Appendix A

CITY OF SNOHOMISH
SHORELINE MASTER PROGRAM

Shoreline Inventory and Characterization

Prepared for
City of Snohomish

June 2010, updated May 2017

City of Snohomish
Shoreline Master Program

Shoreline Inventory and Characterization

Prepared for
City of Snohomish

June 2010, updated May 2017

5309 Shilshole Avenue NW
Suite 200
Seattle, WA 98107
206.789.9658
www.adolfson.com

Los Angeles

Oakland

Olympia

Petaluma

Portland

Sacramento

San Diego

San Francisco

Tampa

Woodland Hills

D209491.00

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

APPENDIX A - MAP FOLIO AND GIS MAPPING DATA SOURCES

APPENDIX B - PHOTOS

1 INTRODUCTION

1.1 Background and Purpose

The City of Snohomish (City) is updating its Shoreline Master Program (SMP) to comply with the requirements of the Washington State Shoreline Management Act (SMA or the Act) (Revised Code of Washington [RCW] 90.58) and the state's shoreline guidelines (Washington Administrative Code [WAC] 173-26, Part III), which were amended in 2003.

As a baseline characterization and inventory, this document sets the stage for a more in-depth and detailed analysis of the type and scale of actions available for the City through administration of its SMP. It provides a basis for setting priorities and a benchmark for measuring change.

The purpose of this report is to provide a baseline inventory and characterization of the City's designated shoreline areas—Snohomish River, Pilchuck River, and Blackmans Lake (Map 2). The report addresses ecosystem-wide processes (also referred to as watershed or landscape processes) and shoreline ecological functions in accordance with the state shoreline guidelines (referred to as "the guidelines") in WAC 173-26-201(3)(c) and (d). The information provided herein will be used to characterize shoreline functions, establish existing shoreline conditions, and ultimately develop goals, policies, and regulations for shoreline management. Other steps to be completed during subsequent phases of the SMP update process will include:

1. Determining shoreline environment designations (SEDs);
2. Assessing cumulative impacts of shoreline development; and
3. Preparing a restoration plan.

This work was funded in part through a grant from the Washington State Department of Ecology (Ecology), Grant #G100030.

1.2 Report Organization

This inventory and characterization report is organized into 10 chapters. The first provides a regulatory overview of state and local plans and requirements for structuring and instituting the City's SMP update. The second chapter provides the technical methods used to identify areas and reaches within the shoreline jurisdiction in the City of Snohomish, and the assessment tools used to determine the baseline ecological conditions of the identified reaches.

Chapter 3 provides an overview of the Snohomish River watershed environment—the physical and biological setting, general land uses, and ecosystem-wide processes. Chapter 4 describes trends in land use in the city and potential use conflicts.

The City's shorelines are discussed specifically in Chapters 5, 6, and 7 (Snohomish River, Pilchuck River, and Blackmans Lake, respectively). For each of these water bodies, the chapter first describes the overall physical, biological, and land use setting, then describes information unique to reaches along the shoreline. Opportunities for restoration and public access are also included. Chapter 8 then synthesizes the information presented in the previous three chapters.

Chapter 9 describes gaps in available data about the shorelines, and Chapter 10 lists the references used in preparing this report.

Appendix A, the map folio, contains maps which are referenced in the report as Maps 1 though 12. In addition, this report contains figures that are embedded in the text. Photos of the City's shoreline are provided in Appendix B.

1.3 Overview of the Washington State Shoreline Management Act

The purpose of the SMA is to "…provide for the management of the shorelines of the state by planning for and fostering all reasonable and appropriate uses" (RCW 90.58.020). The Ecology administers the Act but gives primary permitting authority for shoreline development to local governments. Local governments are also charged with developing SMPs in accordance with the guidelines developed by Ecology. The guidelines give local government discretion to adopt SMPs that reflect local circumstances and to develop other local regulatory and non-regulatory programs related to the goals of shoreline management as provided in the policy statements of RCW 90.58.020, WAC 173-26-176, and WAC 173-26-181.

Shoreline Master Programs have a planning function as well as a regulatory function. Master programs balance and integrate the objectives and interests of local citizens and the people of Washington State, and address the full variety of conditions on the shoreline. Master programs also establish a classification system for specific shoreline environments that is based on the biological and physical character of the shoreline, the existing use pattern, and the goals and aspirations of the community as expressed through the comprehensive plan (WAC 173-26-191 and 173-26-211).

The SMA requires that local governments and state agencies review their plans, regulations, and ordinances that apply to areas within the shoreline jurisdiction, and then modify those plans, regulations, and ordinances so they "achieve a consistent use policy" in conformance with the Act and the SMP (RCW 90.58.340). This means that the Shoreline Element of the City of Snohomish comprehensive plan and the City's development regulations must be consistent with the SMA.

The SMA also regulates development in designated critical areas as defined by the Washington State Growth Management Act (GMA) (RCW 36.70A). Although critical areas in shoreline jurisdiction are to be identified and designated under the GMA, they must also be protected under the SMA. The Washington State Legislature and the Growth Management Hearings Board have determined that local governments must adopt master programs that protect critical areas within the shoreline at a level that is "at least equal" to the level of protection provided by the local critical areas ordinance (CAO). The Legislature clarified that although Washington's shorelines may contain critical areas, designated shorelines of the state themselves are not by default critical areas as defined by GMA.

1.4 Shoreline Management Act Jurisdiction and Study Area Boundary

Under the SMA, the shoreline jurisdiction includes waters that have been designated as "shorelines of statewide significance" or "shorelines of the state." These designations were established in 1972, and are described in Washington Administrative Code (WAC) 173-18.

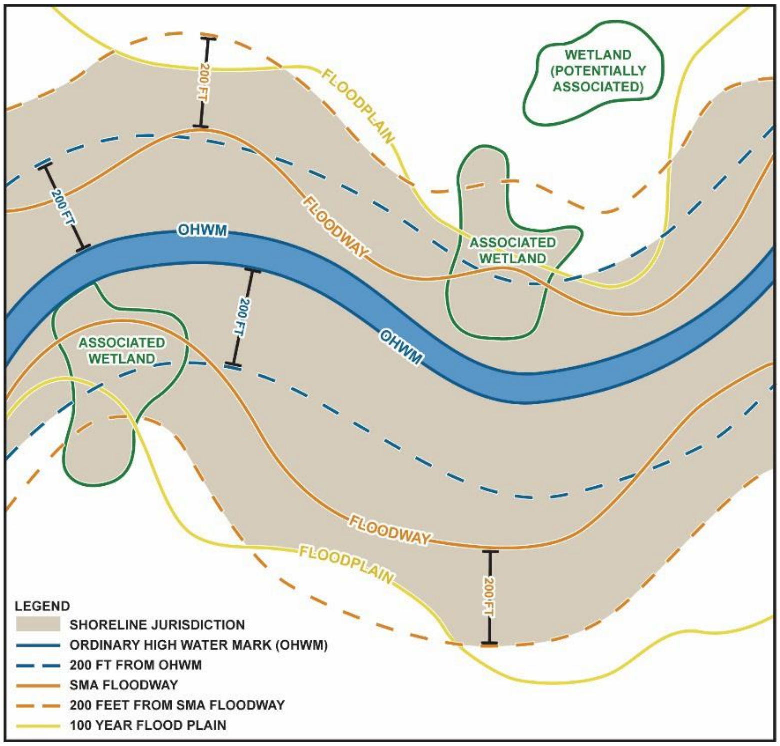
- "Shorelines of statewide significance" are generally described as including portions of Puget Sound and other marine water bodies, rivers west of the Cascade range that have a mean annual flow of 1,000 cubic feet per second (cfs) or greater, rivers east of the Cascade range that have a mean annual flow of 200 cfs or greater, and freshwater lakes with a surface area of 1,000 acres or more.
- "Shorelines of the state" are generally described as all marine shorelines and shorelines of all other streams or rivers having a mean annual flow of 20 cfs or greater and lakes with a surface area greater than 20 acres.

In Snohomish, the designated shorelines of the state are the portions of the Snohomish River, Pilchuck River, and entirety of Blackmans Lake that fall within the Snohomish city limits and urban growth area (UGA) (Map 2). The Snohomish River is also designated as a shoreline of statewide significance.

The shoreline jurisdiction under SMA also includes "shorelands" adjacent to shorelines of the state. "Shorelands" or "shoreland areas" means those lands extending landward for 200 feet in all directions as measured on a horizontal plane from the ordinary high water mark (OHWM); floodways and contiguous floodplain areas landward 200 feet from such floodways; and all wetlands and river deltas associated with such streams, lakes, and tidal waters (see Figure 1-1). "Associated wetlands" means those wetlands, that are in proximity to and either influence or are influenced by tidal waters or a lake or stream subject to the SMA (WAC 173-22-030 (1)). These are typically identified as wetlands that physically extend into the shoreline jurisdiction, or wetlands that are functionally related to the shoreline jurisdiction through surface water connection and/or other factors.

Unless otherwise stated, generalized references to the city or the city's shoreline jurisdiction include shorelines in the UGA and the study area boundary as described above.

Figure 1-1. Schematic of Shoreline Jurisdictional Areas.



1.5 Current Regulatory Framework

This section briefly discusses some of the regulations besides the SMP that control or affect development in the shoreline jurisdiction.

1.5.1 Existing Shoreline Master Program

The existing SMP was adopted by the City in 1976, and has been amended from time to time, with the most recent amendment in 2000. The development regulations are adopted by reference in section 14.250.010 of the Snohomish Municipal Code (SMC) but the standards themselves have not been codified. The City's existing SEDs are shown on Map 12.

1.5.2 Comprehensive Planning and Zoning

The City's current Comprehensive Plan was adopted in 1995, and has been amended from time to time, with the most recent amendment in 2016. The Comprehensive Plan contains policies supporting the City's future growth and development.

Development regulations that apply in the shoreline regulate allowable uses and the physical dimensions of structures, parking areas, and required landscaping. These regulations are found in SMC 14-205.

1.5.3 Critical Areas Regulations

The City's critical areas regulations (SMC 14.255 through 14.280) were adopted in 2005. These regulations govern the development in the following areas:

- Wetlands
- Critical Aquifer Recharge Areas
- Flood Hazard Areas
- Geologically Hazardous Areas
- Habitat Conservation Areas

1.5.4 State and Federal Regulations

Many state and federal regulations apply in the shorelines. The following are the most common regulations that apply to shoreline development:

- Hydraulic Project Approval (State Hydraulic Code)
- Section 404 (Clean Water Act) Permit
- Section 401 (Clean Water Act) approval
- Section 10 (Rivers and Harbors Act) Permit

2 METHODS AND DATA INVENTORY

2.1 Data Sources

Existing data sources, geographical information system (GIS) data, and published technical reports were reviewed and evaluated during the process of preparing this inventory and characterization. The project team compiled data using resources from City of Snohomish, Snohomish County, other local jurisdictions, scientific researchers, and state and federal agencies. This includes information sources pertaining to overall watershed conditions and ecosystem-wide processes as well as ecological functions of the City of Snohomish shorelines. Among the main information sources reviewed for this report were the technical analyses and planning documents prepared for salmon recovery in Water Resource Inventory Area (WRIA) 7, and the *Summary of Shoreline Ecological Functions and Conditions in Snohomish County* report, prepared by Snohomish County in 2006. These reports, and other information sources, are listed in Chapter 10.

Mapping and aerial photographs of the study area were also consulted. Primary mapping sources included:

- FEMA floodplain mapping (2005);
- Snohomish County GIS mapping (2004 – 2007);
- City of Snohomish GIS mapping (2004, 2009);
- Washington Department of Fish and Wildlife (WDFW) Priority Habitats and Species database (2008) and SalmonScape mapping (2010); and
- Washington Department of Natural Resources geologic hazard GIS mapping (2000 – 2004).

2.2 Establishing Shoreline Jurisdiction

This inventory focuses on shorelines of the state within the municipal limits of the City of Snohomish and the City's UGA (Maps 1 and 2). The shoreline planning areas shown on Map 2 generally represent lands within 200 feet of the mapped edges of the Snohomish River, Pilchuck River, and Blackmans Lake, as well as associated wetlands, within the city limits of Snohomish and its UGA. There are also two other parcels within the shoreline planning area, owned by the City but are not contiguous with the main city limits. One parcel is located northeast and well upstream of the city proper at the location of the city's water treatment plant on the Pilchuck River. The other parcel, located east of the city proper, lies within an optional shoreline planning area in the Pilchuck River floodplain. The shoreline planning area covers approximately 4.6 linear miles, including 1.7 miles along the Snohomish River, 1.3 miles along the Pilchuck River, and 1.5 miles around Blackmans Lake. The acreages of the shoreline planning area by water body are shown in Table 2-1.

Table 2-1. Shoreline Planning Areas, City of Snohomish

Water Body and General Shoreline Planning Boundaries	Land Area (acres) [1]		% of City's Shoreline Planning Area
	City Limits	UGA	
Snohomish River 1.7 miles of mainstem river along southern boundary of city and within UGA; from approx. 0.5 miles upstream of Pilchuck River confluence, extending northwest to the western boundary of City's wastewater treatment plant property	53	38	56%
Pilchuck River [2] 1.3 miles of mainstem river just inside eastern city boundary; from approx. 1.3 miles upstream of Snohomish River confluence to the approximate alignment with 10th Street	27	2	18%
Blackmans Lake Entire lake and associated wetlands (approx. 1.5 miles OHWM perimeter)	42	0	26%

Planning area boundaries were developed using the existing GIS information sources listed above. For purposes of this report, the mapped edges of the lake and stream shorelines are assumed to generally correspond to the OHWM, but field inspection is required to identify the OHWM location on a specific property and to determine regulatory setbacks. Similarly, mapped wetlands that are adjacent to or within 200 feet of the OHWM are assumed to be "associated" wetlands, but generally a wetland's relationship to the shoreline must be determined in the field by on-site inspection.

The inventory area is intended for planning purposes only. As a result, the actual regulated boundaries of shoreline jurisdiction may differ from the area shown on Map 2 depending on information gathered on the ground at any specific location.

For this inventory, the 200-foot shorelands and associated wetlands (minimum jurisdictional limits) have been assessed in detail. Because the City has not historically regulated the 100-year floodplain (optional jurisdictional limits) and does not anticipate adding them, the optional floodplain areas are assessed more generally. Map 2 distinguishes the minimum and optional jurisdictional limits.

2.3 Approach to Inventory and Reach-scale Analysis

The inventory of the Snohomish River, Pilchuck River, and Blackmans Lake at the shoreline reach scale is intended to characterize the existing physical environment, biological resources, cultural resources, land use and public access.

2.3.1 Analysis and Mapping

GIS data were used to quantitatively inventory and characterize shoreline conditions wherever possible. Aerial photography and existing reports and planning documents were reviewed to further qualitatively describe and illustrate conditions in the shoreline planning area. Analysis and mapping was conducted at the water body and reach scale. Nine distinct shoreline reaches were defined and evaluated.

Data were used to visually display over 30 mapping themes (e.g., flood hazards, fish distribution, wetlands, and land use/planning) related to individual shoreline reaches. In addition, GIS overlay analysis was used to quantify certain conditions (e.g., spatial extent of wetlands, land use designations) in the shoreline planning area. Mapping the shoreline to visually discern detailed conditions within the SMP jurisdiction (200 feet from OHWM) is referred to as "reach-scale mapping."

2.3.2 Determining Reach Breaks

Reaches (also referred to as shoreline planning areas) were delineated based on significant changes in the physical and biological composition of the regulated waterbody's shoreline. The Snohomish River shoreline was divided into three reaches, the Pilchuck River shoreline into five reaches, and the Blackmans Lake shoreline into one reach (Table 2-2). See Map 2 for reach locations.

Table 2-2. Shoreline Reach Breaks, City of Snohomish

Reach Code	Reach Size (miles / acres) [1]	Reach Boundary Description
Snohomish River		
SNO_RV_01	0.4 miles 42.7 acres	Southern end of city limits/UGA boundary west to Swifty Creek confluence including both north and south riverbanks
SNO_RV_02	0.5 miles 58.9 acres	Swifty Creek west to SR 9 including both north and south riverbanks
SNO_RV_03	0.8 miles 55.0 acres	SR 9 west to city limits/UGA boundary including both north and south riverbanks
Pilchuck River [2]		
PIL_RV_01	0.3 miles 7.2 acres	Southern end of city limits/UGA boundary north to 92nd Street SE crossing, including west riverbank only
PIL_RV_02	0.4 miles 10.6 acres	92nd Street SE crossing north to north end of Pilchuck Community Park, including west riverbank only
PIL_RV_03	0.6 miles 11.9 acres	Pilchuck Community Park north to city limits, including west riverbank only
PIL_RV_04	-- [2]	Pilchuck River floodplain east of river near Three Lakes St. SE
PIL_RV_05	0.02 miles 2.5 acres	Both banks of Pilchuck River near N. Lake Roesiger Rd.
Blackmans Lake		
BLK_LK_01	1.5 miles 109.6 acres	Entire lake plus associated wetlands

[1] Acreages include land plus open water areas.
[2] Reach PIL_RV_04 is an optional shoreline area located in the floodplain.

2.4 Approach to Assessment of Shoreline Functions

SMA guidelines require local jurisdictions to evaluate ecosystem-wide processes during SMP updates. Watershed processes that create, maintain, or affect the City's shoreline resources were characterized using an adapted version of the five-step approach to understanding and analyzing watershed processes described in *Protecting Aquatic Ecosystems: A Guide for Puget Sound Planners to Understand Watershed Processes* (Stanley et al., 2005). This approach defines watershed processes as the delivery, movement, and loss of water, sediment, nutrients, toxins, pathogens, and large woody debris. Only limited detailed information about these watershed processes is available for the City of Snohomish shorelines.

Discussion of watershed processes in this report focuses on geology, climate, and topography. These watershed processes control the amount, type and extent of the smaller scale ecosystem processes at work in the City's shoreline planning area. Ecosystem processes include hydrology, sediment generation and transport, and water quality (see further discussion on the approach to characterizing ecosystem processes in Section 3.5 below). Watershed processes are qualitatively described using available reports and spatial information. Process components, as identified by Stanley et al. 2005, that are not directly called out within this report are discussed under other headings (for example, available information about toxins, pathogens, and nutrients is discussed within Section 3.53, Water Quality) and/or identified in Chapter 9 as a data gap.

Analyzing conditions and processes at the watershed scale informs local planning by providing a broad understanding of the influences on shoreline conditions and functions. Natural processes, and alterations to those processes, are described at a variety of geographic scales based on existing reports and readily available mapping information. No new quantitative analyses were performed to develop the characterization of watershed processes included in this document.

3 ECOSYSTEM PROFILE

This chapter provides an overview of the regional watershed surrounding the city of Snohomish and describes how watershed-scale processes affect shorelines and their functions. In accordance with WAC 173-26-210(3)(d), the City must analyze the "ecosystem-wide processes" that affect the shorelines within the local jurisdiction as part of the shoreline analysis. Information is presented here at a watershed scale and provides a basis for understanding shoreline management in relation to the broader landscape context. This watershed-scale overview is intended to provide context for the reach-scale discussion provided in Chapters 5, 6, and 7.

This chapter is organized to provide:

- An overview of the regional landscape, including physical description, land use changes, and existing habitats;
- A discussion of the process controls that influence the form and ecological functioning of the Snohomish River, Pilchuck River, and Blackmans Lake watersheds; and
- A discussion of key ecosystem processes.

This watershed analysis and overview is based upon the methods outlined in Ecology's guidance document, *Protecting Aquatic Ecosystems: A Guide for Puget Sound Planners to Understand Watershed Processes* (Stanley et al., 2005). Landscape analysis, as described in this methodology, focuses primarily on the role of water movement across the landscape and how water flow in the greater watershed shapes the form and functions of the shorelines. This guidance document recognizes two major types of factors acting upon a watershed: (1) process controls and (2) ecosystem-wide processes.

Process controls are foundational environmental factors (i.e., climate, geology) that form the basis for process interactions at the watershed scale. The combined influence of these process controls in large part determines ecosystem interactions, particularly the movement of water across and through a landscape. For example, the climate of a region, such as the duration and seasonal variability of rainfall, will combine with the geology to influence the surface hydrology of a watershed.

Ecosystem-wide processes are the processes within a watershed that relate to hydrology, sediment transport, water quality, and habitat. These ecosystem processes control the physical form of the landscape and the types of habitats that occur throughout the ecosystem. For example, the flow regime of a river, including modifications to natural flow such as placement of levees, weirs, dams, and other devices, will determine the habitats and shoreline types in that system. Ecosystem processes are formed and function at multiple scales, from the watershed to site-specific or habitat scale.

3.1 Regional Overview

The mainstem Snohomish River forms south of Monroe, where the Skykomish and Snoqualmie Rivers join together. These three rivers—Snohomish, Skykomish, and Snoqualmie—and their tributaries together drain a watershed of 1,856 square miles located in both Snohomish and King Counties (Snohomish County, 2006).

Along with the City of Snohomish, other communities in the Snohomish County portion of the watershed include Everett, Monroe, Lake Stevens, Marysville, Sultan, Gold Bar, Index and the Snohomish and Tulalip Tribes. Over 80% of the population of Snohomish County lives in cities and Urban Growth Areas, with less than 20% in rural areas. Most existing population and development is located in cities and Urban Growth Areas in the western portion of the County (Snohomish County, 2006).

