Approval allows for gold mining in streams and rivers.	Basin-wide/ Planning Unit	State	Streams/rivers on public property	Primarily delivery, and discharge	Ensuring mining HPA works keeps delivery of water and does not create artificial berms.	
National Pollutant Discharge Elimination System	Permit that dictates how selected cities and counties manage stormwater.	Basin-wide	State, Counties, and Cities	Rural/Urban	Delivery, storage, recharge, and discharge	Runoff flow rates from land development projects must meet standards set forth by Ecology, with a focus on infiltrating as much runoff as feasible on site.	
Low Impact Development	Approach to land use and stormwater management that aims to preserve or mimic natural, pre-disturbance hydrologic processes.	Basin-wide	State	Rural/Urban	Delivery, storage, recharge, and discharge	Increases tree cover, infiltration, and storage features through mimicking natural conditions in built landscapes.	
Category 2: Incentives							
Current Use Taxation Program	Tax breaks for people enrolled in programs that protect resources.	Local jurisdiction	Counties and Cities	Agriculture/forestry	Delivery, storage, recharge, and discharge	Could protect key hydrologic areas.	Not in existence.
Public Benefit Rating System	Tax breaks for people enrolled in programs that protect resources.	Local jurisdiction	Counties and Cities	Mostly Rural Residential	Delivery, storage, recharge, and discharge	Could protect key hydrologic areas.	Currently only available in King County.
In-lieu Fee	Developers pay a fee to a public entity and the public entity then uses revenues to achieve the public benefit (in this context, protection) with the fee revenue.	Local jurisdiction	Counties and Cities	Urban/Rural Residential	Delivery, storage, recharge, and discharge	Local jurisdictions could use money to protect key areas of hydraulic importance.	
Conservation Reserve Enhancement Program	Leases land from a farmer to plant a buffer.	Basin-wide	Counties and Cities	Agriculture	Delivery and storage	Maintains riparian buffers, even if only temporarily.	

Tool	Tool Description	Geography	Implementer	Land Use Type	Hydrology Component	Method of Protecting Hydrology	Notes
Forestry Riparian Easement Program	Compensating forest landowners for retaining and improving riparian buffers for a specified period of time.	Basin-wide	Department of Natural Resources	Forested uplands	Delivery, storage, recharge, and discharge	Could protect critical hydrologic zones in forestlands.	
Four-to-One Program	Allows developers to cluster development and for each 1 acre developed, 4 acres must remain undeveloped.	Local jurisdiction	Counties and Cities	Rural Residential interface	Delivery, storage, recharge, and discharge	Could protect key hydrologic areas.	
Added Value Products	Captures additional value by allowing landowners to sell products/byproducts to other industries	Basin-wide	Counties, Cities, and Non-profits	Agriculture and Forestry	Delivery and storage	Establishes riparian buffers.	Not in existence.
Category 3: Acquisitions							
Conservation Easement	Land is permanently kept in a particular land use type.	Local jurisdiction/ Planning Unit	Counties, Cities, and Non-profits	All land use types	Delivery, storage, recharge, and discharge	Could protect key hydrologic areas by maintaining pervious surface.	
Transfer of Development Rights	Landowners sell development rights in the form of credits and developers can buy them to gain development flexibility.	Local jurisdiction	Counties and Cities	Mostly resource lands – agriculture, forestry	Delivery, storage, recharge, and discharge	Could protect key hydrologic areas.	
Purchase of Development Rights	The purchase of development rights extinguishes development rights and restricts easements.	Local jurisdiction	Counties and Cities	Mostly resource lands – agriculture, forestry	Delivery, storage, recharge, and discharge	Could protect key hydrologic areas.	Uses public money and is known as the Farmland Preservation Program in King County.
Reverse Purchase of Development Rights Auction	Public entity purchases development rights based on landowner's set price.	Local jurisdiction	Counties and Cities	Agriculture	Delivery, storage, recharge, and discharge	Could purchase lands critical to maintain hydrologic conditions.	Not in existence.
Outright Purchase	Purchase of land	Local jurisdiction/ Planning Unit	Counties, Cities, and Non-profits	All land use types	Delivery, storage, recharge, and discharge	Could protect key hydrologic areas.	
Public Corporation/ Authority	Public corporations can buy, sell, and own property.	Local jurisdiction	Counties and Cities	All land use types	Delivery, storage, recharge, and discharge	This is a funding approach that could protect key hydrologic areas by maintaining pervious surface.	Not in existence.
Category 4: New Models and Assessments							
Water Typing	Tool that allows better implementation of land use regulations.	Basin-wide/ Planning Unit	State, Counties, Cities, and Non-profits	Mostly forestry but could be applied more broadly.	Delivery	Ensures streams are typed appropriately, to better apply critical areas regulations and other regulations.	
High Resolution Change Detection	High-resolution aerial photography that tracks changes over time.	Basin-wide	State	All land use types	Delivery, storage, recharge, and discharge	Tracks land use over time and can help align policies and regulations to protect hydrology.	
LiDAR	Remote sensing technology that makes very high-resolution maps and is the basis for many models.	Basin-wide	Federal, State, and Counties	All land use types	Delivery, storage, recharge, and discharge	Allows for highly detailed ground truthing of an area and existing features on the landscape.	

Tool	Tool Description	Geography	Implementer	Land Use Type	Hydrology Component	Method of Protecting Hydrology	Notes
Drainage Classification	Classification system to help determine best methods for performing drainage actions.	Basin-wide	Counties	All land use types (mostly agriculture)	Storage, recharge, and discharge	Ensures that areas prime for hydrological storage, recharge, and discharge are protected.	
Stream Gauges	Monitor water flow and water level in streams.	Basin-wide	Federal, State, and Counties	All land use types	Delivery	Helps inform changes in water quantity and timing of water delivery.	
Watershed Characterization	Combines information for assessments from land uses and landforms to present information on the relative importance and degradation of four different components of hydrology: storage, delivery, recharge and discharge.	Basin-wide	State, County, and Local Jurisdictions	All land use types	Delivery, storage, recharge, and discharge	Helps show important hydrologic areas scaled to specific geographic boundaries.	
Category 5: Other Tools/Strategies							
Snohomish-Stillaguamish Local Integrating Organization	Local/regional planning group is part of the Puget Sound Partnership's Action Agenda program.	Basin-wide	State, Counties, Local Jurisdictions, Tribes, and Non-profits	All land use types	Delivery, storage, recharge, and discharge	Could prioritize and fund key actions to protect hydrology.	
Value Capture Financing	New funding through voluntary property taxes for built/natural infrastructure within a specific watershed.	Basin-wide/ Local jurisdiction	State, Counties, and Cities	All land use types	Delivery, storage, recharge, and discharge	Could protect key hydrologic areas depending on priority.	Not in existence, but strengthens incentive to use TDR.
Forest Legacy Program	Protects environmentally important forestlands threatened by conversion to development by acquiring conservation easements.	State	State	Forestland	Delivery, storage, and recharge	Maintains forestlands.	
Community Forest Trust	A community forest will have a management plan developed by DNR and the local community, specifying financial, conservation, and recreation objectives.	State/ Local jurisdiction	State, Counties, and Cities	Forestland	Delivery and storage	Maintains forestlands.	Not in existence.
Trust Land Transfer Program	Allows identified trust lands to remain in public ownership while maintaining and improving economic return to trust beneficiaries.	Basin-wide	State	Forestland	Delivery, storage, recharge, and discharge	Could protect critical hydrologic zones in forestlands.	
WSU North Puget Sound Extension Forestry and Agriculture Programs	Education on forestry including silviculture and managing woodlands for private forest landowners.	Basin-wide	State	Forestland	Delivery, storage, and recharge	Maintains forestlands and promotes stewardship to maintain hydrologic functions.	

Section 5
FUNDING STRATEGIES

As discussed in the strategy assessments, many of the tools available to protect land and hydrologic function across the Basin face funding challenges. This section presents a range of funding opportunities that are available, or that may become available, to support SBPP objectives relating to Basin-wide strategies and early actions.

In the past, public sources have constituted a central component of funding for protection purposes. The long-term certainty of these sources is unclear; state and federal appropriations for funding programs may change and competition for these funds may grow. While many of these programs will continue to play an important role in protection efforts in the Basin, other opportunities may diversify the range of funding. These include expanded use of market-based tools that draw on private sources to achieve protection and emerging forms of incentives that encourage their use. Local funding sources can provide flexibility in achieving protection but may be challenging to expand given competing needs.

Table 9 lists the sources of funding identified to support the objectives of the SBPP. Descriptions of each source are in Sections 5.1 through 5.5, noting the availability, purpose, and applicability to the protection tools that were assessed in Section 4.

Table 9: Summary of Funding Sources

Name of Source	Type of Protection Tool Funded	Availability
Washington Wildlife and Recreation Program	Incentives/acquisitions	Current, state program
Salmon Recovery Funding Board	Acquisitions/assessments	Current, state/federal program
Puget Sound Acquisition and Restoration Fund	Acquisitions	Current, state program
Floodplains by Design	Acquisitions	Current, state program
Estuary and Salmon Restoration Program	Acquisitions	Current, state program
Forest Legacy Program	Acquisitions	Current, state program
Trust Land Transfer Program	Acquisitions	Current, state program
Community Forest Trust	Acquisitions	Current, state program
National Estuary Program	Incentives/regulatory	Current, state/federal program
Land and Water Conservation Fund	Acquisitions	Current, federal program
Cooperative Endangered Species Conservation Fund "Section 6"	Acquisitions	Current, federal program
Natural Resource Conservation Service Farm and Ranch Lands Protection Program	Incentives/acquisitions	Current, federal program
Conservation Futures	Incentives/acquisitions	Current, county programs
Non-levy Revenue	Incentives/acquisitions	Future, county/city option
Bonds	Acquisitions	Future, county option
Impact Fees	Incentives/acquisitions	Future, county/city option
King County Flood District's Cooperative Watershed Management Grants	Incentives/acquisitions/ assessment	Current, King County portion of the Basin
King County Parks Expansion Levy	Acquisition	Current, King County portion of the Basin
King Conservation District Member Jurisdiction Grant Program	Incentives/acquisitions	Current, King County portion of the Basin
Transfer of Development Rights Credit Sales	Incentives	Variable
Property Taxes	Incentives	Current, county/city program
Value Capture Financing	Incentives	Future, county/city option
Density/In-lieu Fees	Incentives	Variable
Tribes	Acquisitions	Current, tribal efforts
Donations	Acquisitions	Current, multiple opportunities

5.1 State Programs and Funding Sources

5.1.1 Washington Wildlife and Recreation Program

The Washington Wildlife and Recreation Program is a state grant program that provides funding to protect habitat, preserve working farms, and create new local and state parks (RCW 79A.15; WWRC 2014). Administered by the State's Recreation and Conservation Office, the program involves a competitive process from which projects are selected for funding. The amount of funding and project approval are decided by the governor and state legislature. Of the project categories that the Washington Wildlife and Recreation Program funds, several are germane to the protection goals of the SBPP.

Applicability

This funding source is available and supports acquisition and incentive protections. Specific funding areas that pertain to the Basin include critical habitat, farmland preservation, natural areas, and riparian protection.

5.1.2 Salmon Recovery Funding Board

Administered through the State's Recreation and Conservation Office, the Salmon Recovery Funding Board is a combined state and federal grant program that awards funding to protect or restore salmon habitat and assist with related activities (RCW 77.85). Local groups develop projects that are evaluated by scientific panels and forwarded to the board for consideration. The emphasis is on encouraging locally-generated project ideas.

Applicability

This funding source is available. A portion of Salmon Recovery Funding Board funding supports acquisition (primarily habitat) and planning projects. Some projects involve a combination of acquisition, restoration, or planning activities.

5.1.3 Puget Sound Acquisition and Restoration Fund

Administered through the State's Recreation and Conservation Office and the Puget Sound Partnership, the Puget Sound Acquisition and Restoration Fund is a biennial state funding source, authorized through the legislature, that awards funding to protect or restore salmon habitat. Local groups develop projects that are evaluated by scientific panels and forwarded to the board for consideration. The fund has a regional large capital component and a local watershed component. The local component follows the same approval process as the Salmon Recovery Funding Board grants.

Applicability

This funding source is available. A portion of Puget Sound Acquisition and Restoration funding supports acquisition (primarily habitat). Some projects involve a combination of acquisition, restoration, or design activities.

5.1.4 Floodplains by Design

This is a public-private partnership that seeks to integrate flood hazard reduction with habitat restoration and protection. It is administered by Ecology with the involvement of the Puget Sound Partnership, The Nature Conservancy, and numerous partners representing tribes, state and federal agencies, and private groups. A project focusing on restoration and infrastructure assessment along the lower Snohomish River has already won funding.

Applicability

This funding source is available and emphasizes coordination in approaches to protection. The Sustainable Lands Strategy continues to be a project proponent, as it is inclusive of many groups and interests. Awards may include funding for acquisitions.

5.1.5 Estuary and Salmon Restoration Program

The Estuary and Salmon Restoration Program provides state funding and technical assistance for nearshore restoration and protection efforts in Puget Sound. Developed as a tactical element by the Puget Sound Nearshore Ecosystem Restoration Project, the Estuary and Salmon Restoration Program is focused on moving from opportunistic grant funding towards strategic ecosystem restoration.

This strong link to science and an ecosystem-scale approach ensure that the Estuary and Salmon Restoration Program's investment decisions are strategic and that the efforts will translate into estuaries, bays, and shorelines that are intact, functioning, and resilient to climate change.

The estuary is the region where fresh water from the Basin mixes with the salt water of Puget Sound. The estuary is a highly productive and diverse environment and provides unique and critical habitat for salmon for rearing, migration, and transitioning between fresh and saltwater.

The nearshore is the area extending from the shoreline into the water. Nearshore areas provide habitat for 80% of the fish species in the United States (USEPA 2012).

Applicability

This funding source is available to funding estuary and nearshore acquisition of intact estuary lands. Projects are large-scale efforts that may involve restoration and assessments.

5.1.6 Forest Legacy Program

The Forest Legacy Program protects environmentally important forestlands threatened by conversion to development. The program operates by paying for conservation easements. To be eligible for the program, properties must be managed to produce forest products and provide non-commodity values such as healthy riparian areas and scenic, cultural, and recreation resources. Projects are prioritized that demonstrate national significance regarding the impact of forestland on the local or regional economy and on environmental values such as water quality and habitat.

Applicability

Although a federal program, Washington State's participation is administered by DNR. The state convenes a panel to determine which projects should move to federal consideration. Each state can submit up to three projects (may not exceed $10 million). The grant process is often lengthy; it can be 2 to 3 years from project submittal to receipt of funding.

5.1.7 Trust Land Transfer Program

DNR manages more than 3 million acres of state trust forest, agricultural, range, and commercial properties. Income from these trust lands goes toward public education and other state institutions to help fund local county services. Some trust lands provide habitat for fish and wildlife and recreation and education opportunities for the public, but do not generate revenue. The Trust Land Transfer Program allows identified trust lands to remain in public ownership while maintaining and improving economic return to trust beneficiaries.

Applicability

The Trust Land Transfer Program is funded by the state legislature. Designated properties are appraised and transferred at market value.

The value of the timber is deposited into the Common School Construction Account to provide revenue for K-12 schools. The value of the land is used to acquire replacement property that is better suited to generate future revenue for schools. The timbered property is transferred to another public agency to be managed and protected for public use and enjoyment.

5.1.8 Community Forest Trust

In 2011, the Washington State Legislature worked with DNR to create a new tool for local community partners to participate in protecting working forestlands. This category of working forest will be held by the state, actively and sustainably managed by DNR, and used by the local community.

Applicability

Community forest candidates are nominated by local communities, selected by DNR, and funded jointly by the community and the legislature. Once acquired, a working forest management plan will be developed for each Community Forest. The plan will specify financial, conservation, and recreation objectives. The Community Forests must be able to support themselves financially through revenue-generating activities.

5.1.9 National Estuary Program Grants

Administered by Ecology and the Washington State Department of Commerce, the National Estuary Program grants are funded through USEPA. The National Estuary Program is a multi-year program awarding annual grants to projects proposed by local jurisdictions, tribes, non-profit organizations, and partnerships. Awards support both restoration activities and planning activities that inform regulatory updates to improve land use decisions and reduce hydrologic impacts by encouraging development within existing urban areas. The program supports projects that advance Puget Sound Partnership Action Agenda (Puget Sound Partnership 2014) items.

Applicability

Cities in the Basin, including Everett and Snohomish, have won awards to fund planning work that improves land use decisions. Planning supported by this program can result in policies and regulations that lead to reduced hydrologic impacts at the Basin level.

5.2 Federal Programs and Funding Sources

5.2.1 Land and Water Conservation Fund

The focus of this federal program is to conserve irreplaceable lands and improve outdoor recreation opportunities nationwide. The program works in partnership with state and local efforts to acquire and protect inholdings and expansions in national parks, wildlife refuges, forests, trails, and Bureau of Land Management areas (LWCF 2014). The program is funded by offshore oil and gas royalties.

Applicability

Funding for this program has been highly variable. Given the estimated value of deferred federal acquisitions and unpredictable revenue streams, opportunities to use this program for protection in the Basin are currently limited.

5.2.2 Cooperative Endangered Species Conservation Fund "Section 6"

This program provides federal grant funding to acquire, enhance, and protect land in perpetuity to benefit threatened and endangered species in support of state and federally recognized HCPs. Grant funds are available to protect lands in perpetuity for habitat conservation through the Recovery Land Acquisition grant or a HCP Land Acquisition grant. Funds are also available to plan and develop an HCP through the Habitat Conservation Planning Assistance grant.

Applicability

DNR works in partnership with WDFW and U.S. Fish and Wildlife Service to administer and implement the national competitive grants. Individuals or groups are eligible to seek federal funding under this grant by working with DNR or WDFW.

5.2.3 Natural Resource Conservation Service Farm and Ranch Lands Protection Program

The Natural Resource Conservation Service (NRCS) offers a grant program available to local jurisdictions that provides matching funds for easement acquisition to keep agricultural land in production. One factor influencing the amount of funding available to state offices of the NRCS is the presence of other programs that also fund farmland protection. NRCS is more likely to allocate higher dollar amounts to program areas with a strong local commitment to protecting agricultural land.

Applicability

NRCS funding is available and has an annual application cycle. Snohomish County has successfully leveraged this funding with CFT funds to acquire easements on farmland in the Tualco Valley through its PDR program. Limitations of this program include a requirement to extinguish development potential (development rights may not be re-sold) and the restriction of all non-agricultural activity.

5.3 Local Programs and Funding Sources

5.3.1 Conservation Futures

At present, Snohomish and King Counties fund a range of programs with revenue from the CFT. Examples of past expenditures include parks funding, grants to cities, TDR purchases, and grants to private entities for conservation projects. Projects receiving CFT funds are recommended by an advisory board.

Applicability

CFT funding is available in both counties. Snohomish County is currently using a portion of this revenue source to service debt on a bond that expires in 2017. Once this bond is paid off, more money might become available to fund protection projects.

5.3.2 Non-levy Revenue

Snohomish County collects non-levy revenues that could potentially be allocated to fund protection tools. These include investment interest, lease-holding tax, timber revenues, and miscellaneous funds. These funds provide a predictable income stream to the County; however, their value is not very large. In 2009, the combined revenue collected from these sources totaled about $250,000.

Applicability

These funding sources are not currently appropriated for protection purposes. Non-levy revenues could supplement other sources of local funding to provide matches for state and federal grant programs.

5.3.3 Bonds

Bonds may be issued by County Council decision (councilmanic) or by popular vote (general obligation). For the purposes of funding acquisitions or incentive programs (such as PDR or a reverse PDR auction), the local governments might explore public opinion around a general obligation bond. The debt service on this type of bond would not come at the expense of other County programs and public support for a general obligation bond would substantiate the value of conserving important natural areas that advance the objectives of the SBPP.

Applicability

The authority already exists for bonding; however, Snohomish County is repaying an existing bond (with CFT revenues) that will end in 2017. Issuing new debt is risky and in the case of general obligation bonds, it must be approved by a majority of voters. It is difficult to predict what public opinion will be on this subject but the County can attempt to measure it through a survey.

5.3.4 Impact Fees

Counties and cities may collect fees on developments to pay for impacts to traffic, infrastructure, and other public benefits. Local jurisdictions set these fees and may choose to absorb a portion of the costs of infrastructure improvements to encourage growth. A portion of these fees may be set aside to fund implementation of protection tools. In one innovative example, the City of Kirkland explored using TDR as an offset for impact fees to more effectively leverage revenue through the Landscape Conservation and Local Infrastructure Program.

Applicability

Local jurisdictions have the authority to charge impact fees. Raising existing fees or creating new ones to fund protection may be a sensitive decision.

5.3.5 King County Flood District's Cooperative Watershed Management Grants

In 2012, the King County Flood Control District agreed to provide funding to support watershed salmon recovery projects and activities in King County watersheds through a Cooperative Watershed Management Grant Program. Eligible applicants include local governments, tribes, and non-profit organizations. Among the highest funding priorities will be those projects or programs that promote recovery of ESA-listed species. In addition, actions that benefit steelhead trout and other salmonids are important. Awards primarily support restoration activities but also support acquisitions, monitoring projects, and watershed planning.

Applicability

Work done by this funding program must be done in King County. All local jurisdictions in the Snoqualmie Basin are eligible for this funding, as well as tribes and non-profit organizations working in the area. Funding for the program is allocated annually by the King County Flood Control district.

5.3.6 King County Parks Expansion Levy

King County Parks secured voter-approved capital funding through a Parks Expansion Levee in 2014. The funding can be matched to CFT funding to purchase intact habitat or purchase conservation easements on forestlands. King County agencies are eligible to apply for funding but the funds can be used within cities as well. The funding is an important match source to CFT due to CFT's 50% match requirement, which can be difficult to obtain in rural areas of King County.

Applicability

King County runs an annual project selection process beginning in January that is approved by the King County Council in November.

5.3.7 King Conservation District Member Jurisdiction Grant Program

Since 1998, jurisdictions in King County have been eligible to apply for project funding though the King Conservation District Member Jurisdiction Grant Program. The program funds habitat restoration, acquisition, outreach, incentives, and monitoring.

Applicability

This funding source is an important match for larger grants, especially for smaller cities that do not have internal funding for acquisitions. Jurisdictions have a set grant allocation each year but must apply to the King Conservation District and secure approval from the King Conservation District Board.

5.4 Market-Based Programs and Funding Sources

5.4.1 TDR Credit Sales

Both King and Snohomish Counties own TDR credits purchased with public funds. Snohomish County's 49 credits stem from a single acquisition under a pilot project; King County holds an inventory of more than 1,000 credits in a TDR bank. Snohomish County has made efforts in the past to sell its credits but has not found adequate demand. King County has made multiple sales of TDR credits from its bank, including recent sales to projects in Seattle through the Landscape Conservation and Local Infrastructure Program (RCW 39.108). King County reinvests proceeds from credit sales in additional acquisitions.

Applicability

The level of market activity in Seattle suggests that there will be further opportunity for King County to sell banked TDR credits, which could support protection efforts in the Basin, particularly of agricultural land. Opportunities for credit sales in Snohomish County are currently limited, but may change as a TDR market expands.

5.4.2 *Property Taxes*

Enacted in 2011, the Landscape Conservation and Local Infrastructure Program (RCW 39.108) creates incentives for cities to invest in public improvements to support growth while conserving resource lands through TDR. Eligible cities can access a portion of a county's share of property taxes in exchange for accepting development rights in a regional marketplace. Development rights can either be transferred through private transactions or public acquisitions (which can then be re-sold).

Applicability

Currently 35 cities in Snohomish, King, and Pierce Counties are eligible to participate. Seattle is the first city to do so, and will generate $27 million for infrastructure funding while protecting up to 25,000 acres of resource lands through private TDR transactions. Seattle's conservation focus is on agricultural lands that are in close proximity to the city.

5.4.3 *Value Capture Financing*

Tax increment financing to pay for public improvements is allowed in Washington State through the Landscape Conservation and Local Infrastructure Program, which combines this tool with TDR on a regional scale. One opportunity for improving the economic benefit to cities (and, by extension, increasing land protection) is to increase the amount of financing that cities can access. Value capture financing would augment existing revenue by authorizing cities to keep more property tax proceeds.

Applicability

While Landscape Conservation and Local Infrastructure Program is available (adopted in Seattle and considered by 12 other cities), value capture financing is not. Realization of this additional funding tool will require state legislation. Should it become available, it will strengthen the incentives for cities to join a regional TDR marketplace.

5.4.4 Density/In-Lieu Fees

In 2010, the Snohomish County Council adopted updates to the County's Urban Centers Code (30.34A Snohomish County Code). This code update included density bonus provisions under which developers may gain density beyond base zoning for projects in Urban Centers by pursuing one or more actions, including paying a density fee. The fee, set at $21 per square foot of bonus floor area, is paid to the County and may be used to fund public purchases of development rights. This is an unpredictable revenue source, has not generated funding since creation, and revenues depend on developers choosing this option when seeking bonus density.

Applicability

This source is available; however, it is unfunded. Demand has not emerged for growth at intensities where developers would use this tool to gain a bonus. Once used, funds will become available to support protection through purchases of development rights.

5.5 Other Programs and Funding Sources

5.5.1 Tribes

Tribes have a vested interest in the natural resources of the Basin and play an important role in the suite of funding for protection projects. In addition to participating in grant programs identified in this section, tribes invest their own revenues to support restoration and protection initiatives. Examples of collaborative endeavors funded in part by tribes include the Tulalip Tribes' participation in the Qualco anaerobic digester in the Tualco Valley—agricultural infrastructure with a range of hydrologic and economic benefits for the watershed.

Applicability

Funding from tribes is available. Natural resource staff identify and prioritize opportunities for projects that support tribal protection objectives; funding decisions are made by the board of directors.

5.5.2 Donations

While not strictly a funding source, donations of easements or property by private landowners represent a cost savings for entities that would otherwise pay for acquisitions of real estate interests. Some landowners will offer donations for altruistic or tax purposes.

Applicability

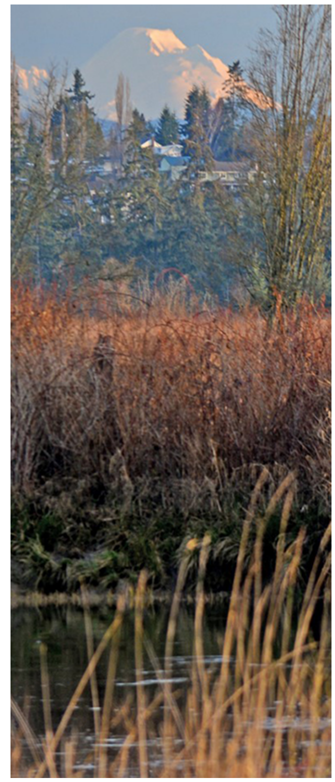
Local jurisdictions and non-governmental conservation organizations often accept donations when opportunities become available. While the cost of acquisition may be free, there are other costs of ownership involving stewardship and monitoring, which need to be covered by other sources such as endowments.

Section 6

PROTECTION APPROACH APPLIED TO SNOHOMISH BASIN SALMON RECOVERY

This section presents a summary example of how the SBPP can guide the development of protection strategies toward a specific program goal—in this case, salmon recovery—and provides updates on information developed since the 2005 Plan. Detailed information on application of the SBPP to salmon recovery is provided in Appendix B. In December 2015, the Snohomish Basin Salmon Recovery Forum (Forum) adopted Appendix B as the first formal adaptive management action for the 2005 Plan. This protection update does not change existing restoration recommendations and habitat goals from the 2005 Plan.

Recommendations for updated salmon recovery protection strategies (packages of specific tools) for specific land uses in the Basin are summarized in Section 6.5 and further detailed in Appendix B.



In 2005, the Shared Strategy Development Committee presented the Recovery Plan to NMFS. NMFS adopted and expanded the Recovery Plan to meet its obligations under ESA. The NMFS Supplement was adopted in January 2007.

Together, the Recovery Plan and NMFS Supplement comprise the Puget Sound Chinook Recovery Plan.

6.1 Protection in the Context of Salmon Recovery

In 1999, Puget Sound Chinook salmon and bull trout were listed as threatened under the federal ESA. The 2005 Plan was adopted by NMFS in January 2007 as a chapter in the regional *Puget Sound Chinook Recovery Plan* (NMFS 2007), referred to as the Recovery Plan in this document. NMFS concluded that the Recovery Plan (including the regional Volume 1 and the watershed-specific chapters in Volume 2) met the requirements of ESA Section 4f, which requires adoption of a species recovery plan for those species listed as “threatened” or “endangered” under ESA. However, NMFS provided additional conditions in the *Final Supplement to the Shared Strategy’s Puget Sound Salmon Recovery Plan* (NMFS 2006), referred to as the NMFS

Photo credit: Roger Tabor, U.S. Fish and Wildlife Service

The 2005 Plan discussed the necessity of integrating harvest, hatchery, and habitat actions for successful recovery of salmonid populations. That concept is referred to as H-integration.

Photo credit: USDA

Supplement in this document. The NMFS Supplement outlines concerns about the 2005 Plan in the following three key areas:

- **Habitat protection** – Volumes 1 and 2 of the Recovery Plan were developed on the assumption that current protection tools were sufficient to "hold the line" and prevent further loss. However, there were few specifics of how this would be deployed. The NMFS Supplement includes water quantity and land use as important elements for a habitat protection strategy.
- **Adaptive management and monitoring** – NMFS requested the development of a monitoring plan connected to an adaptive management process.
- **H-integration** – The region subsequently identified a six-step process to address H-integration for salmon recovery, which was developed by an H-integration work group.

The Forum has been working since 2005 to respond to the gaps identified in the NMFS Supplement. The H-integration Plan was provided to the Forum in 2008 (Kaje et al. 2008), and salmon recovery partners have been working on adaptive management and monitoring, with the development of a draft monitoring plan (2011) and a draft adaptive management framework (2014). There was recognition in 2010 that work was progressing on adaptive management and monitoring and H-integration; however, the Basin had yet to address habitat protection in a comprehensive way.

6.2 Summary of 2005 Plan Strategy and Implementation Progress

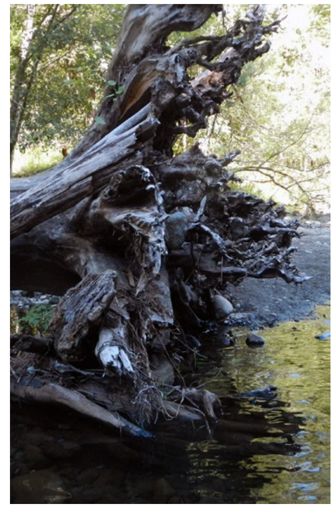
The 2005 Plan proposed a scientifically based suite of actions intended to recover local salmon populations in the Skykomish and Snoqualmie rivers. The 2005 Plan was written as a multi-species plan and identified actions to recover Chinook

salmon, bull trout, and coho salmon as a proxy for all salmonids in the watershed. Actions were focused on habitat, hatchery, and harvest with a strong emphasis on H-integration. All actions related to habitat restoration and protection called for in the 2005 Plan are voluntary; however, jurisdictions provided letters of commitment to implement the 2005 Plan.

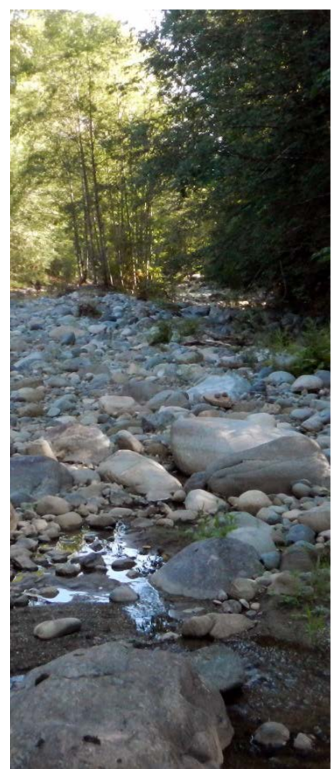
The 2005 Plan presented an ambitious number of capital project types and land-use-based protection strategies that could be implemented to reach scientifically sound habitat gain benchmarks. These actions were predicated on a policy of net gain in the hope was that the watershed partners in the Basin—those who had restoration capacity and land management authority—would adopt this approach. With the partners implementing the 2005 Plan, Basin habitat would be gaining along a trajectory that model outputs said was necessary for recovery.

The majority of the 2005 Plan focused on the habitat restoration strategy. Strong scientific underpinnings for the habitat strategy were developed in the Ecological Analysis for Salmonid Conservation (EASC). Quantitative goals, or "benchmarks," were developed for a variety of habitats types in various locations throughout the Basin. These benchmarks were written to be additive above 2005 condition. The key assumption for habitat protection was net gain in tandem with restoration; any degradation was assumed to be mitigated or replaced with restoration above levels described by the quantitative benchmarks.

Hydrology was considered in the EASC and peak flows were used as a proxy to describe the level of hydrological degradation in the sub-basins. Sub-basins were rated as degraded, moderately degraded, or intact, as a function of 2005 peak flows



The Ecological Analysis for Salmonid Conservation was a compilation and analysis of ecological information about the Basin that provided the scientific foundation for the 2005 Plan.



relative to historical peak flows. Peak flows were modeled as a function of effective impervious area. Though the coarse rating was provided in the EASC, there were no benchmarks developed for either peak flows or impervious areas in any of the sub-basins.

Since 2005, there have been many site-scale successes on restoration projects in the mainstems, estuaries, and tributaries. However, many environmental indicators continue to decline, according to local data and the 2009 and 2013 State of the Sound reports (Puget Sound Partnership 2010). The continued decline calls for greater protection measures watershed-wide, reaching beyond the regulatory framework.

The last 10 years have produced a number of valuable tools and innovative approaches to protection that maximize multiple benefits. In order to provide a full accounting of progress, and protect against future known threats such as climate change, this update presents an array of technical information and protection tools that reflect baseline conditions. Restoration efforts can then build upon this baseline and gain the required lift to both restore conditions for the species that use the Basin and benefit the people who live in it.

6.3 Information Developed Since the 2005 Plan

6.3.1 Protection Progress

There have been varying protective actions taken in the first decade of the 2005 Plan implementation. The following are some examples of protection tools implemented in the Basin:

- The 2005 King County Critical Areas Ordinance and subsequent Critical Areas Ordinance Effectiveness Study show the regulations may be sufficient to protect hydrology (Lucchetti et al. 2014).

- In the 2009 Raging River Headwaters Protection, King County authorized the use of $3.7 million to support a DNR conservation effort to acquire and protect an estimated 4,000 acres of a 7,000-acre purchase in the upper Raging River watershed. This would protect lands from conversion.
- In 2008, the Wild Sky Wilderness was designated, protecting 2.6 million acres of forested headwaters in the North Fork Skykomish Basin.
- The monitoring and regulation update to the Snohomish County CARs provided information on the effectiveness of existing regulations.

However, across the Basin, there has been no effort to uniformly track or report on the amount of land protected, including those areas permanently protected (e.g., designated as federal Wilderness) or temporarily protected (acquired as a conservation easement) across different land use categories. Appendix B includes an effort by the project team to summarize the status of protection efforts. It is possible to report on a handful of efforts, but without system-wide monitoring, there is no way to connect those efforts to current conditions and associated trends in hydrology or salmon habitat. Efforts such as the WDFW High Resolution Change Analysis indicate that there continues to be an overall slow loss of riparian habitat, even when accounting for restoration gains. WDFW found that between 2006 and 2009, 73 acres within 100 meters of fish-bearing streams were lost to permanent development and 163 acres were cleared but not converted to permanent development. This is compared to the 163 acres that were planted as part of restoration efforts.

6.3.2 Climate Change

Climate change was not explicitly addressed in the 2005 Plan, though there was early recognition that effects would likely

include increases in the magnitude of peak flows, prolonged and persistent low flows, reductions in spawning flows, and increased stream temperatures. These conditions would place a greater strain on water resources, threatened salmon populations, and working farms and forests. Information on the predicted effects of climate change has been refined since 2005.

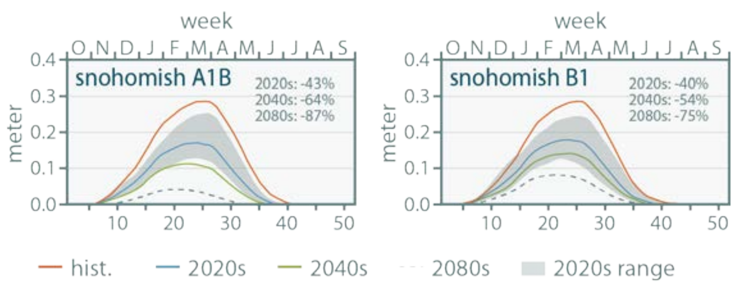


Figure 12: Projected Change in Snohomish Weekly Snow Water Equivalent for the 2020s, 2040s, and 2080s

Adapted from CIG 2009

Several science-based organizations, including the University of Washington Climate Impacts Group and the Pacific Northwest National Laboratories, have released model results (e.g., Figure 12) that provide greater detail on potential changes in water temperature, flow volume, and flow timing.

The 2013 Snow Caps to White Caps report provided information and modeling of water resources in the Basin that are affected by climate change and increased development pressures (PNNL and University of Washington 2013).

The 2005 study of climate change effects on salmon recovery in the Basin by the Climate Impacts Group and the National Oceanic and Atmospheric Administration predicted a 5% to 23% decline in average Chinook salmon abundance even after the 2005 Plan is implemented.

6.3.3 Watershed Characterization

In 2009, Ecology released the Puget Sound Watershed Characterization (PSWC) model. This model combines information for assessments from land uses and landforms to present information on the relative importance and degradation

of four different components of hydrology: storage, delivery, recharge, and discharge. The model is intended for land use planners to guide decisions in areas that are important for restoration and protection. The PSWC tool has been used to take a landscape-scale approach to new hydrology-focused protection strategies with geographic specificity.

6.3.4 Ecosystem Services

In the last decade, there has been an emerging understanding of ecosystem services, and they have come into prominence in considerations of the interaction of people and land. Ecosystem services are benefits that humans derive from the environment. They can include regulating services such as flood control and water quality, provisioning services such as water supply, supporting services such as nutrient cycling, and cultural services such as recreation. The concept of ecosystem services provides the Basin with a new framework and language that allows for a better understanding of how salmon recovery provides multiple benefits.

If treated like an asset with a life span of 100 years, the present value of the Snohomish Basin would be between $13.2 billion and $180.1 billion, using a 2.7% discount rate (Earth Economics 2010).

The 24-acre North Scriber Creek wetland in Lynnwood, Snohomish County, was found by Ecology to have a flood protection value of $8,000 to $12,000/acre/year, and 292 acres of wetland in Renton were found to have a flood protection value of approximately $41,000/acre/year (Leschine et al. 1997).

Traditionally, recovery efforts only considered provisioning services (salmon to support economies) and cultural services (salmon as a spiritual component of tribal culture). Considering ecosystem services helps relate salmon recovery protection efforts to other benefits such as flood control and water quality improvement. By acknowledging the many benefits that are provided by intact watershed processes that support salmon runs, there is opportunity to expand non-traditional partnerships and funding, and improve willingness to protect hydrology and improve implementation.

Given the emerging recognition of the importance of habitat protection in Puget Sound and the Snohomish River Basin, the Forum acknowledged that habitat protection must be more

specific and measurable. In response, the Tulalip Tribes, King County, and Snohomish County developed the USEPA SBPP grant proposal that was funded in 2010. The presentation of a wide range of protection tools within the context of what we know about the hydrology of the Basin is the first step in revamping salmon recovery protection strategies.

Terms used in evaluating salmon populations:

Abundance refers to the number of fish at various life stages or at a specific time, generally measured as population size. A population should be large enough to survive normal environmental variation or human-caused impacts.

Productivity is the growth rate, or a population's potential for increasing or maintaining its abundance over time. A population that consistently fails to reproduce itself is at risk of extinction.

Diversity refers to the differences in genetic and behavioral traits, including life histories, sizes, and other characteristics. Diversity helps protect populations from short-term environmental change and provides a basis for survival during long-term environmental change.

Spatial structure is a means of measuring how the abundance at any life stage is geographically distributed among habitats or potential habitats.

6.4 Connections between Hydrology and Salmon Habitat

The Snohomish Basin is the second largest drainage in the Puget Sound region, and one of the primary producers of anadromous salmon. The Basin contains nine salmonid species including two spawning populations of ESA-listed Chinook salmon and populations of steelhead trout and bull trout. The primary goal of the SBPP is to develop protection strategies that prevent the degradation of hydrologic processes that support salmon or salmon habitat, regardless of the existing state of salmon populations or habitat. Since hydrologic processes were identified as proxies for salmon habitat condition and function for the SBPP, a baseline evaluation of hydrology across the Basin was necessary for strategy development and orientation.

The physical-biological connections between hydrology and salmon life history were fundamental considerations in the development of the SBPP. Through the protection of hydrology, this SBPP aims to protect salmonid habitat quality, quantity, and heterogeneity, helping to promote the overall resilience of salmon populations. The underlying assumption in this approach is that the protection of hydrologic function and processes would inherently influence salmon ecology, biology, and behavior. Protecting these mechanistic and inferential linkages is predicted to result in support for salmon population performance, productivity, and abundance. This approach is similar to the habitat hypotheses emphasized in the 2005 Plan

and employed across regional salmon conservation and restoration efforts.

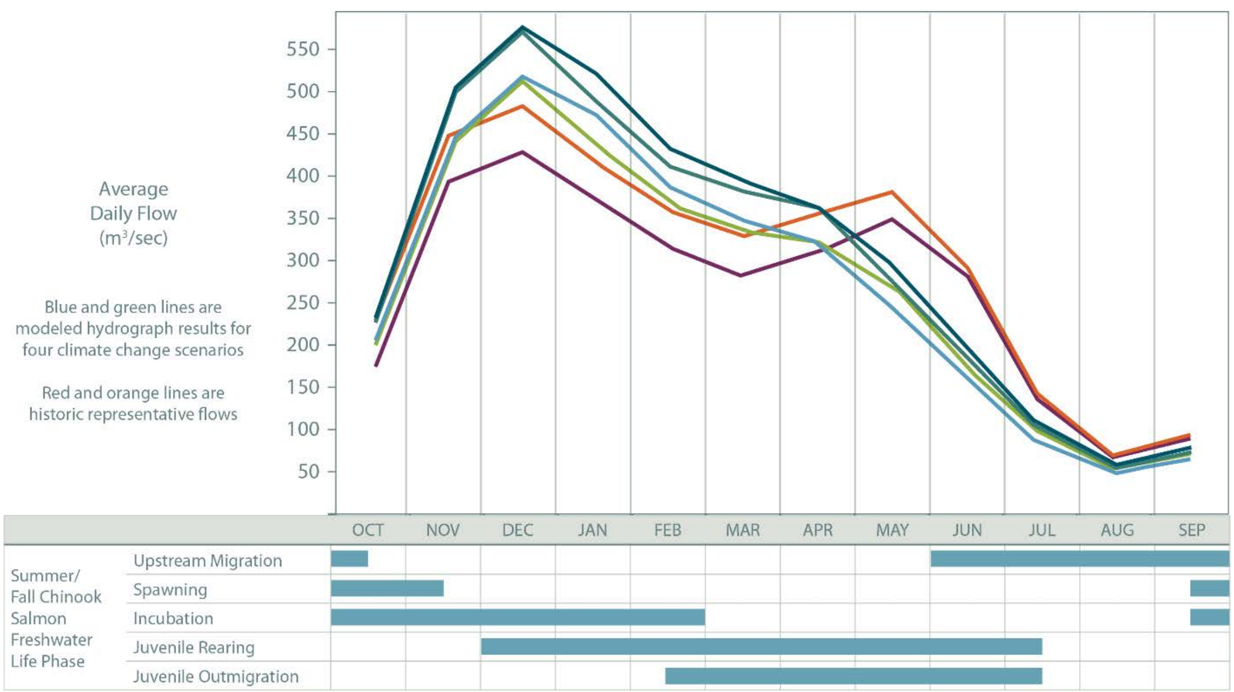
The clear connections between hydrology and salmon life history (see "Scientific Basis of the Connections between Hydrology and Salmon Habitat" on the next page) lend support to the theory that alteration of hydrology and its constituent attributes would subsequently affect salmon survival, growth, and population performance. Ecosystem and hydrologic processes can be disrupted or degraded by human activities including, but not limited to, dams/diversion structures, urbanization, draining and filling of wetlands and floodplains, removal of riparian vegetation, levees and channelization, excessive loading of sediments, forest clearing, and groundwater pumping (Poff et al. 1997; Stanley et al. 2012). Additionally, the influence of climate change would likely have a significant impact on the hydrologic regime as well as related salmon life-history dynamics. These climate change impacts would likely result in alterations in flow, temperature, and habitat quality/quantity across salmon life cycles.

Scientific Basis of the Connections between Hydrology and Salmon Habitat

Aquatic ecosystems are influenced by broad physical, chemical, and biological processes including fluxes of water, nutrients, sediment, organic material, and biota. These processes and attributes interact to form structural features that influence habitat occurrence and function (MacIsaac 2010). Specifically, hydrology acts as a major determinant of physical habitat formation processes by building and sustaining landform features and influencing habitat-specific characteristics.

The attributes of hydrologic regimes—including magnitude, frequency, duration, timing, and rate of change—govern the quality and quantity of water and influence energy sources, physical-biotic relationships, and biotic interactions (Poff and Ward 1989; Richter et al. 1996; Walker et al. 1995; Poff et al. 1997). Through these linkages, variation and patterns in hydrology end up characterizing the relative abundance, composition, and diversity of fish assemblages (Meffe and Sheldon 1988; Pusey et al. 1993, 1998, 2000; Bunn and Arthington 2002). Hydrologic flow regimes have a profound role in the life history of fishes, since critical life events such as phenology of reproduction, spawning behavior, larval survival, growth patterns, and recruitment are dependent on specific flow conditions (Welcomme 1995; Junk et al. 1989; Copp 1989, 1990; Sparks 1995; Humphries et al. 1999).

These ecological and physio-biological connections support the theory that variation and trends in salmonid life history (e.g., body length, upstream migration timing, spawning age and timing, and outmigration age and timing) are likely adaptive responses to specific ranges and seasonal patterns of water and flow conditions (Smith 1969; Beacham and Murray 1987; Quinn et al. 2001; MacIsaac 2010).



Since anthropogenic modifications and climate change impacts will influence flow regimes, and subsequent diversity and functional organization of fish communities, it is essential to understand how flow regimes have been altered and are changing, what the apparent stresses and pressures are, and how different aspects of hydrology are characterized across the landscape. Similarly, since natural seasonal variations in streamflow are primarily driven by local climate and precipitation, and moderated by the hydrologic and geomorphic characteristics of the watershed (MacIsaac 2010), it is important to understand the spatial arrangement of hydrologic function and the condition of related attributes across the landscape. Evaluation of these hydrologic attributes, landscape pressures, and the related salmon habitats provides the context needed to evaluate potential hydrologic protection strategies relevant to salmon habitats.

6.5 Salmon Recovery Protection Strategy Recommendations

Using the technical information from Sections 4 and 5, and the technical assessment results in Appendix A, this section includes summary recommendations for a package of tools for each land use type in the Basin. These recommendations are intended to flesh out the protection strategies from the 2005 Plan. The presentation of protection strategy recommendations by land use type is consistent with the 2005 Plan; they are organized in Sections 6.5.1 through 6.5.5 by basin-wide, urban, rural residential, agricultural, and forestry strategy recommendations.

Solid policy, regulatory, and programmatic actions are necessary to protect hydrology and help achieve the 50-year salmon recovery goals. The recommendations in this section are intended to be guidance for local governments to identify alternatives necessary to protect hydrology. As such, they do

not imply a commitment, mandate, or intent on the part of any local governments to adopt these ideas. Local governments have the final decision-making authority to choose and implement policies that work for their jurisdictions within the context of their broader responsibilities. The caveats associated with the original letters of commitment to the 2005 Plan from jurisdictions still stand.

There are many existing programs and regulations intended to protect salmon habitat and watershed processes, including intact hydrologic processes. State and federal regulations are implemented differently by local jurisdictions throughout the Basin. The strategies below are intended to suggest policy and planning within those frameworks to encourage the alignment of existing regulations with the protection of hydrology. The strategies below are also intended to recognize, support, and suggest improvement to existing outreach, technical assistance, and incentive programs that are already in place.

It is important to note that although the recommendations are presented by land use category, there are many strategies that affect more than one land use type. For example, water typing is important for the proper application of regulations in a working forest environment but is also critical in rural residential areas where critical areas ordinances are based on the type of stream and the presence of fish. Likewise, the recommendations stress beaver management in rural residential areas, but landowners in agricultural areas also regularly deal with the effects of beaver dams. Additionally, rural residential landowners with small areas of crops or limited livestock would benefit from much of the technical assistance that is currently recommended for farmers. As entities look to implement recommendations, focus should remain on where there is need for the protection of hydrology. Detailed information—such as

suggested implementers, more detailed context, effectiveness indicators, and theories of change for each strategy—can be found in Appendix B.

6.5.1 Basin-Wide Strategy Recommendations

The Basin-wide potential losses listed in the 2005 Plan were forest cover, riparian habitat, pervious surfaces, and watershed processes. These potential losses directly affect the delivery, discharge, recharge, and surface storage of water moving in, through, and out of the Basin. Across the various land use types, protection tools can be applied that improve the application and effectiveness of regulations, improve the conservation ethic, support forestry and agriculture to limit new infrastructure, and permanently protect the most valuable hydrologic areas and reaches. The following recommendations span jurisdictions and land use categories:

- **Develop information on hydrologic importance in local jurisdictions**
  - Action 1: Support the development of watershed characterization information by Ecology and continue to update local data and information for every local jurisdiction in the Basin.
  - Action 2: Align regulations to limit the variances and exceptions available in hydrologically sensitive areas that result in loss of function.
  - Action 3: Direct incentive programs, open space acquisitions, and other resource conservation efforts to areas with important hydrological features using watershed characterization analysis.
- **Transfer and purchase of development rights (TDR/PDR)**
  - Action 1: Encourage and expand TDR policies in additional jurisdictions.
  - Action 2: Encourage and expand PDR usage.

- Action 3: Encourage the use of TDR and PDR with a focus on aligning the two efforts.

- **Protect instream flows**

- Action 1: Improve guidelines for what constitutes an "adequate water supply" for new development.
- Action 2: Improve residential water conservation measures.

- **Acquire lands with high hydrologic value**

- Action: Acquire conservation easements or properties with high hydrological importance through outright purchase.

6.5.2 Urban Strategy Recommendations

In the Snohomish Basin, there are 15 cities with Urban Growth Areas. Under the GMA, these areas are intended to assume the majority of the future development. Most of these cities are either in or adjacent to mainstem river floodplains. Due to levels of impervious surfaces, stormwater infrastructure and decreased forest cover, most urban areas have a higher level of hydrological degradation. However, urban areas are still able to contribute to the protection of hydrology through the suggested approaches below. Managing water resources in a changing climate with shifting hydrologic regimes requires that approaches be adopted to build systems that may be regarded as redundancies in stormwater management systems today, but which would promote hydrologic resiliency in the watershed over time.

Jurisdictions within the Snohomish Basin under NPDES permit are either Phase I or II permittees and therefore have different requirements. For example, King and Snohomish Counties are Phase I permittees, and the cities of Everett, Marysville, Mukilteo, Snohomish, Snoqualmie, Lake Stevens, Monroe, and Duvall are Phase II permittees. Some smaller towns are not regulated under the NPDES permit. For smaller cities and

towns, or those with limited staff and capacity, access to technical assistance is particularly significant to the success of implementing LID, and in some cases, the requirements of the NPDES permit. Stormwater management practices are evolving to address the requirements of the permit. In addition, LID and alternatives to traditional "pipe and convey" approaches would become necessary in order to match the present and projected challenges of managing water resources, including mitigating for extreme events such as drought or flood. Urban strategy recommendations are as follows:

- **Augment practices to meet NPDES requirements with LID green infrastructure**
  - Action 1: Identify public and private property with legacy stormwater issues that could be improved with LID and other green infrastructure stormwater management techniques.
  - Action 2: Promote LID and other green infrastructure in development and redevelopment projects appropriate to the lot size in question.
- **Improve tree ordinances and other relevant codes that require planting in urban areas**
  - Action: Encourage jurisdictions to strengthen tree retention and landscaping ordinances and codes.

6.5.3 Rural Residential Strategy Recommendations

The rural residential areas in the Basin are located outside of the Urban Growth Areas, Agricultural Production Districts, areas zoned for forestry, and areas zoned for commercial and industrial use. Land use within rural residential areas varies from multiple housing densities, to small hobby farms, to small forestry production. Much of the rural residential area is located in the Basin lowlands, proximate to tributaries and mainstem rivers.

As rural residential development occurs, forest cover typically decreases and impervious surfaces increase. These changes occur as houses are built and infrastructure to support residents, such as roads and utilities, is expanded. The 2005 Plan stated that the amount of forest cover in rural residential areas was expected to fall below levels needed to recover salmon. The primary goal in the rural residential areas to support intact hydrology is to maintain forest cover, pervious areas, and water detention. This would, in turn, capture and slow water, thereby maintaining functioning delivery and storage.

Currently, rural residential area development is regulated through Snohomish and King Counties' land use regulations as well as the DNR Forest Practices Rules. These regulations control development of shorelines and development within riparian buffers and wetlands. The regulations also control the amount of land that can be cleared of trees and the percentage of impervious surfaces.

Though the current regulations are protective, other regulatory and non-regulatory protection tools can be layered upon them to maximize the potential for intact hydrology on each landowner's property. The following recommendations are a mix of incentives and direct technical assistance, both of which

seek to target areas with the most important hydrology and provide residents with additional resources to best protect landscape features, which support intact hydrologic function:

- **Improve outreach and technical assistance to rural residential landowners**

– Action 1: Align free native tree resources with existing programs that serve rural residential property owners.
– Action 2: Continue and expand technical support and education for landowners to maintain beavers on their property.

- **Explore PBRS in Snohomish County and target outreach of PBRS in King County**

– Action 1: Snohomish County institutes a PBRS program.
– Action 2: King County targets specific areas for PBRS that are identified as important for hydrology.

6.5.4 Agriculture Strategy Recommendations

Farming is a critical cultural and economic land use in the Snohomish Basin that defines many of the rural lowlands and provides food and products for local and regional markets. Most agricultural areas are located in mainstem floodplains, adjacent to many of the focus reaches targeted for capital habitat restoration projects, and also in rural areas.

In the 2005 Plan, one of the primary recommendations was to work cooperatively with the farming community and individual landowners to identify and implement solutions for salmon recovery. While many agricultural landowners have supported restoration projects on their lands, the tension has increased since 2005, with increasing resistance by the broader agricultural community to the restoration of historically or currently farmed land into aquatic or riparian habitat. In an effort to address these tensions and to forge a collaborative path

forward, there are two efforts underway—one in each county, detailed in the paragraphs below—to balance the needs of fish and farmers and to recognize the pressures that affect each.

In Snohomish County, stakeholders representing the agricultural community, the tribes, and environmental interests formed the Sustainable Lands Strategy with facilitation support from Snohomish County Surface Water Management staff. The goals of the Sustainable Lands Strategy include creating actions on-the-ground that result in "net gain" for both salmon recovery and agriculture viability. Additionally, the Sustainable Lands Strategy seeks to reduce process friction, streamline permitting, develop multi-benefit funding solutions, and create broad-based support for recovery actions.

In King County, county staff from the Water and Land Resources Division convened the Snoqualmie Fish, Farm, Flood Project Advisory Committee that includes farmers, tribes, non-governmental organizations, and other partners. The project is using a collaborative process to develop multi-objective strategies for salmon recovery, agriculture viability, and flood risk reduction. The committee will produce specific recommendations, including capital projects, programmatic actions, or changes to policies and regulations, for consideration by the King County Executive and Council.

The following protection recommendations identify additional actions that will benefit hydrology as well as ongoing agricultural practices:

- **Permanently preserve farmland**
  - Action: Permanently extinguish development rights in agricultural areas through TDR and PDR.

- **Provide technical assistance to farmers**

– Action 1: Support development of farm plans and cost-share programs.
– Action 2: Educate and assist farmers in qualifying for easement and tax reduction programs.

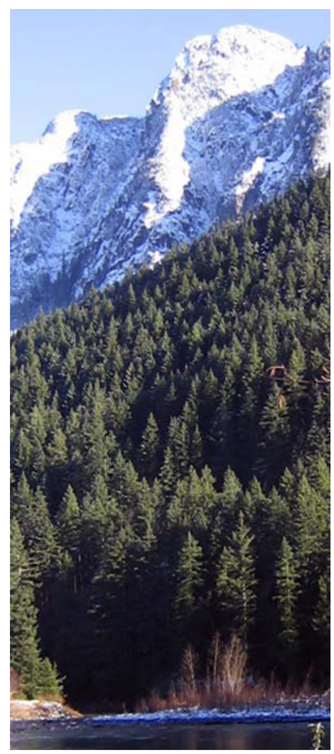
- **Support technical innovations that have conservation and economic benefits in agricultural areas**

– Action: Seek funding and support pilot innovation projects.

- **Develop water banks or similar mechanisms to promote conservation and best use of irrigation rights**

– Action: Develop water banks and facilitate conservation discussion within.

6.5.5 Forestry Strategy Recommendations



In 2005, approximately 75% of the Snohomish Basin land base was forestry, with more than half of the acreage in federal ownership. Other players include private small forest landowners, private industrial timber companies, tribes, DNR, counties, and cities. Commercial forestry is an important economic engine in both Snohomish and King Counties. Many of the communities in the upper watershed have a strong cultural connection to logging history and current operations.

Forests play a crucial role in hydrology. Areas high in the Basin have large areas of aquifer recharge zones, wetlands, and are virtually free of impervious surfaces. Tree cover helps support interception and slow water flowing into stream networks. The current regulations have protection for aquifer recharge areas, wetlands, unstable slopes, riparian buffers, and contiguous cover. However, protection provided by these regulations is only as effective as the information that is used to implement them.

In the last 15 years since the 2005 Plan was written, there have been notable changes in Basin forestry. In 2004, King County acquired development rights for more than 90,000 acres in commercial forest in the Basin. The Roads Maintenance and Abandonment Project, led by DNR, tasked forested landowners to map and treat all forest roads subject to Forest Practice Rules by 2016. Many agencies and organizations, including the Counties, DNR, WSU, and others, have worked to assist small forest landowners (SFLOs) with timber stewardship in order to implement BMPs and keep land from being converted.

In King County, the County Council and Executive formed the Rural Forestry Commission. This 13-member commission is tasked with advising King County government on policies and programs that affect rural forestry, ranging from industrial owners to SFLOs. The Commission helps those working in King County to coordinate efforts and address issues facing forestry with broad forestry representation. In Snohomish County, the Executive's Economic Development Office is working to develop a Focus on Forestry forum. This group would support ongoing needs assessment for forestland owners, and explore solutions to help keep forestry economically viable.

Even with ongoing work, forestry is declining in the Basin. Between 2005 and 2012, formal forest practices permit applications showed 2,152 acres were converted from forest lands to other purposes incompatible with continued forestry. With trends in development, there will be additional pressures on forested areas. It is important to note that the conversion documented during the previous period was during a recession, when development slowed considerably. Between 1988 and 2004, more than 100,000 acres of forestland in King and Snohomish Counties were converted to either developed land or agriculture (Earth Economics 2010). A 2009 study by the

University of Washington's School of Forest Resources found that more than 150,000 acres of private forestland in the Snohomish Basin were at high risk of conversion (University of Washington School of Forest Resources 2009).

The following recommendations support the development of better information in forested areas and propose increased support to SFLOs who are often most vulnerable to the rising risk of conversion as the economy improves:

- **Permanently conserve working forestland**

– Action: Permanently extinguish development rights in forested areas through the TDR, PDR, or acquisition programs such as the USFS Community Forest Programs.

- **Increase coordinated outreach, incentives, and technical assistance to SFLOs**

– Action 1: Coordinate and target outreach to SFLOs.
– Action 2: Support development of expanded education, technical training, forest stewardship plans, and cost-share programs.
– Action 3: Educate and assist SFLOs in qualifying for easement and tax reduction programs.

- **Collect high-resolution LiDAR throughout the entire Basin and coordinate data collection and sharing efforts**

– Action: Develop high quality LiDAR for the entire Basin and coordinate data collection efforts and data sharing.

- **Expand water typing efforts and resources**

– Action 1: Expand ground truthing of current water types in areas not regulated by DNR.
– Action 2: Connect small jurisdictions with robust water typing resources.
– Action 3: Increase organizational capacity for water typing in the Basin.

Section 7

CONCLUSIONS AND PATH FORWARD

It has been 10 years since the 2005 Plan was adopted by the Forum, with broad support of jurisdictions operating in the Basin. Much has been accomplished in the realm of habitat restoration, yet landscape-scale indicators—such as total forest cover and water temperature—continue to show degradation.

The intent of the SBPP process is to provide an update to the 2005 Plan and to serve as planning guidance to achieve greater protection of hydrology and, in turn, salmon habitat. The SBPP and these 2005 Plan updates were developed with the recognition of the need to create watershed and ecosystem resilience in the face of a growing population and changing climatic conditions. Just as restoration relies on partnerships and collaboration, protection of hydrology and habitat cannot be undertaken in isolation or by one entity, group, or agency. As stated by the original chairs of the Forum, "we know that to recover salmon in Puget Sound, we must succeed in the Snohomish Basin."

Through the SBPP and 2005 Plan update, protection strategies and approaches are offered that can be used to promote the protection or enhancement of hydrology and ecosystem function. The recommendations are consistent with the overall protection approach offered in the 2005 Plan. These recommendations add specific actions and suggested geographic focus in an attempt to make protection more immediately actionable. Many of the protection recommendations and specific actions identified in this document are already utilized in the Basin but could be improved. By tracking protection actions and projects as they are implemented, an assessment can

be made of protection gains or losses so that land use decisions can be better informed. It is the hope of all involved with the creation of the SBPP that the approach and highlighted protection tools will serve as a model for other watersheds and future planning processes.

The urgency of increased protection cannot be overstated. Early action projects funded as part of the SBPP effort show that water typing maps continue to have errors, resulting in less protective regulations being applied. A second project shows that many areas with high conservation values in the Basin have no existing protection, beyond applicable land use regulations, and are likely vulnerable to increasing populations and associated development. These two on-the-ground findings underline the need for action now.

There are several considerations and associated actions that will be needed to ensure the implementation of the SBPP. First is the recognition that the guidance is not considered a mandate and that jurisdictions must consider their broader responsibilities and work plans when considering the recommended approaches. Jurisdictions and recovery partners may adjust the recommendations to best accommodate and complement their existing work. Additionally, all commitments, along with stated caveats, that were made in 2005 continue to hold true in the face of protection updates.

As the Forum and partners move forward with the protection guidance, there are several necessary steps and supporting processes to consider. In the near-term, there are two planning tools to be used to advance strategies. The first, used by the Lead Entity program, is the 4-year work plan. This process lays out the implementation approach, complete with an identified sponsor, goals, and associated costs of large capital restoration

projects. The recommended actions in Section 6 of this Plan were developed at a level of detail appropriate for inclusion in the 4-year work plan. This will allow Lead Entity staff and other partners to track the protection actions, implementing groups, and needed funding in a manner consistent with restoration.

The second process to be considered for implementation is the near-term action list that is developed every two years by the Snohomish-Stillaguamish Local Integrating Organization. These actions are eligible for funding through the National Estuary Program and are expected to be advanced in a 2-year timeframe. The protection update recommendations are particularly well suited to be considered as near-term actions, as they address habitat and stormwater; two of the region's three primary strategic initiatives.

The 4-year work plan and the local integrating organization process provide immediate vehicles for the implementation of protection recommendations. However, a longer-term strategic approach will be necessary to address funding. The effort to create the best protection recommendations once again highlighted the need for a comprehensive funding approach that considers both restoration and protection. Issues such as the matching of non-traditional sources, increased nimbleness of funding sources and grant cycles, and incorporating new information/criteria such as watershed characterization should inform updated thinking on a funding approach.

The protection recommendations suggest a variety of metrics that can be used to evaluate the effectiveness of actions over time. The update does not suggest objectives for these actions related to participation in programs, protection of a certain amount of acreage, or goals for the overall condition of

hydrologic status and trends over time. These objectives and ecosystem goals are related to both protection and restoration and must be revisited with a larger effort that assesses progress toward recovery. Currently, the Snohomish Basin (and all Puget Sound watersheds) are engaged in the Chinook Monitoring and Adaptive Management Project. This effort will result in a framework that monitors actions and environmental outcomes over time. The framework will also identify triggers for revisiting 2005 hypotheses, assumptions, objectives, and goals. Through the Monitoring and Adaptive Management Framework, protection strategies can be specified and associated objectives and hydrologic goals can be set.

The SBPP assumes that planning efforts in the Basin will be better informed and tools and strategies will be adopted by jurisdictions to improve the outcomes for hydrologic and ecosystem function. Improved coordination among stakeholders is key; inter-agency and intra-agency collaboration within the Basin is a good starting point. Funding future planning efforts that promote the integration of watershed management and urban planning would promote the understanding of the land-water connection. In addition, it is important to note that stakeholder engagement and political will are imperative to success. In turn, habitat restoration and salmon recovery efforts will be bolstered by protective actions that stakeholders undertake today and in the future.

Section 8

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GLOSSARY OF TERMS

abundance	The number of fish at various life stages or at a specific time, generally measured as population size; a population should be large enough to survive normal environmental variation or human-caused impacts
adaptive management	A decision-making tool to help measure progress and success, and allow strategies to be adjusted accordingly; new data, information about a project's successes and failures, and flexibility are incorporated into a long-term management program
anadromous	Species that hatch in freshwater, mature in saltwater, and return to freshwater to reproduce
best management practices	Structural and procedural measures applied to control the adverse impacts of development and redevelopment
delivery	How water sources—rain, snow, or groundwater—reach the watershed
discharge	The process by which groundwater moves to the land, surface water, or atmosphere
diversity	The differences in genetic and behavioral traits, including life histories (e.g., run timings), sizes, and other characteristics; diversity helps protect populations from short-term environmental change, and provides a basis for survival during long-term environmental change
Ecological Analysis for Salmonid Conservation	A compilation and analysis of ecological information about the Basin that provided the scientific foundation for the 2005 Plan

ecosystem services	Benefits that humans derive from the environment, which can include regulating services such as flood control and water quality; provisioning services such as water supply; supporting services such as nutrient cycling; and cultural services such as recreation
estuary	The region where fresh water from the Basin mixes with the salt water of Puget Sound; the estuary is a highly productive and diverse environment and provides unique and critical habitat for salmon for rearing, migration, and transitioning between fresh and saltwater
floodplain	The area of land adjacent to a waterbody that can be flooded by the lateral overflow during higher flow periods
Forum	(see Snohomish Basin Salmon Recovery Forum)
H-integration	Successful recovery of salmonid populations depends on integrating harvest, hatchery, and habitat actions
headwaters	The source or upper part of a river
hydrometry	Monitoring of the components of the hydrological cycle including rainfall, groundwater characteristics, and water quality and flow characteristics of surface waters
impervious surfaces	Areas covered by materials that water cannot penetrate such as pavement, parking lots, and rooftops; soils compacted by urban development are also highly impervious
large woody debris	Fallen or placed trees, logs, branches, rootwads, and stumps along the edges of waterbodies that stabilize shorelines and provide habitat for salmon and other animals
mainstem	The main channel of a river
nearshore	The area extending from the shoreline into the water

productivity	The growth rate, or a population's potential for increasing or maintaining its abundance over time; a population that consistently fails to reproduce itself is at risk of extinction
recharge	Process by which water moves from surface water to groundwater
riparian	Vegetated area bordering a waterbody
shoreline armoring	The artificial application of materials to protect streambanks from erosion
Snohomish Basin Salmon Recovery Forum (Forum)	The group charged with developing a local salmon recovery response in coordination with regional efforts and promoting implementation of the 2005 Plan; a 41-member committee that includes high-level decision-making representatives from federal, state, and local governments, the Tulalip Tribes, seven special purpose districts, and 11 special interest groups including four farmers and three citizens
spatial structure	How the abundance at any life stage is geographically distributed among habitats or potential habitats
storage	Water retained in surface areas—such as lakes, reservoirs, and wetlands—and in groundwater
Urban Growth Area	The area of a county, as designated in a County Comprehensive Plan, where most future urban growth and development is designated to occur
Water Resource Inventory Area (WRIA)	A geographic area, defined by hydrologic boundaries on the Basin and sub-basin scale, designated by the state as a way to describe administrative units for resource management; the state comprises 63 WRIAs, each of which typically includes a major river drainage, smaller tributaries, and adjacent nearshore areas

watershed	The geographic area that drains into a particular river system or other body of water
watershed processes	Refers to the natural physical, chemical, and biological interactions that form the ecosystem of a watershed
wetland	Areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, vegetation typically adapted for life in saturated soil conditions (40 CFR 230.3)

APPENDIX A
TECHNICAL APPROACH FOR THE SNOHOMISH BASIN PROTECTION PLAN

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LIST OF ACRONYMS AND ABBREVIATIONS

2005 Plan	*Snohomish River Basin Salmon Conservation Plan*
AU	Assessment Unit
BMP	best management practice
Chinook M&AM	Chinook Monitoring and Adaptive Management framework
CUT	Current Use Taxation
DNR	Washington State Department of Natural Resources
Ecology	Washington State Department of Ecology
EDT	Ecosystem Diagnosis Treatment
ESA	Endangered Species Act
FPP	Farmland Preservation Program
LID	Low Impact Development
PBRS	Public Benefit Rating System
PDR	Purchase of Development Rights
PNNL	Pacific Northwest National Laboratory
Recovery Plan	*Puget Sound Salmon Recovery Plan*
RITT	Regional Implementation Technical Team
SBPP	*Snohomish Basin Protection Plan*
TDR	Transfer of Development Rights
UGA	Urban Growth Area
USFS	U.S. Forest Service
WDFW	Washington Department of Fish and Wildlife
WRIA	Water Resource Inventory Area

INTRODUCTION

The Snohomish Basin is the second largest drainage in the Puget Sound and one of the primary producers of anadromous salmon. The Basin contains nine salmon species, including Endangered Species Act (ESA)-listed Chinook salmon, steelhead trout, and bull trout char populations. Among Puget Sound watersheds, it is the largest producer of coho salmon and the second largest producer of Chinook salmon supporting two spawning populations, the Skykomish and the Snoqualmie. In response to declining populations and ongoing habitat loss, the *Snohomish River Basin Salmon Conservation Plan* (2005 Plan) was developed by watershed partners and adopted by the National Marine Fisheries Service as a chapter in the regional *Puget Sound Salmon Recovery Plan* (Recovery Plan) in January 2007. While habitat protection was ubiquitous among recovery strategies across sub-basin strategy groups in the 2005 Plan, there was minimal structure and guidance toward accomplishing the habitat and hydrologic protection needs. Subsequently, through a joint effort between Snohomish County, King County, and the Tulalip Tribes, the *Snohomish Basin Protection Plan* (SBPP) was developed to address these habitat protection strategy needs. The primary goal of the SBPP is to develop protection strategies that "prevent the degradation of hydrologic processes, which support salmon or salmon habitat, regardless of their existing levels of degradation." Since hydrologic processes were used as proxies for salmon habitat condition and function, an initial evaluation of hydrology across the Basin was necessary for strategy development and orientation. This document discusses the hydrologic focus emphasized in the SBPP as well as the technical approach used to evaluate ecological and landscape conditions in the Basin.

Hydrology Tied to Biology: Connecting Hydrology to Salmon Life Cycles

The physical-biological connections between hydrology and salmon life history were fundamental in building the SBPP. Through the protection of hydrology, the SBPP aimed to protect salmonid habitat quality, quantity, and heterogeneity, helping to promote the overall resilience of salmon populations. The underlying assumption in this approach is that the protection of hydrologic function and processes will inherently influence salmon ecology, biology, and behavior. Protecting these mechanistic and inferential linkages would subsequently translate to changes in salmon population performance, productivity, and abundance. This approach is similar to the habitat hypotheses emphasized in the 2005 Plan

and employed across regional salmon conservation and restoration efforts. Inference can be made from these physical-biological interactions due to the mechanistic linkages in aquatic ecosystems between biological processes and hydrologic attributes.

Aquatic ecosystems are influenced by broad physical, chemical, and biological processes including fluxes of water, nutrients, sediment, organic material, and biota. These processes and attributes interact to form structural features which influence habitat occurrence and function (MacIsaac 2010). Flow regime characteristics can provide hydraulic diversity which are dynamic across spatio-temporal extents and result in diverse and complex habitat structures. Specifically, hydrology acts as a major determinant of physical habitat formation processes by building and sustaining landform features and influencing habitat-specific characteristics. The attributes of hydrologic regimes, including magnitude, frequency, duration, timing, and rate of change, govern the quality and quantity of water and influence energy sources, physical-biotic relationships, and biotic interactions (Poff and Ward 1989; Richter et al. 1996; Walker et al. 1995; Poff et al. 1997). Through these linkages, variation and patterns in hydrology end up characterizing the relative abundance, composition, and diversity of fish assemblages (Meffe and Sheldon 1988; Pusey et al. 1993, 1998, 2000; Bunn and Arthington 2002).

Hydrologic flow regimes have a profound role in the life history of fishes since critical life events such as phenology of reproduction, spawning behavior, larval survival, growth patterns, and recruitment are dependent on specific flow conditions (Welcomme 1985; Junk et al. 1989; Copp 1989, 1990; Sparks 1995; Humphries et al. 1999). The natural timing of high or low stream flows provide environmental cues for initiating life cycle transitions in fish including: spawning and recruitment (Milton and Arthington 1983; Montgomery et al. 1983; Nesler et al. 1988; Humphries and Lake 2000; Hodgson et al. 2006); egg survival and hatching (Lisle 1989; Lisle and Lewis 1992; Næsje et al. 1995); rearing (Seegrist and Gard 1978; Harvey 1987; Pearsons et al. 1992); movement onto the floodplain for feeding or reproduction (Junk et al. 1989; Sparks 1995; Welcomme 1992); adult migration upstream to riverine habitats (Everest et al. 1985; Hodgson et al. 2006); and juvenile out-migration downstream to estuarine, nearshore, and offshore marine habitats (TrCpanier et al. 1996; McClure et al. 2008). Additionally, hydrologic flows serve as the primary control in the distribution of rearing fish, life history diversity, and subsequent growth and survival (Bain et al. 1988; Poff et al. 1997; Bunn and Arthington 2002). These ecological and

physio-biological connections support that variation and trends in salmonid life history (e.g., body length, upstream migration timing, spawning age and timing, and outmigration age and timing) are likely adaptive responses to specific ranges and seasonal patterns of water and flow conditions (Smith 1969; Beacham and Murray 1987; Quinn et al. 2001; MacIsaac 2010).

The clear connections between hydrology and salmon life history provide support that an alteration in hydrology and its constituent attributes will subsequently affect salmon survival, growth, and population performance. Since aquatic species have evolved life history strategies primarily in direct response to natural flow regimes, alterations and degradation of hydrology result in a number of impacts, including reduced survival, performance, and biodiversity and loss of native populations (Poff et al. 1997; Paul and Meyer 2001; Bunn and Arthington 2002). For example, extreme hydrological events (e.g., floods and low flows) can have both episodic and/or catastrophic impacts on the survival of adults and juveniles due to egg mortality, displacement, and potential density-dependent population controls on spawning and rearing (Waples et al. 2008).

Ecosystem and hydrologic processes can be disrupted or degraded by human activities including, but not limited to, dams/diversion structures, urbanization, draining and filling of wetlands and floodplains, removal of riparian vegetation, levees and channelization, excessive loading of sediments, forest clearing, and groundwater pumping (Poff et al. 1997; Stanley et al. 2012). Specifically related to urbanization, increased basin imperviousness is well correlated with hydrologic changes (Dunne and Leopold 1978; Brown 1988; Booth and Jackson 1997), degraded water quality (Klein 1979), declines in physical habitat conditions (May et al. 1997; Shaver et al. 1995; Schueler and Galli 1992), and declines in the abundance and diversity of stream biota (May et al. 1997; Shaver et al. 1995; Klein 1979; Steedman 1988; and Schueler and Galli 1992). Because modifications to flow regimes affect fish diversity and the functional organization of fish communities, it is essential to understand how flow regimes have been altered, what the apparent stresses and pressures are, and how different aspects of hydrology are characterized across the landscape. Similarly, because natural seasonal variations in streamflow are primarily driven by local climate and precipitation, and moderated by the hydrologic and geomorphic characteristics of the watershed (MacIsaac 2010), it is important to understand the spatial arrangement of hydrologic function and the condition of related attributes across the landscape. Evaluation of these hydrologic attributes, landscape pressures, and the related salmon habitats provides the context needed

to evaluate potential hydrologic protection strategies relevant to salmon habitats. The following SBPP technical approach aims to provide such evaluation.

Snohomish Basin Protection Plan Technical Approach: Characterization of Landscape Processes and Development of Hydrologic Protection Strategies

To characterize and evaluate hydrologic conditions across the Snohomish Basin, a multi-faceted technical approach was utilized. The technical approach focused on integrating multiple information sources to better assess the overlap of hydrology, anadromous salmon use, and landscape pressures. This overlap helped to determine the spatial location of hydrologic importance relevant to salmon habitat as well as evaluate how corresponding and potential protection strategies could be utilized across the landscape. In order to incorporate the multiple geographic scales relevant to hydrologic protection, information was organized into three spatial extents (Figure 1). The broadest spatial extent (Scale 1) included the entire Snohomish Basin, with the meso-scale extent (Scale 2) focusing on the contributing drainages for the mainstem Skykomish and Snoqualmie rivers. The smallest spatial extent (Scale 3) was organized around combined sub-watershed drainages (hereafter referred to as planning units). Planning units were grouped based on three criteria: contributing basins which routed to critical/priority Chinook areas and focal reaches; sub-watershed with relatively similar hydrology; and sub-watersheds with potentially similar protection strategies due to comparable land uses. While all three spatial extents focused on the overlap of hydrology, anadromous salmon use, and landscape pressures, resulting protection strategies were aligned differently across the landscape scales. Protection strategies relevant to Scales 1 and 2 were focused primarily around land-use type while strategies relevant to planning units at Scale 3 were focused on areas of hydrologic importance. These designations were chosen to best align the suites of strategies with the appropriate scales for implementation.

The technical approach for planning units (Scale 3) was focused on several information sources included primary anadromous fish use, information on habitat changes, precipitation regime, primary land use and activities, modeled hydrologic and habitat conditions, limiting factors related to hydrology; ecosystem services; potential climate change impacts; as well as current and future pressures. These specific data sources were chosen in an effort to characterize the suites of factors influencing hydrology, the related salmon habitats, and the

pressures/stresses across the landscape. The technical approach primarily focused on evaluating previously available information and data sets with the exception of an updated hydrologic and habitat conditions assessment. These supplemental analyses were provided by the Washington State Department of Ecology (Ecology) through their Watershed Characterization Models (discussed in the *Modeled Hydrologic and Habitat Conditions* section). In an effort to "ground-truth" modeled and assessment results, the technical approach emphasized integrating local knowledge and expertise. Input and knowledge from Basin partners and collaborators was collected during a technical approach workshop as well as through several meetings with the Snohomish Basin Salmon Recovery Technical Committee. Details of individual information sources are included in the following sections, a summary of results can be found in Tables 1 through 3, and finalized technical approaches for each planning unit can be found in the *Planning Unit Descriptions* section.

Salmon Use

Primary anadromous fish use was derived from the Washington Department of Fish and Wildlife's (WDFW's) SalmonScape, Statewide Washington Integrated Fish Distribution, as well as the Ecosystem Diagnosis Treatment (EDT, Mobrand Biometrics 2000) used in the Snohomish River Basin Ecological Analysis of Salmon Conservation (EASC 2005). Potential changes in current fish distribution from the EDT designations were evaluated using observed Chinook salmon spawner and redd surveys, conducted from 2003 to 2013 by the WDFW as well as the Tulalip Tribes (post-EDT assessment period). For the sake of consistency with the 2005 Plan, fish distribution was focused on anadromous salmonids, with specific emphasis given to Chinook salmon.

Information on Habitat Changes

Information on anadromous salmon habitat changes was taken from the Snohomish Basin 3-year work plan, river and watershed assessments when available (e.g., Woods Creek Watershed Habitat Conditions Report), as well as local knowledge from project sponsors and Basin partners. Categories considered as improved habitat included levee removal, fish passage, log jam installation, riparian planting, riparian invasive removal, and any particular information that is an improvement but not otherwise categorized. Categories for reduced habitat included natural disturbance (e.g., slides blocking passage), anthropogenic disturbance (e.g., levee), and unknown.

Precipitation Regime

Precipitation was interpreted from the Washington State Department of Natural Resources (DNR) precipitation GIS layers. Precipitation was designated based on the dominant regime with specified categories including high lands, low lands, rain dominate, rain on snow, and snow dominate. The acreage and percentage of each specified category was calculated for each planning unit.

Primary Land Use and Activities

Primary land use and activities were determined from the representative County Comprehensive Plan designation (specific to either Snohomish or King County). Designated land uses included forestry, residential, rural residential, cities, agriculture, open space, and tribal lands. The acreage and percentage of each designated land use type was determined for each planning unit. Current use and expected changes were evaluated using aerial images of the planning units as well as using local knowledge from Basin partners.

Limiting Factors, Pressures/Stresses, and Ecosystem Services

Limiting hydrologic factors and related life cycle stresses were determined from local river assessment, when available, as well as from the pressures/stresses identified in the Snohomish Basin Chinook Monitoring and Adaptive Management framework (Chinook M&AM). The pressures/stresses utilized in the Chinook M&AM process were translated from the Puget Sound Chinook Salmon Recovery common framework (developed by the Regional Implementation Technical Team [RITT]). These life cycle pressures/stresses relate directly to Chinook salmon ecological attributes and serve as a crossroads between ecosystem function and salmonid population response (outlined in the RITT common framework, 2013). The life cycle stresses that were considered in the SBPP technical approach included reduced upriver migration, reduced spawning success, reduced egg development, reduced freshwater rearing, and reduced river outmigration. As mentioned in the *Hydrology Tied to Biology* section, attributes of hydrologic regimes (e.g., flow magnitude, frequency, duration, timing, and rate of change) govern habitat quality and quantity. Modifications and alterations to these attributes subsequently affect life cycle stresses among salmonids. While specific hydrologic attributes can be linked to particular life cycle stresses, generally a suite of related attributes impact the relevant stresses. For example, the life cycle stress of reduced egg development is associated with multiple aspects of an altered flow regime including flow

magnitude, duration, and timing. Aiming to restore and protect a natural flow regime, rather than focusing on a specific hydrologic attribute, will subsequently help to address the suite of relevant attributes affecting life cycle stresses. This technical approach aimed to focus on the overall hydrologic regime, specifically intact and natural flow regimes, is a way to address the suite of hydrologic attributes impacting related salmonid life cycle stresses.

Ecosystem services were selected from *The Whole Economy of the Snohomish Basin: The Essential Economics of Ecosystem Services* (Batker et al. 2010) and considered for each planning unit in the Basin. Because salmon habitat was evaluated from multiple other information sources (e.g., fish use, improved/reduced habitat, and freshwater habitat condition model), ecosystem services outside of salmon-specific habitat support were highlighted in this section. The ecosystem services that were considered included flood regulation, water quality, regulation, drinking water provisioning, recreation, energy production, irrigation, storage, water regulation, and disturbance prevention.

Chinook Monitoring and Adaptive Management Common Framework and Hydrology

In an effort to align the SBPP technical approach with the Chinook M&AM, the technical approach included the relevant ecosystem components, key ecological attributes, and associated stresses. Specifically, the SBPP included the Chinook salmon and freshwater habitat ecosystem components (uplands, large channels, small channels, side channels, and floodplain waterbodies), the high and low flow hydrological regime key ecological attributes, and the altered high and low flow hydrologic regime stresses. These attributes were translated from the RITT common framework and integrated throughout the aforementioned information sources.

Climate Change Impacts and Future Pressures

To evaluate climate change impacts and future pressures, the SBPP focused on utilizing local assessments (e.g., *Climate Change Impacts on Flooding*, King County 2010) and two climate change impact efforts which focused on modeling conditions specific to the Snohomish Basin. The first model that the SBPP evaluated was from Battin et al. (2007), which projected climate change impacts on specific environmental attributes and Chinook salmon populations in the Snohomish Basin. These efforts focused on climate-related changes in

flow, temperature, and habitat capacity across the salmon life cycle. The primary environmental variables emphasized in the analysis included high temperatures during pre-spawning periods (mortality in adults due to temperature), high temperatures during egg incubation periods (egg mortality due to temperature), and high flow during incubation periods (egg mortality due to bed scour). Changes in these attributes were assessed across climate change scenarios for the entire Basin and potential impacts to salmon populations were evaluated through changes in Chinook spawner abundance and distribution. The outputs from these models were subsequently evaluated in the SBPP technical approach to assess the potential impact of climate change on environmental and population attributes. This evaluation was conducted for each planning unit as well as the overall Basin.

The second climate change modeling effort utilized in the SBPP technical approach was the Snow Caps to White Caps project from the Pacific Northwest National Laboratory (PNNL and University of Washington 2013). This effort focused on developing numerical models for water movement and distribution from the top to bottom of the Basin, and it assessed changes in hydrology based on various management questions as well as current and future conditions. Management scenarios included changes in land use (urbanization and forest maturation), and future conditions were evaluated across climate change scenarios. Changes in long-term monthly flow, specifically peak and low flow conditions, were evaluated for the SBPP efforts. Because this PNNL model was not aligned with the planning unit scale, results were interpreted at Scales 1 to 2 among relative precipitation regimes (e.g., high lands, low lands, rain dominate, rain on snow, and snow dominate). Each regime was evaluated using representative sub-basin sites focused in the South Fork Skykomish, North Fork Snoqualmie, Woods Creek, and mainstem Snohomish.

In addition to the aforementioned modeling efforts, the SBPP technical approach also considered potential future factors which may sustain or intensify existing pressures and stresses. This evaluation provided a contextual understanding of how pressures and stresses across the landscape may change in relation to factors outside of solely climate change. Many of these additional factors came from local assessments as well as from local knowledge and expertise. While not comprehensive, some of the discussed factors included timber harvest; natural system modification through urbanization, agriculture, development, or land conversion; water use management; invasive and problematic species; disturbance regimes; and loss of critical habitats.

Modeled Hydrologic and Habitat Conditions

Hydrologic and habitat conditions were assessed using the flow and freshwater habitat importance models developed by Ecology in the Puget Sound Watershed Characterization (Stanley et al. 2012; Wilhere et al. 2013). Watershed Characterization focused on assessing Puget Sound water resources and freshwater habitats based on the dynamic physical and chemical interactions that form and maintain landscapes and ecosystems. The characterization of these ecosystem processes, structure, and functions was assessed through specified numeric and qualitative models. While initially developed to watershed or Water Resource Inventory Area (WRIA) extents, the Watershed Characterization Models were able to provide relative hydrologic and habitat importance at the sub-basins and planning units scales. Subsequently, these assessments can provide spatially explicit information and relative importance of water flow processes and freshwater habitat conditions across the Basin. The technical approach for the SBPP utilized models and sub-models of these assessments to determine areas of hydrologic importance as well as areas of freshwater habitat value for salmonids across scales.

Watershed Characterization included a water-flow model which was based on the delivery, movement, and loss of water within a watershed. Further details beyond the following synopsis are outlined in Stanley et al. (2012). The water-flow model aimed to assess water flow processes through two distinct sub-models, including one for hydrologic importance and one for hydrologic degradation. Because the SBPP was focused on assessing areas of hydrologic importance, regardless of condition (i.e., degradation), the planning unit descriptions focused on evaluating results from the hydrologic flow importance sub-model. The flow importance sub-model evaluated hydrology based on its physical attributes of topography, soils, geology, and hydrology. This sub-model evaluated water-flow processes in an "unaltered" state, without consideration of land-use changes or human modifications, providing a detailed spatial assessment of hydrologic importance across the Basin. The four water-flow processes used in this sub-model included delivery, surface storage, movement (separated into recharge and discharge), and loss of water. While the importance of groundwater and interactions with water flow are prevalent, specific groundwater dynamics are not covered in these analyses. Specifically, water delivery was evaluated from precipitation regime (affecting the timing of water movement); surface storage was estimated from the amount of depressional wetlands, lakes, and stream floodplains; water movement was evaluated from precipitation, soil composition, slope wetlands, and alluvial floodplains;

and loss was estimated through evapotranspiration. Because loss was considered to be relatively uniform across the landscape (in an unaltered state), it was not included in the importance sub-model. The results of the flow importance sub-model were evaluated across Scales 1 to 3 to provide an understanding of spatial orientation of areas with high hydrologic importance. Additionally, descriptions included a spatial evaluation of each individual hydrologic process, which included delivery, surface storage, recharge, and discharge. These cross evaluations provided a detailed description of relative hydrologic importance across all scales (Tables 1 and 3).

Watershed Characterization also included a freshwater habitat conditions model, which was based on hydrogeomorphic features, the quantity and quality of salmon habitats, and the accumulated downstream habitats. Further details beyond the following synopsis are outlined in Wilhere et al. (2013). All of these attributes were combined to create a habitat index which was used to assess relative habitat values across the landscape. Hydrogeomorphic features were assessed from the densities of wetland and floodplain waterbodies, and the accumulated downstream habitats were evaluated from the quality and quantity of upstream contributing habitats. Salmon habitat quality and quantity was combined into a representative category and weighted to account for species presence and stock status. Within the salmon habitat component, habitat quality was determined from ecological integrity (intactness of upstream and local conditions) as well as potential habitats identified from species-specific intrinsic potential models. Habitat quantity was determined from the length of habitat within reaches that were considered of value to salmon species (derived from species-specific presence and habitat quality). While the Watershed Characterization efforts focused on eight salmonid species, the freshwater habitat model was tailored specific to the SBPP to weight model outputs toward anadromous salmonids (included in the stock status weighting). This was conducted in an effort to align the freshwater habitat model with the anadromous salmonids emphasized in the 2005 Plan (Chinook, coho, and bull trout). The freshwater habitat model provided a detailed spatial assessment of relative habitat importance and was evaluated across planning units to understand spatial orientation of high value salmonid habitats (Table 3).

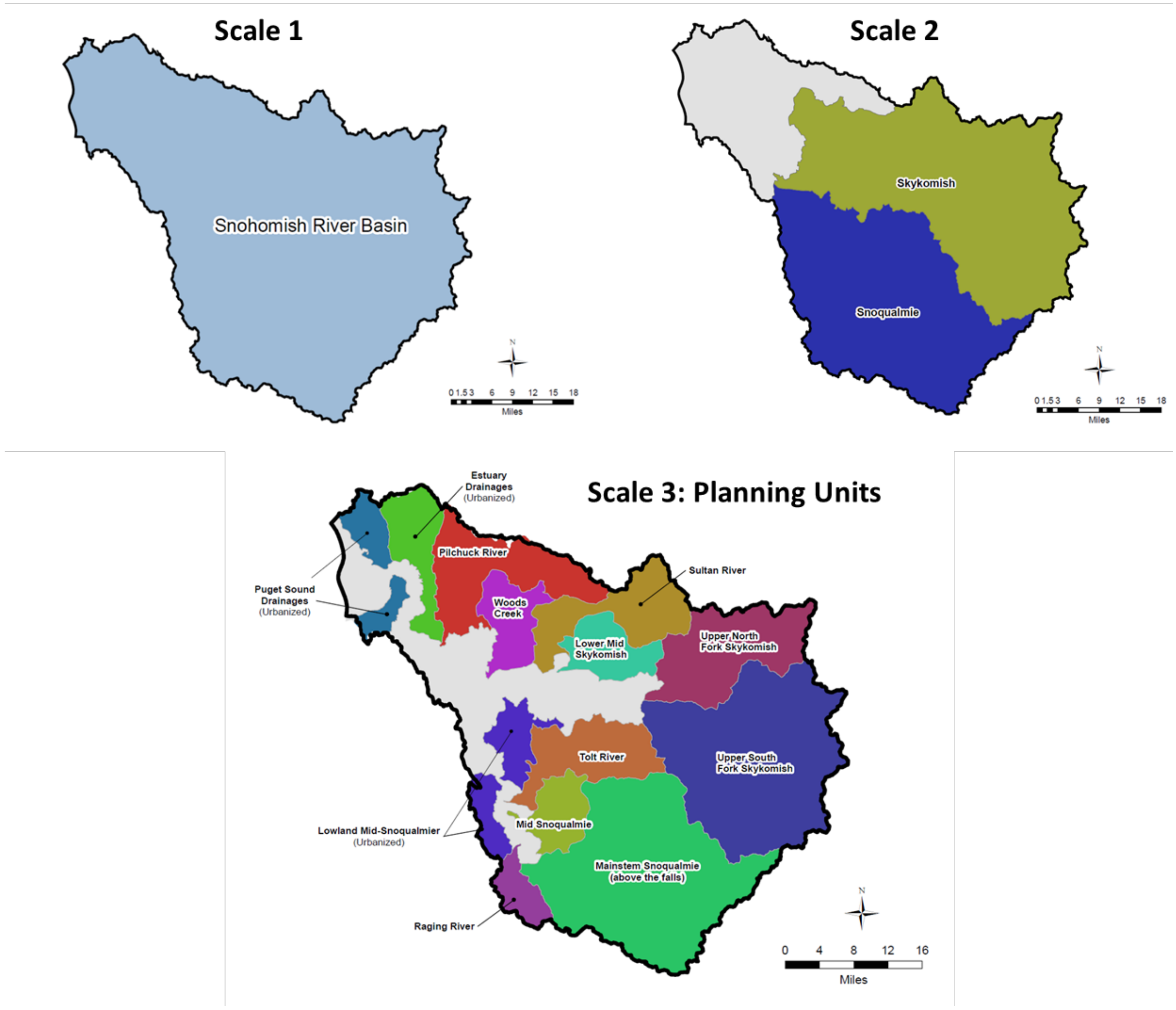


Figure 1: Spatial Extents used in the Snohomish Basin Protection Plan

Table 1: Watershed Characterization Model Outputs for Scales 1 through 3

Geographic Extent (Scale)	Overall Flow Importance Model	Delivery Importance Model	Surface Storage Importance Model	Recharge Importance Model	Discharge Importance Model
Scale 1					
Snohomish River Basin	• Upper watersheds of Snoqualmie and Skykomish basins • In particular, Upper Snoqualmie, Upper South Fork Skykomish, and Upper North Fork Skykomish planning units contain significant proportions of AUs ranked highest or moderate-high for importance to overall water flow processes	• North Fork Skykomish, Upper South Fork Skykomish, and Upper Snoqualmie • To a lesser extent, Sultan, Tolt, and Upper Pilchuck rivers	• Lower Snohomish mainstem near estuary and lower portions of Pilchuck River • Areas of the lower portion of Skykomish mainstem, Woods Creek, and Sultan River • Snoqualmie mainstem, Cherry Creek, and Upper Snoqualmie are of moderate importance	• Snoqualmie River basin • Skykomish River basin	• Snohomish and Snoqualmie rivers • Lower Pilchuck and estuary drainages • To a lesser degree, Upper Snoqualmie, Skykomish mainstem, and lower middle Skykomish
Scale 2					
Snohomish Mainstem	• Pilchuck and Snohomish rivers mainstem planning units • Estuary drainage also contain some moderate-high to high ranked AUs	• Upper Pilchuck • Eastern drainage of Snohomish mainstem	• Snohomish mainstem • Snohomish estuary • Lower Pilchuck (at a moderate-high degree)	• Upper Pilchuck • Eastern portion of Snohomish mainstem • Quilceda Creek	• Pilchuck mainstem • Allen Creek • Snohomish mainstem
Snoqualmie Mainstem	• Upper Snoqualmie planning unit, though some areas of highest and moderate-high-ranked AUs can be found in North and South Forks Tolt River, as well as lower Snoqualmie mainstem • Generally, Upper Snoqualmie ranks highest for overall importance, followed by Tolt and Raging rivers planning units	• Upper Snoqualmie (all three forks) • North and South Forks Tolt River	• Snoqualmie mainstem • Patterson and Cherry creeks • Middle Fork Upper Snoqualmie	• Upper Snoqualmie • Tolt • To a lesser degree, Raging River and Snoqualmie mainstem	• Snoqualmie mainstem • Cherry and Patterson Creek • Middle Fork Upper Snoqualmie
Skykomish Mainstem	• Upper reaches of South Fork Skykomish, Upper North Fork Skykomish, and Sultan River planning units • Skykomish mainstem • Upper North Fork Skykomish and Upper South Fork Skykomish rank highest in Skykomish basin for overall importance to water flow process	• Upper portions of North and South Forks are the most important to delivery • Sultan River is of moderate importance	• Woods Creek • Skykomish mainstem • Lower Sultan • Lower middle Skykomish	• North and South Forks Skykomish River • Upper Sultan River	• Skykomish mainstem • Woods Creek • Lower Sultan River • Olney Creek
Scale 3					
Above the Snoqualmie Falls	• Entire Middle Fork Snoqualmie • Taylor River • Tate Creek	• Headwaters • Eastern extents of Upper North Fork • Middle Fork Snoqualmie	• Lower-mid Middle Fork Snoqualmie • Coal Creek • Tate Creek (around North Bend and Snoqualmie)	• Taylor River • Eastern headwaters • Upper portions of North and Middle Forks	• Middle Fork Snoqualmie • Tate Creek • Coal Creek • Northern tributaries of North Fork Snoqualmie

Geographic Extent (Scale)	Overall Flow Importance Model	Delivery Importance Model	Surface Storage Importance Model	Recharge Importance Model	Discharge Importance Model
Snohomish Estuary Drainages	• East Fork Quilceda Creek • Allen Creek drainage	• Upper portion of Quilceda Creek (specifically, East Fork south of Arlington)	• Areas near confluence of West and East Forks Quilceda • Allen Creek drainage	• Primarily, East and West Forks Quilceda Creek (excluding headwaters of East Fork)	• Lower East Fork Quilceda • Allen Creek drainage
Lower Mid Skykomish	• Lower middle Skykomish	• Upper Wallace River • May Creek • Lower reaches of Olney Creek	• Headwaters in Upper Wallace Creek • Upper Olney Creek • Upper May Creek	• Mid-lower Olney Creek • Upper Bear Creek • Lower May Creek (around Gold Bar) • Confluence of Wallace River with May and Olney creeks	• Upper Olney Creek • Upper Wallace River • Upper May Creek • Lower May Creek
Lowland Snoqualmie Tributaries	• Mid-lower Patterson Creek • Eastern headwaters of Cherry Creek • Lower Cherry Creek near confluence with Snoqualmie River (near Duvall) • Mid-upper portion of Harris Creek	• Headwaters of Patterson Creek • Eastern headwaters of Cherry Creek	• Northern headwaters of Patterson Creek • Lower Patterson near confluence with Snoqualmie River • Harris Creek • Lower Cherry Creek near confluence with Snoqualmie (near Duvall)	• Mid-lower Patterson Creek • Cherry Creek	• Mid-lower Patterson Creek • Mid-lower Harris Creek • Lower Cherry Creek
Mid Snoqualmie Tributaries	• Headwaters of Tokul Creek (Canyon Creek, Beaver Creek, and Ten Creek drainages) • Western portions of Griffin Creek drainage	• Eastern portion of Tokul Creek drainage (including Beaver Creek and Ten Creek drainages)	• Western drainage of Griffin Creek • Southern drainage of Tokul Creek	• Eastern portion of Tokul Creek drainage (including Beaver Creek and Ten Creek drainages)	• Griffin Creek drainage • Beaver and Ten Creek drainages
North Fork Skykomish	• Lower North Fork Skykomish (around Index and up to Bitter Creek) • Mid North Fork (from Silver Creek to Goblin Creek)	• Upper North Fork Skykomish • West Cady Creek	• North Fork Skykomish from Bear Creek down to confluence with South Fork Skykomish (around Index)	• Upper North Fork Skykomish including west Cady Creek, Goblin Creek, and Troublesome Creek drainages	• Lower-mid North Fork Skykomish
Pilchuck	• Upper headwaters of Pilchuck • Portions of middle Pilchuck between Granite Falls and Lake Stevens • Mouth of Pilchuck near Snohomish	• Headwaters in Upper Pilchuck down to Granite Falls	• Areas around Lake Stevens • Catherine Creek • Little Pilchuck • Portions of middle Pilchuck • Mouth of Pilchuck near Snohomish	• Headwaters of Upper Pilchuck • Tributaries near Granite Falls • Mouth of Pilchuck near Snohomish	• Areas around Granite Falls down to confluence of Dubuque and Little Pilchuck • Worthy Creek • Upper Panther Creek • Lower Pilchuck near confluence of Snohomish
Puget Sound Drainages	• Tulalip Creek and Mission Creek drainages (on Tulalip reservation)	• Drainages around Port Gardner • Japanese Gulch Creek • Merrill Creek • Ring Creek • Pigeon Creek drainage	• Tulalip Creek • Mission Creek drainage	• Tulalip Creek • Mission Creek • Japanese Gulch • Merrill Creek • Ring Creek	• Tulalip Creek • Mission Creek
Raging River	• Headwaters rank moderately high in importance to basin hydrology	• Headwaters (near Tiger Mountain)	• Mouth of Raging River near Preston and Fall City	• Headwaters (near Tiger Mountain) • Middle portion of basin	• Mouth of Raging River near Preston and Fall City

Geographic Extent (Scale)	Overall Flow Importance Model	Delivery Importance Model	Surface Storage Importance Model	Recharge Importance Model	Discharge Importance Model
South Fork Skykomish	• Lower South Fork Skykomish drainage from confluence with North Fork up to confluence with Miller River (excluding Index Creek, Barclay Creek, and Money Creek drainages) • East Fork Miller River drainage • West Fork Foss drainage • Lower Tye River drainage	• Rapid River • Miller River • Foss River • Deception Creek drainage	• South Fork Skykomish mainstem • Upper Miller River • West Fork Foss River • Alpine Creek drainage	• Miller River • Foss River • Rapid River • Johnson Creek drainage	• South Fork Skykomish mainstem from confluence with North Fork up to confluences with Beckler/Rapid, Tye, Foss, and Miller rivers
Sultan	• Upper Sultan River (upstream of Spada Lake) • Lower Sultan (up to Woods Creek)	• Headwaters and upper portions of Sultan River	• Lower Sultan • Spada Lake	• Upper Sultan (upstream of Spada Lake)	• Lower Sultan (near Sultan and up to Woods Creek)
Tolt	• Lower Tolt River (near Carnation) • Upper South Fork Tolt	• Upper portions of North and South Forks Tolt	• South Fork Tolt (below South Fork reservoir) • Drainage below confluence of North and South Forks Tolt	• Eastern headwaters of North and South Forks Tolt • Areas directly below South Fork reservoir	• North Fork Creek drainage • Areas directly below South Fork reservoir • Lower Tolt near Carnation
Woods	• Primarily, East Fork from confluence with Rosinger Creek down to confluence with West Fork • Richardson Creek drainage	• East Fork Woods Creek	• Lower East Fork • Richardson Creek • Below confluence of East and West Forks	• East Fork from confluence with Rosinger Creek down to confluence with West Fork • Richardson Creek	• East Fork from confluence with Rosinger Creek down to confluence with West Fork • Richardson Creek

Note:
AU = Assessment Unit (a smaller basin broken out within a planning unit that allowed the Watershed Characterization Model to be run at a more refined scale)

Table 2: Habitat Model Outputs and Assessment of Protection Considerations for Scale 3 (Planning Units)

Planning Unit	Habitat Model	Protection Consideration
Scale 3		
Above the Snoqualmie Falls	• Generally, North and Middle Forks Snoqualmie have higher watershed habitat indices than South Fork Snoqualmie and western drainages • Upper portions of North and Middle Forks, in addition to Taylor River, displayed the highest watershed habitat values • While habitat potential is good, Snoqualmie Falls is a natural barrier that prevents anadromous fish from being able to access this habitat	• North Fork: protection of delivery and recharge; restoration of delivery and recharge processes in mid reaches • Middle Fork: restoration of storage and protection of delivery and recharge • South Fork: protection of delivery and recharge processes
Snohomish Estuary Drainages	• West Fork Quilceda Creek • Allen Creek drainage • Majority of eastern drainages into Ebey Slough	• Restoration of surface storage • Protection of recharge and delivery
Lower Mid Skykomish	• Mid-lower Olney Creek • Mid-lower May Creek	• Wallace River • Lower Olney Creek • Lower May Creek (around Gold Bar)
Lowland Snoqualmie Tributaries	• Generally, Cherry and Harris creeks have higher watershed habitat values than Patterson and Ames creeks • Within Cherry-Harris Creek area, mid-lower Cherry Creek near Duvall and northern tributaries of middle Cherry Creek have high watershed habitat values	• Cherry Creek: restoration of discharge and surfaces storage processes • Patterson Creek: restoration of discharge and surface storage processes
Mid Snoqualmie Tributaries	• Griffin Creek • Tokul Creek	• Protection and restoration of surface storage and discharge
North Fork Skykomish	• Lower North Fork Skykomish (near Index) • Areas around Bear and San Juan creeks	• Protection of delivery • Protection and restoration of recharge
Pilchuck	• Specifically, from confluence of Little Pilchuck and middle Pilchuck up to Purdy Creek • Upper portion of Dubuque Creek • Upper portion of Little Pilchuck Creek	• Highest protection in upper watershed • Protection of recharge and delivery in upper watershed • Restoration of discharge and surface storage in lower watershed
Puget Sound Drainages	• Lower Tulalip Creek and lower Mission Creek drainages have the highest watershed index values • Among those, lower Mission Creek drainage has the highest watershed habitat indices	• Northern drainages around Tulalip Creek: protection of surface storage and recharge and discharge • Restoration of discharge, delivery, and recharge in southern drainages
Raging River	• Best habitat is in lower portions of Raging River • Upper reaches of Raging are considered moderate quality or importance	• Protect delivery and recharge in upper watershed
South Fork Skykomish	• Lower portions of South Fork Skykomish mainstem drainages (downstream of Index Creek confluence), areas around confluence of Miller River, and areas around confluence of Foss with Tye rivers have the highest watershed index values • Deception Creek drainage in Tye River drainage was also characterized as having high watershed habitat indices	• Northern tributaries: restore recharge and protect and restore delivery • Southern tributaries: protect recharge and delivery • South Fork mainstem: restore surface storage
Sultan	• Much of Sultan has high watershed habitat value; however, lower portions near Sultan, areas below Spada Lake, and Elk Creek drainage have the highest habitat values because above Spada Lake reservoir there is no passage for anadromous fish at the Jackson Dam	• Upper watershed: protection of surface storage and recharge • Lower watershed: restoration of discharge and surface storage
Tolt	• All of drainages below confluence of North and South Forks Tolt have high watershed habitat values. Specifically, the areas directly below South Fork reservoir and lower Tolt near Carnation have the highest habitat values. • Only spawning reach for summer steelhead in South Fork Tolt is below dam, which is highlighted as a unique population in the distinct population segment	• North Fork: restoration of delivery and protection of recharge • South Fork: protection and restoration of delivery and recharge • Mainstem: protection and restoration of surface storage
Woods	• Much of Woods Creek has high watershed habitat value, with the Richardson Creek drainage, Upper West and East Forks drainages (area at top of the East Fork is not accessible to anadromy), and areas near the confluence of the West and East Forks having the highest habitat values	• Restoration of surface storage and discharge

Table 3: Information Sources included in Scale 3 (Planning Units) for the SBPP Technical Approach

Planning Unit	Salmonid Use[1, 2]	Precipitation Regime	Primary Land Uses	Life Cycle Limiting Factors	Current and Future Pressures	Ecosystem Services	Climate Change Impacts	Existing Protection Strategies in Unit	Opportunities
Scale 3									
Above the Snoqualmie Falls	No anadromous fish use (assumed bull trout presence)	• Highland (30%) • Snow Dominant (26%) • Rain on Snow (21%) • Rain Dominant (18%)	• Forestry (91%) • Rural Residential (6%) • Cities (3%)	NA; anadromous fish not present in this planning unit	• City growth and rural residential development • Forestry practices • Water withdrawals • High water temperatures • Revetments/levees disconnect river from floodplain • Limited large wood recruitment from logging and development	• Flood regulation • Water quality regulation • Drinking water provisioning • Recreation • Energy production • Spawning • Water storage • Disturbance prevention	• Minimal increase for pre-spawning temperature (Battin et al. 2007) • Shift to earlier runoff timing and increases in magnitude of extreme precipitation and discharge events (King County 2010)	• PBRS 0.3% • Forestland 16.1% • Agriculture 0.1% • FPP 0.1% • Public 77.2% (12.6% of basin in TDR and 30.8% of basin in wilderness protection)	• Decrease private inholdings surrounded by public land • Study impacts of groundwater withdrawals on instream flows and groundwater • Acquire TDRs in key areas of hydrologic importance • Ensure timber harvest methods are protective of hydrology
Estuary Drainages	• Chinook salmon/bull trout use = low • Bull trout = presumed presence • Coho salmon use = low to moderate • Steelhead = present	• Lowland (100%)	• Rural Residential (34.7%) • City (45%)	• Upriver migration • Spawning • Egg deposition • Egg development • Freshwater rearing • Estuarine rearing • River outmigration	• Continued expansion of UGAs • Industrial development along mainstem	• Recreation • Irrigation	No data for spawning and incubation	• Public Lands (11.3%) • Agriculture (0.9%) • Timber (2.0%) • Open Space (1.0%)	• Implement LID for future development • Protect lands in floodplains for future levee setbacks • Protect urban trees • Protect open space and agriculture in estuary areas under the Comprehensive Plan
Lower Middle Skykomish	• Wallace River = Chinook = moderate; coho/bull trout = low use; steelhead = present • Olney Creek = no Chinook salmon use; bull trout/coho presumed use; steelhead = present • Bear Creek = no Chinook salmon use; bull trout/coho = low; steelhead = modeled presence • May Creek = moderate Chinook use; bull trout/coho = low use; steelhead = present	• Rain Dominant (39.1%) • Rain on Snow (22.9%) • Snow Dominant (20.4%) • Highland (10.7%) • Lowland (7%)	• Forestry (88.6%) • Rural Residential (7.7%)	• Upriver migration • Spawning • Egg deposition • Egg development • Freshwater rearing • River outmigration	• Most important areas for hydrology are in and near cities; future development will have impacts on hydrology • Conversion of forest land to rural residential • Dredge mining in upper areas of lower middle Skykomish • Areas of agriculture that correspond to key areas of surface storage will need to be maintained	• Flood regulation • Water quality regulation • Recreation • Hatchery water supply • Storage • Water quantity regulation	• Small to significant increase in incubation peak flow • Minimal to moderate decrease (Upper Wallace) in minimum spawning flow • Minimal change to moderate increase (Olney) in pre-spawning temperature • Change in average number of adult Chinook spawners: slight decrease in one of six scenarios in May Creek • No change or slight increase in others	• Public Lands (65.7%) • Timberlands (22.4%) • Open Space (0.2%)	• Protect forestlands from conversion • Ensure protective timber harvest methods and allow for adaptive management in the face of climate change • Work on acquiring TDRs in key areas of hydrologic importance • Decrease private inholdings surrounded by public lands • Protect floodplain areas between Highway 2 and Snohomish River, upstream of Start Up levee; area is important for surface storage and discharge • Use LID in cities and UGA • Use inventive programs in residential areas

Planning Unit	Salmonid Use[1, 2]	Precipitation Regime	Primary Land Uses	Life Cycle Limiting Factors	Current and Future Pressures	Ecosystem Services	Climate Change Impacts	Existing Protection Strategies in Unit	Opportunities
Lowland Snoqualmie Tributaries	• Cherry Creek: - Chinook salmon/ bull trout use = low - Coho = high - Steelhead = present • Harris Creek: - Chinook salmon/ bull trout use = low - Coho = moderate - Steelhead = present • Ames Creek: - Chinook salmon = none - Coho/bull trout = low - Steelhead = presumed presence • Patterson Creek: - Chinook salmon/ bull trout use = low - Coho = moderate - Steelhead = present	• Lowland (74%) • Rain Dominant (25%) • Rain on Snow (1%)	• Rural Residential (60.2%) • Forestry (27.9%) • Agriculture (8%)	• Upriver migration • Spawning • Egg deposition • Egg development • Freshwater rearing • River outmigration	• Conversion of forestry lands to rural residential development • Growth of cities and UGAs • Increase of water withdrawals in rural residential areas (Cherry)	• Flood regulation • Water quality regulation • Recreation • Irrigation • Storage • Water quantity regulation	• Moderate increase in incubation peak flow • Minimal decrease in minimum spawning flow • No change to minimal increase in pre-spawning temperature • Change in average number of adult Chinook spawners: - Cherry/Harris creeks: increase in all scenarios - Patterson/Ames: assumed decrease in all scenarios (Battin et al. 2007)	• Public Lands (21%) • Forestlands (13%) • Agriculture Lands (8%) • PBRS (7%)	• Implement stormwater regulations as cities grow • Ensure that timber harvest methods are protective of hydrology and can adaptively manage with climate change • Acquire TDRs in key areas of hydrologic importance • Continue to enhance open spaces—limit conversions • Enroll rural residential properties into appropriate CUT • Decrease number of private inholdings surrounded by public lands • Study groundwater withdrawals to understand impacts on instream flows and groundwater recharge
Mid Snoqualmie Tributaries	• Chinook salmon = low use • Coho = high use (Griffin) and low use (Tokul) • Bull trout = presumed presence) • Steelhead = present	• Rain Dominant (89%) • Rain on Snow (2%) • Lowland (9%)	• Forestry (96.1%) • Rural Residential (2.8%)	• Upriver migration • Spawning • Egg deposition • Egg development • Freshwater rearing • River outmigration	• Biological resource use—in particular, timber harvest • Natural system modification • Human intrusions and disturbance • Development • Invasive and problematic species	• Flood regulation • Water quality regulation • Recreation • Irrigation • Storage • Water quantity regulation	• Moderate increase in incubation peak flow • Minimal decrease in minimum spawning flow • Moderate increase in pre-spawning temperature • Moderate decrease in average number of adult Chinook spawners in four of six scenarios (Battin et al. 2007)	• Forestland (95%) • PBRS 0.3% • Agriculture CUT 1% • Public Lands 1% • 0.3% of Agriculture Land is in FPP • 92% of forestlands in TDR	• Place non-protected parcels into appropriate CUT programs, particularly in hydrologically important areas • Ensure timber harvest methods are protective of hydrology

Planning Unit	Salmonid Use[1, 2]	Precipitation Regime	Primary Land Uses	Life Cycle Limiting Factors	Current and Future Pressures	Ecosystem Services	Climate Change Impacts	Existing Protection Strategies in Unit	Opportunities
North Fork Skykomish	• Chinook Salmon = low • Bull trout = known presence to high • Coho = high use (known use in upper reaches) • Steelhead = present	• Highlands (46.4%) • Snow Dominant (27.4%) • Rain on Snow (18.8%) • Rain Dominant (7.4%)	• Forestry (99.9%) • City (0.1%)	None identified	• New roads • Bank hardening for road protection • Geothermal/hydropower exploration	• Recreation	• Incubation peak flow: moderate to major increase • Minimum spawning flow: moderate to major decrease • Pre-spawning temperature: minimal to moderate increase • Change in average number of adult Chinook spawners: moderate decrease	• Public Lands (84.1%) • Timberlands (0.5%) • Open Space (0.1%)	• Educate the population in this basin and recreational users about the importance of leaving wood in the river system and not harvesting it for firewood • Use LID techniques in and around the Town of Skykomish • Protect hydrology as exploration of geothermal and hydropower increase in the area • Encourage acquisition of private inholdings in and around public lands
Pilchuck	• Chinook salmon = low • Bull trout = presumed presence • Coho = known presence to moderate • Steelhead = present	• Rain on Snow (33.1%) • Lowland (56.7%)	• Rural Residential (51.1%) • Forestry (37.9%)	• Upriver migration • Spawning • Egg development • Freshwater rearing • River outmigration	• Conversion of forest land and farmland to rural residential • Additional bank armoring • Loss of critical areas • Increased flooding and diking with climate change • Loss of wood in river due to firewood	• Flood regulation • Water quality regulation • Drinking water provisioning • Recreation • Water quantity regulation	• Incubation peak flow: moderate increase • Minimal decrease in pre-spawning minimum spawning flow • No change to minimal increase in temperature	• Public Lands (35.2%) • Timberlands (6.7%) • Agriculture (2.3%) • Open Space (1.8%)	• Protect forestry and agricultural lands from conversion • Use PDR/TDR to purchase development rights in agricultural land • Buy development rights in areas currently forested that are zoned rural residential • Study impacts of exempt wells on basin hydrology and find ways to minimize those impacts
Puget Sound Drainages	• Tulalip/Battle Creek: - Chinook salmon = none - Bull trout = none - Coho = none - Steelhead = present • Everett Coastal: - Chinook salmon = none - Bull trout = low - Coho= low - Steelhead = present	• Lowland (100%)	• Cities (39.4%) • Rural Residential (32.1%) • Tribal Land (27.1%)	Freshwater rearing	• Transportation infrastructure	• Recreation • Water storage (artificial)	None listed	• Public Lands (9.7%) • Timberlands (2.2%) • Open Space (1.2%)	• Use acquisitions to acquire key areas such as wetlands • Cities should use best management practices when it comes to LID • Snohomish County could adopt a PBRS (very similar to Open Space CUT program) that could potentially allow more urban property owners to take advantage of a CUT program

Planning Unit	Salmonid Use[1, 2]	Precipitation Regime	Primary Land Uses	Life Cycle Limiting Factors	Current and Future Pressures	Ecosystem Services	Climate Change Impacts	Existing Protection Strategies in Unit	Opportunities
Raging River	• Chinook salmon = high use • Coho = moderate • Bull trout = presumed presence • Steelhead = present	• Rain Dominant (63.1%) • Rain on Snow (27.9%) • Lowland (4.5%) • Snow Dominant (4.4%)	• Forestry (72.6%) • Rural Residential (24.6%)	• Upriver migration • Spawning • Egg deposition • Egg development • Freshwater rearing • River outmigration	• Biological resource use—in particular, timber harvest • Natural system modification • Human intrusions and disturbance • Development • Invasive and problematic species	• Flood regulation • Water quality regulation • Recreation • Storage • Water quantity regulation	• Slight decrease in incubation peak flow • Minimal decrease in minimum spawning flow • Moderate increase in pre-spawning temperature • Decrease in average number of adult Chinook spawners in five of six scenarios (Battin et al. 2007)	• Public Lands (79.2%) • TDR (20%) • Forestlands (3.6%) • PBRS (2.2%) • Agriculture (0.3%)	• Try to capture any DNR Public Trust lands to avoid being put into private ownership • Ensure timber methods are protective of hydrology • Enroll private properties into CUT programs • Decrease private inholdings surrounded by public land
South Fork Skykomish	• Chinook = high use (Upper South Fork) and low use (South Fork) • Coho = known presence • Bull trout = known presence) • Steelhead = present	• Highland (47.9%) • Snow Dominant (24.1%) • Rain on Snow (19.1%) • Rain Dominant (8.9%)	• Forestry (98.1%) • Rural Residential (1.8%) • Cities (0.1%)	• Upriver migration • Spawning • Egg deposition • Egg development • Freshwater rearing • River outmigration	• Timber harvest • Removal of large woody debris • Natural system modification • Human intrusions and disturbance • Development • Geothermal energy, oil, gas, and mineral • Hydropower	• Flood regulation • Water quality regulation • Recreation • Storage • Water quantity regulation • Disturbance prevention	• Moderate increase in incubation peak flow • Moderate decrease in minimum spawning flow • Minimal increase in pre-spawning temperature • Decrease in average number of adult Chinook spawners	• Public Lands (94.2%) • Forestlands (5.76%)	• Acquire key parcels to protect hydrology in the face of development • Explore beaver reintroduction to improve hydrologic conditions • Continue to use current minimum road strategy implemented by USFS • Improve and relocate bridges, roads, and railways to improve hydrologic conditions • Engage in planning processes for hydropower development, geothermal energy development, and oil, gas, and mineral resource development proposals to ensure hydrology is not further degraded • Decrease number of private inholdings in public areas • Ensure timber harvest methods are protective of hydrology

Planning Unit	Salmonid Use[1, 2]	Precipitation Regime	Primary Land Uses	Life Cycle Limiting Factors	Current and Future Pressures	Ecosystem Services	Climate Change Impacts	Existing Protection Strategies in Unit	Opportunities
Sultan	• Chinook = high use (in the river downstream of the City of Everett Diversion Dam) • Coho = known presence • Bull trout = presumed presence • Steelhead = present	• Rain Dominant (27.9%) • Rain on Snow (25.9%) • Snow Dominant (22.7%) • Highland (15.7%) • Lowland (7.2%)	• Forestry (90.4%) • City (5.6%)	• Freshwater rearing (currently debatable)	• Timber harvest • Natural system modification (bank hardening) in lower watershed • Development in lower watershed • Invasive species	• Flood regulation • Water quality regulation • Drinking water provisioning • Recreation • Energy production • Storage • Water quantity regulation	Hydrology largely regulated by Culmback Dam for next 45 years	• Public Lands (89.6%) • Timberlands (3.2%)	• Enroll lands into CUT programs • Reduce number of private inholdings in public lands through targeted acquisitions • Ensure that forestry practices are using best available management practices for harvesting • Use LID practices • Focus education programs on importance of stream buffers
Tolt	• Chinook salmon = high use below forks and low use above forks • Coho = high use below forks and low use above forks • Bull trout = presumed presence • Steelhead = present	• Rain Dominant (35.4%) • Rain on Snow (24.2%) • Snow Dominant (21.8%) • Lowland (10.1%)	• Forestry (92.7%) • Rural Residential (3.83%)	• Upriver migration • Spawning • Egg deposition • Egg development • Freshwater rearing • River outmigration	• Floodplain disconnection • Lack of natural cover leading to a lack of habitat in Lower Tolt • Sediment impacts from historic gravel removal • Residential development • Invasive and problematic species	• Flood regulation • Water quality regulation • Drinking water provisioning • Recreation • Energy production • Storage • Water quantity regulation	• Significant increase in incubation peak flow • Minimal decrease in minimum spawning flow • Moderate increase in pre-spawning temperature • Decrease in average number of adult Chinook spawners in five of six scenarios • Hydrology will be largely regulated by South Fork Tolt dam (Battin et al. 2007) • Some models predicting decreased low flows, higher frequency of high flow events, and increased annual peak flow (King County 2010)	• Forestlands (72.9%) • TDR (65.2%) • Public Lands (40.1%) • PBRS (0.6%) • Agriculture (0.3%) • FPP (0.2%)	• Continue acquisitions and levee setbacks • Decrease private inholdings surrounded by public lands • Ensure timber harvest methods are protective of hydrology • Support and improve small forestry owner-harvest methods • Participate in South Fork project relicensing to ensure protection of hydrology

Planning Unit	Salmonid Use[1, 2]	Precipitation Regime	Primary Land Uses	Life Cycle Limiting Factors	Current and Future Pressures	Ecosystem Services	Climate Change Impacts	Existing Protection Strategies in Unit	Opportunities
Woods	• Chinook = low use • Bull trout = presumed presence • Coho = moderate use • Steelhead = present	• Rain Dominant (51.5%) • Lowland (48.5%)	• Rural Residential (51.3%) • Forestry (42.1%)	• Upriver migration • Spawning • Egg deposition • Egg development • Freshwater rearing • Hydrology: frequency	• Conversion of open space to residential development • UGA expansion – City of Monroe • Loss of critical areas • Loss of beaver ponds/wetlands	• Flood regulation • Water quality regulation • Drinking water provisioning (exempt wells) • Recreation • Energy production • Irrigation • Hatchery water supply	• No increase to moderate increase in incubation peak flow • Minimal decrease in minimum spawning flow • Minimal increase in pre-spawning temperature • Decrease or little change in average number of adult Chinook spawners in four of six scenarios	• Public Lands (43.9%) • Timberlands (10.8%) • Agriculture (0.8%) • Open Space (1.6%)	• Decrease number of private inholdings surrounded by public lands • Work on acquiring TDRs in key areas of hydrologic importance • Enroll properties in CUT program • Implement LID in cities and rural residential areas • Increase education with homeowners on importance of stream buffers

Notes:
1 Chinook salmon, bull trout, and coho salmon data from the Ecological Analysis for Salmonid Conservation
2 Steelhead data from Washington Department of Fish and Wildlife Salmonscape
CUT = Current Use Taxation
DNR = Washington State Department of Natural Resources
FPP = Farmland Preservation Program
LID = Low Impact Development
NA = not applicable
PBRS = Public Benefit Rating System
PDR = Purchase of Development Rights
TDR = Transfer of Development Rights
UGA = Urban Growth Area
USFS = U.S. Forest Service

SNOHOMISH BASIN PROTECTION PLAN TECHNICAL APPROACH STEPS: SCALE 3 PLANNING UNIT DESCRIPTIONS

The SBPP team worked with the Snohomish Basin Salmon Recovery Technical Committee to create baseline technical information for each of the Scale 3 planning units in the Basin. This information allowed for local expertise to help inform the current conditions and protection opportunities in each of these planning units. These summaries are geared to help those working in the Basin understand how their actions and projects could help protect hydrology in the key areas of the planning unit.

The information gathered was summarized into two tables. Table 1 includes all the different lenses that are used to help identify key areas important to hydrology and the opportunities and tools appropriate for protection in the area. Table 2 summarizes the Watershed Characterization Model results from Ecology.

Above the Falls, Snoqualmie River Planning Unit

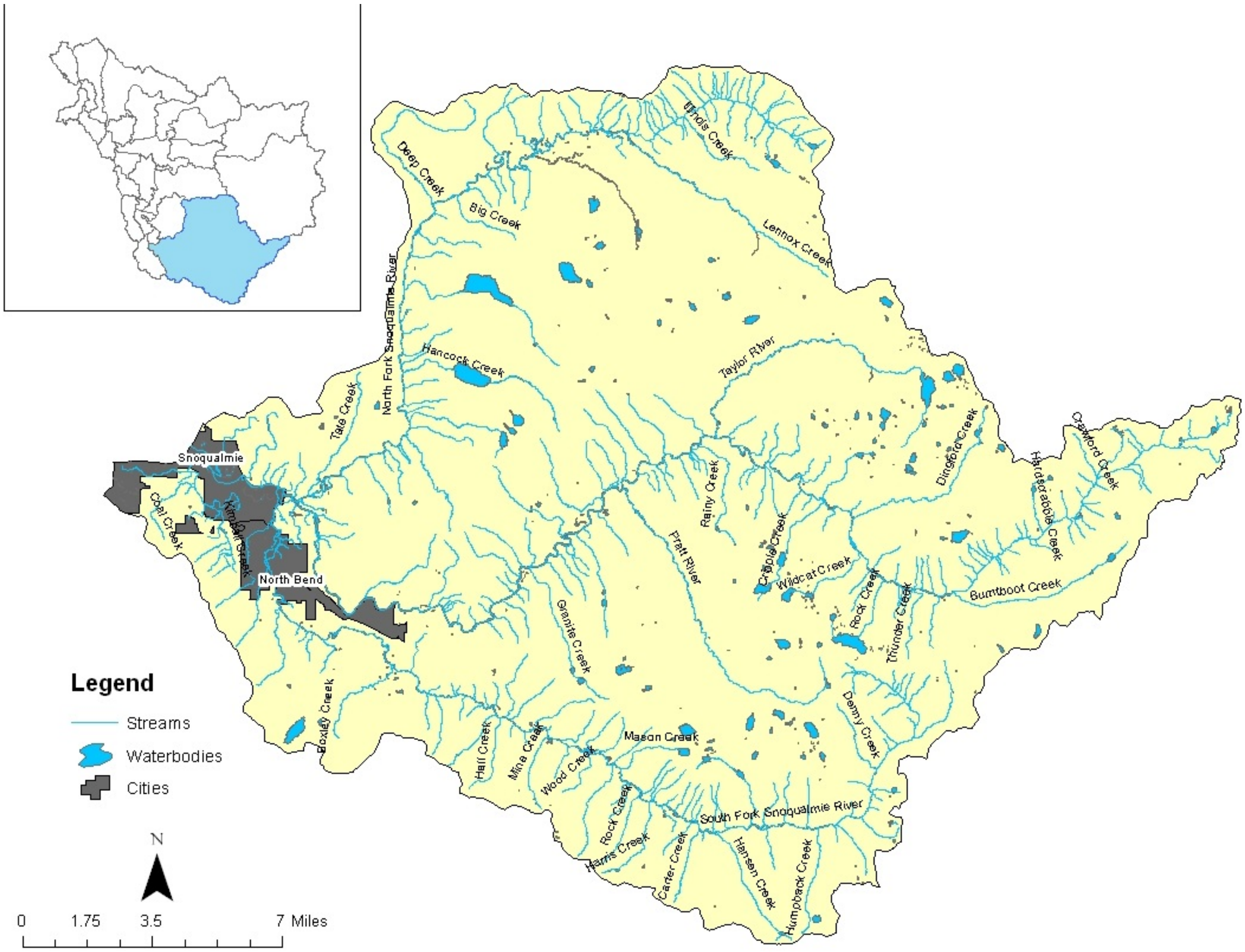


Figure 2: Above the Falls, Snoqualmie River Planning Unit

Basin(s) Name(s): Above the Snoqualmie Falls includes Upper North Fork Snoqualmie, Taylor River, Upper Middle Fork Snoqualmie, Pratt River, Lower North Fork Snoqualmie, Lower Middle Fork Snoqualmie, Upper South Fork Snoqualmie, Upper Coal Creek, Lower South Fork Snoqualmie, and the mainstem Snoqualmie River from the confluence of the three forks to the Snoqualmie Falls

Sub-basin Strategy Group: Protection Above Natural Barriers (Upper North Fork Snoqualmie, Taylor River, Upper Middle Fork Snoqualmie, and Pratt River) and Restoration Above Falls and Dams (Lower North Fork Snoqualmie, Lower Middle Fork Snoqualmie, Upper South Fork Snoqualmie, Upper Coal Creek, and Lower South Fork Snoqualmie)

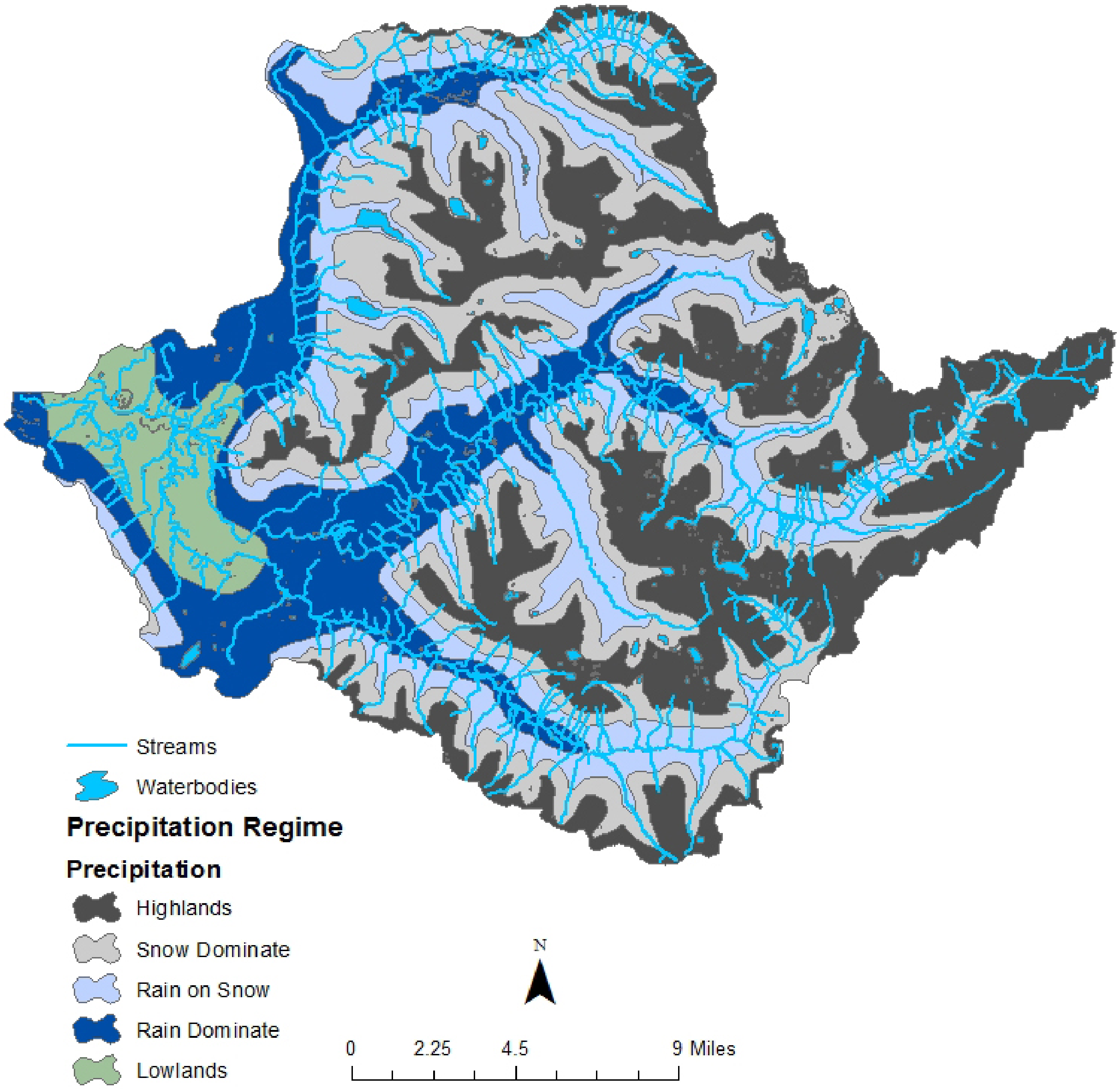


Figure 3: Above the Falls, Snoqualmie River Precipitation Regime

Precipitation Regime	Acres	Percent of Planning Unit
Highlands	72,824	30%
Snow Dominate	61,840	26%
Rain on Snow	49,334	21%
Rain Dominate	43,563	18%
Lowlands	12,988	5%

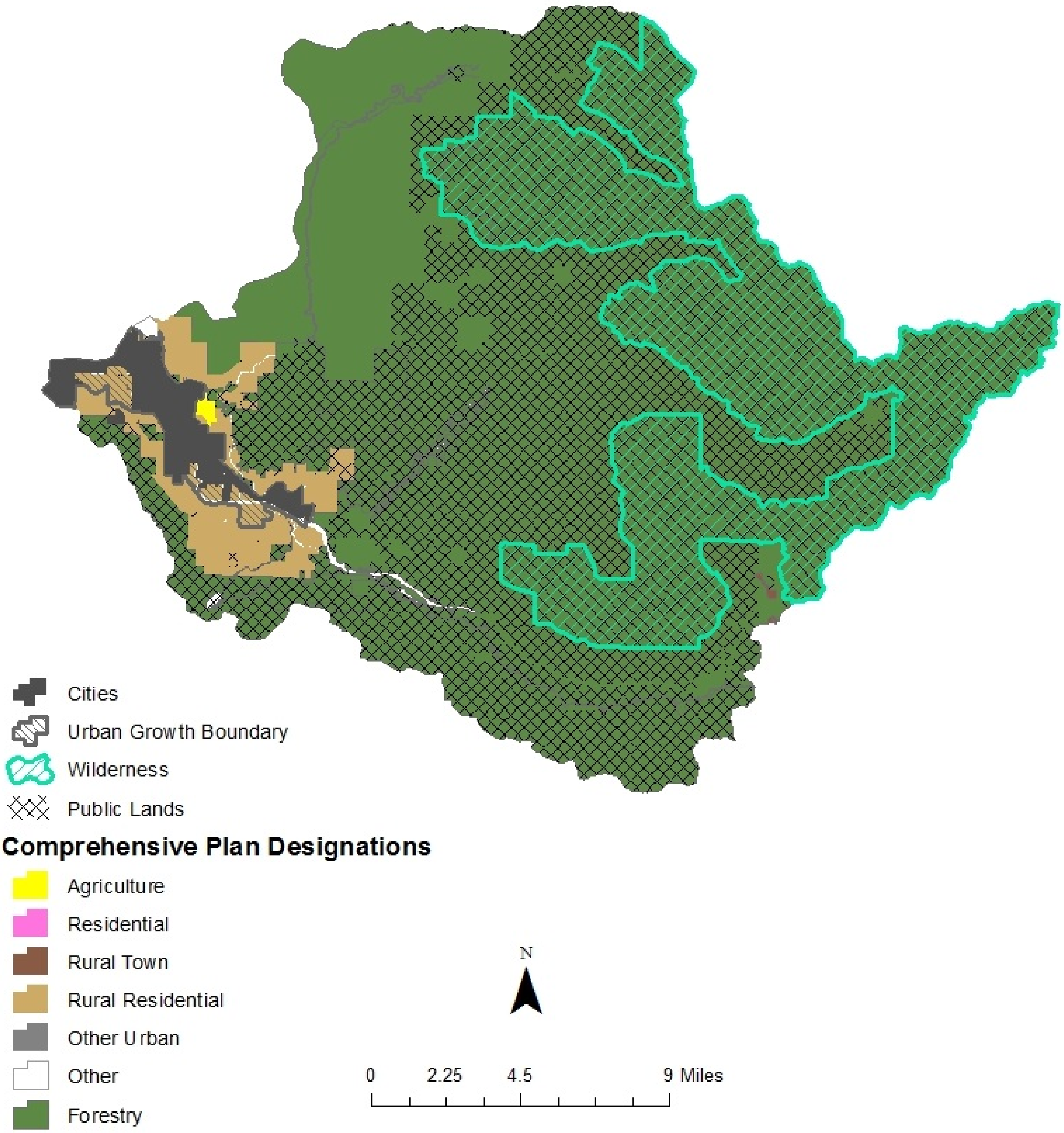


Figure 4: Above the Falls, Snoqualmie River Land Use

Land Use Type	Acres	Percent of Planning Unit
Forestry	219,024	91%
Other	205	0%
Rural Residential	15,117	6%
Rural Town	117	0%
Cities	6,224	3%

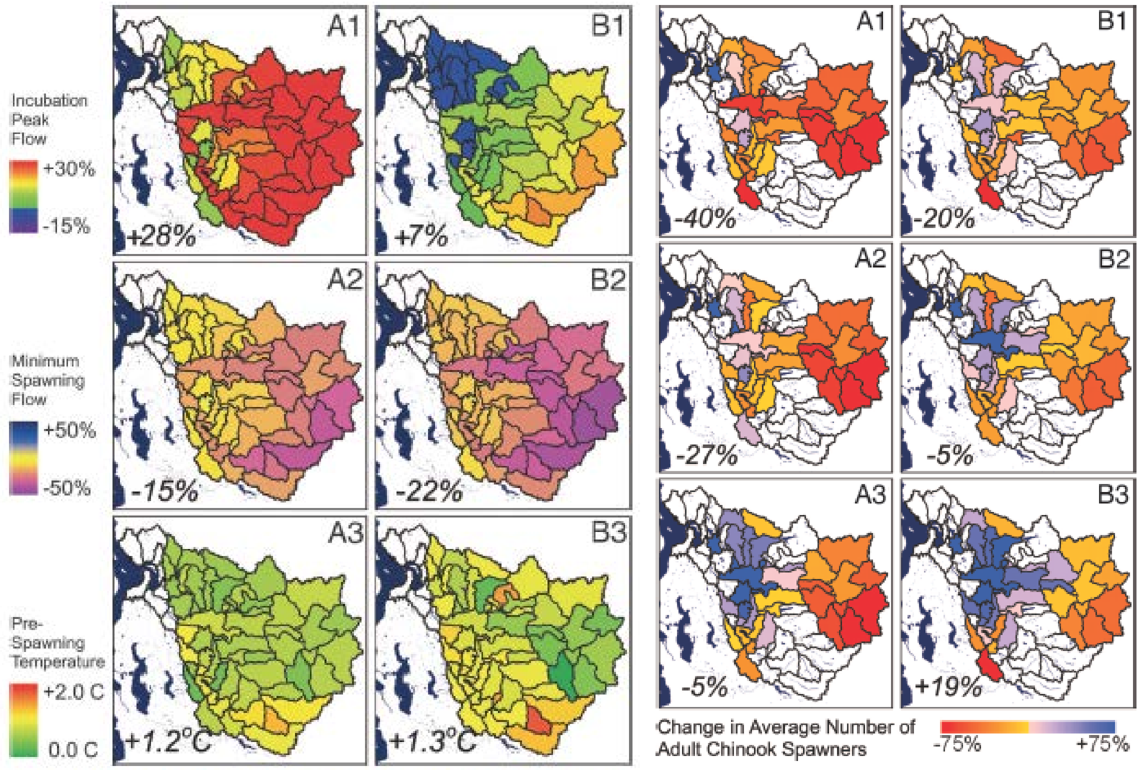


Figure 5: Maps of Modeled Climate Change Effects in the Above the Falls, Snoqualmie River Planning Unit

From Battin et al. 2007

- Incubation peak flow: moderate to major increase (Battin et al. 2007)
- Minimum spawning flow: moderate to major decrease (Battin et al. 2007)
- Pre-spawning temperature: moderate increase (Battin et al. 2007)
- Change in average number of adult Chinook spawners: N/A

In the face of climate change, it is expected that the snow dominate areas will transition to rain on snow dominate areas. Areas that are currently rain on snow will convert to rain dominate areas. This also translates to higher winter flows and lower summer flows with the decrease in spring snow melt.

It has also been noted that there will be a shift to earlier runoff timing and increases in magnitude of extreme precipitation and discharge events (King County 2010).

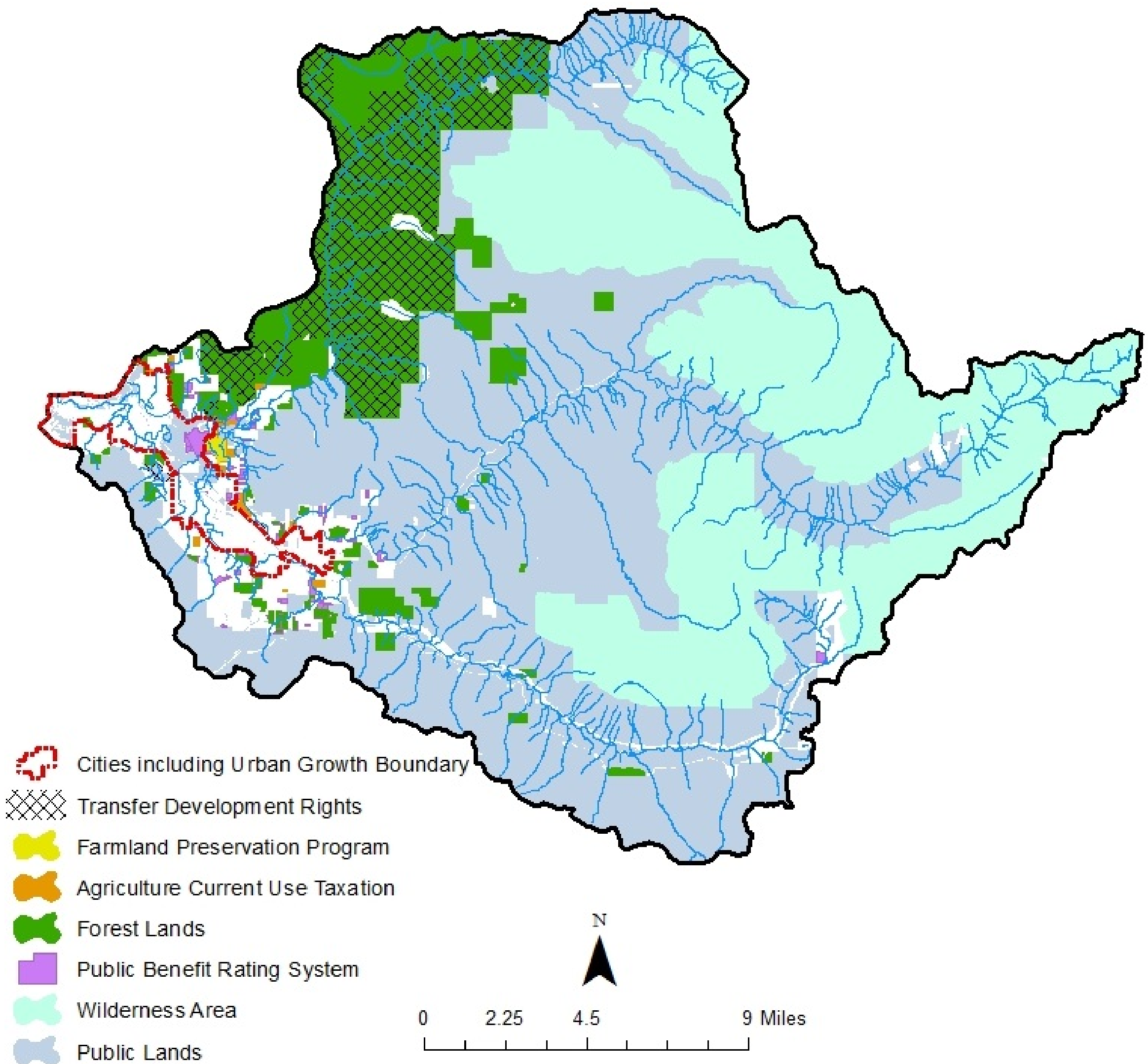


Figure 6: Current Protection Strategies Used in the Above the Falls, Snoqualmie River Planning Unit

Protection Type	Acres	Percent of Planning Unit
Public Benefit Rating System (PBRS)	839	0.3%
Forest Land	38,688	16.1%
Agriculture Current Use Taxation (CUT)	315	0.1%
Farmland Preservation Program (FPP)	217	0.1%
Public Lands	185,620	77.2%
Transfer of Development Rights (TDR)*	30,322	12.6%
Wilderness**	74,171	30.8%

* TDRs are sending sites in the forest lands.

** Wilderness is located in the Public Lands; 74,171 acres of the 185,620 acres in public land are located in Wilderness designation.