The City of Snohomish is located on the north side of the lower Snohomish River valley, approximately 11 miles upstream from where the river enters Puget Sound at Everett. The city is bordered by the Snohomish River to the south and the Pilchuck River to the east. The Pilchuck River enters the Snohomish River 0.5 miles south of the city limits.

Prior to European settlement, the Snohomish River valley was used by several Coast Salish Indian tribes, including the Tulalip, Pilchuck, Snohomish, and Snoqualmie. Large, permanent winter villages were located along the Snohomish River where people made a living by fishing, hunting, and gathering (City of Snohomish, undated).

European settlers were first drawn to the Snohomish River valley in the 1850s by the deep, fertile soils which were suitable for farming. During the late 1880s, the construction of railroad lines allowed the timber industry to become established in the area. The town of Cadyville, later renamed Snohomish, was founded in 1859 and became the county seat in 1861 (a designation lost to the city of Everett in 1895). Major industries included sawmills, lumber finishing, agricultural and dairy processing, canneries, meatpacking, and railroad services. The city endured several catastrophes over the years, including large fires and recurring floods (City of Snohomish, undated).

Today, resource industries such as timber are still important for the city, but it has become an important residential and historical center of the county as well. Evidence of the city's history is apparent along its shorelines. For example, levees and dikes along the Snohomish River speak to efforts to control flooding along the city's historic downtown area and to protect municipal facilities such as the city's wastewater treatment plant. Residences, docks, and parks around Blackmans Lake exhibit residents' desires to live and recreate in a lakeshore setting.

The Snohomish River watershed supports a variety of fish and wildlife species. Wildlife habitat types that are common in the city of Snohomish and vicinity include freshwater aquatic areas and associated riverine habitats; wetlands and associated riparian areas; lowland conifer-hardwoods; agricultural and pasture areas; and urban areas. In the city of Snohomish and vicinity, wildlife habitats are most suited to species that tolerate some level of human disturbance.

The Snohomish River watershed supports Chinook, chum, coho, and pink salmon; bull trout and Dolly Varden; cutthroat, steelhead, rainbow, and brook trout; and warmwater fish such as smallmouth and largemouth bass, yellow perch, bluegill, and green sunfish (Pentec, 1999; Snohomish County, 2006).

Federally and state listed species known or presumed to occur in Snohomish County include orca whale, spotted owl, gray wolf, grizzly bear, Oregon spotted frog, sandhill crane, bald eagle, marbled murrelet, bull trout, and Chinook salmon (Snohomish County, 2006).

3.2 Process Controls

3.2.1 Climate and Geology

Western Snohomish County has a temperate, maritime climate. Winters are cool and wet, while there is typically a drought period in the summer and early fall. The climate is influenced by Puget Sound to the west and the Cascade Mountains to the east. Average annual precipitation ranges from approximately 30 inches near Puget Sound to 90 inches in the Cascade foothills (Golder, 1999).

The geology of western Snohomish County consists of bedrock underneath layers of glacial sediments deposited by glaciers, as well as sand and gravel (alluvium) deposited recently by modern rivers (Snohomish County, 2006). During the most recent ice age, the Frasier Glaciation approximately 20,000 years ago, a continental ice sheet several thousand feet thick covered all of Puget Sound and extended as far south as Tenino (south of Olympia). The glaciers carved hills and valleys, and left massive deposits of boulders, gravel, and clay across the landscape (Krukeberg, 1991). Today, major rivers drain from the Cascade Mountains to Puget Sound, carving and eroding the glacially formed plateaus of western Snohomish County. Soils in Snohomish County range from poorly drained alluvium in river valleys and floodplains, to well drained soils over compacted glacial till in upland areas (Snohomish County, 2006).

The floodplain of the Snohomish River is widest from its confluence with the Skykomish River to its delta at Puget Sound by Everett and Marysville. The river within this portion of the floodplain has a relatively low gradient, and the river has been channelized and diked over the years to prevent flooding. These measures have limited the river's ability to meander or migrate within its floodplain (Snohomish County, 2006).

3.2.2 Vegetation

The Snohomish River watershed contains a wide range of vegetation types, from marine nearshore areas in the Snohomish River delta to forests in the Cascade foothills. In general, the largest undeveloped areas are located at higher elevation in the eastern part of the watershed, while lower areas toward Puget Sound tend to be the most urbanized.

European settlement, logging, and development have removed much of the native vegetation in the watershed. In the lower valleys and urbanized areas, riparian vegetation is often absent or sparse, consisting mainly of agricultural fields or scattered stands of trees. Vegetation in the vicinity of the city of Snohomish is consistent with the "Eastern Puget Riverine Lowlands" vegetation type described in the *Summary of Shoreline Ecological Functions and Conditions in Snohomish County* (Snohomish County, 2006). This type historically consisted of forests of western red cedar and western hemlock along with wetlands that were cleared and drained for farming and development. These lands are now dominated by agricultural fields, remnant forest, and urban areas. Common native tree species still remaining include western red cedar, western hemlock, red alder, black cottonwood, big leaf maple and Sitka spruce (Snohomish County, 2006).

3.2.3 Land Cover

Since the founding of the City of Snohomish in the 1800s, the city has changed the natural landscape, as is typical of conditions encountered throughout the Puget Sound Lowlands. The Snohomish River floodplain was historically an area of extensive large conifer stands, wetlands, and woody debris. Following European settlement, forests were cleared, large quantities of wood removed to allow navigation, channels straightened, and dikes and tide gates constructed to allow for agriculture (Pentec, 1999).

Today the city of Snohomish is located in a transitional area between rural, agricultural and forestlands to the east, and developed areas such as Everett to the west. Much of the land use in the city is single-family residential, with many residents working in Everett or other surrounding communities.

The city's downtown historic district runs along the north side of the Snohomish River and is a focus of tourist activity. Industrial uses such as lumber processing and the Harvey Field Airport are located on the south side of the river in the city's UGA (Map 10). Modern commercial businesses such as chain restaurants, retail stores, and auto dealerships are focused along the Avenue D/Bickford Avenue corridor. City parks and open space are located largely near Blackmans Lake, on the west bank of the Pilchuck River, and in the southeastern portion of the city (Map 10).

3.3 Ecosystem Processes

The following section describes the landscape-scale processes that shape and influence the freshwater shoreline environments of the city of Snohomish. These processes include the delivery, movement, and loss of water, sediment, nutrients, toxins, pathogens, and large woody debris through the watershed (Stanley et al., 2005). For purposes of discussion, these processes are grouped into the topics of hydrology, sediment, water quality, and organic materials.

Table 3-1 summarizes the key factors or natural controls that typically contribute to these processes under natural conditions. Important locations where these controls occur are also summarized. The sections following the table then discuss how changes to these processes have occurred in the Snohomish River watershed as a result of human activities. This will provide a basis for understanding management issues and priorities, and identifying potential areas for restoration.

Table 3-1. Summary of Landscape-Scale Processes – Controls and Important Areas

Process	Natural Controls	Types of Important Areas
Hydrology (surface and ground water)	Climate and precipitation patterns Timing of snowmelt Soils and geology Vegetation	Recharge areas Rain-on-snow or snow dominated zones Saturated areas Low gradient areas, slope breaks Floodplains Geologic deposits of low or high permeability and contacts between them
Sediment	Topography Soil erodibility Vegetation cover	Steep slopes with erodible soils Landslide hazard areas Unconfined channels Depressional wetlands Lakes Floodplains
Water quality (nutrients, toxins, pathogens)	Climate patterns Geology and soil characteristics Hydrologic regime Biotic cover and composition Wildlife Factors that kill pathogens (UV radiation, pH, etc.)	Steep slopes with erodible fine soils Depressional wetlands Lakes, floodplains, depositional channels Upland areas near water bodies Headwater streams Riparian areas with constant groundwater Geologic deposits of low or high permeability
Organic materials (large wood)	Water energy Riparian vegetation Soil erodibility Topography Climate Biotic interactions	Unconfined channels Mass wasting areas Low gradient channels Forest within 100 ft of water bodies

Source: Summarized from Stanley et al. (2005)

3.3.1 Hydrology (Surface and Groundwater)

Lakes and rivers in Snohomish County receive water via precipitation and groundwater. Water moves through and leaves the watershed through surface flows, evaporation, transpiration from plants, and groundwater movement. In the city of Snohomish and vicinity, major types of alterations to this natural water movement process include: river channelization, diking of floodplains, loss of wetlands, clearing of forests, increased impervious surface, flow diversions, and municipal water withdrawals.

In the past, the Snohomish River migrated across its floodplain through an area of large wetlands. Over the past century, however, the lower Snohomish has been channelized and diked, disconnecting the river from its floodplain. Almost all of the major wetlands in the lower basin have been drained. Out of 107 miles of streambank surveyed in the Snohomish basin, Pentec

(1999) found that 35 percent had been diked. These alterations have reduced the capacity of the watershed to store and moderate the flows of surface water (Snohomish County, 2006).

Historical clearing of forests and construction of impervious surfaces have also changed the movement of water through the watershed. Both of these alterations reduce infiltration and change the timing of surface runoff. Most of the subbasins in the Snohomish watershed have peak flows that are considered unhealthy for salmon conservation, based on analyses of forest cover, road density, and impervious surface (Snohomish County, 2006).

Compounding these alterations are the naturally low flows in the Snohomish watershed in the summer, which affect salmonid productivity. In the lower basin, the groundwater table is relatively shallow and connected to surface water. "This means that groundwater withdrawals and other land uses that affect aquifer water levels have the potential to affect peak and low flows. Since impervious areas reduce aquifer recharge, land uses with high impervious surface areas are likely result in reduced flows in rivers and streams in the basin" (Snohomish County, 2006).

The only river in the Snohomish watershed where water withdrawals are known to cause low flows is the Pilchuck River (Snohomish County, 2006). During summer months, it is estimated that withdrawals by the City of Snohomish can remove 5 to 20 percent of the summer low flows from the river (Pentec, 1999; Steward and Associates, 2004). Potential low instream flow is a factor affecting aquatic habitat degradation in the Pilchuck River (Snohomish County, 2006).

The hydrology of Blackmans Lake has been significantly altered to maintain desired water levels in the lake. The lake historically discharged to Swifty Creek, which runs south through the city into the Snohomish River (Map 4). In the 1980s, a flow splitter was installed to direct high flows in Swifty Creek through a pipe system that discharges into the Pilchuck River. Low flows discharge to the Snohomish River, while flows above 1 to 2 cfs discharge to the Pilchuck River bypass pipe.

3.3.2 Sediment

"Sediment delivery to aquatic ecosystems is a natural phenomenon with a natural range of variability; however, excessive amounts of sediment can undermine the condition of many types of aquatic ecosystems" (Stanley et al., 2005). Under natural conditions, sediment reaches aquatic ecosystems through surface erosion, mass wasting, and erosion from within the stream channel. Excess sediment can result from human activities that expose soils and increase runoff without providing adequate erosion control measures.

Sediment is generally transported through high gradient (steeply sloping) streams and deposited in lower gradient reaches. Diking prevents flood waters from redistributing sediment across the floodplain, affecting soils, vegetation, and floodplain habitat (Snohomish County, 2006).

Bank erosion above a natural background level can indicate hydrologic or sediment conditions that are out of balance. Surveys by Snohomish County found many streambanks to be unstable, with some potentially sources of excess sediment. Clearing of riparian vegetation, and diking and channelization that alter flow patterns, were suspected as causes (Snohomish County, 2006).

3.3.3 Water Quality (nutrients, toxins, pathogens)

A complex array of chemical and physical processes governs the movement of nutrients (phosphorous and nitrogen), toxins, and pathogens through the watershed. Human activities can directly affect how much of these materials are delivered to the watershed (e.g., overapplication of fertilizers resulting in excess nutrients). Human alterations also indirectly influence how these materials are stored or released in the environment (e.g., draining or filling of wetlands changes adsorption to soil particles or reduces areas available for denitrification).

Runoff from agricultural and residential areas is a significant source of fecal coliform bacteria and nutrients entering rivers and streams in the Snohomish watershed. The contribution of excess nutrients and pathogens is exacerbated by the removal of riparian vegetation and loss of wetlands that would otherwise capture or slow the entry of these pollutants into waterbodies. "Water quality is the poorest in the mainstems of the Stillaguamish and Snohomish rivers where the greatest alterations to forest cover, channel complexity, riparian vegetation, and wetlands have occurred." (Snohomish County, 2006)

Heavily developed lakes in Snohomish County have high levels of fecal coliform bacteria and phosphorous due to runoff from residential areas and agricultural activities. Excess waterfowl can also contribute to poor water quality (Snohomish County, 2006).

3.3.4 Organic Materials (large wood)

Large woody debris (LWD) reaches water bodies as trees are transported via landslides, windthrow, and bank erosion (Stanley et al., 2005). Large wood provides habitat structure, shade, and nutrients to aquatic systems. Human activities in the Snohomish area that have altered the process of moving organic materials (large wood) through the watershed include clearing of riparian vegetation, removal of debris jams, and diking of floodplain areas.

Historical clearing of forests from the Snohomish River floodplain removed a major source of woody debris. Out of 107 miles of riparian area surveyed in the Snohomish basin, Pentec (1999) found that nearly two-thirds of the riparian vegetation consisted of grass, brush, or sparse trees.

Diking and channelization of streams, as on the lower Snohomish River, reduces bank erosion and subsequent tree fall (Stanley et al., 2005). Dikes and levees are often maintained to prevent tree growth that would weaken the flood control structure, leading to further loss of potential wood contribution to the stream. In addition, large woody debris jams are often removed from river channels to allow for safe navigation and flood protection (Snohomish County, 2006).

Fallen trees also provide aquatic habitat in lakes. Construction of docks and bulkheads often requires removal of existing wood from the lake and shoreline. On lakes (and rivers) where shoreline vegetation helps to filter stormwater runoff, removal of riparian vegetation can contribute to poor water quality (Snohomish County, 2006).

The loss of riparian vegetation on the Snohomish River has impacted salmonid habitat by reducing the food supply for fry, increasing solar heating of the water, and reducing cover and refuge habitat (Pentec, 1999). Fish habitat features such as complex channels, overhanging cover, and pools have declined in the lower Snohomish River basin. This is due in part to the loss of LWD in the river, which helps to create pools and to collect sediment and gravels (Snohomish County, 2006).

Terrestrial wildlife is also affected because many species depend on wetlands and riparian zones. For example, riparian forests are used by songbirds for nesting and foraging, by big game for forage and calving areas, and by other forest species as movement corridors between rivers and upland habitats (Pentec, 1999).

4 LAND USE ANALYSIS

This chapter describes land use trends and plans in and near the shorelines of the city of Snohomish.

4.1 Trends and Future Demand

State guidelines for SMP updates require that local jurisdictions analyze current and projected shoreline use patterns and trends and identify potential conflicts (WAC 173-26-2013)(d)(ii)). This section focuses on trends and projected demand for shoreline uses.

The City of Snohomish encompasses an area of approximately 3.25 square miles, with another 4.7 miles of unincorporated land within the Snohomish UGA (City of Snohomish, 2010a). As of April 2016, the population within the city was estimated to be 9,625, not including those areas within the UGA. Population growth in Snohomish has averaged approximately 0.5% a year since 2000, which is somewhat lower than the county average of 1.7% per year (OFM, 2016).

The *City of Snohomish Comprehensive Plan*, last revised in March 2016, was developed in conjunction with the *Countywide Planning Policies* adopted by Snohomish County Tomorrow (SCT). SCT is an interjurisdictional forum whose "mission is to adopt a publicly shared vision, including goals and policies, to guide effective growth management and to preserve Snohomish County's unique quality of life" (Snohomish County, 2010).

For the purposes of comprehensive growth planning, the City uses the target population and employment projections developed by SCT for the planning horizon year of 2035. According to this data, the city of Snohomish will have a population of 12,139 within its current city limits by the year 2035, or an average increase of 1.2% per year. Growth within the unincorporated portion of the UGA is estimated to increase to a population of 2,354 in 2035, an increase of approximately 0.4% (Snohomish County, 2016).

4.1.1 Shoreline Development Trends

The city of Snohomish's orientation to the Snohomish River has a long history, and was in fact, the basis for establishment of the community in 1859 (City of Snohomish, 2007). Snohomish developed as a port city, and then as a center for agriculture and industry. A lumber mill was established on the south bank of the Snohomish River in 1900, in the same location that the Seattle Snohomish Mill Company operates today (City of Snohomish, 2010b).

Industrial and commercial businesses continued to develop along the shorelines and in the floodplains of the Snohomish and Pilchuck Rivers over the years, which became an evident problem with the first major flood in 1921. By the 1950s, the City began implementing flood control measures to protect those businesses and homes in the low-lying areas (City of Snohomish, 2010b). Although flooding problems have continued, and the commercial focus has moved away from the water-dependent uses of the past, the focus and heart of the City of Snohomish has remained connected to the rivers.

Today, little remains of the agricultural uses within the city limits, with the few remaining farms in the north and south UGA areas. The City's shoreline planning areas currently contain a mix of industrial, commercial, residential, horticultural, and parks and open space uses. The waterfront areas along the Snohomish River are dominated by industrial and commercial uses, including the Downtown Historic Business District and the Seattle Snohomish Mill Company (currently not operating). The Pilchuck River and Blackmans Lake shorelines are predominantly residential areas interspersed with many parks and open spaces.

4.1.2 Demand for Water-Dependent Uses

Water-dependent uses in Snohomish have historically included commerce, transportation, sustenance, and recreation (City of Snohomish, 2008). The demand for water-dependent uses has decreased with the change in the economic basis of the community. Where the City of Snohomish once depended on the river as a source of transportation and commerce, it has now become a destination for recreation and tourism.

The City adopted *Imagine Snohomish* in 2007 as a five-year plan "to help promote both community vitality and character" (City of Snohomish, 2007). This strategic plan set five goals intended to work together to help the City manage its financial and planning objectives. Among the specific steps identified to obtain these goals are several relating to the City's shorelines. Strengthening and further developing the downtown area's orientation to the Snohomish River is key, as well as promoting both rivers and Blackmans Lake for tourism and increased public access.

Based on recommendations in the *Snohomish Riverfront Master Plan* (1998) and the *Master Plan 2002 Update*, additional redevelopment of the Snohomish River shoreline, west of the Avenue D Bridge, has been identified as a priority area. Although this area has been developed with commercial and industrial uses for many years, the City would like to see the shorelines redeveloped with more opportunities for public access while at the same time keeping those existing businesses economically viable (City of Snohomish, 2002).

4.1.3 Parks, Recreation, and Open Space

The City of Snohomish Parks, Recreation, and Open Space (PROS) Long-Range Plan provides an analysis of the recreation trends within the city and the region (City of Snohomish, 2007c). This analysis is based on regional information provided in the Statewide Comprehensive Outdoor Recreation Plan, and on estimated demographic and population data. According to the data provided, the average resident participates in the following activities per year:

- Walking/hiking – 26 times;
- Bicycle riding – 9 times;
- Activities at indoor community facilities – 6 times;
- Picnicking – 5 times;
- Water-based activities (fishing) – 5 times;
- Water-based activities (excluding fishing) – 5 times (City of Snohomish, 2007c).

These current use numbers, along with population estimates, were then used to estimate future trends in recreational participation. Overall, participation in most outdoor recreational activities in expected to increase in proportion with population increases.

During the planning process for the current PROS Long-Range Plan, the City of Snohomish updated the way recreation level-of-service (LOS) is determined. The LOS standards now required within the city limits are shown in Table 4-1.

Table 4-1. Parks, Recreation and Open Space LOS Standards

Park Type	LOS Standard
Neighborhood	75% of population within ½ mile of a neighborhood park
Community	90% of population within 1½ miles of a community park
Non-motorized Trails	90% of population within 1½ miles of a trail
Open Space	10% of the City maintained as open space

Source: City of Snohomish, 2007c.

All shoreline planning areas in the City of Snohomish are within areas that meet the LOS standard for community parks; all shoreline planning areas, except for the portion of the Snohomish River west of SR 9, are within areas that meet the LOS standard for non-motorized trails. There is currently only one neighborhood park in Snohomish, which lies on the Pilchuck River shoreline. At the time the PROS Long-Range Plan was adopted, 4% of the City of Snohomish was maintained as open space (City of Snohomish, 2007c).

The Master Plan 2002 Update outlines the City's plan to address "long-term use and preservation of the Snohomish River's north shore" (City of Snohomish, 2002). First and foremost in the plan is development of the City's trail system to enhance the orientation of the downtown area to the Snohomish River and to connect to the regional Centennial Trail system. Public support of and demand for multi-purpose trails have increased in the area over the years, both as a form of recreation and as a non-motorized transportation corridor. Many of the City's planning efforts include components to support the construction of new trails, connections to the existing system, and enhancement of the City's orientation to the riverfront area (City of Snohomish, 1998, 2001, 2002, 2005, 2007a-c, 2008).

Additional information about specific planned facilities in each of the shoreline planning areas is given in the following sections.

4.2 Potential Use Conflicts

As stated in Section 4.1, the SMA requires local jurisdictions to identify potential conflicts between current and projected development trends and SMA objectives. Potential conflicts in this context are focused on competing planning priorities inherent in the overall SMA policy intent, such as the preference for water-dependent uses and for ecological protection. Potential conflicts may also address conflicts between SMA policy objectives and other interests or regulatory requirements affecting shoreline resources.

The City of Snohomish has identified a desire to visually enhance the riverfront in the downtown area. The water-sides of many of the businesses along the shoreline are not maintained as well as the street sides, and the City's Pest Management Plan makes maintenance of the landscaping labor-intensive and expensive. In addition, shoreline management requirements for the maintenance of riparian vegetation are not conducive to some shoreline improvements (City of Snohomish, 2008).

Replanting riparian vegetation is identified as an important restoration opportunity in the Snohomish River watershed. However, woody vegetation is often removed during levee maintenance. Planting native trees on top of levees or dikes may be in conflict with the need to maintain these flood control facilities.

Lakeshore landowners often maintain their properties as lawns or with ornamental landscaping that allows views and access to the water. This type of vegetation maintenance can be in conflict with restoring native woody vegetation along the shoreline to improve lakeshore ecological functions.

Restoration projects in the vicinity of Harvey Field airport will need to consider the potential to attract birds that may result in birdstrike hazards for aircraft.

The city currently receives drinking water from both the City of Everett and via withdrawals from the Pilchuck River. If larger withdrawals from the Pilchuck River occur, as allowed under the City's water right and to accommodate a growing population, this may be in conflict with the need to protect fish habitat during summer low flows.

5 SNOHOMISH RIVER

5.1 Physical and Biological Characterization

5.1.1 Process and Channel Modifications

The major process and channel modifications to the lower Snohomish River in the vicinity of the city of Snohomish include:

- Construction of levees and dikes, which disconnected the river from its floodplain and reduced off-channel habitat;
- In-stream gravel mining;
- Clearing of forest from the floodplain and riparian areas;
- Increased surface runoff, stormwater pollution, and sedimentation due to increased impervious surfaces in developed areas;
- Filling and draining of wetlands;
- Removal of large wood from the river to allow for navigation and protect structures; and
- Fecal coliform and excess nutrients in runoff from agricultural and residential areas.

The Snohomish River valley was historically a mosaic of wetlands and forests, and the river transported large quantities of woody debris. In 1864, logging began along the mainstem, and logging companies used the river to store and transport timber. Beginning in the 1860s and continuing to the present, thousands of snags have been removed from the river to remove boating hazards and protect bridges (Haas and Collins, 2001).

Settlers began to build levees in the Snohomish River valley before the turn of the century. Formal diking and drainage districts were formed in the early 1900s. Currently over 40 miles of levees protect almost 20,000 acres in the Snohomish River valley from flooding (Snohomish County Public Works, 1991). Approximately 53% of the Snohomish River banks between Port Gardner Bay and French Creek (just upstream of the Pilchuck confluence) are armored (Snohomish County Public Works, 2009a). The area of side-channel sloughs accessible to juvenile salmonids has decreased by 55% compared to historic conditions (Haas and Collins, 2001).

Between 1962 and 1991, approximately 5,000 to 6,000 cubic yards of gravel were mined each year from the Snohomish River channel just upstream of the city (river mile 13.7). Additional gravel mining is known to have occurred along the river both upstream and downstream of the city limits. The effects of gravel mining on river systems have recently begun to be studied and better understood. It is known that removing material from a river channel can lead to channel incision (downcutting) for a considerable distance downstream. A change in the channel elevation can affect the local groundwater table and alter base flows. Instream gravel mining can change the shape and elevation of the channel, and reduce the formation of gravel bars downstream. Mining may involve clearing riparian vegetation and removing large wood from the channel. During mining operations, increased fine sediment may infiltrate fish spawning gravels and fill pools. Together these changes can negatively impact fish habitat (Kondolf, 2001). The degree to which the shorelines of Snohomish were affected by mining is not known.

5.1.2 Drainage Basin, Tributary Streams and Associated Wetlands

The Snohomish River drains 342 square miles (Pentec, 1999). The mainstem Snohomish River extends from Port Gardner Bay upstream to the confluence of the Snoqualmie and Skykomish Rivers at river mile (RM) 20.5 (Haring, 2002). The lower portion of the river, up to approximately RM 8.1, flows through estuarine habitat. The city of Snohomish is located upstream of the estuarine area, on the north bank of the Snohomish River at approximately RM 12.6. From approximately RM 8.1 to RM 15.3, the river channel is diked and armored. Daily tidal fluctuations in this part of the river are up to 11 feet (Steward and Associates, 2004).

Tributaries to the Snohomish River within the city's shoreline planning area include Swifty Creek, which enters the river at RM 12.9, and the Pilchuck River, which enters the Snohomish at RM 13.4 (Haring, 2002). Swifty Creek is the outlet stream from Blackmans Lake.

A large wetland complex is located adjacent to the City's wastewater treatment plant in reach SNO_RV_03 (Map 4). This wetland includes palustrine emergent, scrub-shrub, and forested vegetation communities. The wetland covers approximately 18 acres, or 33% of reach SNO_RV_03. Cemetery Creek meanders through this wetland system and discharges to the Snohomish River at a point just north and west of the city limits (Map 4). This wetland is believed to be part of a historical meander of the Snohomish River that was cut off when the river was channelized. Tides now create large off-channel pools in the wetland that may provide salmonid juvenile rearing and adult holding habitat (Steward and Associates, 2004).

5.1.3 Geologic and Flood Hazard Areas

The floodplain of the Snohomish River is mapped as an aquifer recharge area (Map 4). The aquifer is fairly shallow and therefore may be sensitive to groundwater pollution.

Localized steep slopes are present in the shoreline planning area (Map 6). These slopes are typically associated with armored riverbanks. Mapping data for erosion and landslide hazards is currently being developed by the City including review of existing State Department of Natural Resources data sources use of digital elevation model / LiDAR data. This review and mapping will likely identify the riverbank along the city's downtown area (from Avenue D to Cady Park), where a history of bank failures suggests potential for reoccurrence in the future due to flooding, heavy rains, or major seismic events (City of Snohomish, 2002). The downtown shoreline area and the river floodplain are mapped as having moderate to high susceptibility to liquefaction (Map 7). The design and construction of the City's new Riverfront Trail includes measures to minimize the risk of future slope failures along this portion of the riverbank.

The Snohomish River shoreline planning area is located within the mapped floodway and the 100-year floodplain (Map 8). Numerous large and destructive floods have occurred in the city over the years. Like other major rivers in the watershed, the Snohomish River experiences two periods of peak flows each year: during the heavy rains of November – January, and during snowmelt in May and June. Flows are typically lowest in August when there is little rain and the snowpack in the Cascades has melted (Pentec, 1999).

The Snohomish River mainstem channel is currently stable as a result of extensive diking and bank armoring. Channel migration was likely more significant in the past, when the channel could meander across a broad floodplain (Haas and Collins, 2003).

5.1.4 Critical or Priority Habitat and Species

The Snohomish River in the vicinity of the city supports several salmonid species, including Chinook salmon (federally listed threatened), coho salmon, chum salmon, pink salmon, sockeye salmon, bull trout/Dolly Varden (federally listed threatened), and steelhead (federally listed threatened). Of these species, summer Chinook salmon are documented to spawn in this portion of the river (WDFW, 2017a).

The mainstem Snohomish River upstream of the city provides good fish habitat, with features such as gravel bars, riffles, pools, and side channels. The portion of the river from Thomas' Eddy up to the confluence of the Skykomish and Snoqualmie Rivers provides spawning habitat for Chinook, pink salmon, and steelhead; rearing and holding habitat for Chinook; and overwintering habitat for bull trout. Downstream of Thomas' Eddy, the river gradient decreases and the substrate becomes sandy and silty. Dikes and two pump stations protect adjacent farmland from flooding. Because the extensive diking and channelization severely limit overbank flows, finer materials such as sand, silt, and clay tend to be deposited in the flatter, slower moving portions of the lower river channel rather than being distributed across the floodplain. Spawning habitat in this lower reach of the Snohomish River is limited and it serves mainly as a fish migration corridor (Pentec, 1999; Snohomish Basin Salmon Recovery Forum, 2005; Steward and Associates, 2004).

Rearing habitat for Chinook and coho has been degraded by the reduction in floodplain area due to dikes and levees. It is estimated that the Snohomish River floodplain could support 1.2 million pre-smolt Chinook in the mid-19th century but only 36,000 in 1998. The production potential for coho smolt dropped to similar low levels. Drops in salmon productivity are attributed to the disconnection off-channel sloughs and the large Marshland and French Creek marshes (Haas and Collins, 2001). Restoration currently being planned for the mouth of the Snohomish River will reopen some floodplain areas in an effort to reverse this trend.

The Washington Department of Fish and Wildlife (WDFW) maintains a list and mapping of priority habitats and species throughout the state. Priority habitats are those that have a high value to many fish and wildlife species and may be limited or vulnerable. Priority species are those requiring protection or management to ensure their survival (WDFW, 2017b). Priority wildlife habitats mapped in the shoreline planning area of the Snohomish River and the adjacent floodplain include wetlands and riparian zones (Map 5). The wetlands, open water areas, and shoreline trees provide foraging and nesting habitats for priority species such as waterfowl, bald eagle, bats, great blue heron, and pileated woodpecker.

5.1.5 Water Quality

Water quality issues in the lower Snohomish River have recently included low dissolved oxygen, high temperatures, elevated fecal coliforms, and toxins such as metals, phenols, and PCBs (Pentec, 1999). The Snohomish River near the city is included on Ecology's 303(d) list of impaired water bodies due to elevated fecal coliform levels, and is a water of concern for temperature (Ecology, 2008). Water temperature measurements by Steward and Associates near the SR 9 crossing found temperatures above the state standards for salmonids in July and August 2003 (Steward and Associates, 2004).

The City's wastewater treatment plant discharges treated effluent to the Snohomish River within reach SNO_RV_03. On average the plant treats one million gallons of wastewater per day, but this can reach as much as 10 million gallons per day due to combined sewer and stormwater inputs from older parts of the city. The City has plans to separate the stormwater from sewage flows. The City operates the plant under an NPDES permit that sets conditions on plant operation to ensure that federal Clean Water Act requirements are met. The City performs sampling and testing of the quality of effluent discharged into the Snohomish River (City of Snohomish Public Works, undated).

5.2 Shoreline Use Patterns

5.2.1 Existing Land and Shoreline Uses

Table 5-1. Land Uses– Snohomish River

Reach Name	Length (Miles)	Current Shoreline Environment Designation	Land Use Designation* (shows percent of segment)				Historic or Cultural Resources
			City of Snohomish		UGA		
SNO_RV_01	0.37	Urban Suburban Rural	Hist. Business HDR Park Urban Hort.	1% 6% 24% 69%	Industrial O/S	38% 62%	n/a
SNO_RV_02	0.59	Urban	Commercial Hist. Business HDR MDR Parks	65% 26% <1% 1% 8%	Industrial	100%	Snohomish City Historic District (WHR/NRHP**)
SNO_RV_03	0.77	Urban	Commercial O/S Parks SFR	7% 6% 81% 6%	Industrial	100%	n/a

* Land Use Designation definitions: HDR=High-Density Residential; MDR=Medium-Density Residential; SFR=Single-Family Residential; O/S=Open Space; Urban Hort.=Urban Horticulture.

** WHR = Washington Historic Register; NRHP = National Register of Historic Places.

5.2.2 Shoreline Modifications

Shoreline modifications refer to structural alterations of the shoreline's natural bank or construction of a physical element. Such modifications are typically used to stabilize the shoreline and prevent erosion, or to prepare the shoreline for a specific use. These modifications can include levees, dikes, floodwalls, riprap, docks, piers, or other in-water structures, but they can include other actions such as clearing, grading, application of chemicals, or significant vegetation removal (WAC 173-26-231(1)).

The most commonly occurring shore modification is termed shoreline armoring, which typically refers to shore parallel structures such as armoring or riprap used to protect coastal property from erosion (Johannessen and MacLennan 2007). These modifications also alter natural process dynamics. Shoreline armoring typically impedes sediment supply to downstream areas and nearshore habitats. This sediment starvation can cause or heighten erosion along downstream shorelines, and can lead to changes in nearshore substrate composition from sand or mud to coarse sand, gravel, and finally hardpan. This may, in turn, alter the habitat conditions and composition. Construction of shoreline armoring may cover or destroy habitat and overwater structures may deprive vegetation of light. Bulkheads and piers may also affect fish life by diverting juvenile salmonids away from shallow shorelines into deeper water, thereby increasing their potential for predation (Nightingale et al, 2001).

The Snohomish River shoreline planning area has been modified by decades of industrial and commercial uses. In Snohomish, the river is confined on both the north and south by levees. On the north shore is a levee that runs from the western extent of the city limits to just east of SR 9. From there to the eastern extent of the city, the shoreline has been fortified in places with rip rap, such as along the Riverside Trail to the Cady Park boat ramp (an older boat ramp which will be retained as an access and launch point for hand launch of non-motorized boats), and the river subsequently channelized by nearshore development. Similarly, the south shore has also been developed with industrial, agricultural, and residential uses and rip rap in most areas. Lowell Snohomish River Road runs adjacent to the shoreline from the western extent of the city limits to 99^{th} Avenue SE and acts as a levee. Historic floodplains have had most native vegetation removed and have been developed with agricultural, industrial, and commercial uses. Over 60% of the Snohomish River's banks (including areas both within and outside of the city) contain little or no riparian forest (Haas and Collins, 2001).

There are three over-water structures within the Snohomish River shoreline planning area: the SR 9 and Avenue D bridges, and the railroad trestle. The boat launch at 20 Lincoln Avenue, the hand launch ramp at Cady Park, and the unnamed beach access at the east end of the city are the only water access points along this stretch of the river. There are no functional piers or docks in the Snohomish River shoreline planning area.

5.2.3 Shoreline Environment Designations and Land Use

The current SEDs and land use designations for the Snohomish River shoreline planning area are shown in Table 5-1. The current SEDs include a small Rural-designated area on the southeast end of the river and a small area designated as Suburban on the northeast end. The remainder of the Snohomish River shoreline planning area has a designation of Urban (Map 12). The land use designations, established in the Comprehensive Plan, show a mix of commercial, historic business, residential, and parks and open space (Map 10). Land use within the City of Snohomish UGA is predominantly industrial, with some open space. The downtown Historic Business district is described further in Section 5.2.6.

5.2.4 Existing Public Access

A large portion of the Snohomish River shoreline is accessible to the public within the city limits (see Map 11). Along with the current parks and trails in the downtown area, there is also an informal water access point for fishing, and other proposed access points west of the bridge at Avenue D. A summary of the parks and public access facilities within the Snohomish River shoreline planning area is shown in Table 5-2.

Table 5-2. Parks and Public Access – Snohomish River

Reach Name	Public Access Facility Name	Water Access	Comments
SNO_RV_01	20 Lincoln Avenue	☒	Boat launch
	Cady Park	☒	Boat ramp for hand launched, non-motorized boats
	Willow ROW	☐	Unimproved open space
	Unnamed beach access	☒	Unimproved open space
SNO_RV_02	Kla Ha Ya Park	☐	Collectively, the Riverfront Trail, Cady & Kla Ha Ya Parks and the Gazebo are referred to as the Riverfront Community Park
	Avenue A Gazebo	☐	Viewpoint
	Riverfront Trail	☐	ADA accessible
	Visitor's Center	☐	
SNO_RV_03	None	☐	

5.2.5 Historical and Cultural Resources

Historic and cultural resources are documented through a variety of sources. Official registers include the National Register of Historic Places and the Washington State Heritage Register. In 1973, the City adopted an ordinance to protect historic buildings and structures. New construction and remodels are encouraged to retain the historic character within the district. To aid in this, the City developed Historic District Design Standards for this area, which are outlined in SMC 14.225. In 1974, the Historic Business District was placed on the National Register of Historic Places (NRHP). There are approximately 50 historic buildings within this 26-block area. The Historic Business District is known regionally as "The Antique Capital of the Northwest" (City of Snohomish, 2010b).

Previous investigations for cultural resources along the Snohomish River within the city have revealed the presence of historic and prehistoric artifacts. Several debris and lithic (prehistoric rock) scatter sites have been identified within and near the Snohomish River shoreline planning area. These sites are indicative of Native American and Euro-American settlements (Landau Associates, 2008).

5.2.6 Areas of Special Interest

According to Ecology guidelines, areas of special interest to be inventoried include priority habitats, eroding shorelines, developing or redeveloping harbors or waterfronts, dredge disposal sites, and toxic or hazardous waste clean-up sites (WAC 173-26-201(3)(c)(iv)). Priority habitats are discussed above in Section 5.1.4. Eroding shorelines are described in the context of regulated geological hazard areas above. Other elements are described below.

There is only one property listed on any state or federal list for contaminated sites within the Snohomish shoreline planning area that is currently active. The Carterman Property site, on the south bank of the Snohomish River in the City of Snohomish UGA, was reported to have soils contaminated by metals and petroleum products. Ecology reports the status of this site as awaiting a site hazard assessment (Ecology, 2010).

5.3 Reach Scale Assessment

Table 5-3 summarizes the major features of each reach on the Snohomish River.

Table 5-3. Reach Assessment for the Snohomish River

Reach No.	Reach Location	Reach Length (miles)	Land Use	Modifications	Unique Features	Riparian Zones and Wetlands
SNO_RV_01	Cedar Avenue to the BNSF railroad trestle	0.37	Agriculture, open space	Levees, riprap, vegetation removal Substantial impervious areas in downtown Snohomish (Map 9) 35% of reach in low to high intensity development and developed open space (NOAA, 2006)	Significant amount of public land potentially available for public access development (Map 11)	West end of reach has a significant riparian buffer area on north shore
SNO_RV_02	Just east of the SR 9 bridge to Cedar Avenue	0.59	Commercial, industrial, trail access, residential	Levees, riprap, vegetation removal Substantial impervious areas in downtown Snohomish (Map 9) 48% of reach in low to high intensity development and developed open space (NOAA, 2006)	Riverfront Community Park (Map 11) Industries and airport located in large floodplain area south of river	Sparse riparian trees; invasive vegetation along shoreline
SNO_RV_03	Western extent of city limits to just east of the SR 9 bridge	0.77	Public Utility, agriculture, commercial, residential	Levees, riprap, vegetation removal 12% of reach in low to high intensity development and developed open space (NOAA, 2006)	City wastewater treatment plant facility (Map 4)	Large wetland system associated with river and Cemetery Creek

5.4 Opportunity Areas

5.4.1 Restoration

Restoration opportunities for the Snohomish River shoreline are limited by the existing dikes and levees. Where possible, riparian zones could be restored by controlling invasive vegetation and replanting native conifer trees. Techniques in the *Integrated Streambank Protection Guidelines* could be used to incorporate vegetation and large wood into flood control structures (Washington State Aquatic Habitat Guidelines Program, 2003). Removing or setting back dikes would increase wood availability, shade, habitat complexity, and off-channel rearing areas. Engineered logjams could also be added to help accumulate wood and form pools. Fencing to prevent livestock access to the river would also improve water quality (Tulalip Tribes and Snohomish County, 2001).

City-owned properties may present the best opportunities for restoration in areas where shoreline vegetation has been impacted by recreation or other uses. Potential restoration sites include the city's wastewater treatment plant property, city shop yard, Cady Park, Kla Ha Ya Park, urban horticulture property (north bank of river in reach SNO_RV_01 and adjacent floodplain), and open space located on the south bank of the river in reach SNO_RV_01 (see Figure III-2, Steward and Associates, 2004).

5.4.2 Public Access

Several of the city's planning documents have identified public access opportunities that have received support from the community. The *Snohomish Riverfront Master Plan* and the *PROS Long-Range Plan* identified the area on the west end of the city, north of the Snohomish River, as City-owned land that could be redeveloped with new parks and trails (City of Snohomish, 1998, 2002, and 2007c). A draft prospectus was written specifically for this possibility. The prospectus analyzed the potential for property acquisitions/trades, creation of a new trail that would tie into the Riverfront Trail, and construction of a river-servicing location (City of Snohomish, 2005).

Additional projects for parks and recreation are identified in the *Riverfront Master Plan*, the *Riverfront Master Plan Update* and the *PROS Long-Range Plan* (City of Snohomish, 1998, 2002 and 2007c). Included are tie-ins to the regional Centennial Trail, which would create optional "loop trails" within the city. Although none of the proposed tie-ins are located within shoreline planning areas, having a complete, connected trail network would create greater opportunities for access to the existing Riverfront Trail and the Snohomish River shorelines.

6 PILCHUCK RIVER

The shoreline planning area for the Pilchuck River is limited to the west side of the river (Map 2). The city of Snohomish boundary lies along the lower portion of the Pilchuck River, from the approximate alignment with Grove Street in the south, to the approximate alignment with 11th Street in the north (approximately RM 1.3 to RM 2.4 on the Pilchuck River). North and south of this area, the city boundary veers west, outside of the shoreline planning area. The exceptions to this are two parcels owned by the City that are not contiguous with the main city limits (Map 2). One parcel is located northeast and well upstream of the city proper on N. Lake Roesiger Road, at the location of the city's water treatment plant on the Pilchuck River (approximately RM 26). The other parcel, located east of the city proper on Three Lakes Street SE, lies within an optional shoreline planning area in the Pilchuck River floodplain (RM 3.3).