Opportunities for Protection

Currently, the headwaters of the Snoqualmie are zoned for forestry and under U.S. Forest Service (USFS) management, and 30.8% of that land is in the Alpine Lake Wilderness which allows for recreation but protects the natural conditions of the area. Also, much of the private forestry development rights have been purchased by King County, creating the Snoqualmie Tree Farm, which is managed by Hancock Timber Resource Group. While much of the planning unit is currently in protection, there are still opportunities to ensure this area continues to provide the necessary cool, clean water to the lower basin. The opportunities are as follows:

- Decrease the number of private inholdings surrounded by public lands through acquisitions
- Work on acquiring TDRs in key areas of hydrologic importance to ensure those areas do not get developed
- Understand the impacts groundwater withdrawals have on instream flows to ensure appropriate quantities of water are making it to the stream and groundwater systems
- Ensure that timber harvest methods are protective of hydrology and can adaptively manage the harvest methods as precipitation regimes shift with climate change

Planning Unit	Above the Snoqualmie Falls
Salmonid Use	No anadromous fish use (assumed Bull Trout presence)
Precipitation Regime	• High Lands (30%) • Snow Dominant (26%) • Rain on Snow (21%) • Rain Dominant (18%)
Primary Land Uses	• Forestry (91%) • Rural Residential (6%) • Cities (3%)
Limiting Factors	NA; anadromous fish not present in this planning unit
Current and Future Pressures	• City growth and rural residential development • Forestry practices • Water withdrawals • High water temperatures • Revetments/levees disconnect the river from the floodplain • Limited large wood recruitment from logging and development

Ecosystem Services	• Flood regulation • Water quality regulation • Drinking water provisioning • Recreation • Energy production • Spawning • Water storage • Disturbance prevention
Climate Change Impacts	• Minimal increase for pre-spawning temperature (Battin et al. 2007) • Shift to earlier runoff timing and increases in magnitude of extreme precipitation and discharge events (King County 2010)
Existing Protection Strategies in Unit	• PBRS 0.3% • Forestland 16.1% • Agriculture 0.1% • FPP 0.1% • Public 77.2% (12.6% of basin in TDR; 30.8% of basin in Wilderness)
Opportunities	• Decrease private inholdings surrounded by public land • Study the impacts of groundwater withdrawals on instream flows and groundwater • Acquire TDRs in key areas of hydrologic importance • Ensure timber harvest methods are protective of hydrology

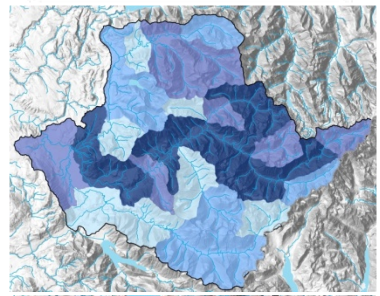
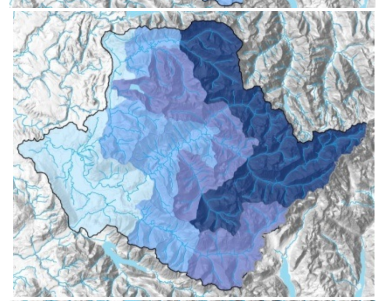
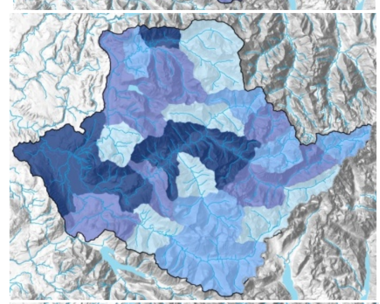
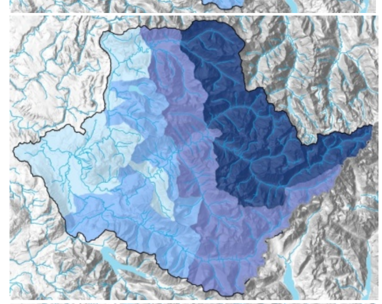
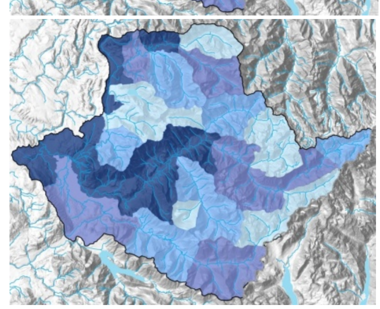
Legend	
Overall	
Delivery	
Surface Storage	
Recharge	
Discharge	

Figure 7: Overall Water Flow Maps for the Above the Falls, Snoqualmie River Planning Unit

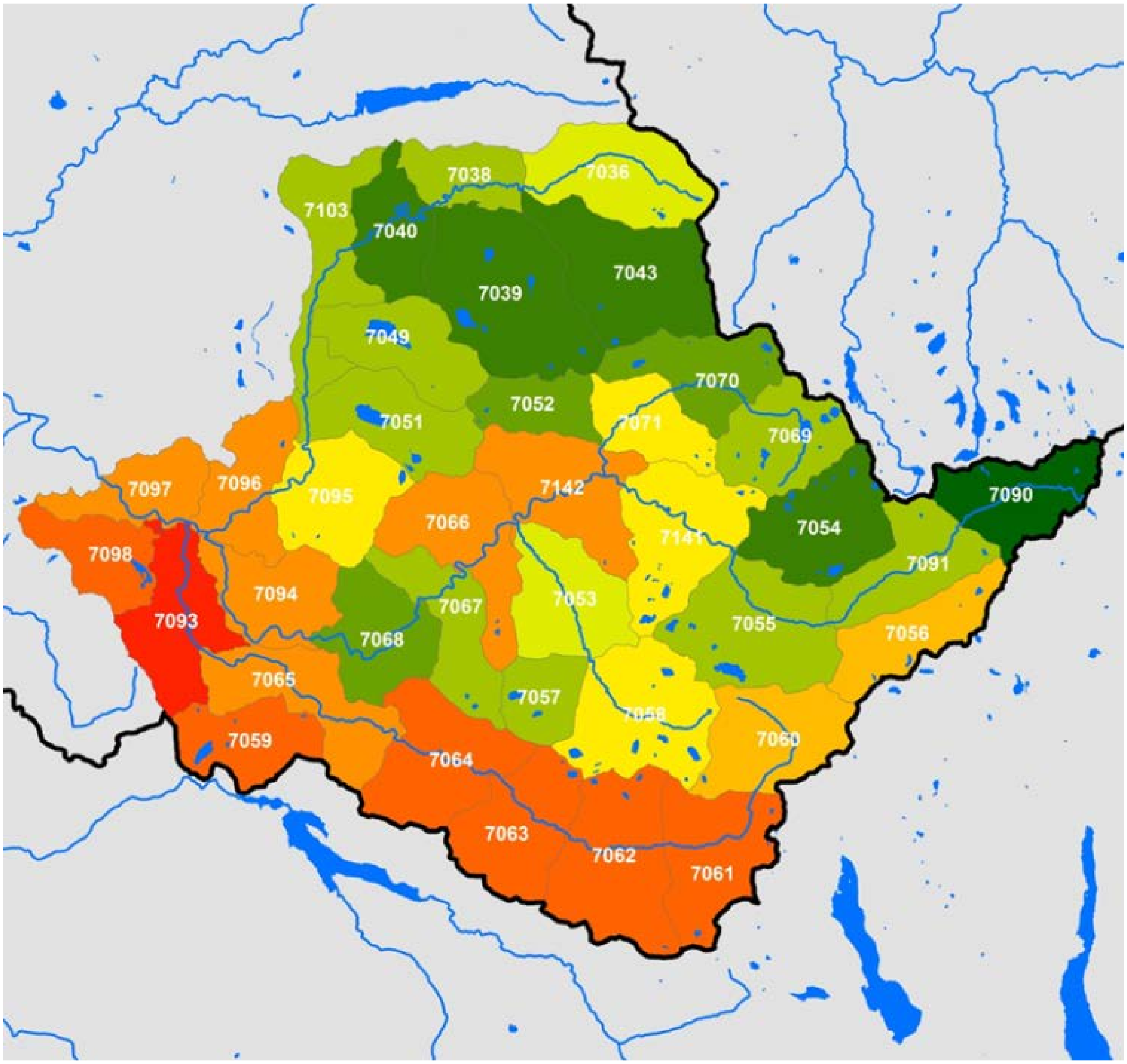


Figure 8: Watershed Characterization Habitat Model Map for the Above the Falls, Snoqualmie River Planning Unit

Numbers are labels for spatial units

Watershed Characterization Summary

Planning Unit	Above the Snoqualmie Falls
Overall Flow Importance Model	• Entire Middle Fork Snoqualmie • Taylor River • Tate Creek

Delivery Importance Model	• Headwaters • Eastern extents of the upper North Fork • Middle Fork Snoqualmie
Surface Storage Importance Model	• Lower-mid Middle Fork Snoqualmie • Coal Creek • Tate Creek (around North Bend and Snoqualmie)
Recharge Importance Model	• Taylor River • Eastern headwaters • Upper portions of the North Fork and Middle Fork
Discharge Importance Model	• Middle Fork Snoqualmie • Tate Creek • Coal Creek • Northern tributaries of the North Fork Snoqualmie
Habitat Model	Generally, the North and Middle Forks of the Snoqualmie have higher watershed habitat indices than the South Fork Snoqualmie and western drainages. The upper portions of the North and Middle Forks, in addition to Taylor River, displayed the highest watershed habitat values. *While habitat potential is good, the Snoqualmie Falls is a natural barrier that prevents anadromous fish from being able to access this habitat. However, above falls is designated (ESA-threatened) bull trout habitat. Thompson et al. conducted thorough surveys of all the forks; another team recently resurveyed the North Fork Snoqualmie canyon, and no bull trout were detected.*
Protection Consideration	• North Fork: Protection of delivery and recharge; restoration of delivery and recharge processes in mid reaches • Middle Fork: restoration of storage; protection of delivery and recharge • South Fork: protection of delivery and recharge processes

Mid-Snoqualmie Tributaries Planning Unit

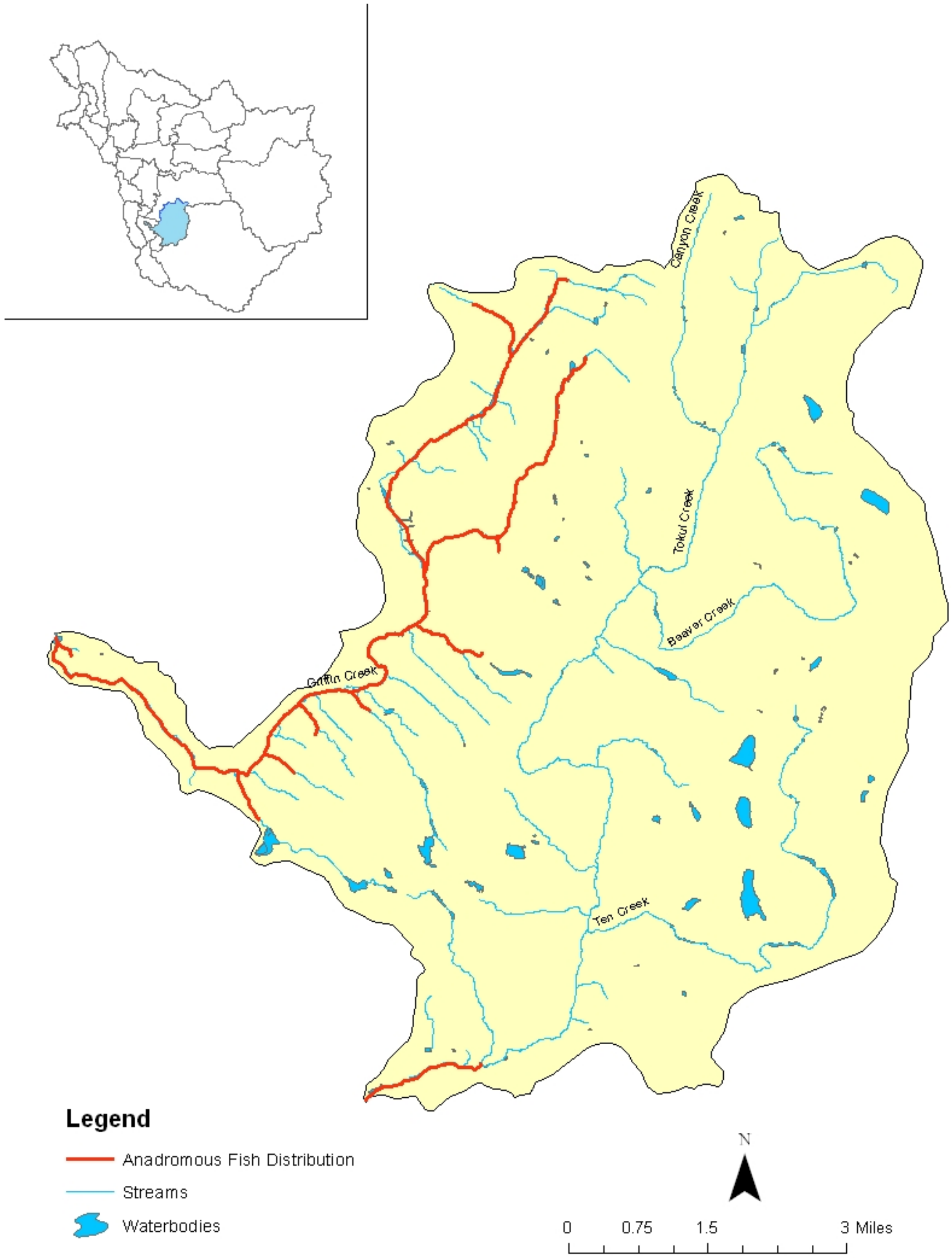


Figure 9: Mid-Snoqualmie Tributaries Planning Unit

Basin(s) Name(s): Mid-Snoqualmie River

Sub-basin Strategy Group: Headwaters Secondary Restoration

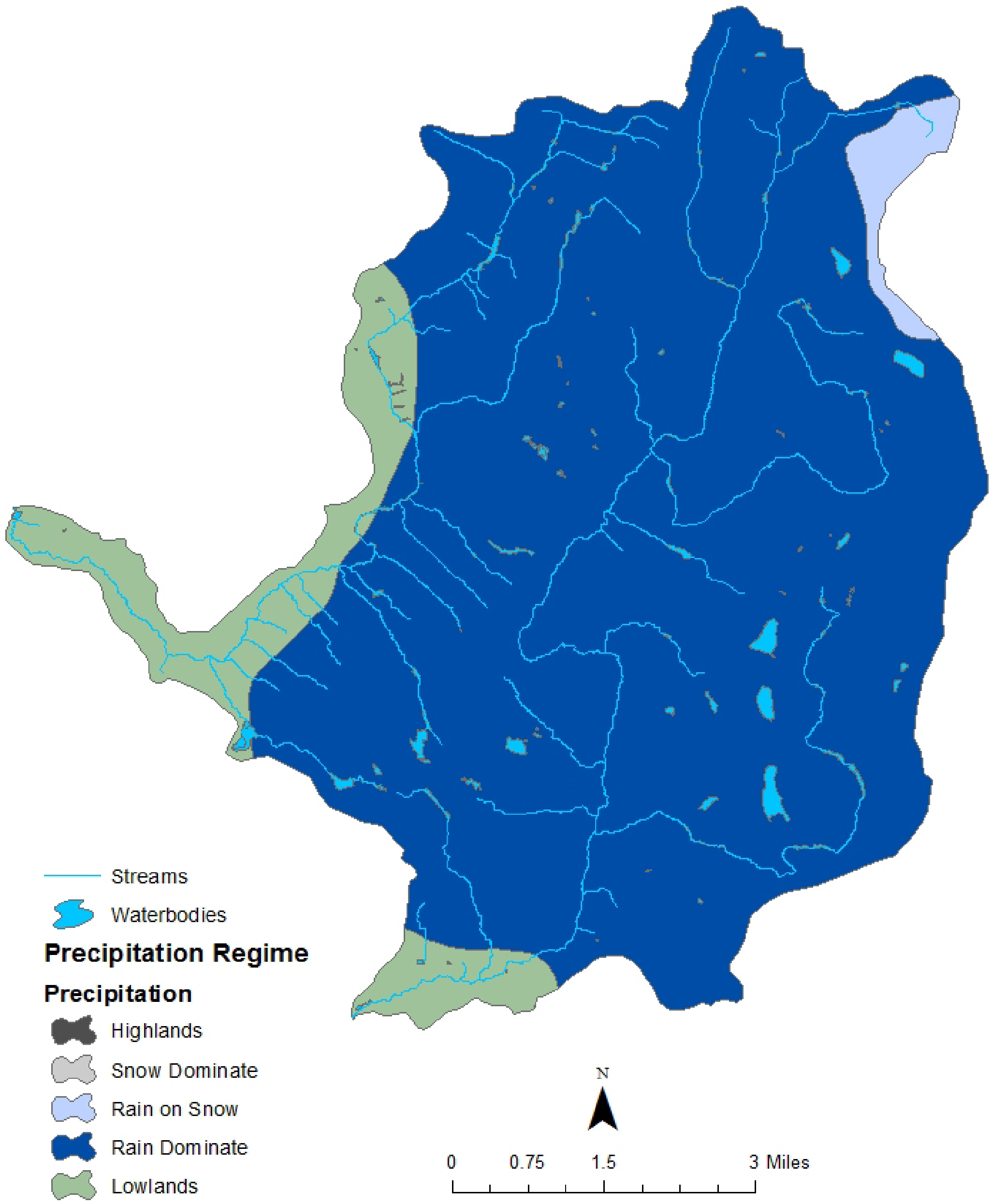


Figure 10: Mid-Snoqualmie Tributaries Precipitation Regime

Precipitation Regime	Acres	Percent of Planning Unit
Rain Dominate	29,309	89%
Lowlands	3,063	9%
Rain on Snow	583	2%

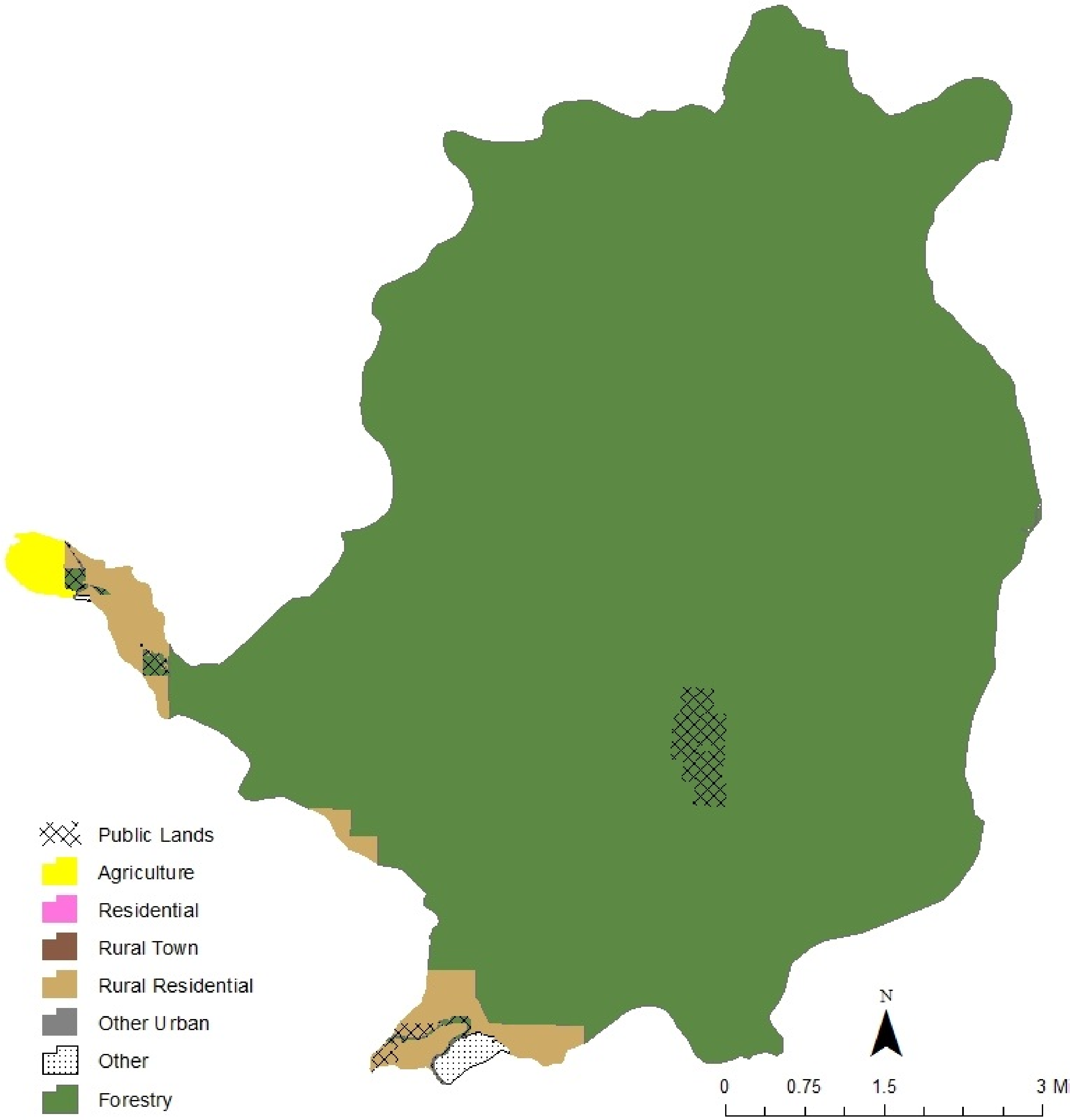


Figure 11: Mid-Snoqualmie Tributaries Land Use

Land Use Type	Acres	Percent of Planning Unit
Other	110	0.3%
Rural Residential	914	2.8%
Agriculture	173	0.5%
Forestry	31,657	96.1%

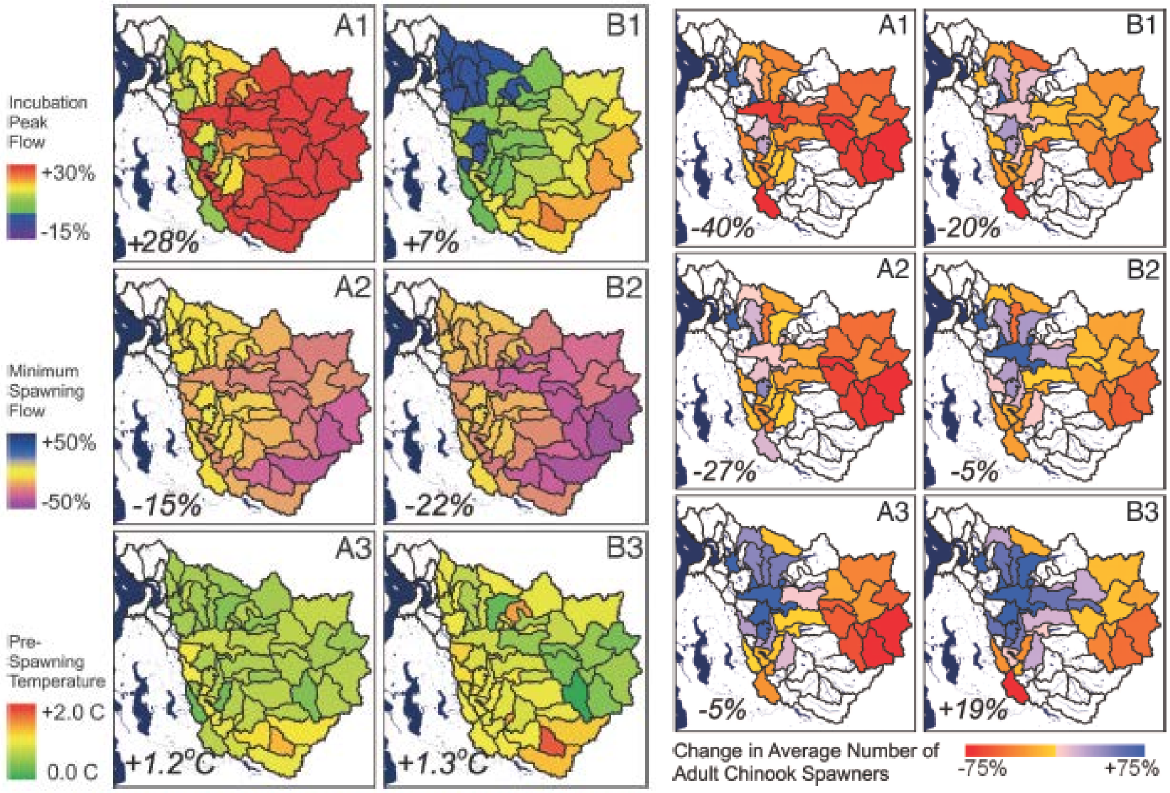


Figure 12: Maps of Modeled Climate Change Effects in the Mid-Snoqualmie Tributaries Planning Unit

From Battin et al. 2007

- Incubation peak flow: moderate increase (Battin et al. 2007)
- Minimum spawning flow: minimal decrease (Battin et al. 2007)
- Pre-spawning temperature: moderate increase (Battin et al. 2007)
- Change in average number of adult Chinook spawners: moderate decrease in number under A1, A2, B1, and B2 and slight increase in numbers under A3 and B3 (Battin et al. 2007)

In the face of climate change, it is expected that the snow dominate areas will transition to rain on snow dominate areas. Areas that are currently rain on snow will convert to rain dominate areas. This also translates to higher winter flows and lower summer flows with the decrease in spring snow melt (Battell 2014).

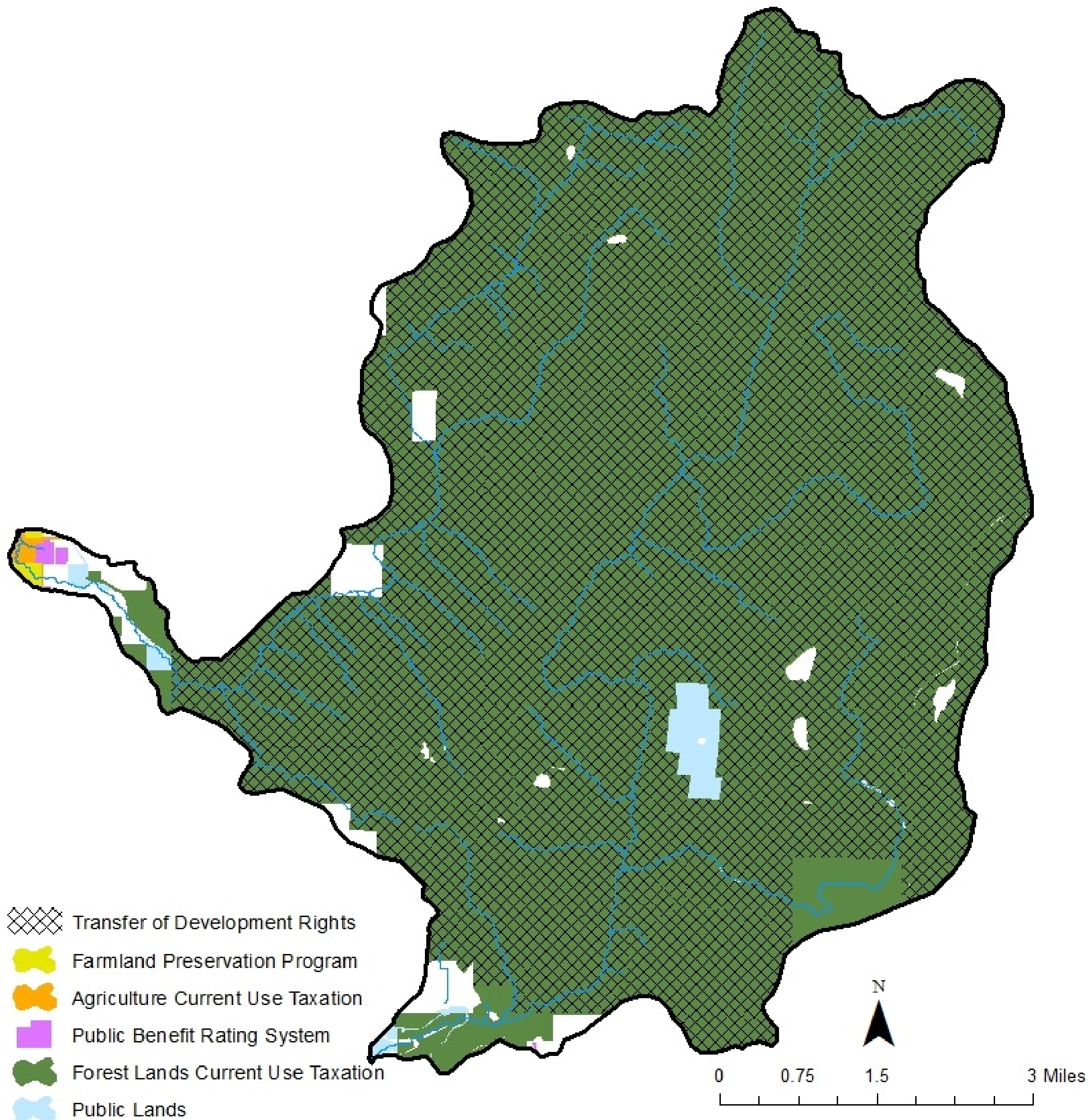


Figure 13: Current Protection Strategies Used in the Mid-Snoqualmie Tributaries Planning Unit

Protection Type	Acres	Percent of Planning Unit
Agriculture CUT	186	1%
FPP	114	0.3%
PBRS	91	0.3%
Forest Land CUT	31,327	95%
Public Lands	446	1%
TDR*	30,384	92%

* All TDRs are sending sites in the forest lands

Opportunities for Protection

Currently, the headwaters of Tokul and Griffin Creeks are in CUT programs for forestry, and 92% of those lands have TDRs placed on them, protecting that area from development. While much of the planning unit is currently in protection, there are still the following opportunities to ensure this area continues to provide cool, clean water:

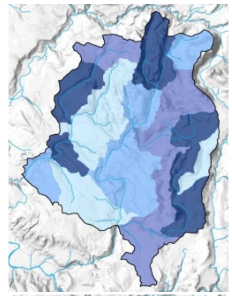
- Ensure that timber harvest methods are protective of hydrology and can adaptively manage the harvest methods as precipitation regimes shift with climate change
- Enroll areas of private forestry into a CUT program
- Enroll rural residential properties into the appropriate CUT program to ensure natural resources are protected, which, in turn, protects the hydrology

Planning Unit	Mid Snoqualmie
Salmonid Use	• Chinook = low use • Coho = high use (Griffin) and known use (Tokul) • Bull trout = presumed presence (Griffin) and none (Tokul) • Steelhead = moderate use
Precipitation Regime	• Rain Dominant (89%) • Rain on Snow (2%) • Low Lands (9%)
Primary Land Uses	• Forestry (96.1%) • Rural Residential (2.8%)
Limiting Factors	• Upriver migration • Spawning • Egg deposition • Egg development • Freshwater rearing • River outmigration
Current and Future Pressures	• Biological resource use—in particular, timber harvest • Natural system modification • Human intrusions and disturbance • Development • Invasive and problematic species
Ecosystem Services	• Flood regulation • Water quality • Regulation • Recreation • Irrigation • Storage • Water quantity regulation

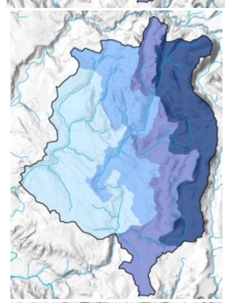
Climate Change Impacts	• Moderate increase in incubation peak flow • Minimal decrease in minimum spawning flow • Moderate increase in pre-spawning temperature • Moderate decrease in average number of adult Chinook spawners in four of six scenarios (Battin et al. 2007)
Existing Protection Strategies in Unit	• Forestland (95%) • PBRS 0.3% • Agriculture CUT 1% • Public Lands 1% • 0.3% of Agriculture Land is in FPP • 92% of forestlands in TDR
Opportunities	• Place non-protected parcels into appropriate CUT programs, particularly in hydrologically important areas • Ensure timber harvest methods are protective of hydrology

Legend

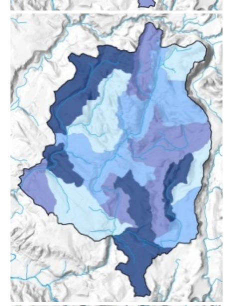
Overall



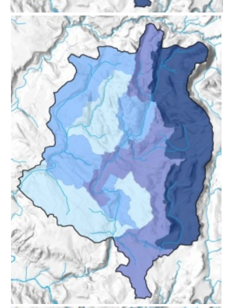
Delivery



Surface Storage



Recharge



Discharge

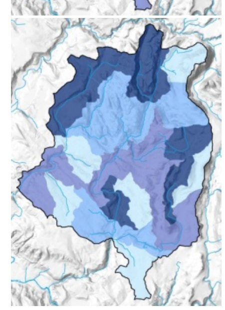


Figure 14: Overall Water Flow Maps for the Mid-Snoqualmie Tributaries Planning Unit

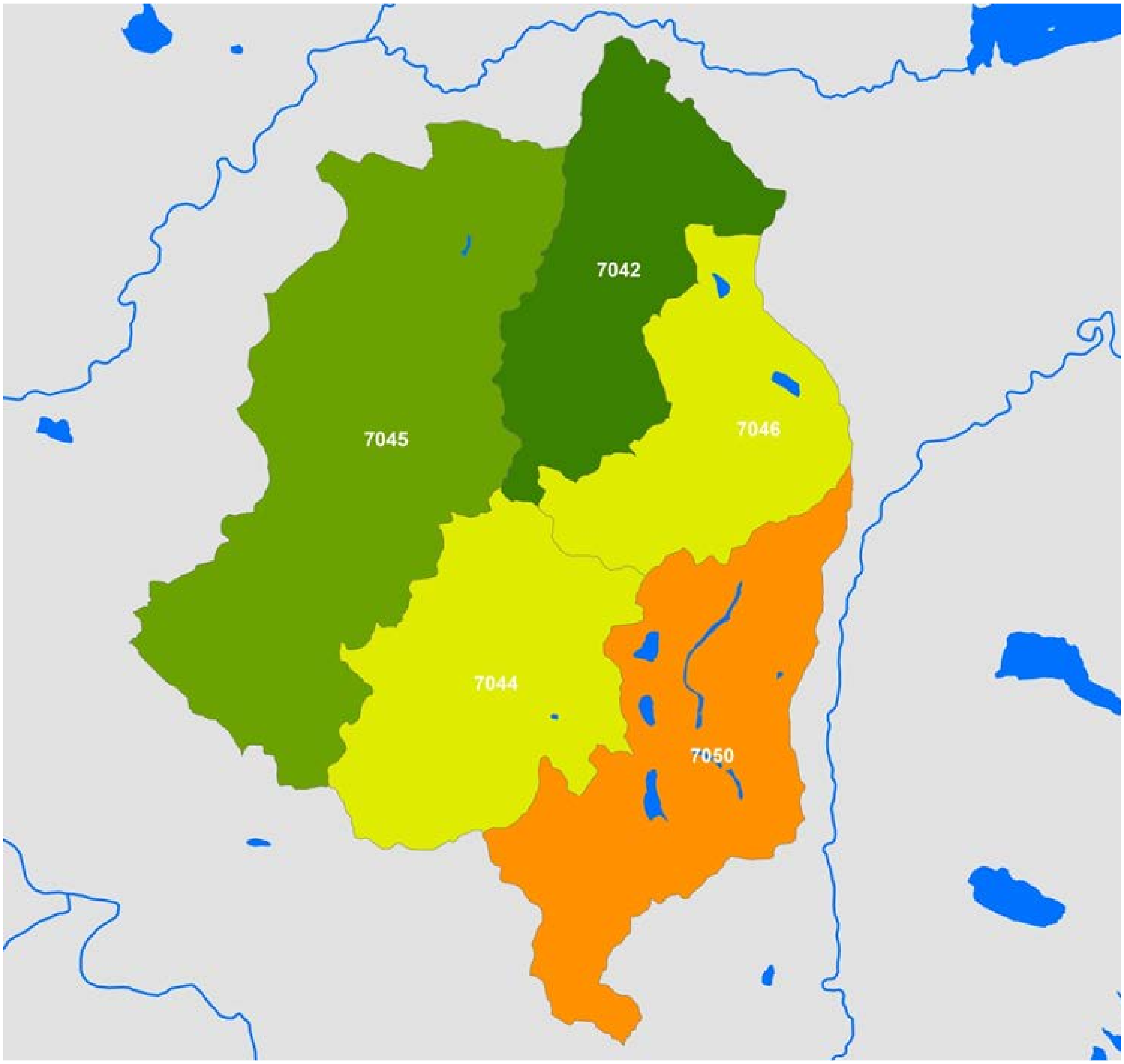


Figure 15: Watershed Characterization Habitat Model Map for the Mid-Snoqualmie Tributaries Planning Unit

Numbers are labels for spatial units

Watershed Characterization Summary

Planning Unit	Mid-Snoqualmie
Overall Flow Importance Model	• Headwaters of Tokul Creek (Canyon Creek, Beaver Creek, and Ten Creek drainages) • Western portions of the Griffin Creek drainage
Delivery Importance Model	• Eastern portion of the Tokul Creek drainage (including the Beaver Creek and Ten Creek drainages)
Surface Storage Importance Model	• Western drainages of Griffin Creek • Southern drainages of Tokul Creek
Recharge Importance Model	• Eastern portion of the Tokul Creek drainage (including the Beaver Creek and Ten Creek drainages)
Discharge Importance Model	• Griffin Creek drainage • Beaver and Ten Creek drainages
Habitat Model	• Griffin Creek • Tokul Creek
Protection Consideration	• Protection and restoration of surface storage and discharge

Raging River Planning Unit

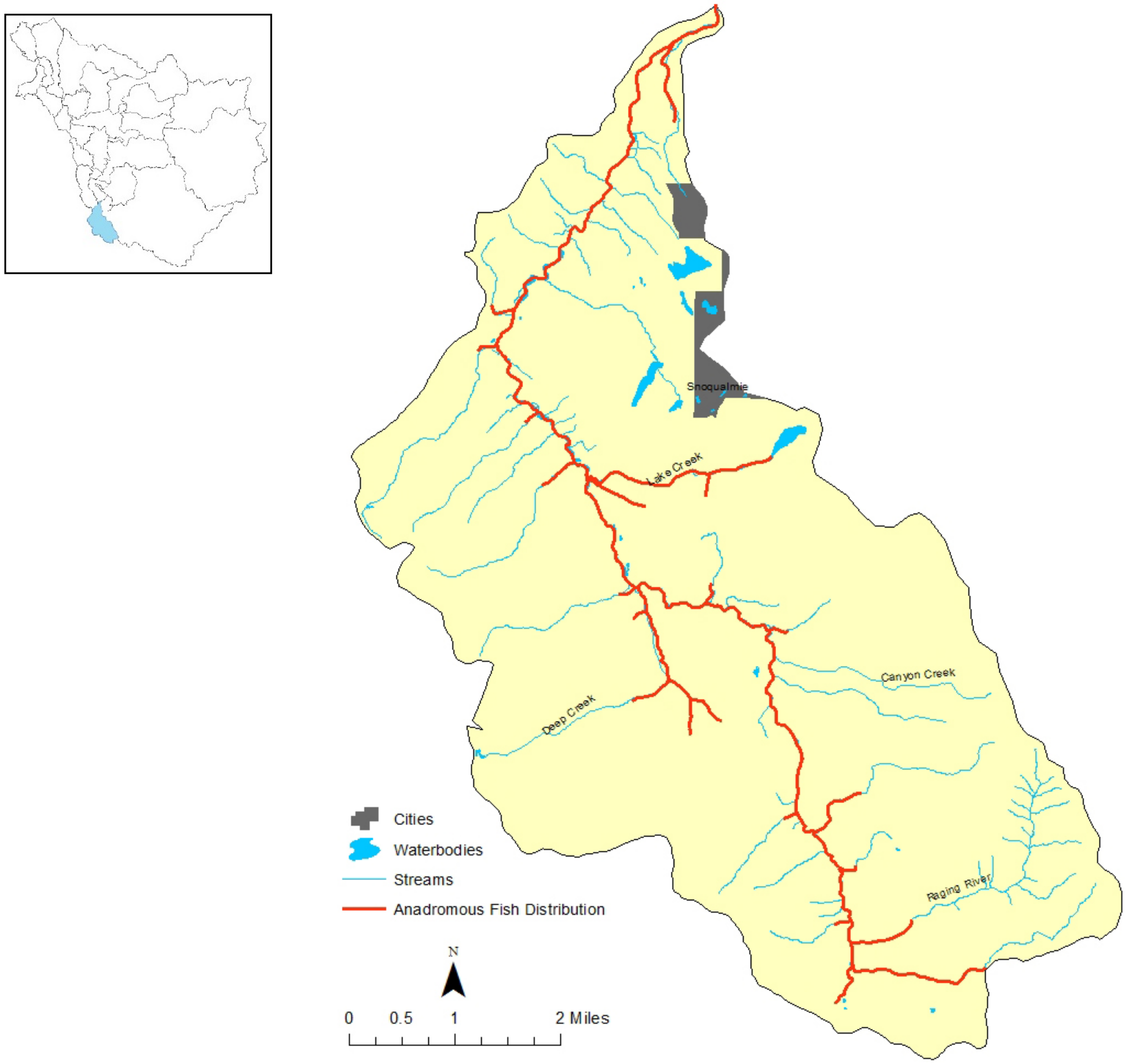


Figure 16: Raging River Planning Unit

Basin(s) Name(s): Raging River

Sub-basin Strategy Group: Mainstem Primary Restoration

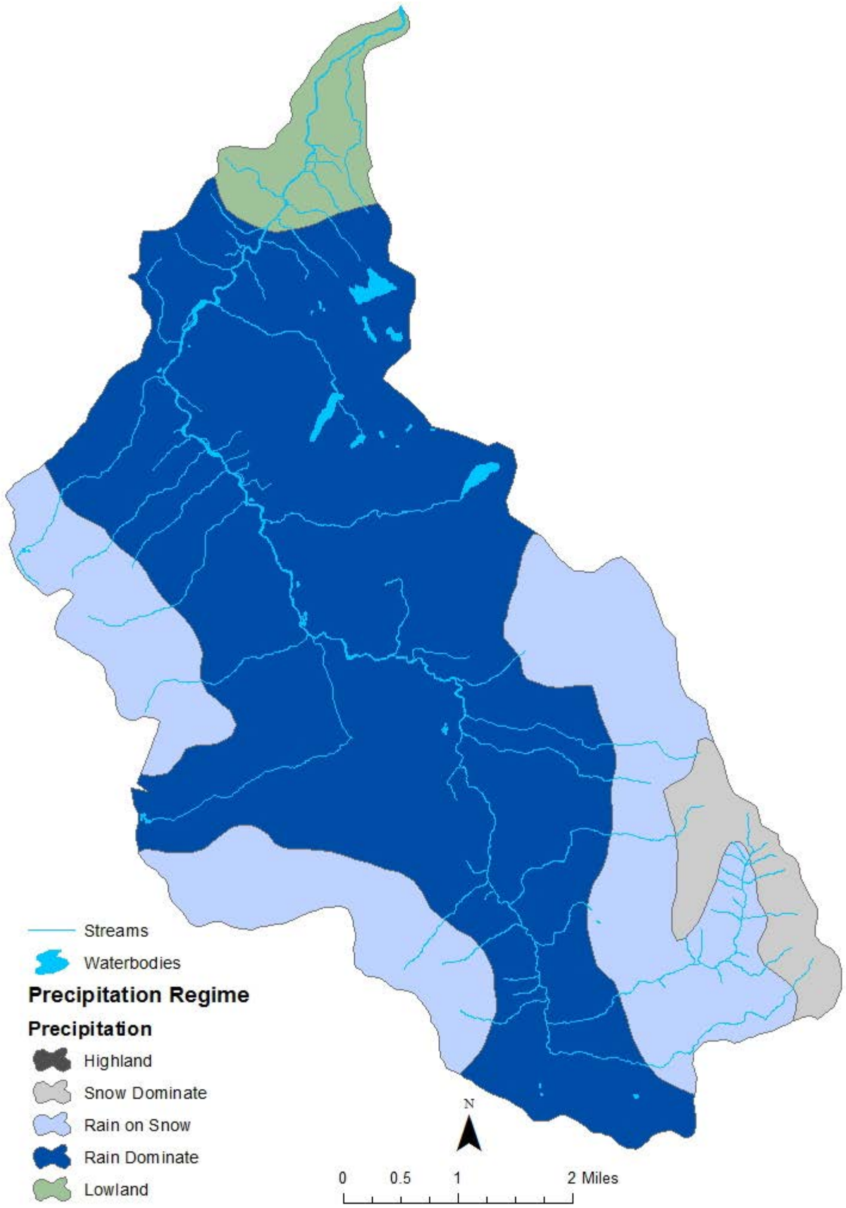


Figure 17: Raging River Precipitation Regime

Precipitation Regime	Acres	Percent of Planning Unit
Snow Dominate	916	4.4%
Rain on Snow	5,865	27.9%
Rain Dominate	13,243	63.1%
Lowlands	951	4.5%

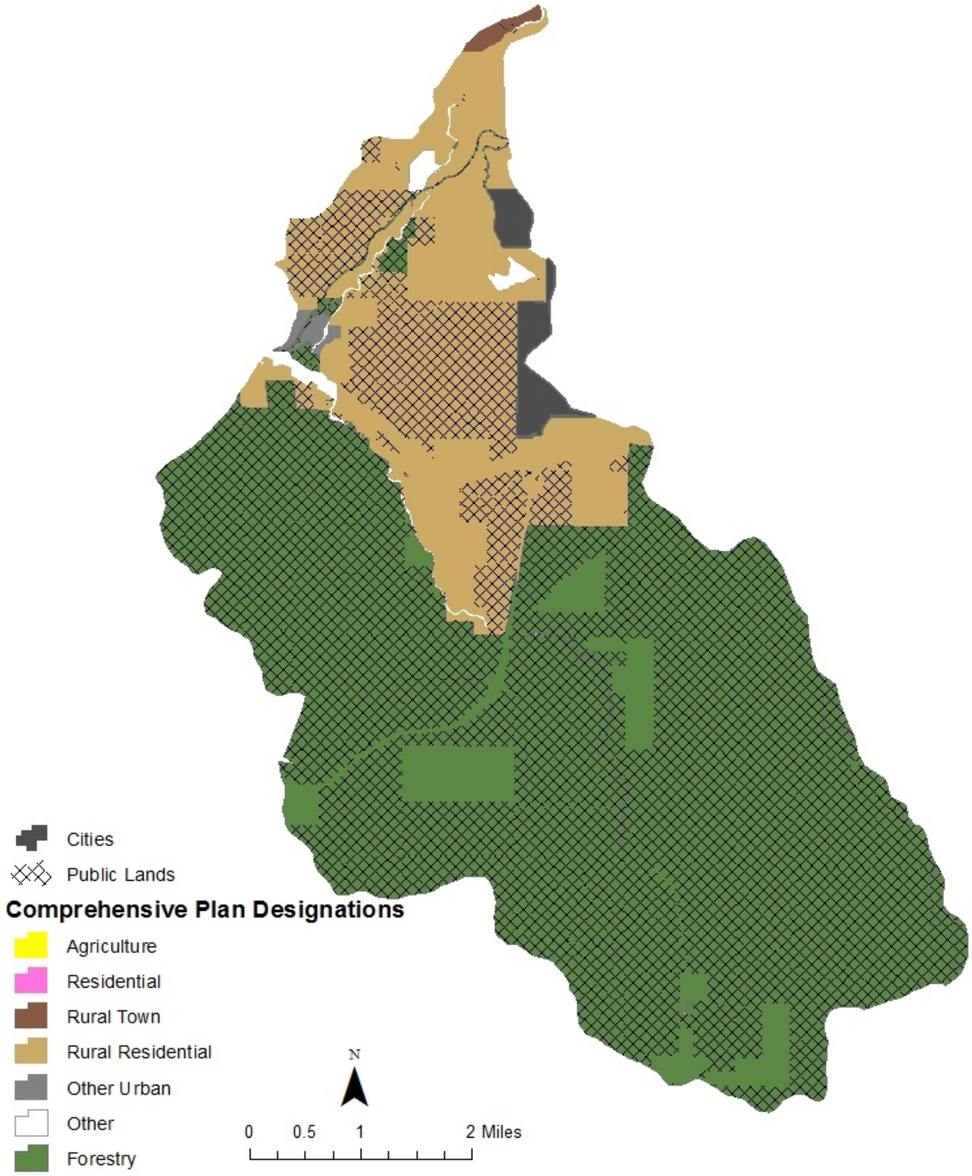


Figure 18: Raging River Land Use

Land Use Type	Acres	Percent of Planning Unit
Forestry	15,244	72.6%
Rural Residential	5,157	24.6%
Rural Town	63	0.3%
Other	46	0.2%
Cities	74	0.4%

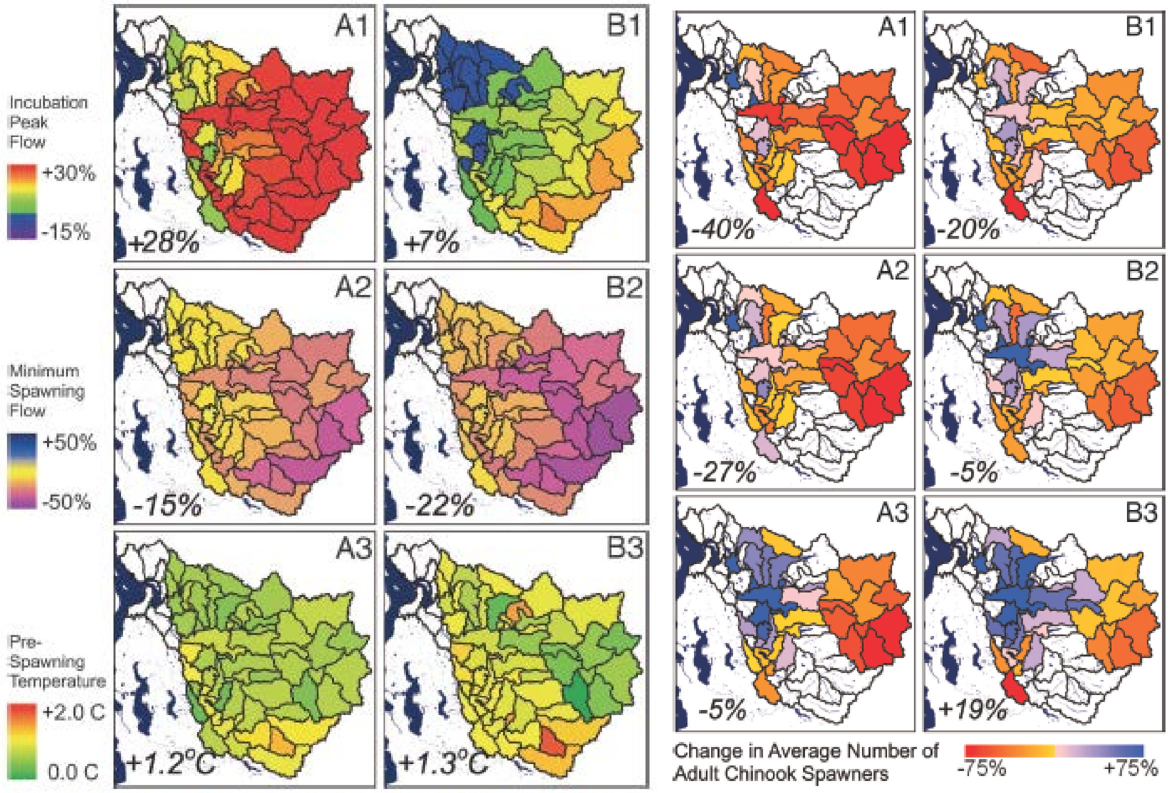


Figure 19: Maps of Modeled Climate Change Effects in the Raging River Planning Unit

From Battin et al. 2007

- Incubation peak flow: slight decrease (Battin et al. 2007)
- Minimum spawning flow: minimal decrease (Battin et al. 2007)
- Pre-spawning temperature: moderate increase (Battin et al. 2007)
- Change in average number of adult Chinook spawners: decrease in number under A1, B1, B2, A3, and B3 and slight increase in numbers under A2 (Battin et al. 2007)

In the Raging River Planning Unit, some models are predicting higher winter discharges due to increased winter rain. Summer models still show very low discharges. This basin is predominantly rain dominate. There is very little snow accumulation in the headwater areas; therefore, there is not an increase in discharge in the spring, unlike many of the other snow or snow on rain dominate basins (King County 2010).

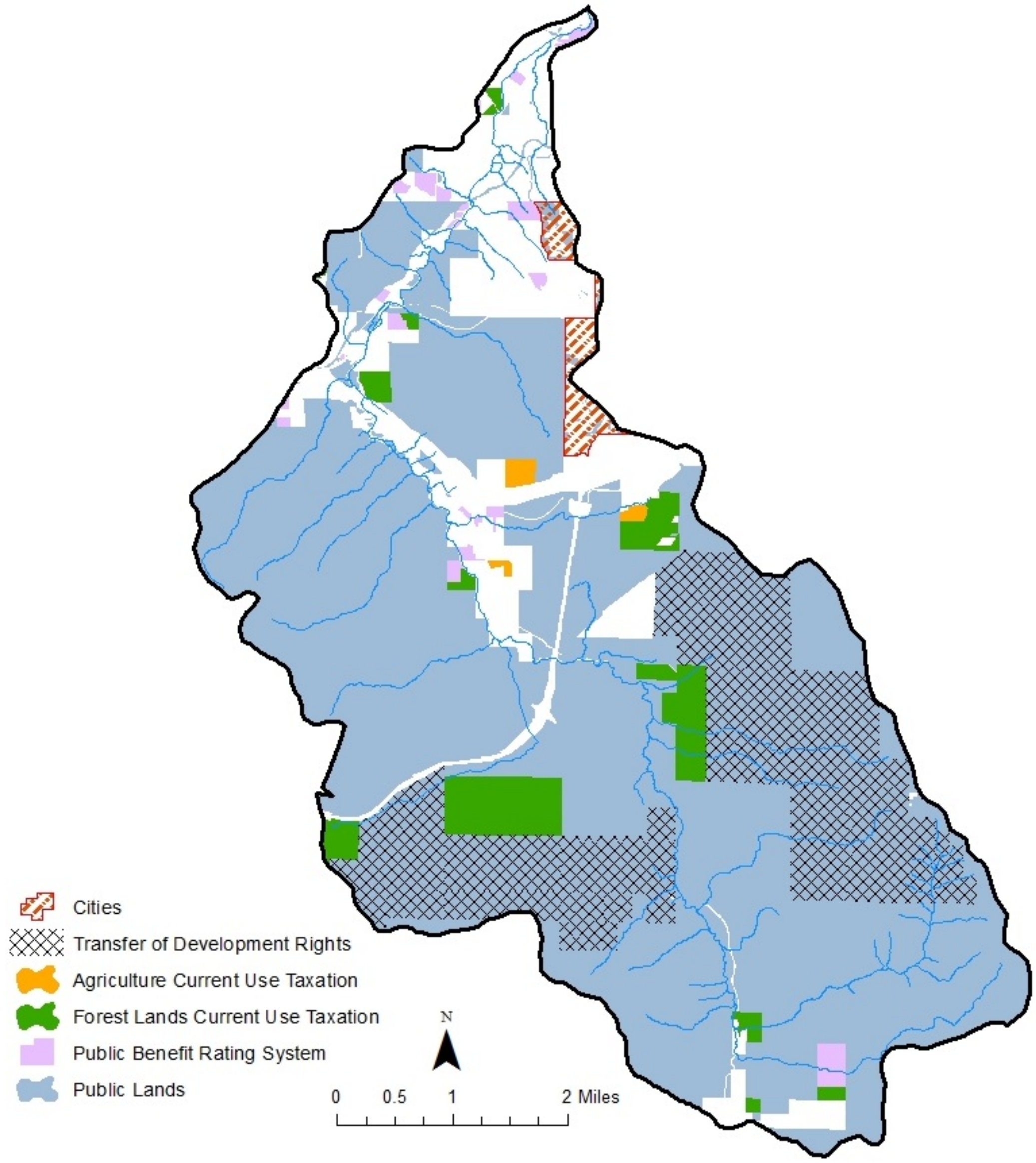


Figure 20: Current Protection Strategies Used in the Raging River Planning Unit

Protection Type	Acres	Percent of Planning Unit
PBRS	388	1.8%
Forest Lands CUT	840	4.0%
Agriculture CUT	59	0.3%
Public Lands	16,619	79.2%
TDR*	4,193	20%

* TDRs are located in the public lands

Opportunities for Protection

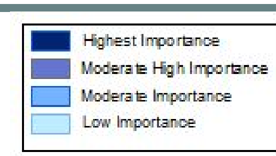
Currently, 79.2% of the Raging River Planning Unit is in public ownership. King County has purchased 20% of the development rights in the basin, keeping it protected in forestry use. This is an excellent start to protection in the Raging River; however, the following opportunities still exist to further protection of hydrology in the planning unit:

- Ensure that public lands do not get converted to private lands by tracking the DNR-owned lands and noting if they become part of the public trust.
- Ensure that timber harvest methods are protective of hydrology and can adaptively manage the harvest methods as precipitation regimes shift with climate change.
- Enroll rural residential properties into the appropriate CUT program to ensure natural resources are protected, which, in turn, protects the hydrology.
- Decrease the number of private inholdings surrounded by public lands through acquisitions.

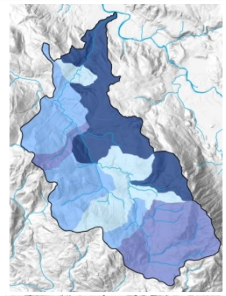
Planning Unit	Raging River
Salmonid Use	• Chinook = moderate to high use • Coho = high use • Bull trout = presumed presence • Steelhead = high use
Precipitation Regime	• Rain Dominant (63.1%) • Rain on Snow (27.9%) • Low Lands (4.5%) • Snow Dominant (4.4%)
Primary Land Uses	• Forestry (72.6%) • Rural Residential (24.6%)
Limiting Factors and Life Cycle Stressors	• Upriver migration • Spawning • Egg deposition • Egg development • Freshwater rearing • River outmigration
Current and Future Pressures	• Biological resource use—in particular, timber harvest • Natural system modification • Human intrusions and disturbance • Development • Invasive and problematic species

Ecosystem Services	• Flood regulation • Water quality regulation • Recreation • Storage • Water quantity regulation
Climate Change Impacts	• Slight decrease in incubation peak flow • Minimal decrease in minimum spawning flow • Moderate increase in pre-spawning temperature • Decrease in average number of adult Chinook spawners in five of six scenarios (Battin et al. 2007)
Existing Protection Strategies in Unit	• Public Lands (79.2%) • TDR (20%) • Forestlands (3.6%) • PBRS (2.2%) • Agriculture (0.3%)
Opportunities	• Try to capture any DNR Public Trust lands to avoid being put into private ownership • Ensure timber methods are protective of hydrology • Enroll private properties into CUT programs • Decrease private inholdings surrounded by public land

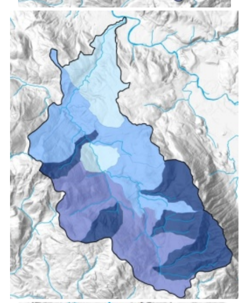
Legend



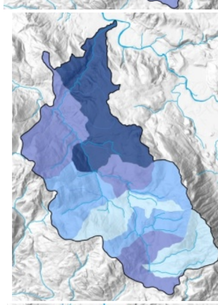
Overall



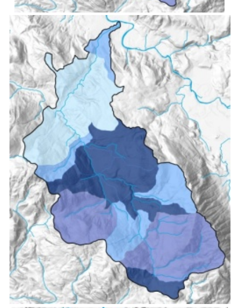
Delivery



Surface Storage



Recharge



Discharge

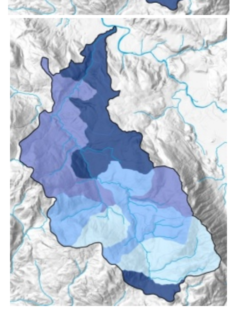


Figure 21: Overall Water Flow Maps for Raging River Planning Unit

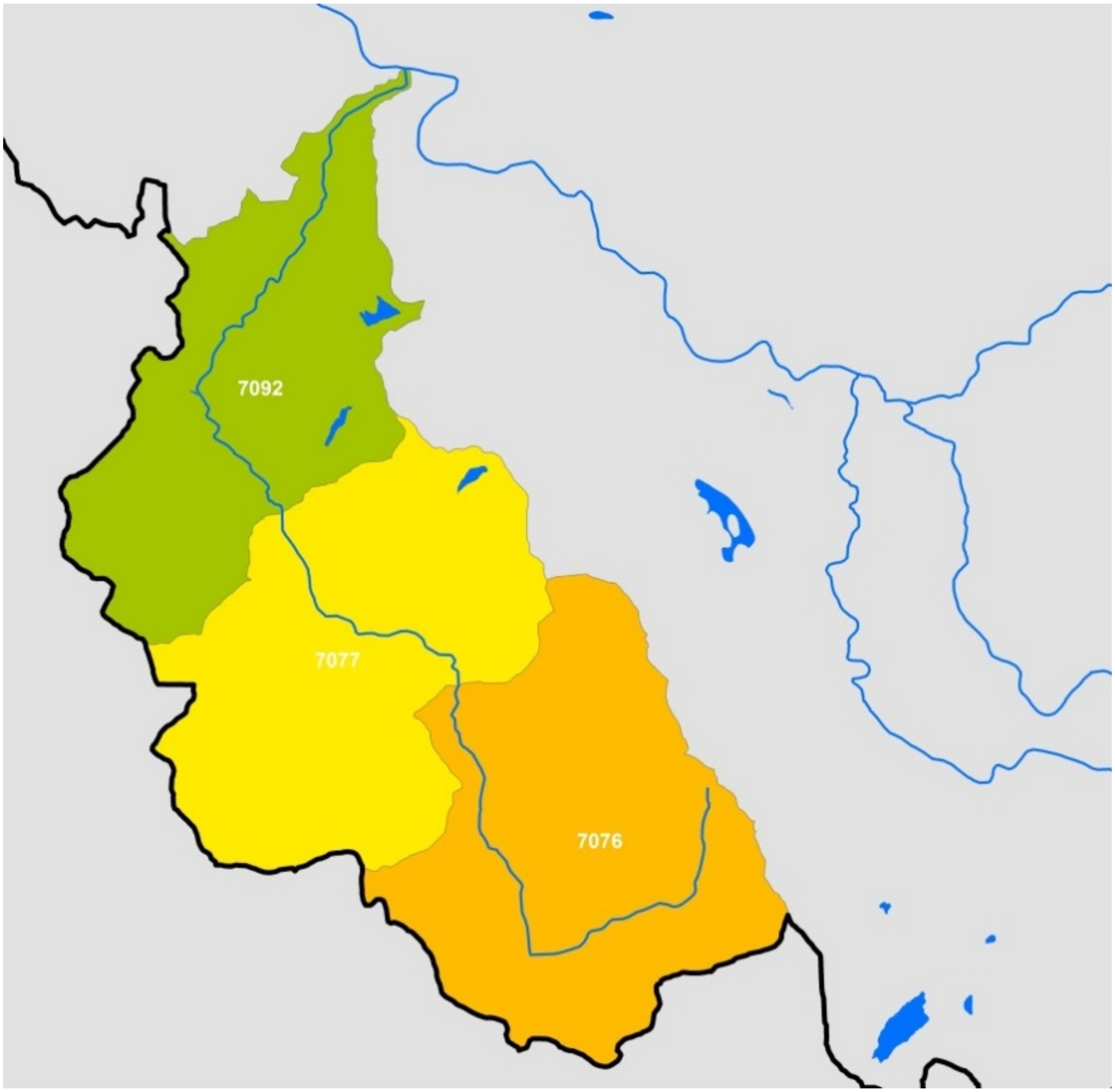


Figure 22: Watershed Characterization Habitat Model Map for the Raging River Planning Unit

Numbers are labels for spatial units

Watershed Characterization Summary

Planning Unit	Raging River
Overall Flow Importance Model	Headwaters rank moderately high in importance to the hydrology of the basin
Delivery Importance Model	Headwaters (near Tiger Mountain)

Surface Storage Importance Model	Mouth of the Raging River near Preston and Fall City
Recharge Importance Model	Headwaters (near Tiger Mountain) and the middle portion of the basin
Discharge Importance Model	Mouth of the Raging River near Preston and Fall City
Habitat Model	• The best habitat is in the lower portions of the Raging River • Upper reaches of the Raging River are considered moderate quality or importance
Protection Consideration	Protect delivery and recharge in the upper watershed

Lowland Snoqualmie Tributaries Urban Planning Unit

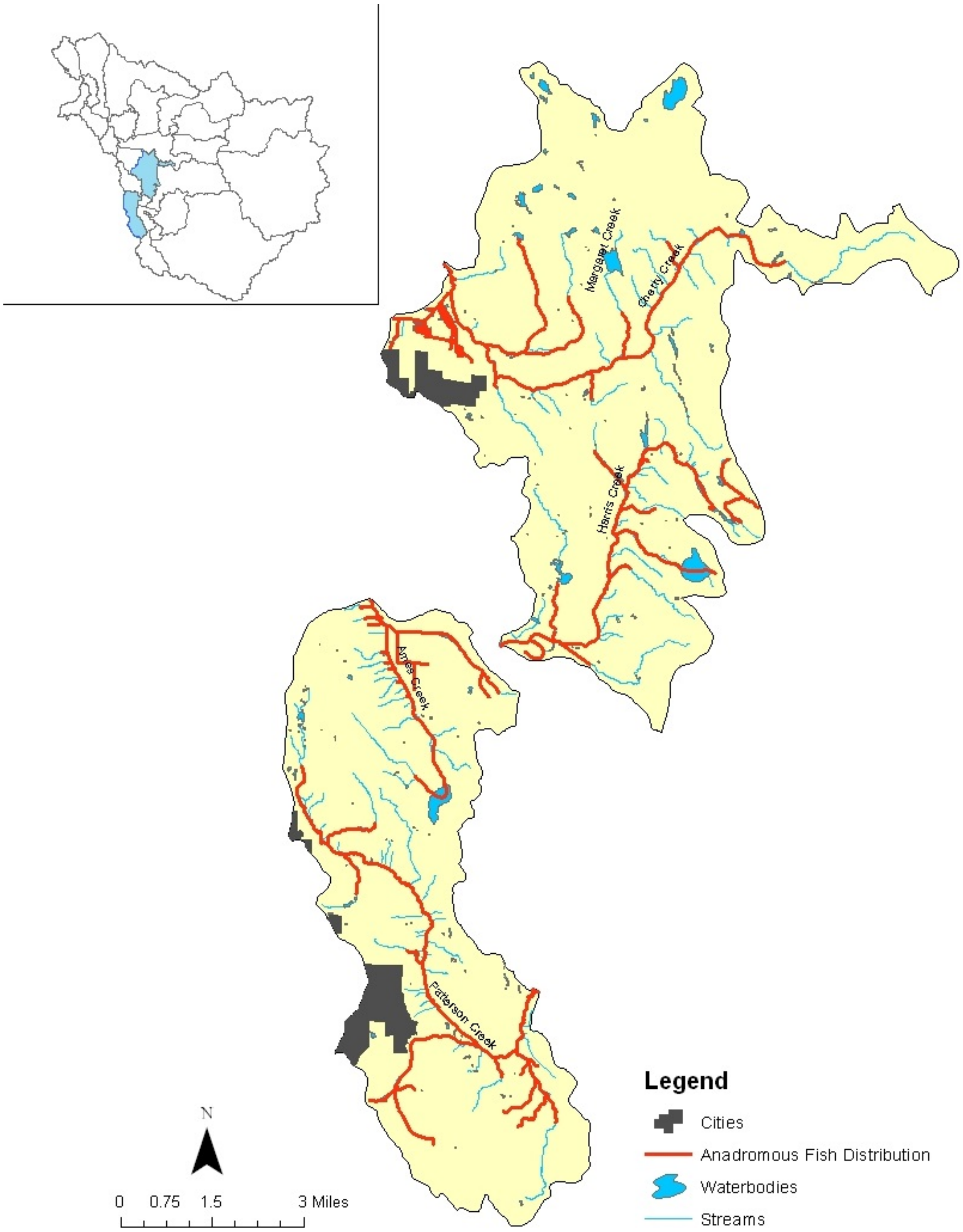


Figure 23: Lowland Snoqualmie Tributaries Urban Planning Unit

Basin(s) Name(s): Cherry Creek, Harris Creek, Ames Creek, and Patterson Creeks
Sub-basin Strategy Group: Rural Streams – Primary Restoration (Cherry Creek) and Rural Streams – Secondary Restoration (Patterson Creek, Harris Creek, and Ames Creeks)

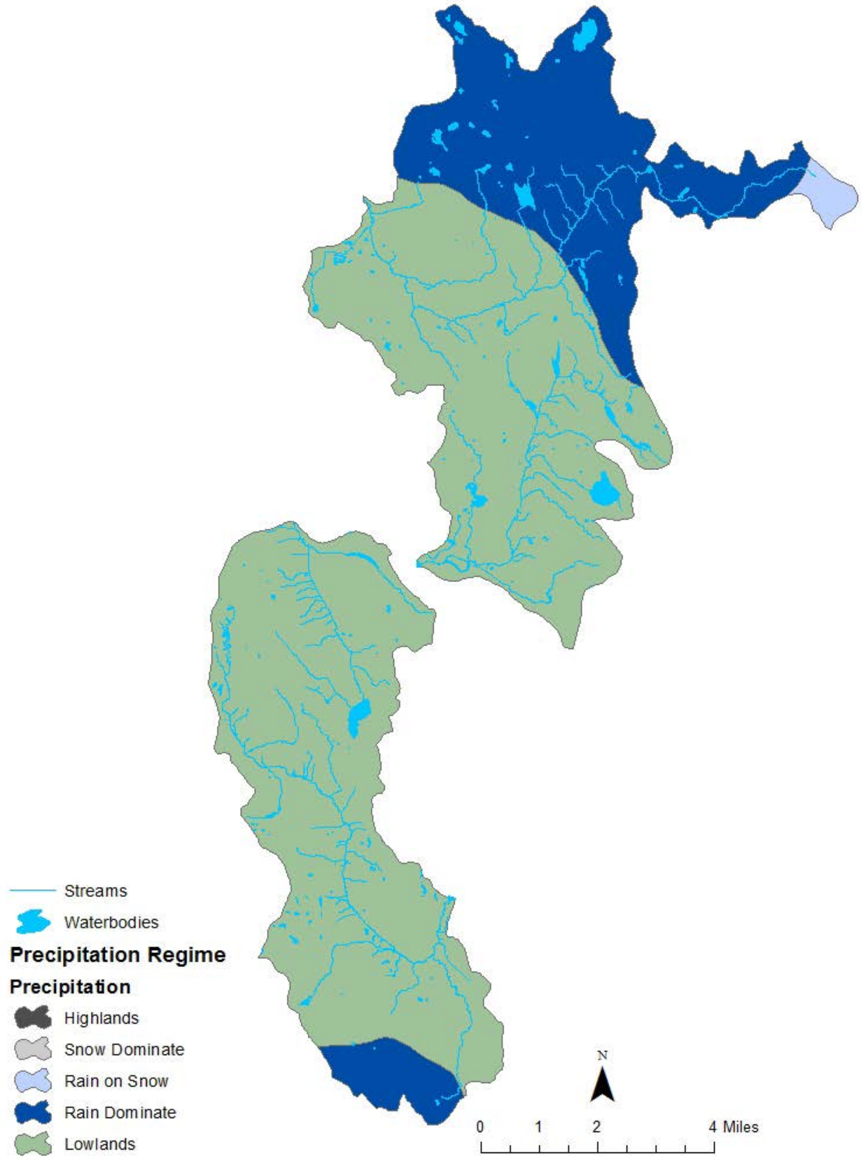


Figure 24: Lowland Snoqualmie Tributaries Precipitation Regime

Precipitation Regime	Acres	Percent of Planning Unit
Rain on Snow	419	1%
Rain Dominate	11,237	25%
Lowlands	32,656	74%

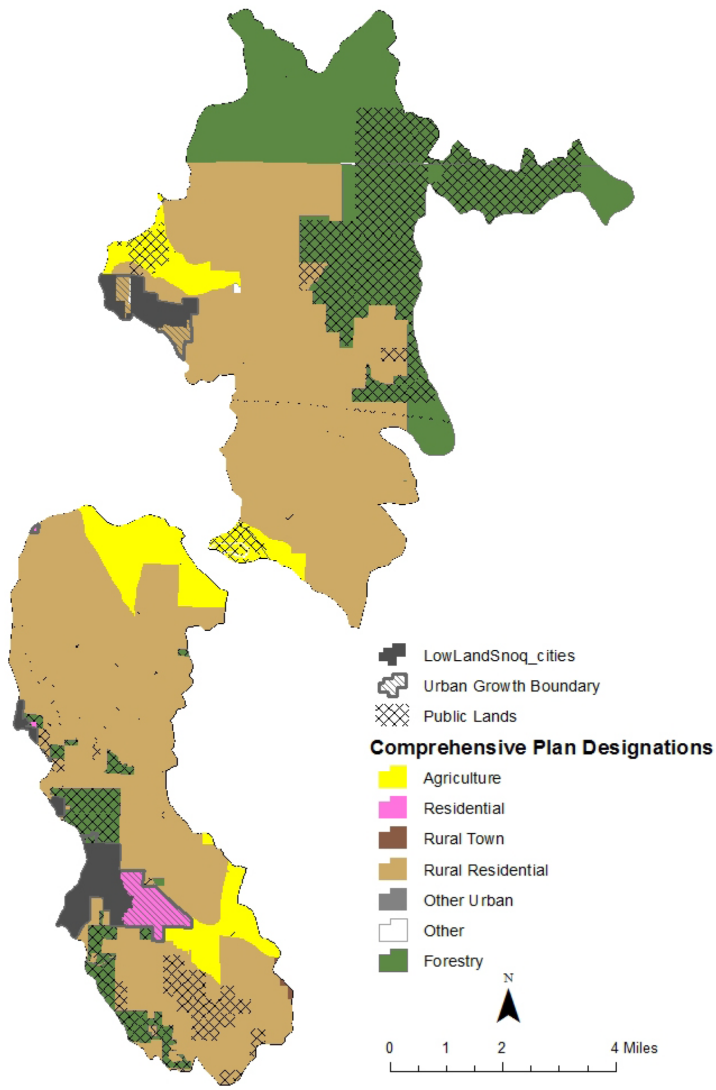


Figure 25: Lowland Snoqualmie Tributaries Land Use

Land Use Type	Acres	Percent of Planning Unit
Agriculture	3,521	7.95%
Forestry	12,395	27.97%
Other	14	0.03%
Rural Residential	26,658	60.16%
Residential	1,335	3.01%
Rural Town	17	0.04%

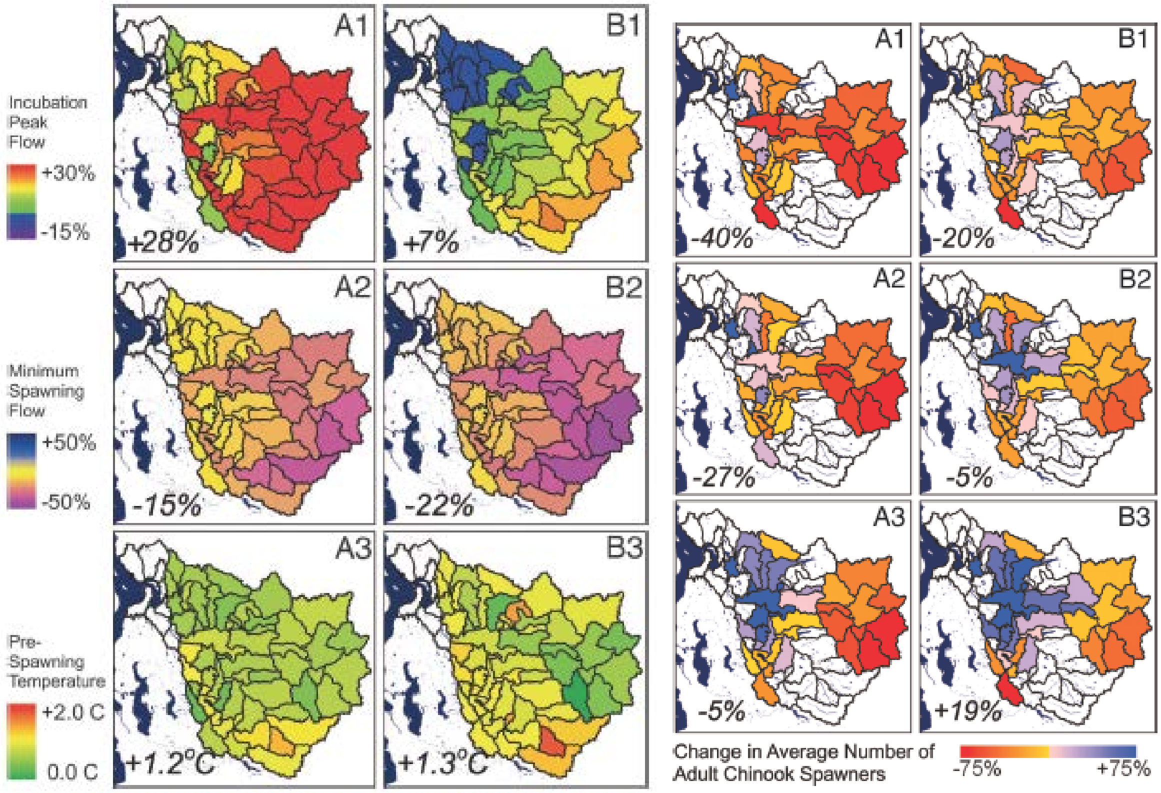


Figure 26: Maps of Modeled Climate Change Effects in the Lowland Snoqualmie Tributaries Urban Planning Unit

From Battin et al. 2007

This planning unit is predominately rain dominate, and precipitation type is not likely to change with climate change. However, climate models suggest that winter peaks will increase and there will be less pronounced spring peaks. Summer flow volumes are also expected to decrease due to earlier spring melt and drier summers (Battin et al. 2007).

- Incubation peak flow: moderate increase
- Minimum spawning flow: minimal decrease
- Pre-spawning temperature: no change to minimal increase
- Change in average number of adult Chinook spawners:
  - Cherry/Harris Creeks: increase in all scenarios
  - Patterson/Ames: no information on Ames and Patterson; could experience slight to moderate decreases in all scenarios

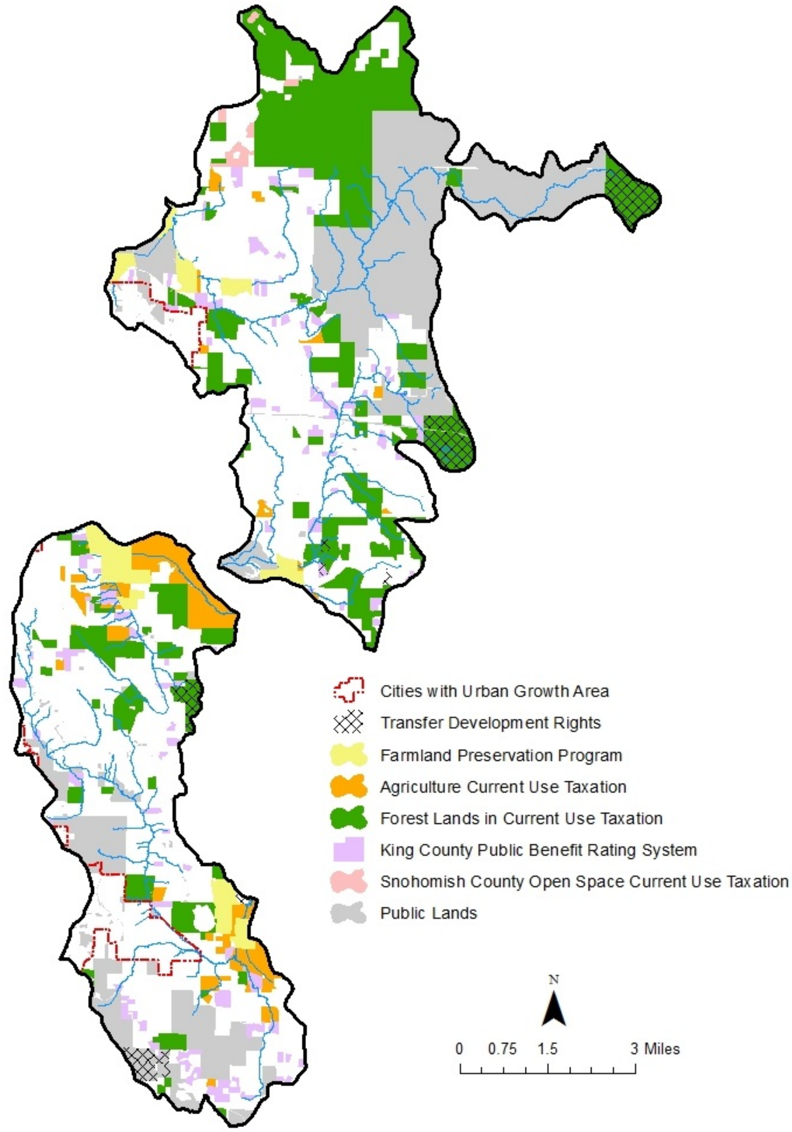


Figure 27: Current Protection Strategies Used in the Lowland Snoqualmie Tributaries Planning Unit

Protection Type	Acres	Percent of Planning Unit
Forest Land	8,995	20%
PBRS	1,587	4%
FPP	1,358	3%
Agriculture Lands	2,125	5%
Public Lands	11,376	26%
Transfer Development Rights*	2,004	5%

* TDRs are sending sites in the forest and public lands

Opportunities for Protection

Currently, half the basin is in some form of protection. However, there are still the following opportunities to improve the protection of hydrology in these basins:

- As cities expand into the Urban Growth Areas (UGAs), implement stormwater regulations and Low Impact Development (LID) practices that protect hydrology
- Ensure that timber harvest methods are protective of hydrology and can adaptively manage the harvest methods as precipitation regimes shift with climate change
- Work on acquiring TDRs in key areas of hydrologic importance to ensure those areas do not get developed
- Continue to enhance open spaces such as forestry and agriculture, and work on preserving these activities and limiting conversions
- Enroll rural residential properties into the appropriate CUT program to ensure natural resources are protected, which, in turn, protects the hydrology
- Decrease the number of private inholdings surrounded by public lands through acquisitions
- Study groundwater withdrawals to understand the impacts on instream flows and groundwater recharge

Planning Unit	Lowland Snoqualmie
Salmonid Use	• Cherry Creek: Chinook/bull trout use = low, Chinook = B, bull trout = C, Combined = B • Harris Creek: Chinook/bull trout use = low, Chinook = C, bull trout = C, Combined = A • Ames Creek: Chinook/bull trout use = none/low, Chinook = D, bull trout = C, Combined = C • Patterson Creek: Chinook/bull trout use = low, Chinook = C, bull trout = C, Combined = B
Precipitation Regime	• Lowland (74%) • Rain Dominant (25%) • Rain on Snow (1%)
Primary Land Uses	• Rural Residential (60.2%) • Forestry (27.9%) • Agriculture (8%)

Limiting Factors	• Upriver migration • Spawning • Egg deposition • Egg development • Freshwater rearing • River outmigration
Current and Future Pressures	• Conversion of forestry lands to rural residential development • Growth of cities and UGAs • Increase of water withdrawals in rural residential areas (Cherry)
Ecosystem Services	• Flood regulation • Water quality regulation • Recreation • Irrigation • Storage • Water quantity regulation
Climate Change Impacts	• Moderate increase in incubation peak flow • Minimal decrease in minimum spawning flow • No change to minimal increase in pre-spawning temperature • Change in average number of adult Chinook spawners (Battin et al. 2007): ▪ Cherry/Harris Creeks: increase in all scenarios ▪ Patterson/Ames: assumed decrease in all scenarios
Existing Protection Strategies in Unit	• Public Lands (21%) • Forestlands (13%) • Agriculture Lands (8%) • PBRS (7%)
Opportunities	• Implement stormwater regulations as cities grow • Ensure that timber harvest methods are protective of hydrology and can adaptively manage with climate change • Acquire TDRs in key areas of hydrologic importance • Continue to enhance open spaces and limit conversions • Enroll rural residential properties into the appropriate CUT • Decrease the number of private inholdings surrounded by public lands • Study groundwater withdrawals to understand the impacts on instream flows and groundwater recharge

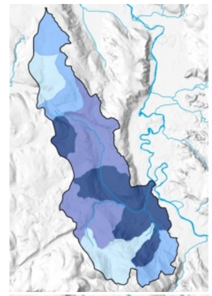
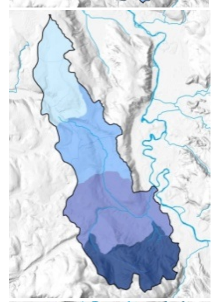
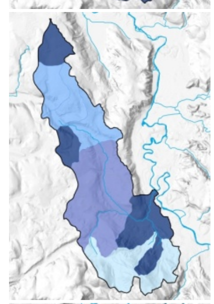
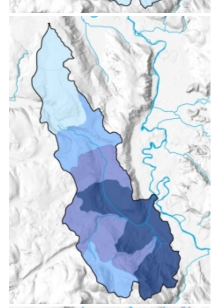
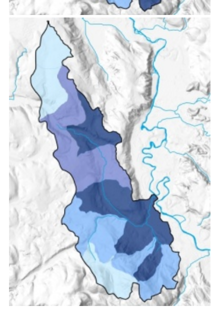
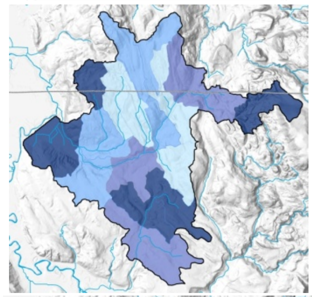
Legend	
Overall	
Delivery	
Surface Storage	
Recharge	
Discharge	

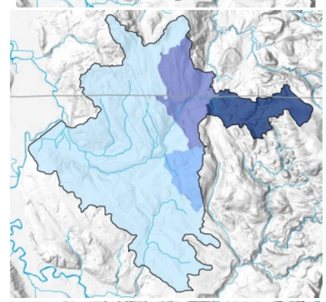
Figure 28: Overall Water Flow Maps for Lowland Mid-Snoqualmie Tributaries (Patterson Creek)

Legend

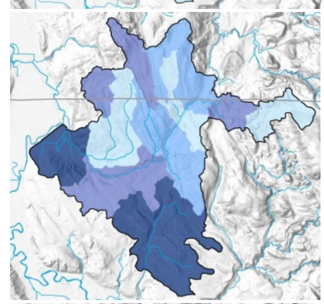
Overall



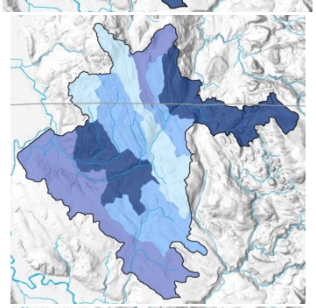
Delivery



Surface Storage



Recharge



Discharge

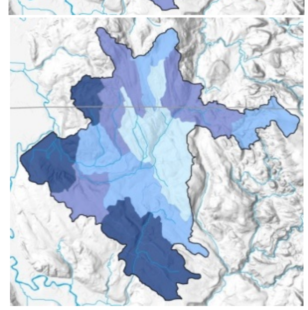


Figure 29: Overall Water Flow Maps for Lowland Mid-Snoqualmie Tributaries (Cherry and Harris Creeks)

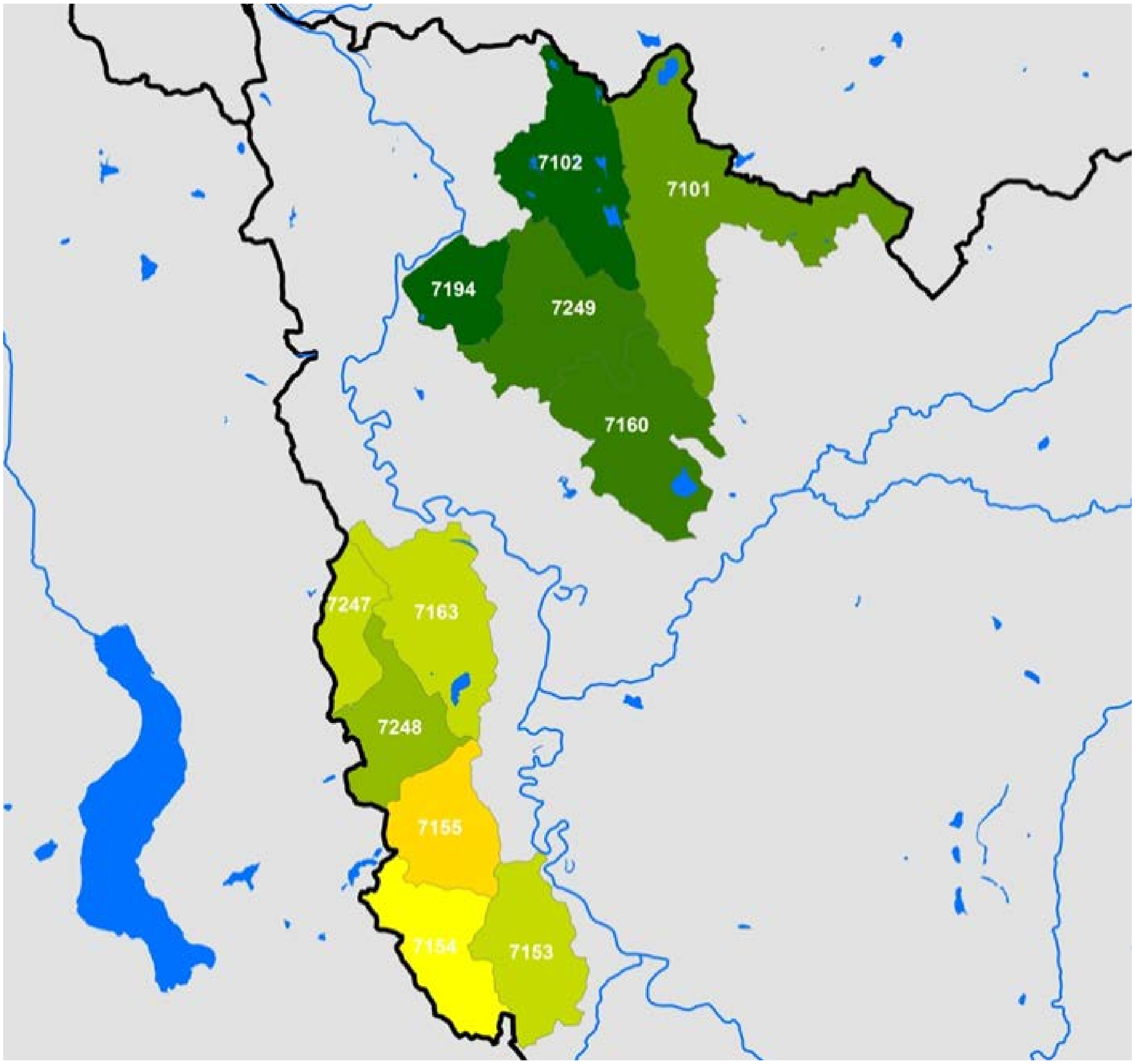


Figure 30: Watershed Characterization Habitat Model Map for the Lowland Snoqualmie Tributaries Planning Unit

Numbers are labels for spatial units

Watershed Characterization Summary

Planning Unit	Lowland Snoqualmie
Overall Flow Importance Model	• Mid-lower Patterson Creek • Eastern headwaters of Cherry Creek • Lower Cherry Creek near the confluence with the Snoqualmie River (near Duvall) • Mid-upper portion of Harris Creek

Delivery Importance Model	• Headwaters and eastern portions of Patterson Creek • Headwaters of Cherry Creek
Surface Storage Importance Model	• Northern headwaters of Patterson Creek • Lower Patterson near the confluence with the Snoqualmie River • Harris Creek • Lower Cherry Creek near the confluence with the Snoqualmie (near Duvall)
Recharge Importance Model	• Mid-lower Patterson Creek • Cherry Creek
Discharge Importance Model	• Mid-lower Patterson Creek • Mid-lower Harris Creek • Lower Cherry Creek
Habitat Model	Generally, Cherry and Harris Creeks have higher watershed habitat values than Patterson and Ames Creeks. Within the Cherry-Harris Creek area, mid-lower Cherry Creek near Duvall, and northern tributaries of middle Cherry Creek have high watershed habitat values.
Protection Consideration	• Cherry Creek: restoration of discharge and surfaces storage processes • Patterson Creek: restoration of discharge and surface storage processes

Tolt River Planning Unit

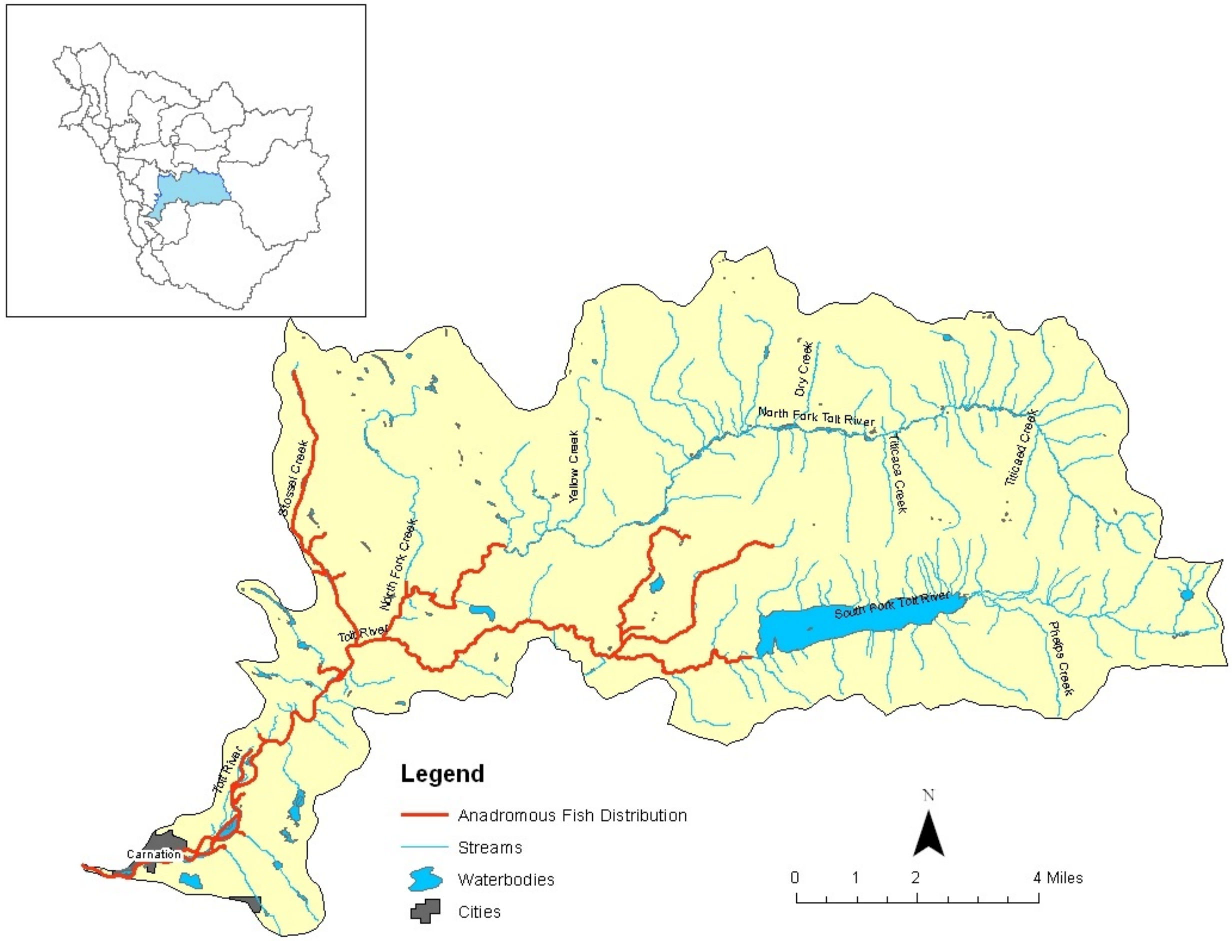


Figure 31: Tolt River Planning Unit

Basin(s) Name(s): Tolt River

Sub-basin Strategy Group: Mainstem Primary Restoration

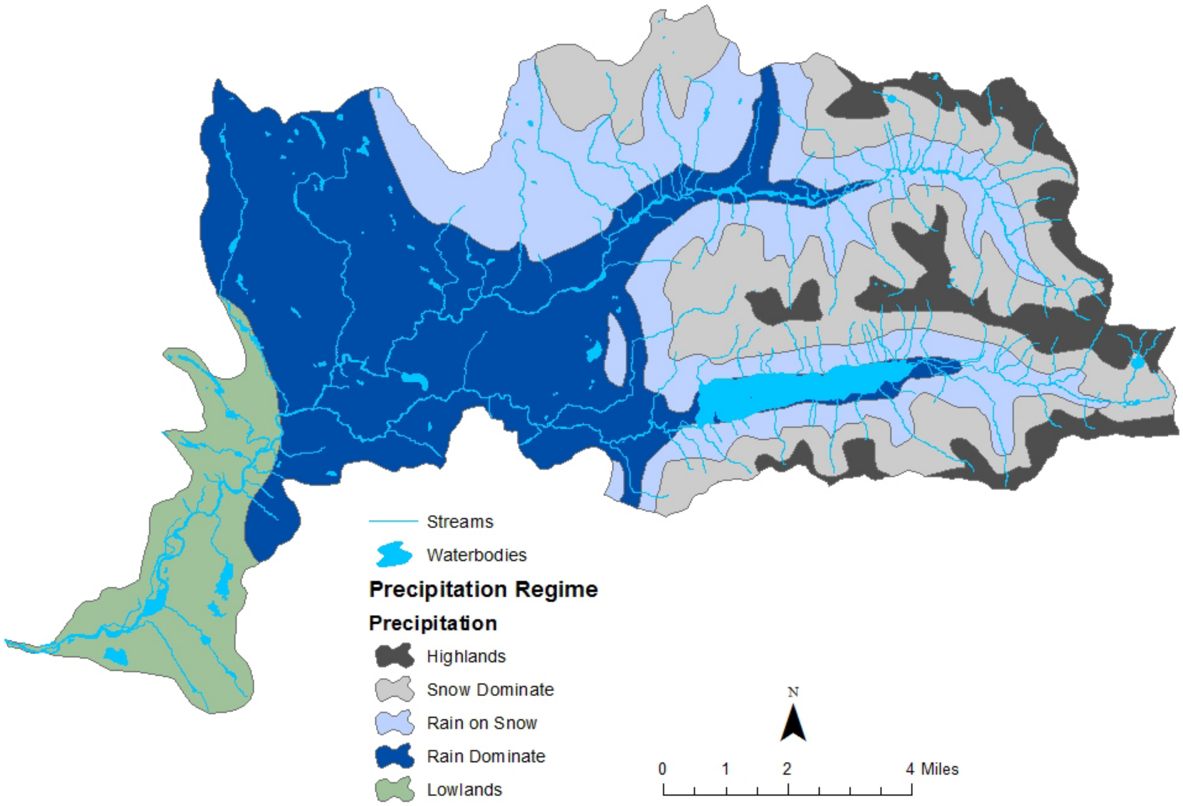


Figure 32: Tolt River Precipitation Regime

Precipitation Regime	Acres	Percent of Planning Unit
Highlands	5,331	8.4%
Snow Dominate	13,825	21.8%
Rain on Snow	15,340	24.2%
Rain Dominate	22,388	35.4%
Lowlands	6,389	10.1%

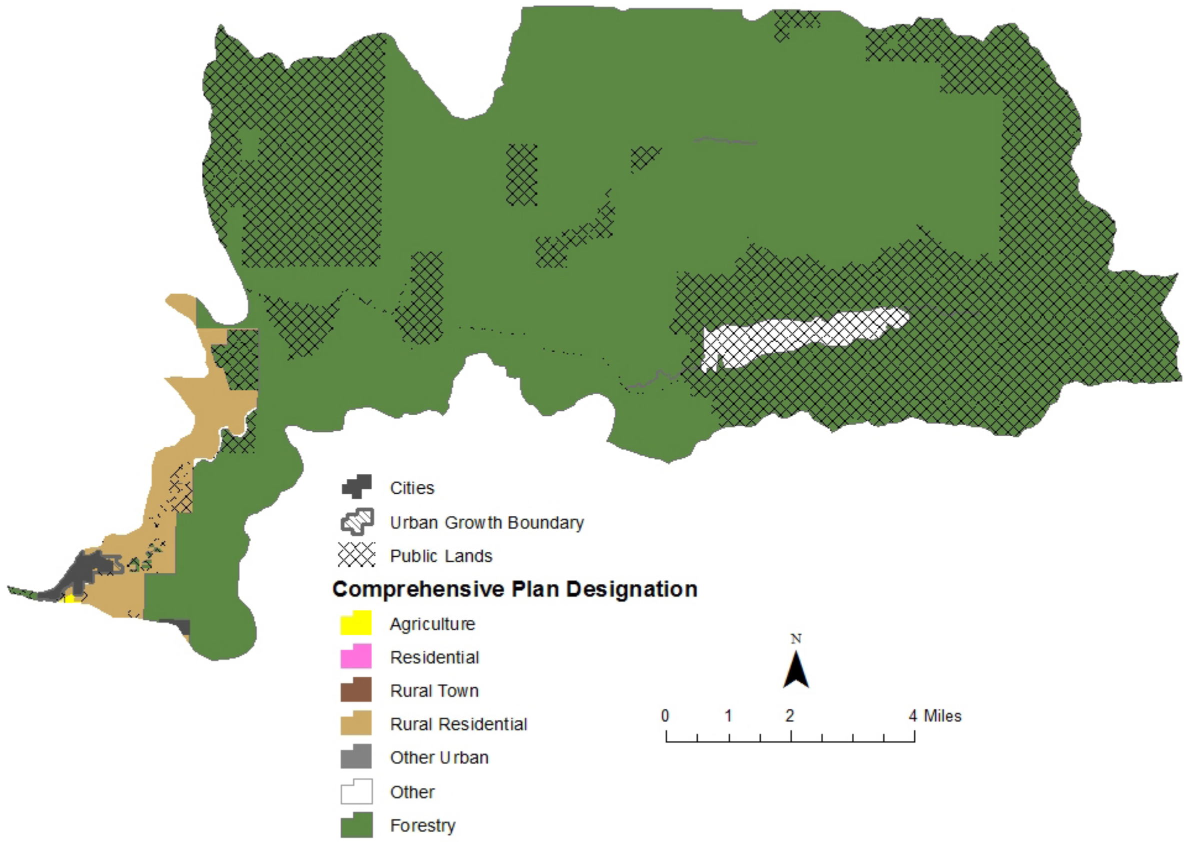


Figure 33: Tolt River Land Use, Including Public Lands

Land Use Type	Acres	Percent of Planning Unit
Cities	733	1.2%
Agriculture	14	0.02%
Forestry	58,632	92.7%
Rural Residential	2,422	3.8%

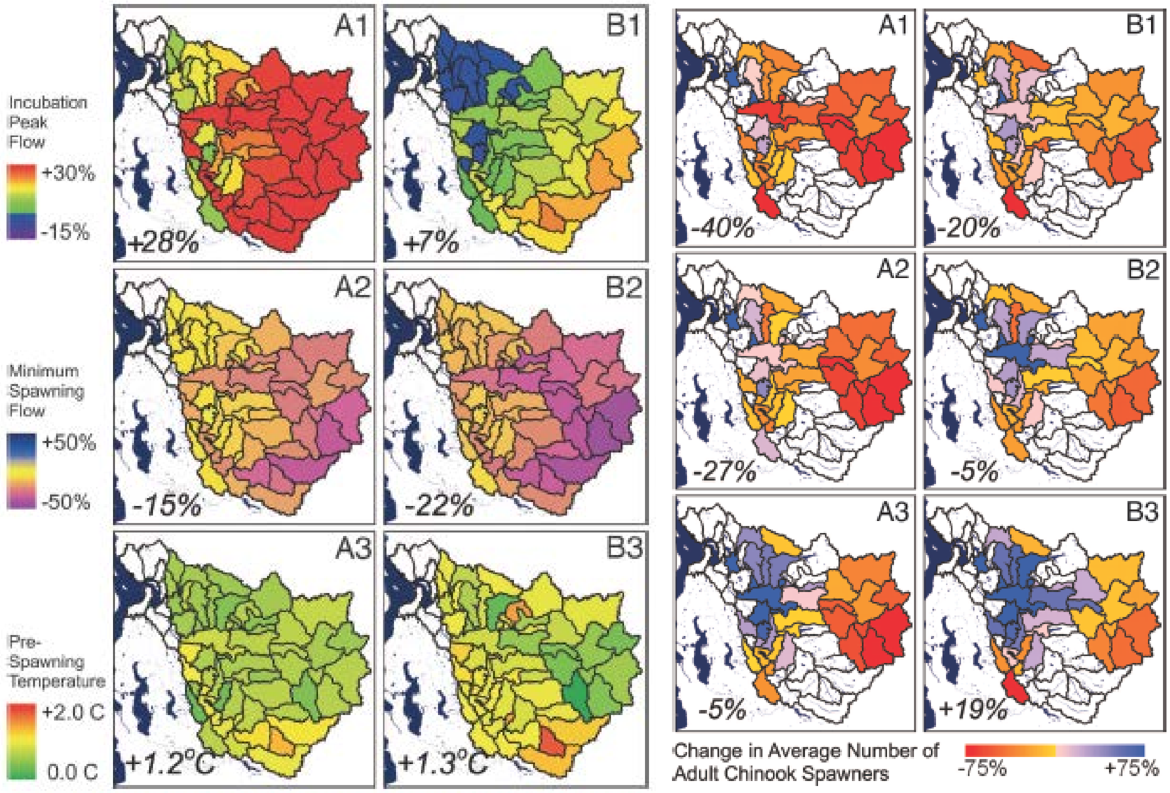


Figure 34: Maps of Modeled Climate Change Effects in the Tolt River Planning Unit

From Battin et al. 2007

- Incubation peak flow: significant increase (Battin et al. 2007)
- Minimum spawning flow: minimal decrease (Battin et al. 2007)
- Pre-spawning temperature: moderate increase (Battin et al. 2007)
- Change in average number of adult Chinook spawners: decrease in number under A1, A2, A3, B1, and B2 and slight increase in numbers under B3 (Battin et al. 2007)

In the Tolt River Planning Unit, some models are predicting decreased low flows, higher frequency of high flow events, and increased annual peak flows (King County 2010).

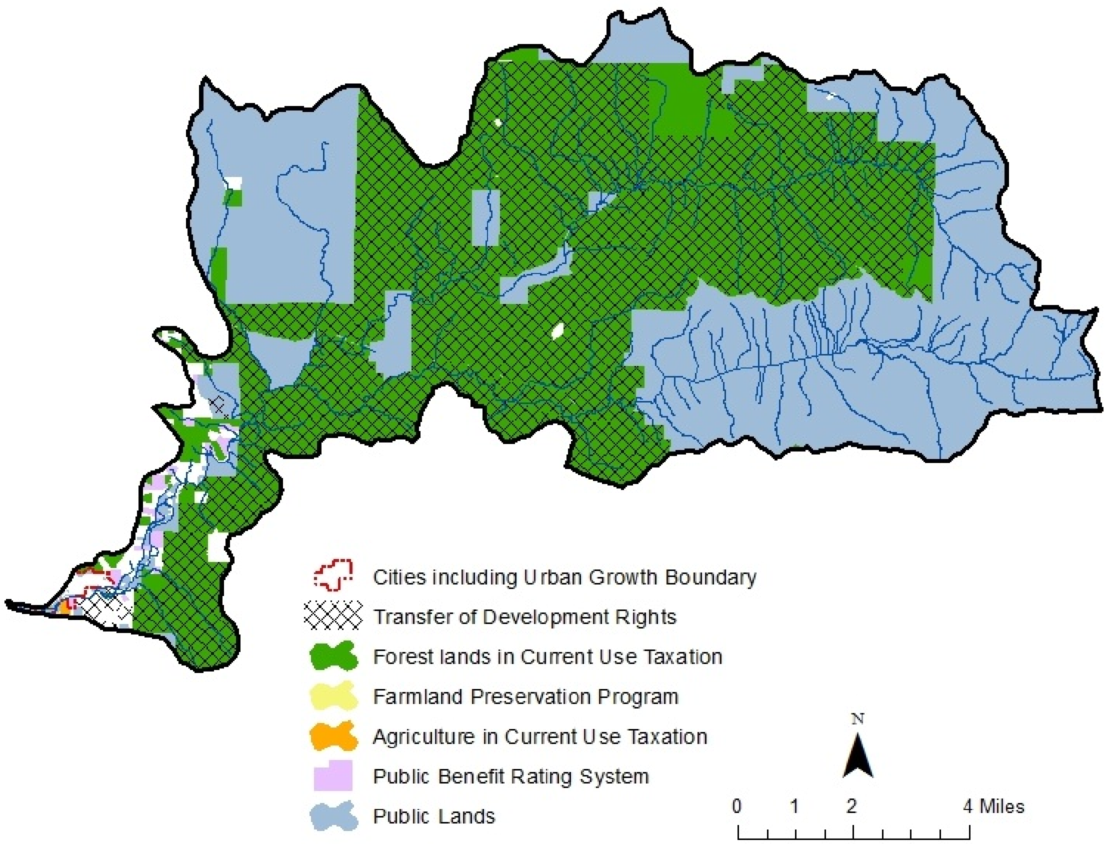


Figure 35: Current Protection Strategies Used in the Tolt River Planning Unit

Protection Type	Acres	Percent of Planning Unit
PBRS	361	0.6%
Forestlands	46,145	72.9%
Agriculture	181	0.3%
FPP*	144	0.2%
Public Lands	25,345	40.1%
TDR**	41,260	65.2%

* Farmland Preservation Program easements are located in agriculture areas

** TDRs are sending sites in the forest lands

Opportunities for Protection

The majority of the headwaters in the Tolt River Planning Unit have some level of protection applied to land through public land, forest land CUT programs, and TDR. Even with this protection, the following opportunities exist to ensure this area continues to protect hydrology:

- Look at policies such as increasing timber harvest timelines and consider taking some lands out of production.
- Try to forecast future water withdrawal needs in the Tolt to help determine what hydrologic protection tools are essential.
- Continue acquisition of private lands in the floodplain of the Lower Tolt and set back levees to help connect the river to the historical floodplain, allowing for better hydrologic recharge, discharge, and storage.
- Decrease the number of private inholdings surrounded by public lands through acquisitions.
- Address key hydrologic concerns during the South Fork Tolt Project relicensing within the next 15 years. It is not likely that the South Fork Tolt reservoir location and operation will change appreciably in the near term.
- Possibly work with private foresters to improve how small scale forestry is practiced in the Tolt.

Planning Unit	Tolt
Salmonid Use	• Chinook = high use below forks and low use above the forks • Coho = high use • Bull trout = presumed presence • Steelhead = high use
Precipitation Regime	• Rain Dominant (35.4%) • Rain on Snow (24.2%) • Snow Dominant (21.8%) • Low Lands (10.1%)
Primary Land Uses	• Forestry (92.7%) • Rural Residential (3.83%)
Limiting Factors	• Upriver migration • Spawning • Egg deposition • Egg development • Freshwater rearing • River outmigration

Current and Future Pressures	• Floodplain disconnection • Lack of natural cover leading to a lack of habitat in the Lower Tolt • Sediment impacts from historic gravel removal • Residential development • Invasive and problematic species
Ecosystem Services	• Flood regulation • Water quality regulation • Drinking water provisioning • Recreation • Energy production • Storage • Water quantity regulation
Climate Change Impacts	• Significant increase in incubation peak flow • Minimal decrease in minimum spawning flow • Moderate increase in pre-spawning temperature • Decrease in average number of adult Chinook spawners in five of six scenarios • Hydrology will be largely regulated by South Fork Tolt dam (Battin et al. 2007) • Some models predicting decreased low flows, higher frequency of high flow events, and increased annual peak flow (King County 2010)
Existing Protection Strategies in Unit	• Forestlands (72.9%) • TDR (65.2%) • Public Lands (40.1%) • PBRS (0.6%) • Agriculture (0.3%) • FPP (0.2%)
Opportunities	• Continue acquisitions and levee setbacks • Decrease private inholdings surrounded by public lands • Ensure timber harvest methods are protective of hydrology • Support and improve small forestry owner harvest methods • Participate in South Fork project relicensing to ensure protection of hydrology

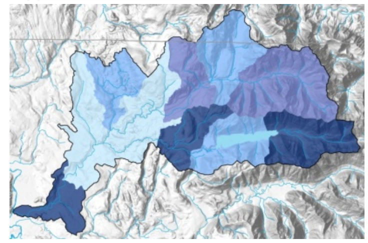
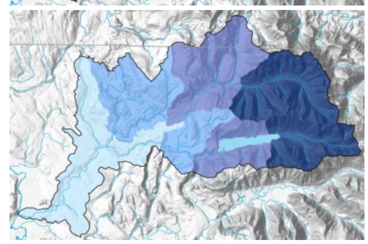
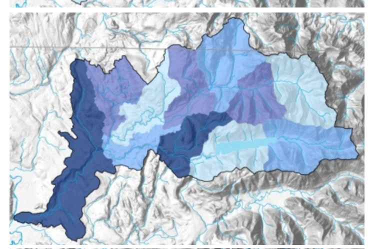
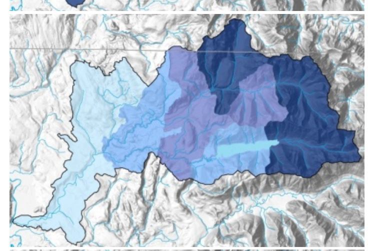
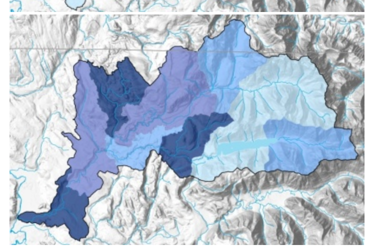
Legend	
Overall	
Delivery	
Surface Storage	
Recharge	
Discharge	

Figure 36: Overall Water Flow Maps for the Tolt River Planning Unit

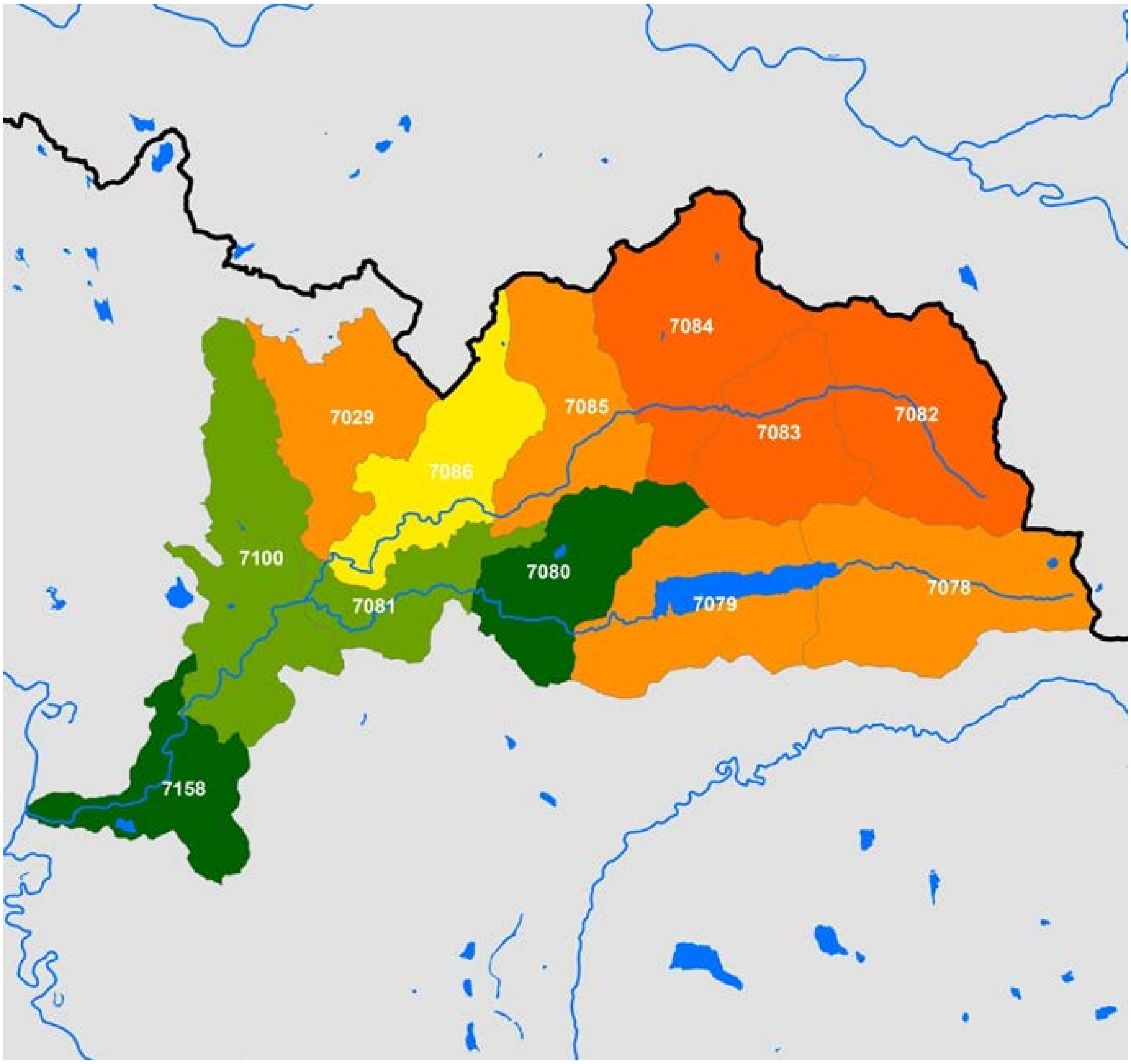


Figure 37: Watershed Characterization Habitat Model Map for the Tolt River Planning Unit

Numbers are labels for spatial units

Watershed Characterization Summary

Planning Unit	Tolt
Overall Flow Importance Model	• Lower Tolt River (near Carnation) • Upper South Fork Tolt
Delivery Importance Model	• Upper portions of the North and South Fork Tolt
Surface Storage Importance Model	• South Fork Tolt (below the South Fork reservoir) • Drainages below the confluence of the North and South Fork Tolt

Recharge Importance Model	• Eastern headwaters of the North and South Tolt forks • Areas directly below the South Fork reservoir
Discharge Importance Model	• North Fork Creek drainage • Areas directly below the South Fork reservoir • Lower Tolt near Carnation
Habitat Model	• All of the drainages below the confluence of the North and South Fork Tolt have high watershed habitat values. Specifically, the areas directly below the South Fork reservoir and the lower Tolt near Carnation have the highest habitat values. • Below the dam is the only spawning reach for summer steelhead in the South Fork Tolt, which is highlighted as a unique population in the Distinct Population Segment.
Protection Consideration	• North Fork: restoration of delivery and protection of recharge • South Fork: protection and restoration of delivery and recharge • Mainstem: protection and restoration of surface storage

South Fork Skykomish Planning Unit

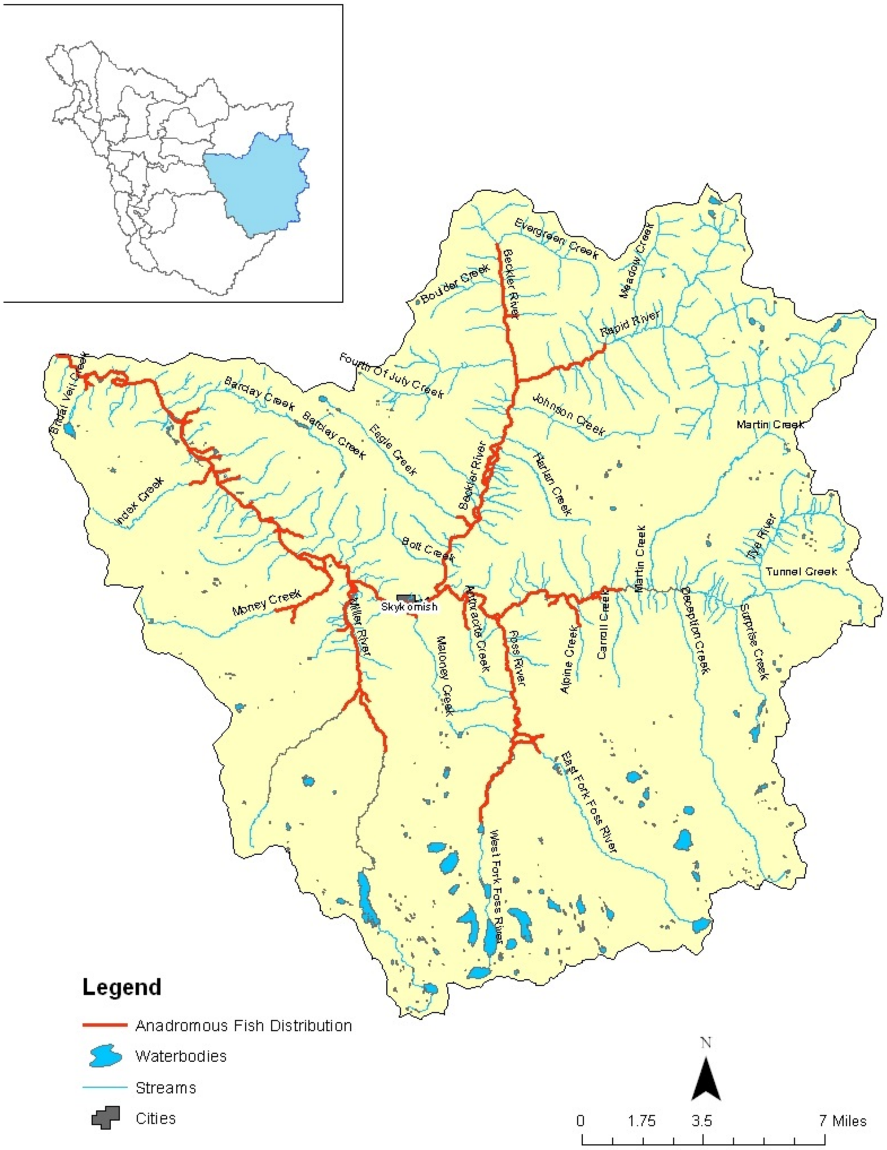


Figure 38: Upper South Fork Skykomish River Planning Unit

Basin(s) Name(s): Upper South Fork Skykomish River

Sub-basin Strategy Group: Mainstem Primary Restoration (South Fork Skykomish and Upper South Fork Skykomish), Primary Protection (Foss River), Secondary Protection (Miller and Rapid rivers), and Secondary Restoration (Beckler and Tye rivers)

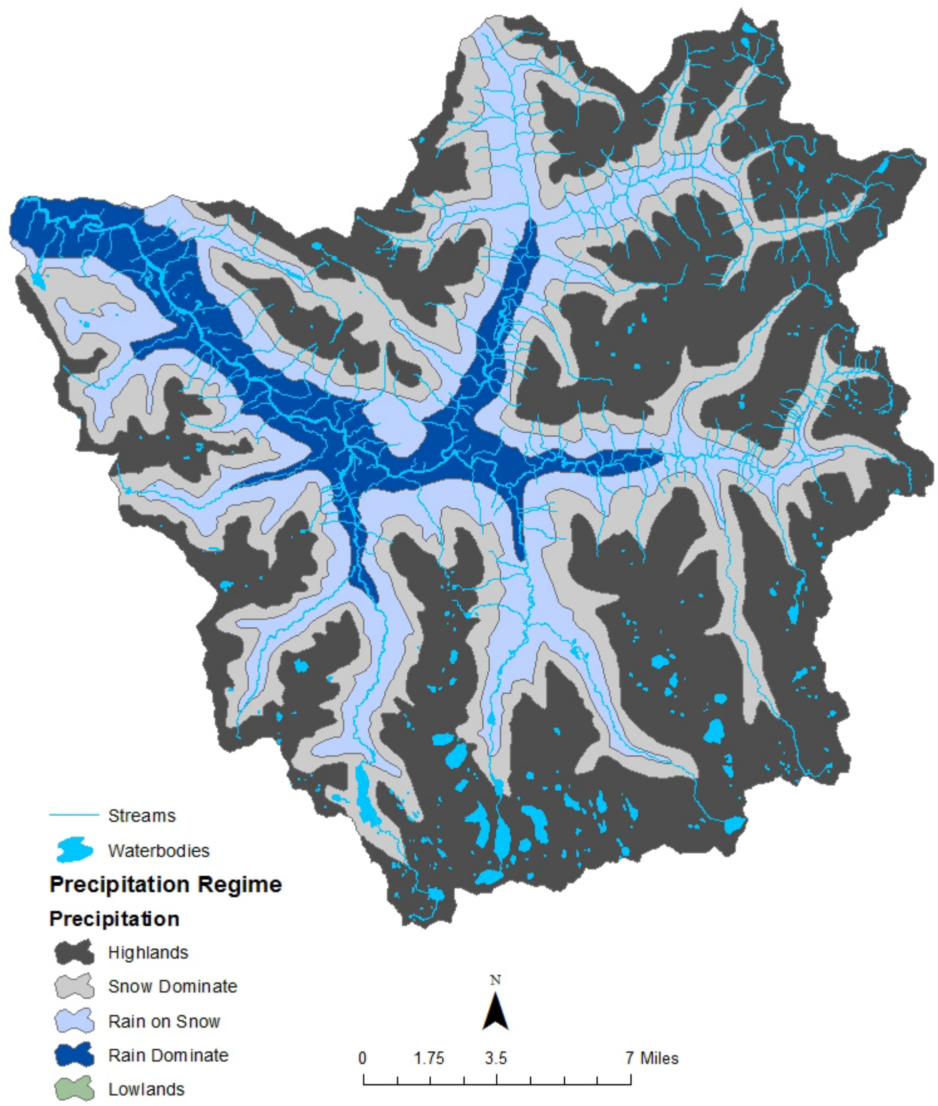


Figure 39: South Fork Skykomish River Precipitation Regime

Precipitation Regime	Acres	Percent of Planning Unit
Highlands	110,833	47.9%
Rain Dominant	20,475	8.9%
Rain on Snow	44,256	19.1%
Snow Dominant	55,765	24.1%

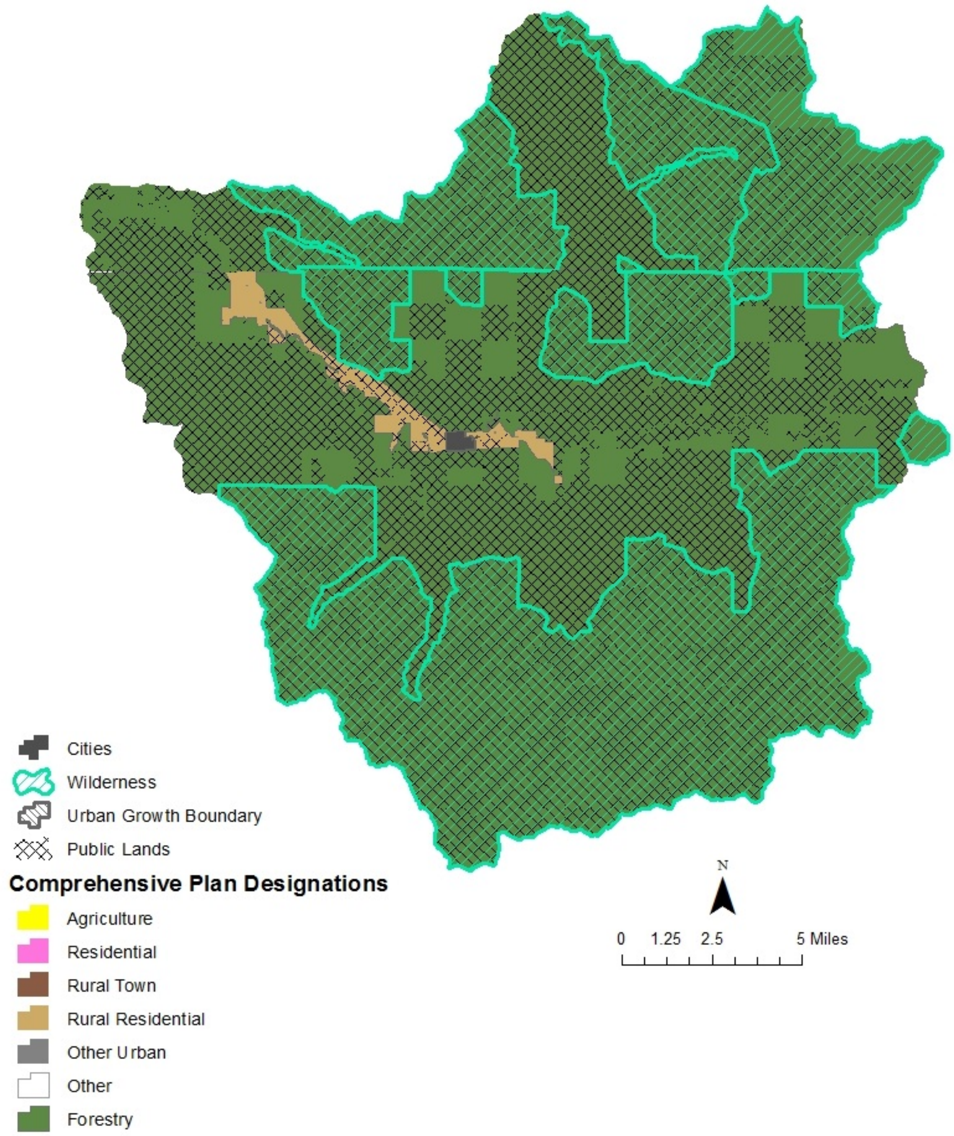


Figure 40: South Fork Skykomish River Comprehensive Plan Land Use

Land Use Type	Acres	Percent of Planning Unit
City	213	0.09%
Forestry	227,047	98.1%
Rural Residential	4,103	1.8%

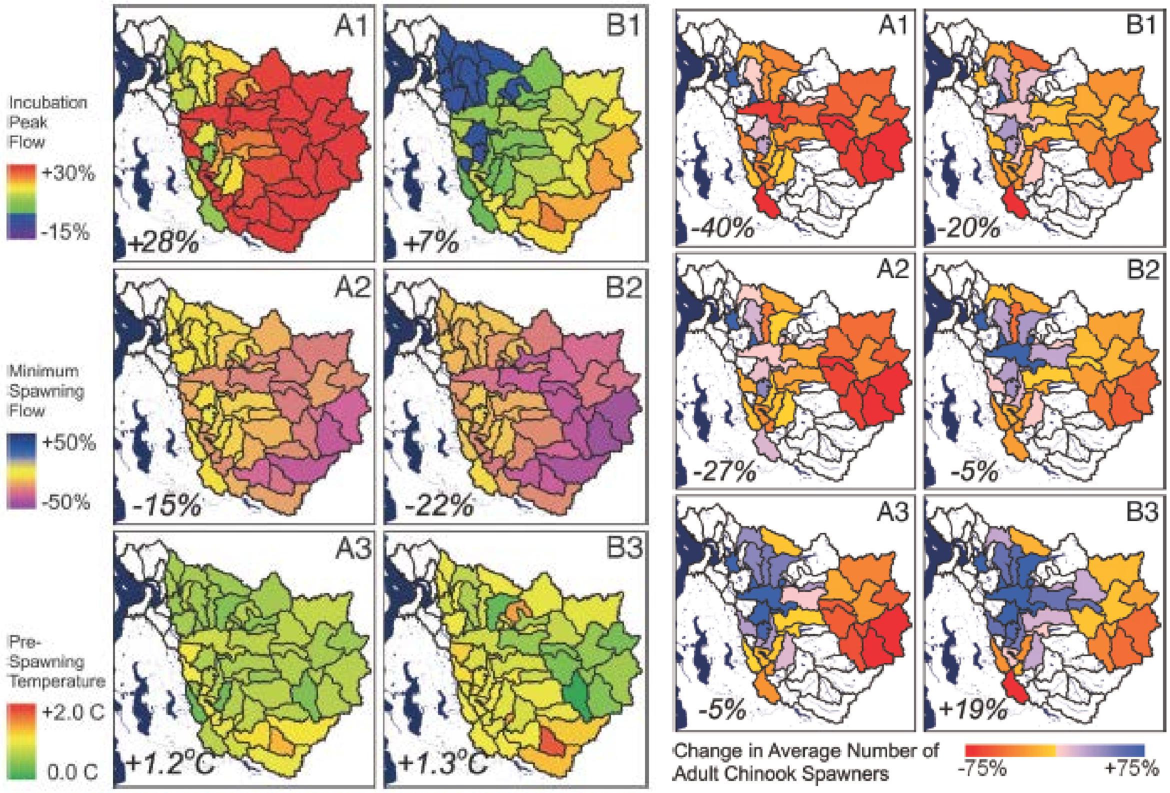


Figure 41: Maps of Modeled Climate Change Effects in the South Fork Skykomish River Planning Unit

From Battin et al. 2007

- Incubation peak flow: moderate increase (Battin et al. 2007)
- Minimum spawning flow: moderate decrease (Battin et al. 2007)
- Pre-spawning temperature: minimal increase (Battin et al. 2007)
- Change in average number of adult Chinook spawners: decrease in number under A1, A2, A3, B1, and B2 and slight decrease in numbers under B3 (Battin et al. 2007)

In the South Fork Skykomish River Planning Unit, some models are predicting higher winter discharges due to increased winter rain. Summer models still show very low discharges. This basin is predominantly rain on snow dominate. The annual discharge is expected to increase, frequency and magnitude of floods are expected to increase, and the spring peak is expected to move earlier in the year (King County 2010).

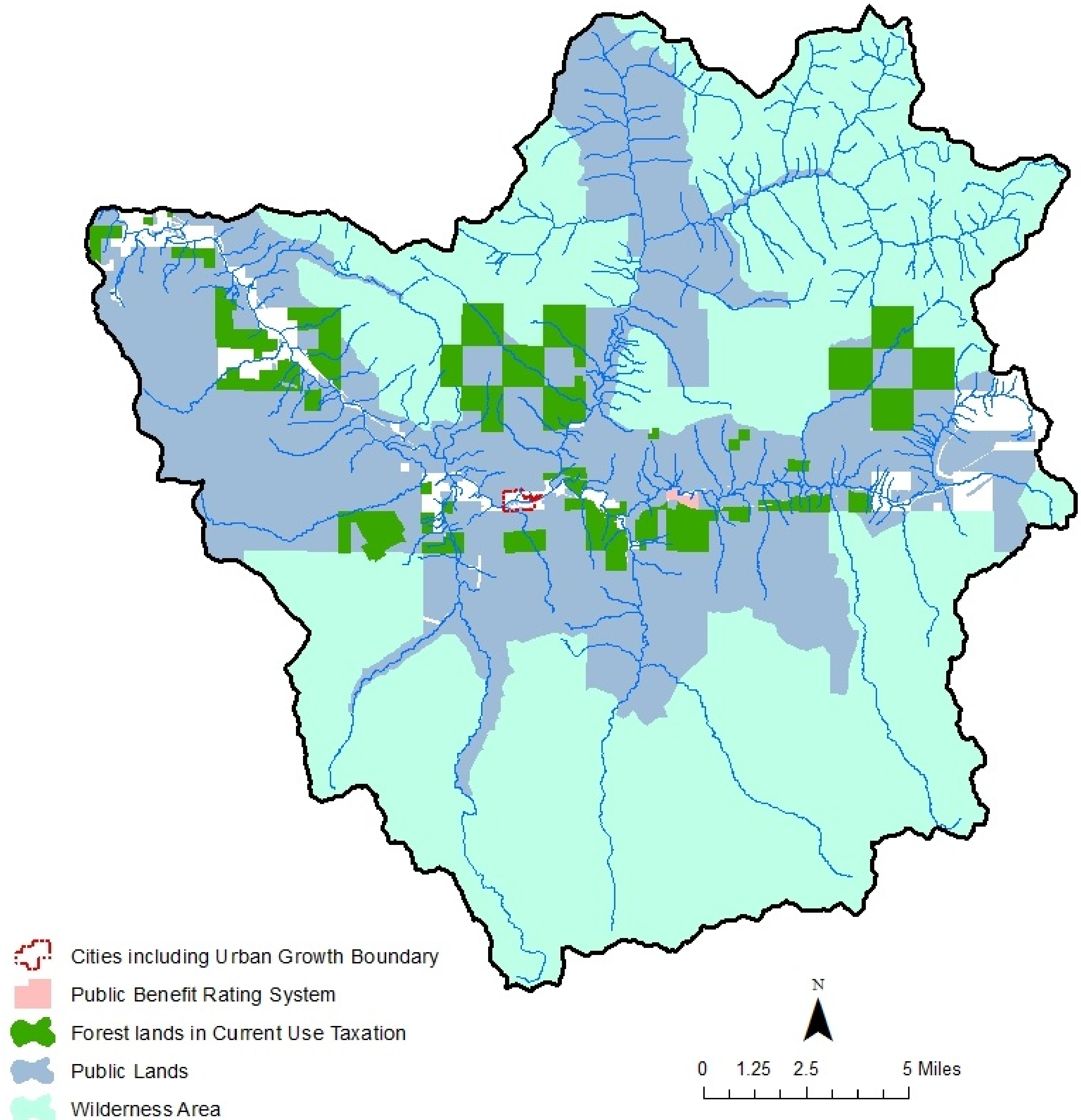


Figure 42: Current Protection Strategies Used in the South Fork Skykomish Planning Unit

Protection Strategy	Acres	Percent of Planning Unit
PBRS	112	0.05%
Forestlands	13,336	5.76%
Public	217,881	94.19%
Wilderness*	126,983	54.89%

* Wilderness is located in the public lands

Opportunities for Protection

Currently, the South Fork Skykomish River Planning Unit is more than 81% in federal ownership, and 43% is designated as wilderness. Areas located in the wilderness allow for recreation but protect the natural conditions of the area. While the majority of the South Fork Skykomish Planning Unit is in some form of protection, the following opportunities to be more protective remain:

- Acquire key pieces important to hydrology; with Stevens Pass, numerous recreation areas, and State Route 2 running through the valley, development pressure is expected to increase over time.
- Explore beaver reintroduction on forestlands to improve the resilience of ecohydrology, currently being performed by Tulalip Tribes, in conjunction with the USFS and the University of Washington.
- Encourage the continued use of the minimum road strategy as a tool for the USFS to encourage appropriate road systems for forestry activities.
- Encourage the protection of instream large woody debris. There are instances where the wood in the streams is harvested for firewood, and it has an impact on the hydrology and habitat of the system. Promote the retention of this large wood through education.
- Explore the possibility of improving and relocating bridges, roads, and railroad infrastructure to improve hydrologic conditions in the planning unit.
- Engaged partners in the planning processes for hydropower development; geothermal energy development; and oil, gas, and mineral resource development proposals to ensure hydrology is not further degraded.
- Decrease the number of private inholdings surrounded by public lands through acquisitions.
- Ensure that timber harvest methods are protective of hydrology and can be adaptively managed as precipitation regimes shift with climate change.

Planning Unit	South Fork Skykomish
Salmonid Use	• Chinook = high use (South Fork) and low use (Miller, Foss, Beckler, and Tye rivers) • Coho = known presence • Bull trout = high use (Foss), moderate use (Beckler), known presence (South Fork) • Steelhead = known presence

Precipitation Regime	• High Lands (47.9%) • Snow Dominant (24.1%) • Rain on Snow (19.1%) • Rain Dominant (8.9%)
Primary Land Uses	• Forestry (98.1%) • Rural Residential (1.8%) • Cities (0.1%)
Limiting Factors and Life Cycle Stress	• Upriver migration, spawning • Egg deposition • Egg development • Freshwater rearing • River outmigration
Current and Future Pressures	• Timber harvest • Removal of large woody debris • Natural system modification • Human intrusions and disturbance • Development • Geothermal energy, oil, gas, and mineral • Hydropower
Ecosystem Services	• Flood regulation • Water quality regulation • Recreation • Storage • Water quantity regulation • Disturbance prevention
Climate Change Impacts	• Moderate increase in incubation peak flow • Moderate decrease in minimum spawning flow • Minimal increase in pre-spawning temperature • Decrease in average number of adult Chinook spawners
Existing Protection Strategies in Unit	• Public Lands (94.2%) • Forestlands (5.76%)
Opportunities	• Acquire key parcels to protect hydrology in the face of development • Explore beaver reintroduction to improve hydrologic conditions • Continue to use current minimum road strategy implemented by USFS • Improve and relocate bridges, roads, and railways to improve hydrologic conditions • Engage in the planning processes for hydropower development; geothermal energy development; and oil, gas, and mineral resource development proposals to ensure hydrology is not further degraded • Decrease the number of private inholdings in public areas • Ensure timber harvest methods are protective of hydrology

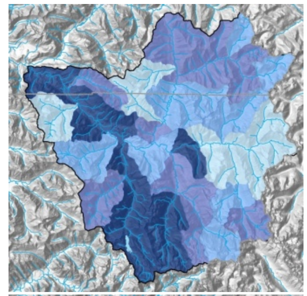
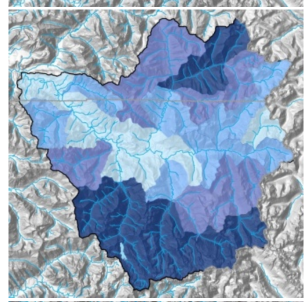
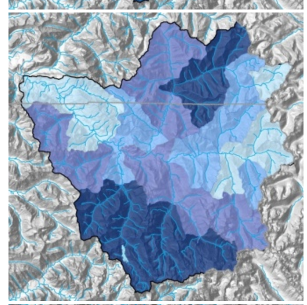
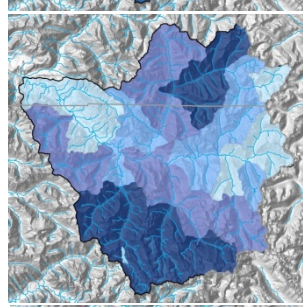
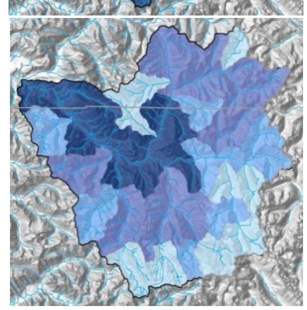
Legend	
Overall	
Delivery	
Surface Storage	
Recharge	
Discharge	

Figure 43: Overall Water Flow Maps for the South Fork Skykomish Planning Unit

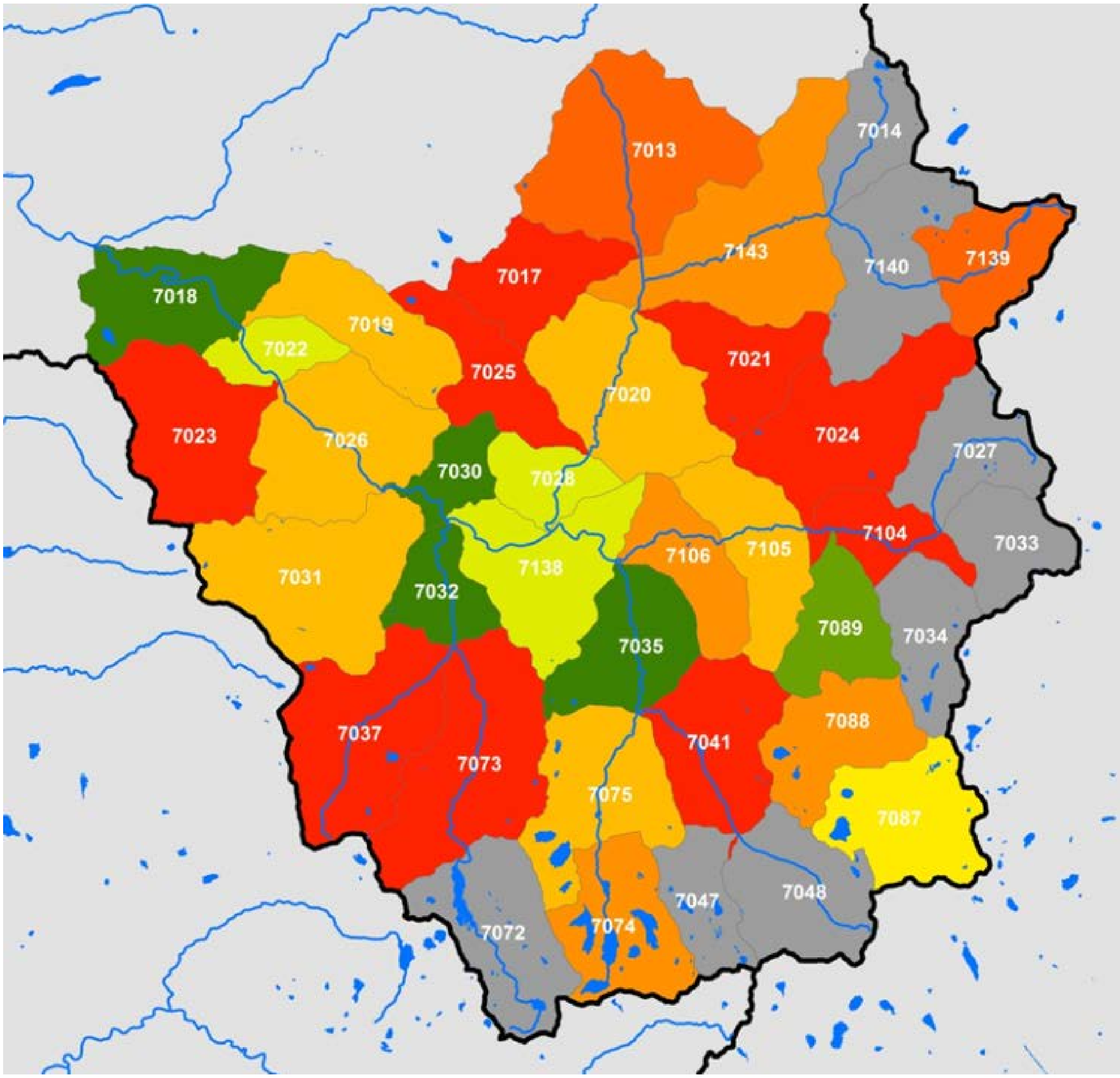


Figure 44: Watershed Characterization Habitat Model Map for the South Fork Skykomish Planning Unit

Numbers are labels for spatial units

Watershed Characterization Summary

Planning Unit	South Fork Skykomish
Overall Flow Importance Model	• Lower South Fork Skykomish drainages from the confluence with the North Fork up to confluence with Miller River (excluding the Index Creek, Barclay Creek, and Money Creek drainages) • East Fork Miller River drainage • West Fork Foss drainage • Lower Tye River drainage
Delivery Importance Model	• Rapid River • Miller River • Foss River • Deception Creek drainages
Surface Storage Importance Model	• Mainstem South Fork Skykomish • Upper Miller River • West Fork Foss River • Alpine Creek drainages
Recharge Importance Model	• Miller River • Foss River • Rapid River • Johnson Creek drainages
Discharge Importance Model	• Mainstem South Fork Skykomish from the confluence with the North Fork up to the confluences with Rapid, Tye, Foss, and Miller rivers
Habitat Model	• Lower portions of the South Fork Skykomish mainstem drainages (downstream of the Index Creek confluence), areas around the confluence of Miller River, and areas around the confluence of the Foss River with the Tye River have the highest watershed index values. • The Deception Creek drainage in the Tye River drainage was also characterized as having high watershed habitat indices.
Protection Consideration	• Northern tribs: restore recharge and protect and restore delivery • Southern tribs: protect recharge and delivery • South Fork mainstem: restore surface storage

Estuary Drainages

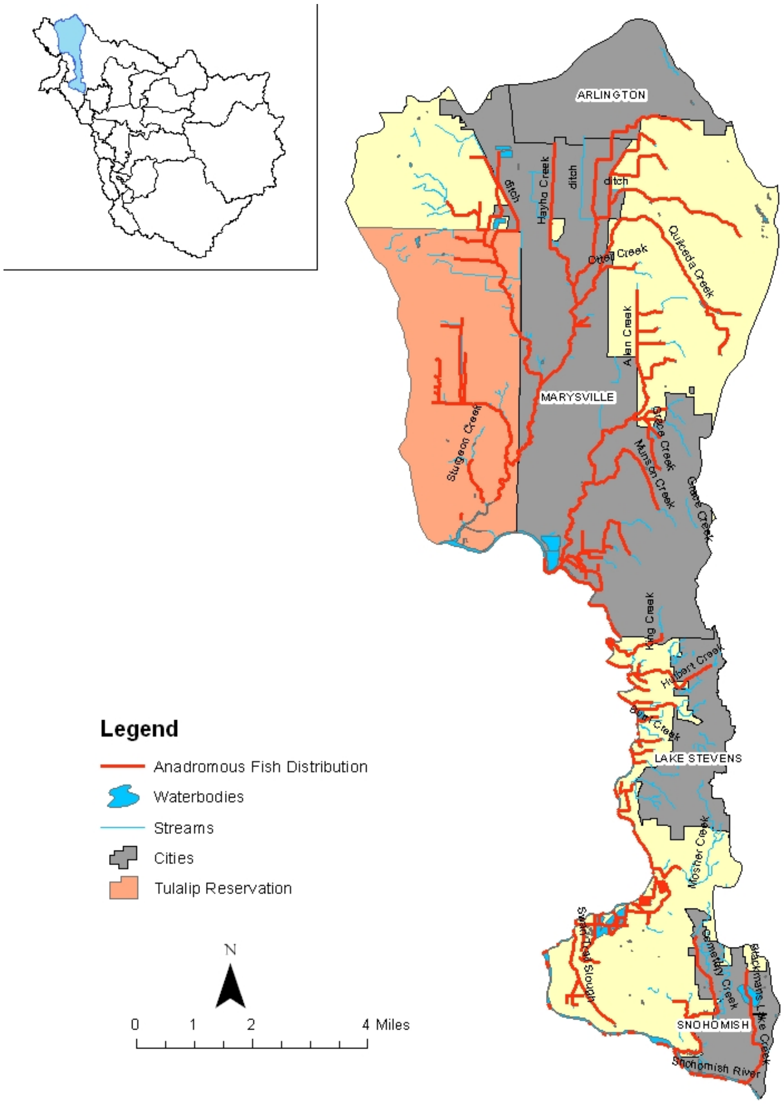


Figure 45: Estuary Drainages Planning Unit

Basin(s) Name(s): Quilceda and Allen Creeks, Everett Drainages

Sub-basin Strategy Group: Lowland Tributaries and Urban Streams – Restoration

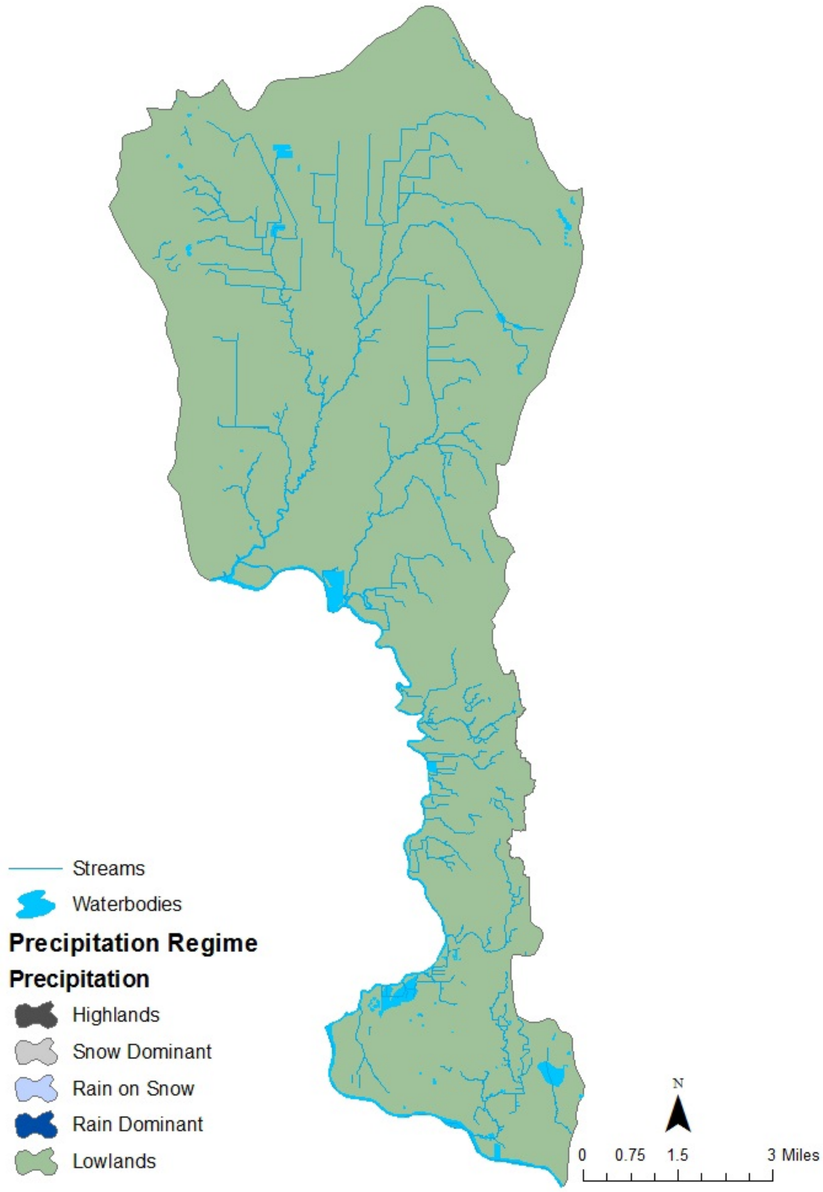


Figure 46: Estuary Drainages Planning Unit Precipitation Regime

Precipitation Regime	Percent of Planning Unit
Lowlands	100%

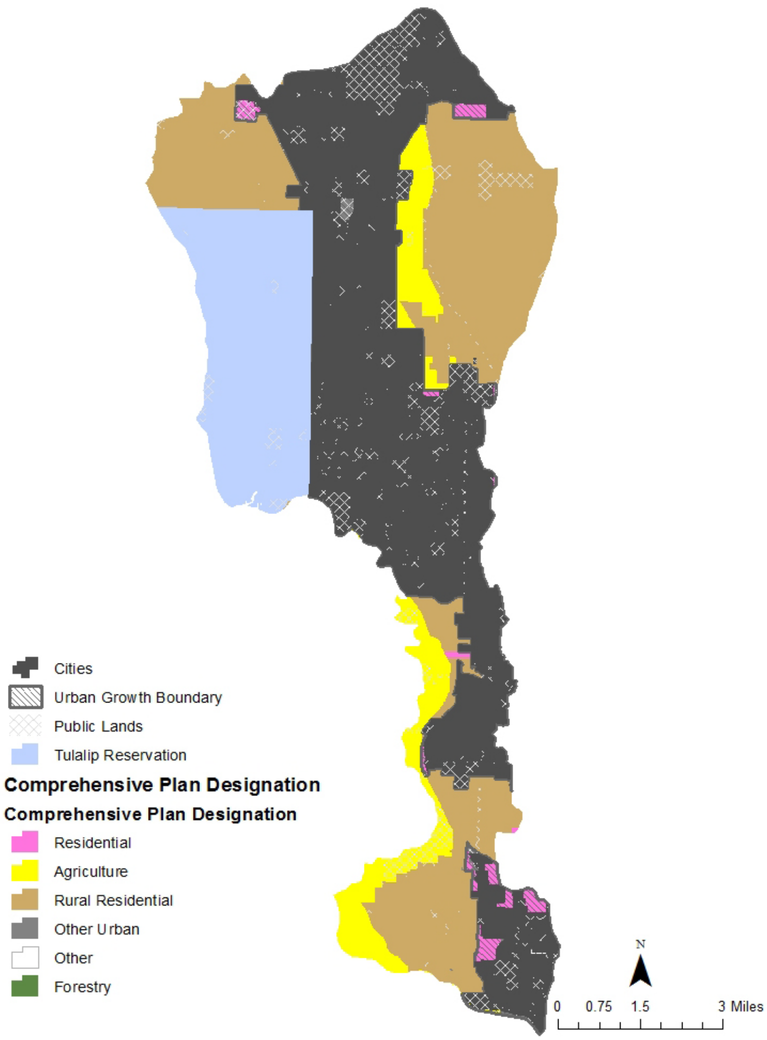


Figure 47: Estuary Drainages Planning Unit Land Use

Land Use Type	Acres	Percent of Planning Unit
Agriculture	4,021	9.2%
Forestry	82	0.2%
Residential	596	1.4%
Reservation	3,948	9.0%
Rural Residential	15,164	34.7%
Other Urban	191	0.4%
City	19,648	45.0%

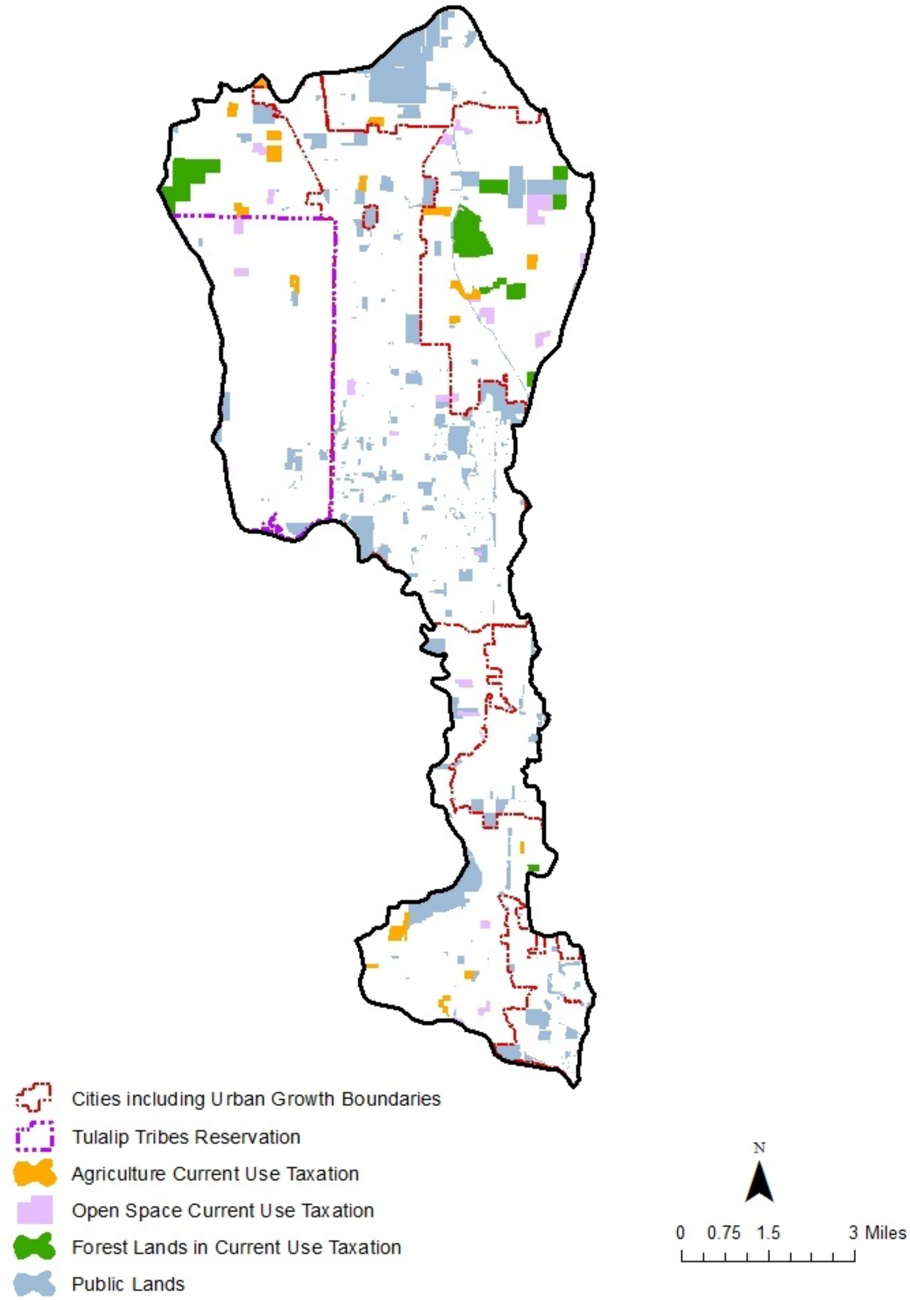


Figure 48: Current Protection Strategies Used in the Estuary Drainages Planning Unit

Protection Type	Acres	Percent of Planning Unit
Agriculture	387	0.9%
Open Space	422	1.0%
Timber	874	2.0%
Public Lands	4,927	11.3%

Opportunities for Protection

In the Estuary Drainages, continued growth within UGA puts additional pressure on the system. However, there may be some functions still remaining in the UGA. Therefore, growth strategies that continue to protect the existing function and restoration strategies that improve that function are necessary. Opportunities are as follows:

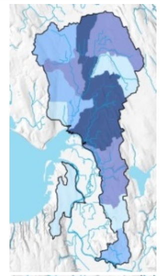
- Ensure that residential areas are following best management practices (BMPs) for LID. This could include incentives, stormwater retention and infiltration, and rain garden programs. It will be important to increase LID in the future and retrofit existing development.
- Continue to maintain and enhance rural, agricultural, and other open space areas under the Comprehensive Plan. More fish will have access when downstream restoration is complete, potentially making upstream restoration more important (e.g., fish passage at upstream barriers and riparian buffers).
- Help protect canopy cover and areas of infiltration through urban tree protection strategies.
- Seek further acquisition opportunities where the estuary is predicted to shift locations due to sea-level rise and/or levee setbacks/removals.