6.1 Physical and Biological Characterization

6.1.1 Process and Channel Modifications

The major process and channel modifications to the lower Pilchuck River in the vicinity of the City of Snohomish include:

- Diking and armoring, which disconnect the river from its floodplain;
- Removal of native riparian vegetation;
- Gravel mining from the channel, gravel bars, and floodplain; and
- Low flows potentially exacerbated by municipal water withdrawals.

Much of the streambank on the lower Pilchuck River has been armored, and native riparian vegetation is lacking along the lower reaches. Large woody debris is lacking, and the river channel lacks habitat complexity such as pools and off-channel areas. Invasive vegetation such as reed canarygrass, Himalayan blackberry, and knotweed is dominant along the river. (Snohomish County Public Works, 2002; Haring, 2002).

Mining of in-channel gravel bars has occurred along much of the lower Pilchuck River. From 1969 to 1972, approximately 45,800 cubic yards of gravel were removed from the river each year. From 1972 through 1991, in-channel mining removed approximately 14,400 cubic yards of gravel from the Pilchuck each year. Floodplain gravel mining has also occurred along the upper Pilchuck River (Kondolf, 2001). The potential effects of gravel mining on river systems and fish habitat are discussed in Section 5.1.1.

The City water treatment plant is located approximately 16 miles northeast of Snohomish at RM 26.4 on the Pilchuck River. A dam diverts river water to the treatment plant. The plant produces approximately one million gallons of potable water a day at full operation. A fish ladder at the dam provides passage for migrating fish. However, constant maintenance of the ladder is required to keep it free of debris and sediment. (City of Snohomish Public Works, undated). In 2016, the City Council passed a resolution to conditionally close the water treatment plant and remove the diversion dam. Current projections estimate the earliest removal of the dam would be 2020.

There are numerous other private water withdrawals on the river for agriculture, irrigation, and other uses (Haring, 2002).

6.1.2 Drainage Basin, Tributary Streams and Associated Wetlands

The Pilchuck River drains an area of approximately 84,000 acres (Haring, 2002). The upper watershed is located in the forested foothills of the Cascades, while the lower portion flows through rural agricultural and residential areas. Along with Snohomish, the cities of Granite Falls and Lake Stevens are located in the Pilchuck River watershed. The Pilchuck River confluence is at RM 13.4 on the Snohomish River. The watershed of Bunk Foss Creek, a major tributary to the Pilchuck River, includes areas in the northeastern portion of the city and northern UGA.

No wetlands are mapped within the Pilchuck River shoreline planning area. The river's floodplain is constrained by steep bluffs on the western bank, and levees along the eastern bank.

6.1.3 Geologic and Flood Hazard Areas

The floodplain of the Pilchuck River is mapped as an aquifer recharge area (Map 4). The aquifer is fairly shallow and therefore may be sensitive to groundwater pollution.

The west bank of the Pilchuck River in the shoreline planning area consists of steep bluffs (Map 6). As a result, the river floodway and 100-year floodplain are constrained to the west and extend mainly to the east and outside of the city limits. Ecology technical assistance staff, however, note that levees and hardening on the east site of the river likely increase river energy and erosion along the steep banks on the City's side of the river. Potential for erosion and associated channel movement (migration) on the west bank of the Pilchuck River should be considered with City's implementation of shoreline management and integrated geologically hazardous areas standards (Olsen, 2010). The floodplain widens in reach PIL_RV_01 near the confluence with the Snohomish River; in this area, Ecology's Floodplain Management group support staff have noted past flood damage occurring in City limits (Steele, 2010; Map 8).

The Pilchuck River shoreline planning area is mapped within an area of moderate to high liquefaction susceptibility (Map 7).

6.1.4 Critical or Priority Habitat and Species

The Pilchuck River in the vicinity of the city supports several salmonid species, including Chinook salmon (federally listed threatened), coho salmon, chum salmon, pink salmon, sockeye salmon, bull trout/Dolly Varden (federally listed threatened), steelhead (federally listed threatened), whitefish, and rainbow and cutthroat trout (Steward and Associates, 2004). The lower Pilchuck River provides spawning habitat for fall Chinook and winter steelhead, and rearing habitat for coho and bull trout/Dolly Varden (WDFW, 2017a; Avery and Hook, 2003).

Salmon habitat in the river is affected by changes in river flows, bank armoring, lack of habitat complexity in the channel, lack of off-channel habitat, and high water temperatures (Avery and Hook, 2003). Gravel mining and bank erosion have contributed to excess sediment in the river. Because the river is cut off from its floodplain, sediments become deposited within the channel.

Pool habitats in the downstream portions of the Pilchuck River are sparse and the substrates embedded with sediment (Steward and Associates, 2004).

The Washington Department of Fish and Wildlife (WDFW) maintains a list and mapping of priority habitats and species throughout the state. Priority habitats are those that have a high value to many fish and wildlife species and may be limited or vulnerable. Priority species are those requiring protection or management to ensure their survival (WDFW, 2017b). Priority wildlife habitats mapped in the shoreline planning area of the Pilchuck River and the adjacent floodplain include wetlands, riparian zones, and urban natural open space (Map 5). The wetlands, open water areas, and shoreline trees provide habitat for priority species such as waterfowl, bald eagle, bats, and pileated woodpecker.

6.1.5 Water Quality

The Pilchuck River is included on Ecology's list of impaired waters as a water of concern for elevated temperatures (Ecology, 2008). Steward and Associates (2004) measured water temperatures above state standards for salmonids near the confluence of Bunk Foss Creek in 2003. However, temperatures they measured in a pool between the Second Street Bridge and the soccer fields were within the standards.

The other major water quality concern for the river is fecal coliform bacteria. The Pilchuck River is included in Ecology's Total Maximum Daily Load (TMDL) plan for fecal coliforms. Pollution sources in the watershed appear to be livestock access to the river, poor pasture management, failing on-site septic systems, and bacterial contributions from urbanized tributary areas (Ecology, 2003).

The river receives high flows from Swifty Creek, the outlet stream from Blackmans Lake (see discussion in Section 7.1.2).

6.2 Shoreline Use Patterns

6.2.1 Existing Land and Shoreline Uses

Table 6-1. Land Uses– Pilchuck River

Reach Name	Length (Miles)	Shoreline Env. Designation	Land Use Designation (shows percent of segment)		UGA		Historic or Cultural Resources
PIL_RV_01	0.32	Urban Rural	Parks	100%	O/S	100%	None
PIL_RV_02	0.43	Urban	Commercial Mixed Use Parks	15% 79% 6%	n/a		None
PIL_RV_03	0.55	Urban Suburban	MDR Mixed Use Parks SFR Urban Hort.	>1% 7% 40% 48% 5%	n/a		None
PIL_RV_05	0.02	n/a	Industrial	100%	n/a		None

* Land Use Designation definitions: MDR=Medium-Density Residential; SFR=Single-Family Residential; O/S=Open Space; Urban Hort.=Urban Horticulture.

6.2.2 Shoreline Modifications

Shoreline modifications along the Pilchuck River are predominantly due to adjacent development resulting in channelization. Areas of near-shore vegetation removal are evident at Pilchuck Park, between 4th and 5th Streets, and sporadically near some single-family homes. Most back-shore vegetation has been removed for residential, parks and commercial development. Other than the road crossings at 2nd Street and 5th Street, there are no other over-water structures. Rip rap and other types of shoreline armoring are evident in places, especially beneath the bridges. There are water access points at both Pilchuck Park and Morgantown Park for swimming; however, there is no boat access.

6.2.3 Shoreline Environment and Land Use Designations

The current SEDs and land use designations for the Pilchuck River shoreline planning area are shown in Table 6-1. Current SEDs include a small Rural-designated area on the south end of the river, an Urban designation from the south end of Pilchuck Park to 7th Street, and a Suburban designation from 7th Street to just north of 11th Street (Map 12). Land uses on the south end of the planning area are dominated by parks and recreation uses, including Pilchuck Park and the privately-owned Stocker Field soccer facility. From 2nd Street to 6th Street, land use designations are mostly commercial and mixed use. North of 6th Street, the majority of the area has residential land use designations, with another large portion designated as Parks. In addition, the City of Snohomish owns and has jurisdiction another parcel on the Pilchuck River that is not contiguous with the rest of the city. This parcel, used for the City's water treatment facility, has a land use designation of industrial. Land use designations are shown on Map 10.

6.2.4 Existing Public Access

There are several parks and open space areas along the Pilchuck River, including the City's only neighborhood park and portions of the regional Centennial Trail (Map 11). Although not within the city limits, there are other existing and planned public access facilities along the east bank of the Pilchuck River that provide tie-ins to city facilities, such as the County proposed Pilchuck Community Park and the levy trail that runs south from the 6th Street Bridge. Table 6-2 lists all of the existing public access facilities within the Pilchuck River shoreline planning area.

Table 6-2. Parks and Public Access – Pilchuck River

Reach Name	Public Access Facility Name	Water Access	Comments
PIL_RV_01	Pilchuck Park	☒	Community park; Swimming access
PIL_RV_02	None	☐	
PIL_RV_03	Pilchuck Riverbank - Sixth St.	☐	Community open space; Proposed to be combined with Old Pump House Site as the Pilchuck River Trail*
	Morgantown Park	☒	Neighborhood park; Swimming access; ADA accessible trail
	Centennial Trail	☐	Regional ADA access trail
	Old Pump House Site	☐	Community open space
PIL_RV_05	None	☐	Restricted access public water intake site

*PROS Long-Range Plan (City of Snohomish, 2007c)

6.2.5 Historical and Cultural Resources

There are two identified cultural resource sites within the Pilchuck River shoreline planning area. The first, found in the general vicinity of PIL_RV_01 and PIL_RV_02, was a stone artifact estimated to be from pre-historic times. The second site is the old City of Snohomish cemetery. Long since abandoned, this site was recorded as an historic site in 1976.

6.2.6 Areas of Special Interest

According to Ecology guidelines, areas of special interest to be inventoried include priority habitats, eroding shorelines, developing or redeveloping harbors or waterfronts, dredge disposal sites, and toxic or hazardous waste clean-up sites (WAC 173-26-201(3)(c)(iv)). Priority habitats are discussed above in Section 6.1.4. Eroding shorelines are described in the context of regulated geological hazard areas above.

There were no contaminated or hazardous waste sites identified within the Pilchuck River shoreline planning area.

6.3 Reach Scale Assessment

Table 6-3 summarizes the major features of each reach on the Snohomish River.

Table 6-3. Reach Assessment for the Pilchuck River *

Reach No.	Reach Location	Reach Length (miles)	Land Use	Modifications	Unique Features	Riparian Zones and Wetlands
PIL_RV_01	Just south of the SE city limit, within the UGA, north to 2nd St	0.32	Parks	Bridge crossing for 2nd/92 St. Severe bank erosion downstream of bridge 75% of reach in low to medium intensity development or developed parks (NOAA, 2006)	Open space areas within adjacent floodplain (Pilchuck Park)	Between 0 – 100 feet of riparian vegetation present
PIL_RV_02	2nd St to 6th St	0.43	Residential, Mixed-use, Commercial	Commercial development and impervious surfaces (Map 9) Native vegetation removal, shoreline armoring, invasive vegetation 98% of reach in low, medium, or high intensity land use (NOAA, 2006)	Steep bluff on west riverbank	Approximately 50 feet of riparian vegetation in most places, ranging between 0 – 100 feet present
PIL_RV_03	6th St to the approximate alignment with Ivy St	0.55	Residential, Parks	Residential development and impervious surfaces (Map 9) 84% of reach in low to medium intensity development (NOAA, 2006)	Steep bluff on west riverbank Morgantown Park	Between 50 – 170 feet of riparian vegetation present
PIL_RV_04*	North of Three Lakes St. SE, spanning US Hwy 2	--	Open space along US Hwy 2	Heavily disturbed by major highway traffic and ongoing road maintenance	Outer portion of mapped river floodplain	Reach is separated from river (see Map 2); mostly mowed grass with scattered trees
PIL_RV_05	One City-owned parcel on N Lake Roesiger Rd	0.02	Public utility	Water intake and treatment facility 36% of reach developed (NOAA, 2006)	Diversion dam and City water treatment plant	Riparian vegetation present

* Reach PIL_RV_04 is an area of optional shoreline jurisdiction within the Pilchuck River floodplain, on the east side of the river.

6.4 Opportunity Areas

6.4.1 Restoration

Restoration opportunities for the Pilchuck River include creating off-channel habitat by replacing levees to allow controlled flooding, and restoring riparian zones by controlling invasive vegetation and replanting a mix of native hardwood and conifer trees. Engineered logjams could be added in the channel to help accumulate wood and form pools (Snohomish County Public Works, 2002; Avery and Hook, 2003). Techniques in the *Integrated Streambank Protection Guidelines* could be used to incorporate vegetation and large wood into flood control structures (Washington State Aquatic Habitat Guidelines Program, 2003).

City-owned properties such as those listed in Table 6-2 may present the best opportunities for restoration in areas where shoreline vegetation has been impacted by recreation or other uses.

Steward and Associates (2004) identified potential methods to reduce the effects of the City's water diversion dam on fish passage in the Pilchuck River. These included, for example, creating step pools in the river channel, moving the fish ladder to the opposite side of the dam, removing the dam and converting to groundwater withdrawal, installing an electronic fish monitoring device, and making changes to the existing fish ladder.

In 2016, the City Council decided to start the process to close the city's water treatment plant if certain conditions are realized. The closure would include removal of the dam, fish ladder and intake structure.

6.4.2 Public Access

Additional projects for parks and recreation are identified in the *Riverfront Master Plan*, the *Riverfront Master Plan Update* and the *PROS Long-Range Plan* (City of Snohomish, 1998, 2002 and 2007c). Included are tie-ins to the regional Centennial Trail, which would create optional "loop trails" within the city. Although none of the proposed tie-ins are located within shoreline planning areas, having a complete, connected trail network will create greater opportunities for access to the existing trails and the Pilchuck River shorelines. Future plans could include tie-ins that lead to water access points. Also included in the City's plans is the creation of a new regional park south of Stocker Field (City of Snohomish, 1998, 2002 and 2007c).

7 BLACKMANS LAKE

7.1 Physical and Biological Characterization

7.1.1 Process and Channel Modifications

The major process modifications to Blackmans Lake include:

- Excess nutrients contributed by runoff from residential areas, stormwater runoff drains, waterfowl, pets, and livestock;
- Removal of large wood and shoreline vegetation for construction of docks, bulkheads, and landscaping; and
- Development of the watershed with an associated increase in impervious surfaces.

The Blackmans Lake watershed was historically forested and then logged and used for farming. The watershed experienced a dramatic increase in development between the 1970s and 1990s. Agricultural areas were replaced by residences and other developments, and by the mid-1990s half of the watershed had been urbanized (Snohomish County Public Works, 2003; GeoEngineers, 2007).

The lake experiences seasonal fluctuations in water levels that have led to wintertime flooding and summertime low water. The city has undertaken a project to stabilize the water levels.

7.1.2 Drainage Basin, Tributary Streams and Associated Wetlands

Blackmans Lake has a surface area of approximately 57 acres and a watershed area of 445 acres. The lake's maximum depth is 29 feet (Snohomish County Public Works, 2002, 2003). Blackmans Lake Creek and Grassy Bottom Creek enter the north side of the lake. Swifty Creek is the outlet stream from Blackmans Lake and discharges to the Snohomish River near Cady Park and the Pilchuck River at 6^{th} Street.

A narrow, blind channel known as Champagne Lane extends from the northeastern side of the lake. This channel is maintained by local homeowners. It is included within the Blackmans Lake shoreline planning area (Map 2).

Swifty Creek was historically a tributary to the Snohomish River at RM 20.8 (Steward and Associates, 2004). In the 1980s, a flow splitter was installed to direct high flows in Swifty Creek through a pipe system installed along 6^{th} Street, to discharge into the Pilchuck River. Low flows discharge to the Snohomish River, while flows above 1 to 2 cfs discharge to the Pilchuck River bypass pipe. Much of the Swifty Creek channel has been piped along its course through the city (Snohomish County Public Works, 2002, 2003; TetraTech, 2008).

Approximately 21 acres of wetland are mapped in the Blackmans Lake shoreline planning area (Map 4). These include palustrine emergent, scrub-shrub, and forested vegetation communities located near the lake's inlet and outlet streams. These wetlands cover 19% of the lake's shoreline planning area.

7.1.3 Geologic and Flood Hazard Areas

Moderately steep slopes are located around Blackmans Lake (Map 6). The lake is located in an area with low susceptibility to liquefaction (Map 7).

No flood hazard areas are mapped by FEMA around the lake (Map 8). However, water levels in Blackmans Lake fluctuate seasonally and during wet winter months the lake occasionally floods lakeside properties. High water levels result in part from the lake's constricted outlet through a set of culverts on the south side of the lake. An outlet improvement project completed in 2016 removed accumulated sediment and encroaching invasive vegetation along 370 lineal feet of the existing outlet channel, constructed an additional 580 lineal feet of new channel, and replaced 150 lineal feet of 24-inch culvert. The project included habitat restoration along the outlet channel, including native tree and shrub plantings. By stabilizing the water level of the lake the shoreline ecology should benefit.

In the summer, lake levels drop and affect recreational uses (GeoEngineers, 2007; TetraTech, 2008). The City worked with Snohomish County to install a lake level gauge at Hill Park in 2014. Lake level data will be collected and if the data shows that Blackmans Lake level drops below the recommended minimum elevation, then a new or modified outlet weir would be considered in the future as a means of controlling water levels in the lake.

7.1.4 Critical or Priority Habitat and Species

The Blackmans Lake/Swifty Creek system was historically used by coho salmon, chum salmon, and cutthroat (Snohomish County Public Works, 2002). However, no salmonid use of these water bodies is documented on current Salmonscape mapping (WDFW, 2017a). Barriers such as perched culverts, long pipes, and poor water quality in Swifty Creek prevent fish passage into the stream from the Snohomish and Pilchuck Rivers (Steward and Associates, 2004).

Blackmans Lake supports game fish such as rainbow trout, largemouth bass, yellow perch, and brown bullhead. WDFW stocks the lake with rainbow trout (Snohomish County Public Works, 2003).

The Washington Department of Fish and Wildlife (WDFW) maintains a list and mapping of priority habitats and species throughout the state. Priority habitats are those that have a high value to many fish and wildlife species and may be limited or vulnerable. Priority species are those requiring protection or management to ensure their survival (WDFW, 2017b). Priority wildlife habitats mapped in the shoreline planning area of Blackmans Lake include wetlands and waterfowl concentrations (Map 5). Priority species that are listed as occurring within the vicinity of Blackmans Lake is the little brown bat (*Myotis Lucifungus*), which has a communal roost site in the vicinity of the lake (WDFW, 2017).

7.1.5 Water Quality

Water quality monitoring in the 1990s for tributaries to Blackmans Lake indicated seasonally high stream temperatures, low dissolved oxygen, and high nutrient concentrations (Snohomish County Public Works, 2002).

Between 1996 and 2009, the levels of phosphorous in the upper waters of the lake were moderate but increasing, indicating that nutrients are being carried into the lake from the surrounding watershed. Phosphorous levels in the deeper waters have been decreasing. Phosphorous is a key nutrient for excess algal growth (Snohomish County Public Works, 2010). Ecology's data indicate the lake has recently met water quality standards for total phosphorous (Ecology, 2008). However, the lake has experienced toxic blue-green algae blooms, including a bloom in December 2008 that tested above Washington State Department of Health recreational standards for toxins. There was an additional blue-green algae bloom in fall 2009 which tested positive for toxins but at low levels (Snohomish County Public Works, 2010).

A survey of aquatic plants in Blackmans Lake in September 2009 identified both native and invasive water lilies. Patches of the invasive species, fragrant water lily, were dominant on the northern shore of the lake, while the native species, yellow water lily, was prevalent on the southern shoreline (Snohomish County Public Works, 2010).

Blackmans Lake is included on Ecology's 303(d) list of impaired water bodies due to elevated fecal coliform levels. Blackmans Lake Creek (inlet to the lake) is considered a water of concern for fecal coliforms. Sources of fecal coliforms include abundant waterfowl on the lake and livestock in pastures upstream of the lake. Swifty Creek was found to have *E. coli* concentrations above state standards for primary contact recreation in 2003 (Steward and Associates, 2004; Ecology, 2008).

7.2 Shoreline Use Patterns

7.2.1 Existing Land and Shoreline Uses

Table 7-1. Land Uses– Blackmans Lake

Reach Name	Length (Miles)	Shoreline Env. Designation	Land Use Designation (shows percent of segment)		UGA	Historic or Cultural Resources
BLK_LK_01	1.52	Suburban Rural	O/S Parks SFR	16% 7% 77%	n/a	n/a

* Land Use Designation definitions: SFR=Single-Family Residential; O/S=Open Space.

7.2.2 Shoreline Modifications

The majority of the Blackmans Lake shoreline planning area has been modified for development. Most natural vegetation has been removed in areas of residential and park development to provide views of and access to the water. There are approximately 28 docks and piers on Blackmans Lake.

7.2.3 Shoreline Environment and Land Use Designations

The current SEDs and land use designations for the Blackmans Lake shoreline planning area are shown in Table 7-1. The lake currently has a Rural designation at Ferguson Park and in the wetland areas in the north and northwest. The remainder of the shoreline area has an SED of Suburban (Map 12). Land use designations in this area are a mix of single-family residential, parks, and open space (Map 10). All residences, as well as the parks, are situated to take advantage of lake access.

7.2.4 Existing Public Access

Blackmans Lake is a popular spot for water recreation, including fishing, wildlife viewing, non-motorized boating, and swimming. Two community parks provide formal recreation facilities, and there are two open space areas for informal recreation, hiking, and lake access. Table 7-2 and Map 11 show the parks and public access opportunities on Blackmans Lake.

Table 7-2. Parks and Public Access – Blackmans Lake

Reach Name	Public Access Facility Name	Water Access	Comments
BLK_LK_01	Ferguson Park	☒	Boat launch; Swimming access; Fishing pier
	Hill Park	☒	Swimming access; Fishing piers; ADA accessible trail
	Lake Mount Site	☒	Community open space
	Casino Royale – Powerline Trail	☐	Community open space; Trail

7.2.5 Historical and Cultural Resources

There are no historical or cultural resources identified within the Blackmans Lake shoreline planning area.

7.2.6 Areas of Special Interest

According to Ecology guidelines, areas of special interest to be inventoried include priority habitats, eroding shorelines, developing or redeveloping harbors or waterfronts, dredge disposal sites, and toxic or hazardous waste clean-up sites (WAC 173-26-201(3)(c)(iv)). Priority habitats are discussed above in Section 7.1.4. Other elements are described below.

There were no contaminated or hazardous waste sites identified within the Blackmans Lake shoreline planning area.

7.3 Reach Scale Assessment

Table 7-3 summarizes the major features of the Blackmans Lake shoreline planning area.

Table 7-3. Reach Assessment for Blackmans Lake

Reach No.	Reach Location	Reach Length (miles)	Land Use Description	Modifications	Unique Features	Riparian Zones and Wetlands
BLK_LK_01	Shoreline of Blackmans Lake and associated wetlands	1. 52	Residential, parks, open space	Vegetation removal, docks and piers, impervious surfaces (Map 9) 34% of shoreline in medium or low intensity development and developed parks (NOAA, 2006)	Ferguson and Hill Parks Boat launch	Large wetlands near lake inlet and outlet streams

7.4 Opportunity Areas

7.4.1 Restoration

Restoration opportunities for Blackmans Lake include restoring degraded shoreline areas by replanting native vegetation and controlling invasive species such as English ivy and Himalayan blackberry. Problems with excess waterfowl could be addressed in part by posting “no waterfowl feeding” signs at public access areas. The City owns a substantial portion of the Blackmans Lake shoreline, including Ferguson Park and Hill Park, where restoration could be undertaken. In 2016, the City completed Blackmans Lake Outlet Control Project efforts, which included constructing a new parallel overflow channel along Ferguson Park Road and Avenue A; cleaning the existing channel downstream of the Woodlake Manor driveway; and constructing a gravel shoulder along Ferguson Park Road and Avenue A to function as a pedestrian path and access for maintenance equipment to clean the overflow channel as needed. The overflow channel, along with 150 lineal feet of replaced 24-inch culver along Ferguson Park Road, are intended to address the high lake levels and decrease incidents of flooding. Previously in late 2013, sediment and debris were removed from the culverts at the Woodlake Manor driveway, 13th Street and Smithson Place. At that time the culverts were inspected and it was determined that they were in acceptable condition and would not be replaced presently. Other improvements that were completed as part of the Blackmans Lake Outlet Control Project include: construction of an earth berm, enhancing the outlet channel riparian zone with invasive species control and native plantings and removal of structures and obstructions.

The wetland on the north side of the lake, at the confluence of Blackmans Lake Creek, is important in removing pollutants from surface flows before they enter the lake. Restoration opportunities for this wetland system include planting native vegetation and creating a more sinuous stream channel (Steward and Associates, 2004).

There are also opportunities to educate landowners in the watershed about ways to minimize nutrient inputs to the lake. Measures landowners can take include avoiding use of fertilizers, or using zero-phosphorus fertilizers; preventing erosion from construction sites; repairing failing septic systems; controlling stormwater runoff to the lake; planting buffers of native vegetation along the shoreline; and cleaning up pet wastes (Snohomish County Public Works, 2010).

7.4.2 Public Access

The PROS Long-Range Plan proposed development of a trail that would create a loop route around Blackmans Lake, and would include both on- and off-road segments. Another proposed trail would make use of an existing transmission line right-of-way to connect the neighborhood south of 56th Street SE to the existing Casino Royale open space and trail. As the transmission line is located on private property, creation of this trail would require obtaining an access easement. Although this proposed section does not lie within the shoreline planning area, the connections would enhance public access to Blackmans Lake for the residents to the north.

8 SHORELINE ANALYSIS SUMMARY

This section synthesizes the area-specific issues and opportunities identified in the previous chapters, and provides shoreline management recommendations in the context of other local and regional planning activities.

The City of Snohomish is a smaller community located in the lower portion of the 342-square-mile Snohomish River watershed, at the lower end of the Pilchuck River basin. The ecological functions associated with waters regulated by the City's SMP have been and continue to be caused by conditions largely outside of the control of the City. However, shoreline uses in the city affect the cumulative condition of these waters and are therefore part of comprehensive solutions to these watershed issues. Table 8.1 summarizes the impairments to ecosystem processes described in this inventory, and indicates whether the impairments are primarily at the large (basin) scale, or if they are primarily local, as in at the scale of a specific reach of the shoreline. In some cases, the impairments may be at both the basin and the reach scales.

Table 8-1 also includes some initial recommendations on how these impaired processes can be addressed. These recommendations are intended to inform the update to the City's shoreline master program by identifying: 1) opportunities for ecological conservation and restoration, and 2) policy issues related to future shoreline use and development.

Table 8-1. Impairments to Shoreline Ecosystem Processes and Management Opportunities

Ecosystem Process	Causes of Impairment to Ecosystem Process	Scale of Alterations	Protection and Restoration Opportunities
Snohomish River			
Water Quality	Loss of riparian canopy has affected river temperature. Changes in land use have increased input of pollutants to the river, including metals, phenols, and PCBs. Fecal coliform and excess nutrients in runoff from agricultural and residential areas issues in the river are likely due to livestock and possibly septic system sources outside of the city.	Basin and Reach	• Encourage low impact development. • Continue to seek funding for upgrades to the City's stormwater and wastewater utilities. • Provide education and incentives to address water quality issues. • Protect and restore riparian vegetation by enforcing critical areas regulations and implementing protection incentives and flexible development tools. • Require fencing to prevent livestock access to the river.
Biological Resources	Historic and current development and bank stabilization have reduced shoreline vegetation and large wood debris. Loss of riparian canopy upstream has affected river temperature and limited salmonids. Water quality problems and physical barriers have reduced fish access to tributaries. Filling and draining of wetlands has reduced fish refuge habitat as well as habitat for amphibian and terrestrial species associated with the river. Construction of levees and dikes, has disconnected the river from its floodplain and reduced off-channel habitat.	Basin and Reach	• Riparian zones could be restored by controlling invasive vegetation and replanting native conifer trees. • Techniques in the Integrated Streambank Protection Guidelines could be used to incorporate vegetation and large wood into flood control structures. • Removing or relocating dikes would increase wood availability, shade, habitat complexity, and off-channel rearing areas. • Engineered logjams could help accumulate wood and form pools. • Remaining wetlands could be protected and wetland restoration encouraged through regulations and incentives
Hydrology	In-stream gravel mining may have caused incision of the riverbed. Increased impervious surfaces in developed areas have increased surface runoff and sedimentation. Construction of levees and dikes has disconnected the river from its floodplain and reduced off-channel habitat.	Basin	• Prohibit instream gravel mining. • Protect and restore riparian and upland wetlands by enforcing critical areas regulations and implementing protection incentives and flexible development tools

Ecosystem Process	Causes of Impairment to Ecosystem Process	Scale of Alterations	Protection and Restoration Opportunities
Sediment Generation and Transport	Disconnection of river from its floodplain and some associated wetlands has altered sediment transport. Changes in land use have increased input of sediment to the river.	Basin	• Update shoreline development standards to control erosion • Protect and restore riparian and upland wetlands by enforcing critical areas regulations and implementing protection incentives and flexible development tools
Pilchuck River			
Water Quality	Removal of native riparian vegetation has adversely affected temperature in the river. Fecal coliform levels are high and are likely due to livestock sources outside of the city.	Basin	• Protect and restore existing wetlands by enforcing critical areas regulations and implementing protection incentives and flexible development tools. • Require fencing to prevent livestock access to the river.
Biological Resources	Removal of native riparian vegetation has adversely affected temperature in the river. Diking and armoring, disconnect the river from its floodplain and off-channel habitat for fish	Basin and Reach	• Protect and restore existing wetlands by enforcing critical areas regulations and implementing protection incentives and flexible development tools. • Require new development to incorporate restoration of native vegetation communities. • Continue to evaluate and secure funding for improvements at the City's dam and fish ladder or removal of both.
Hydrology	Low flows could potentially be exacerbated by municipal water withdrawals. Diking and armoring disconnect the river from its floodplain.	Reach	• Encourage water conservation measures and to minimize demand for water during low flow months.
Sediment Generation and Transport	Gravel mining from the channel, gravel bars, and floodplain may have reduced gravel and altered channel profile.	Reach	• Prohibit gravel mining in the river bed and floodway.

Ecosystem Process	Causes of Impairment to Ecosystem Process	Scale of Alterations	Protection and Restoration Opportunities
Blackmans Lake			
Water Quality	Excess nutrients contributed by runoff from residential areas, stormwater runoff drains, waterfowl, pets, and livestock. Fecal coliform issues from upstream rural land uses, waterfowl, and pets. Low dissolved oxygen, possibly due to breakdown of emergent vegetation. Toxic algae blooms likely caused by elevated phosphorus levels, which have been increasing in recent years in shallow waters	Basin	• Conduct public education on environmentally friendly lakeside living, such as restoring some native vegetation at the lake edge and reducing fertilizer use. • Conduct public education on environmentally friendly watershed living. • Encourage low impact development in basin. • Manage water lilies and other emergent vegetation to reduce artificial buildup of organic debris in lake. • Consider measures for managing waterfowl population and reducing fecal coliform input from livestock and pets.
Biological Resources	Removal of large wood and shoreline vegetation for construction of docks, bulkheads, and landscaping. Fragrant water lily, an invasive, non-native plant species, dominates the north portion of the lake. Barriers such as impassable culverts, long pipes, and poor water quality in Swifty Creek prevent fish passage into the lake from the Snohomish and Pilchuck Rivers. Introduced carp prey upon and displace other fish species.	Reach	• Conduct public education on environmentally friendly lakeside living, such restoring some native vegetation at the lake edge. • Include construction design standards and standards for overwater structures. • Manage invasive fish populations, through education and, if necessary, eradication programs.
Hydrology	Development of the watershed including an increase in impervious surfaces and stormwater runoff.	Basin	• Encourage low impact development in basin. • A weir could be considered in the future as a means of controlling water levels in Blackmans Lake if the level drops below the recommended minimum.
Sediment Generation and Transport	Removal of emergent vegetation from lake may have caused erosion of shoreline beach on south side of lake.	Reach	• Consider emergent vegetation management practices or other methods to reduce erosion.

The land use trends described in previous chapters also pose challenges, especially taken together with addressing impaired ecological functions as required in the guidelines for shoreline master program updates (WAC 173-26). The following recommendations provide a starting point for those policy discussions:

> The City should consider a community education and/or incentive program to identify and develop restoration opportunities on private property that support the overall goals of shoreline management. For example, residents along Blackmans Lake could be encouraged to create native vegetation buffers, reduce the use of fertilizers and pesticides, and/or control or eliminate livestock use, as means to improving lake water quality. To be most effective, this program should extend upstream from the lake as well, and include property owners outside of the shoreline jurisdiction.
>
> This inventory has not identified the need for shorelands to support any specific water dependent uses other than public access to the water. While planning for the shorelines should still allow and support such uses in appropriate locations, the SMP guidelines provide that non-water-dependent uses may be allowed in mixed-use developments. The City should consider requiring any non-water- dependent or non-water-related development in the shoreline to provide for public access improvements, either directly through easements and improvements, or indirectly through a fee-in-lieu program.
>
> The City should consider ways to link improvements in public access with specific areas targeted for shoreline habitat enhancement to offset impacts that public access improvements might have on habitat functions. By establishing a specific plan and formula, the City can facilitate the community's vision of increased connection of the historic downtown business district with the river, such as through view corridors, additional signage and amenities along the riverfront trail, and encouragement of outdoor seating at riverside businesses. For example, the City may want to establish another shoreline area along the Snohomish River outside of the downtown district, or specific areas near downtown where ecological restoration is the primary objective. Applicants for redevelopment of downtown shoreline properties could then provide for restoration of this designated area in lieu of revegetating their own properties. If such a program is instituted, it should also consider public access improvements the City might make, and how the impacts should be offset.
>
> The City should coordinate with the County regarding public access to the Pilchuck River. Public access improvements on the City's side of the river are limited because the river runs adjacent to steep slopes in much of the City jurisdiction, but the east side of the river may be better suited for a low-intensity trail system that would allow the public to enjoy the salmon and steelhead runs and other pleasures of this area. The City should protect this resource through enforcement of its critical areas buffers, including in parks. There may also be opportunities for restoration that the City could sponsor or support.
>
> Standards for management of vegetation, fish, and waterfowl at Blackmans Lake should be carefully reviewed to ensure that they allow flexibility to effectively control invasive non-native species and support long-term ecological restoration, a viable sport fishery, and safe recreational use of the lake.

Standards for all over-water structures could be explored to increase light penetration to the water below. Options may include increasing the structure height over the water, modifying the structure orientation, minimizing the structure size, using grating as a surface material, placing floating docks in deeper water to avoid grounding during low water levels, and considering the potential for carefully placed community docks.

For new shoreline stabilization projects, demonstration of the need for engineered armoring approaches to shoreline stabilization should be required before approval. The use of bioengineering, alternative bank stabilization, and/or soft-shore armoring techniques could be encouraged in the City's shoreline master program.

Incentive programs could be put in place to encourage property owners to replace existing hard armoring with habitat-friendly erosion control structures or to remove existing structures when shore armoring is unnecessary. Similar incentives could be offered to property owners who revegetate shorelines with native woody plant species. Incentives could include allowing reduced setbacks or expansion or reconstruction of a non-conforming structure.

As the City evaluates the feasibility of removing the Pilchuck River Dam or upgrading the existing fish ladder, the City could itemize the benefits to the functions and values of the riparian environment that could be realized.

9 DATA GAPS

The City is currently completing updates to critical areas inventory mapping layers for geologically hazardous areas (including landslide hazard areas and areas with steep slopes), wetlands, streams, and other designated critical areas, based on updates made to the Critical Areas Ordinance (CAO). The updated critical areas inventory mapping layers will support the City in implementing integrated critical areas standards within the updated SMP.

10 REFERENCES

City of Snohomish. 1998. Snohomish Riverfront Master Plan. Adopted October 20, 1998.

City of Snohomish. 2001. Economic Development Plan and Appendix. Snohomish, Washington. January 2001.

City of Snohomish. 2002. Snohomish Riverfront Master Plan 2002 Update. Prepared for the City of Snohomish by MacLeod Reckord. September 3, 2002.

City of Snohomish. 2005. Draft Prospectus Riverfront redevelopment Area. Snohomish Washington. May 17, 2005.

City of Snohomish. 2007a. City of Snohomish, Washington Comprehensive Plan. Adopted April 4, 1995, last amended November 20, 2007.

City of Snohomish. 2007b. Imagine Snohomish, Promoting Vitality and Preserving Character. Prepared for the City of Snohomish by Berk & Associates. January 2007.

City of Snohomish. 2007c. City of Snohomish Parks, Recreation, and Open Space Long Range Plan. Prepared for the City of Snohomish by EDAW/AECOM. Adopted November 20, 2007.

City of Snohomish. 2008. Draft Orientation of Downtown to the Snohomish River. December 15, 2008.

City of Snohomish. 2010a. Quick Facts for the City of Snohomish. Accessed February 2010 at http://www.ci.snohomish.wa.us/QuickFacts.htm.

City of Snohomish. Undated. The Historical Development of Snohomish. Accessed February 2010 at http://www.ci.snohomish.wa.us/HistoryDevelopment.htm.

City of Snohomish Public Works. Undated. Public Works web page. Available: http://www.ci.snohomish.wa.us/EngineeringPublicWorks.htm#Water Treatment Plant. Accessed March 2010.

DAHP (Washington State Department of Archaeology and Historic Preservation). 2010. Washington Information System for Architectural and Archaeological Records Data. Database accessed March 3, 2010.

Ecology (Washington State Department of Ecology). 2003. Lower Snohomish River Tributaries Fecal Coliform Bacteria Total Maximum Daily Load – Detailed Implementation Plan. June 2003.

Ecology (Washington State Department of Ecology). 2008. Water Quality Assessment data. Available: http://apps.ecy.wa.gov/wqawa2008. Accessed February 2010.

Ecology (Washington State Department of Ecology). 2010. Integrated Site Information System. Accessed February 2010 at https://fortress.wa.gov/ecy/tcpwebreporting/.

GeoEngineers. 2007. Swifty Creek Geomorphic Analysis. July 12, 2007.

Golder Associates, Inc. 1999. Snohomish County Ground Water Management Plan. Prepared for the Snohomish County Ground Water Advisory Committee. May 1999.

Haas, A. and B. Collins. 2001. A Historical Analysis of Habitat Alterations in the Snohomish River Valley, Washington, Since the mid-19th Century: Implications for Chinook and Coho Salmon. Tulalip Tribes and Snohomish County Public Works, February 2001.

Haring, D. Salmonid Habitat Limiting Factors Analysis – Snohomish River Watershed, Water Resource Inventory Area 7. Washington State Conservation Commission.

Johannessen, J. and A. MacLennan. 2007. Beaches and Bluffs of Puget Sound. Puget Sound Nearshore Partnership Report No. 2007-04. Report No. 2007-04. Published by Seattle District, U.S. Army Corps of Engineers, Seattle, Washington.

Krukeberg, A.R. 1991. The Natural History of Puget Sound Country. Weyerhaeuser Environmental Books.

Kondolf, G.M., M. Smeltzer, and L. Kimball. 2001. White Paper – Freshwater Gravel Mining and Dredging Issues. Center for Environmental Design Research, Berkeley, CA. Prepared for WDFW, Washington State Department of Ecology, and WSDOT. December 10, 2001.

Landau Associates. 2008. Cultural Resources Report, Snohomish CSO Modifications Project, Snohomish, Washington. Prepared by Douglas F. Tingwall, Linda Naoi Goetz, and Kara M. Kanaby for BHC Consultants, LLC. March 26, 2008.

Nightingale, B. and C. Simenstad. 2001. Overwater structures: Marine issues. Prepared for Washington Department of Fish and Wildlife, Washington Department of Ecology, and Washington Department of Transportation. University of Washington. Seattle, WA.

NOAA (National Oceanic and Atmospheric Administration). 2006. Land cover analysis data. Coastal Services Center. Available: http://www.csc.noaa.gov/crs/lca/tech_cls.html#2.

OFM (State of Washington Office of Financial Management), Forecasting Division. 2008. Washington State Growth Management Population Projections for Counties: 2000 to 2030. March 19, 2008.

OFM (State of Washington Office of Financial Management), Forecasting Division. 2009. 2009 Population Trends, State of Washington. September 2009.

Olsen, Patricia. 2010. Personal communication to P. Lambert (Ecology Shoreline Planner) regarding channel migration hazards in Snohomish. Washington State Department of Ecology Shorelands and Environmental Assistance. Email: July 8, 2010.

Pentec Environmental. 1999. Snohomish River Basin Conditions and Issues Report; Revised Final Report. Prepared for Snohomish River Basin Work Group. December 1999.

Savery, A., and A. Hook. 2003. Habitat Conditions and Chinook Use in the Pilchuck River. Tulalip Tribes Natural Resources Department. September 2003.

Snohomish Basin Salmon Recovery Forum. 2005. Snohomish River Basin Salmon Conservation Plan. June 2005.

Snohomish County. 2006. Summary of Shoreline Ecological Functions and Conditions in Snohomish County. Available: ftp://ftp.snoco.org/Planning_and_Development_Services. Accessed February 2010.

Snohomish County. 2009. Countywide Planning Policies for Snohomish County. Adopted February 4, 1994, last amended September 18, 2009.

Snohomish County. 2010. Snohomish County Tomorrow informational website. Accessed February 2010 at http://www1.co.snohomish.wa.us/County_Services/SCT/.

Snohomish County Public Works. 1991. Snohomish River Comprehensive Flood Control Management Plan. Final – December 1991.

Snohomish County Public Works. 2002. Snohomish UGA Drainage Needs Report. December 2002.