Planning Unit	Snohomish Estuary
Salmonid Use	• Chinook/bull trout use = low • Coho use = high
Precipitation Regime	Lowland (100%)
Primary Land Uses	• Rural Residential (34.7%) • City (45%)
Limiting Factors and Life Cycle Stresses	• Upriver migration • Spawning • Egg deposition • Egg development • Freshwater rearing • Estuarine rearing • River outmigration
Current and Future Pressures	• Continued expansion of UGAs • Industrial development along mainstem
Ecosystem Services	• Recreation • Irrigation
Climate Change Impacts	No data for spawning and incubation

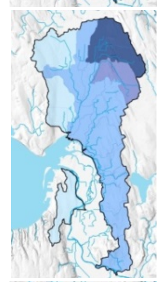
Existing Protection Strategies in Unit	• Public Lands (11.3%) • Agriculture (0.9%) • Timber (2.0%) • Open Space (1.0%)
Opportunities	• LID for future development • Protect lands in the floodplains for future levee setbacks • Protect urban trees • Protect open space and agriculture in the estuary areas under the Comprehensive Plan

Legend

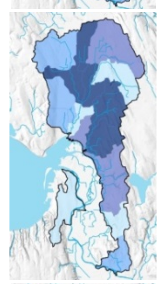
Overall



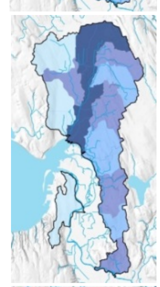
Delivery



Surface Storage



Recharge



Discharge

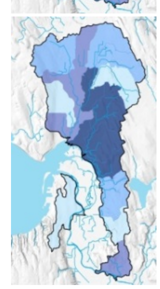


Figure 49: Overall Water Flow Maps for the Estuary Drainages Planning Unit

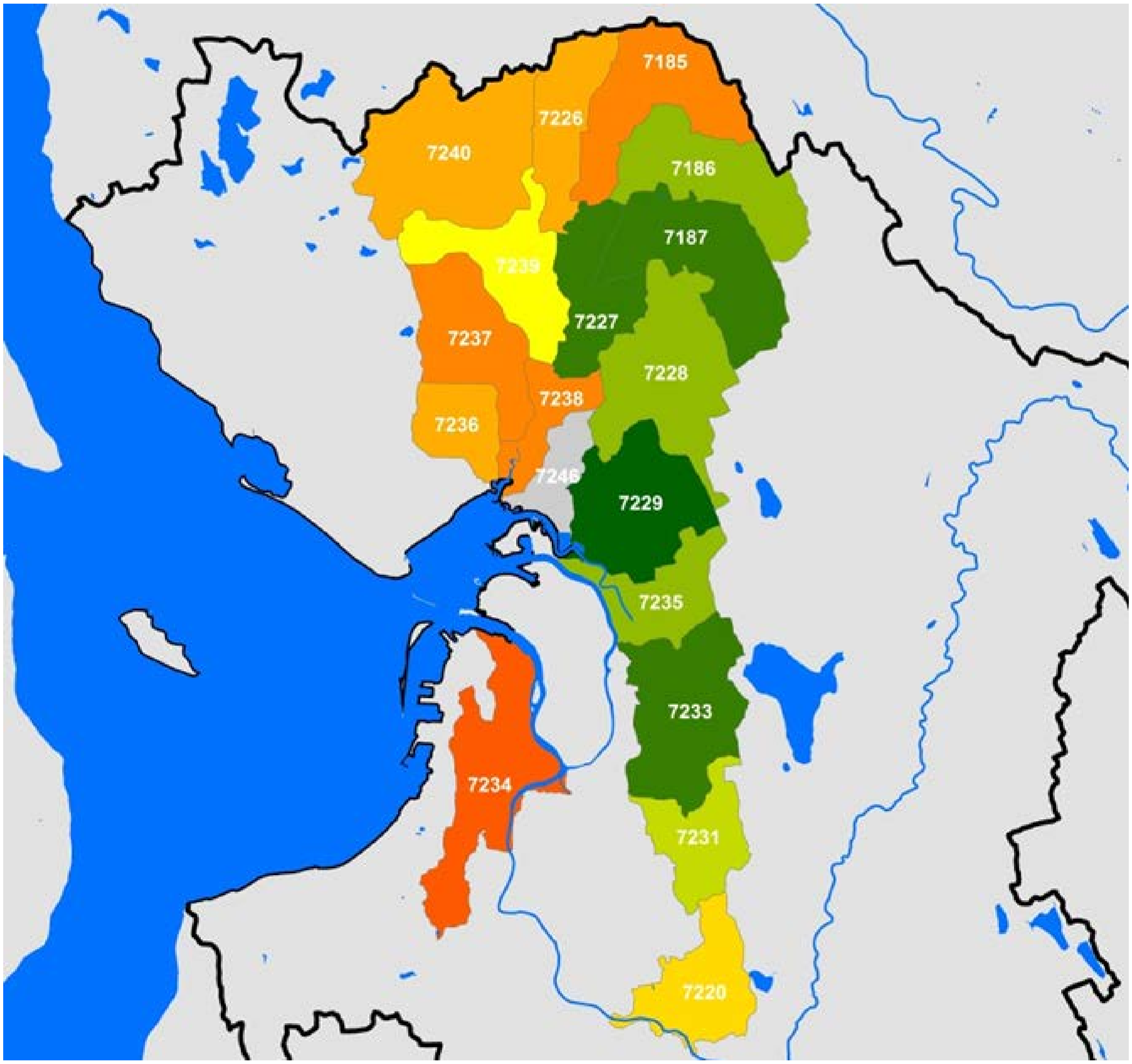


Figure 50: Watershed Characterization Habitat Model Map for the Estuary Drainages Planning Unit

Numbers are labels for spatial units

Watershed Characterization Summary

Planning Unit	Snohomish Estuary
Overall Flow Importance Model	• East Fork of Quilceda Creek • Allen Creek drainage
Delivery Importance Model	• Upper portion of Quilceda Creek (specifically the East Fork south of Arlington)

Surface Storage Importance Model	• Areas near the confluence of the West and East Fork Quilceda • Allen Creek drainage
Recharge Importance Model	• Primarily the East and West Fork Quilceda Creek (excluding the headwaters of the East Fork)
Discharge Importance Model	• Lower East Fork Quilceda • Allen Creek drainage
Habitat Model	• West Fork of Quilceda Creek • Allen Creek drainage • Majority of the eastern drainages into Ebey Slough
Protection Consideration	• Restoration of surface storage • Recharge • Delivery

Lower-Middle Skykomish River

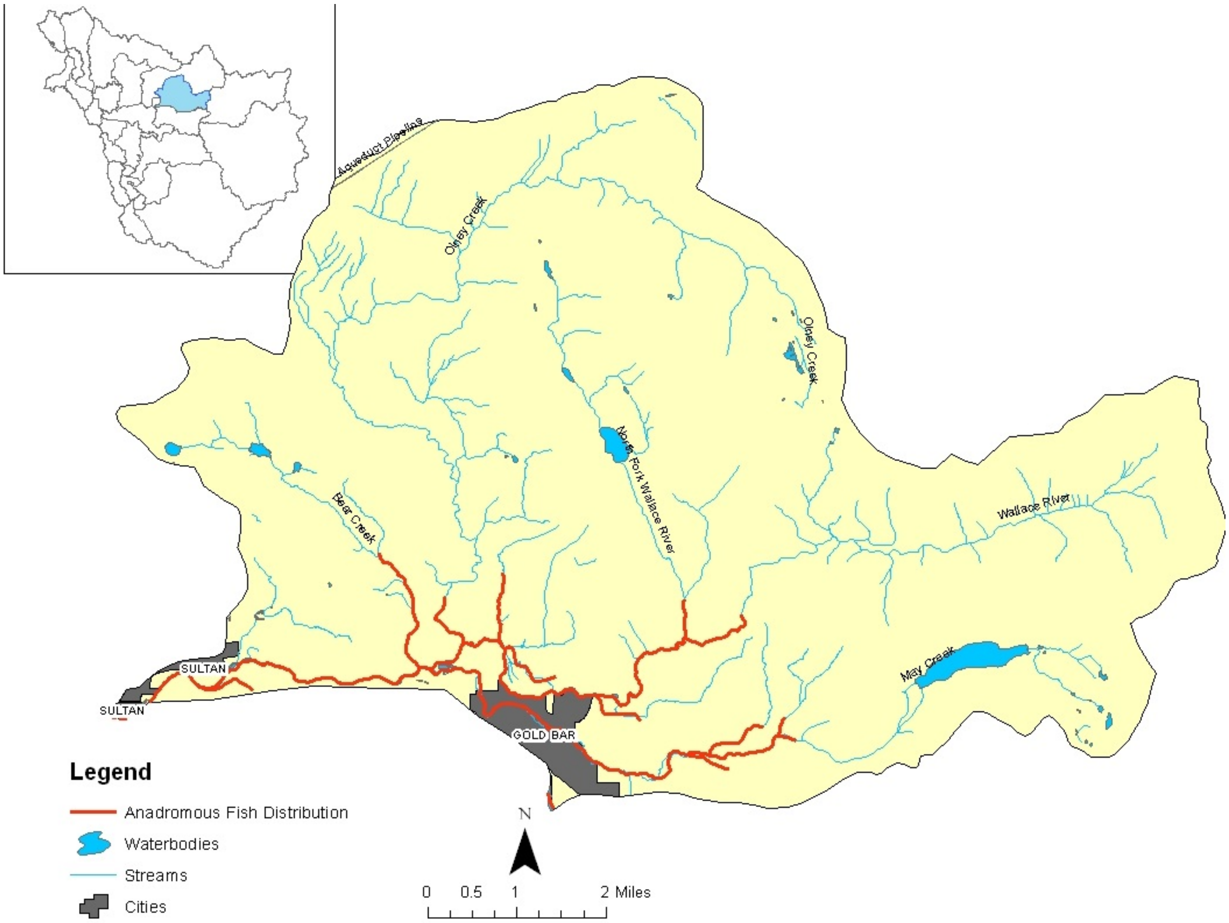


Figure 51: Lower-Middle Skykomish River Planning Unit

Basin(s) Name(s): This planning unit includes May Creek, Wallace River, Olney Creek, and Bear Creek.

Sub-basin Strategy Group: Mainstem Secondary Restoration (May Creek), Headwaters Primary Restoration (Wallace River), Headwaters Secondary Protection (Olney Creek), and Rural Secondary Restoration (Bear Creek)

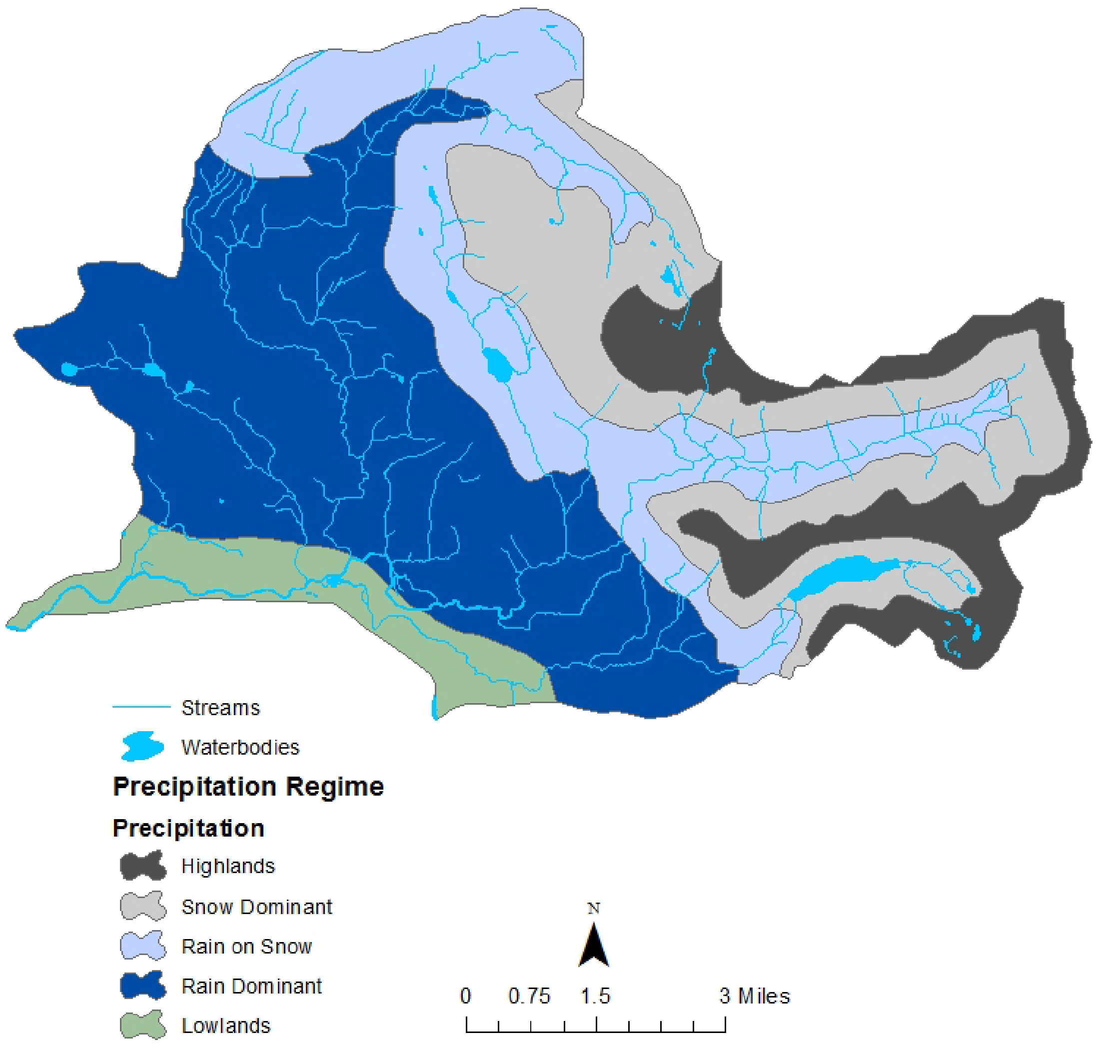


Figure 52: Lower-Middle Skykomish River Precipitation Regime

Precipitation Regime	Acres	Percent of Planning Unit
Snow Dominate	7,767	20.4%
Rain Dominate	14,857	39.1%
Lowlands	2,667	7.0%
Rain on Snow	8,697	22.9%
Highlands	4,052	10.7%

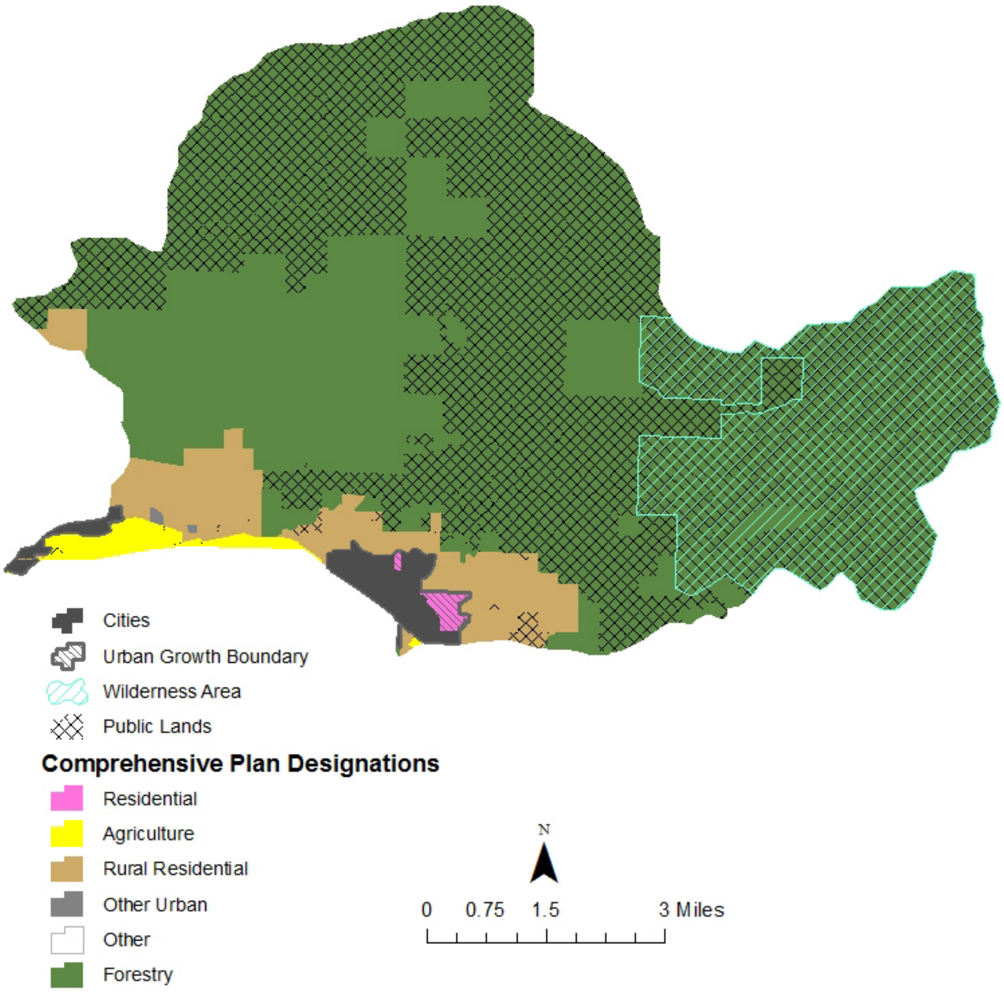


Figure 53: Lower-Middle Skykomish River Land Use

Land Use Type	Acres	Percent of Planning Unit
City	712	1.9%
Agriculture	521	1.4%
Forestry	33,720	88.6%
Residential	138	0.4%
Rural Residential	2,922	7.7%
Other Urban	26	0.1%

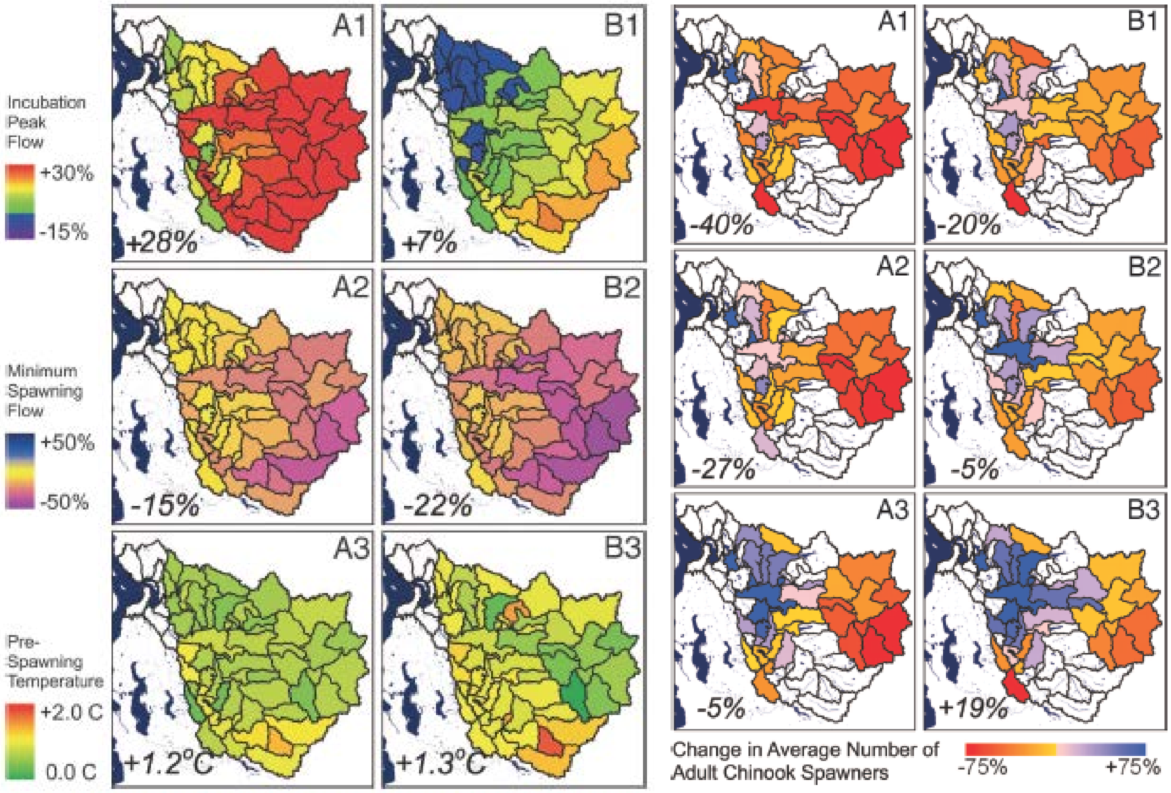


Figure 54: Maps of Modeled Climate Change Effects in the Lower-Middle Skykomish River Planning Unit

From Battin et al. 2007

- Incubation peak flow: minimal to major increase (Battin et al. 2007)
- Minimum spawning flow: moderate to major decrease (Battin et al. 2007)
- Pre-spawning temperature: minimal increase (Battin et al. 2007)
- Change in average number of adult Chinook spawners:
  - A1/B1 = major to moderate decrease
  - A2/B2 = moderate decrease
  - A3/B3 = moderate decrease/slight increase

There is no specific information on this area, but the patterns are expected to be consistent with information generated in Battin et al. and by the recent Snow Caps to White Caps work. The upper Wallace and upper May will likely move from snow dominate and rain on snow watersheds to rain dominate watersheds. This means there will be higher winter

flows, less of a spring peak, and lower summer baseflows. This shift will likely cause warmer summer temperatures and higher winter scour.

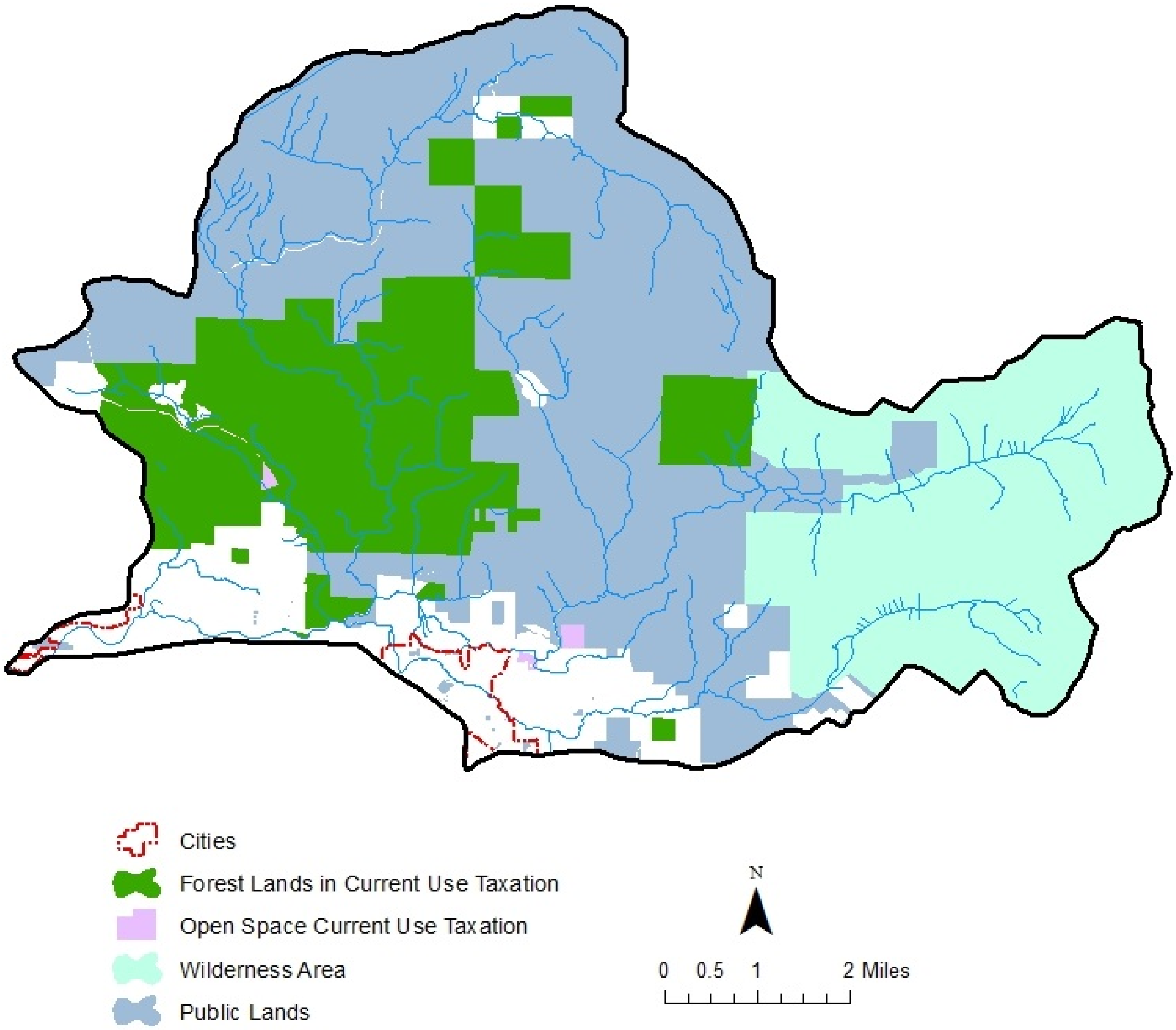


Figure 55: Current Protection Strategies Used in the Lower-Middle Skykomish River Planning Unit

Protection Program	Acres	Percent of Planning Unit
Open Space	74	0.2%
Timber Lands	8,511	22.4%
Public Lands	25,000	65.7%

Opportunities for Protection

A large portion of the Lower-Middle Skykomish Planning Unit is in public ownership, which helps protect much of the natural resources and ecosystem services provided by the Lower-Middle Skykomish Basin. To further protect the hydrology, especially as the rural residential areas are expected to expand, the following opportunities remain:

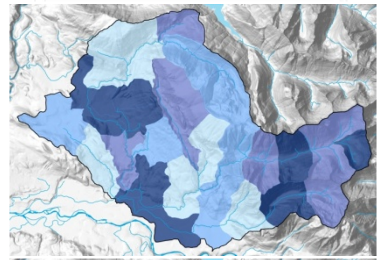
- Likely need to protect the fringe of rural residential and private forestry so that forestlands are not converted into developed areas. Few of these areas are currently taking advantage of protection programs offered by either the counties or state.
- Ensure that timber harvest methods are protective of hydrology and can adaptively manage the harvest methods as precipitation regimes shift with climate change.
- Work on acquiring TDRs in key areas of hydrologic importance to ensure those areas do not get developed.
- Decrease the number of private inholdings surrounded by public lands through acquisitions.
- Protect the floodplain areas between Highway 2 and the Snohomish River, upstream of the Start Up levee, which are important for surface storage and discharge.
- Work with cities to ensure LID is used in the cities and the UGA.
- Use inventive programs in residential areas to encourage the protection of natural resources and hydrology.
- Protect the interface between the urban/residential areas and forestry, through easements or incentive programs.

Planning Unit	Lower Middle Skykomish
Salmonid Use	• Wallace River = no Chinook use • Olney Creek = no Chinook use • Bear Creek = low fish use • May Creeks = low fish use
Precipitation Regime	• Rain Dominant (39.1%) • Rain on Snow (22.9%) • Snow Dominant (20.4%) • High Lands (10.7%) • Low Lands (7%)
Primary Land Uses	• Forestry (88.6%) • Rural Residential (7.7%)

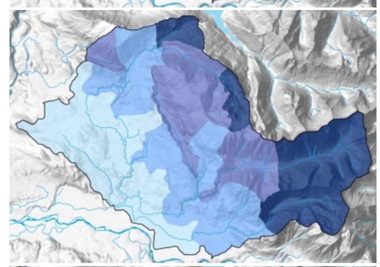
Limiting Factors and Life Cycle Stresses	• Upriver migration • Spawning • Egg deposition • Egg development • Freshwater rearing • River outmigration
Current and Future Pressures	• Most important areas for hydrology are in and near cities. Future development will have impacts on hydrology. • Conversion of forest land to rural residential. • Dredge mining in upper areas of the Lower Middle Skykomish. • Areas of agriculture that correspond to key areas of surface storage will need to be maintained.
Ecosystem Services	• Flood regulation • Water quality regulation • Recreation • Hatchery water supply • Storage • Water quantity regulation
Climate Change Impacts	• Small to significant increase in incubation peak flow • Minimal to moderate decrease (Upper Wallace) in minimum spawning flow • Minimal change to moderate increase (Olney) in pre-spawning temperature • Slight decrease in average number of adult Chinook spawners in one of six scenarios in May Creek; no change or slight increase in others
Existing Protection Strategies in Unit	• Public Lands (65.7%) • Timberlands (22.4%) • Open Space (0.2%)
Opportunities	• Protect forestlands from conversion • Ensure protective timber harvest methods and allow for adaptive management in the face of climate change • Work on acquiring TDRs in key areas of hydrologic importance • Decrease the number of private inholdings surrounded by public lands through acquisitions • Protect the floodplain areas between Highway 2 and the Snohomish River, upstream of the Start Up levee, which are important for surface storage and discharge • Use LID in the cities and the UGA • Use inventive programs in residential areas

Legend

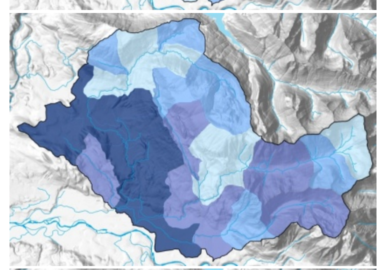
Overall



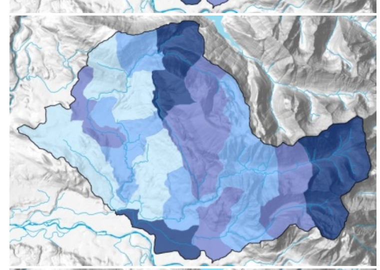
Delivery



Surface Storage



Recharge



Discharge

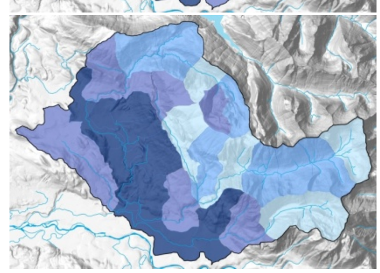


Figure 56: Overall Water Flow Maps for the Lower-Middle Skykomish River Planning Unit

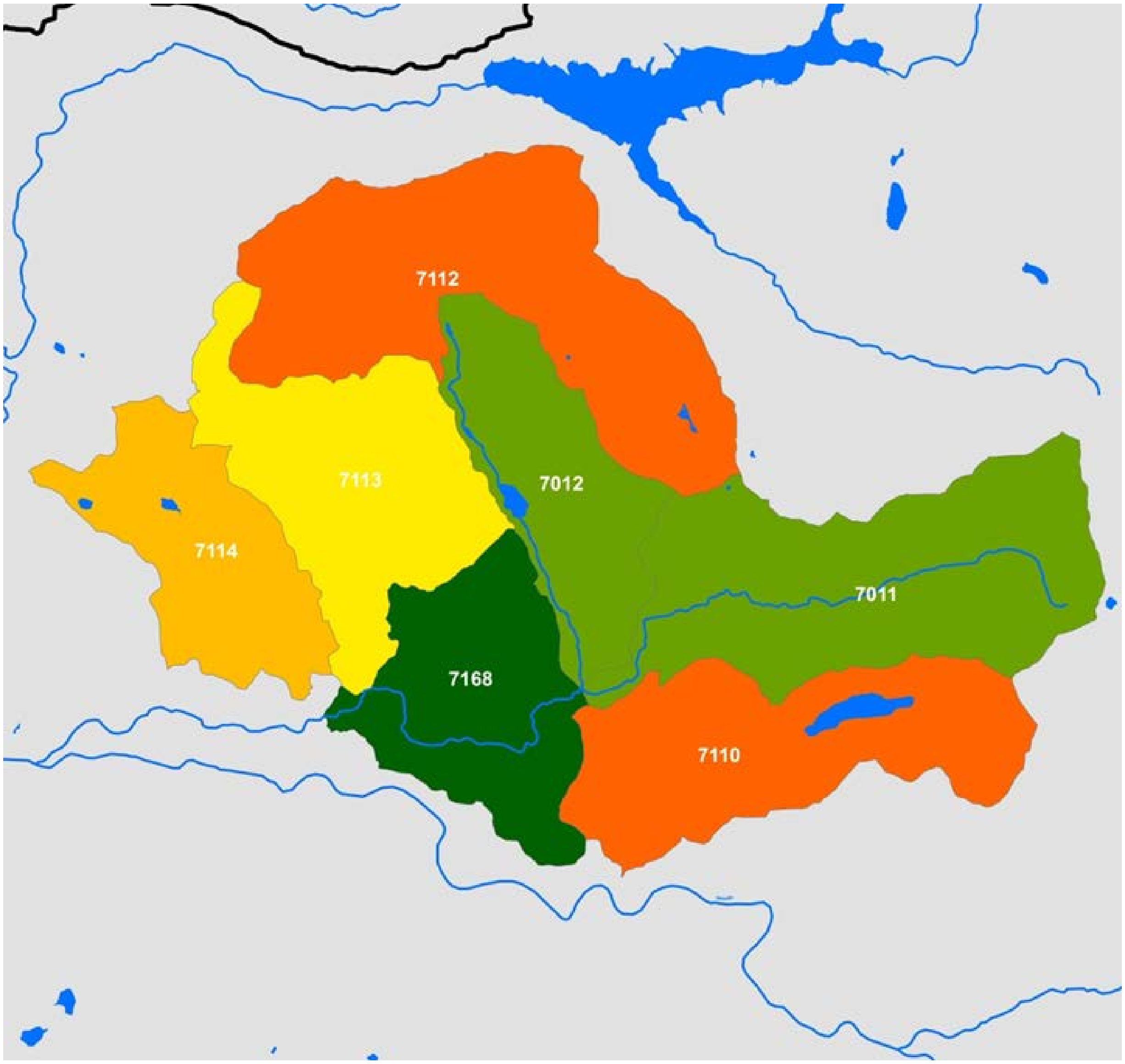


Figure 57: Watershed Characterization Habitat Model Map for the Lower-Middle Skykomish River Planning Unit

Numbers are labels for spatial units

Watershed Characterization Summary

Planning Unit	Lower-Middle Skykomish
Overall Flow Importance Model	• Upper Wallace River • May Creek • Lower reaches of Olney Creek

Delivery Importance Model	• Headwaters in the upper Wallace Creek • Upper Olney Creek • Upper May Creek
Surface Storage Importance Model	• Mid-lower Olney Creek • Upper Bear Creek • Lower May Creek (around Gold Bar) • Confluence of Wallace River with May and Olney Creek
Recharge Importance Model	• Upper Olney Creek • Upper Wallace River • Upper May Creek • Lower May Creek
Discharge Importance Model	• Mid-lower Olney Creek • Mid-lower May Creek
Habitat Model	• Wallace River • Lower Olney Creek • Lower May Creek (around Gold Bar)
Protection Consideration	• Restoration of surface storage and discharge

North Fork Skykomish Planning Unit

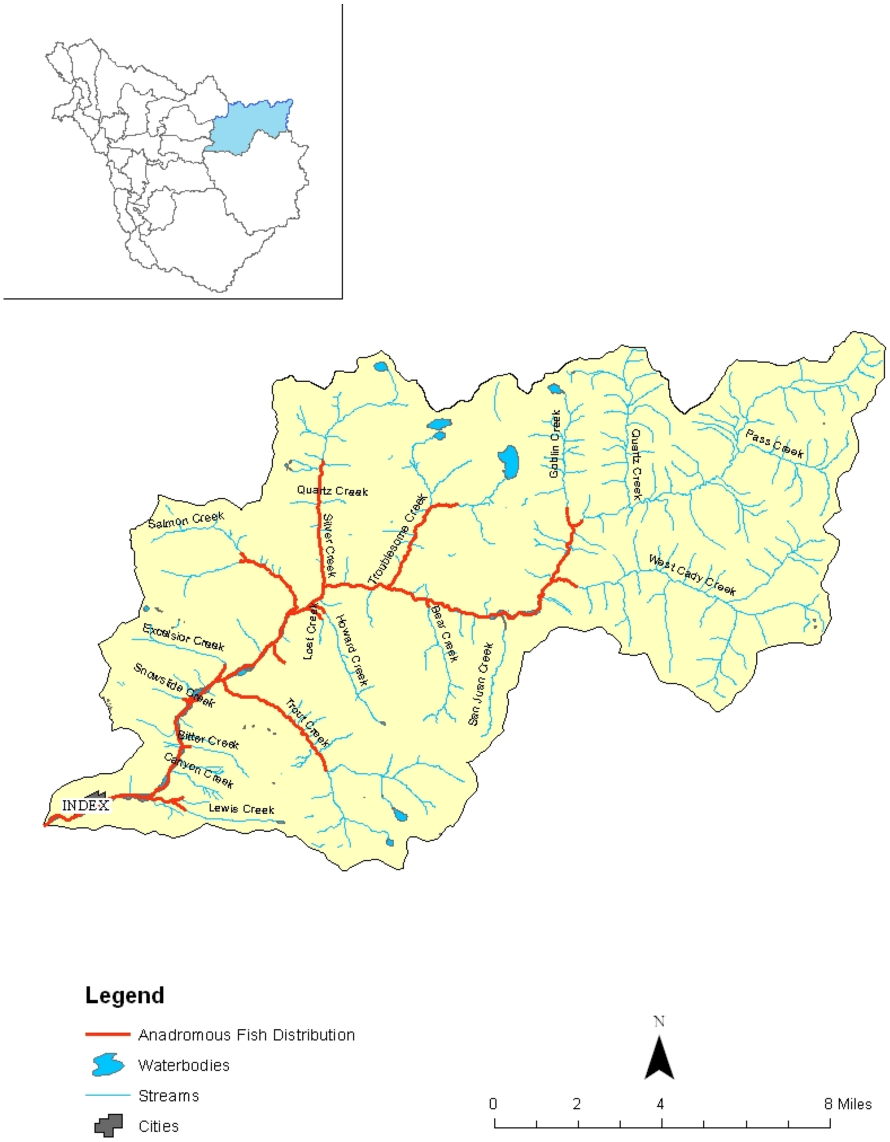


Figure 58: North Fork Skykomish Planning Unit

Basin(s) Name(s): North Fork Skykomish

Sub-basin Strategy Group: Secondary Restoration (lower) and Primary Protection

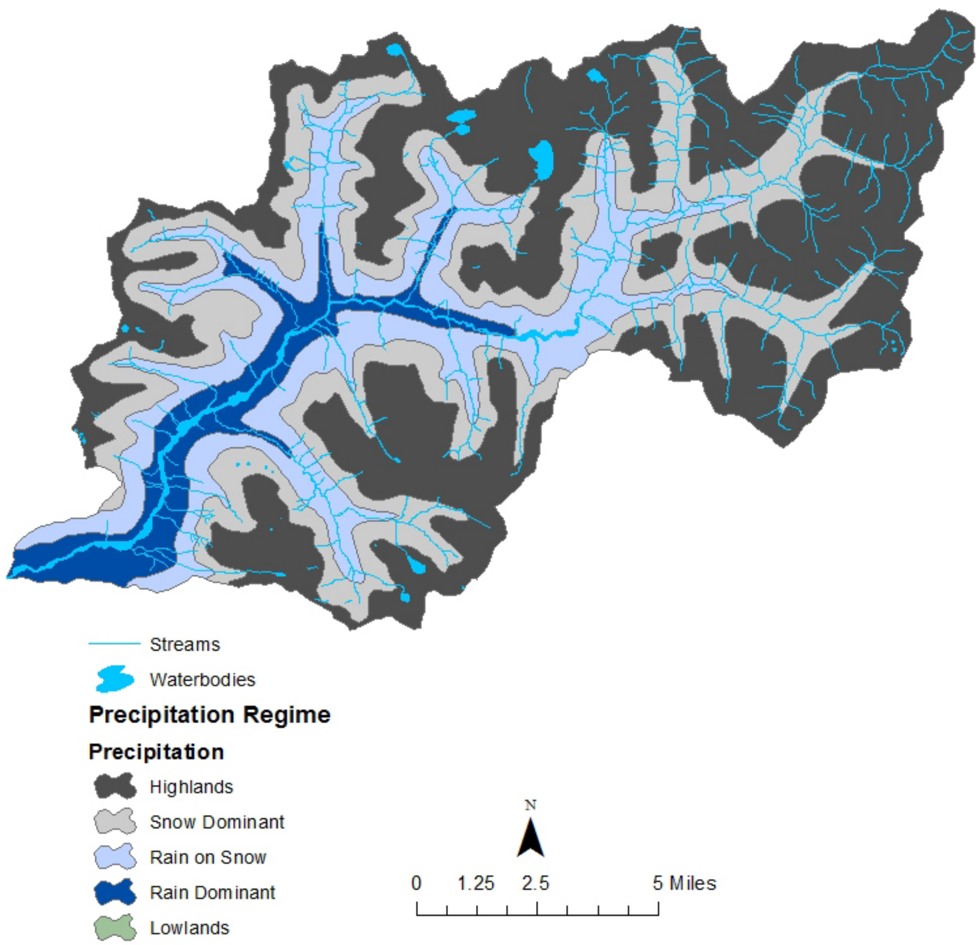


Figure 59: North Fork Skykomish Precipitation Regime

Precipitation Regime	Acres	Percent of Planning Unit
Highlands	43,542	46.4%
Snow Dominate	25,690	27.4%
Rain Dominate	6,917	7.4%
Rain on Snow	17,683	18.8%

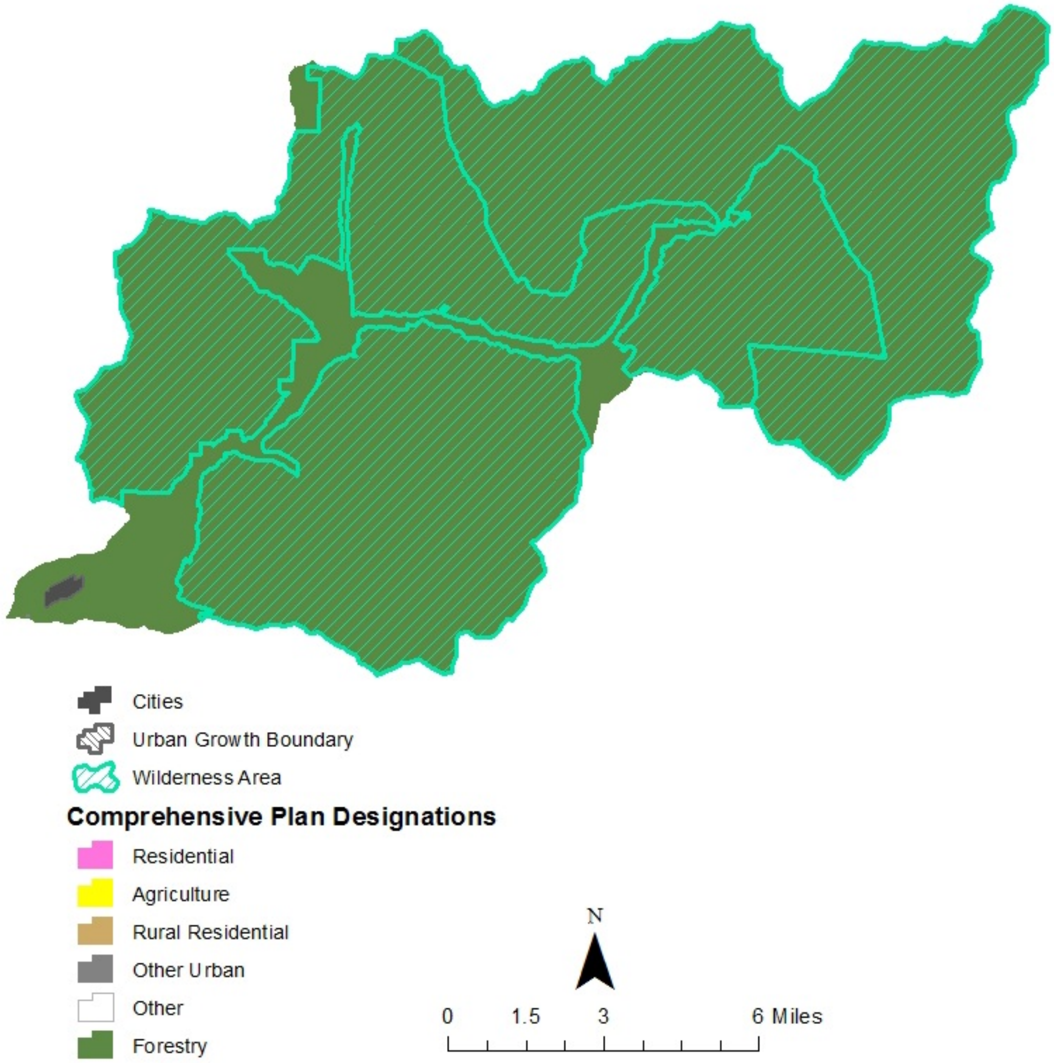


Figure 60: North Fork Skykomish Planning Unit Land Use

Land Use Type	Acres	Percent of Planning Unit
City	134	0.1%
Forestry	93,697	99.9%
Other Urban	3	0.0%

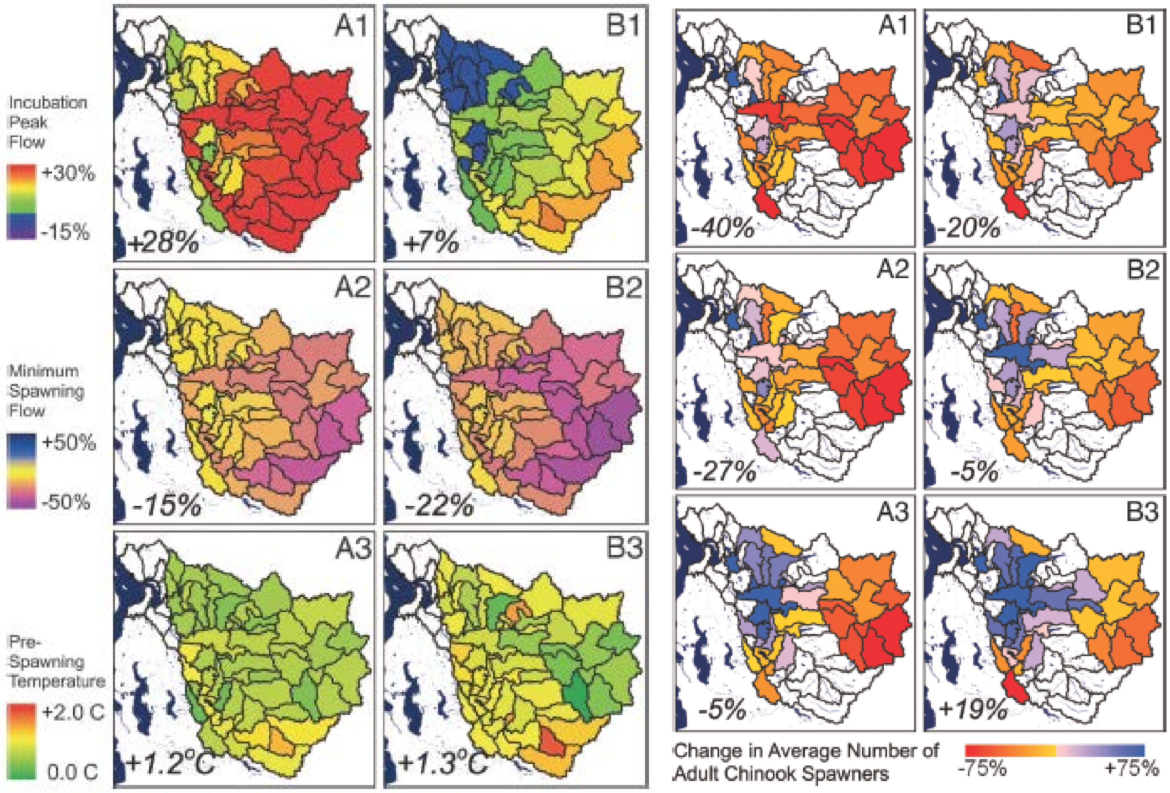


Figure 61: Maps of Modeled Climate Change Effects in the North Fork Skykomish Planning Unit

From Battin et al. 2007

- Incubation peak flow: moderate to major increase (Battin et al. 2007)
- Minimum spawning flow: moderate to major decrease (Battin et al. 2007)
- Pre-spawning temperature: minimal to moderate increase (Battin et al. 2007)
- Change in average number of adult Chinook spawners: moderate decrease (Battin et al. 2007)

The North Fork Skykomish is likely to lose the spring flood peak and have reduced base flows.

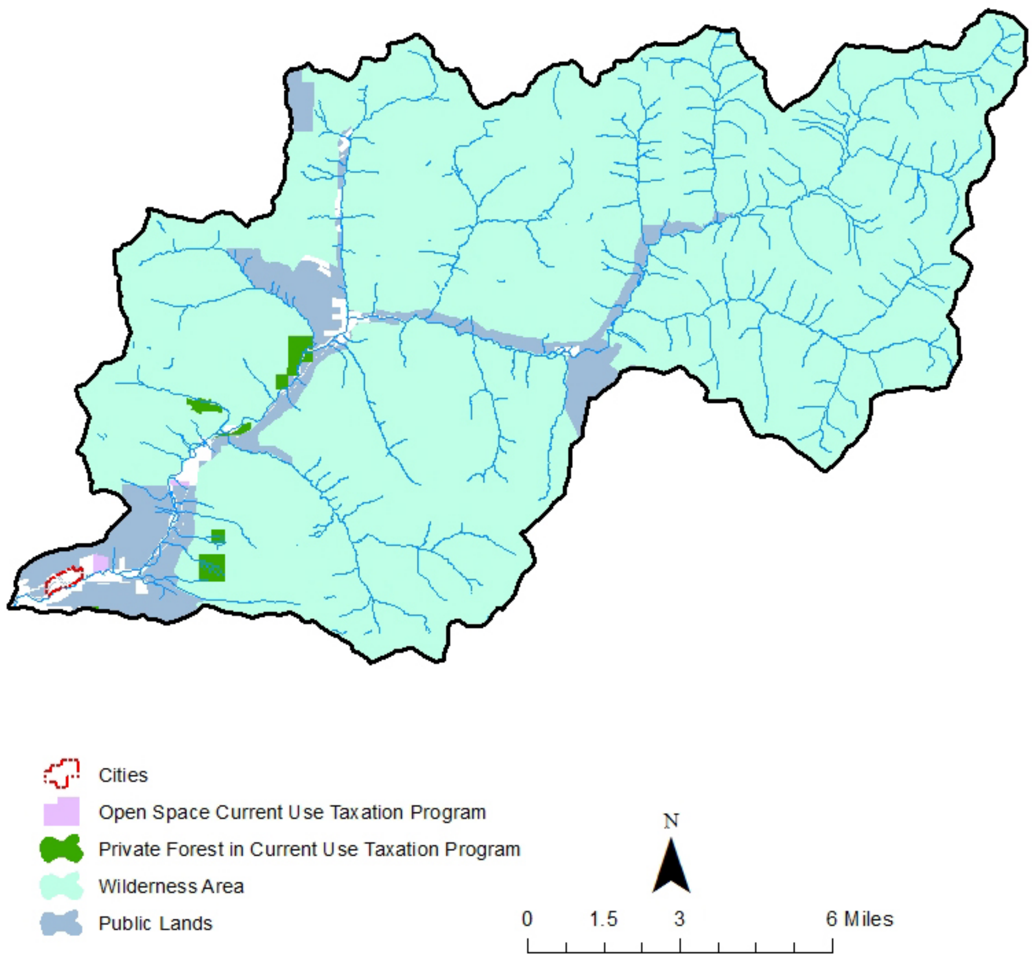


Figure 62: Current Protection Strategies Used in the North Fork Skykomish Planning Unit

Protection Type	Acres	Percent of Planning Unit
Open Space CUT	66	0.1%
Timber Lands	506	0.5%
Public Lands	84,232	89.8%

Opportunities for Protection

The North Fork Skykomish Planning Unit already has a very high level of protection, with 89% of the planning unit being in designated wilderness. However, there are a few key protection tools that should be implemented to ensure this planning unit continues to support intact hydrologic function. The opportunities are as follows:

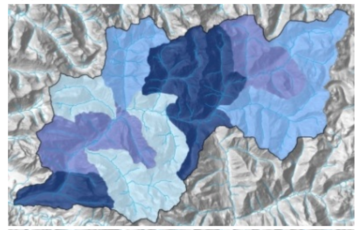
- Educate the population in this basin and recreational users about the importance of leaving wood in the river system and not harvesting it for firewood.

- Use LID techniques in and around the Town of Index.
- Protect hydrology as exploration of geothermal and hydropower increase in the area.
- Encourage the acquisition of private inholdings in and around public lands.

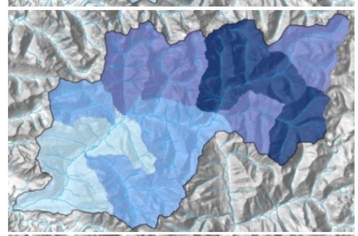
Planning Unit	North Fork Skykomish
Salmonid Use	• North Fork Skykomish = C of low use • The area is known to support bull trout
Precipitation Regime	• Highlands (46.4%) • Snow Dominant (27.4%) • Rain on Snow (18.8%) • Rain Dominant (7.4%)
Primary Land Uses	• Forestry (99.9%) • City (0.1%)
Limiting Factors	• Loss of floodplain function due to proximity of Index-Galena Road
Current and Future Pressures	• New roads • Bank hardening for road protection • Geothermal/hydropower exploration
Ecosystem Services	• Recreation
Climate Change Impacts	• Moderate to major increase in incubation peak flow • Moderate to major decrease in minimum spawning flow • Minimal to moderate increase in pre-spawning temperature • Moderate decrease in average number of adult Chinook spawners
Existing Protection Strategies in Unit	• Public Lands (89.8%) • Timberlands (0.5%) • Open Space (0.1%)
Opportunities	• Educate the population in this basin and recreational users about the importance of leaving wood in the river system and not harvesting it for firewood • Use LID techniques in and around the Town of Index • Protect hydrology as exploration of geothermal and hydropower increase in the area • Encourage the acquisition of private inholdings in and around public lands

Legend

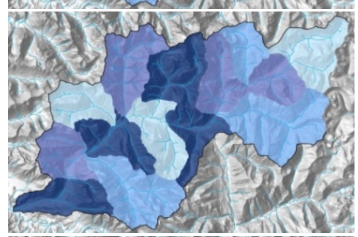
Overall



Delivery



Surface Storage



Recharge

Discharge

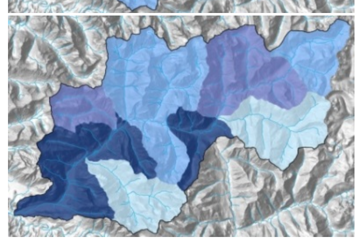


Figure 63: Overall Water Flow Maps for the North Fork Skykomish Planning Unit

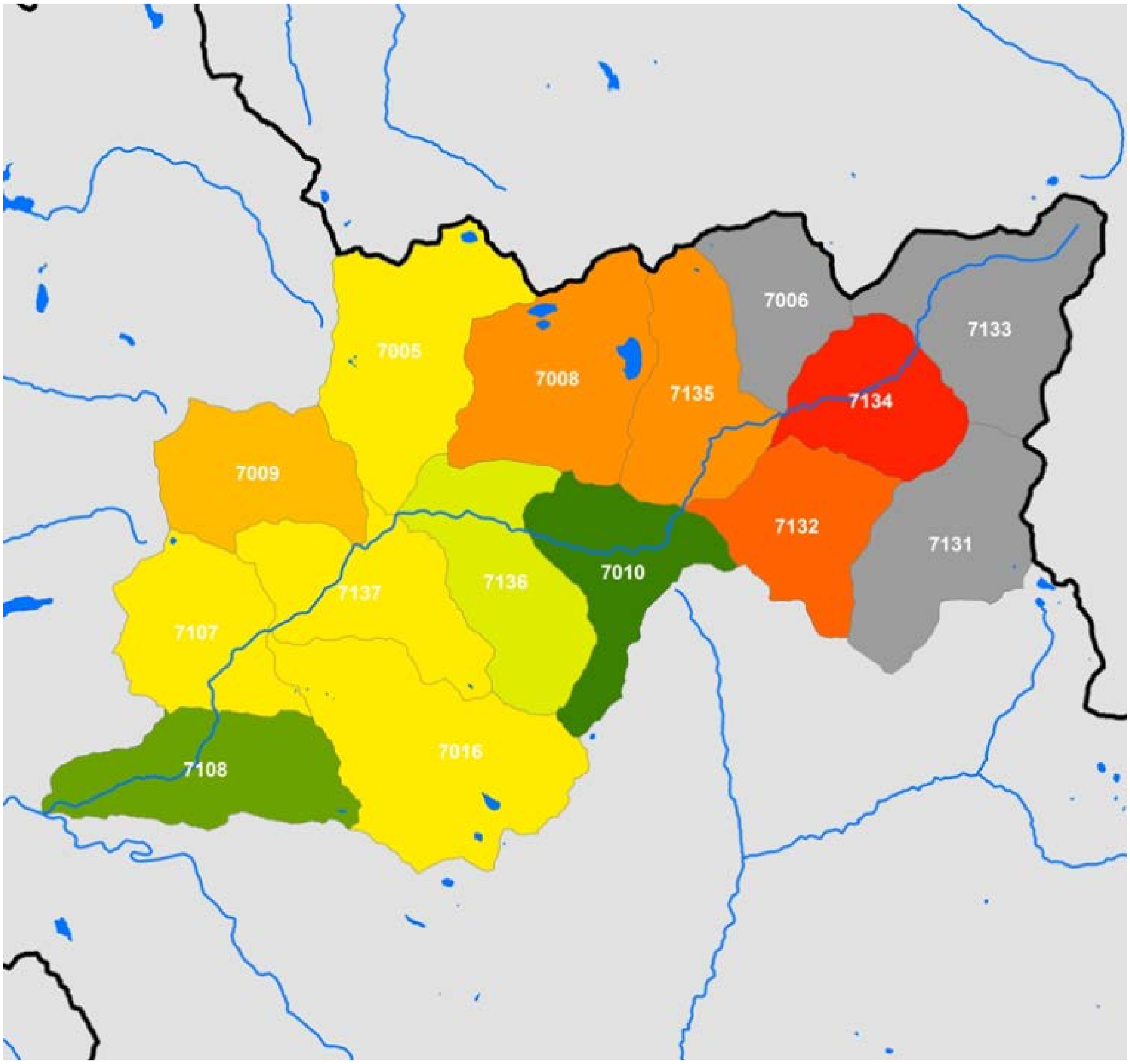


Figure 64: Watershed Characterization Habitat Model Map for the North Fork Skykomish Planning Unit

Numbers are labels for spatial units

Watershed Characterization Summary

Planning Unit	North Fork Skykomish
Overall Flow Importance Model	• Lower North Fork Skykomish (around Index and up to Bitter Creek) • Mid North Fork (from Silver Creek to Goblin Creek)
Delivery Importance Model	• Upper North Fork Skykomish • West Cady Creek

Surface Storage Importance Model	North Fork Skykomish from Bear Creek down to the confluence with the South Fork Skykomish (around Index)
Recharge Importance Model	Upper North Fork Skykomish including west Cady Creek, Goblin Creek, and Troublesome Creek drainages
Discharge Importance Model	Lower-mid North Fork Skykomish
Habitat Model	• Lower North Fork Skykomish (near Index) • Areas around Bear and San Juan Creeks
Protection Consideration	Protection of delivery and protection and restoration of recharge

Pilchuck Planning Unit

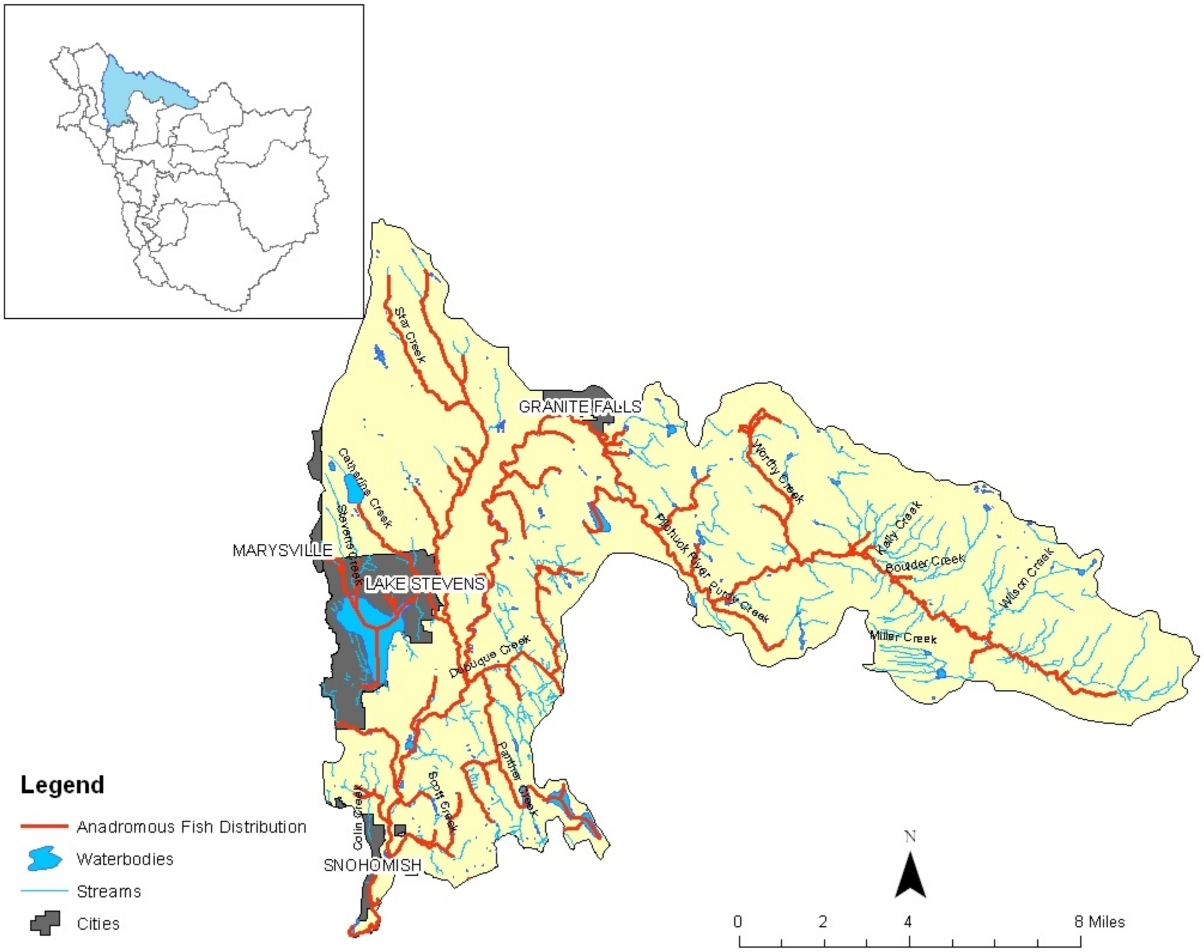


Figure 65: Pilchuck Planning Unit

Basin(s) Name(s): Pilchuck River (Lower Pilchuck, Lake Stevens, Dubuque, Little Pilchuck, Middle Pilchuck, and Upper Pilchuck)

Sub-basin Strategy Group: Urban Streams, Secondary Rural Streams, Primary Mainstem, primary headwaters

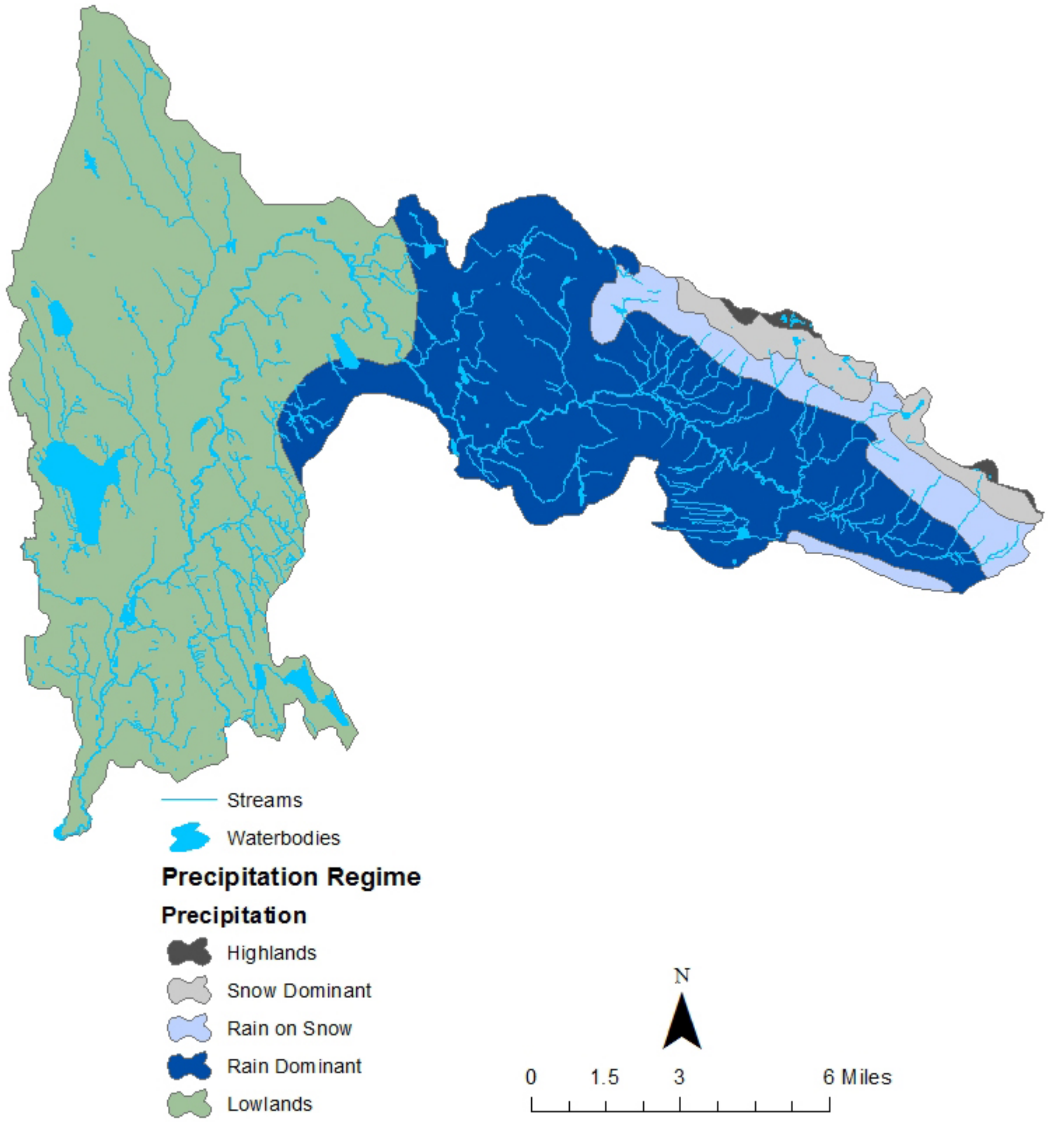


Figure 66: Pilchuck Precipitation Regime

Precipitation Regime	Acres	Percent of Planning Unit
Highlands	410	0.5%
Snow Dominate	2,830	3.3%
Rain on Snow	5,526	6.4%
Rain Dominate	28,481	33.1%
Lowlands	48,750	56.7%

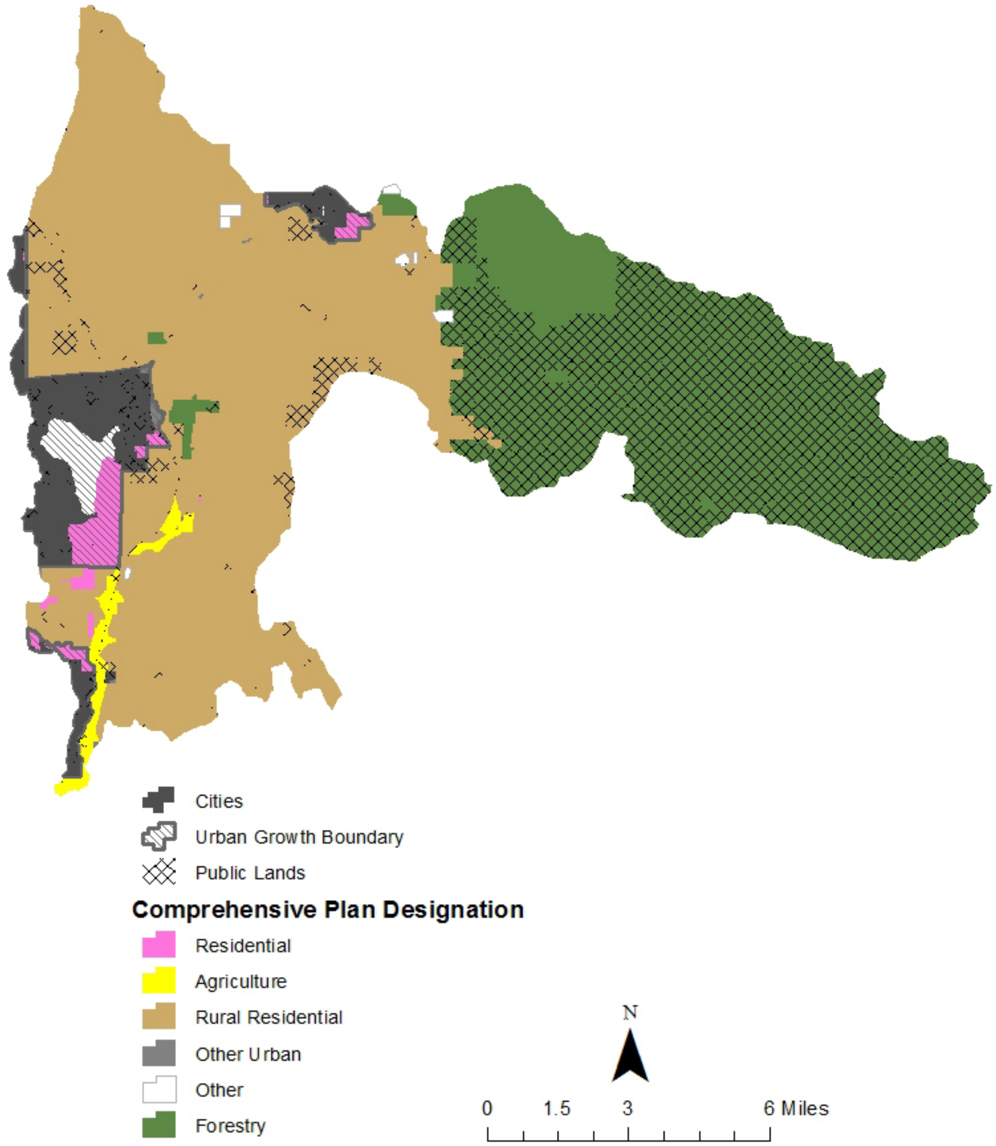


Figure 67: Pilchuck Land Use

Land Use Type	Acres	Percent of Planning Unit
Agriculture	1,203	1.4%
Forestry	32,555	37.9%
Rural Residential	43,981	51.1%
Residential	1,850	2.2%
City	1,064	1.2%
Other Urban	137	0.2%
Other	281	0.3%

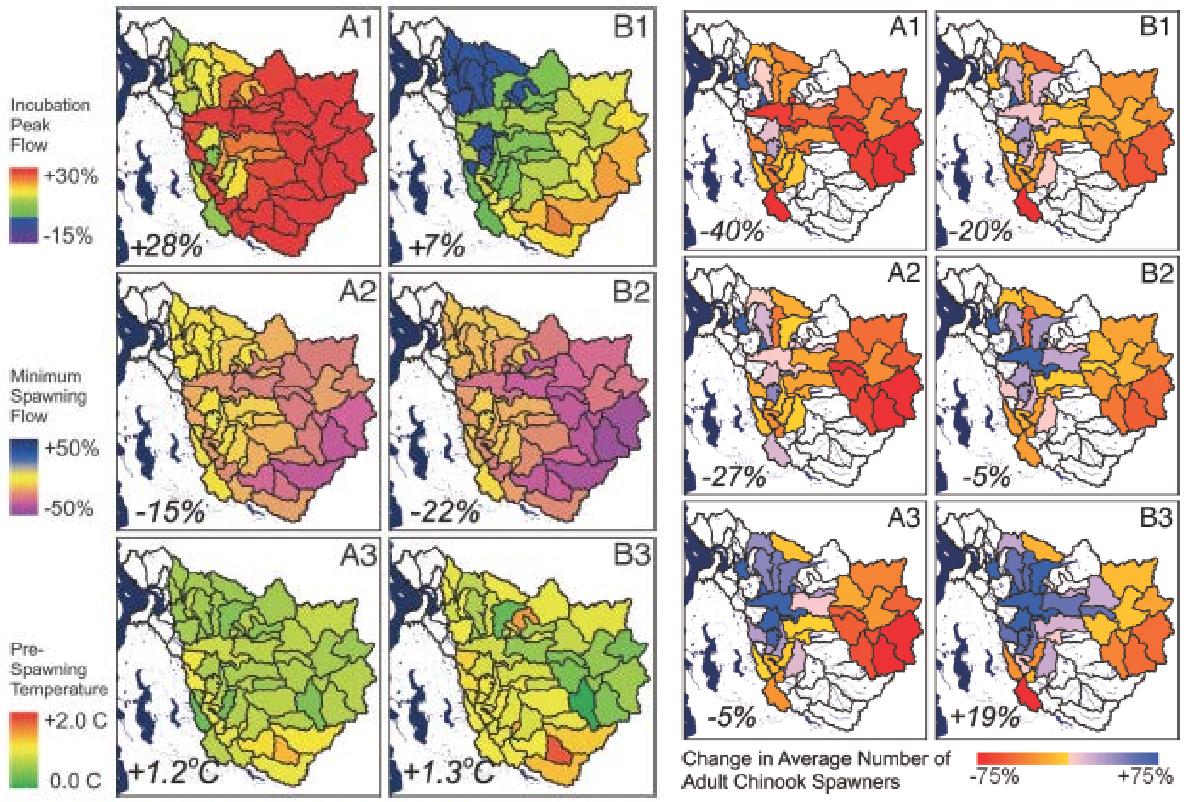


Figure 68: Maps of Modeled Climate Change Effects in the Pilchuck Planning Unit

From Battin et al. 2007

- Incubation peak flow: decrease to moderate increase (Battin et al. 2007)
- Minimum spawning flow: minor to moderate decrease (Battin et al. 2007)
- Pre-spawning temperature: minimal increase (Battin et al. 2007)
- Change in average number of adult Chinook spawners: slight decrease to moderate increase (Battin et al. 2007)

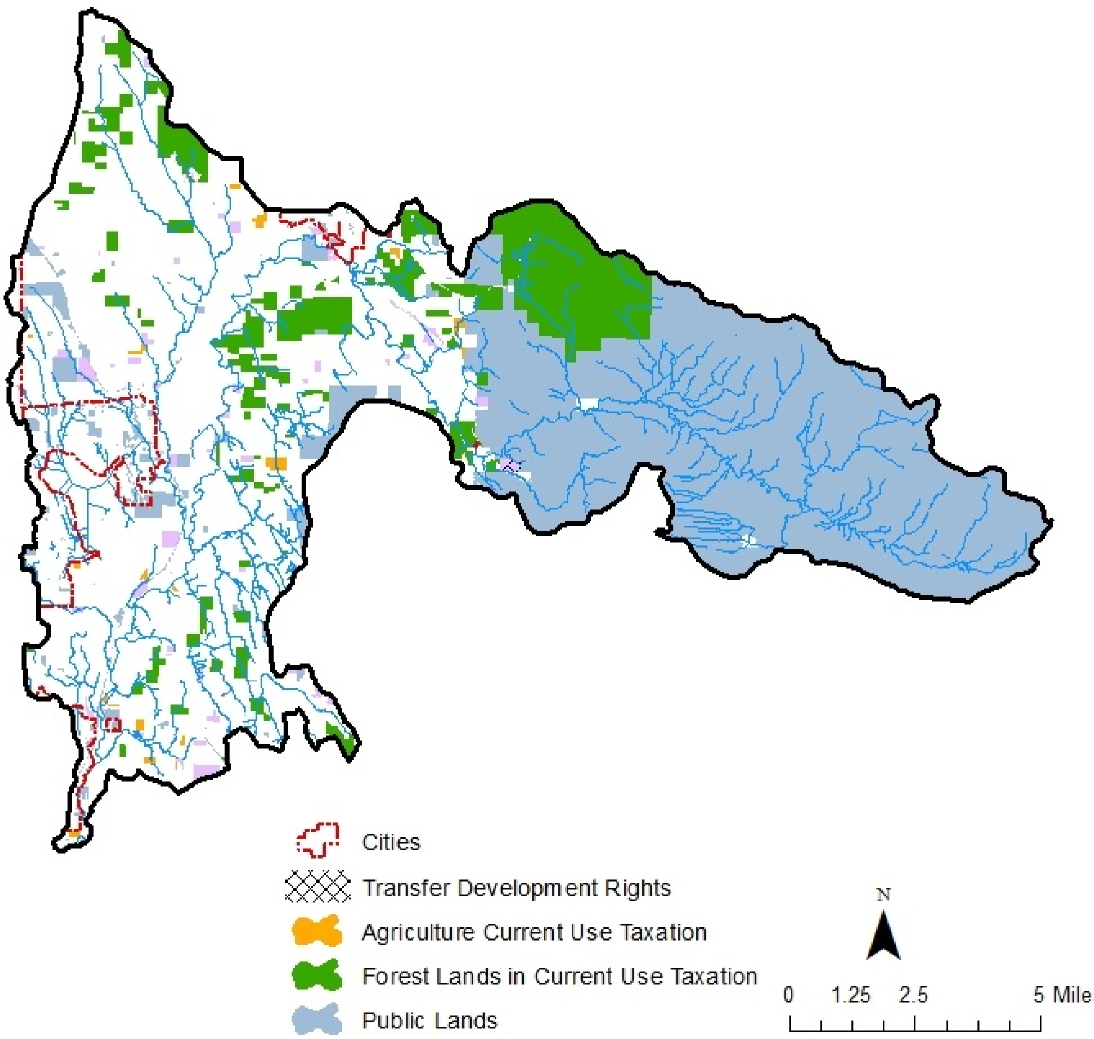


Figure 69: Current Protection Strategies Used in the Pilchuck Planning Unit

Protection Type	Acres	Percent of Planning Unit
TDR	39	0.05%
Open Space	1,069	1.24%
Agriculture	370	0.43%
Timberlands	9,282	10.79%
Public Lands	30,206	35.12%

Opportunities for Protection

The Pilchuck Planning Unit is one of the most diverse in the terms of land use. There are many different types of protection tools that can be used in this planning unit that will help protect the hydrology of the system, including the following opportunities:

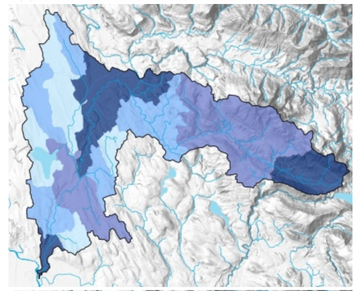
- Protect forestry and agricultural lands from conversion.
- Use Purchase of Development Rights (PDR)/TDR to purchase development rights in Agricultural land that is zoned Rural 5—primarily along the floodplain.
- Buy development rights in areas currently forested that are zoned rural residential. A good portion of this area is in the highest overall importance for hydrology in watershed characterization.
- Study the impacts that exempt wells have on the basin hydrology, and find ways to minimize those impacts.