Snohomish County Public Works. 2003. Blackman Lake State of the Lakes Report. March 2003. Surface Water Management.

Snohomish County Public Works. 2009a. Shoreline Inventory Status Report for Snohomish County Critical Area Monitoring. Snohomish County Surface Water Management. January 2009.

Snohomish County Public Works. 2009b. Blackmans Lake 2008 State of the Lakes Update. Surface Water Management, April 2009.

Snohomish County Public Works. 2010. 2009 State of the Lakes Update – Blackmans Lake. February 2010.

SRBSRTC (Snohomish River Basin Salmonid Recovery Technical Committee). 2002. Snohomish River Basin Salmonid Habitat Conditions Review. Snohomish County Department of Public Works, Surface Water Management Division, Everett, WA.

Stanley, S., J. Brown, and S. Grigsby. 2005. Protecting Aquatic Ecosystems: A Guide for Puget Sound Planners to Understand Watershed Processes. Washington State Department of Ecology. Publication #05-06-027. Olympia, WA.

Steel, Chuck. 2010. Personal communication to P. Lambert (Ecology Shoreline Planner). Washington State Department of Ecology Floodplain Management. Email: June 30, 2010.

Steward and Associates. 2004. City of Snohomish Endangered Species Act Response Planning. Prepared for City of Snohomish. May 2004.

Tetra Tech. 2008. Blackmans Lake Level Evaluation: Summary of Outlet Analysis. Prepared for City of Snohomish. January 2008.

Tulalip Tribes and Snohomish County. 2001. Ecosystem Restoration Opportunities in the Snohomish River Valley, Washington. February 2001.

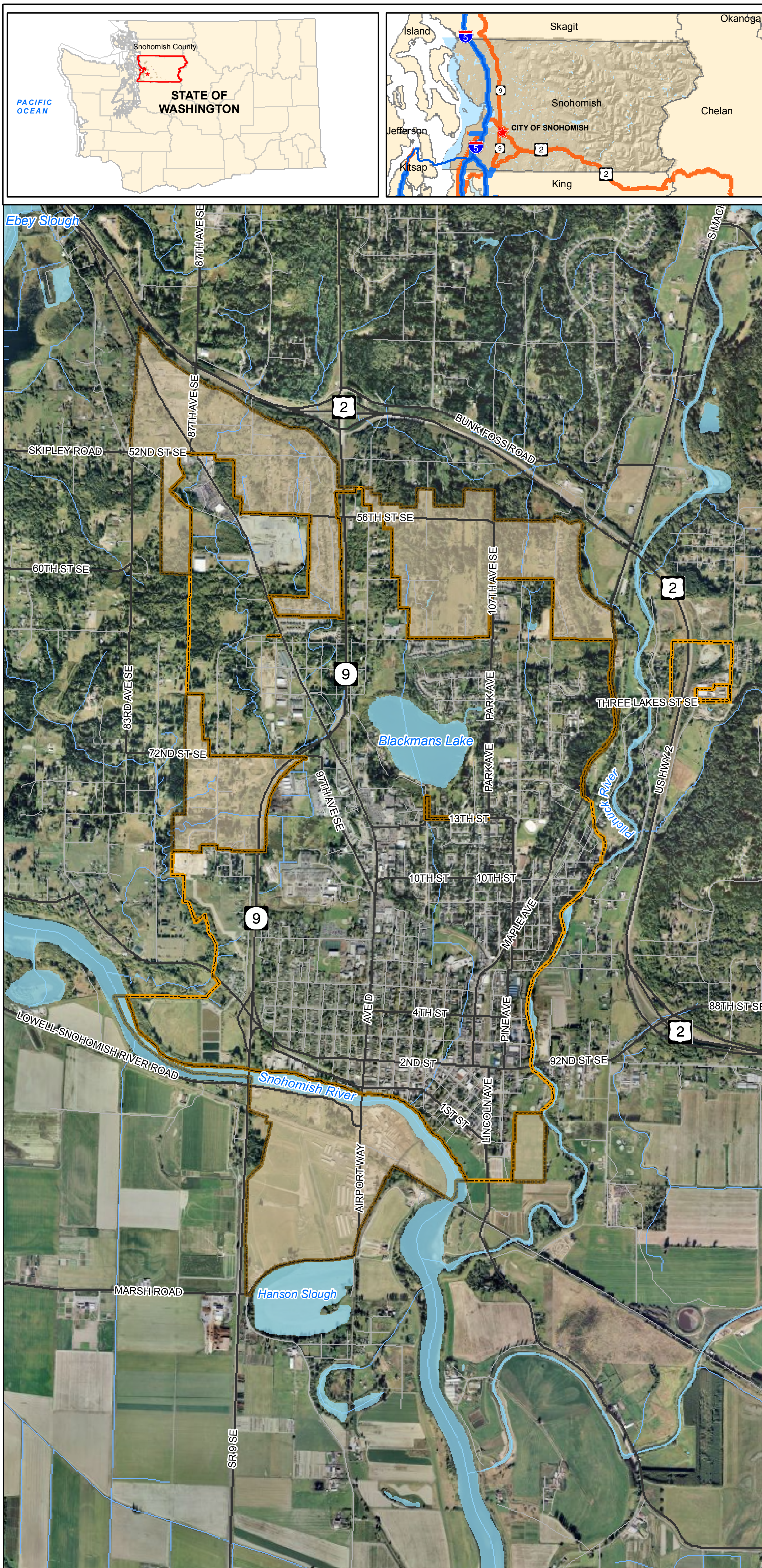
Washington State Aquatic Habitats Guidelines Program. 2003. Integrated Streambank Protection Guidelines. Available: http://wdfw.wa.gov/hab/ahg/ispgdoc.htm. Accessed March 2010.

WDFW (Washington Department of Fish and Wildlife). 2017a. Salmonscape web mapping. Available: http://fortress.wa.gov/dfw/gispublic/apps/salmonscape. Accessed April 2017.

WDFW (Washington Department of Fish and Wildlife). 2017b. Washington State Priority Habitats and Species List. Available: http://wdfw.wa.gov/hab/phslist.htm. Accessed April 2017.

APPENDIX A. MAP FOLIO AND GIS MAPPING DATA SOURCES

Note: For maps presenting critical areas inventory data layers, see also updated critical areas inventory figures prepared for the City in May 2017. Critical areas data layers are presented on Maps 4, 5, 6, 7 and 8.



SNOHOMISH WASHINGTON

Map 1: Vicinity Map

Legend

- City Limits
- Urban Growth Area
- Waterbodies
- Streams
- Major Roads
- Minor Roads

N W E S

0 1,000 2,000

Feet

1" Represents 2,250 Feet

January, 2010

SOURCE: Snohomish County, 2008; Microsoft Virtual Earth Imagery, 2009

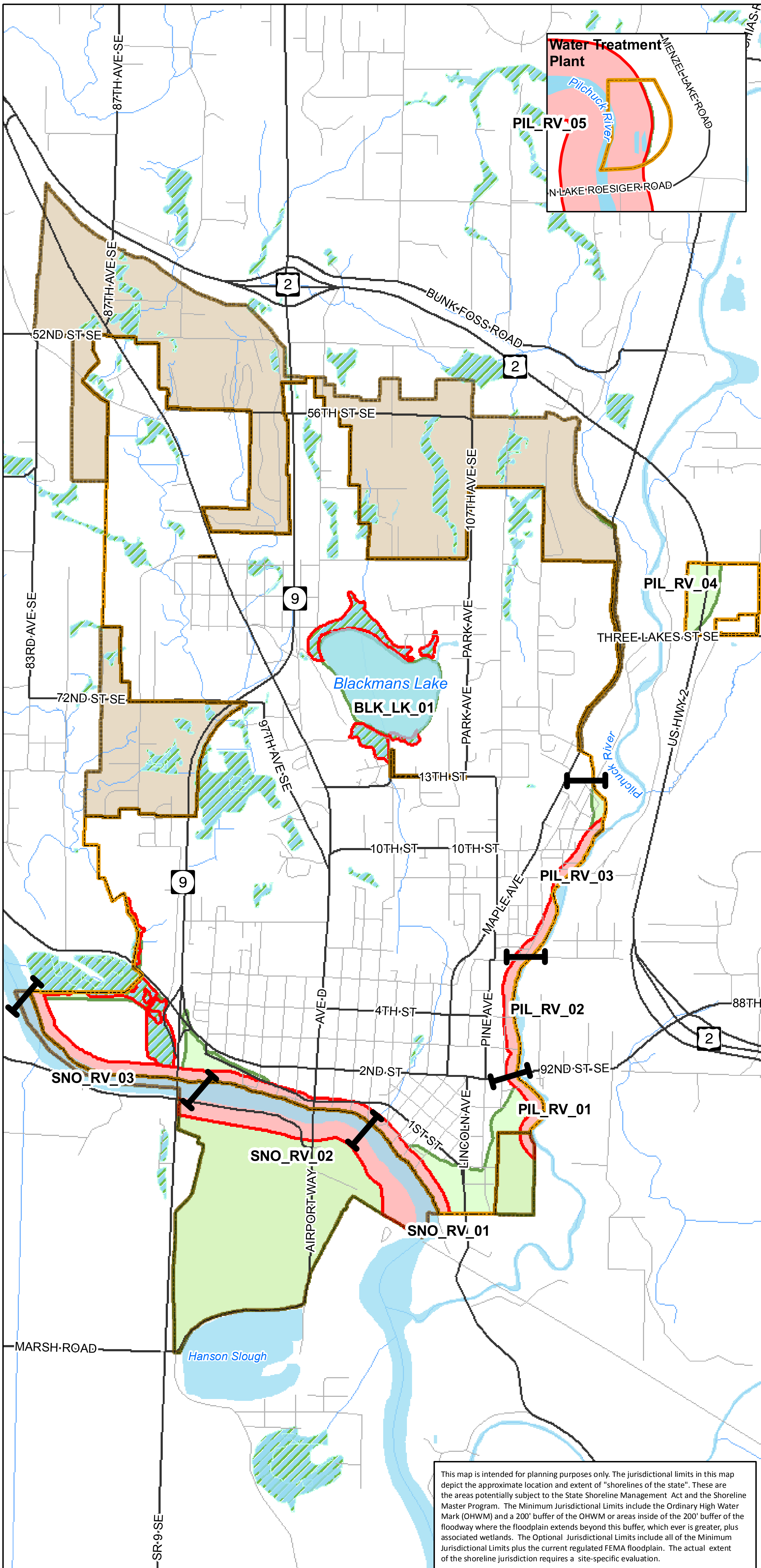
Prepared by: ESA Adolfson, 2010

ESA Adolfson

City of Snohomish
116 Union Avenue
Snohomish, WA 98290
(360) 568-3115
www.ci.snohomish.wa.us

G:\ENVIR IMPACTS\2009 Projects\209491_SnohomishSMP\05_Graphics_GIS_Modeling\GIS\MXDs\MapFolio\VicinityMap_revised.mxd (MJL; 1/14/10)

Map 2: Shoreline Planning Areas



SNOHOMISH
WASHINGTON

Legend

- Shoreline Planning Area Breaks
- OHWM
- Streams

Shoreline Jurisdiction

- Minimum Jurisdictional Limits
- Optional Jurisdictional Limits
- Associated Wetlands
- Wetlands
- Major Roads
- Minor Roads
- City Limits
- Urban Growth Area

N
W E
S
0 1,000 2,000
Feet
1" Represents 2,250 Feet

January, 2010

SOURCE: Snohomish County, 2008.

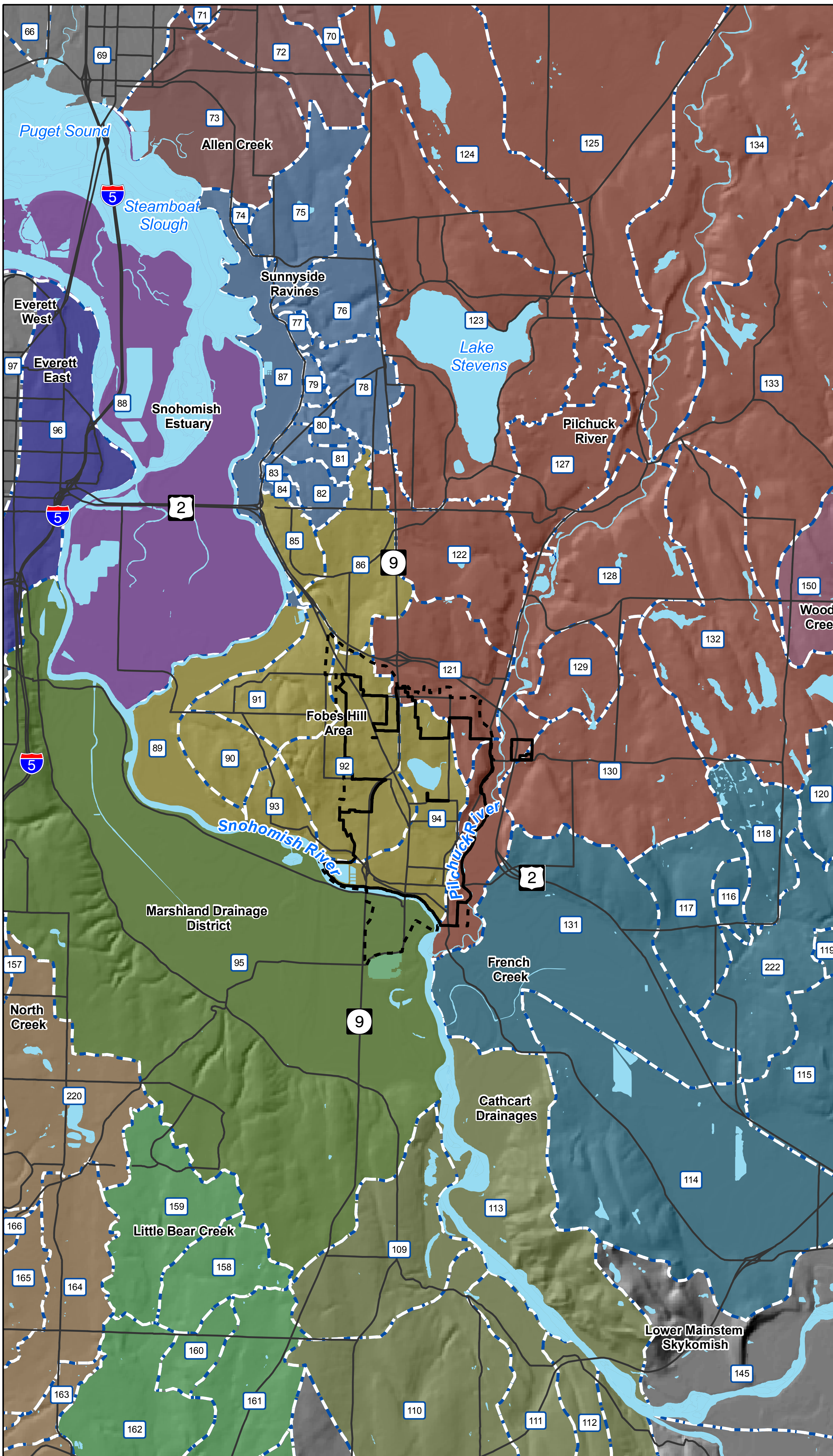
Prepared by: ESA Adolfson, 2010

ESA Adolfson

The City of Snohomish disclaims any warranty of merchantability or warranty of fitness of this map for any particular purpose, either express or implied. No representation or warranty is made concerning the accuracy,currency, completeness or quality of data depicted on this map. Any user of this map assumes all responsibility for use thereof, and further agrees to hold the City of Snohomish harmless from and against any damage, loss, or liability arising from any use of this map. It does not represent survey accuracy. Property lines are for illustrative purposes only and depict generalized parcelization. This map is based on the best available information as of the date shown on the map.

City of Snohomish
116 Union Avenue
Snohomish, WA 98290
(360) 568-3115
www.ci.snohomish.wa.us

G:\ENVIR IMPACTS\2009 Projects\209491_SnohomishSMP\05_Graphics_GIS_Modeling\GIS\MXDs\MapFolio\Shoreline_Planning_Areas_revised.mxd (MJL; 1/14/10)



Legend

Subbasins and Catchments (Number, Catchment)

Allen Creek
70, Upper Allen Creek
71, Middle Allen Creek
72, Munson Creek
73, Lower Allen Creek

Cathcart Drainages
109, Cathcart Drainage
110, Evans Creek
111, Anderson Creek
112, Elliot Creek
113, Lords Hill

Everett East
96, Unnamed

Everett West
97, Unnamed

Fobes Hill Area
85, Cavaleros Road Drainage
86, Mosher Creek
89, Floodplain Area
90, Swans Trail Creek
91, Anderson Creek
92, Cemetery Creek
93, Riverview Road Drainage
94, Blackmans Lake Creek

French Creek
114, Lords Hill
115, Cripple Creek
116, Alston Road Creek
117, Golf Course Creek
118, Stables Creek
119, Chain Lake Creek
120, Spada Road Creek
131, Lower French Creek
222, Upper French Creek

Little Bear Creek
158, Trout Stream
159, Upper Little Bear Creek
160, Doll House Creek
161, Great Dane Creek
162, Middle Little Bear Creek

Marshland Drainage Dist.
95, Unnamed

North Creek
157, 220, Penny Creek
163-165, Silver Creek
166, Nickel Creek

Pilchuck River
121-122, Lower Pilchuck River;
123-126, Little Pilchuck Creek
127-130, Lower Pilchuck River
131, Lower French Creek
132-133, Dubuque Creek
134, Middle Pilchuck River

Snohomish Estuary
88, Unnamed

Sunnyside Ravines
74, Tributary Drainage
75, Sunnyside Creek
76, Hulbert Creek
77, Tributary Drainage
78, Weiser Creek
79, Tributary Drainage
80, Burri Creek
81, Carleton Creek
82, Ravine2
83, Tributary Drainage
84, Ravine1
87, Floodplain Area

Woods Creek
150, West Fork Woods Creek

City Limits
UGA Boundary
Waterbodies

SNOHOMISH
WASHINGTON

Map 3: Subbasins and Catchments

Legend

Subbasins

- Allen Creek
- Cathcart Drainages
- Everett East
- Fobes Hill Area
- French Creek
- Little Bear Creek
- Marshland Drainage Dist.
- North Creek
- Pilchuck River
- Snohomish Estuary
- Sunnyside Ravines
- Woods Creek
- Waterbodies
- City Limits
- UGA Boundary

N W E S

0 0.5 1 2
Miles

1" Represents 7,000 Feet

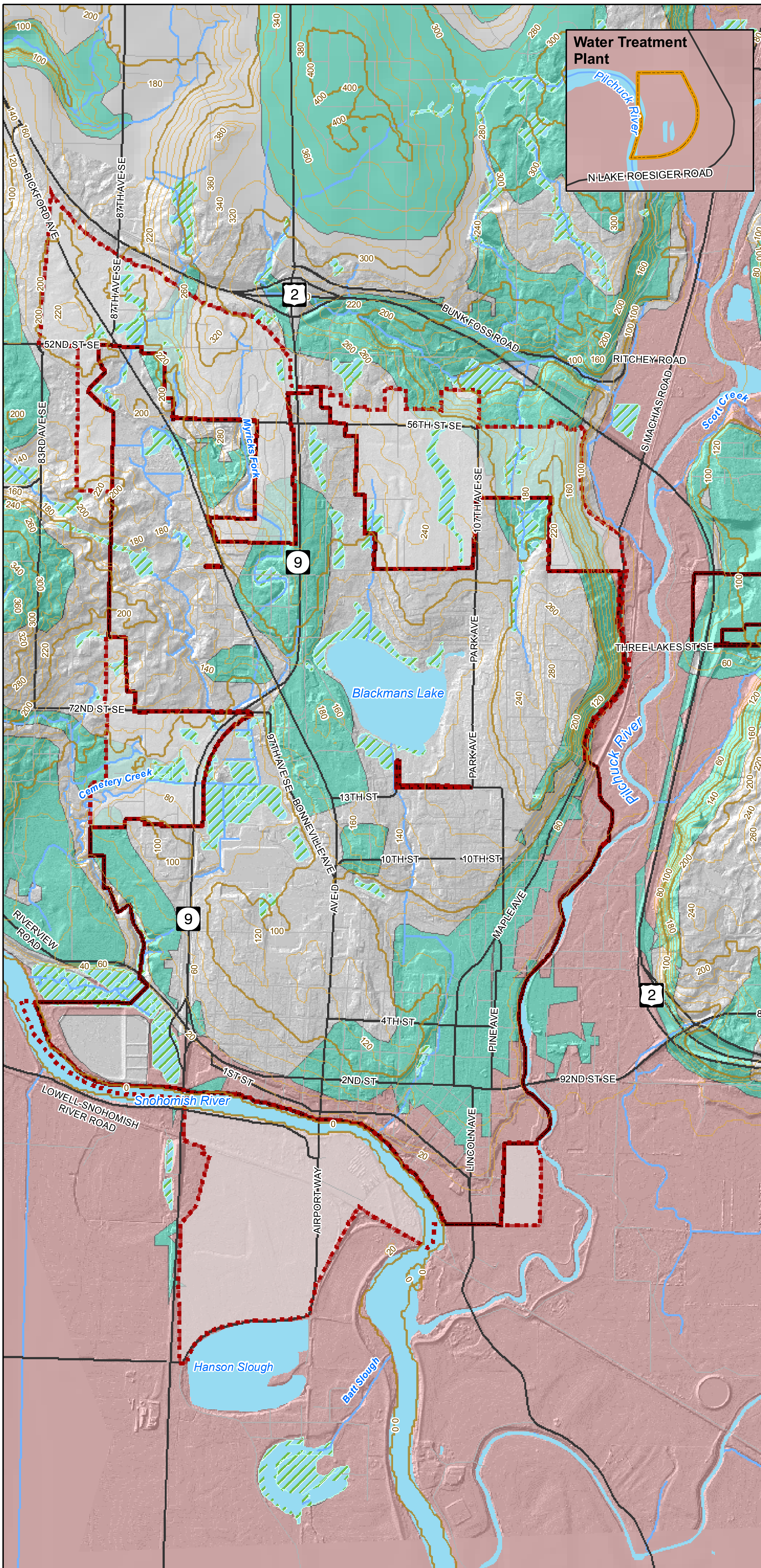
January, 2010

SOURCE: Snohomish County, 2008;
Prepared by: ESA Adolfson, 2010

ESA Adolfson

City of Snohomish
116 Union Avenue
Snohomish, WA 98290
(360) 568-3115
www.ci.snohomish.wa.us

Shoreline Master Program Map 3: Subbasins and Catchments



SNOHOMISH
WASHINGTON

Map 4: Topography and Hydrology

Legend

- Streams
- Waterbodies
- Wetlands

USGS Aquifer Recharge Areas
Aquifer Sensitivity with Depth to Aquifer

- Low, Over 100ft.
- Moderate, 40-100ft.
- High, 0-40ft.
- 100' Contours
- 20' Contours
- Major Roads
- Minor Roads
- City Limits
- Urban Growth Area

N W E S

0 1,000 2,000
Feet

1" Represents 2,250 Feet

January, 2010

SOURCE: Snohomish County, 2008; PSLC, 2003 (LiDAR); USGS, 1997).