Planning Unit	Pilchuck
Salmonid Use	• Chinook = none to low • Coho = known presence to moderate • Bull trout = presumed presence
Precipitation Regime	• Rain on Snow (33.1%) • Lowland (56.7%)
Primary Land Uses	• Rural Residential (51.1%) • Forestry (37.9%)
Limiting Factors and Life Cycle Stresses	• Upriver migration • Spawning • Egg development • Freshwater rearing • River outmigration
Current and Future Pressures	• Conversion of forest land and farmland to rural residential • Additional bank armoring • Loss of critical areas • Increased flooding and diking with climate change • Loss of wood in river due to firewood
Ecosystem Services	• Flood regulation • Water quality regulation • Drinking water provisioning • Recreation • Water quantity regulation
Climate Change Impacts	• Moderate increase in incubation peak flow • Minimal decrease in pre-spawning minimum spawning flow • No change to minimal increase in temperature
Existing Protection Strategies in Unit	• Public Lands (35.12%) • Timberlands (10.79%) • Agriculture (0.43%) • Open Space (1.24%)

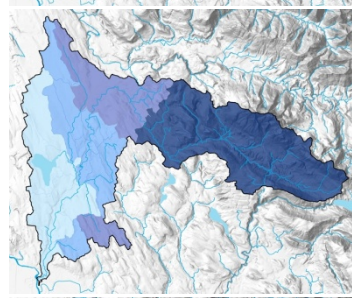
Opportunities	• Protect forestry and agricultural lands from conversion • Use PDR/TDR to purchase development rights in agricultural land • Buy development rights in areas currently forested that are zoned rural residential • Study the impacts that exempt wells have on the basin hydrology, and find ways to minimize those impacts

Legend

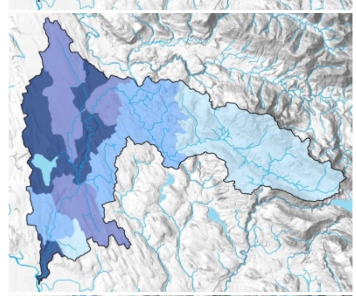
Overall



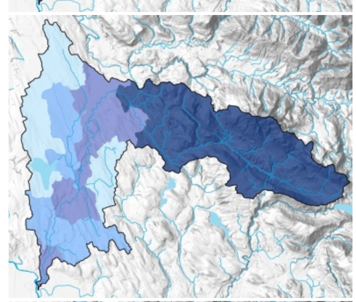
Delivery



Surface Storage



Recharge



Discharge

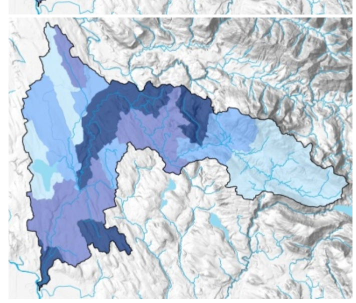


Figure 70: Overall Water Flow Maps for the Pilchuck Planning Unit

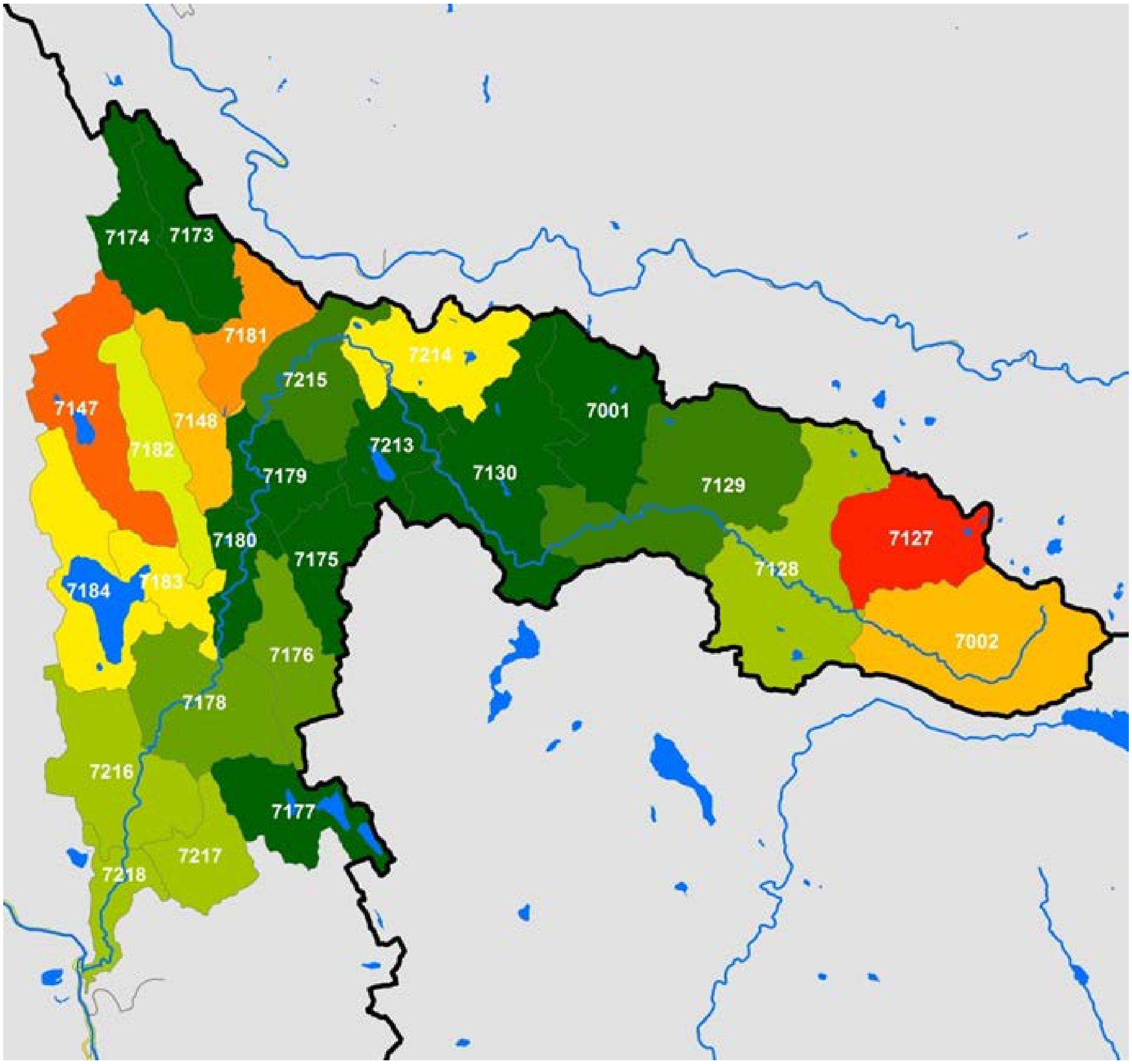


Figure 71: Watershed Characterization Habitat Model Map for the Pilchuck Planning Unit

Numbers are labels for spatial units

Watershed Characterization Summary

Planning Unit	Pilchuck
Overall Flow Importance Model	• Upper headwaters of the Pilchuck • Portions of the middle Pilchuck between Granite Falls and Lake Stevens • Mouth of the Pilchuck near Snohomish
Delivery Importance Model	• Headwaters in the upper Pilchuck down to Granite Falls

Surface Storage Importance Model	• Areas around Lake Stevens • Catherine Creek • Little Pilchuck • Portions of the middle Pilchuck • Mouth of the Pilchuck near Snohomish
Recharge Importance Model	• Headwaters of the upper Pilchuck • Tributaries near Granite Falls • Mouth of the Pilchuck near Snohomish
Discharge Importance Model	• Areas around Granite Falls down to the confluence of Dubuque and Little Pilchuck • Worthy Creek • Upper Panther Creek • Lower Pilchuck near the confluence of the Snohomish
Habitat Model	• Specifically, from the confluence of the Little Pilchuck and the Middle Pilchuck up to Purdy Creek • Upper portion of Dubuque Creek • Upper portion of Little Pilchuck Creek
Protection Consideration	• Highest protection in upper watershed, protection of recharge and delivery in upper watershed, and restoration of discharge and surface storage in lower watershed

Puget Sound Drainages Planning Unit

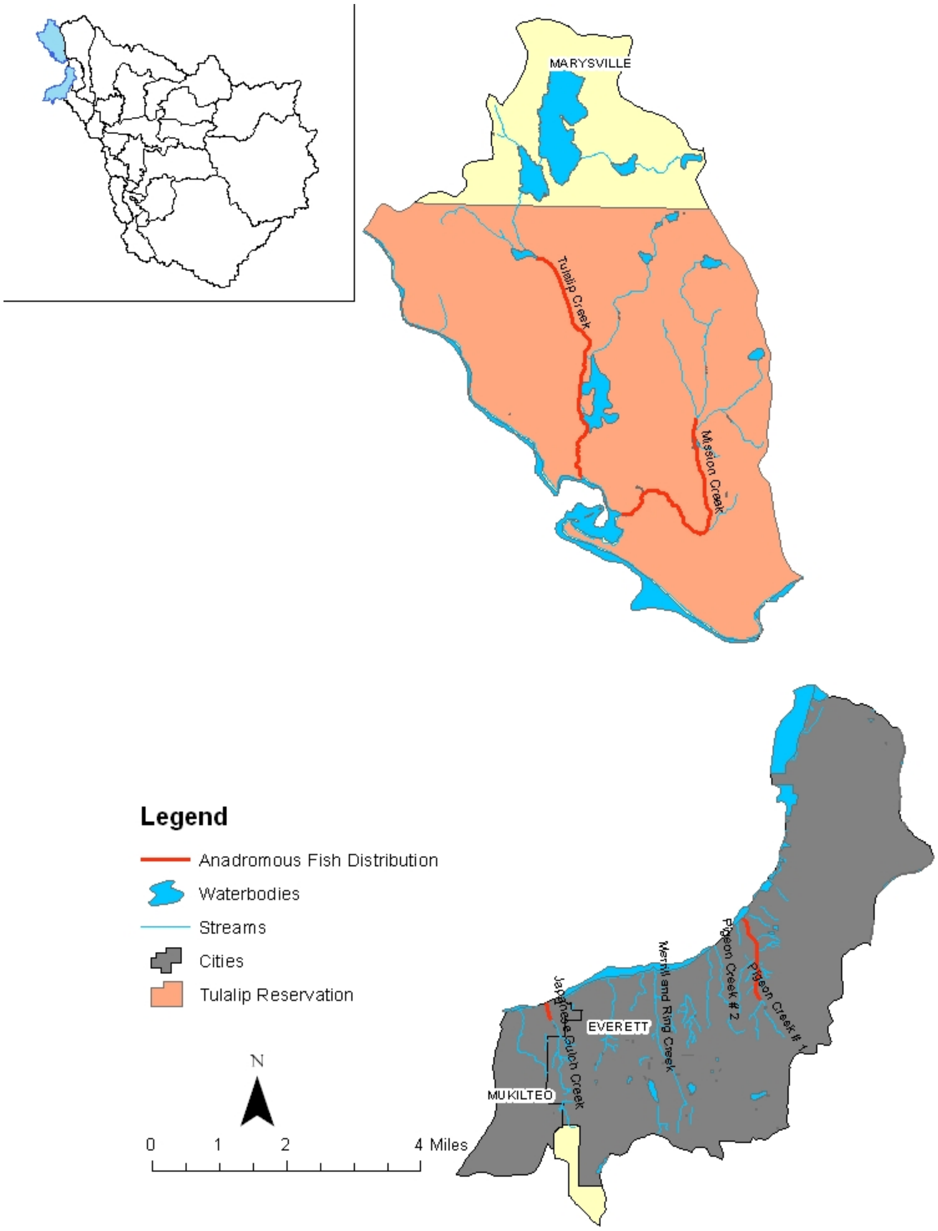


Figure 72: Puget Sound Drainages Planning Unit

Basin(s) Name(s): Tulalip and Western Everett Drainages

Sub-basin Strategy Group: Rural Streams and Urban Streams

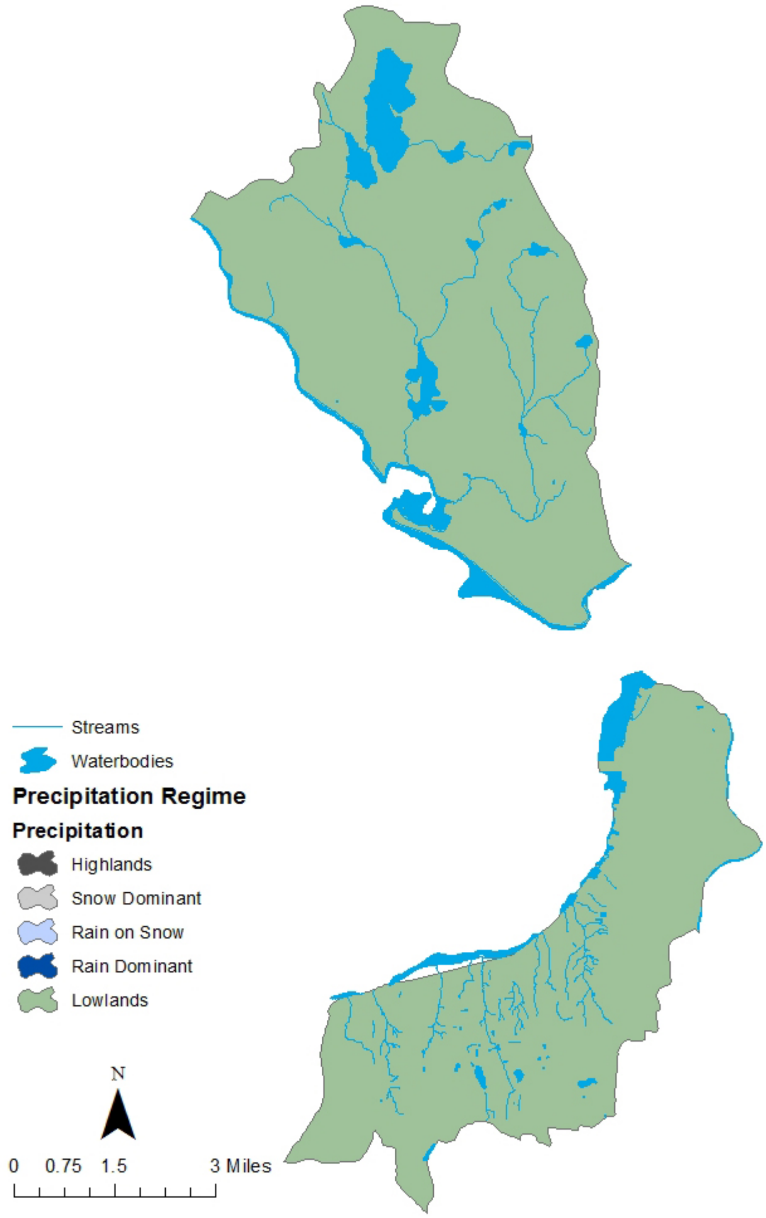


Figure 73: Puget Sound Drainages Precipitation Regime

Precipitation Regime	Acres	Percent of Planning Unit
Lowlands	32,794	100%

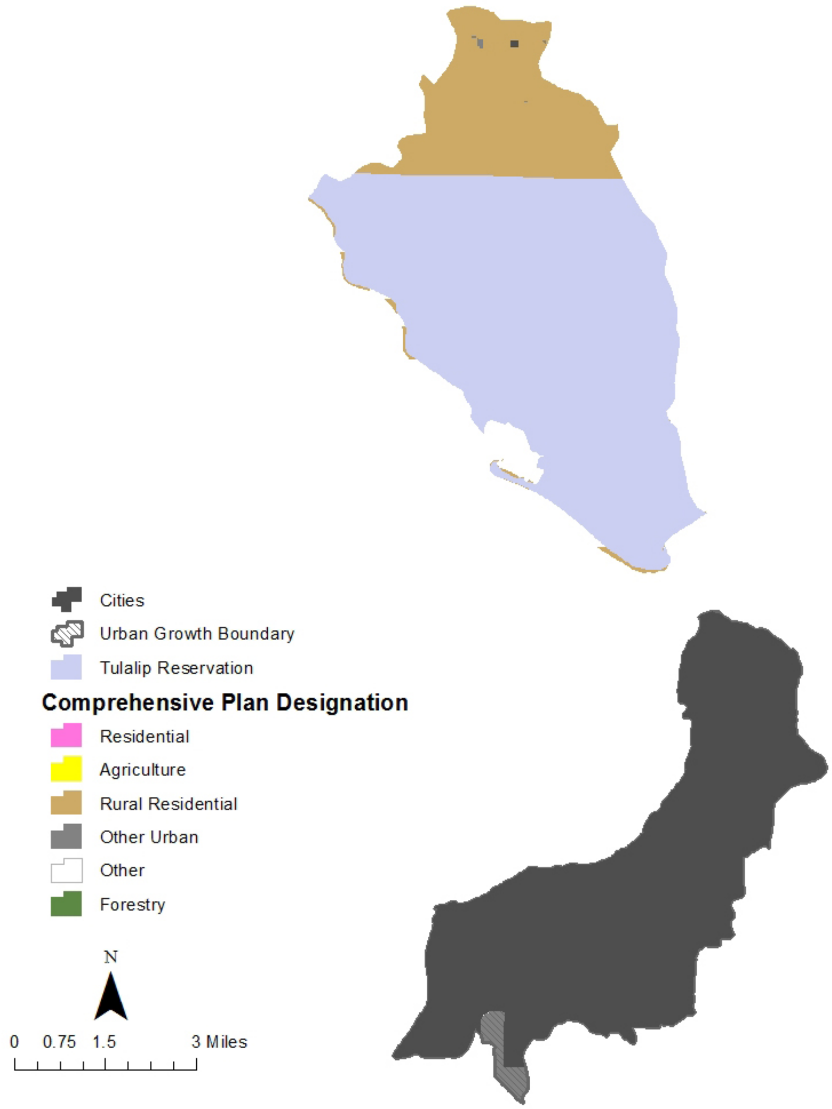


Figure 74: Puget Sound Drainages Land Use

Land Use Type	Acres	Percent of Planning Unit
Forestry	201	0.6%
City	12,905	39.4%
Other Urban	304	0.9%
Reservation	8,892	27.1%
Rural Residential	10,518	32.1%

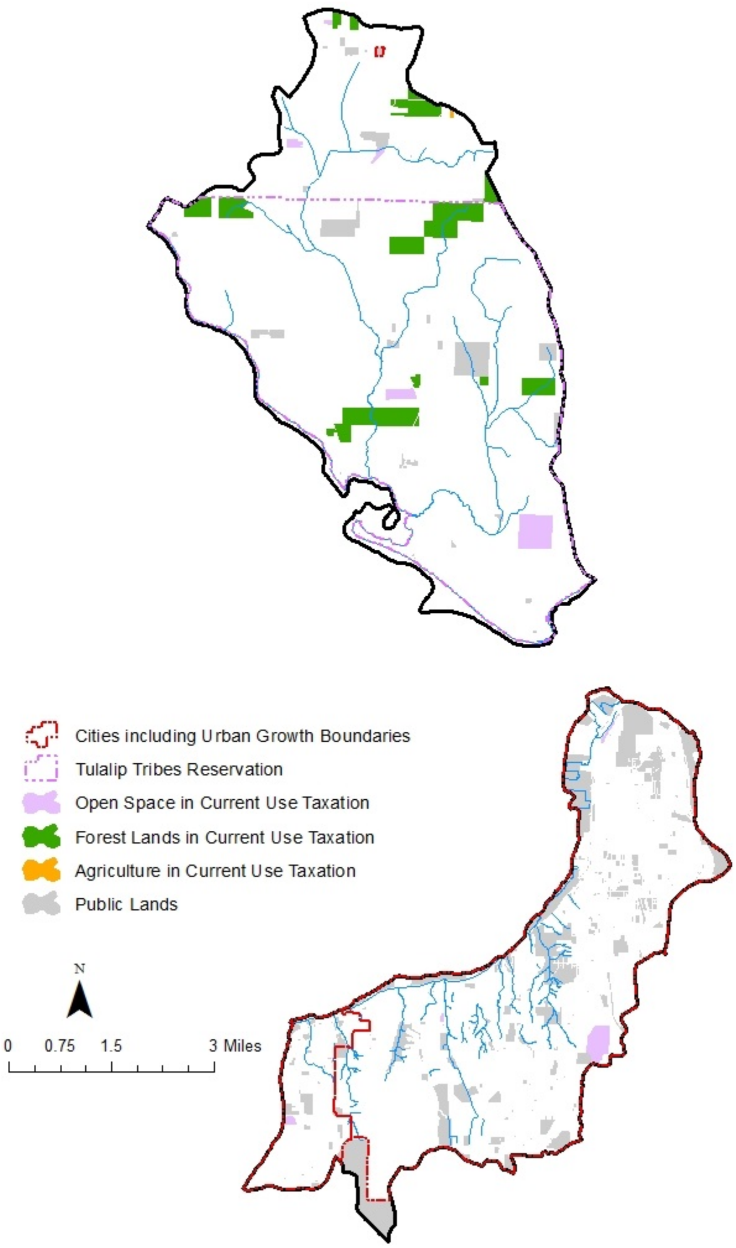


Figure 75: Current Protection Strategies Used in the Puget Sound Drainages Planning Unit

Protection Strategy	Acres	Percent of Planning Unit
Agriculture	10	0.03%
Open Space	349	1.1%
Timber	966	2.9%
Public Lands	3,186	9.7%

Opportunities for Protection

The Puget Sound Planning Unit is significantly developed, with the City of Everett being almost 40% of the planning unit. Protection in this area will be geared to make sure that the hydrology of the area is not further degraded. There are several tools that can be used to achieve that goal. Opportunities are as follows:

- Local jurisdictions should use acquisitions to acquire key areas, such as wetlands, to ensure water storage and recharge is protected
- Cities should use the BMPs when it comes to LID as well as stormwater retrofits in existing areas
- Snohomish County could adopt a PBRS (very similar to Open Space CUT program) that could potentially allow more urban property owners to take advantage of a CUT program

Planning Unit	Puget Sound Drainages
Salmonid Use	• Tulalip/Battle Creek: Chinook = D, bull trout = D, Combined = D • Everett Coastal: Chinook = D, bull trout = C, Combined = C • Substantial coho use in small drainages south of Everett
Precipitation Regime	Lowland (100%)
Primary Land Uses	• Cities (39.4%) • Rural Residential (32.1%) • Tribal Land (27.1%)
Limiting Factors	Freshwater rearing
Current and Future Pressures	Transportation infrastructure
Ecosystem Services	• Recreation • Water storage (artificial)
Climate Change Impacts	None listed
Existing Protection Strategies in Unit	• Public Lands (9.7%) • Timberlands (2.9%) • Open Space (1.1%)
Opportunities	• Use acquisitions to acquire key areas, such as wetlands • Cities should use the BMPs when it comes to LID • Snohomish County could adopt a PBRS (very similar to Open Space CUT program) that could potentially allow more urban property owners to take advantage of a CUT program

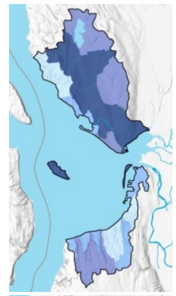
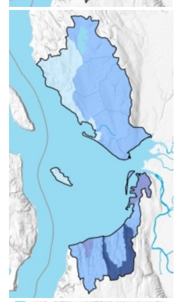
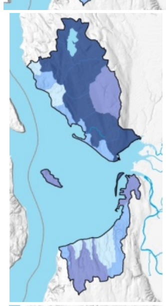
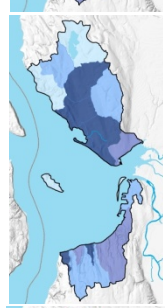
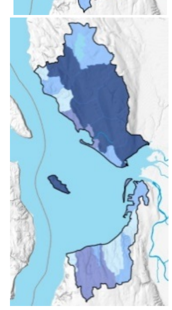
Legend	
Overall	
Delivery	
Surface Storage	
Recharge	
Discharge	

Figure 76: Overall Water Flow Maps for the Puget Sound Drainages Planning Unit

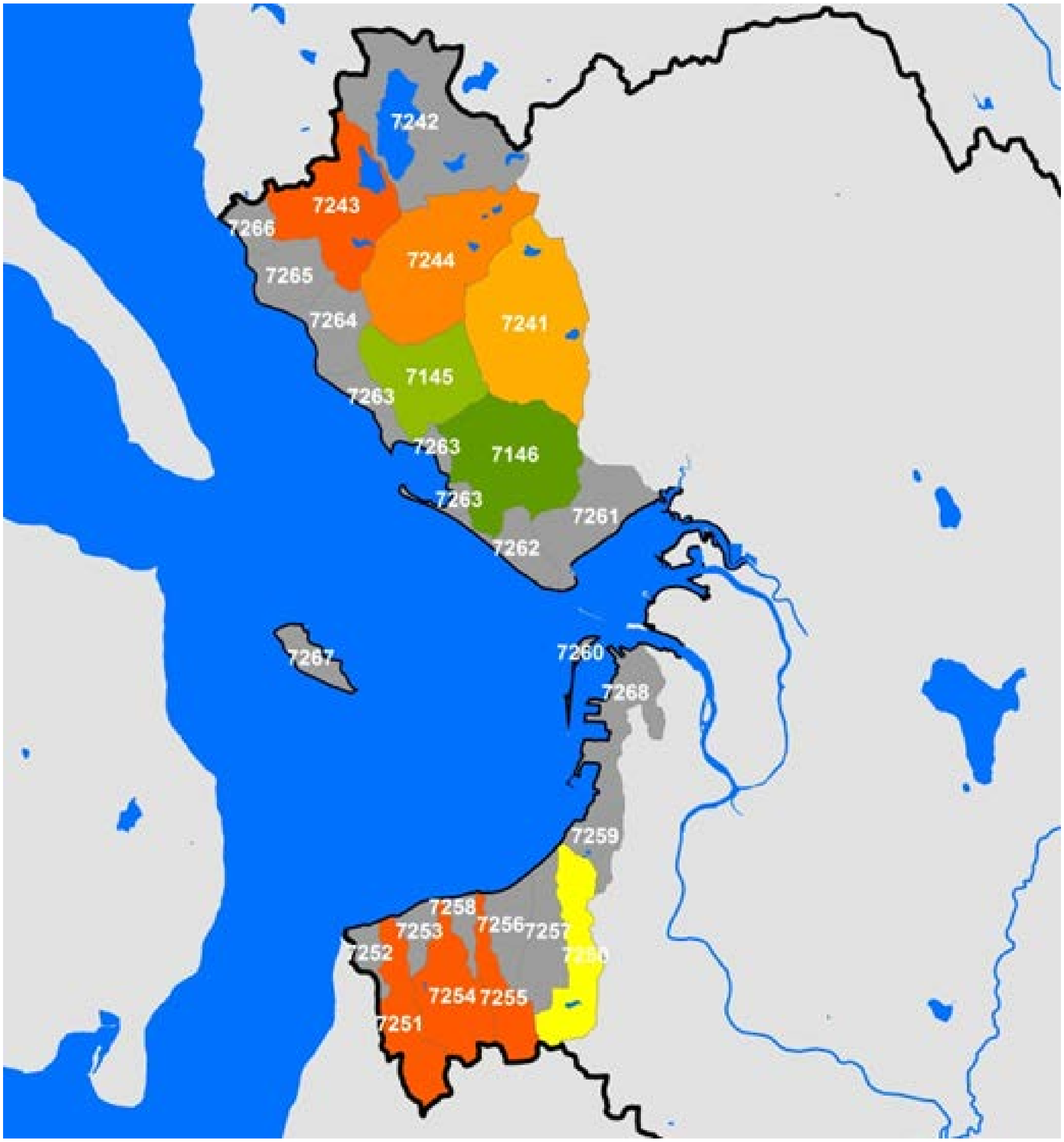


Figure 77: Watershed Characterization Habitat Model Map for the Puget Sound Drainages Planning Unit

Numbers are labels for spatial units

Watershed Characterization Summary

Planning Unit	Puget Sound Drainages
Overall Flow Importance Model	Tulalip Creek and Mission Creek drainages (on the Tulalip reservation)
Delivery Importance Model	• Drainages around Port Gardner • Japanese Gulch Creek • Merrill Creek • Ring Creek • Pigeon Creek drainages
Surface Storage Importance Model	• Tulalip Creek • Mission Creek drainages
Recharge Importance Model	• Tulalip Creek • Mission Creek • Japanese Gulch • Merrill Creek • Ring Creek
Discharge Importance Model	• Tulalip Creek • Mission Creek
Habitat Model	The lower Tulalip Creek and lower Mission Creek drainages have the highest watershed index values. Among those, the lower Mission Creek drainage has the highest watershed habitat indices.
Protection Consideration	• Northern Drainages around Tulalip Creek: protection of surface storage, recharge, and discharge • Restoration of discharge, delivery, and recharge in southern drainages

Sultan River Planning Unit

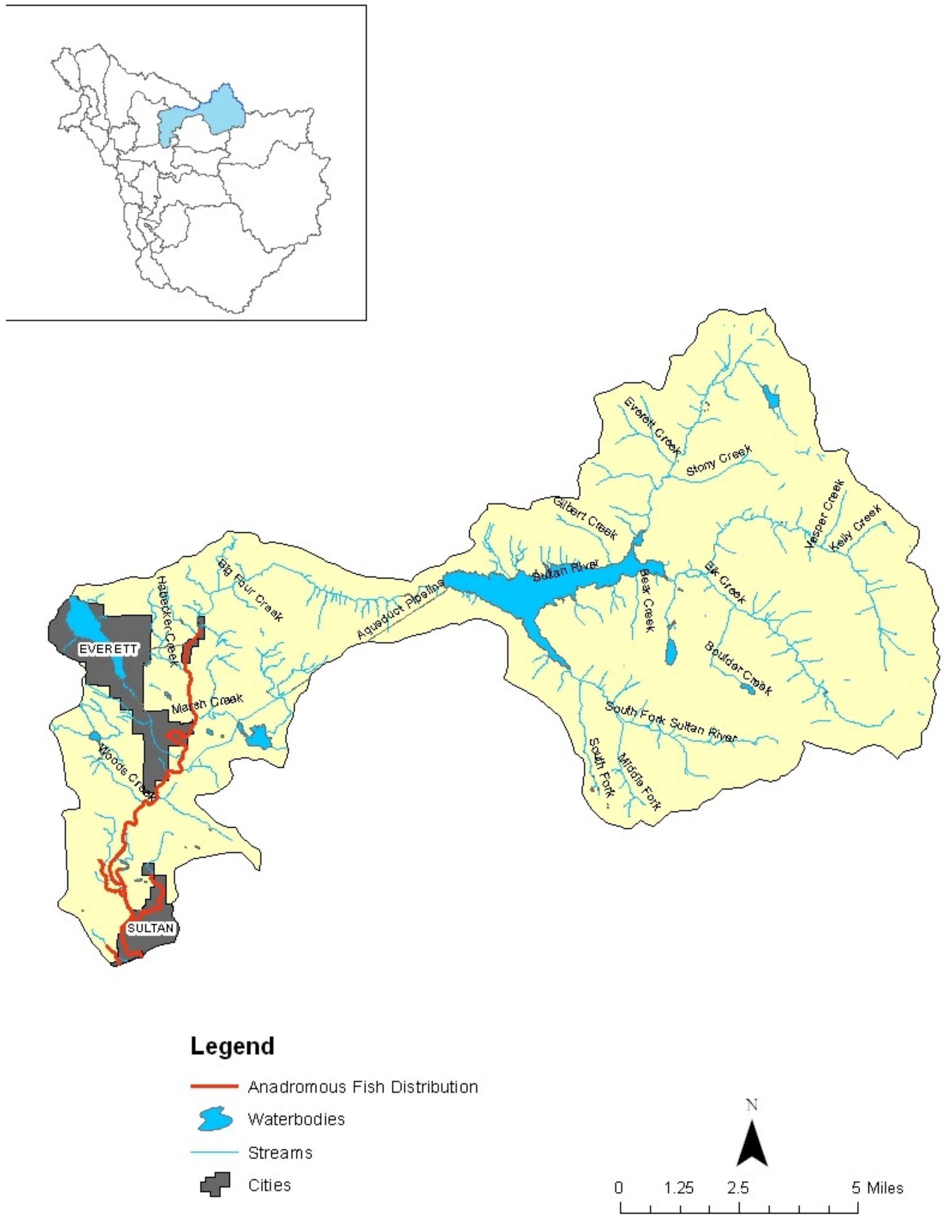


Figure 78: Sultan River Planning Unit

Basin(s) Name(s): Sultan River

Sub-basin Strategy Group: Mainstem primary restoration (below Culmback Dam) and headwaters restoration above falls and dam

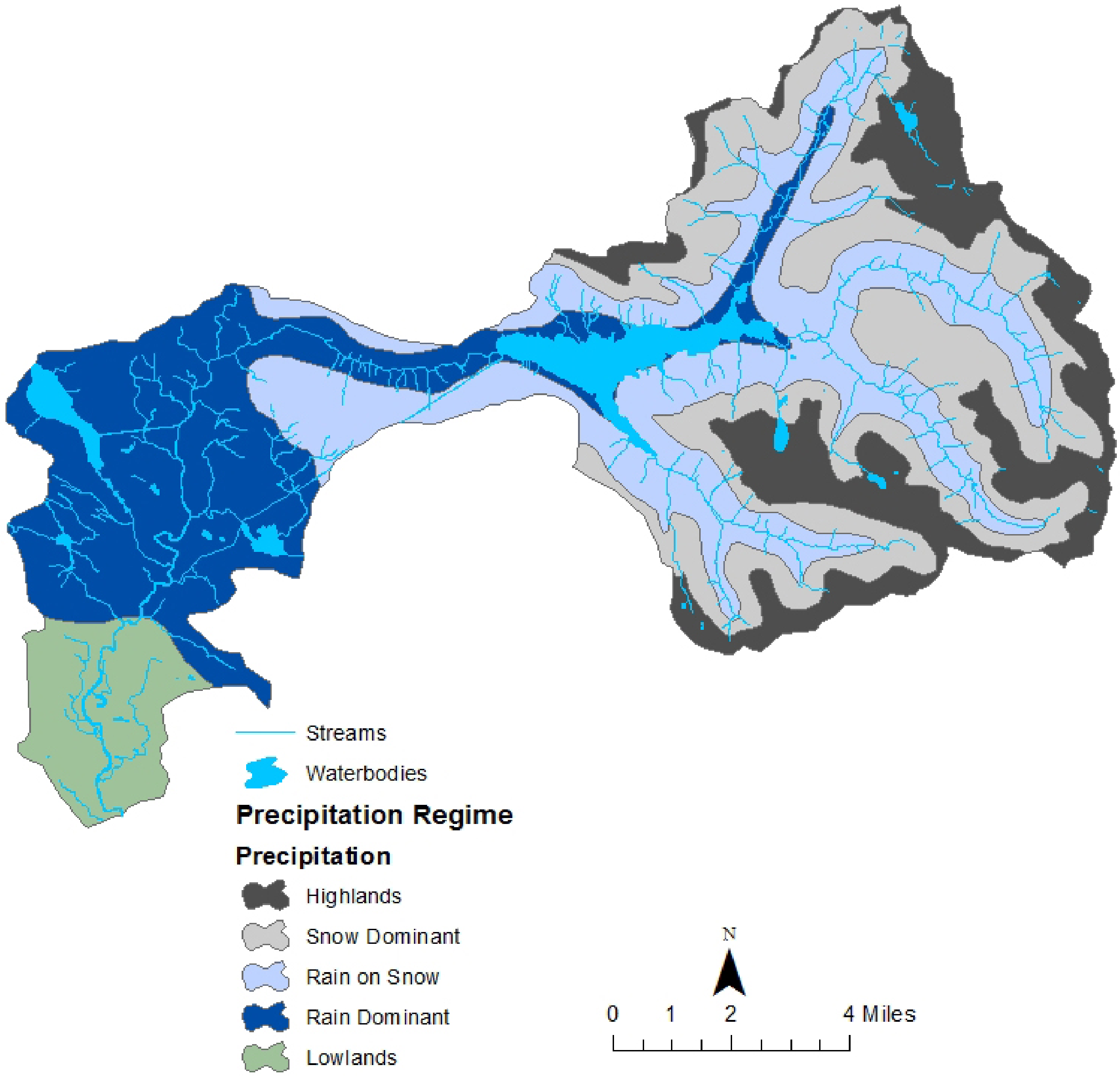


Figure 79: Sultan River Precipitation Regime

Precipitation Regime	Acres	Percent of Planning Unit
Highlands	10,540	15.7%
Snow Dominate	15,262	22.7%
Rain on Snow	17,380	25.9%
Rain Dominate	18,713	27.9%
Lowlands	4,811	7.2%

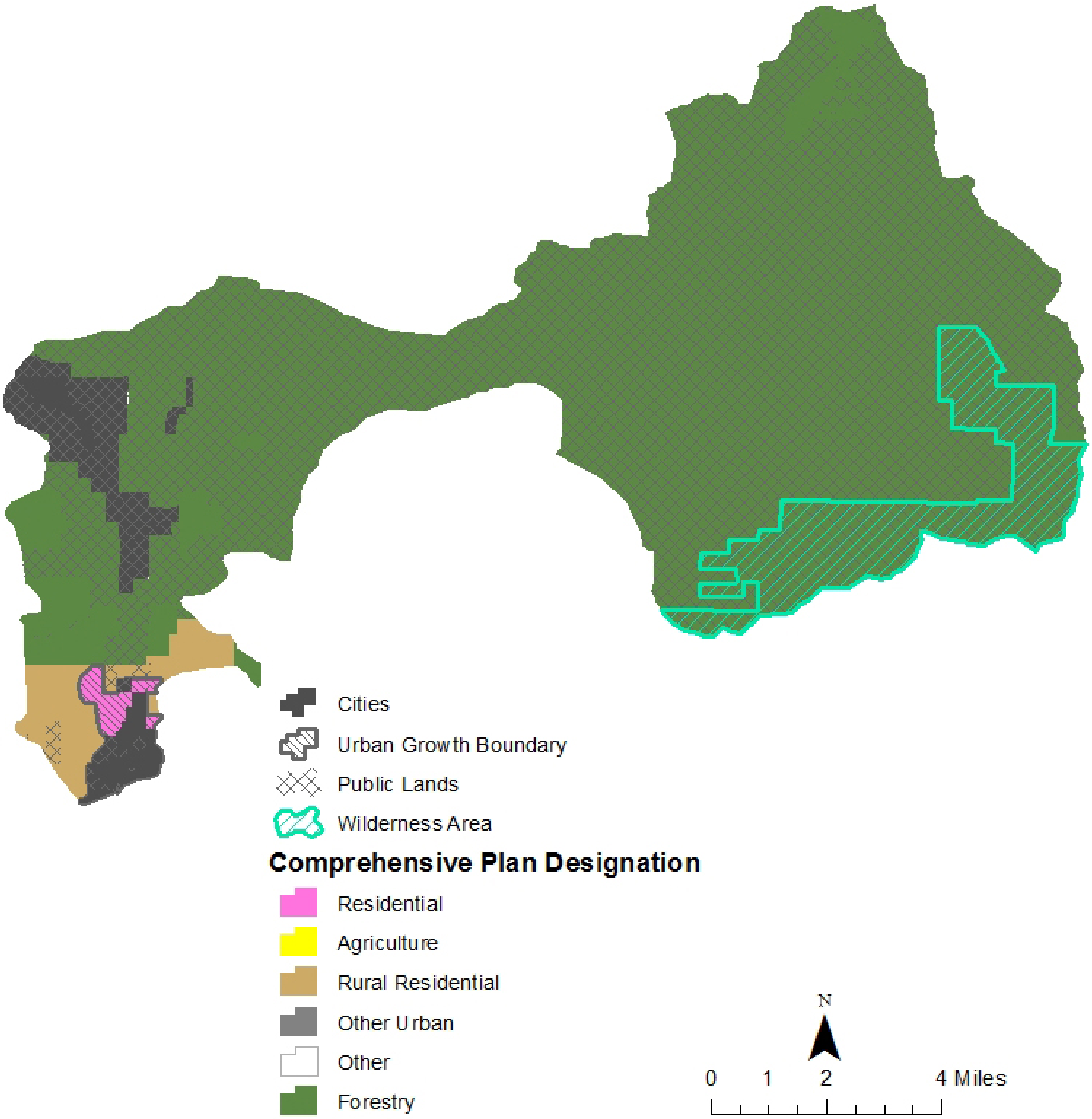


Figure 80: Sultan River Land Use

Land Use Type	Acres	Percent of Planning Unit
Agriculture	4	0.0%
Forestry	60,726	90.4%
Residential	485	0.7%
Rural Residential	2,194	3.3%
City	3,734	5.6%

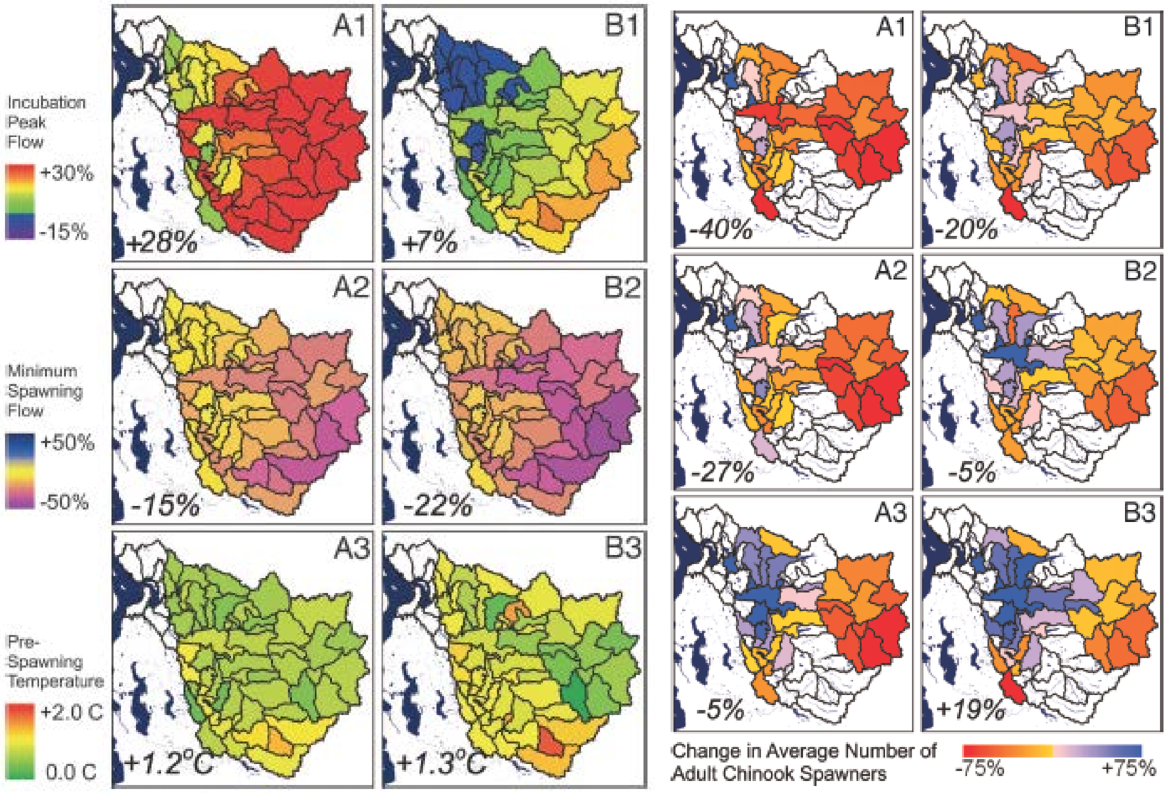


Figure 81: Maps of Modeled Climate Change Effects in the Sultan River Planning Unit

From Battin et al. 2007

- Incubation peak flow: no increase to significant increase (Battin et al. 2007)
- Minimum spawning flow: minimal decrease (Battin et al. 2007)
- Pre-spawning temperature: none to minimal increase (Battin et al. 2007)
- Change in average number of adult Chinook spawners: decrease in number under A1 and A2, moderate increase in numbers under B1 and B2, and major increase under A3 and B3 (Battin et al. 2007)

In the Sultan River Planning Unit, some models are predicting higher winter discharges due to increased winter rain. Summer models still show slightly lower discharges. This basin is dominated by snow in the upper watershed (above the dam) and is rain dominate in the lower watershed. Normally, this would result in predicted higher discharges. However, because the basin's mainstem is regulated by the Culmback Dam, flows are expected to be

determined by the license conditions. The storage of the reservoir would probably change based on timing of flows.

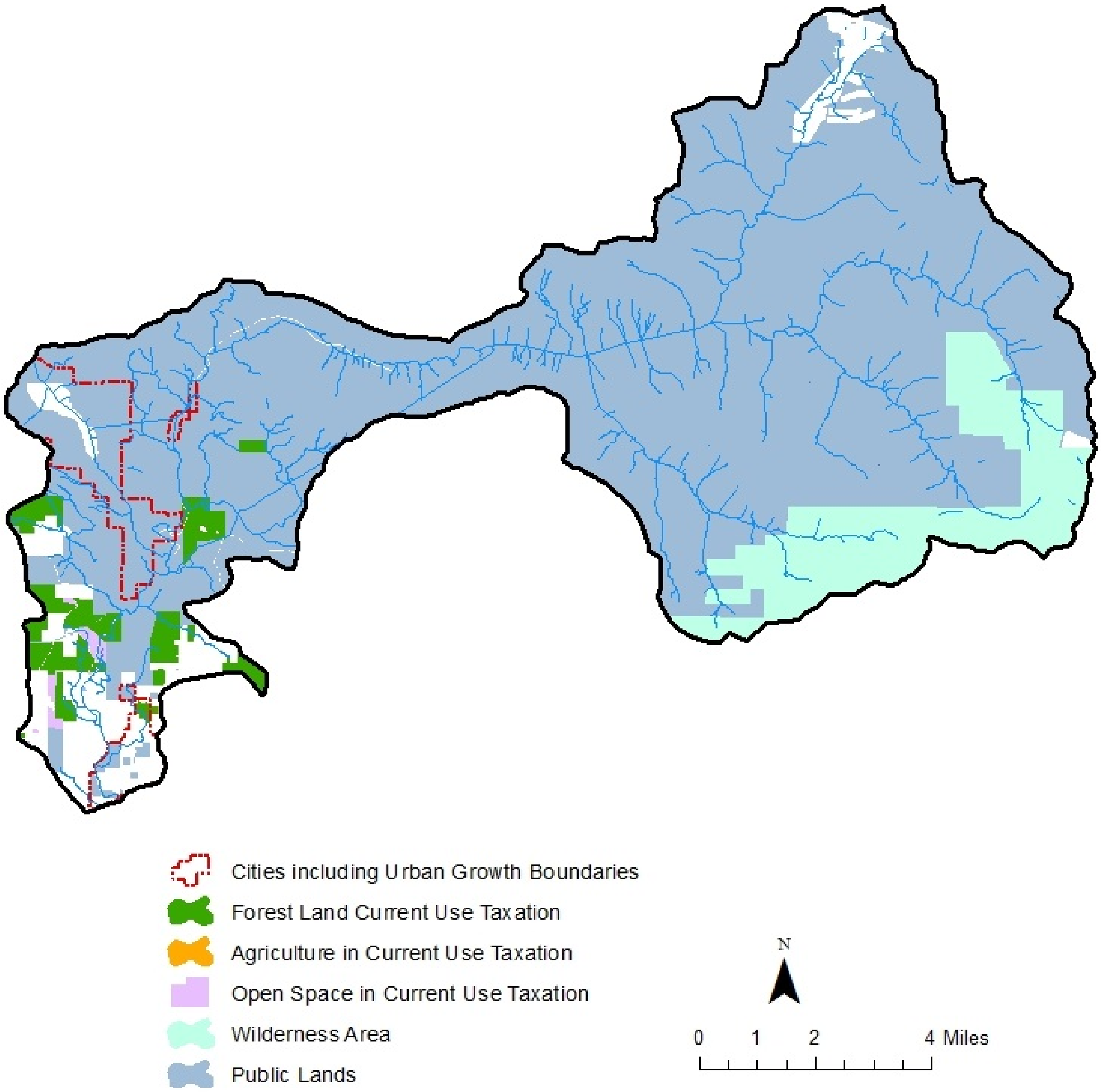


Figure 82: Current Protection Strategies Used in the Sultan River Planning Unit

Protection Type	Acres	Percent of Planning Unit
Agriculture	5	0.01%
Open Space	200	0.3%
Timber Land	2,148	3.2%
Public Lands	60,172	89.6%

Opportunities for Protection

The Sultan Planning Unit is primarily in Public Lands which helps protect the hydrology. To help ensure that future development will not have adverse impacts on the hydrology, the lower portions of the planning unit still have the following opportunities for protection strategies:

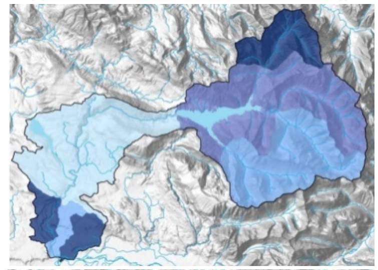
- Enroll lands into a CUT program to protect natural resources and hydrology.
- Reduce the number of private inholdings in public lands through targeted acquisitions.
- Ensure that forestry practices are using best available management practices for harvesting and that those methods can be adaptively managed for climate change.
- Use LID practices where residential and city development will occur.
- Put education programs in place that educates landowners about the importance of stream buffers and how to protect and maintain them.

Planning Unit	Sultan
Salmonid Use	• Chinook = high use (in the river downstream of the City of Everett Diversion Dam) • Coho = known presence • Bull trout = infrequent utilization of lower river for foraging • Steelhead = high use
Precipitation Regime	• Rain Dominant (27.9%) • Rain on Snow (25.9%) • Snow Dominant (22.7%) • High Lands (15.7%) • Low Lands (7.2%)
Primary Land Uses	• Forestry (90.4%) • City (5.6%)
Limiting Factors and Life Cycle Stresses	• Freshwater rearing (currently debatable)
Current and Future Pressures	• Timber harvest • Natural system modification (bank hardening) in the lower watershed • Development in the lower watershed • Invasive species
Ecosystem Services	• Flood regulation • Water quality regulation • Drinking water provisioning • Recreation • Energy production • Storage • Water quantity regulation

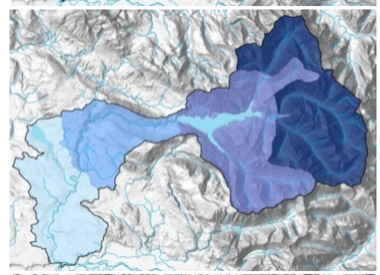
Climate Change Impacts	• Hydrology largely regulated by Culmback Dam for the next 45 years
Existing Protection Strategies in Unit	• Public Lands (89.6%) • Timberlands (3.2%)
Opportunities	• Enroll lands into CUT programs • Reduce the number of private inholdings in public lands through targeted acquisitions • Ensure that forestry practices are using best available management practices for harvesting • Use LID practices • Focus education programs on the importance of stream buffers

Legend

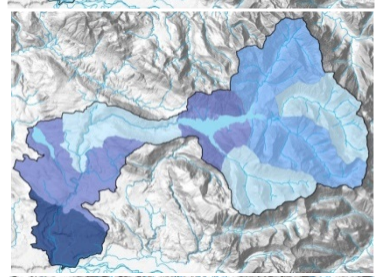
Overall



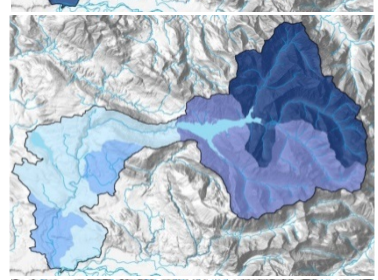
Delivery



Surface Storage



Recharge



Discharge

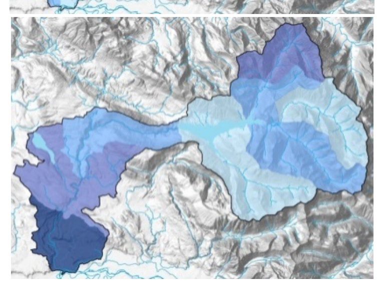


Figure 83: Overall Water Flow Maps for the Sultan River Planning Unit

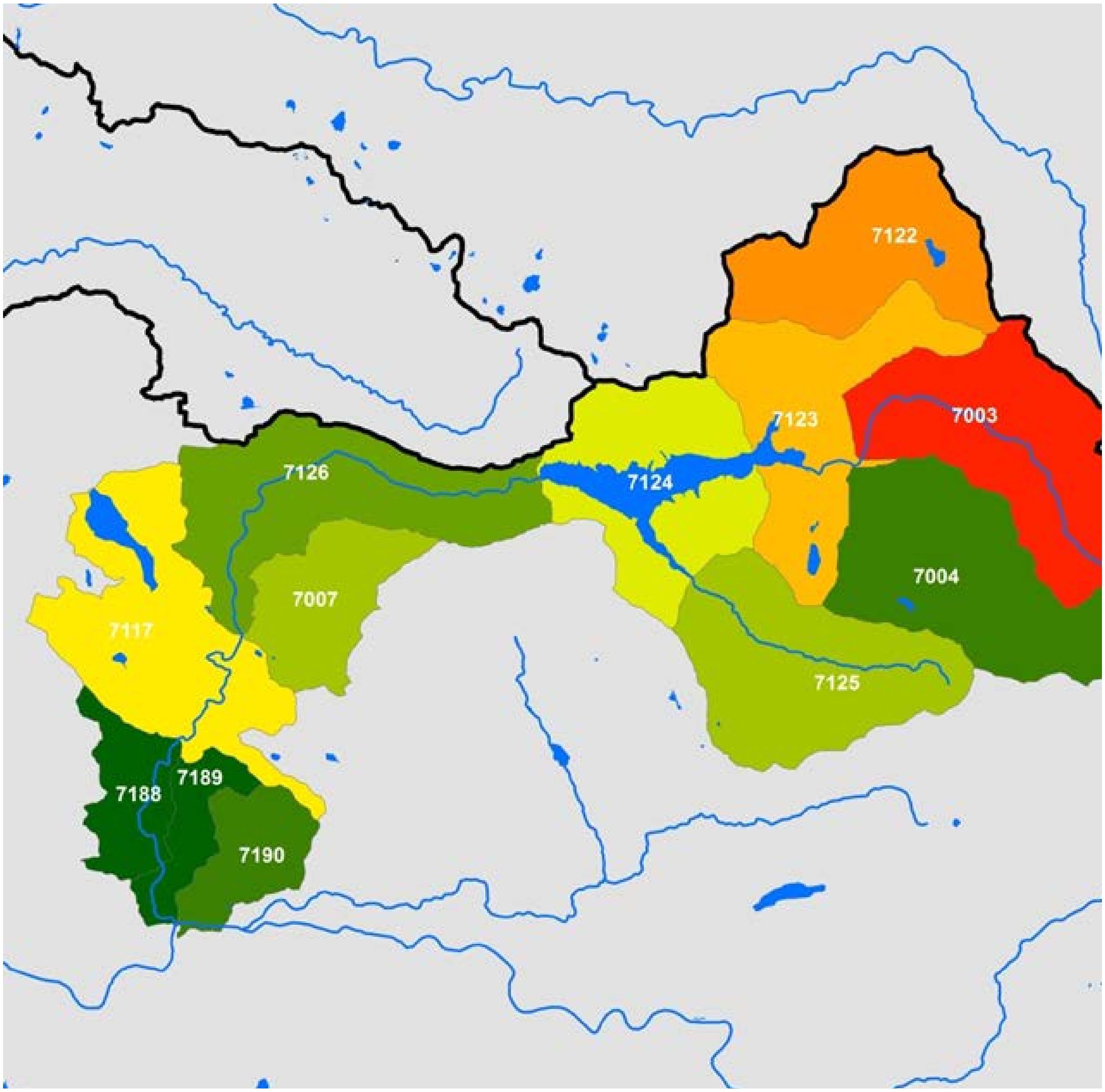


Figure 84: Watershed Characterization Habitat Model Map for the Sultan River Planning Unit

Numbers are labels for spatial units

Watershed Characterization Summary

Planning Unit	Sultan
Overall Flow Importance Model	• Upper Sultan River (upstream of Spada Lake) • Lower Sultan (up to Woods Creek)
Delivery Importance Model	• Headwaters and upper portions of the Sultan River

Surface Storage Importance Model	• Lower Sultan • Spada Lake
Recharge Importance Model	Upper Sultan (upstream of Spada Lake)
Discharge Importance Model	Lower Sultan (near Sultan and up to Woods Creek)
Habitat Model	Much of the Sultan has high watershed habitat value, with the lower portions near Sultan, areas below Spada Lake, and the Elk Creek (above the Spada Lake reservoir so non-anadromous salmonids) drainage having the highest habitat values
Protection Consideration	• Upper watershed: protection of surface storage and recharge • Lower watershed: restoration of discharge and surface storage

Woods Creek Planning Unit

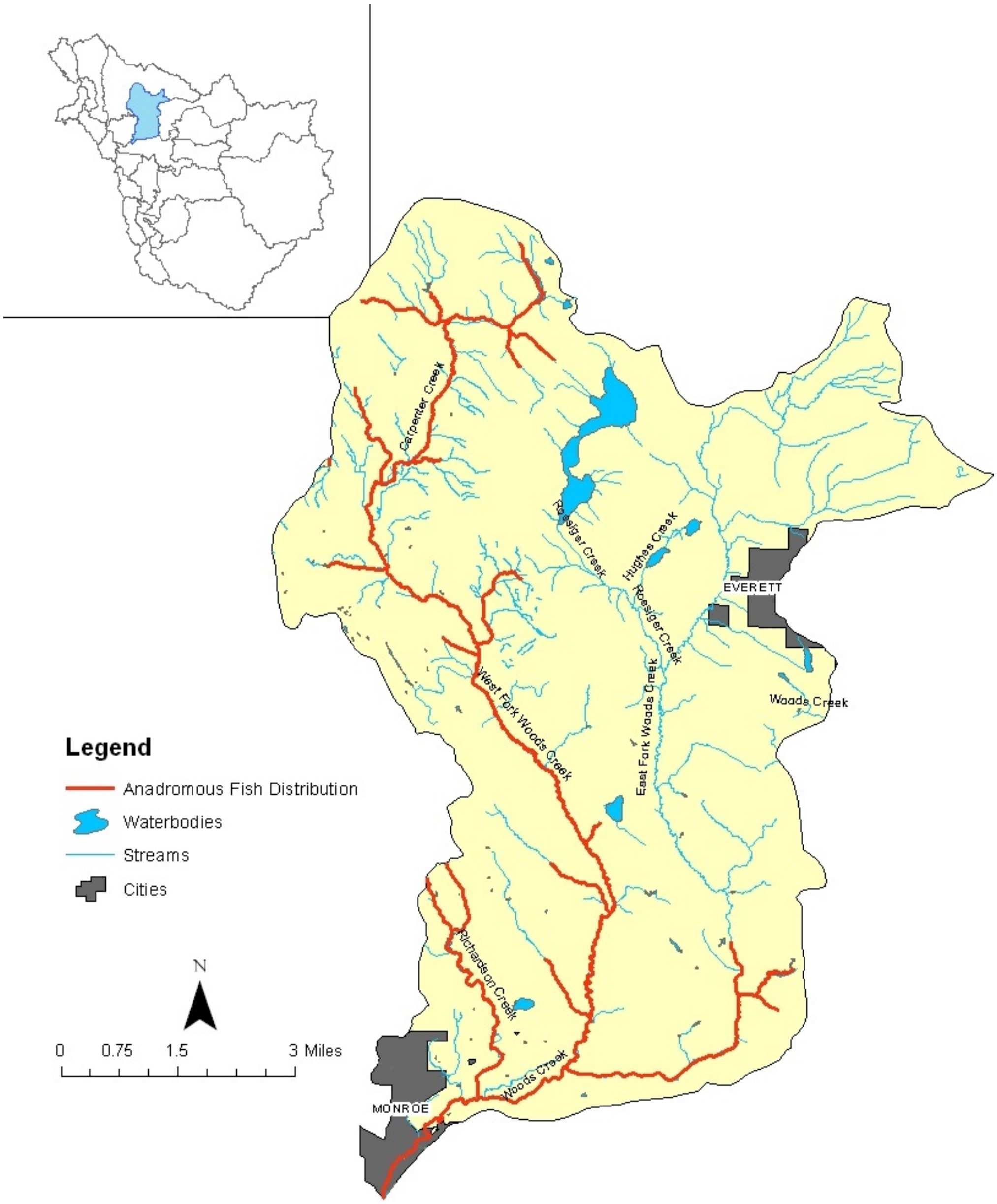


Figure 85: Woods Creek Planning Unit

Basin(s) Name(s): Woods Creek

Sub-basin Strategy Group: Rural Streams Primary (West Fork) and Rural Streams Secondary

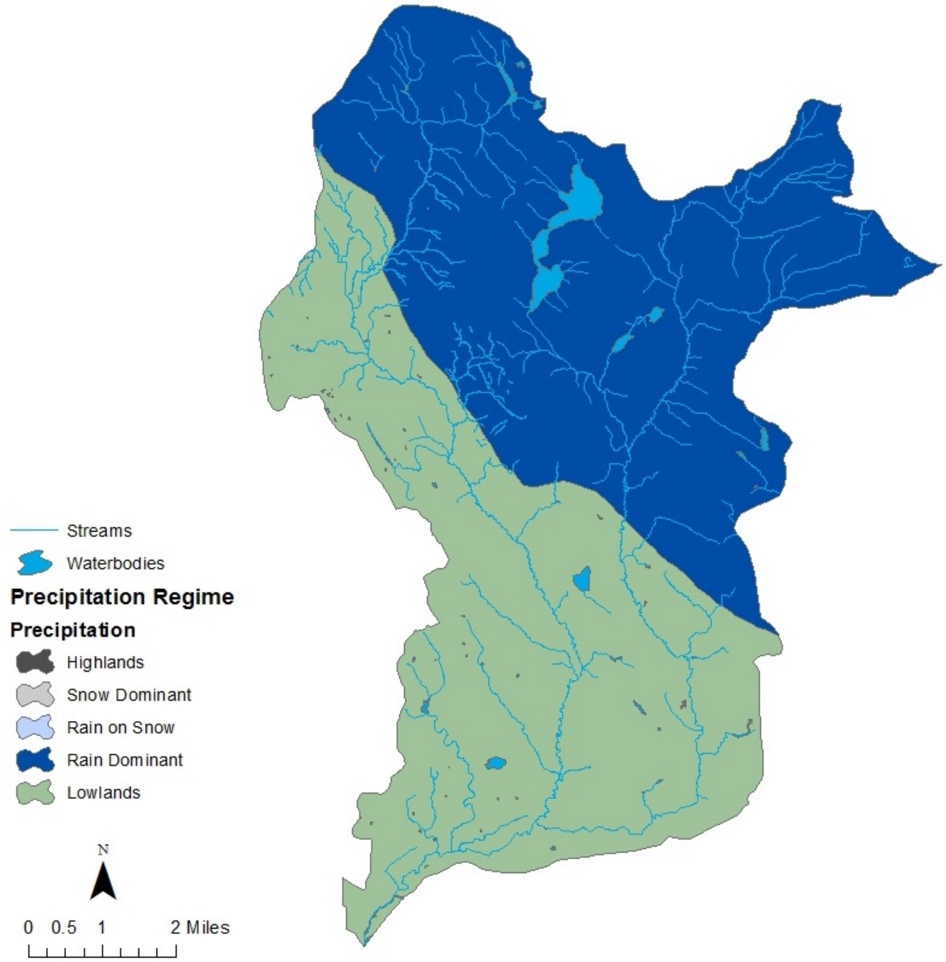


Figure 86: Woods Creek Precipitation Regime

Precipitation Regime	Acres	Percent of Planning Unit
Rain Dominate	20,124	51.5%
Lowlands	18,938	48.5%

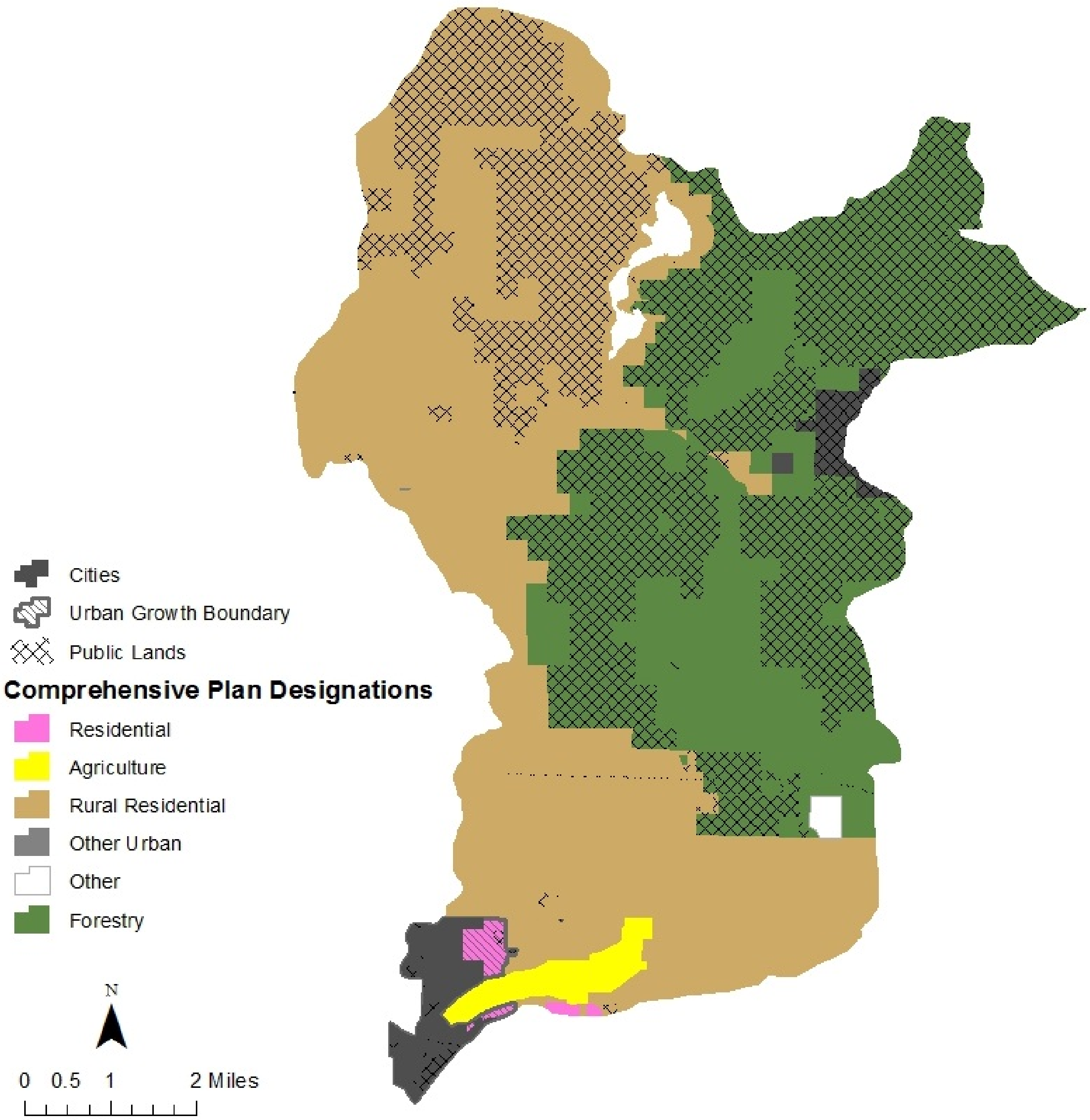


Figure 87: Woods Creek Land Use

Land Use Type	Acres	Percent of Planning Unit
Agriculture	669	1.7%
Forestry	16,426	42.1%
Residential	236	0.6%
Rural Residential	20,055	51.3%
City	1,232	3.2%
Other	111	0.3%

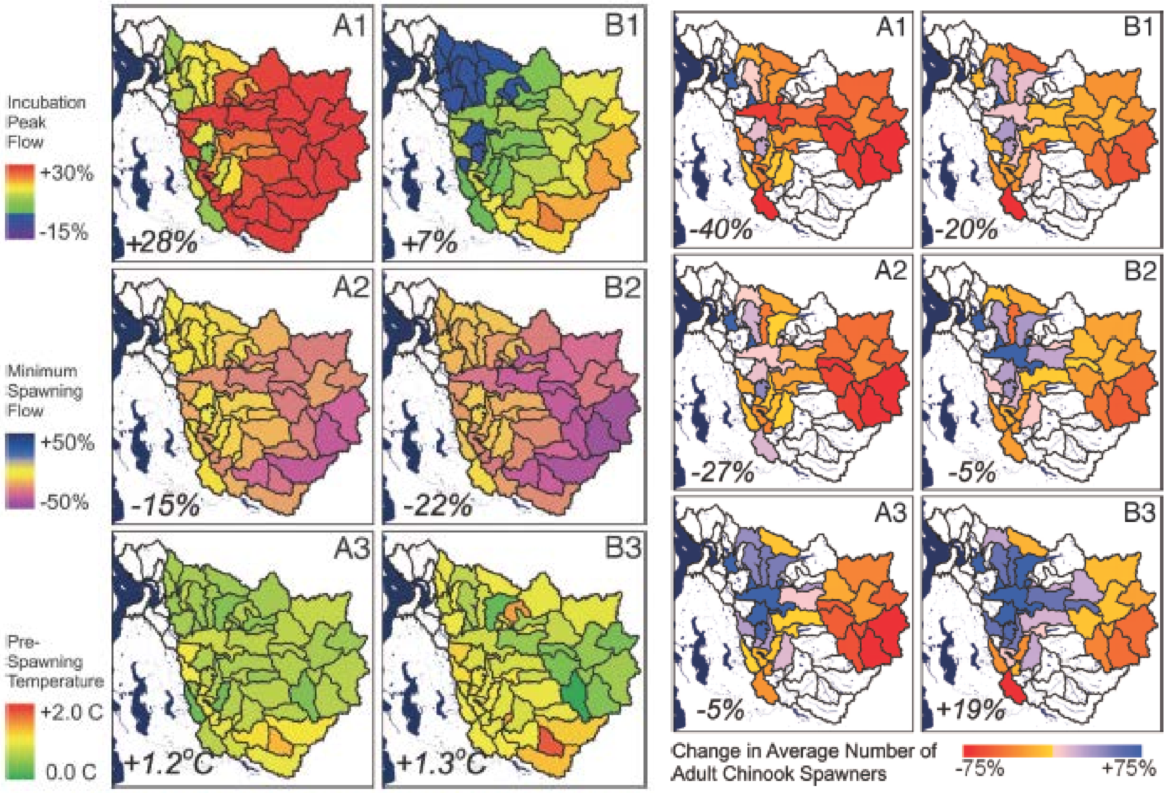


Figure 88: Maps of Modeled Climate Change Effects in the Woods Creek Planning Unit

From Battin et al. 2007

- Incubation peak flow: moderate increase in one scenario and moderate decrease another (Battin et al. 2007)
- Minimum spawning flow: minor increase (Battin et al. 2007)
- Pre-spawning temperature: minor decrease (Battin et al. 2007)
- Change in average number of adult Chinook spawners: minor decrease to moderate increase

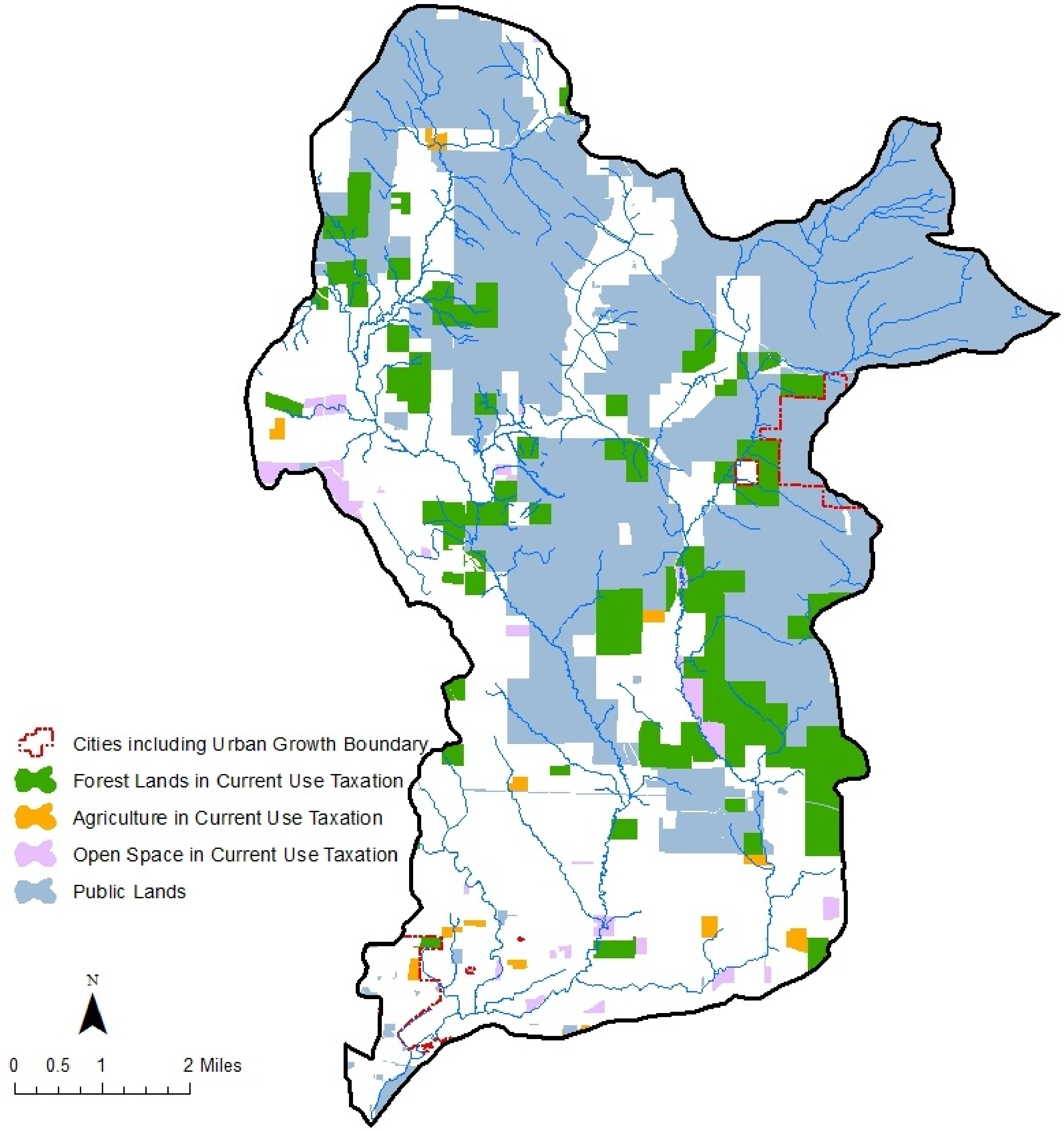


Figure 89: Current Protection Strategies Used in the Woods Creek Planning Unit

Protection Type	Acres	Percent of Planning Unit
Open Space	613	1.6%
Agriculture	296	0.8%
Timber Lands	4,217	10.8%
Public Lands	17,136	43.9%

Opportunities for Protection

Almost half of the Woods Creek Planning Unit is in public ownership, which protects a large portion of the headwaters in the basin. To ensure hydrologic functions continued to be protected, especially in the lower drainages, the following tools and strategies are important:

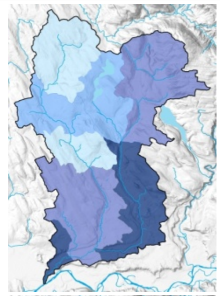
- Decrease the number of private inholdings surrounded by public lands through acquisitions
- Work on acquiring TDRs in key areas of hydrologic importance to ensure those areas do not get developed
- Enroll properties in CUT programs to limit the potential of conversion from open space to residential developments
- Use LID in cities and rural residential areas
- Increase education with homeowners on the importance of stream buffers and how planting and maintenance can improve hydrology in the watershed
- Study the impacts exempt wells and water withdrawals are having on the instream flows in Woods Creek
- Participate and monitor any discussion on new power projects in the planning unit

Planning Unit	Woods
Salmonid Use	• Chinook: Woods, Woods lower, Woods west fork – all low (C) • Chinook, coho, chum, and pink salmon, as well as steelhead and presumably bull trout, all live in Woods Creek
Precipitation Regime	• Rain Dominant (51.5%) • Low Lands (48.5%)
Primary Land Uses	• Rural Residential (51.3%) • Forestry (42.1%)
Limiting Factors and Life Cycle Stressors	• Upriver migration, spawning, egg deposition, egg development, and freshwater rearing • Hydrology: frequency
Current and Future Pressures	• Conversion of open space to residential development • UGA expansion in City of Monroe • Loss of critical areas • Loss of beaver ponds/wetlands

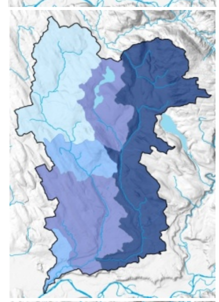
Ecosystem Services	• Flood regulation • Water quality regulation • Drinking water provisioning (exempt wells) • Recreation • Energy production • Irrigation • Hatchery water supply
Climate Change Impacts	• No increase to moderate increase in incubation peak flow • Minimal decrease in minimum spawning flow • Minimal increase in pre-spawning temperature • Decrease or little change in average number of adult Chinook spawners in four of six scenarios
Existing Protection Strategies in Unit	• Public Lands (43.9%) • Timberlands (10.8%) • Agriculture (0.8%) • Open Space (1.6%)
Opportunities	• Decrease the number of private inholdings surrounded by public lands • Work on acquiring TDRs in key areas of hydrologic importance • Enroll properties in CUT program • Use LID in cities and rural residential areas • Increase education with homeowners on the importance of stream buffers

Legend

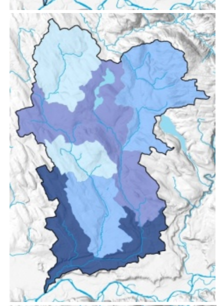
Overall



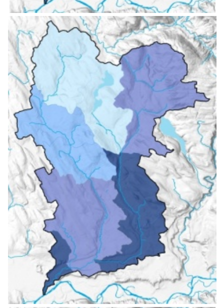
Delivery



Surface Storage



Recharge



Discharge

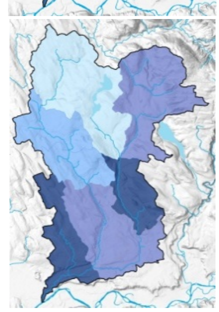


Figure 90: Overall Water Flow Maps for the Woods Creek Planning Unit

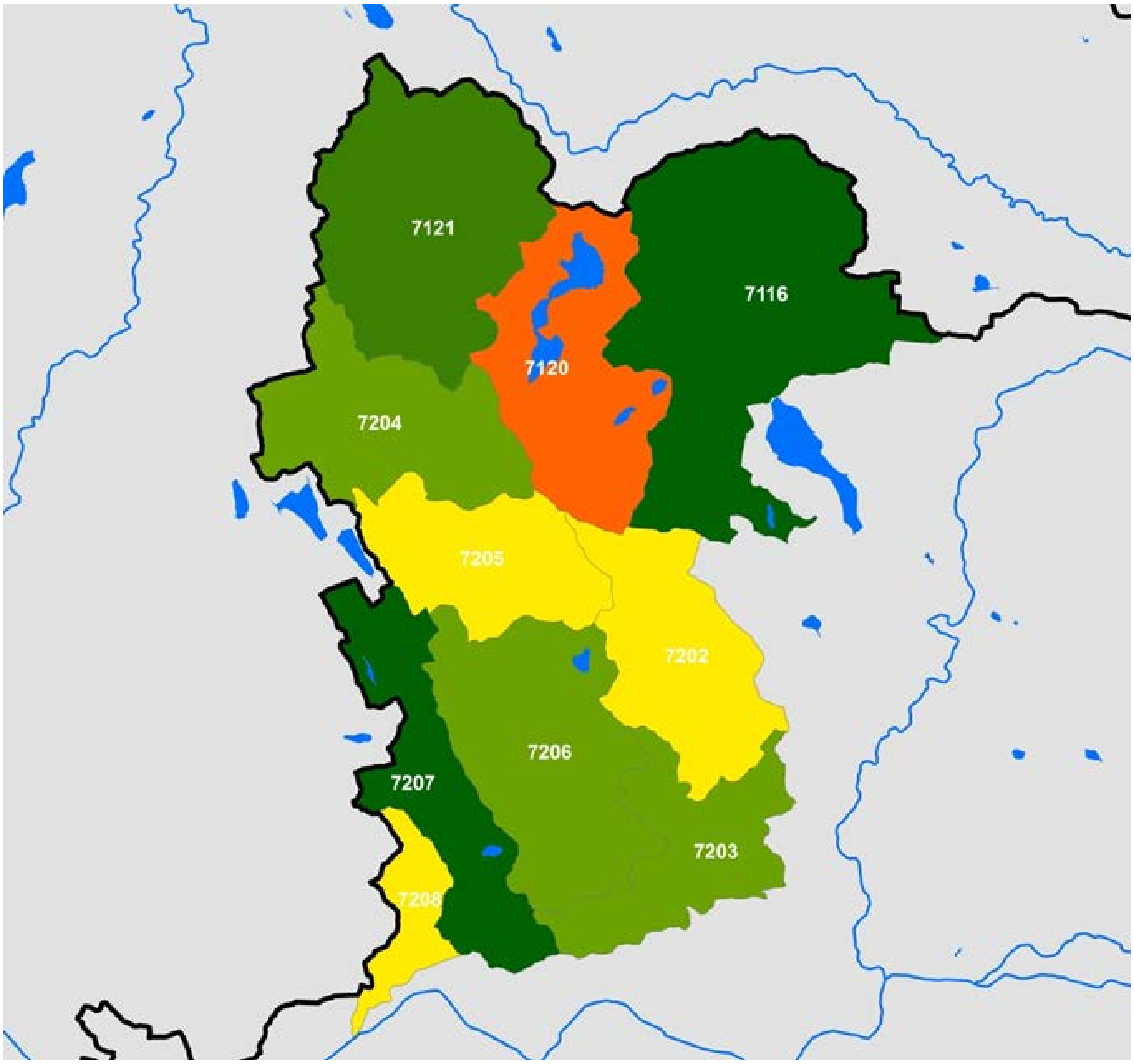


Figure 91: Watershed Characterization Habitat Model Map for the Woods Creek Planning Unit

Numbers are labels for spatial units

Watershed Characterization Summary

Planning Unit	Woods
Overall Flow Importance Model	• Primarily the East Fork from the confluence with Rosinger Creek down to the confluence with the West Fork • Richardson Creek drainage
Delivery Importance Model	East Fork Woods Creek

Surface Storage Importance Model	• Lower East Fork • Richardson Creek • Below the confluence of East and West Forks
Recharge Importance Model	• East Fork from the confluence with Rosinger Creek down to the confluence with the West Fork • Richardson Creek
Discharge Importance Model	• East Fork from the confluence with Rosinger Creek down to the confluence with the West Fork • Richardson Creek
Habitat Model	Much of Woods Creek has high watershed habitat value, with the Richardson Creek drainage, upper West and East forks drainages (the area at the top of the East Fork is not accessible to anadromy), and areas near the confluence of the West and East forks having the highest habitat values
Protection Consideration	Restoration of surface storage and discharge

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APPENDIX B
PROTECTION STRATEGY UPDATES FOR THE 2005 SNOHOMISH RIVER BASIN SALMON CONSERVATION PLAN

EXECUTIVE SUMMARY

Snohomish Basin Salmon Conservation Plan Update

The primary goal of the 2015 *Snohomish Basin Protection Plan* (SBPP) and protection strategy updates is to identify protection strategies that prevent the degradation of hydrologic processes that support salmon or salmon habitat. In 2005, the Snohomish Basin Salmon Recovery Forum (Forum) members approved the *Snohomish Basin Salmon Conservation Plan* (Forum 2005; referred to as the 2005 Plan in this document) and laid out a 50-year road map for multi-species recovery. The 2005 Plan was based on historical records, the best available science, and social and economic conditions. The 2005 Plan recognized that it was critical to use adaptive management to increase the chances of success by incorporating new data, information about successes and failures, and new opportunities provided by changing context in the Snohomish River Basin.

Since 2005, there have been many site-scale successes on restoration projects in the mainstems, estuaries, and tributaries. However, many environmental indicators continue to decline, according to local data and the 2009 and 2013 State of the Sound reports (Puget Sound Partnership 2010, 2013). The continued decline calls for greater protection measures.

This 2015 update recommends a suite of strategies and actions focused on the protection of hydrology. Through the protection of hydrology, the update aims to ultimately protect habitat quality and quantity and provide resilience in the face of expected climate change. Solid policy, regulatory, and programmatic actions are necessary to protect hydrology and help achieve the 50-year salmon recovery goals. The recommendations in this document are intended to be guidance for local governments, non-profit organizations, tribes, and other partners to identify alternatives necessary to protect hydrology. As such, they do not imply a commitment, mandate, or intent on the part of any local governments to adopt these ideas outright. Local governments and planning entities working in the Basin have the final decision-making authority to choose and implement policies that work for their jurisdictions within the context of their broader responsibilities. The caveats that were associated with the original letters of commitment to the 2005 Plan from jurisdictions still stand.

This 2015 update is the first formal adaptive management action and coincides with the 10-year anniversary of the 2005 Plan. The update focuses on the protection of hydrology

and seeks to be as specific as possible. The recommendations are not materially different from those recommended in 2005; however, they provide specificity on which geographic areas should be prioritized, the specific actions needed for implementation, and how to measure success. These recommendations would also allow the effectiveness of protection to be evaluated, in tandem with restoration, in the next 10-year benchmark review.

New Data, Information, and Opportunities

Though the 2005 Plan was approved by the National Marine Fisheries Service, the approval was caveated with a note that habitat protection needed further detail. The 2005 Plan was developed on the assumption that current protection tools were sufficient to "hold the line" and prevent further loss; however, there were few specifics of how this would be deployed. This update seeks to clarify which subset of the available protection tools should be implemented first and how and where these tools could be implemented.

Information on climate change and water processes has improved significantly since 2005. Climate models now show that shifting temperatures and precipitation regimes would result in more rain in the winter and less in the summer, with a shift in the timing of annual floods. The Washington State Department of Ecology released the Puget Sound Watershed Characterization model, which shows how water moves through the watershed with areas of particular importance highlighted. These two new sources of data and information drove Forum members to target the protection of hydrology, a critical watershed process that creates and maintains salmon habitat and cues salmon life stage behavior.

There has also been increased focus on integrating the needs of Basin residents and different populations of salmonids. Neither interest can be managed in a vacuum. There is a growing understanding of ecosystem services, the benefits provided to humans through the natural environment. In the Snohomish Basin, an intact hydrologic regime supports drinking water supplies, irrigation rights, recreation opportunities, and safety from floods and drought, in addition to supporting fish. As conditions change in the watershed, there is a need to protect hydrology for humans and fish, leading to greater opportunity to implement protection strategies across a wide range of beneficiaries.

Technical Approach to Assessing Hydrology and Protection Needs

This update used the technical assessment approach suggested in the 2015 SBPP. The SBPP proposed that a number of factors be considered in the assessment of hydrology and protection opportunities, including watershed characterization results, zoning, land use, current protections in place, fish use, and expected flow regime shifts due to climate change. This approach allows for analysis at a range of scales, ranging from basin-wide, to fish populations, and finally, sub-basins. The SBPP also provides an extensive description of protection tools that could be applied across the landscape in the categories of regulatory mechanisms, incentives, acquisitions, and new models and assessments, as well as other useful tools and strategies.

Results from the SBPP technical assessment indicate that forest cover, recharge zones, natural drainage networks, storage features, and pervious surfaces would all support intact hydrologic processes. The strategies proposed in this update are focused on maintaining these characteristics while encouraging compatible land uses.

Recommended Protection Strategy Updates

The protection strategy updates are organized by basin-wide tools and key land use areas. The basin-wide approach suggests a variety of tools that can be applied to many landscape types or river reaches. The specific land use category recommendations seek to recognize and improve existing protection efforts where possible and suggest new approaches based on opportunities that have emerged in the last decade. These specific strategies include recommendations for urban areas, rural residential areas, forest lands, and agricultural lands.

It is important to note that the recommendations are not a comprehensive listing of all protection tools that could be used in the Basin. Instead, these are the tools that are most likely to result in measurable change over time and can be implemented in the next 10 years.

The success of suggested protection strategy updates depends on the Forum partners' strong commitment to salmon recovery. The recommendations are intended as guidance for local governments, non-profit organizations, tribes, conservation districts, and private partners. As such, they do not imply a commitment to adopt any of these ideas wholesale. All partners must consider these recommendations in the context of their broader responsibilities. The

protection strategy recommendations from this update are briefly summarized in the following lists.

Basin-wide Recommendations

- Develop information on hydrologic importance in local jurisdictions
- Transfer and purchase of development rights
- Protect instream flows
- Acquire lands with high hydrologic value

Urban Recommendations

- Augment practices to meet National Pollutant Discharge Elimination System requirements with low impact development green infrastructure
- Improve tree ordinances and other relevant codes that require planting in urban areas

Rural Residential Recommendations

- Improve outreach and technical assistance to rural residential landowners
- Explore Public Benefit Rating System (PBRS) in Snohomish County and target outreach of PBRS in King County

Agriculture Recommendations

- Permanently preserve farmland
- Provide technical assistance to farmers
- Support technical innovations that have conservation and economic benefits in agricultural areas
- Develop water banks or similar mechanisms to promote conservation and best use of irrigation rights

Forestry Recommendations

- Permanently conserve working forestland
- Increase coordinated outreach, incentives, and technical assistance to small forest landowners
- Collect high resolution LiDAR throughout the entire basin and coordinate data collection and sharing efforts
- Expand water typing efforts and resources

With the adoption of the protection updates, the Forum signals a renewed commitment to improving conditions for fish, residents, foresters, and farmers who depend on intact hydrologic processes. The Forum, supported by staff and other partners, would continue to reflect on the progress of recovery strategies and improve the chances of salmon recovery in the Snohomish Basin.

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LIST OF ACRONYMS AND ABBREVIATIONS

2005 Plan	*Snohomish Basin Salmon Conservation Plan*
BAS	Best Available Science
BMP	best management practice
CUT	Current Use Taxation
DNR	Washington State Department of Natural Resources
EASC	Ecological Analysis for Salmonid Conservation
Ecology	Washington State Department of Ecology
ESA	Endangered Species Act
Forum	Snohomish Basin Salmon Recovery Forum
GMA	Growth Management Act
LID	Low Impact Development
LiDAR	Light Distance and Ranging
NMFS	National Marine Fisheries Service
NMFS Supplement	Final Supplement to the Shared Strategy's Puget Sound Salmon Recovery Plan
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resource Conservation Service
PBRS	Public Benefit Rating System
PDR	Purchase of Development Rights
PSWC	Puget Sound Watershed Characterization
RCW	Revised Code of Washington
Recovery Plan	*Puget Sound Chinook Recovery Plan*
SBPP	*Snohomish Basin Protection Plan*
SFLO	small forest landowner
TDR	Transfer of Development Rights
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency

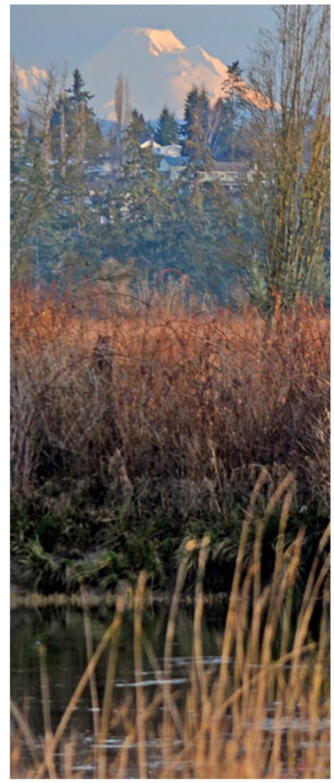
USFS	U.S. Forest Service
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WSU	Washington State University

Section 1

PROTECTION APPROACH APPLIED TO SNOHOMISH BASIN SALMON RECOVERY

This appendix presents detailed information on the application of the *Snohomish Basin Protection Plan* (SBPP) to salmon recovery. It is the intention of the SBPP partners to have the Snohomish Basin Salmon Recovery Forum (Forum) adopt this appendix as the first formal adaptive management action for the 2005 Plan. This protection update would not change existing restoration recommendations and habitat goals from the 2005 Plan.

Recommendations for updated salmon recovery protection strategies (packages of specific tools) for specific land uses in the Basin are detailed in Sections 2 through 7.



In 2005, the Shared Strategy Development Committee presented the Recovery Plan to NMFS. NMFS adopted and expanded the Recovery Plan to meet its obligations under ESA. The NMFS Supplement was adopted in January 2007.

Together, the Recovery Plan and NMFS Supplement comprise the Puget Sound Chinook Recovery Plan.

1.1 Protection in the Context of Salmon Recovery

In 1999, Puget Sound Chinook salmon and bull trout were listed as threatened under the federal Endangered Species Act (ESA). The 2005 Plan was adopted by the National Marine Fisheries Service (NMFS) in January 2007 as a chapter in the regional *Puget Sound Chinook Recovery Plan* (NMFS 2007), referred to as the Recovery Plan in this document. NMFS concluded that the Recovery Plan (including the regional Volume 1 and the watershed-specific chapters in Volume 2) met the requirements of ESA Section 4f, which requires adoption of a species recovery plan for those species listed as "threatened" or "endangered" under ESA. However, NMFS provided additional conditions in the *Final Supplement to the Shared Strategy's Puget Sound Salmon Recovery Plan* (NMFS 2006), referred to as the NMFS Supplement in this document.

Photo credit: Roger Tabor,
U.S. Fish and Wildlife Service

The 2005 Plan discussed the necessity of integrating harvest, hatchery, and habitat actions for successful recovery of salmonid populations. That concept is referred to as H-integration.

Photo credit: USDA

The NMFS Supplement outlines concerns about the 2005 Plan in the following three key areas:

- **Habitat protection** – Volumes 1 and 2 of the Recovery Plan were developed on the assumption that current protection tools were sufficient to "hold the line" and prevent further loss. However, there were few specifics of how this would be deployed. The NMFS Supplement includes water quantity and land use as important elements for a habitat protection strategy.
- **Adaptive management and monitoring** – NMFS requested the development of a monitoring plan connected to an adaptive management process.
- **H-integration** – The region subsequently identified a six-step process to address H-integration for salmon recovery, which was developed by an H-integration work group.

After the listing of Puget Sound Chinook salmon, the salmon recovery structure in the Snohomish Basin was formalized, following the lead entity requirements as described in Revised Code of Washington (RCW) 77.85.

The Forum is the citizen's committee. The 41-member committee includes high-level decision-making representatives from federal, state, and local governments; the Tulalip Tribes; seven special purpose districts; and 11 special interest groups including four farmers and three citizens. The Forum provides a means for coordinating and responding to the ESA listings at the local level and promotes the implementation of the 2005 Plan.

The Snohomish Basin Salmonid Recovery Technical Committee includes scientific and restoration implementation staff from agencies and organizations working in the Basin. The Technical Committee reviews actions and projects and makes recommendations to the Forum. The group of scientists

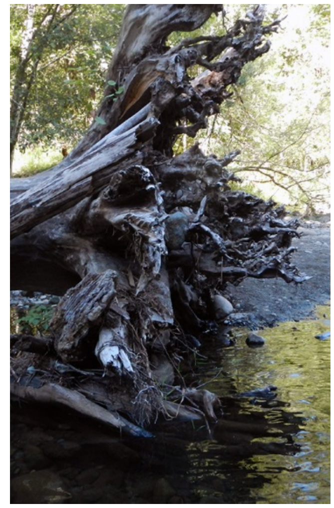
provides support for the protection and enhancement of the abundance, productivity, diversity, and spatial structure of all salmonids in the Basin.

The Forum has been working since 2005 to respond to the gaps identified in the NMFS Supplement. The H-integration Plan was provided to the Forum in 2008 (Kaje et al. 2008), and salmon recovery partners have been working on adaptive management and monitoring, with the development of a draft monitoring plan (2011) and a draft adaptive management framework (2014). There was recognition in 2010 that work was progressing on adaptive management and monitoring and H-integration; however, the Basin had yet to address habitat protection in a comprehensive way.

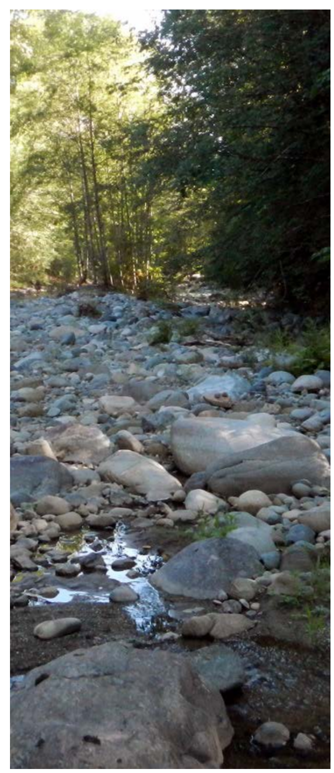
1.2 Summary of 2005 Plan Strategy and Implementation Progress

The 2005 Plan proposed a scientifically based suite of actions intended to recover local salmon populations in the Skykomish and Snoqualmie rivers. The 2005 Plan was written as a multi-species plan and identified actions to recover Chinook salmon, bull trout, and coho salmon as a proxy for all salmonids in the watershed. Actions were focused on habitat, hatchery, and harvest with a strong emphasis on H-integration. All actions related to habitat restoration and protection called for in the 2005 Plan are voluntary; however, jurisdictions provided letters of commitment to implement the 2005 Plan.

The Forum membership reflects the interests of many of the local governments, resource managers, and organizations that have direct influence on local habitat conditions and the land uses and regulations that affect the habitats.



The Ecological Analysis for Salmonid Conservation was a compilation and analysis of ecological information about the Basin that provided the scientific foundation for the 2005 Plan.



The word "action" is used in both the 2005 Plan and this document for consistency with the Puget Sound Local Integrating Organizations' efforts to foster implementation of Action Agenda priorities. Refer to Section 1.6 for additional details.

The 2005 Plan presented an ambitious number of capital project types and land-use-based protection strategies that could be implemented to reach scientifically sound habitat gain benchmarks. These actions were predicated on a policy of net gain in the hope that the watershed partners in the Basin—those who had restoration capacity and land management authority—would adopt this approach. With the partners implementing the 2005 Plan, Basin habitat would be gaining along a trajectory that model outputs said was necessary for recovery.

The majority of the 2005 Plan focused on the habitat restoration strategy. Strong scientific underpinnings for the habitat strategy were developed in the Ecological Analysis for Salmonid Conservation (EASC). The EASC reviewed habitat conditions and predicted future conditions based on a "current path" scenario. EASC assessments then determined the amount of habitat needed to reach recovery targets set by co-managers. The EASC determined the primary bottleneck for recovery of Chinook salmon was juvenile rearing. As a result, emphasis on habitat gains was placed on the nearshore, estuary, and mainstem areas of the Snohomish watershed.

Quantitative goals, or "benchmarks," were developed for a variety of habitats types in various locations throughout the Basin. These benchmarks were written to be additive above 2005 condition. The key assumption for habitat protection was net gain in tandem with restoration; any degradation was assumed to be mitigated or replaced with restoration above levels described by the quantitative benchmarks.

Hydrology was considered in the EASC, and peak flows were used as a proxy to describe the level of hydrological degradation in the sub-basins. Sub-basins were rated as degraded,

moderately degraded, or intact, as a function of 2005 peak flows relative to historical peak flows. Peak flows were modeled as a function of effective impervious area. Though the coarse rating was provided in the EASC, there were no benchmarks developed for either peak flows or impervious areas in any of the sub-basins.

Since 2005, there have been many site-scale successes on restoration projects in the mainstems, estuaries, and tributaries. However, many environmental indicators continue to decline, according to local data and the 2009 and 2013 State of the Sound reports (Puget Sound Partnership 2010, 2013). The continued decline calls for greater protection measures watershed-wide, reaching beyond the regulatory framework.

The last 10 years have produced a number of valuable tools and innovative approaches to protection that maximize multiple benefits. In order to provide a full accounting of progress, and protect against future known threats such as climate change, this update presents an array of technical information and protection tools that reflect baseline conditions. Restoration efforts can then build upon this baseline and gain the required lift to both restore conditions for the species that use the Basin and benefit the people who live in it.

1.3 Protection Strategies and Gaps in the 2005 Plan

In the 2005 Plan, protection strategies were organized by land use type, consistent with the arrangement of sub-basin strategy groups (see Section 11 of the 2005 Plan). The protection strategies were broad and contained a mixed arrangement of acquisition, incentive, education, and regulatory improvement. Protection strategies did not specifically address hydrologic

function, though it is mentioned as a way to focus or direct protection resources.

Throughout the 2005 Plan protection strategies, there was a consistent gap related to which geographic areas should be prioritized, the specific actions needed for implementation, and how to measure success. The descriptions below broadly outline the 2005 strategies, along with the identified gaps that formed the basis for this plan.

Protection in the Nearshore

The 2005 Plan recommended that undeveloped portions of the Snohomish nearshore be targeted for acquisition and programmatic regulatory protection. With the recognition that the railroad impacts a majority of the south end of the nearshore, the 2005 Plan put special focus on areas north of Everett. The strategy included protecting forest cover and prohibiting fill and dredging in the photic zone. The strategy intends to protect nearshore sediment processes, large woody debris recruitment, and shading.

Nearshore 2005 Gaps

None identified through this project.

Protection in Agriculture Lands

Agriculture and working lands have long been identified as a key resource to protect in the Basin. However, many salmon recovery protection and restoration actions focus on land that is currently being farmed, creating a situation of conflicting goals. Since 2005, much effort in the Basin has focused on working with the agriculture community to better meet agriculture and salmon needs. Many new strategies are in development (i.e., the Sustainable Lands Strategy and the Fish Farm Flood group) and have been included in the 3-year work plans since 2009.

Agriculture 2005 Gaps

- Identification of priority floodplain areas for protection of watershed process
- Development of specific strategies for working with the agricultural community to ensure, and hopefully enhance, the health of local farms and the overall farming economy where restoration activities are occurring

Protection in Forest Lands

Forestry is a key resource in the Basin and is highly valued for the open space that it conserves. The Recovery Plan speaks to intact habitat on forestry lands. Forest areas are also recognized as having an important role in protecting the Basin's hydrologic flows. Programs currently exist to protect forestry areas from conversion. These programs can provide funding, incentive, securing easements, and technical assistance to land owners. Funding to apply these programs and tools needs to be more readily attainable and available.

Forest Lands 2005 Gaps

- Further identification and clarification of the role of forests in hydrologic protection in the Basin
- Protection of working forests vulnerable to change in land use
- Increased description of incentive tools and the resources needed to implement them
- Development of specific strategies for how to offer technical assistance and incentives to small forest landowners (SFLOs)

Protection in Rural Residential Areas

The goals of the 2005 Plan are the protection of forested lands and wetlands as well as managing rural residential areas for the highest protection of salmon. The 2005 Plan discusses the

protection of rural residential land use areas in Section 9.0 and encourages actions such as stewardship, outreach, and enrollment in Current Use Taxation (CUT) programs.

Rural Residential 2005 Gaps

- Description of specific strategies that are most acceptable to rural residents
- Description of flexible tools to reach all types of rural residential land owners
- Education of rural residential owners on what they can do to maximize function on their properties
- Consideration of consistency across Basin jurisdictions

Protection in Urban Areas

The 2005 Plan speaks to the importance of urban areas in the context of salmon recovery, as urban areas are slated to absorb future planned growth in accordance with the Washington State Growth Management Act (GMA), thereby preserving intact habitat and open space in rural areas. Recommended strategies in urban areas suggest that growth should be focused in urban areas but that techniques should use Low Impact Development (LID) and green building techniques in order to protect remaining habitat and water quality. Funding for programs that promote salmon recovery (e.g., integrative plans, policies/regulations, and outreach/stewardship) is limited.

Urban 2005 Gaps

- Thorough description or consideration of water quality and stormwater management
- Sophisticated understanding of green infrastructure tools and incentives
- Description of the highest priority protection areas within urban basins

1.4 Status of the Resource: 2005 to Present

Building on the long-term vision and recovery approach, in 2005 the Forum recommended significantly improving habitat conditions by 2015. The Forum agreed to pursue quantitative 10-year habitat improvement milestones for the nearshore, estuary, mainstem, and rural stream sub-basin strategy groups, shown in Tables 1 and 2. For the mainstem primary restoration sub-basin strategy group, the Forum recommended the milestone of restoring 60% of the original riparian forest levels in both the King and Snohomish County portions of the Basin, an overall increase of about 4%. In addition to these targets, the 2005 Plan recommends improving other habitat conditions across the Basin: fish passage, forest roads, forest cover, riparian forest, impervious surfaces, and water quality, coupled with regulatory and policy actions as well as technical assistance. The "gains" needed in Tables 1 and 2 represent the sum of gains from capital restoration, gains from natural processes, and losses from habitat degradation.

Table B-1: 10-year Habitat Gains Needed in Key Sub-basin Strategy Groups

Sub-basin Strategy Group and Habitat Condition	Current Intact (2005)	Needed Gain in Next 10 years (Including Current Path Gains; 2005 to 2015)	Total Needed at Year 2015
Nearshore Beaches and Shoreline	8.4 miles	At least 1 mile	At least 9.4 miles
Estuary: Tidal Marsh	1,483 acres	1,237 acres	2,720 acres
Mainstem Primary Restoration:			
Restored Edge Habitat	236 miles	10.4 miles	246.4 miles
Restored Riparian Forest	5,991 acres	256 acres	6,247 acres
Restored Off-Channel Habitat	350 acres	167 acres	517 acres
Large Woody Debris	N/A	41 new log jams	

See Table 1.1 of 2005 Plan

Table B-2: Riparian Forest and Off-Channel Habitat Gains Needed in Other Sub-basin Strategy Groups

Sub-basin Strategy Group and Sub Basins	Riparian Forest (acres)		Off Channel Habitat (acres)	
	50 year	10 year	50 year	10 year
Mainstem – Secondary Restoration	31	6	27	6
Rural Streams – Primary Restoration	67	13	49	10
Rural Streams – Secondary Restoration	0	0	203	41
Urban Streams	379	75	0	0

1.5 Information Developed Since the 2005 Plan

1.5.1 Protection Progress

There have been varying protective actions taken in the first decade of the 2005 Plan implementation. The following are some examples of protection tools implemented in the Basin:

- The 2005 King County Critical Areas Ordinance and subsequent Critical Areas Ordinance Effectiveness Study show the regulations may be sufficient to protect hydrology (Lucchetti et al. 2014).
- In the 2009 Raging River Headwaters Protection, King County authorized the use of $3.7 million to support a Washington State Department of Natural Resources (DNR) conservation effort to acquire and protect an estimated 4,000 acres of a 7,000-acre purchase in the upper Raging River watershed. This would protect lands from conversion.
- In 2008, the Wild Sky Wilderness was designated, protecting 2.6 million acres of forested headwaters in the North Fork Skykomish Basin.
- The monitoring and regulation update to the Snohomish County critical areas regulations provided information on the effectiveness of existing regulations.

However, across the Basin, there has been no effort to uniformly track or report on the amount of land protected, including those

areas permanently protected (e.g., designated as federal Wilderness) or temporarily protected (acquired as a conservation easement) across different land use categories. Table B-3 shows an effort by the project team to summarize the status of protection efforts. It is possible to report on a handful of efforts, but without system-wide monitoring, there is no way to connect those efforts to current conditions and associated trends in hydrology or salmon habitat. Efforts such as the Washington Department of Fish and Wildlife (WDFW) High Resolution Change Analysis indicate that there continues to be an overall slow loss of riparian habitat, even when accounting for restoration gains. WDFW found that between 2006 and 2009, 73 acres within 100 meters of fish-bearing streams were lost to permanent development and 163 acres were cleared but not converted to permanent development. This is compared to the 163 acres that were planted as part of restoration efforts.

Table B-3: Status and Pace of Habitat Protection

<table>
<tr><th>Habitat Protection (2012)</th><th>2005 Intact</th><th>Status</th><th>3-year Outcome Needed to be on Track in 3 Years</th></tr>
<tr><td colspan="2">Nearshore Beaches and Shoreline</td><td rowspan="27">Habitat loss is not systematically monitored throughout the Basin. Current status information includes:
• Mainstem riparian forest loss pilot project (Skykomish River only)
• High resolution land cover change analysis (Pierce 2011)
• King and Snohomish Counties critical areas monitoring
• Acquisition reporting</td><td rowspan="27">SBPP:
• Fully funded USEPA grant
• Completion of watershed characterization and characterization of reach-scale processes within protection priority sub-basins
• Tulalip Pilchuck protection pilot project (2011) advances the larger Snohomish USEPA grant

The Tulalip Tribes' comparative analysis of resource management and restoration policies and authorities project is developing tables of overlapping jurisdictional authorities and where they are consistent, in conflict, or have gaps.

Development and implementation of Status and Trend (Cumulative Effectiveness) element of Basin Monitoring Plan through Open Standards Miradi work.</td></tr>
<tr><td>Riparian Areas (focus reaches)</td><td>297 acres</td></tr>
<tr><td>Edge Habitat (focus reaches)</td><td>22 miles</td></tr>
<tr><td colspan="2">Estuary: Tidal Marsh</td></tr>
<tr><td>Riparian Areas (focus reaches)</td><td>165 acres</td></tr>
<tr><td>Edge Habitat (focus reaches)</td><td>27 miles</td></tr>
<tr><td>Forest Cover</td><td>687 acres</td></tr>
<tr><td colspan="2">Mainstem – Primary</td></tr>
<tr><td>Riparian Areas (focus reaches)</td><td>5,991 acres</td></tr>
<tr><td>Edge Habitat (focus reaches)</td><td>236 miles</td></tr>
<tr><td>Forest Cover</td><td>116,633 acres</td></tr>
<tr><td colspan="2">Mainstem – Secondary</td></tr>
<tr><td>Riparian Areas (focus reaches)</td><td>2,497 acres</td></tr>
<tr><td>Edge Habitat (focus reaches)</td><td>79 miles</td></tr>
<tr><td>Forest Cover</td><td>44,935 acres</td></tr>
<tr><td colspan="2">Rural Streams – Primary</td></tr>
<tr><td>Riparian Areas (focus reaches)</td><td>709 acres</td></tr>
<tr><td>Forest Cover</td><td>18,286 acres</td></tr>
<tr><td colspan="2">Rural Streams – Secondary</td></tr>
<tr><td>Riparian Areas (focus reaches)</td><td>258 acres</td></tr>
<tr><td>Forest Cover</td><td>36,624 acres</td></tr>
<tr><td colspan="2">Urban Streams</td></tr>
<tr><td>Riparian Areas (focus reaches)</td><td>137 acres</td></tr>
<tr><td>Forest Cover</td><td>8,558 acres</td></tr>
<tr><td colspan="2">Headwaters Primary Protection</td></tr>
<tr><td>Riparian Areas (focus reaches)</td><td>1,318 acres</td></tr>
<tr><td>Forest Cover</td><td>61,865 acres</td></tr>
</table>

Notes:
WDFW high-res work is specific to and covers the whole Snohomish Basin.
SBPP Snohomish Basin Protection Plan
USEPA U.S. Environmental Protection Agency

1.5.2 Restoration Progress

In comparison to a lack of information about the implementation and effectiveness of protection measures, there is good information on restoration gains that is gathered each year by Snohomish Lead Entity staff. The progress toward 10-year benchmarks is varied with many habitat types not on track to meet needed gains. Others are assumed to have met 10-year gains so long as the assumption that the 2005 habitat status was not degraded is correct. Table B-4 shows implementation—or activity—progress toward the 2005 Plan's restoration targets as of the 2013 restoration season. Riparian restoration is considered to be more or less on track; therefore, a systematic update was not conducted. Values relating to the other restoration targets were updated based on Habitat Work Schedule-completed projects and staff knowledge. This will be further refined in 2015 and 2016 during the 10-year status update of the Recovery Plan.

Tracking implementation of restoration actions is part of an iterative process in monitoring, reporting, and adaptively managing the strategies and actions outlined in the 2005 Plan and will continue to evolve in the future. Table B-4 neither reflects the effectiveness of the projects implemented (achieving full ecological function), nor does it reflect the overall changes in the watershed landscape (planted riparian areas vs. areas lost due to development or channel migration). Restoration actions are long-term investments toward achieving habitat conditions that will support healthy Chinook salmon populations. Some actions (such as removal of a migration barrier) realize immediate impacts, while others (such as riparian plantings) take decades to reach maturity. While building a mature riparian forest takes time, the actions in Table B-4 are critical to our ultimate goal of restoring natural processes. The values in the table also have a range of confidence associated with them.

Confidence in the figures is eroded where there are less data on exact overlap with focus reaches, more project sponsors implementing projects, a range of restoration methodologies and approaches to measuring outcomes, and issues of how to quantify restoration outcomes where "we let the river do the work for us." Monitoring these actions and their associated effectiveness will evolve over time, and both project sponsors and the Technical Committee remain supportive of resolving these issues. In addition, Basin partners may choose to refine or revise the metrics being used to measure implementation progress as part of the expected 2015 update.

Table B-4: Pace/Status of Habitat Restoration

Habitat Restoration	Needed Habitat Gain in 10 Years	Progress since 2005	Percent 10-year Benchmark	Currently on Target to Meet Benchmark?	Outcome Needed to be on Track
Nearshore Beaches and Shoreline	At least 1 mile	0.39 mile	39%	Progress made	• Howarth Park construction (0.6 mile) • Nearshore nourishment completed (0.73 mile)
Estuary: Tidal Marsh	1,237 acres	460.6 acres	37%	Yes	• Qwuloolt construction (350 acres); 2015 breach • Smith Island construction (315 acres); 2016 breach • Mid Spencer enhancement (74 acres); 2016/2017 • Blue Heron Slough; 2017 breach
Mainstem – Primary					
Restored Edge Habitat	10.4 miles	2.9 miles	28%	No	7.5 miles
Restored Riparian Habitat*	256 acres	191 acres	75%	Yes	*
Restored Off-channel Habitat	167 acres	31.27 acres	19%	No	135 acres

Habitat Restoration	Needed Habitat Gain in 10 Years	Progress since 2005	Percent 10-year Benchmark	Currently on Target to Meet Benchmark?	Outcome Needed to be on Track
Large Woody Debris	41 logjams	6 logjams	15%	Progress made	Unknown, given lack of information about habitat loss/project performance**
Mainstem – Secondary					
Restored Riparian Habitat*	6 acres	0	0%	No	8 acres are identified in the 2014/2015 3-year work plan project list
Restored Off-channel Habitat	6 acres	0	0%	No	6 acres
Rural Streams – Primary					
Restored Riparian Habitat*	13 acres	6 acres	46%	Progress made	Assumed on track*
Restored Off-channel Habitat	10 acres	5 acres	0%	No	5 acres
Rural Streams – Secondary					
Restored Riparian Habitat*	0	14 acres	Met, assuming no habitat loss	Yes	Assumed on track*
Restored Off-channel Habitat	41 acres	7 acres	17%	No	34 acres
Urban Streams					
Restored Riparian Habitat*	75 acres	26 acres	28%	Progress made	Assumed on track*
Restored Off-channel Habitat	0	-	Met, assuming no habitat loss	Yes	Unknown, given lack of information about habitat loss

Notes:

* Not systematically updated in 2014 but assumed to generally be on track based on implementation information.

** Six large logjams were installed as part of the Tolt River project, but there have not yet been flows at levels to activate them; therefore, they are not counted in this table. In addition, work to install flood fencing to capture sediment and logs has not had time to develop into mature jams and, therefore, are not counted in this metric.

1.6 Additional Drivers for Updating Protection Strategies in Salmon Recovery

The primary driver for the creation of the update protection strategies was the deficiencies of the 2005 Plan and the Recovery Plan cited in the NMFS Supplement. Since 2005, there have also been a variety of new reports, regional processes, tools, and models that have been developed that further support the need for additional protective actions and a review of protection strategies. The primary drivers for the revisions of the protection strategies are listed below.

1.6.1 Implementation Progress Reports

3-year Work Plans

In 2010, the halfway mark toward the restoration 10-year benchmarks, it became increasingly clear that restoration in the Basin, and Puget Sound as a whole, was not being achieved at the expected pace and that 10-year benchmarks likely would not be met. Impediments listed in the 3-year work plans included shortfalls in funding, difficulties securing landowner willingness, and cumbersome permitting processes. The lag in restoration implementation stressed the importance of protecting intact habitat and processes, as demonstrated in the previous tables.

Treaty Rights at Risk

In 2011, the Treaty Indian Tribes in Western Washington also produced a white paper called *Treaty Rights at Risk: Ongoing Habitat Loss, the Decline of the Salmon Resource, and Recommendations for Change* (Treaty Tribes 2011). The white paper asserted that restoration in the Puget Sound watersheds was not keeping pace with ongoing systematic loss of habitat, resulting in an overall degradation of conditions. While some stakeholders question some data and conclusions, the paper

highlighted that the implementation and efficacy of habitat protection measures continues to cause consternation.

As part of the Treaty Rights at Risk Initiative, the Tribes also released the *State of Our Watersheds Report* in 2012 (NWIFC 2012). The watershed-specific chapters highlighted concerns related to habitat loss since the ESA listing of Chinook salmon. The Tulalip Tribes authored the chapter on the Snohomish River Basin. Concerns included specific examples of ongoing degradation and an overall lack of faith in the 2005 base assumption that no further habitat losses would occur.

2011 NOAA Implementation Report

Five years after the creation of the regional and watershed salmon recovery plans, the National Oceanic and Atmospheric Administration (NOAA) conducted a review to assess progress of the implementation of habitat, hatchery, and harvest actions. The report concluded that there were demonstrable successes with hatchery, harvest, and habitat restoration actions; however, it was difficult to assess progress on habitat protection work. Additionally, the NOAA report points out that, according to the 2009 State of the Sound report (Puget Sound Partnership 2010), habitat continued to decline. Specifically, the report points out that the protection strategies called out in the Recovery Plan (NMFS 2006, 2007) were still largely non-existent. These strategies included:

- Protection of existing physical habitat and habitat-forming processes
- Protection and restoration of the nearshore, Puget Sound, and Pacific Ocean
- Water quantity strategies for achieving and protecting instream flows
- Water quality strategies
- Commercial forestry strategies

- Commercial agriculture strategies
- Research, monitoring, and adaptive management

1.6.2 New Planning Frameworks

Puget Sound Partnership and the Action Agenda

The Washington State Legislature established the Puget Sound Partnership as a state agency in 2007 with the goal of achieving and sustaining a healthy human population, a vibrant quality of life, a thriving species and food web, protected and restored habitat, abundant water quantity, and healthy water quality.

To lead the region's collective effort to restore and protect Puget Sound, the Partnership works closely with hundreds of partners representing local, state, federal, and tribal governments, as well as science, non-profit organizations, business, and other members of our communities. The Partnership creates and manages the infrastructure needed to enable and encourage partners to come together to develop and implement the priority actions needed to accelerate recovery. The agency does this by mobilizing partners around a common agenda, tracking progress and improving systems through common measures, and supporting partners in advancing Puget Sound investments.

The Partnership serves a coordinating role for the Puget Sound National Estuary Program and as the regional salmon recovery organization to coordinate Puget Sound salmon recovery efforts. The Partnership also convenes a number of other state priority workgroups that impact Puget Sound.

The Puget Sound Action Agenda is the region's shared roadmap and provides the organizing framework guiding Puget Sound restoration efforts, based on a vision for recovery that supports the people, species, and ecosystems necessary for a thriving

region. The first Action Agenda was created in 2008 through a multi-stakeholder processes and is updated every 2 years. The Action Agenda contains hundreds of near-term actions intended to be implemented within 2 years and make progress on specific Puget Sound vital sign indicators.

The Action Agenda is organized around the following three strategic initiatives that drive resources and investment:

- Preventing pollution from urban stormwater runoff
- Protecting and restoring habitat
- Recovering shellfish beds

The Action Agenda development process is science-based; derived through a region-wide process that includes participation from federal, state, local, tribal, non-profit, private, and other interests; and is managed by the Partnership through an adaptive management framework.

Adaptive management is a decision-making tool to help measure progress and success and allow strategies to be adjusted accordingly. New data, information about a project's successes and failures, and flexibility are incorporated into a long-term management program.

Local Integrating Organizations

Local communities around Puget Sound are working to integrate local efforts to advance the Action Agenda. Local governments, tribes, and non-profit organizations—along with watershed, marine resource, and salmon recovery groups, and various business, education, and citizen interest groups—are collaborating to develop and coordinate local integrating organizations that foster implementation of Action Agenda priorities.

These local integrating organizations enable communities to guide the implementation of Action Agenda priorities and prioritize local actions for investment. One of the nine local integrating organizations in Puget Sound is the Snohomish-Stillaguamish Local Integrating Organization. This group

focuses on developing high-priority actions for ecosystem recovery in the Snohomish and Stillaguamish watersheds.

Regional Chinook Salmon Monitoring and Adaptive Management

When NOAA Fisheries approved the Puget Sound Chinook Salmon Recovery Plan in 2007, it noted that the plan lacked a comprehensive adaptive management and monitoring component, and it required that the Puget Sound region address this gap. Without a robust monitoring program, it is difficult to assess or quantify changes in Chinook salmon populations and supporting habitats.

In order to fill this gap, the Chinook Monitoring and Adaptive Management Project engaged all 16 watersheds and the Puget Sound Salmon Recovery Council in developing technically rigorous, logical, and regionally consistent monitoring and adaptive management processes so that the Puget Sound region can assess and respond to the status of Chinook salmon populations and their habitats.

The watershed teams translated existing watershed plans into the Common Framework. The Common Framework, developed by the Recovery Implementation Technical Team, uses the Open Standards for the Practice of Conservation (Open Standards) method to organize information from each watershed plan into a consistent set of terms and relationships. This translation process has assisted each watershed with the following:

- Establishing monitoring metrics and priorities.
- Assessing the status of Chinook salmon populations and associated habitats.

- Developing logic models illustrating why they believe the strategies and actions in their plans would lead to Chinook salmon recovery.
- Identifying gaps in existing watershed plans.

The Puget Sound Salmon Recovery Council would use the newly available consistent watershed-scale information to look at the status of Chinook populations and their habitat across Puget Sound. The Salmon Recovery Council would also use this information to refine its action and funding priorities, including monitoring priorities.

In addition to Chinook Monitoring and Adaptive Management using Open Standards, the Puget Sound Partnership also adopted the approach for its Action Agenda and Ecosystem Recovery reporting. As the Monitoring and Adaptive Management work provides a mechanism by which to update significant changes to strategies and is a stated regional priority, King County, Snohomish County, and the Tulalip Tribes (as leaders in salmon recovery) were motivated to update protection strategies following the methodology which could easily be translated into the Open Standards approach to link with the region and other watersheds.

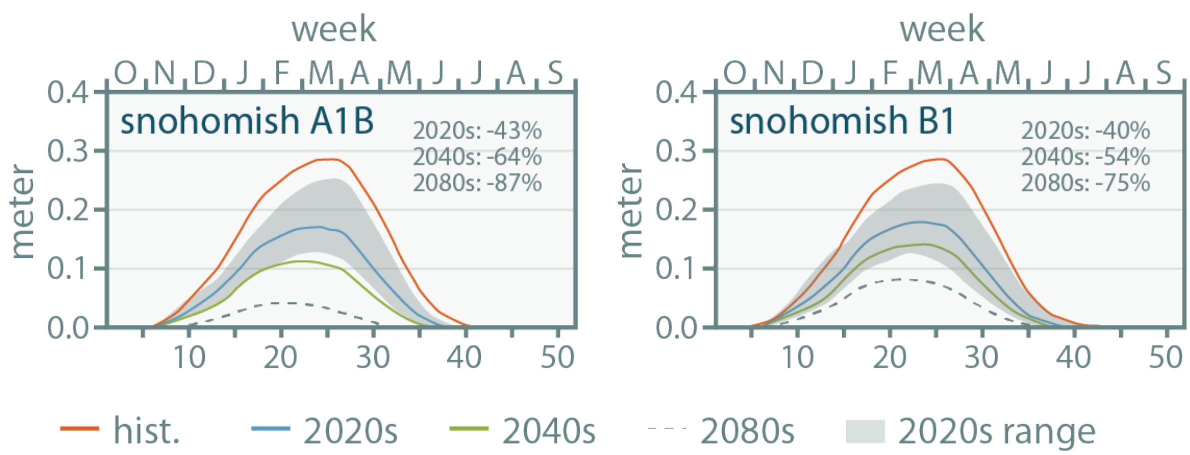
1.7 New Models, Tools, and Information

1.7.1 Climate Change

Climate change was not explicitly addressed in the 2005 Plan, though there was early recognition that effects would likely include increases in the magnitude of peak flows, prolonged and persistent low flows, reductions in spawning flows, and increased stream temperatures. These conditions would place a greater strain on water resources, threatened salmon

populations, and working farms and forests. Information on the predicted effects of climate change has been refined since 2005.

Several science-based organizations, including the University of Washington Climate Impacts Group and the Pacific Northwest National Laboratories, have released model results that provide greater detail on potential changes in water temperature, flow volume, and flow timing. For an example, refer to the following projections:



Projected Change in Snohomish Weekly Snow Water Equivalent for the 2020s, 2040s, and 2080s

Adapted from CIG 2009

The 2013 Snow Caps to White Caps report provided information and modeling of water resources in the Basin that are affected by climate change and increased development pressures (PNNL and University of Washington 2013).

The 2005 study of climate change effects on salmon recovery in the Basin by the Climate Impacts Group and NOAA predicted a 5% to 23% decline in average Chinook salmon abundance even after the 2005 Plan is implemented.

1.7.2 Watershed Characterization

In 2009, the Washington State Department of Ecology (Ecology) released the Puget Sound Watershed Characterization (PSWC) model. This model combines information for assessments from land uses and landforms to present information on the relative importance and degradation of four different components of hydrology: storage, delivery, recharge, and discharge. The model is intended for land use planners to guide decisions in areas that are important for restoration and protection. The PSWC tool has been used to take a landscape-scale approach to new hydrology-focused protection strategies with geographic specificity.

If treated like an asset with a life span of 100 years, the present value of the Snohomish Basin would be between $13.2 billion and $180.1 billion, using a 2.7% discount rate (Earth Economics 2010).

The 24-acre North Scriber Creek wetland in Lynnwood, Snohomish County, was found by Ecology to have a flood protection value of $8,000 to $12,000/acre/year, and 292 acres of wetland in Renton were found to have a flood protection value of approximately $41,000/acre/year (Leschine et al. 1997).

1.7.3 Ecosystem Services

In the last decade, there has been an emerging understanding of ecosystem services. Ecosystem services are benefits that humans derive from the environment. They can include regulating services such as flood control and water quality, provisioning services such as water supply, supporting services such as nutrient cycling, and cultural services such as recreation. The concept of ecosystem services provides the Basin with a new framework and language that allows for a better understanding of how salmon recovery provides multiple benefits.

Traditionally, recovery efforts only considered provisioning services (salmon to support economies) and cultural services (salmon as a spiritual component of tribal culture). Considering ecosystem services helps relate salmon recovery protection efforts to other benefits. Farmers depend on water for irrigation in summer and can suffer production losses during floods. Communities require drinking supplies and safe areas to build. Recreational river users depend on clean rivers for swimming and fishing, and flow levels to support boating.

In December 2006 alone, the Snohomish County Emergency Management Department estimated $5.3 million worth of damage from floods to farms along the Skykomish and Snohomish Rivers (HeraldNet 2011). In addition, the City of Snoqualmie is one of the most flood-prone cities in Washington and has produced the highest number of flood claims of any city in the state (City of Snoqualmie 2014).

In 2002, Snohomish County farms sold more than $126 million in agriculture products, and King County had comparable sales (USDA 2009). Many of these products depend on the availability of existing water rights. Ecology is currently not issuing new irrigation rights in the majority of the Basin's agricultural areas.

The City of Everett depends on the upper Sultan watershed forests to provide natural water purification for its Spada Lake water supply. This source provides clean, safe water for more than 570,000 people and 80% of the businesses and residents of Snohomish County through a network of local water providers (City of Everett 2015). Snohomish County residents receive water captured and largely filtered by natural systems. When the City's filter system was compromised, the U.S. Environmental Protection Agency allowed the City to continue providing drinking water because the forest-filtered water met clarity parameters and there was no threat to public safety (Earth Economics 2010). The City of Seattle maintains a similar system in the Cedar River Watershed and estimates that management of its forests has avoided construction of a water filtration plant and the estimated cost of $200 million (Earth Economics 2010).

Recreation provides a boost to the entire Puget Sound economy. Nearly 80% of the state's revenue from tourism occurs in Puget

Sound, with Snohomish and King Counties within the top four counties (OFM 2007). According to the recreation surveys and public records used in a recent Earth Economics study (Briceno and Shundeler 2015), there were a total of about 446 million participant days per year spent on outdoor recreation in Washington, resulting in $21.6 billion dollars in annual expenditures. Expenditures were highest for recreation associated with public waters.

By acknowledging the many benefits that are provided by intact watershed processes that support salmon runs, there is opportunity to expand non-traditional partnerships and funding, and improve willingness to protect hydrology and improve implementation.

1.8 Connections between Hydrology and Salmon Habitat

The Snohomish Basin is the second largest drainage in the Puget Sound region and one of the primary producers of anadromous salmon. The Basin contains nine salmonid species including two spawning populations of ESA-listed Chinook salmon and populations of steelhead trout and bull trout. The primary goal of the SBPP and protection strategy updates is to identify protection strategies that prevent the degradation of hydrologic processes that support salmon or salmon habitat, regardless of the existing state of salmon populations or habitat. Since hydrologic processes were identified as proxies for salmon habitat condition and function for the SBPP, a baseline evaluation of hydrology across the Basin was necessary for strategy development and orientation.

The physical-biological connections between hydrology and salmon life history were fundamental considerations in the

Terms used in evaluating salmon populations:

Abundance refers to the number of fish at various life stages or at a specific time, generally measured as population size. A population should be large enough to survive normal environmental variation or human-caused impacts.

Productivity is the growth rate, or a population's potential for increasing or maintaining its abundance over time. A population that consistently fails to reproduce itself is at risk of extinction.

Diversity refers to the differences in genetic and behavioral traits, including life histories, sizes, and other characteristics. Diversity helps protect populations from short-term environmental change and provides a basis for survival during long-term environmental change.

Spatial structure is a means of measuring how the abundance at any life stage is geographically distributed among habitats or potential habitats.

development of the SBPP. Through the protection of hydrology, this SBPP and associated Plan update aims to protect salmonid habitat quality, quantity, and heterogeneity, helping to promote the overall resilience of salmon populations. The underlying assumption in this approach is that the protection of hydrologic function and processes would inherently influence salmon ecology, biology, and behavior. Protecting these mechanistic and inferential linkages is predicted to result in support for salmon population performance, productivity, and abundance. This approach is similar to the habitat hypotheses emphasized in the 2005 Plan and employed across regional salmon conservation and restoration efforts.

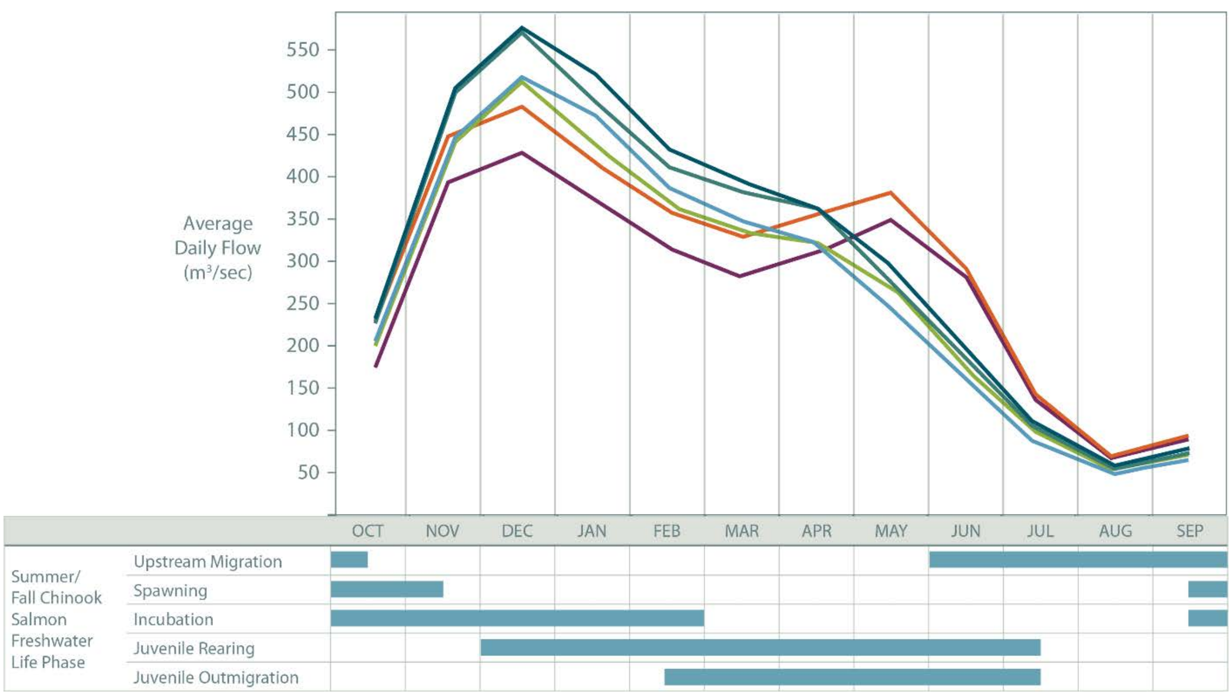
The clear connections between hydrology and salmon life history (see "Scientific Basis of the Connections between Hydrology and Salmon Habitat" on the next page) lend support to the theory that alteration of hydrology and its constituent attributes would subsequently affect salmon survival, growth, and population performance. Ecosystem and hydrologic processes can be disrupted or degraded by human activities including, but not limited to, dams/diversion structures, urbanization, draining and filling of wetlands and floodplains, removal of riparian vegetation, levees and channelization, excessive loading of sediments, forest clearing, and groundwater pumping (Poff et al. 1997; Stanley et al. 2012). Additionally, the influence of climate change would likely have a significant impact on the hydrologic regime as well as related salmon life-history dynamics. These climate change impacts would likely result in alterations in flow, temperature, and habitat quality/quantity across salmon life cycles.

Scientific Basis of the Connections between Hydrology and Salmon Habitat

Aquatic ecosystems are influenced by broad physical, chemical, and biological processes including fluxes of water, nutrients, sediment, organic material, and biota. These processes and attributes interact to form structural features that influence habitat occurrence and function (MacIsaac 2010). Specifically, hydrology acts as a major determinant of physical habitat formation processes by building and sustaining landform features and influencing habitat-specific characteristics.

The attributes of hydrologic regimes—including magnitude, frequency, duration, timing, and rate of change—govern the quality and quantity of water and influence energy sources, physical-biotic relationships, and biotic interactions (Poff and Ward 1989; Richter et al. 1996; Walker et al. 1995; Poff et al. 1997). Through these linkages, variation and patterns in hydrology end up characterizing the relative abundance, composition, and diversity of fish assemblages (Meffe and Sheldon 1988; Pusey et al. 1993, 1998, 2000; Bunn and Arthington 2002). Hydrologic flow regimes have a profound role in the life history of fishes, since critical life events such as phenology of reproduction, spawning behavior, larval survival, growth patterns, and recruitment are dependent on specific flow conditions (Welcomme 1995; Junk et al. 1989; Copp 1989, 1990; Sparks 1995; Humphries et al. 1999).

These ecological and physio-biological connections support the theory that variation and trends in salmonid life history (e.g., body length, upstream migration timing, spawning age and timing, and outmigration age and timing) are likely adaptive responses to specific ranges and seasonal patterns of water and flow conditions (Smith 1969; Beacham and Murray 1987; Quinn et al. 2001; MacIsaac 2010).



Since anthropogenic modifications and climate change impacts will influence flow regimes, and subsequent diversity and functional organization of fish communities, it is essential to understand how flow regimes have been altered and are changing, what the apparent stresses and pressures are, and how different aspects of hydrology are characterized across the landscape. Similarly, since natural seasonal variations in streamflow are primarily driven by local climate and precipitation, and moderated by the hydrologic and geomorphic characteristics of the watershed (MacIsaac 2010), it is important to understand the spatial arrangement of hydrologic function and the condition of related attributes across the landscape. Evaluation of these hydrologic attributes, landscape pressures, and the related salmon habitats provides the context needed to evaluate potential hydrologic protection strategies relevant to salmon habitats.

1.9 Salmon Recovery Protection Strategy Recommendations

Sections 3 through 6 recommend packages of tools for each land use type in the Snohomish Basin, along with basin-wide recommendations in Section 2. These recommendations are intended to update the protection strategies in the 2005 Snohomish Basin Salmon Conservation Plan. Throughout the 2005 Plan protection strategies, there was a consistent gap related to which geographic areas should be prioritized, the specific actions needed for implementation, and how to measure success. The presentation of protection strategies by land use type in this update is consistent with the 2005 Plan.

Solid policy, regulatory, and programmatic actions are necessary to protect hydrology and help achieve the 50-year salmon recovery goals. The recommendations in Sections 2 through 6

are intended to be guidance for local governments, non-profit organizations, tribes, and other partners to identify alternatives necessary to protect hydrology. As such, they do not imply a commitment, mandate, or intent on the part of any local governments to adopt these ideas. Local governments have the final decision-making authority to choose and implement policies that work for their jurisdictions within the context of their broader responsibilities. The caveats associated with the original letters of commitment to the 2005 Plan from jurisdictions still stand.

There are many existing programs and regulations intended to protect salmon habitat and watershed processes, including intact hydrologic processes. State and federal regulations are implemented differently by local jurisdictions throughout the Basin. The strategies in Sections 2 through 6 are intended to suggest policy and planning within those frameworks to encourage the alignment of existing regulations with the protection of hydrology. The strategies also intend to recognize, support, and suggest improvement to existing outreach, technical assistance, and incentive programs that are already in place.

Each strategy package contains guidance for why the strategy is important, who could implement the strategies, where the strategies should be applied first, and how salmon recovery partners could measure the implementation and effectiveness of the strategies over time. Additionally, a "results chain" graphic is provided for each strategy package, which details the logic of how changes in protection context can result in a successful hydrological outcome.

Results chains are a tool to describe a theory of change and are used throughout the Puget Sound region for efforts related to Chinook salmon recovery as well as the Puget Sound

Partnership's Action Agenda. Results chains help make assumptions explicit about how protection interventions contribute to the reduction of pressures and support the conservation of hydrology. Results chains also serve as a framework to build activities, implementation indicators, and effectiveness indicators. The framework gives managers the ability to make corrections mid-strategy in order to address cases in which intermediate outcomes are not realized. Additionally, results chains help to test assumptions about the pressures that are most harmful for hydrology and other priority habitats, species, and ecosystem processes.

Although there are many monitoring efforts taking place across the Snohomish Basin, the information is neither centralized nor is much of it specifically being collected to evaluate progress toward salmon recovery and the protection of hydrology (e.g., regulatory effectiveness monitoring and water quality monitoring). The suggested metrics in this section are largely unfunded and not mandated. In the 2005 Plan, monitoring and adaptive management needs were estimated to cost $5.6 million for the first 10 years of implementation.

Objectives related to implementation and effectiveness indicators are not explicitly detailed in the strategies in Sections 2 through 6. The effectiveness indicators identified can continue to be developed at the Basin scale by the Policy Development Committee once status and trends information is updated, and at the local scale by implementing jurisdictions. The 2005 Plan presented a number of benchmarks for status and trends of different habitat types including riparian forest, total forest cover, off-channel habitat, edge habitat, and large woody debris, all with the assumption that habitat losses would not continue to occur. Additionally, the EASC supporting technical analyses rated the condition of peak flows at the reach scale.

Future monitoring efforts should evaluate whether or not protective actions are contributing toward the habitat benchmark goals and whether peak flow and low flow conditions are changing over time.

Table B-5: Intact Habitat by Sub-basin Strategy Group

Sub-basin Strategy Group	Habitat Condition	Percent Intact for Sub-basin Group	Intact Acres
Mainstem – Primary Restoration	Riparian area (focus reaches)	56	5,991
	Forest cover	50	116,633
	Pervious surface	97	N/A
Mainstem – Secondary Restoration	Riparian area (focus reaches)	74	2,497
	Forest cover	59	44,935
	Pervious surface	97	N/A
Rural Streams – Primary Restoration	Riparian area (focus reaches)	62	709
	Forest cover	45	18,286
	Pervious surface	99	N/A
Rural Streams – Secondary Restoration	Riparian area (focus reaches)	60	258
	Forest cover	36	36,624
	Pervious surface	97	N/A
Rural Streams – Urban Restoration	Riparian area (focus reaches)	20	137
	Forest cover	13	8,558
	Pervious surface	77	N/A
Headwaters – Primary Protection	Riparian area (focus reaches)	80	1,318
	Forest cover	77	61,865
	Pervious surface	100	N/A
Headwaters – Secondary Restoration	Riparian area (focus reaches)	79	1,431
	Forest cover	69	87,414
	Pervious surface	100	N/A
Headwaters – Secondary Protection	Riparian area (focus reaches)	84	959
	Forest cover	76	92,434
	Pervious surface	100	N/A
Headwaters – Protection above Natural Barriers	Riparian area (focus reaches)	N/A	N/A
	Forest cover	78	82,798
	Pervious surface	100	N/A

Sub-basin Strategy Group	Habitat Condition	Percent Intact for Sub-basin Group	Intact Acres
Headwaters – Restoration above Falls and Dams	Riparian area (focus reaches)	N/D	N/D
	Forest cover	67	104,180
	Pervious surface	99	N/A

Notes:
N/A not applicable
N/D no data

Sections 2 through 6 present the strategy packages, organized by land use category. Once approved, the metrics can be folded into ongoing salmon recovery monitoring efforts. The long-term effects of the strategy would be captured by ongoing status and trends monitoring. If metrics indicate that the strategy is not proceeding as expected, salmon recovery partners would be able to adaptively manage accordingly.

It is important to note that although the recommendations are presented by land use category, there are many strategies that affect more than one land use type. For example, water typing is important for the proper application of regulations in a working forest environment but is also critical in rural residential areas where critical areas ordinances are based on the type of stream and the presence of fish. Likewise, the recommendations stress beaver management in rural residential areas, but landowners in agricultural areas also regularly deal with the effects of beaver dams. Additionally, rural residential landowners with small areas of crops or limited livestock would benefit from much of the technical assistance that is currently recommended for farmers. As entities look to implement recommendations, focus should remain on where there is need for the protection of hydrology.

Section 2

BASIN-WIDE STRATEGY RECOMMENDATIONS

This section provides Basin-wide recommendations for action in the following four areas: 1) using hydrologic information to improve local planning and development; 2) using TDR to preserve local resource lands; 3) protection of instream flows; and 4) acquiring lands with high hydrologic value.

Develop Information on Hydrologic Importance in Local Jurisdictions

In recent years, there has been a greater focus on modeling hydrological importance and degradation in order to produce information that can be used by local planners to make land use decisions and to guide the development of local programs. This effort would provide valuable mapping that should be included as Best Available Science (BAS) as local jurisdictions make decisions about where to direct future growth, designating allowable uses and associated development regulations, how to implement protective incentive programs, and where best to focus efforts on improving infrastructure and acquiring or protecting open space lands.

King and Snohomish Counties, as well as all cities contained within the Snohomish Basin, are required to plan for population growth and its impacts under the GMA. The GMA requires jurisdictions to designate and protect critical areas and to designate natural resource lands. The GMA also imposes requirements on jurisdiction planning under the GMA, including identification and protection of critical areas; identification and conservation of agricultural, forest, and mineral resource lands; and adoption of county-wide planning policies to coordinate comprehensive planning among counties

and their cities. Comprehensive plans, updated periodically, set a policy framework and articulate goals for jurisdictions that shape development of regulations as well as other local programs. These plans include elements focusing on land use and the environment, which, by extension, affect hydrology. Land use designations are important in that they identify the primary function of lands, which is then codified by land use regulations, including density limits, impervious surface limits, and the like. Critical Area Ordinance and Shoreline Master Program updates are required to use BAS.

Land use regulations control development patterns and functions, thereby affecting hydrology by limiting the constraints and pressures on hydrologic attributes. While the specific regulations differ significantly across jurisdictions, the following programs are also required to use BAS:

- Critical area regulations, which restrict development in ecologically sensitive areas such as wetlands or areas unsuitable for development, such as steep slopes or other geologically hazardous areas
- Shoreline master programs, which control what structures and uses are appropriate along state-designated waterbodies, including large lakes, larger streams, rivers, and marine shorelines

Development regulations affect the form and location of buildings and can define maximum heights, design guidelines, setbacks, and whether or not structures may be built in floodplains. In order to ensure compliance with comprehensive plans, local governments update development regulations periodically.

Additionally, jurisdictions are continually evaluating programs—including incentives, LID, public education, and

acquisitions—that seek to protect and restore features that can protect hydrology. The decisions on where and how to deploy these programs should be based on the best information available on where hydrology and associated features are most important, as well as where there is opportunity for the program to succeed.

An updated assessment of hydrological importance, including a set of watershed characterization maps, in each Snohomish Basin local jurisdiction would ensure that land use decisions and specialty programs include an understanding of how hydrology works in the area and how best it can be protected.

Action 1: Support the development of watershed characterization information by Ecology and continue to update local data and information for every local jurisdiction in the Snohomish Basin

Watershed characterization, developed and supported by Ecology, generally prioritizes protection actions in watersheds that are highly important and are relatively less degraded for watershed processes. This should not indicate that protection should not be applied across other degraded areas that are indicated as less important. Rather, given limited resources, these might be the first place a planner would want to focus on to increase the likelihood of improving watershed processes in key areas.

Improved information, through watershed characterization, would also give smaller jurisdictions with limited staff resources a higher degree of technical capacity to propose the best policies and regulations. Ecology's support of model development at the local scale and training on how to incorporate the results would be critical in ensuring that the information is used.

Effectiveness Indicators:

- Local jurisdictions are provided with watershed characterization maps and training by Ecology by the end of 2016
- Local jurisdictions cite watershed characterization findings in proposed changes to policies and regulations
- New BAS (such as expanded aquifer mapping) is cited in updates

Action 2: Align regulations to limit the variances and exceptions available in hydrologically sensitive areas that result in loss of function

Local jurisdictions continually revisit their land use regulations, including the Shoreline Master Program, Critical Areas Ordinances, and zoning. Jurisdictions should work to align definitions and application across the various land use regulations to ensure that hydrologically sensitive areas, as defined by watershed characterization and other evaluations, are not degraded. Specifically, jurisdictions should work to limit the exceptions, exemptions, and variances that can result in decreased function of features such as shorelines, wetlands, forest cover, and riparian zones. Regular implementation and compliance monitoring, currently assessed by both counties in the Snohomish Basin, would be useful to understand where variances, exemptions, or failed mitigation measures have resulted in decreased function.

Effectiveness Indicators:

- Number of variances, exceptions, and exemptions resulting in loss of function that are issued in wetlands, on shorelines, and in riparian zones

- Changes in impervious cover, forest cover, and shoreline armoring associated with variances, exceptions, and exemptions

Action 3: Direct incentive programs, open space acquisitions, and other resource conservation efforts to areas with important hydrological features using watershed characterization analysis

Jurisdictions currently have programs focused on incentivizing landowners to manage their lands for conservation and acquiring open space. As jurisdictions prioritize where to implement the programs within their jurisdiction, their efforts should consider the most recent information available from watershed characterization.

Effectiveness Indicators:

- Number of landowners reached in hydrologically important areas that receive direct outreach for incentive program
- Number of new/revised programs that target specific areas
- Number of landowners that participate in incentive programs

Focus Areas:

All local jurisdictions in the Snohomish Basin (both counties and cities) are the focus of this strategy. Smaller jurisdictions with limited technical staff and capacity would especially benefit from updated information. The City of Duvall provides an excellent example[1] of how watershed characterization and other local overlays could provide for recommendations ranging from Comprehensive Plan updates (specifically new Urban Growth Area boundaries) to incentive programs.

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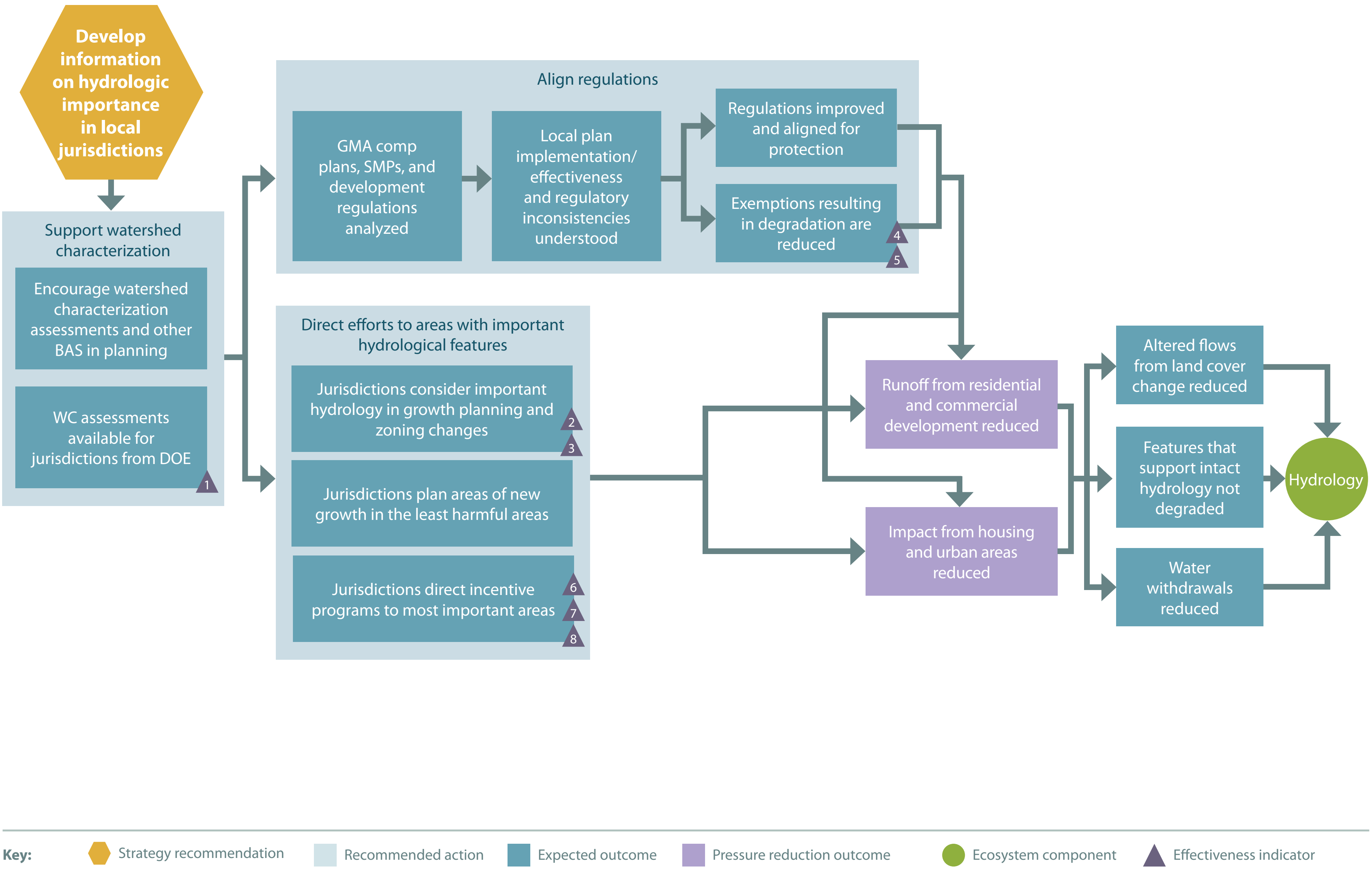
[1] See http://www.duvallwa.gov/DocumentCenter/Home/View/2402

Basin-wide Protection Strategy



1 Local jurisdictions are provided with watershed characterization maps and training by Ecology by the end of 2016
2 Local jurisdictions cite watershed characterization findings in proposed changes to policies and regulations
3 New BAS (such as expanded aquifer mapping) is cited in updates
4 Number of variances, exceptions, and exemptions resulting in loss of function that are issued in wetlands, on shorelines, and in riparian zones
5 Changes in impervious cover, forest cover, and shoreline armoring associated with variances, exceptions, and exemptions
6 Number of landowners reached in hydrologically important areas by direct outreach for incentive program
7 Number of new/revised programs that target specific areas
8 Number of landowners that participate in incentive programs

Transfer and Purchase of Development Rights

Transfer and Purchase of Development Rights (TDR/PDR) is a voluntary, market-based real estate tool that gives landowners the option to sell development potential in the form of credits to buyers who may, in turn, use the credits to build to higher densities in designated areas than zoning otherwise allows. The goal of TDR is to preserve resource lands and low-density rural lands by transferring development potential (via subdivision) to specific (usually urban) areas. Land protection is permanent and enforced through a conservation easement, which entails monitoring and enforcement.

PDR is a voluntary real estate tool in which landowners may sell or donate the development potential from resource lands. The chief distinctions from TDR are that the tool is publicly funded, development potential is extinguished (rather than transferred), and easements are typically more restrictive. Like TDR, permanent easements require monitoring and enforcement. PDR can operate as a standalone program or can be modified to work in conjunction with TDR. Both counties have used TDR and PDR to varying degrees as a means to permanently protect resource lands.

Considerations influencing a more extensive use of TDR in the Basin include the dependency of local programs on market conditions, and the breadth of program adoption and credit absorption. As more cities participate in the county and regional programs, they would absorb more credits and, by extension, create more conservation.

Considerations influencing a more extensive use of PDR include (but are not limited to) public funding/sources and staffing and support. With existing programs in place, the ability to expand

PDR likewise relies on an ability to update county policies and conservation priorities.

Action 1: Encourage and expand TDR policies in additional jurisdictions

The two counties already have prioritized sending sites for TDR programs. The key to increasing the use of TDR programs and protecting resource lands is to increase the demand side of transactions. As the Snohomish Basin's population continues to grow, there should be an increased market demand for TDR. Counties, non-governmental organizations, and others should encourage cities to develop TDR policies that allow for them to take advantage of future demand.

Effectiveness Indicators:

- Number of TDR transactions and associated acreage and land use categories
- Number of new jurisdictions that adopt TDR policies

Action 2: Encourage and expand PDR usage

PDR has been funded at radically different levels across the counties in the past, but in recent years, both have shared a dearth of new funding. Consequently, as of 2015, neither are as active. Given the reliance on public funding, a first step is capitalizing PDR programs to the extent feasible—which would differ by county. Subsequent steps would require providing adequate resources to administer the program, as well as consider opportunities for conservation target prioritization and program expansion.

Effective Indicator:

- Number of PDR transactions and associated acreage and land use categories

Action 3: Encourage the use of TDR and PDR with a focus on aligning the two efforts

Both counties have TDR programs. Both programs include all designated and certain non-designated farmland and forests as conservation targets; however, King County's program also makes certain properties eligible that provide habitat, trail connections, or urban separation.

Likewise, both counties have PDR programs in place, each of which is focused on farmland preservation.

Opportunity exists to dedicate more resources to these programs for both funding and outreach to landowners. Opportunity also exists to generate synergy between PDR and TDR activities by making publicly acquired development rights eligible for sale through the TDR program. The King County TDR Bank effectively does this, as could a similar bank under consideration in Snohomish County; however, this model could be expanded to the PDR programs. Program and easement revisions would be required.

Effectiveness Indicators:

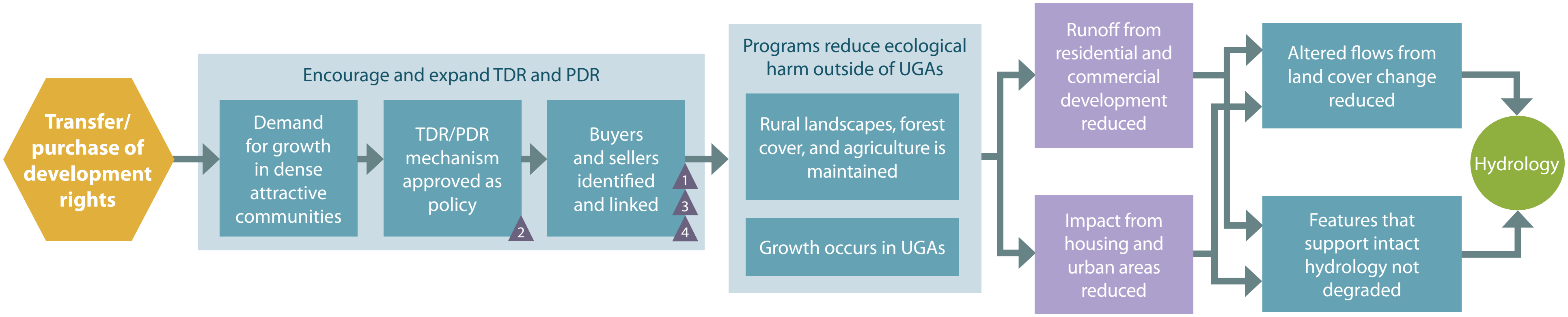
- Number of TDR and PDR transactions in Snohomish and King Counties
- Number of transactions and acreage of properties that are located in areas of high hydrologic importance

Focus Areas:

In Snohomish County, agriculture areas in floodplains are a high-priority policy. This coincides with many of the areas identified by watershed characterization as the most important for hydrological function. In King County, many transactions have been put toward both agricultural and forested areas. In

the future, both counties should integrate new climate change information and resilience strategies with PDR programs.