Prepared by: ESA Adolfson, 2010

ESA Adolfson

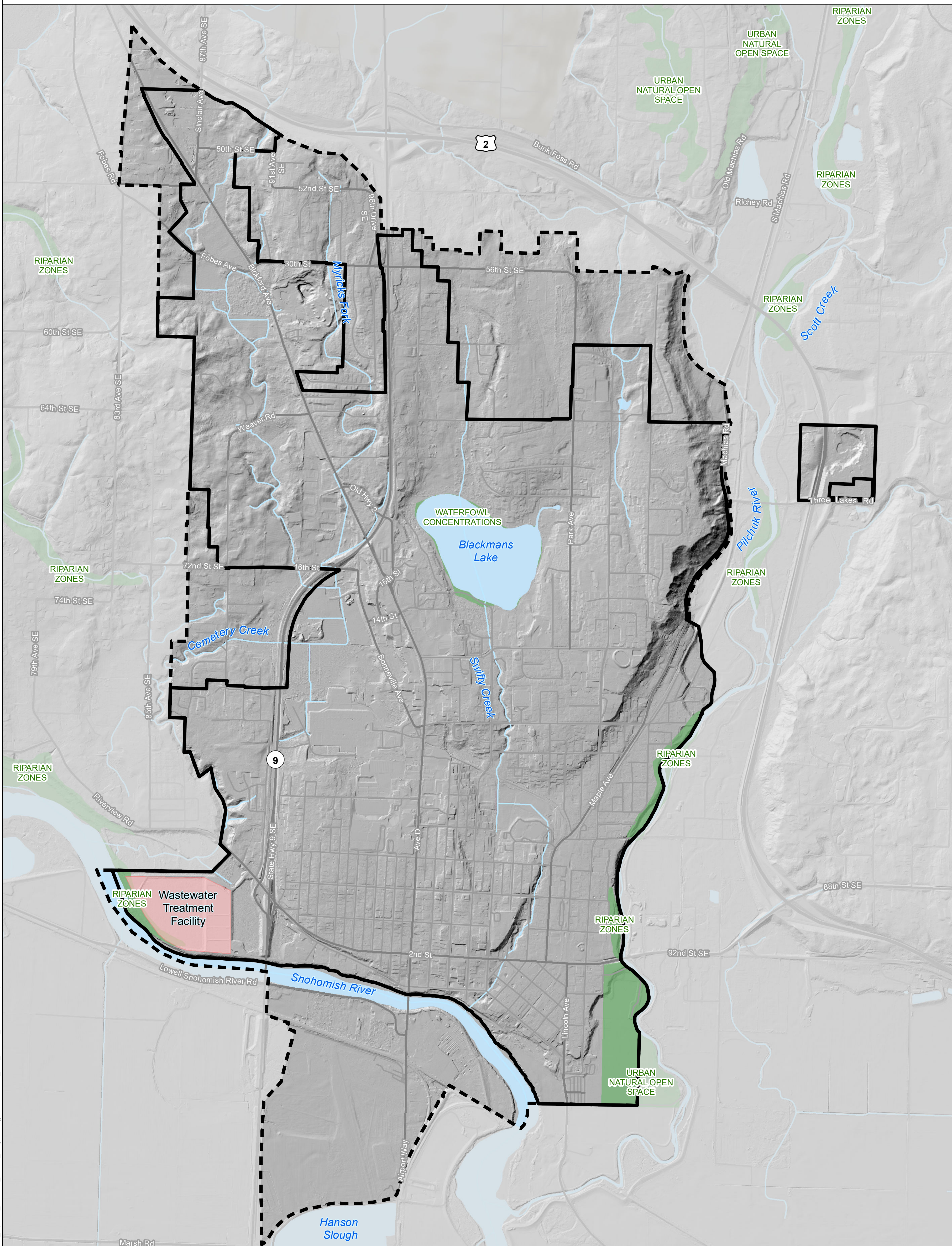
City of Snohomish
116 Union Avenue
Snohomish, WA 98290
(360) 568-3115
www.ci.snohomish.wa.us

G:\ENVIR IMPACTS\2009 Projects\209491_SnohomishSMP\05_Graphics_GIS_Modeling\GIS\MXDs\MapFolio\Topography_Hydrology_revised.mxd (MJL; 1/14/10)

SNOHOMISH
WASHINGTON

Critical Areas Inventory

Priority Habitats and Species Areas



SOURCE: PSLC 2015; Open Street Map, 2016; Wa Ecology, 2016; Snohomish Co, 2016

- Priority Habitats & Species Areas
- Urban Growth Area
- City Limits
- Stream
- Water Body

February, 2017

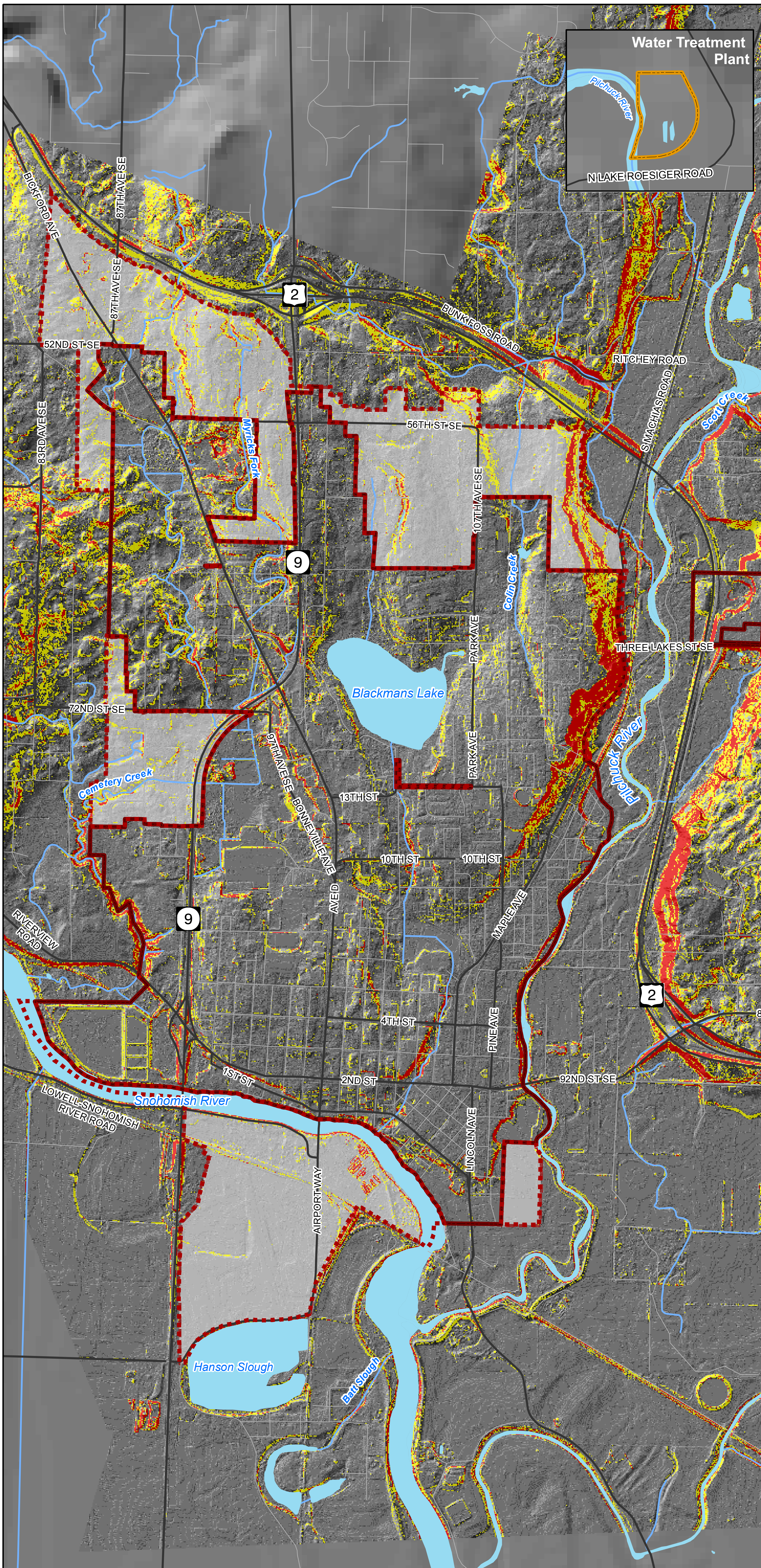
0 0.5
Miles

N

The City of Snohomish disclaims any warranty of merchantability or warranty of fitness of this map for any particular purpose, either expressed or implied. No representation or warranty is made concerning the accuracy, currency, completeness or quality of data depicted on this map. Any user of this map assumes all responsibility for the use thereof, and further agrees to hold the City of Snohomish harmless from and against any damage, loss or liability arising from any use of this map.

ESA

DRAFT



Map 6: Steep Slopes

Legend

Steep Slopes

Degrees

- 0 - 20
- 20.01 - 40.00
- > 40.00
- Streams
- Waterbodies
- Major Roads
- Minor Roads
- City Limits
- Urban Growth Area

N W E S

0 1,000 2,000
Feet

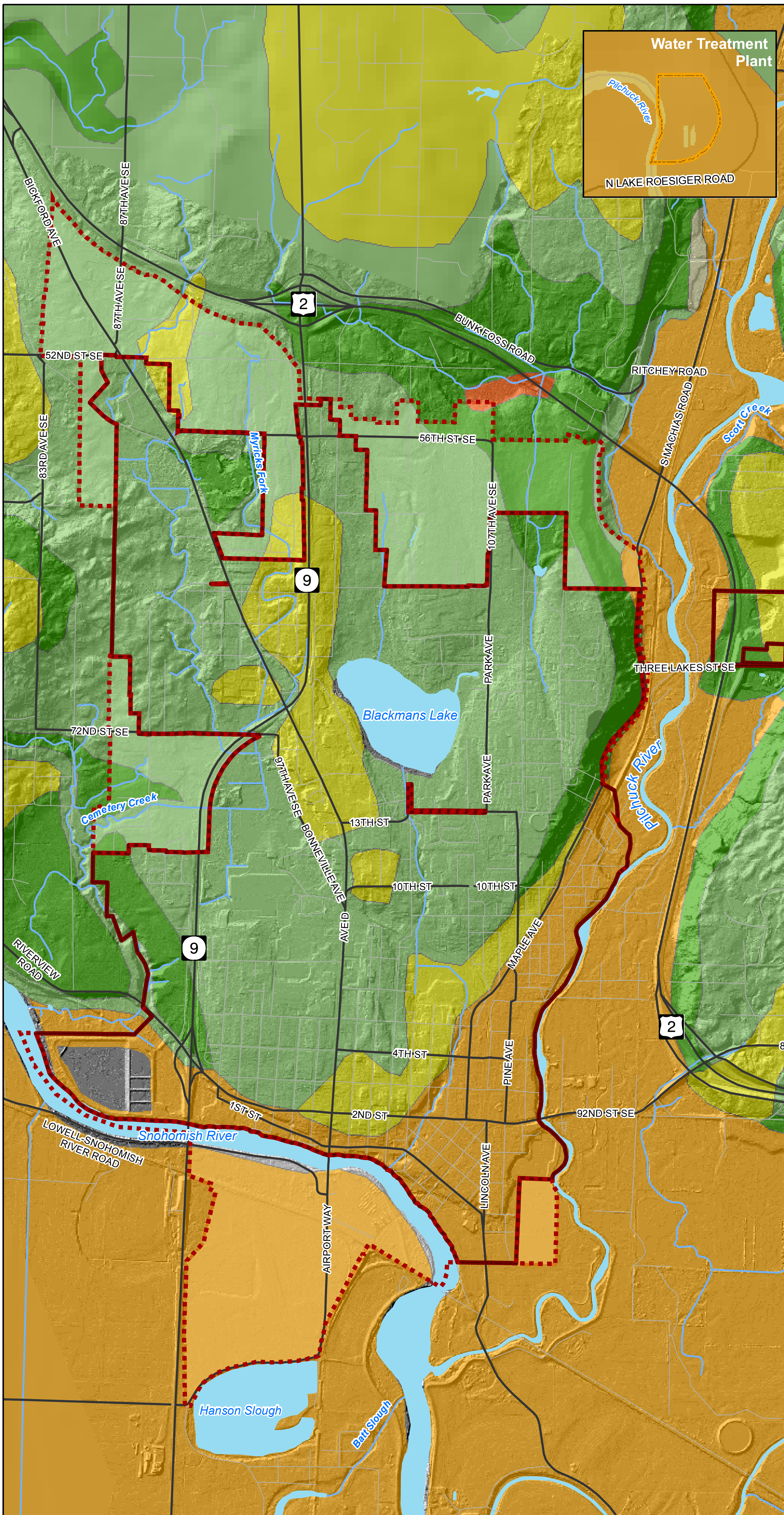
1" Represents 2,250 Feet

January, 2010

SOURCE: Snohomish County, 2008; PSLC (LiDAR), 2005 - Steep Slopes Derived from LiDAR data.

Prepared by: ESA Adolfson, 2010

City of Snohomish
116 Union Avenue
Snohomish, WA 98290
(360) 568-3115
www.ci.snohomish.wa.us



This liquid susceptibility map provides an estimate of the likelihood that soil will liquefy as a result of earthquake shaking. This type of map depicts the relative susceptibility in a range that varies from very low to high. Areas underlain by bedrock or peat are mapped separately as these earth materials are not liquefiable, although peat deposits may be subject to permanent ground deformation caused by earthquake shaking.

SNOHOMISH
WASHINGTON

Map 7: Earthquake Hazard Areas

Legend

Liquefaction Zones (Susceptibility)

- High
- Moderate to High
- Low to Moderate
- Low
- Very Low to Low
- Very Low
- Bedrock
- Peat
- Streams
- Waterbodies
- Major Roads
- Minor Roads
- City Limits
- Urban Growth Area

N
W E
S

0 1,000 2,000
Feet

1" Represents 2,250 Feet

January, 2010

SOURCE: DNR, 2004 (Liquefaction data); Snohomish County, 2008;

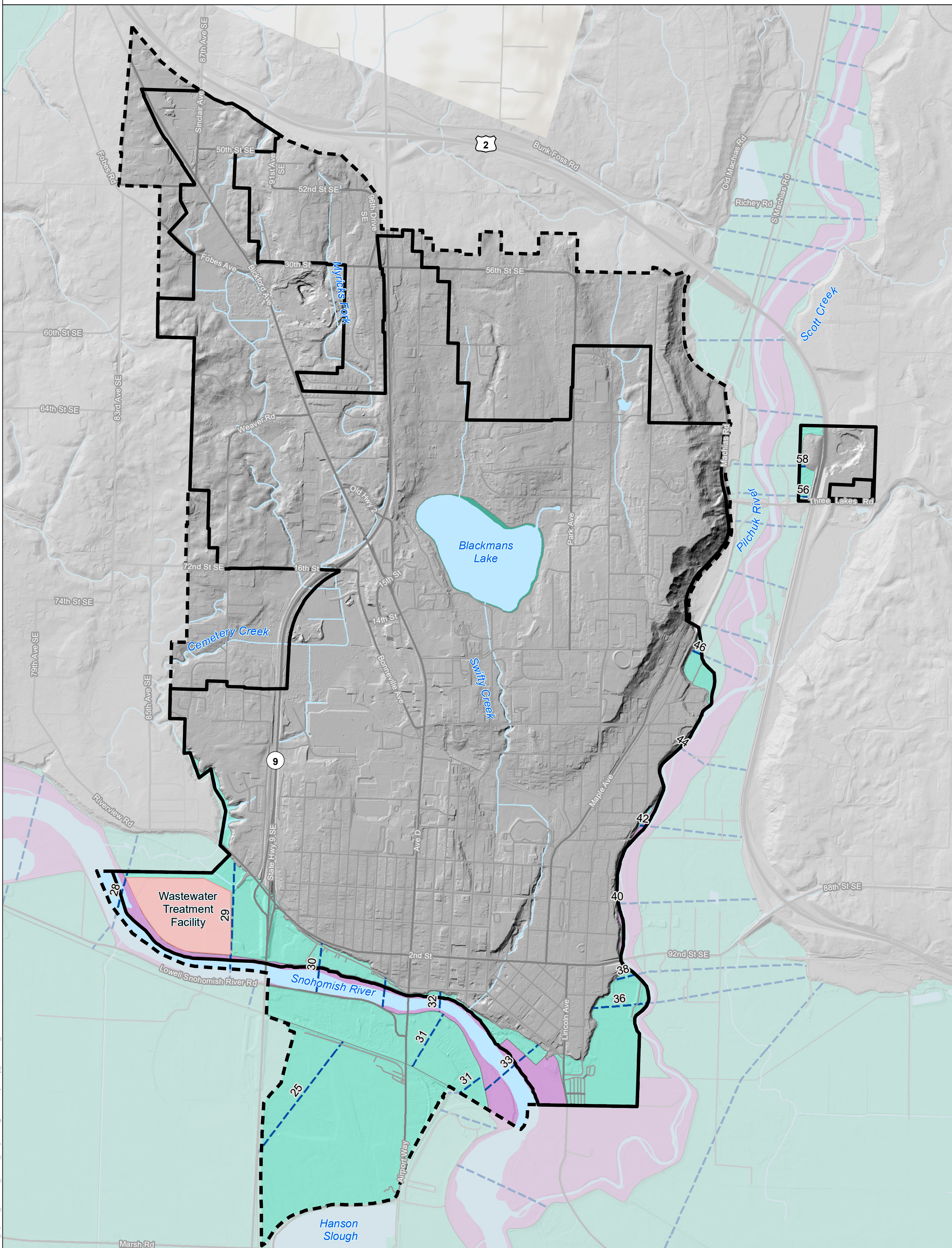
Prepared by: ESA Adolfson, 2010

ESA Adolfson

City of Snohomish
116 Union Avenue
Snohomish, WA 98290
(360) 568-3115
www.ci.snohomish.wa.us

Critical Areas Inventory

Frequently Flooded Areas



SOURCE: PSLC 2015; Open Street Map, 2016; Wa Ecology, 2016; Snohomish Co, 2016

1% Chance Annual Flood Zone

- Zone A - No Elevation Established
- Zone AE - Elevation Established
- Floodway

- Base Flood Elevation Line & Value (Feet Above Sea Level, NAVD88)
- Urban Growth Area
- City Limits
- Stream
- Water Body