Basin-wide Protection Strategy



Key: Strategy recommendation | Recommended action | Expected outcome | Pressure reduction outcome | Ecosystem component | Effectiveness indicator

1 Number of TDR/PDR transactions and associated acreage and land use categories
2 Number of new jurisdictions that adopt TDR policies
3 Number of TDR and PDR transactions in Snohomish and King Counties
4 Number of transactions and acreage of properties that are located in areas of high hydrologic importance

Protect Instream Flows

In 1988, Ecology set minimum instream flows for several locations in the Snohomish Basin through 173-507 Washington Administrative Code (WAC). Partners, including those interested in salmon recovery, assisted in adopting these rules. In addition, several sub-basins have been closed to further consumptive rights since the 1940s and 1950s. However, because administrative instream flows have no bearing on rights that are senior to the date of the flow rule, the majority of the minimum instream flow levels are routinely unmet, and low flows continue to adversely affect salmonids, prey species, and adjacent wetland habitats.

Water rights in the Snohomish Basin are already over appropriated, and Ecology is not permitting new water rights. However, residents continue to be issued building permits, which results in the installation of new exempt wells on those properties. This allows residents to use up to 5,000 gallons per day for household use. There is no consideration for whether or not the well is placed in areas that are hydrologically connected to streams or rivers or basins closed by rule to further withdrawals.

Ecology currently has limited resources for enforcement of instream flow rules that relies primarily on a complaint-driven system to address illegal diversions or impairments of senior water rights. Ecology is unlikely to adopt more instream flow rules due to ongoing litigation. Short of reporting illegal uses, the Forum lacks jurisdiction to enforce against illegal use. The recommendations below address one aspect of the proliferation of exempt wells, as well an ongoing conservation levels.

Action 1: Improve guidelines for what constitutes an "adequate water supply" for new development

One action is to encourage Ecology to create development guidelines for counties that add specificity around the GMA requirements for proving the existence of adequate water supply before permitting new development. Currently, new development is allowed to cite a prospective exempt well as evidence of adequate water supply without assessing whether the development is in a basin closed to further water appropriations or if the well site is in hydrologic continuity with closed or flow-limited surface waters. Development guidelines that prohibit impairment of instream flows by requiring mitigation can assist in restoring regulatory flows. The new policy should be applied first in basins that have high densities of exempt wells and watersheds that are closed to further appropriations or are not meeting regulatory flows.

Effectiveness Indicators:

- Creation of Ecology guidelines for approving a legal source of water supply for development applications
- Number of new development applications approved that use exempt wells for water supply
- Number of new exempt wells in sub-basins with known low flow issues

Action 2: Improve residential water conservation measures

The second recommended action to directly affect instream flows is to improve and expand water conservation measures, particularly in areas that are either supported by small water purveyors or single-family exempt wells. Improved water conservation efforts have resulted in a marked decrease in household use. There are several ways to encourage lower water use, including public education and housing covenants that require low water landscaping techniques and encouraging

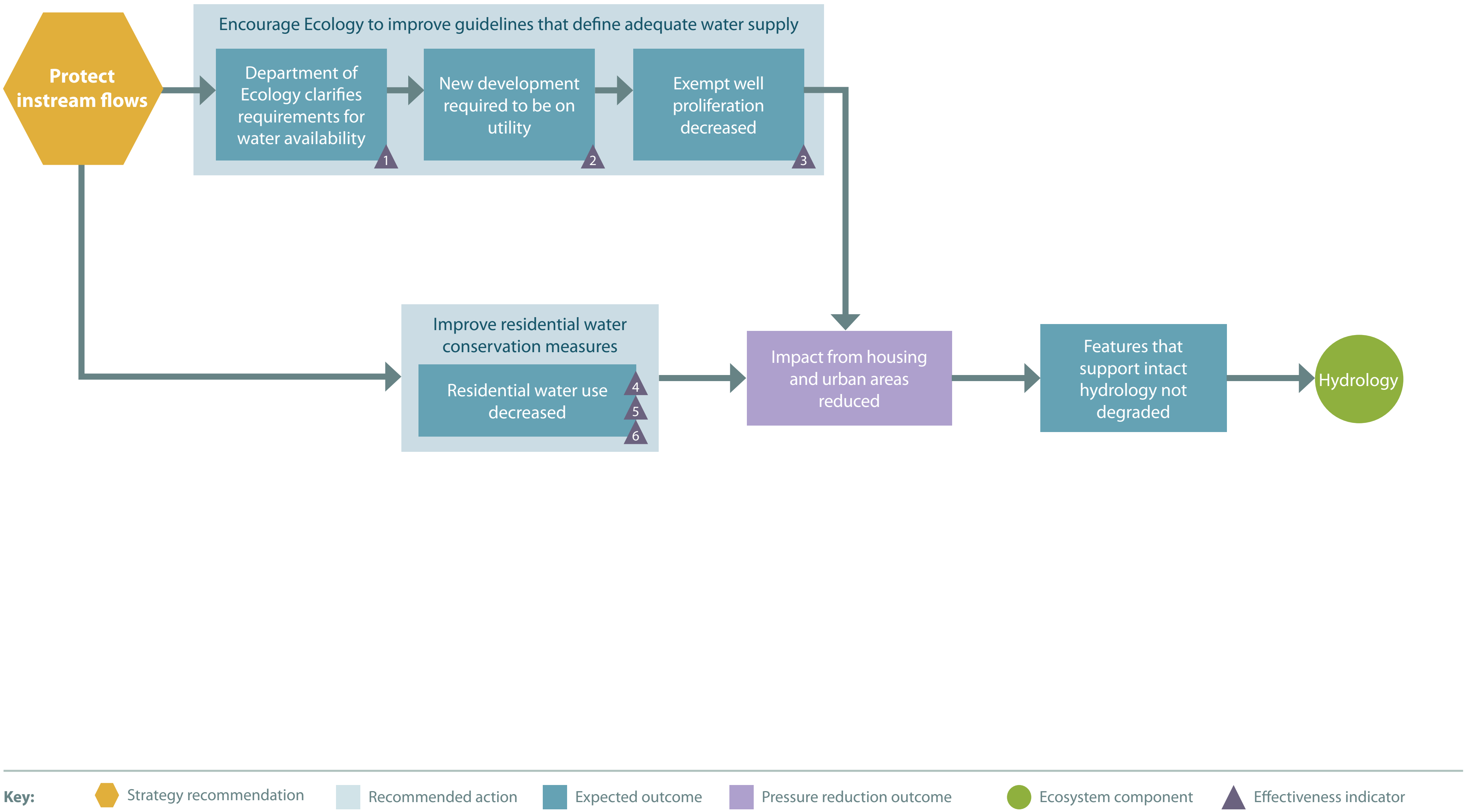
conservation through variable rate structures in areas supported by small utilities.

Effectiveness Indicators:

- Number of new land use regulations or residential covenants addressing low water landscaping techniques
- Number of new variable rate structures dependent upon water usage adopted by small utilities
- Water use (as tracked by water meters)

Focus Areas:
The focus areas for improving and expanding water conservation measures are basins closed to further appropriations: Griffin, Harris, Patterson, Raging River, Little Pilchuck, May Creek, Quilceda, and Unnamed (Bodell) tributary to the Pilchuck.

Basin-wide Protection Strategy



1 Creation of Ecology guidelines for approving a legal source of water supply for development applications
2 Number of new development applications approved that use exempt wells for water supply
3 Number of new exempt wells in sub-basins with known low flow issues
4 Number of new land use regulations or residential covenants addressing low water landscaping techniques
5 Number of new variable rate structures dependent upon water usage adopted by small utilities
6 Water use (as tracked by water meters)

Acquire Lands with High Hydrologic Value

Currently, there are two forms of acquisition taking place in the Basin: conservation easements and outright purchase.

A conservation easement allows a qualified private land conservation organization or government to constrain land uses on private or public properties to achieve certain conservation or preservation purposes. Landowners can sell conservation easements or donate them for tax benefits. They are typically permanent. Some involve restoration of portions of the protected property, and all involve monitoring to enforce easement terms.

Public or private entities may protect land by purchasing it outright (also referred to as "in fee"). This is an appropriate mechanism for when a landowner has no further interest in a property and it may otherwise face conversion pressure or if conservation of a property creates a compelling public benefit. An example of this could be purchase of land for a public park, or the acquisition of frequently flooded properties in floodplains. Depending on the ultimate use of land protected through outright purchase, monitoring and stewardship may be part of the long-term management plan and would require funding.

Action: Acquire conservation easements or properties with high hydrological importance through outright purchase

Both acquisition approaches have been successfully used in a variety of applications and are proven protection mechanisms. Hydrologic benefits include maintaining pervious areas in a multitude of locations across the Basin.

Effectiveness Indicators:

- Number of acres acquired in areas with high hydrological importance as determined by BAS or watershed characterization

Focus Areas:

Watershed characterization provides guidance on where high importance areas are within the Basin as a whole. Areas of high importance generally include features such as wetlands, floodplains, and forested headwaters. Additionally, purchasers can consider watershed characterization results for a smaller-scale understanding of relative importance in an area with special focus or authority.

Basin-wide Protection Strategy

Key: Strategy recommendation; Recommended action; Expected outcome; Pressure reduction outcome; Ecosystem component; Effectiveness indicator

1 Number of acres acquired in areas with high hydrological importance as determined by BAS or watershed characterization

Section 3

URBAN STRATEGY RECOMMENDATIONS

In the Snohomish Basin, there are 15 cities with Urban Growth Areas. Under the GMA, these areas are intended to assume the majority of the future development. Most of these cities are either in or adjacent to mainstem river floodplains. Due to levels of impervious surfaces, stormwater infrastructure, and decreased forest cover, most urban areas have a higher level of hydrological degradation. However, urban areas are still able to contribute to the protection of hydrology through the suggested approaches below. Managing water resources in a changing climate with shifting hydrologic regimes requires that approaches be adopted to build what may be regarded today as redundancies in stormwater management systems, but this shift would promote hydrologic resiliency in the watershed over time.

Jurisdictions within the Snohomish Basin under permit are either Phase I or II permittees and therefore have different requirements under the National Pollutant Discharge Elimination System (NPDES) permit. For example, King and Snohomish Counties are Phase I permittees, and the City of Everett is a Phase II permittee, along with the cities of Marysville, Mukilteo, Snohomish, Snoqualmie, Lake Stevens, Monroe, and Duvall. Some smaller towns are not regulated under the NPDES permit. For smaller cities and towns, or those with limited staff and capacity, access to technical assistance is particularly significant to the success of implementing LID and, in some cases, the requirements of the permit. Stormwater management practices are evolving to address the requirements of the permit. In addition, LID and alternatives to traditional "pipe and convey" approaches would become necessary in order to match the present and projected challenges of managing

water resources, including mitigating for extreme events such as drought or flood.

Augment Practices to Meet NPDES Requirements with Low Impact Development Green Infrastructure

The NPDES permit system regulates wastewater discharges from industries and municipal wastewater systems as well as stormwater discharges from industries, construction sites, and municipal separate storm sewer systems. The NPDES municipal stormwater permit was issued in 1995 to six Phase I jurisdictions, and when reissued in 2007 and 2012 more than 100 additional cities and counties within Washington were issued Phase II permits. These permits contain requirements for construction and land development affecting both private and public construction. Permittees are required to adopt land development and redevelopment regulations that contain the equivalent of those directly set forth in the NPDES permit. Ecology's Stormwater Management Manual for Western Washington provides specifications to meet permit requirements and comply with the Clean Water Act. These include LID best management practices (BMPs). Jurisdictions with regulated municipal separate storm sewer systems must follow the Manual or choose to develop and adopt a State-approved manual with equivalent practices to meet permit requirements.

Cities can address NPDES permit requirements by adopting LID approaches where feasible. Key tenets of LID include minimizing site disturbance, conserving native vegetation, and reducing impervious surface; controlling stormwater at or near its source through the use of BMPs is the goal. These decentralized stormwater BMPs, which are commonly referred to as green stormwater infrastructure, are small, distributed

facilities that manage stormwater runoff through infiltration, bio-filtration, storage, evaporation, and transpiration. LID BMPs include site facilities such as rain gardens, bioswales, permeable pavement, and vegetated roofs. It is imperative that these LID facilities are sited and sized appropriately. Further, “the right site, right design, and right team” is a good rule of thumb approach to ensure that these built facilities are effectively meeting design objectives and, in turn, working as part of the stormwater system to meet overall permit requirements.

LID has been criticized as expensive to maintain. Cost-benefit analysis that takes life cycle costs and benefits into account is the key to demonstrating the return on investment. That said, in some areas, it is not clear that private property owners would manage their green stormwater solutions for the long term. Another challenge is the lack of internal alignment across agency divisions; on-the-ground practices sometimes result in the destruction of green infrastructure. Permitting redevelopment has also resulted in the removal of LID stormwater facilities and replacement with traditional conveyance infrastructure. It is important to map and maintain these facilities, particularly if the facilities are being used to satisfy requirements of an NPDES permit.

Incentivizing and facilitating public-private partnerships and private investment of green infrastructure can work toward financing successful redevelopment projects in the region. This approach in partnering has been successful across the region and the nation. One example is the “Swale on Yale” or the Capitol Hill Water Quality Improvement Project in Seattle. In conjunction with a large redevelopment site, public entities have partnered with the developer to retrofit the existing

stormwater system with LID features to protect water quality in Lake Union.

Action 1: Identify public and private property with legacy stormwater issues that could be improved with LID and other green infrastructure stormwater management techniques

Local jurisdictions have the most control over land parcels that they own and maintain. Counties, cities, and towns have mainly sited LID facilities in right of ways, public parks, parking lots, and in other publicly controlled areas. This also provides an opportunity to lead by example and demonstrate the potential benefits of LID implementation.

Effectiveness Indicators:

- Percent of public retrofit projects using LID BMPs
- Percent of public stormwater projects that are mapped as stormwater infrastructure and maintained
- New or revised maintenance policies reflect proper operations and management of LID facilities

Action 2: Promote LID and other green infrastructure in development and redevelopment projects appropriate to the lot size in question

Due in large part to technical assistance and past funding from the State, LID is currently incorporated in most jurisdictions' codes. As of January 2017, LID will also be required where feasible as part of the NPDES Phase II permits, as it is with Phase I. Jurisdictions should work with developers to partner and share technical support to achieve the most effective level of green infrastructure in order to mimic natural flows. Examples of LID may include permeable pavement, rain barrels, tree planting, and downspout disconnection. On appropriate parcels, additional green infrastructure could include green

roofs, and retention features on property, such as vegetated swales or rain gardens.

Effectiveness Indicators:

- Number of new developments or redevelopments that incorporate LID BMPs where LID was determined to be feasible

Improve Tree Ordinances and Other Relevant Codes that Require Planting in Urban Areas

Benefits provided by urban forests include reduced stormwater runoff, improved water and air quality, attractive communities, stronger property values, greenhouse gas reduction, habitat for native wildlife, and improved quality of life. Currently, tree planting efforts in the big cities are focused on public lands and right of ways. In highly dense areas in Everett, redevelopment often requires some tree planting, mostly as street trees in front of properties. Everett Parks and Recreation and Forterra created the Green Everett Partnership to improve the health of Everett's forested parks and natural areas, which are in decline. Snohomish County recently rewrote their tree ordinance to incentivize development and redevelopment to maintain as much native tree cover as possible, with a goal of minimum 30% tree cover. This ordinance applies within the urban growth areas but outside of city limits. The counties of the Basin are encouraging and actively pursuing replanting and tree retention. Small cities, such as Duvall, are taking a stronger regulatory approach to tree retention. Climate change adaptation measures may include tree planting in the Basin.

Action: Encourage jurisdictions to strengthen tree retention and landscaping ordinances and codes

Jurisdictions have opportunities to improve their tree ordinances and other relevant codes to both provide incentives and require more planting in urban areas.

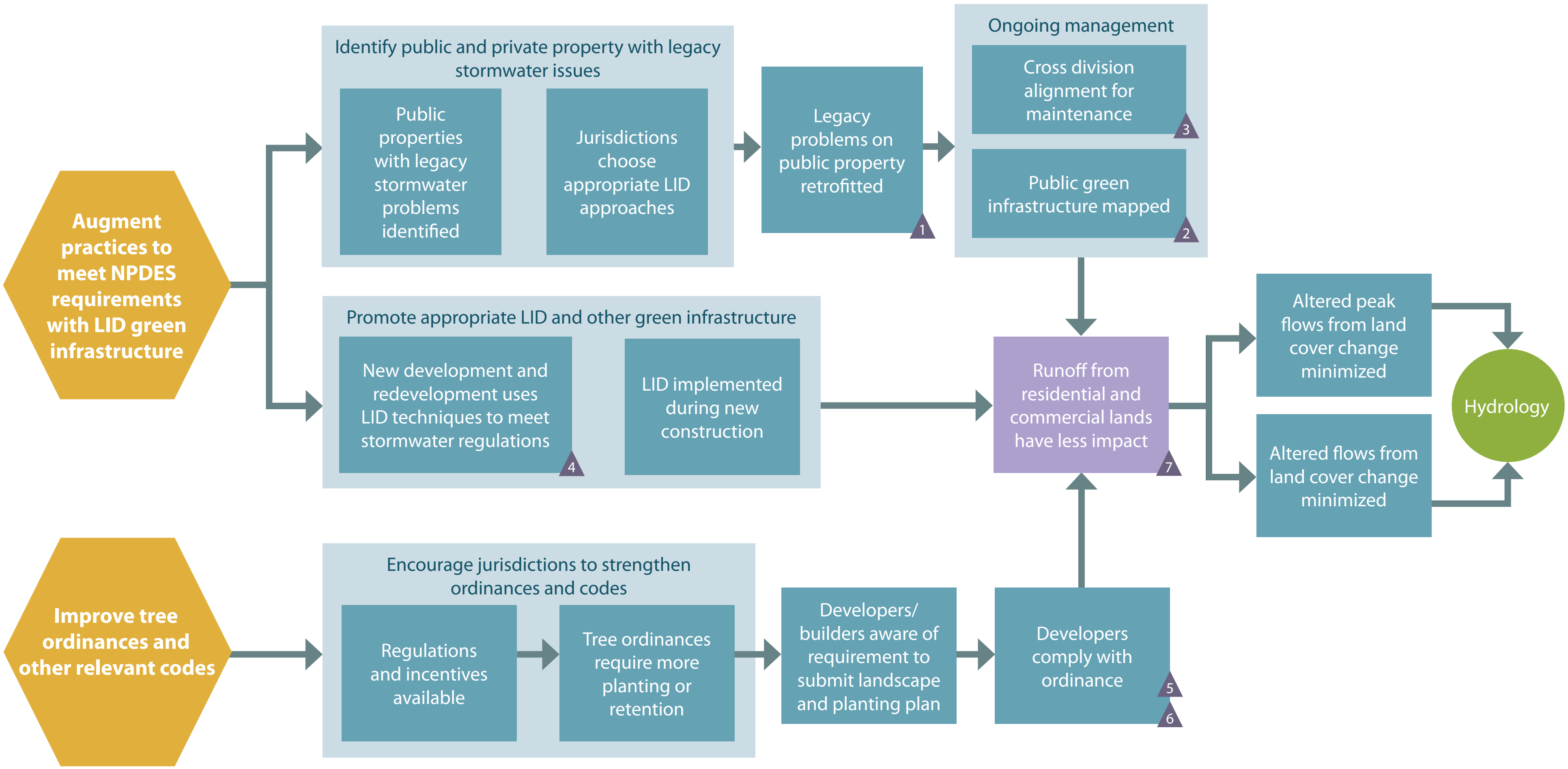
Effectiveness Indicators:

- Trees planted
- Percent of new development and redevelopment property owners in compliance with codes and ordinances
- Forest cover in urban areas

Focus Areas:

All urban growth areas with an emphasis on where watershed characterization identifies the most important analysis units for protection.

Urban Protection Strategy



Key: Strategy recommendation | Recommended action | Expected outcome | Pressure reduction outcome | Ecosystem component | Effectiveness indicator

1 Percent of public retrofit projects using LID BMPs
2 Percent of public stormwater projects that are mapped as stormwater infrastructure and maintained
3 New or revised maintenance policies reflect proper operations and management of LID facilities
4 Number of new developments or redevelopments that incorporate LID BMPs where LID was determined to be feasible
5 Trees planted
6 Percent of new development and redevelopment property owners in compliance with codes and ordinances
7 Forest cover in urban areas

Section 4

RURAL RESIDENTIAL STRATEGY RECOMMENDATIONS

The rural residential areas in the Snohomish Basin are located outside of the Urban Growth Areas, Agricultural Production Districts, areas zoned for forestry, and areas zoned for commercial and industrial use. Land use within rural residential areas varies from multiple housing densities to small hobby farms to small forestry production. Much of the rural residential area is located in the Snohomish Basin lowlands, proximate to tributaries and mainstem rivers.

As rural residential development occurs, typically forest cover decreases and impervious surfaces increase. These changes occur as houses are built and infrastructure to support residents, such as roads and utilities, is expanded. In the 2005 Plan, the amount of forest cover in rural residential areas was expected to fall below levels needed to recover salmon. The primary goal in the rural residential areas to support intact hydrology is to maintain forest cover, pervious areas, and water detention. This would, in turn, capture and slow water, thereby maintaining functioning delivery and storage.

Currently, rural residential area development is regulated through Snohomish and King Counties' land use regulations as well as DNR's Forest Practices Act. These regulations control development of shorelines and development within riparian buffers and wetlands. The regulations also control the amount of land that can be cleared of trees and the percentage of impervious surfaces.

Though the current regulations are protective, other regulatory and non-regulatory protection tools can be layered upon them

to maximize the potential for intact hydrology on each landowner's property. The recommendations below are a mix of incentives and direct technical assistance. Both strategies seek to target areas with the most important hydrology and provide residents with additional resources to best protect landscape features, which support intact hydrologic function.

Improve Outreach and Technical Assistance to Rural Residential Landowners

Currently in the Snohomish Basin, many players including county staff, conservation districts, and non-profit organizations are working to support stewardship of rural residential lands. These groups access rural residents either through direct requests for assistance (e.g., residents calling to request help with problematic beaver) or through proactive outreach campaigns.

Securing consistent funding for rural residential outreach and technical support is a challenge for most of these players. Several funding sources to support salmon restoration and water quality efforts exist, but these are usually focused directly on the stream corridor, largely seeking to improve riparian zones and stream crossings. There are few funding sources available to work on issues such as increasing tree cover and reducing pervious surfaces at the larger watershed scale, even though these actions support healthy watershed processes that improve habitat and water quality. The Puget Sound Partnership has worked on social marketing outreach campaigns to improve stewardship of natural resources, but these campaigns have focused primarily on water quality in the urban areas.

A regional move toward building climate change resilience through reforestation by King County and others may provide

an opportunity to connect tree planting campaigns for carbon storage with rural residential hydrology protection efforts.

The actions below provide a range of options for how to encourage residents to maximize the hydrologic function on their property.

Action 1: Align free native tree resources with existing programs that service rural residential property owners

Offering free trees to landowners is a way to increase native tree cover while also building stewardship of existing trees. Currently, many restoration partners in the Basin supply free native trees to landowners through their own nurseries, including Snohomish County, the Tulalip Tribes, conservation districts, and Sound Salmon Solutions. The capacity of these organizations, however, to promote this opportunity at the watershed scale does not currently exist. Building a program that could sustain the demand for trees across the watershed would require building additional partnerships to grow and access native plants, including local community college and university horticulture programs. Also, climate change carbon storage efforts, such as King County's 2015 announcement to plant 1 million trees as part of their Climate Action Plan and Forterra's C3 program that seeks to offset business' carbon footprint, could help to create supply for the programs that have access to private property owners.

Counties, non-profit organizations, and conservation districts already provide rural residential property owners with a variety of technical assistance services that can include site visits to discuss BMPs. Free trees can be an incentive that technical service providers can provide to landowners through these already existing programs. Working through these existing programs ensures that property owners have a site evaluation to

determine appropriate species and make a personal commitment to planting and maintaining the native plants. This added incentive also provides an opportunity for technical assistance providers to educate landowners about the importance trees and shrubs play in maintaining healthy soils and how healthy soils support basin hydrology. Below are examples of how a free trees incentive tool could be incorporated into the various types of technical assistance already provided:

- Noxious weeds and invasive species control. Many rural residents contact technical assistance organizations for advice controlling weeds on their property. Partners with native nurseries could work to follow up any invasive species removal with an offer of free trees to plant in the treated areas.
- Pasture management. The conservation districts currently assist rural residents with horse and livestock pasture management. Questions related to mud management and promotion of healthy forage grasses are common. Site visits to discuss pastures often include promotion of riparian buffer plantings and exclusion fencing. An offer of free plants, therefore, could increase the likelihood of BMP implementation.
- "Environmentally friendly" signs and certifications. Residents are often motivated to change behavior if it results in a sign to post on their property. Programs such as Stewardship Partners' "Salmon Safe" and Audubon's "Backyard Habitat" certification have been effective in engaging private citizens. If these programs and others were augmented with free trees and tree requirements, tree cover could be increased.
- LakeWise certification. In Snohomish County, property owners can show that they manage their property in a manner that qualifies them to be LakeWise Certified. This certification requires a site visit from County staff. This is an

excellent opportunity for property owners to be consulted on increasing tree cover and offered free trees.

- Outreach with free tree follow-up for easement and tax reduction programs such as CUT, which pays landowners (through property tax reductions) to increase forest cover on their property. Often, however, these payments are not enough to incentivize residents to invest in trees and plant. Landowners could be better engaged through targeted program outreach that couples trees and technical assistance, thereby lowering the barrier for entry into those programs.

Effectiveness Indicators:

- Number of partnerships between existing nurseries/tree suppliers and existing programs
- Number of trees planted
- Forest cover in rural residential areas

Action 2: Continue and expand technical support and education for landowners to maintain beaver on their property

Beavers are known to increase ponding, slow runoff, and increase infiltration at a site scale. However, beavers often create nuisance or safety issues if flooding affects bridges, roads, septic drain fields, wells, pastures, or other land uses. Currently, there are a few entities that are able to provide technical assistance to landowners concerned about beavers on their property, including the counties, conservation districts, WDFW, and non-profit organizations.

In some cases, a pond leveler device can be constructed to maintain a consistent pond level and reduce beaver/landowner conflict. Encouraging the use of this non-lethal management technique results in less dam removal (requiring a state-issued hydraulic project approval permit and generally ineffective) and/or beaver trapping (and euthanization).

Counties, WDFW, and conservation districts respond to beaver management complaints with a site visit to educate landowners on their options. In both counties, staff cannot address beaver issues directly unless public infrastructure is impacted. In Snohomish County, property owners are often referred to the Snohomish Conservation District for assistance on private property. If the site is appropriate for a device and funding is available, the conservation district would pay for pond leveler materials if the landowner agrees to pay for installation.

If beaver concerns are directed to King County, staff usually refer the property owner to the Adopt-A-Stream Foundation. The beaver complaints are currently spread over a variety of staff in King County, ranging from ecologists to road engineers. It is highly recommended that King County establish one point of contact for property owners with beaver concerns and a response that includes several resources (including non-profit organizations such as Adopt-A-Stream and Beavers Northwest) so that residents are most likely to get the technical assistance that they need.

In order to encourage the maintenance of beaver ponds on private property in appropriate locations that are not causing damage to adjacent properties, groups responding to beaver complaints should continue to educate landowners about the hydrologic benefits of beavers and the technical assistance available to help. In cases where the state or counties cannot provide direct technical assistance for non-lethal beaver management, contact information for non-profit organizations or conservation districts with technical assistance expertise should be provided in person and on websites. A new outreach technique could be a sign or certificate program that would reward landowners who work to maintain dams and beavers on their property. Given the success of other environmental sign

programs, this could be an effective way to spread the word about the benefits to hydrology that beavers provide to the watershed.

Effectiveness Indicators:

- Number of devices installed following call for assistance
- Number of permits to trap (and kill) following calls for assistance
- Extent of beaver ponds in areas important for storage and recharge

Focus Areas:

Both actions listed above are opportunistic. However, where possible, free tree incentive efforts should focus on areas listed as important for delivery, and beaver retention should be directed to areas where storage and recharge are listed as important.

Explore PBRS in Snohomish County and Target Outreach of PBRS in King County

Under the Open Space Taxation Act, counties may choose to adopt a Public Benefit Rating System (PBRS) program (RCW 84.34.055) to establish more specific criteria used to evaluate or rate open space resource value on properties. PBRS offers property owners an incentive (a property tax reduction) to protect or restore open space resources on their land. A PBRS program identifies open space resources and assigns a rating or score to determine the level of property tax savings participating properties are eligible for. Properties with the highest scores, and therefore the greatest conservation values, are eligible for the greatest tax reduction.

King County first adopted a PBRS program in 1992. Over the past 10 to 15 years, an average of 60 to 80 new applications have been received each year (with 500 to 600 acres added to the program annually). Approximately 11,000 acres are currently enrolled in the program. There are 23 possible resource categories under which property owners can qualify, ranging from public access provisions to conservation management. Roughly a third of the point categories relate directly to hydrologic function, including credit for increased buffer widths, tree cover, and wetland protection. Points are awarded for each PBRS resource category that a property qualifies for. The total points awarded for a property's PBRS resources translate into a 50% to 90% reduction in the taxable land assessed value for the portion of the property enrolled. The average property tax savings is $1,500 annually. The program is maintained by two full-time staff. Given the steady enrollment numbers and limitations on staff time, compliance monitoring is conducted somewhat sporadically, often through utilization of aerial photos and assessment of aerial photos as a result of property sales.

Snohomish County has had a CUT program that includes an Open Space General category for rural residential landowners since 1971, when Chapter 4.28 Snohomish County Code was first adopted by resolution. In order to qualify for the program, landowners must meet one of 20 criteria, including the presence of wetlands, undeveloped natural areas, sensitive wildlife habitat, or unstable slopes. Snohomish County uses a per-acre rate dependent upon the land type. The highest Open Space General reduction rate for the 2016 tax year will be $1,500 per acre (good land) and the lowest will be $100 (waste rate) per acre. There are currently about 7,600 acres enrolled in Open Space/Open Space General and 4,500 acres in Open Space Agricultural Conservation. Applicants must demonstrate

compliance with County code criteria in order to be initially classified; however, ongoing monitoring and enforcement, to establish whether or not the property is in compliance and providing a public benefit, is not regularly conducted. Eligibility is often reassessed when the Assessor's Office conducts audits or requests review from the Planning Department following the sale of an enrolled property.

The recommendations below are intended to improve the effectiveness of the Snohomish County program and target King County's program on the most important hydrological resources.

Action 1: Snohomish County institutes a PBRS Program

Snohomish County has considered the merits of a PBRS program several times in recent years, as the adoption of a rating system has the potential to make implementation of the Open Space CUT classification more effective and equitable. The Department of Revenue suggested adoption of the program after an audit of the CUT program in 2013. However, the County has been reluctant to develop and adopt a PBRS due to staff capacity issues and budget constraints. Additionally, there is the chance that landowners currently enrolled in the CUT program may not be eligible for the PBRS criteria, thereby jeopardizing their property tax reduction.

The recommendation is that Snohomish County seek grant funding to assess the current level of public benefit of properties enrolled in the Open Space General category. Through this assessment, a better understanding of who would remain eligible for some level of PBRS qualification could be developed. This assessment could help justify the program by highlighting issues of tax fairness and public good.

Following the assessment, Snohomish County could seek grant funding to create a point system, to be approved by Snohomish County Council. Based on recent work by the Puget Sound Partnership's Ecosystem Coordination Board, this implementation effort would be eligible for regional grant funding.

The final recommendation is to implement the PBRS program with dedicated staffing resources. This would require continued funding, at a level of one or two full-time employees, from the County. Implementation would include offering those currently enrolled in the Open Space program who are ineligible for PBRS the opportunity to un-enroll from the program without penalty. The new PBRS program could target areas that are known to be hydrologically important and have features that support intact hydrology. It could also target shoreline restoration issues identified by the Puget Sound Partnership and other local priorities.

Effectiveness Indicators:

- Assessment of public benefit provided by parcels enrolled in the Open Space General category in order to transition to PBRS
- Creation of a PBRS point program or improvement of existing criteria
- Number of parcels enrolled in the program

Action 2: King County targets specific areas for PBRS that are identified as important for hydrology

In the past 5 years, King County has received grant funding to target the Raging River and Patterson Creek sub-basins for PBRS enrollment. This effort included the development of outreach material and direct solicitation of landowners. The result was an increase in enrollment in these basins.

The recommendation is that King County continues to seek funding to expand direct outreach in areas that are known to be hydrologically important. In addition, King County would need to secure additional funding to process the increased number of applications and conduct program compliance monitoring.

Effectiveness Indicators:

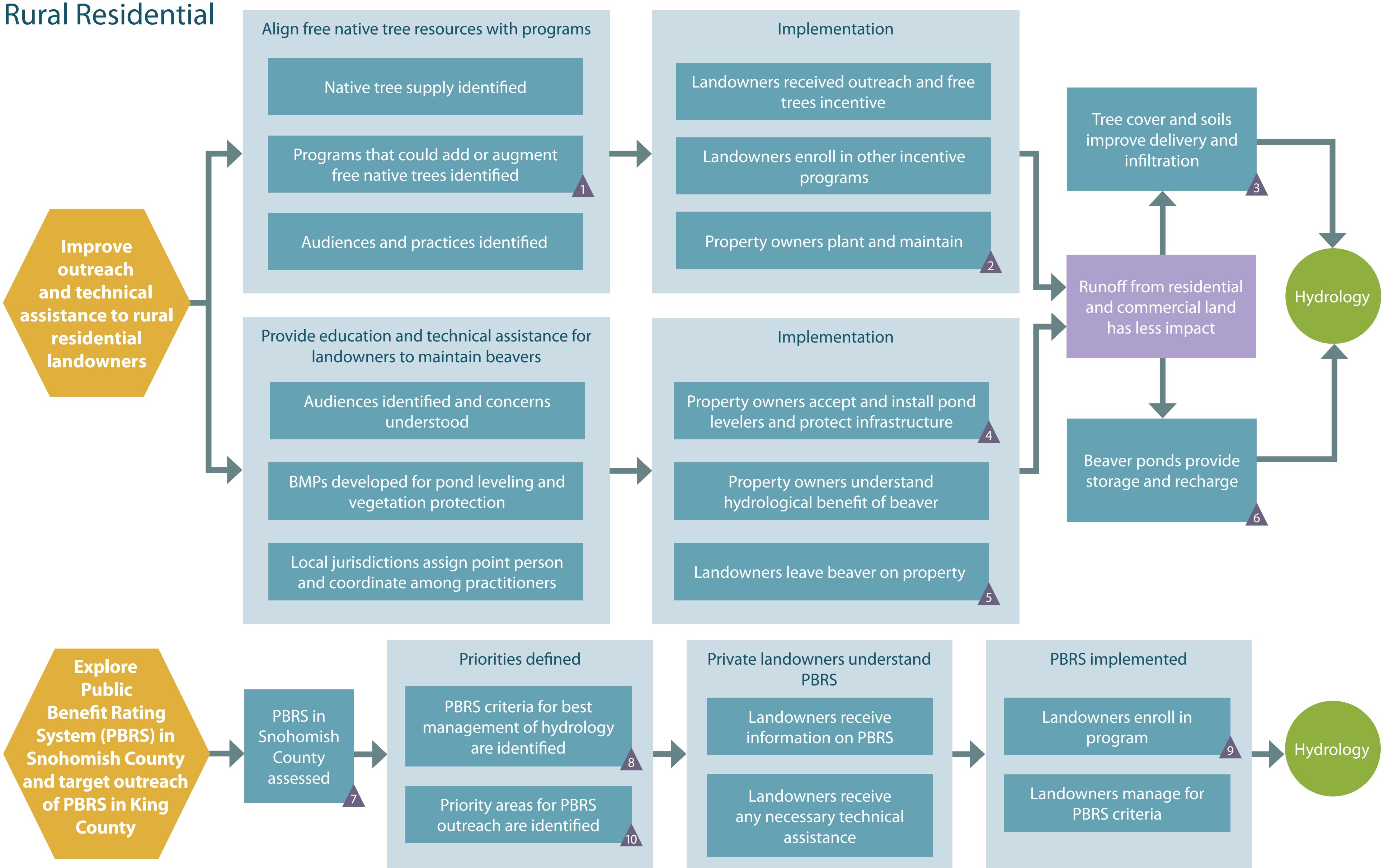
- Number of focused outreach campaigns to sub-basins with important hydrology/number of enrolled participants

Focus Areas:

PBRS should focus on the following areas that have been identified as important for hydrology and are not currently enrolled in any other easement programs (have no levels of protection above regulations):

- Snohomish County: lower Pilchuck, lower Woods Creek, French Creek, and floodplain parcels on the mainstem Snohomish and Skykomish
- King County: areas in the lower Snoqualmie River floodplain and adjacent to the Agricultural Production District in the lower Snoqualmie, as well as the floodplain areas of the lower Raging River and Tolt River

Rural Residential



Key: Strategy recommendation | Recommended action | Expected outcome | Pressure reduction outcome | Ecosystem component | Effectiveness indicator

1 Number of partnerships between existing nurseries/tree suppliers and existing programs
2 Number of trees planted
3 Forest cover in rural residential areas
4 Number of devices installed following call for assistance
5 Number of permits to trap (and kill) following calls for assistance
6 Extent of beaver ponds in areas important for storage and recharge
7 Assessment of public benefit provided by parcels enrolled in the Open Space General category in order to transition to PBRS
8 Creation of a PBRS point program or improvement of existing criteria
9 Number of parcels enrolled in program
10 Number of focused outreach campaigns to sub-basins with important hydrology/number of enrolled participants

Section 5

AGRICULTURE STRATEGY RECOMMENDATIONS


Photo courtesy of Janne Kaje

Farming is a critical cultural and economic land use in the Snohomish Basin that defines many of the rural lowlands and provides food and products for local and regional markets. Most agricultural areas are located in mainstem floodplains, adjacent to many of the focus reaches targeted for capital habitat restoration projects, and also in rural areas.

In the 2005 Plan, one of the primary recommendations was to "work cooperatively with the farming community and individual landowners to identify and implement solutions for salmon recovery." While many agricultural landowners have supported restoration projects on their lands, the tension has increased since 2005, with increasing resistance by the broader agricultural community to the restoration of historically or currently farmed land into aquatic or riparian habitat. In an effort to address these tensions and to forge a collaborative path forward, there are two efforts underway, one in each county, to balance the needs of fish and farmers and to recognize the pressures that affect each.

In Snohomish County, stakeholders representing the agricultural community, the tribes, and environmental interests formed the Sustainable Lands Strategy with facilitation support from Snohomish County Surface Water Management staff. The goals of the Sustainable Lands Strategy include creating actions on the ground that result in "net gain" for both salmon recovery and agriculture viability. Additionally, the Sustainable Lands Strategy seeks to reduce process friction, streamline permitting, develop multi-benefit funding solutions, and create broad-based support for recovery actions.

With direction from the King County Council embodied in Comprehensive Plan Policy R-650, the Water and Land Resources Division convened the Snoqualmie Fish, Farm, Flood Project Advisory Committee that includes farmers, tribes, non-governmental organizations, and other partners. The Snoqualmie Fish, Farm, Flood Project is using a collaborative process to develop multi-objective strategies for salmon recovery, agriculture viability, and flood risk reduction. The Snoqualmie Fish, Farm, Flood Project Advisory Committee will produce specific recommendations in several areas, including capital projects, programmatic actions or changes to policies, and regulations for consideration by the King County Executive and Council.

The recommendations in this document focus on three outcomes:

- Preventing conversion of farmland to other uses that are more harmful hydrologically
- Improving soil condition and other attributes of farmlands through the application of BMPs to strengthen the farming operation while protecting hydrology
- Increasing funding for assistance programs to improve the financial bottom line for farms, which would, in turn, bolster the economic viability of farming

Clearly, there are strong feedback loops between the three outcomes, as improved economic conditions would also reduce the incentive to convert lands to other uses.

The protection recommendations below seek to identify actions that would benefit hydrology as well as ongoing agricultural practices.

Permanently Preserve Farmland

Conversion of farmland often results in more infrastructure and increased impervious surfaces such as rural residential homes or smaller estates. The most important recommendation for agricultural areas is to keep farmers farming by maintaining their business viability.

While transferring development rights and maintaining agricultural zoning are ways of protecting agriculture, they do not solve complex issues that exist between salmon recovery and agricultural viability. Challenges for farms and salmon recovery, such as drainage regulations, the ability to site future restoration projects in large mainstem floodplains, and ramifications of easement programs for salmon habitat, would not be addressed by preventing conversion. Two efforts, the Sustainable Lands Strategy and Fish Farm Flood groups, are exploring solutions that balance all interests.

Action: Permanently extinguish development rights in agricultural areas through TDR and PDR

TDR and PDR may provide the best opportunities to permanently protect farmland from conversion to residential housing or other uses that would degrade hydrologic function, at least in areas outside of floodplains that may otherwise be vulnerable to conversion. In floodplain areas, these same tools can be used strategically to prevent subdivision of large blocks of farmland into "estate" farms, while recognizing that having smaller blocks of farm land on the market can make it easier for new farmers to get started. Both King and Snohomish Counties currently have TDR and PDR programs in place. These efforts could be expanded through partnerships and additional funding. For PDR, which is a relatively expensive protection mechanism when applied in areas with residential or commercial development potential, emphasis should be placed on securing a

stable, adequate level of funding to acquire permanent conservation easements on commercially and hydrologically important farmland. For TDR, emphasis should be placed on encouraging market demand for TDR credits through local development codes and identifying/designating sending areas where the land has significant conservation value and landowners are willing to sell permanent easements at fair market price.

Effectiveness Indicators:

- Number of acres of farmland with permanently extinguished development rights

Focus areas:
Effort should be placed on developing a strategy that identifies priority agricultural lands to preserve based on hydrologic value, agricultural value, risk of conversion, and impact of climate change.

Provide Technical Assistance to Farmers

There are many groups already providing technical assistance to farmers, including the Snohomish Conservation District, Snohomish County, the King Conservation District, King County, the Natural Resource Conservation Service (NRCS), and Washington State University (WSU) Extension. These groups conduct site visits and provide technical expertise on soil management, pasture management, nutrient application and management, invasive species control, buffers and filter strips, drainage assistance, and other BMPs.

The Washington State Conservation Commission and Puget Sound Partnership have worked with interested and affected stakeholders to evaluate the effectiveness of voluntary incentive

programs in Washington (ICF 2014), and these recommendations build off their regional recommendations for next steps.

Action 1: Support development of farm plans and cost-share programs

Technical assistance offered, in part, through farm plans results in the application of BMPs that support stewardship of natural resources, most of which benefit hydrologic processes. Farm plans, in particular, provide a comprehensive plan for a property that addresses multiple resource concerns. A property owner may have identified one issue they need help with, but technical assistance providers engage a landowner in a broader discussion of their property. In addition to recommendations that improve water quality and wildlife habitat, these plans focus on practices that improve soil health, which can reduce compaction and provide improved infiltration.

In King County, the adoption of a farm plan provides the landowner with increased flexibility in certain farm-related regulations. Many farmers seek out farm planning support voluntarily. However, property owners in both counties are also referred to conservation districts by regulating agencies to encourage BMP implementation as a non-regulatory pathway to achieving compliance. If property owners choose not to work with conservation districts to implement measures voluntarily, they may be subject to compliance enforcement.

Inadequate funding for farm planning and technical assistance limits organizations' ability to provide these services more broadly. There are several funding sources that provide cost-share for project implementation, but these do not provide the staff time necessary for outreach to and education of these landowners in the process leading up to project implementation.

King Conservation District was recently able to increase its tax assessment dollars that enable it to provide this technical assistance more consistently and comprehensively. If Snohomish Conservation District is able to increase its assessment amount, it would significantly increase the ability to provide much needed technical assistance and farm planning and also cost-share funding for project implementation.

There are also capacity issues in processing farmers' applications, resulting in long wait times to enroll in programs and some loss of interest in participation due to timelines. Regularly used cost-share programs include Farm Bill programs through NRCS and the Farm Service Agency, such as the Agricultural Conservation Easement Program, the Conservation Stewardship Program, the Environmental Quality Incentives Program, and the Conservation Reserve Enhancement Program. Additional local and state dollars are also available through grants, conservation districts, the Washington State Conservation Commission, and county programs.

Cost-share funding sources can be extremely competitive in the state and are often prioritized by impact to water quality or salmon habitat. For this reason, projects to manage pollutants, install exclusion fences, and plant buffers on properties located along streams receive a large portion of the funding. Away from streams and riparian areas, conservation districts often recommend implementation of BMPs on properties but may or may not be able to secure cost-share funding to help the landowner complete them. This could be one major reason BMPs are not installed as often in sites located away from waterways, even though those sites also contribute to properly functioning hydrology. In addition, because many BMPs can be extremely costly and cost-share funding sources rarely cover

100% of expenses, farmers usually cannot afford to pay their portion of project installation costs.

Effectiveness Indicators:

- Number of farmers who request site visits
- Number of farmers who implement farm plans
- Number of farmers who implement BMPs
- Number of BMPs implemented
- Length of time in backlog for enrolling in cost-share programs

Action 2: Educate and assist farmers in qualifying for easement and tax reduction programs

Both King and Snohomish Counties, both conservation districts, the U.S. Department of Agriculture Farm Service Agency, American Farmland Trust, PCC Farmland Trust, Stewardship Partners, the Mountains to Sound Greenway Trust, and Forterra work with landowners to identify tax reduction and easement programs for which farmers could qualify. These programs could include King County's Farmland Preservation Program, the federal Conservation Reserve Enhancement Program, Agricultural Conservation Easement Program, Wetlands Reserve Program, Open Space Taxation, and the state Farm and Agriculture CUT Program. By supporting farmers in qualifying for these programs, the features on farm properties that support intact hydrology would be protected and improved.

Effectiveness Indicators:

- Acres enrolled in easement programs
- Number of acres enrolled in the Farm and Agriculture CUT Program
- Number of farms (and acres) where development rights have been extinguished

Focus Areas:

The biggest gaps for technical support and easement programs currently are agricultural lands with no riparian areas outside of the floodplain. Many of these areas support smaller farms and livestock pastures. These property owners are the most difficult to access due to the large numbers of properties, lack of regulatory oversight, and lack of water quality infractions. However, the properties play an important role in drainage and infiltration and water quality.

Support Technical Innovations that Have Conservation and Economic Benefits in Agricultural Areas

Improving the protection of hydrology would take innovation as well as traditional protective action. Farmers are faced with having too much water in the winter and drought conditions during the summer, resulting in drainage and irrigation challenges. Innovative approaches may be the key to managing water in a way that allows for drainage and storage solutions. There are few examples of projects that have tested new technologies and have resulted in gains for fish and farms. These projects are testing creative solutions and technologies that benefit all interests.

An example of a win-win innovative project focused on water quality is the Qualco Digester project. This project resulted in both environmental and economic gains. In the early 2000s, the lower Snoqualmie was suffering from poor water quality, due in part to local dairy operators. In an unusual partnership, a non-profit organization was formed by Northwest Chinook Recovery, the Tulalip Tribes, and the Sno/Sky Agricultural Alliance, which is directed by five local dairymen and one cattle farmer. Qualco's aim was to solve the water quality problem in a collaborative way where farmers and fish profited. The result

of the partnership was the installation of an anaerobic digester that received dairy waste, processed it into compost, and generated electricity to sell back to the grid. Local farmers who participated in the project were able to resolve their waste management issues while improving point source water quality in adjacent streams. These types of creative solutions should be expanded in the Basin.

Action: Seek funding and support pilot innovation projects

One example of a possible pilot innovation project is the working buffers approach being promoted by the Snohomish Conservation District in which agroforestry practices are incorporated onto farms as a way to expand riparian buffer function and diversify income sources for farmers. An alley cropping system, for example, could involve rows of trees that are harvested for nuts/fruit or timber with a traditional crop grown in-between. A more densely forested area could be thinned for timber while also growing high-value shade crops such as medicinals, spices, and mushrooms. Incorporating trees into an agricultural landscape increases soil organic matter and infiltration rates while also increasing soil moisture in times of drought.

Water drainage is a persistent issue for farmers and productivity. There are several innovative ideas that could help farmers drain water from their properties efficiently with the best practices for hydrology in mind. An example involves increasing water storage on farmland by placing valves at the end of drain tiles and the downstream end of ditches. Farmers would be able to lower water levels in the spring to allow for planting but would continue to hold and/or release additional water throughout the summer low flow months. This could provide benefits to both farmers and instream flows. The operations of pump stations could also be investigated to improve hydrological outcomes

while still allowing farmers to manage their lands for productive crops.

None of the techniques described above have been piloted with salmon recovery goals in mind in the Snohomish Basin, so their environmental benefits have not yet been demonstrated. However, this type of creative thinking could encourage win-win solutions in the future, which benefit hydrologic function for salmon and water availability for farmers, namely drainage and irrigation.

Effectiveness Indicators:

- Number of innovative pilots
- Adoption of new techniques that improve hydrology in agricultural areas

Focus Areas:
Focus areas depend heavily on the types of issues that are being solved for farmers and hydrologic function. Working buffers could be applied to many different agriculture areas while issues involving drainage solutions would likely be limited to floodplains.

Develop Water Banks or Similar Mechanisms to Promote Conservation and Best Use of Irrigation Rights

Water banks are a mechanism developed at a watershed level in order to facilitate the legal transfer and market exchange of various types of surface, groundwater, and storage water rights. A water bank purchases water from willing sellers and then holds, transfers, and exchanges water rights on behalf of willing buyers. The seller can be anyone who holds a water right, and the buyer can be anyone who needs to mitigate for a new water use or restore instream flows. A bank can also facilitate

transactions to place water rights in trust to benefit stream flows without risking the loss of the right to the owner due to lack of use. Perhaps most importantly, water banks create the place to have conversations at a community scale about current rights and the needs of irrigators and instream conditions.

There are many diking and drainage districts within the Snohomish Basin that have exclusive charge for the maintenance and operation of their drainage systems. Water banking would also need to consider these special authorities.

Water banks can be formed by districts or privately. Water banks have to follow all Ecology processes associated with making changes to existing rights, such as changes in the type of beneficial use, the area of use, or the point of diversion. These banks can work with landowners to put rights into trust through the state, in order to avoid the disincentive of "use it or lose it."

Action: Develop water banks and facilitate conservation discussion within

Currently, one water bank program has been initiated in the Basin, in an effort led by the proposed new Snoqualmie Valley Watershed Improvement District, facilitated by the Snoqualmie Valley Preservation Alliance. The program has had several pilot water transfers. Each transfer starts with validation of the legal water right. New users of the right are subject to stricter use conditions, including compliant fish screens, hydraulic project approvals from WDFW, and metering of water use. The proposed water transfers in the Snoqualmie are expected to improve irrigation efficiencies, allowing farmers to either reduce their water usage for current crop production or to maintain the same water usage while increasing production.

Although the goal of this water bank is to support agricultural out-of-stream uses, it is conceivable that water banks could provide a framework to have conversations about conservation goals as well. Water banks could create the mechanism for water rights to be leased or purchased for conservation purposes

in years of drought when instream flows are critically low. In addition, they could generally encourage water conservation by assigning value and/or monetizing irrigation water use.

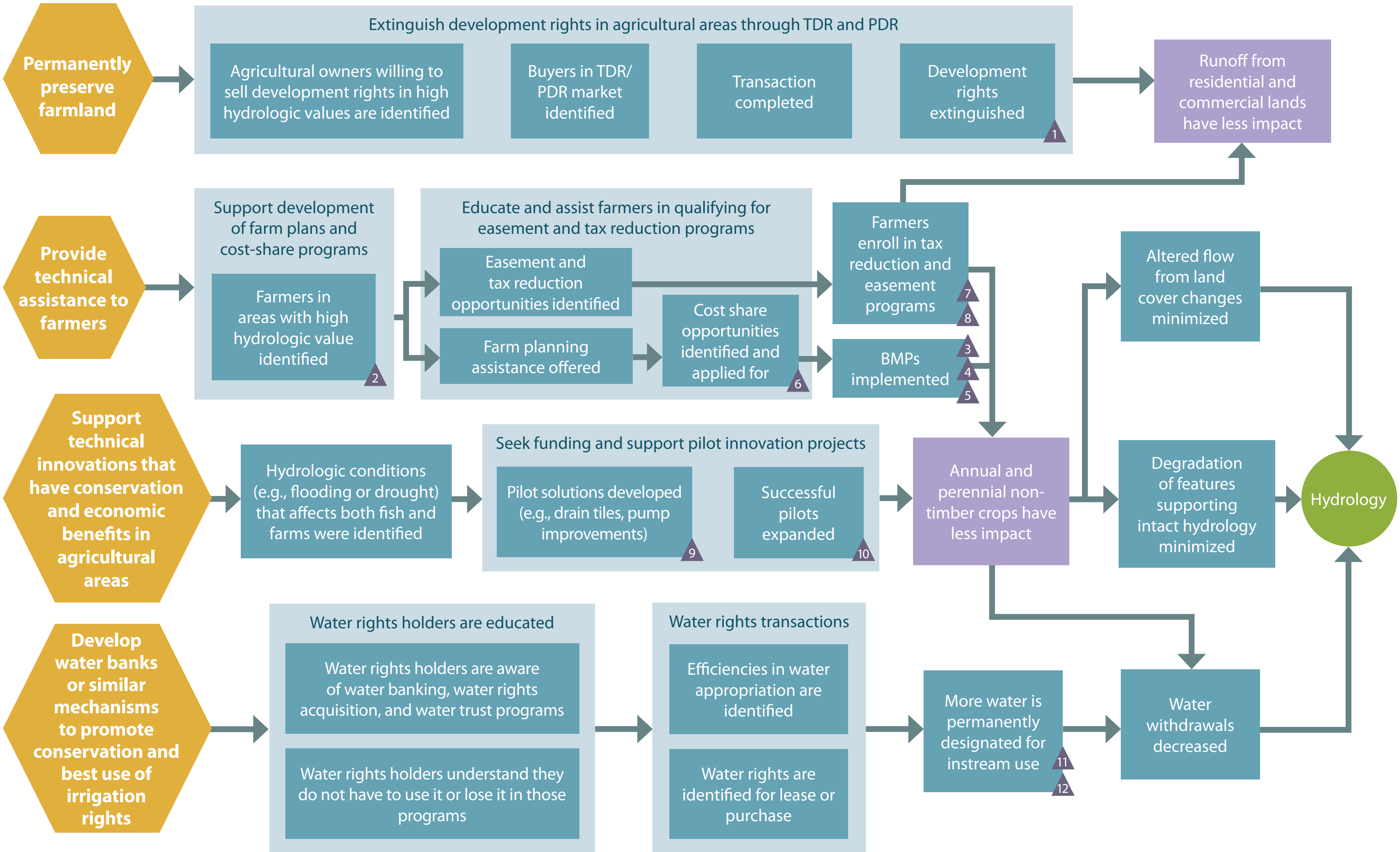
Water banks could also facilitate movements of device points (points of diversion and withdrawal) to locations that benefit the ecology of the stream (e.g., moving from surface to ground, where it is deemed beneficial to fish). This has been done successfully elsewhere in the state.

Effectiveness Indicators:

- Number of transactions through water banks
- Number of transactions intended to augment instream flows

Focus Areas:
All areas with hydrologically connected floodplains in agriculture: lower Pilchuck, lower Snohomish, lower Skykomish, and lower Snoqualmie.

Agriculture Protection Strategy



Key: Strategy recommendation | Recommended action | Expected outcome | Pressure reduction outcome | Ecosystem component | Effectiveness indicator

1 Number of acres of farmland with permanently extinguished development rights
2 Number of farmers who request site visits
3 Number of farmers who implement farm plans
4 Number of farmers who implement BMPs
5 Number of BMPs implemented
6 Length of time in backlog for enrolling in cost-share programs
7 Acres enrolled in easement programs
8 Number of acres enrolled in the Farm and Agriculture CUT Program
9 Number of innovative pilots
10 Adoption of new techniques that improve hydrology in agricultural areas
11 Number of transactions through water banks
12 Number of transactions intended to augment instream flows

Section 6

FORESTRY STRATEGY RECOMMENDATIONS

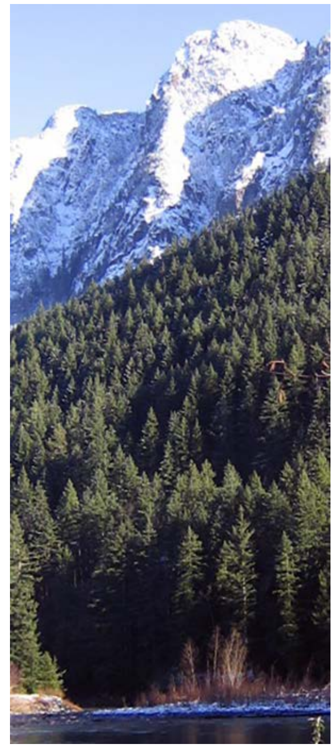


Photo courtesy of Janne Kaje

In 2005, approximately 75% of the Snohomish Basin land base was forested. More than half of this acreage was in federal ownership with the remaining acreage owned by a variety of individuals and entities, including private small forest landowners, private industrial timber companies, DNR, counties, and cities. Today, commercial forestry is still an important economic engine in both Snohomish and King Counties. Many of the communities in the upper watershed have a strong cultural connection to the Basin's logging history as well as current operations.

Forests play a crucial role in hydrology. Areas high in the Basin have large areas of aquifer recharge zones, and wetlands, and are virtually free of impervious surfaces. Tree cover helps support interception and slow water flowing into stream networks. Current regulations provide protection for aquifer recharge areas, wetlands, unstable slopes, riparian buffer, and contiguous cover. However, protection provided by these regulations is only as effective as the information that is used to implement them.

In the last 15 years since the 2005 Plan was written, there have been notable changes in Snohomish Basin forestry. In 2004, King County acquired development rights from more than 90,000 acres of commercial forest in the Snoqualmie Basin. The Roads Maintenance and Abandonment Plan, led by DNR, tasked forested landowners to map and treat all forest roads subject to Forest Practice Rules by 2016. Many agencies and organizations, including the Counties, DNR, the Family Forest Fish Passage Program, WSU Extension, and others, have worked

to assist SFLOs with timber stewardship in order to implement BMPs and keep land from being converted.

In King County, the County Council and Executive formed the Rural Forestry Commission. This 13-member Commission is tasked with advising King County government on policies and programs that affect rural forestry, ranging from industrial owners to SFLOs. The Commission helps those working in King County to coordinate efforts and address issues facing forestry with input from a broad range of forestry stakeholders. In Snohomish County, the Executive's Economic Development Office is working to develop a "Focus on Forestry" forum. This group would support ongoing needs assessment for forestland owners, and explore solutions to help keep forestry economically viable.

Even with ongoing work, forestry is declining in the Snohomish Basin and between the years 2005 through 2012, 2,152 acres were converted from forest lands to other purposes incompatible with continued forestry (measured by formal forest practices permit applications). During the recession, development slowed considerably; with the end of the recession, there will likely be additional pressures on forested areas. Between 1988 and 2004, more than 100,000 acres of forestland in King and Snohomish Counties were converted to either developed land or agriculture (Earth Economics 2010). A 2009 study by the University of Washington's School of Forest Resources found that more than 150,000 acres of private forestland in the Snohomish Basin were at "high risk" of conversion (University of Washington School of Forest Resources 2009).

The recommendations below support the development of better information in forested areas and propose increased support to

SFLOs who are often most vulnerable to the rising risk of conversion as the economy improves.

Permanently Conserve Working Forestland

Due to declining forest cover and the increasing threat of conversion, the first recommendation is to use existing tools to extinguish development rights and keep a majority of the watershed in a healthy forest condition.

Action: Permanently extinguish development rights in forested areas through the TDR, PDR, or acquisition programs such as the U.S. Forest Service Community Forest Programs

TDR/PDR programs have already been successful in areas of the Snoqualmie Basin and in Snohomish County (the recent Hidden Valley Camp transfer). The TDR/PDR market should continue to be encouraged, particularly in areas adjacent to existing development. The Community Forest Program is a grant program that authorizes the U.S. Forest Service (USFS) to provide financial assistance to local governments, tribal governments, and qualified non-profit entities to establish community forests (through fee simple acquisition) that provide continuing and accessible community benefits.

Effectiveness indicators:

- Number of forested parcel TDR/PDR transactions

Focus areas:

Industrial landowners who are willing to sell development rights on large tracts of lowland forest (e.g., Hancock property in Snohomish County), SFLOs adjacent to existing development, and properties with high hydrological value.

Increase Coordinated Outreach, Incentives, and Technical Assistance to SFLOs

SFLOs in the Snohomish Basin are located in areas zoned for forestry, rural residential areas designated for forestry, and in rural residential areas that simply have larger parcels with forest cover. Often, in areas designated for rural residential, there are several land uses on forested properties, including housing, forestry, and in some cases, agriculture.

Due to growing populations and expanded development, many small forested properties are increasingly vulnerable to conversion to other land uses. This has raised concerns that the continuity of knowledge on how to manage stands may be lost, increasing the chances that forest stewardship would cease and land use would change.

The actions below are intended to prevent conversion of forested lands to other uses. They are also intended to help property owners actively manage for healthy forests, which in turn would support intact hydrologic functions.

Action 1: Coordinate and target outreach to SFLOs

WSU Extension, DNR, and King County have created outreach materials that describe options and programs that SFLOs may be eligible for. Although there is coordinated outreach in King County, there is currently no coordinated approach to engaging forest landowners throughout the entire Snohomish Basin. Most of the contact with SFLOs comes after landowners reach out to the counties for help. In order to better focus on the SFLOs who need the most assistance, outreach should be targeted to: 1) specific areas, such as basins with hydrologic importance; 2) categories of SFLOs, such as those who have had recent ownership changes; or 3) those that are at high risk of conversion. The target areas could be recommended through

the Rural Forest Commission in King County and Focus on Forestry in Snohomish County. Outreach efforts could be expanded and improved through coordination with WSU Extension and the Conservation Districts.

Effectiveness Indicators:

- Development of criteria for where outreach should be targeted
- Identification of SFLOs properties for outreach

Action 2: Support development of expanded education, technical training, Forest Stewardship Plans, and cost-share programs

The SFLOs in Snohomish Basin are currently underserved. Although King County, King Conservation District, Snohomish Conservation District, DNR, and WSU Extension are conducting outreach and providing technical assistance, there is opportunity to increase the coordinated approach to help interested SFLOs access education resources and technical training, develop Forest Stewardship Plans, or apply for cost-share opportunities. Building on Action 1, the groups working to provide assistance should help landowners with available resources.

Forest Stewardship Plans help SFLOs assess the condition and health of their forests, identify potential problems, and develop management approaches to meet future goals. DNR currently lacks the funding necessary to provide a free advisory site visit for forestland owners who have 10 or more acres, which is a critical step in SFLO outreach. Forest Stewardship Plans and education often help SFLOs qualify for cost-shares and other incentive programs.

Cost-share programs can help SFLOs cover expenses associated with implementing Forest Stewardship Plans. The Environmental Quality Incentives Program through the NRCS is a current example of a cost-share program that offers many opportunities for forest owners. The Environmental Quality Incentives Program can help to offset costs for restoring buffers and managing soil health.

Effectiveness Indicators:

- Number of Forest Stewardship Plans developed and implemented through DNR's SFLO office
- Number of SFLOs participating in cost-share programs

Action 3: Educate and assist SFLOs in qualifying for easement and tax reduction programs

In addition to technical assistance and cost-share programs, SFLOs can qualify for easement and tax reduction programs. In Snohomish County, SFLOs are able to reduce their property tax under the Open Space Timberland Program. In King County, SFLOs can apply to the Open Space Timberland program, the PBRS, or the Forestland program. Each has different tax reduction implications and management requirements. Once enrolled in these programs, the landowner would be required to keep land in active commercial management to qualify and would be penalized with back tax payments if they withdrew.

Easement programs include the Forest Riparian Easement Program, and Rivers and Habitat Conservation Easements administered by DNR. DNR also manages the Family Forest Fish Passage Program, a program that provides small landowners with 75% to 100% of the cost to replace fish barriers on their property. Finally, the USFS Forest Legacy Program works specifically to protect private timberlands. To maximize public benefits, the program acquires conservation and recreation

easements. The above programs could provide more benefit to SFLOs if funded to a level that allowed broader availability.

Effectiveness Indicators:

- Number of SFLOs enrolled annually in tax reduction programs
- Number of SFLOs enrolled annually in easement programs

Focus Areas:
Focus areas need to be developed as part of Action 1.

Collect High Resolution LiDAR throughout the Entire Basin and Coordinate Data Collection and Sharing Efforts

Light Distance and Ranging (LiDAR) is an active remote sensing technology that creates highly accurate distance measurements. These horizontal and vertical measurements can provide precise spatial resolution (within 3 feet) and information on features such as specific trees. With high quality LiDAR, it is possible to see stream networks and drainage patterns on areas proposed for harvest. This information can help regulators and land managers better understand what features need to be verified on the ground, in order to apply the appropriate regulations. LiDAR also provides the ability to evaluate forest stand structure, possible unstable slopes, and basic wetland features. In areas that have already been harvested, compliance with regulations can be evaluated. LiDAR can provide information that supports models that can be used to predict future conditions caused by climate change in the forested landscape. Finally, LiDAR has many applications outside of the protection of hydrology, including timber inventory assessments, floodplain mapping, road construction and decommissioning, and wildlife habitat identification.

Action: Develop high quality LiDAR for the entire Basin and coordinate data collection efforts and data sharing

The different resolutions of LiDAR information across the Snohomish Basin limit the ability of managers to remotely assess on-ground information. With better resolution, local managers and regulators could better assign limited staff resources to on-ground reviews and verification. The primary cost of collecting LiDAR is to pay for the airplane flight and data processing. If agencies, such as counties, the state, and USFS, could coordinate to pool resources for one flight, the cost would be greatly reduced to each. This coordinated approach could also result in cooperative sharing of information, as with the Puget Sound LiDAR Consortium.

Effectiveness Indicators:

- LiDAR obtained

Focus Areas:

Much of Snohomish County's LiDAR coverage is relatively high quality, though it is incomplete in the upper federally-owned portion of the watershed. King County, while complete, currently has lower quality/resolution LiDAR data in the majority of the forested landscape, which limits the usefulness of the data.

Expand Water Typing Efforts and Resources

Water typing is the state-sanctioned process by which the locations of streams and waterbodies, and fish habitats within them, are mapped; it is described in WAC 222-16-031. DNR's regulatory water-typing maps show stream reaches classified as "fish bearing" (F) or "non-fish bearing" (N). Reach classification is used to determine the type of streamside buffer required to protect waterbodies from impacts from adjacent forest practices.

Stream reaches typed “F” receive larger protective buffers than stream reaches typed “N.” Most local governments throughout Puget Sound use the same or a similar water type classification system to determine the amount of protection that streams receive through critical areas ordinances.

DNR acknowledges that their modeled water type maps are inaccurate and advises against using them without field verification. Field data demonstrate that in some western Washington watersheds, more than half of the streams are misclassified, mismapped, or unmapped (Wild Fish Conservancy 2007). This is significant as inaccurately mapped or typed stream reaches may not receive the protection they warrant under existing regulations.

WDFW has cautioned against the use of DNR water type maps outside of regulated forest practices because of their demonstrated inaccuracies (Knight 2009). Similarly, the Washington Department of Commerce adopted WAC 365-190-130, which states “Counties and cities … should not rely solely on DNR maps of these stream types for purposes of regulating land uses or establishing stream buffers.” Still, DNR water type maps are widely used in some local and state government planning efforts, as they are often the only tool available and agencies often lack the capacity to consistently review and correct them. Low-relief landscapes like those found throughout the Puget lowlands are precisely where DNR modeled water-type map errors are greatest; this is true because the model relies in part on a coarse digital elevation model, not LiDAR.

Proactively performing field surveys to ground truth and correct DNR’s regulatory water type maps is fundamental to responsible growth and resource management planning. Accurate water

type data would improve state and local governments' ability to use existing environmental regulations at the site scale to effectively protect intact watershed habitats and processes.

Action 1: Expand ground truthing of current water types in areas not regulated by DNR

Groups, such as Wild Fish Conservancy, currently have priority areas in the Snohomish Basin that should have water types validated. The continued updates should be supported in the Basin. Additionally, through the course of permit applications, in the case where the water type is found to be wrong, counties should work through the DNR process to formally update maps to help with accuracy in future land use decisions.

Effectiveness Indicators:

- Sub-basins with updated stream type layers

Action 2: Connect local jurisdictions with robust stream typing resources

Another way to ensure that streams are properly typed is to add capacity to local jurisdictions' planning departments. It is important for qualified personnel to do the typing, and use of DNR's regulatory water type maps that have not been validated should be discouraged. Tribes and non-profit organizations, such as Wild Fish Conversancy, could be connected to planning departments directly and serve as an "on-call" technical resource.

Effectiveness Indicators:

- Sub-basins with updated stream type layers
- Number of agreements between small jurisdictions and water typing experts

Action 3: Increase organizational capacity for water typing in the Snohomish Basin

There are many situations in the Snohomish Basin where staff are asked to make determinations of water type and subsequent regulatory decisions without proper training. Local government staff should seek protocol training if they intend to review or use water type maps.

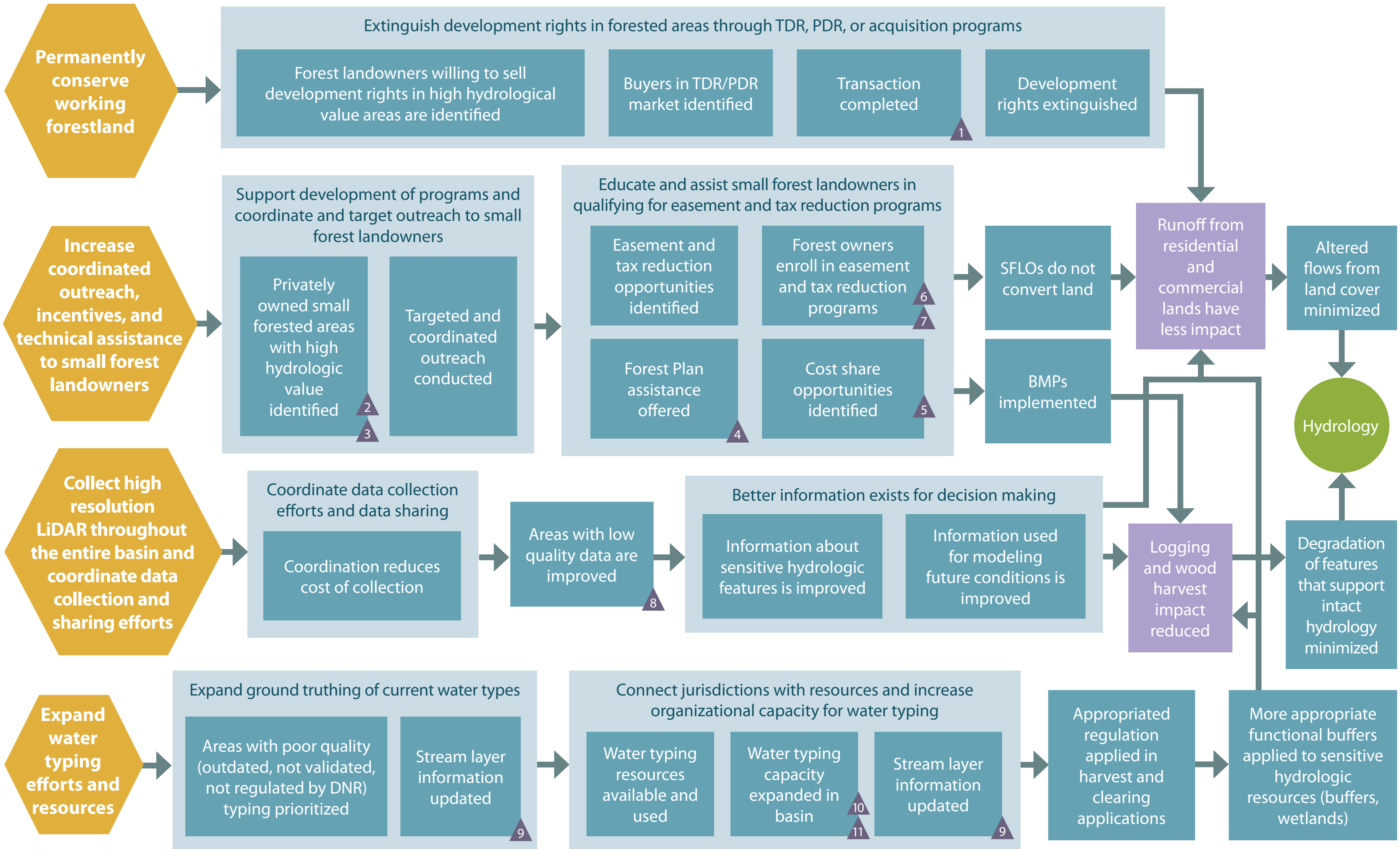
Effectiveness Indicators:

- Sub-basins with updated stream type layers
- Number of local government staff qualified, with proper training credentials, to determine water types

Focus Areas:

Currently, because areas regulated by DNR (Forest Practices Act) have validation requirements, the focus of this strategy should be in rural residential areas and local jurisdictions.

Forestry Protection Strategies



Key: Strategy recommendation | Recommended action | Expected outcome | Pressure reduction outcome | Ecosystem component | Effectiveness indicator

1 Number of forested parcel TDR/PDR transactions
2 Development of criteria for where outreach should be targeted
3 Identification of SFLOs properties for outreach
4 Number of Forest Stewardship Plans developed and implemented through DNR's SFLO office
5 Number of SFLOs participating in cost-share programs
6 Number of SFLOs enrolled annually in tax reduction programs
7 Number of SFLOs enrolled annually in easement programs
8 LiDAR obtained
9 Sub-basins with updated stream type layers
10 Number of agreements between small jurisdictions and water typing experts
11 Number of local government staff qualified, with proper training credentials, to determine water types

Section 7

CONCLUSIONS AND PATH FORWARD

It has been 10 years since the 2005 Plan was adopted by the Forum, with broad support of jurisdictions operating in the Basin. Much has been accomplished in the realm of habitat restoration, yet landscape-scale indicators—such as total forest cover and water temperature—continue to show degradation.

The intent of the SBPP process is to provide an update to the 2005 Plan and to serve as planning guidance to achieve greater protection of hydrology and, in turn, salmon habitat. The SBPP and these 2005 Plan updates were developed with the recognition of the need to create watershed and ecosystem resilience in the face of a growing population and changing climatic conditions. Just as restoration relies on partnerships and collaboration, protection of hydrology and habitat cannot be undertaken in isolation or by one entity, group, or agency. As stated by the original chairs of the Forum, "we know that to recover salmon in Puget Sound, we must succeed in the Snohomish Basin."

Through the SBPP and 2005 Plan update, protection strategies and approaches are offered that can be used to promote the protection or enhancement of hydrology and ecosystem function. The recommendations are consistent with the overall protection approach offered in the 2005 Plan. These recommendations add specific actions and suggested geographic focus in an attempt to make protection more immediately actionable. Many of the protection recommendations and specific actions identified in this document are already utilized in the Basin but could be improved. It is hoped that by tracking protection actions and projects as they are implemented, an

assessment can be made of protection gains or losses so that land use decisions can be better informed.

Alongside this planning guidance, there are several considerations and associated actions that will be needed to ensure the implementation of the SBPP. First is the recognition that the guidance is not considered a mandate and that jurisdictions must consider their broader responsibilities and work plans when considering the recommended approaches. Jurisdictions and recovery partners may adjust the recommendations to best accommodate and complement their existing work. Additionally, all commitments, along with stated caveats, that were made in 2005 continue to hold true in the face of protection updates.

As the Forum and partners move forward with the protection guidance, there are several necessary steps and supporting processes to consider. In the near-term, there are two planning tools to be used to advance strategies. The first, used by the Lead Entity program, is the 4-year work plan. This process has traditionally laid out the 3-year approach, complete with an identified sponsor, goals, and associated costs of large capital restoration projects. The actions laid out in this guidance were developed with an eye toward detail associated with the 3-year work plan. This will allow Lead Entity staff and other partners to track the protection actions, implementing groups, and needed funding in a manner consistent with restoration.

The second process to be considered for implementation is the near-term action list that is developed every 2 years by the Snohomish-Stillaguamish Local Integrating Organization. These actions are eligible for funding through the National Estuary Program and are expected to be advanced in a 2-year timeframe. The protection update recommendations are particularly well

suited to be considered as near-term actions, as they address habitat and stormwater; two of the region's three primary strategic initiatives.

The 4-year work plan and the local integrating organization process provide immediate vehicles for the implementation of protection recommendations. However, a longer-term strategic approach will be necessary to address funding. The effort to create the best protection recommendations once again highlighted the need for a comprehensive funding approach that considers both restoration and protection. Issues such as the matching of non-traditional sources, increased nimbleness of funding sources and grant cycles, and incorporating new information/criteria such as watershed characterization should inform updated thinking on a funding approach.

The protection recommendations suggest a variety of metrics that can be used to evaluate the effectiveness of actions over time. The update does not suggest objectives for these actions related to participation in programs, protection of a certain amount of acreage, or goals for the overall condition of hydrologic status and trends over time. These objectives and ecosystem goals are related to both protection and restoration and must be revisited with a larger effort that assesses progress toward recovery. Currently, the Snohomish Basin (and all Puget Sound watersheds) are engaged in the Chinook Monitoring and Adaptive Management Project. This effort will result in a framework that monitors actions and environmental outcomes over time. The framework will also identify triggers for revisiting 2005 hypotheses, assumptions, objectives, and goals. Through the Monitoring and Adaptive Management Framework, protection strategies can be specified and associated objectives and hydrologic goals can be set.

The SBPP assumptions include a hope that planning efforts in the Basin will be better informed and tools and strategies will be adopted by jurisdictions to improve the outcomes for hydrologic and ecosystem function. Improved coordination among stakeholders is key; inter-agency and intra-agency collaboration within the Basin is a good starting point. Funding future planning efforts that promote the integration of watershed management and urban planning would promote the understanding of the land-water connection. In addition, it is important to note that stakeholder engagement and political will are imperative to success. In turn, habitat restoration and salmon recovery efforts will be bolstered by protective actions that stakeholders undertake today and in the future.

Section 8

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