February, 2017

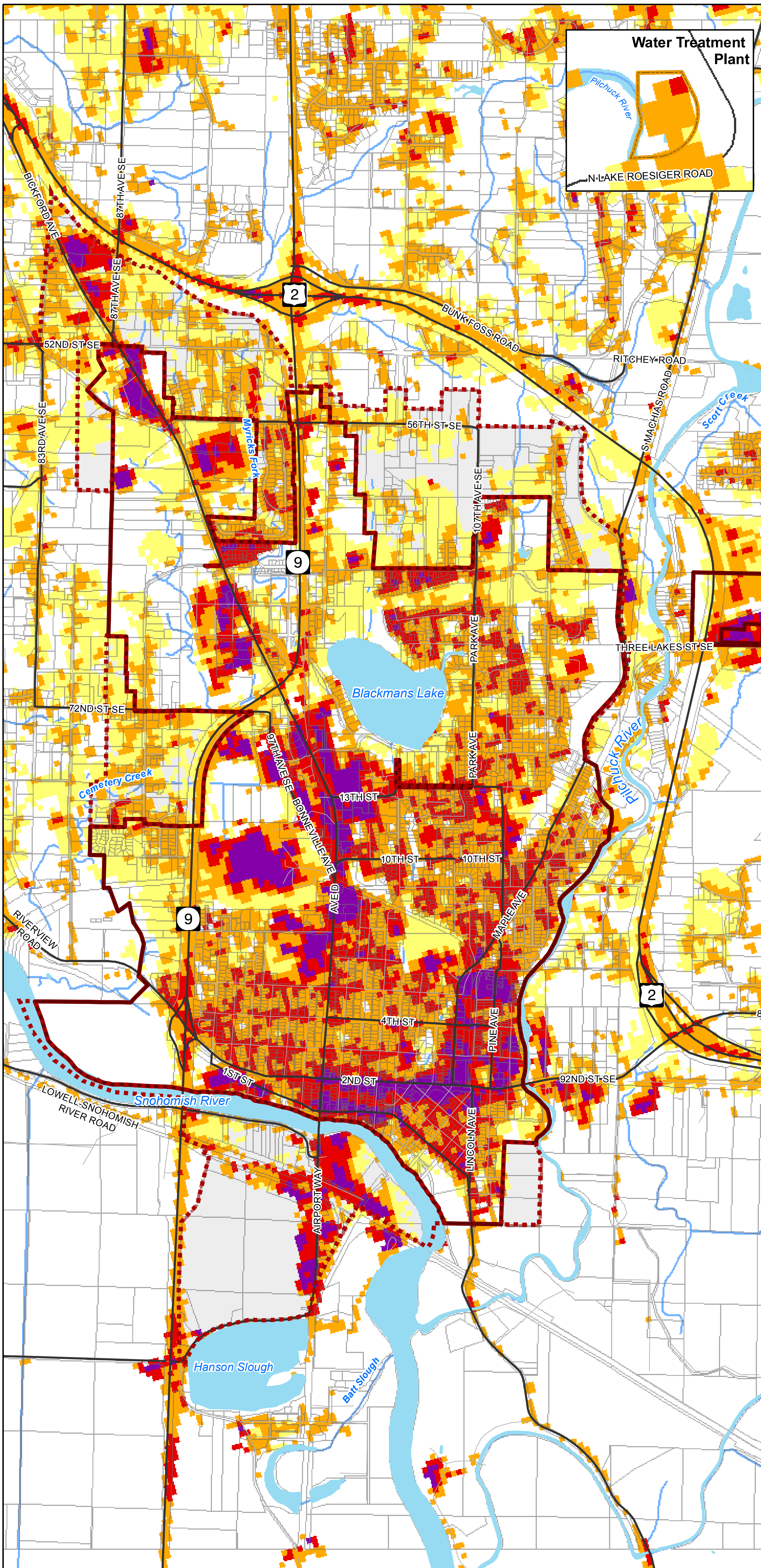
0 0.5
Miles

The City of Snohomish disclaims any warranty of merchantability or warranty of fitness of this map for any particular purpose, either expressed or implied. No representation or warranty is made concerning the accuracy, currency, completeness or quality of data depicted on this map. Any user of this map assumes all responsibility for the use thereof, and further agrees to hold the City of Snohomish harmless from and against any damage, loss or liability arising from any use of this map.

ESA

DRAFT

Path: U:\GIS\GIS\Projects\16xxxx\D160727.00_City_of_Snohomish_SMP_Update_CAO\03_MXDs_Projects\Figures\Frequently_Flooded_Areas.mxd, lxe 4/5/2017



Map 9: Impervious Surface (2006)

Legend

Impervious Surfaces (2006)

(Percent Impervious)

- < 20
- 21 - 49
- 50 - 79
- 80 - 100
- Parcels
- Streams
- Waterbodies
- Major Roads
- Minor Roads
- City Limits
- Urban Growth Area

N W E S

0 1,000 2,000

Feet

1" Represents 2,250 Feet

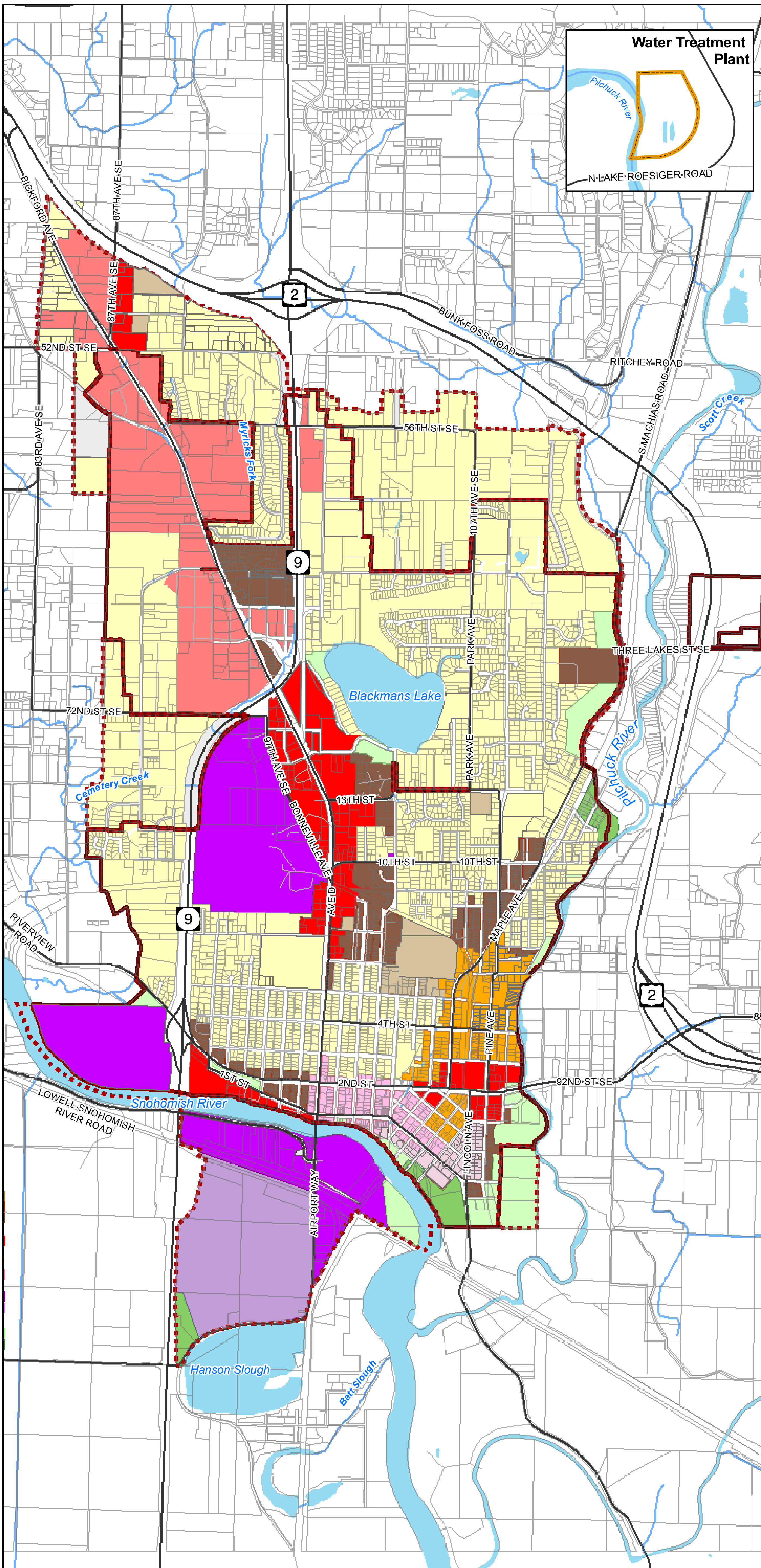
January, 2010

SOURCE: NOAA CCAP/NLCD, 2006; Snohomish County, 2008;

Prepared by: ESA Adolfson, 2010

City of Snohomish
116 Union Avenue
Snohomish, WA 98290
(360) 568-3115
www.ci.snohomish.wa.us

G:\ENVIR IMPACTS\2009 Projects\209491_SnohomishSMP\05_Graphics_GIS_Modeling\GIS\MXDs\MapFolio\Impervious_Surface_revised.mxd (MJL; 1/14/10)



Map 10: Land Use Designations

Legend

Residential
- Single Family
- Low Density Residential
- Medium Density Residential
- High Density Residential

Commercial
- Commercial
- Mixed Use
- Business Park
- Historic Business

Industry
- Industry
- Airport Industry

Other
- Open Space
- Urban Horticulture
- Parcels
- Streams
- Waterbodies
- Major Roads
- Minor Roads
- City Limits
- Urban Growth Area

N W E S

0 1,000 2,000

Feet

1" Represents 2,250 Feet

January, 2010

SOURCE: City of Snohomish, 2009 (September); Snohomish County, 2008;

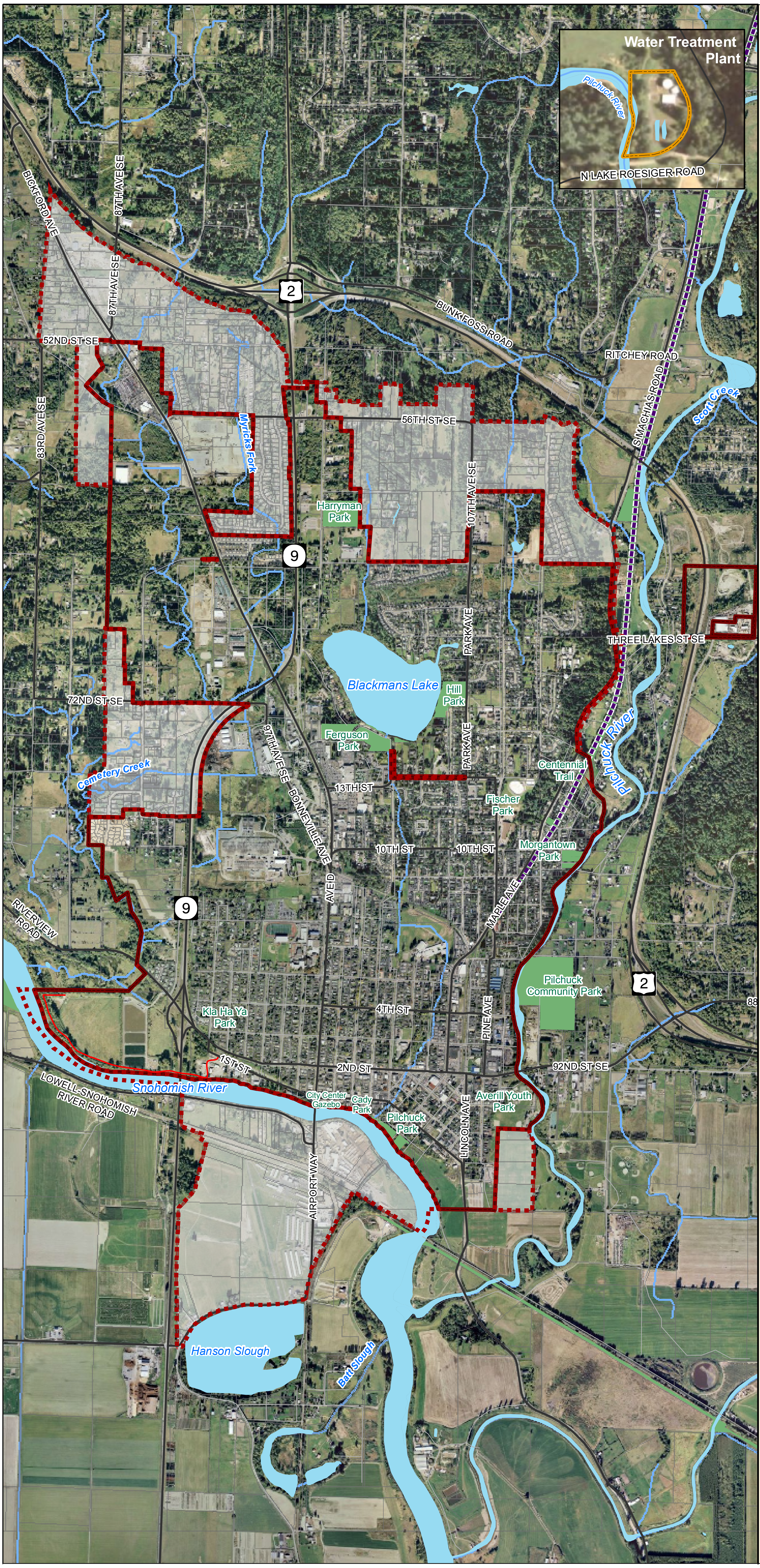
Prepared by: ESA Adolfson, 2010

ESA Adolfson

The City of Snohomish disclaims any warranty of merchantability or warranty of fitness of this map for any purpose, either express or implied. No representation or warranty is made concerning the accuracy,currency, completeness or quality of data depicted on this map. Any user of this map assumes all responsibility for use thereof, and further agrees to hold the City of Snohomish harmless from and against any damage, loss, or liability arising from any use of this map. It does not represent survey accuracy. Property lines are for illustrative purposes only and depict generalized parcelization. This map is based on the best available information as of the date shown on the map.

City of Snohomish
116 Union Avenue
Snohomish, WA 98290
(360) 568-3115
www.ci.snohomish.wa.us

G:\ENVIR IMPACTS\2009 Projects\209491_SnohomishSMP\05_Graphics_GIS_Modeling\GIS\MXDs\MapFolio\LandUse.mxd (MJL; 1/14/10)



Map 11: Parks, Open Space and Public Access

Legend

- Parks and Open Space Areas
- County Trails
- Parcels
- Streams
- Waterbodies
- Major Roads
- Minor Roads
- City Limits
- Urban Growth Area

N W E S

0 1,000 2,000
Feet

1" Represents 2,250 Feet

January, 2010

SOURCE: City of Snohomish, 2009; Snohomish County, 2008.

Prepared by: ESA Adolfson, 2010

City of Snohomish
116 Union Avenue
Snohomish, WA 98290
(360) 568-3115
www.ci.snohomish.wa.us

G:\ENVIR IMPACTS\2009 Projects\209491_SnohomishSMP\05_Graphics_GIS_Modeling\GIS\MXDs\MapFolio\Parks_PublicAccess_revised.mxd (MJL; 1/14/10)

Preliminary Shoreline Inventory GIS Mapping Data Sources

The following represents a preliminary draft list of GIS datasets and data sources. The list is a work in progress and future deletions, additions, or alterations may be made upon acquisition, discovery, or creation of additional GIS datasets and materials.

Layer	GIS Layer name	Source	Date	Comments
1% Chance Annual Flood (Floodplain)	Dfirm_snoco	FEMA	2005	Preliminary FEMA DFIRMs for Snohomish County
100 Ft Index Contours	contour_100	Snohomish County	2000	USGS DEM derived 100 ft contours
20 Ft intermediate Contours	contours	Snohomish County	2000	USGS DEM derived 20 ft contours
Airports	runways	Snohomish County	2000	Displays the paved surfaces of airports in Snohomish County
Aquifer Recharge Area	aquifer_recharge	USGS	2006	Downloaded from Snohomish County Website
Basin	basins	Snohomish County	2004	Contains 108 subbasins
County Boundaries	Counties	WSDOT	1995	
Critical Areas	Critical areas Seward and Assoc 2004	City of Snohomish (prepared by Seward and Assoc.)	2004	CAD File - Wetlands, Enhanced Riparian Areas and recommended buffers prepared by Seward and Assoc.
Easements	easements	Snohomish County	2007	Created as part of Snohomish County's cadastral conversion project
Elevation	snoDEM, snoHILL	Puget Sound LiDAR Consortium	2005	LiDAR (bare earth) elevation data for the City of Snohomish (q47122h11be and 13be
Erodible Soils	erodible_soils	WDNR	2000	Derived from Private Forest Land Grading (PFLG) system and subsequent soil surveys
ESA Bull Trout and Chinook	ChinBullVer3arcs (polys)	Snohomish County	200?	ESA listed bull trout and Chinook distribution (lines and polygons) countywide
Floodway	Dfirm_Snoco	FEMA	2005	Preliminary FEMA DFIRMs for Snohomish County
Geology	geology	WDNR	2002	Provided by Washington Division of Geology and Earth Resources Division, WDNR
Hillshade	snohomishhill	WDNR	2002	Derived resampling USGS 30-meter DEMS (Digital Elevation Models)
Impervious Surfaces	impervious1_091406	NOAA CCAP	2006	Companion impervious surface layer to CCAP land cover layer

Layer	GIS Layer name	Source	Date	Comments
Joint Planning Area	snojcpa	Snohomish County	2000	Defines that area of land outside of the Urban Growth Area in which the city and county have identified common interests
Land Cover	wa_wa2006	NOAA CCAP	2006	
Land Use (Current)	LAND USE map_layers_2009	City of Snohomish	2009	CAD data layer obtained from City as Official Land Use
Land Use (Future)	futurelanduse	Snohomish County	2000	Information contained in the dataset is used for the planning of future development activities in the County
Landslide Areas	landslide_hazard	WDNR	2004	Inventory of landslides
Major Roads	arterial_circ	Snohomish County	2006	Data source for the Arterial Circulation Map including freeways, state routes, and unconstructed roads (planned)
Municipal Boundaries	cities	Snohomish County	2002	Contains city limits for municipalities within Snohomish County
Ortho Imagery (1 M)	naip_1-1_1n_s_wa061_2006_1	USDA (NAIP)	2009	
Ortho Imagery (1:10000)	Snohomish_1933	Puget Sound River History Project	1933	Historic aerial photo of Snohomish River extent from 1933
Parcels	allparcels	Snohomish County	2007	
Parks	county_parks	Snohomish County	2004	Contains County Parks, Parks Dept. properties, and the two major trail properties
Parks	parksland	Snohomish County	2004	Shows land areas managed by Snohomish County Parks Department.
Parks	snofpark	Snohomish County	2000	These sites are designated by the City of Snohomish as locations for local neighborhood play grounds serving future subdivision development.
Priority Fish Distribution	fishdist_sv	WDFW	2008	Data part of Washington Lakes and Rivers Information System (WLRIS) database; data compiled using Limiting Factors Analysis criteria to define documented, presumed, potential, or undetected fish distribution.
Priority Habitat Species Polygon	phs_poly	WDFW	2006	

Layer	GIS Layer name	Source	Date	Comments
Railroads	railroads	Snohomish County	2004	Shows the location and owner of existing major rail lines in Snohomish County
Reaches	Reaches	ESA Adolfson	2010	Dataset created and derived through SMP inventory process
Rights of Way	rows	Snohomish County	2002	Cartographic layer depicting rights of way holding boundaries
Riverbank Survey	bigriver_survey	Snohomish County	2004	includes information on riverbank condition (natural vs. modified), bank stability, and toe class
Roads	centerlines	Snohomish County	2007	Represents center of right-of-ways and easements
Roads	streets	Snohomish County	2007	Displays connected linear network of streets
Roads (Major)	majorroads	Snohomish County	2007	Includes interstate freeways, state highways, and major roads
Seismic Hazard	snohomish_liqfial	WDNR	2004	Provided by Washington Division of Geology and Earth Resources Division, WDNR
Shoreline Planning Area	shoreline_ planning_area	ESA Adolfson	2010	Dataset created and derived through spatial analysis. Union of floodplain, 200 ft stream buffer, and intersecting wetlands.
Slope	Sno_slope	Puget Sound LiDAR Consortium	2005	Raster data layer derived from BE LiDAR data for identification of steep slopes
Soils (NRCS)	soilmu_a_wa661	NRCS (USGS)	2006	Natural Resources Conservation Service (NRCS)
Storm water	Storm water map system map layers 2009	City of Snohomish	2009	CAD data layer obtained from the City depicting stormwater system
Streams	wtrcrs	Snohomish County	2007	Derived from LiDAR and survey data
Trails	countytrails	Snohomish County	2004	Shows recreational Trails within County Parks, the Interurban Trail, and Centennial Trail. Not all county trails are shown
Urban Growth Areas	urbangrowth	Snohomish County	2000	Shows where urban growth will be encouraged and supported by public facilities and services for the next 20 years
Urban Growth Area (Snohomish)	snohuga	Snohomish County	2000	Shows the future land use designations for the unincorporated urban growth area surrounding the City of Snohomish.

Layer	GIS Layer name	Source	Date	Comments
Wastewater system	Wastewater system map_Layers 2009	City of Snohomish	2009	CAD data layer obtained from the City depicting wastewater system
Water system	Water system map_layers 2009	City of Snohomish	2009	CAD data layer obtained from the City depicting water system
Waterbodies	wtrbdy	Snohomish County	2008	Includes rivers, large streams, lakes, ponds, and reservoirs
Wells	Wellhd_p	Snohomish County (via City of Snohomish)	2008	Well head locations for the City of Snohomish
Wetlands	wetlands	Snohomish County	2004	Created from county sponsored wetland projects from 1986 and 2002, wetlands primarily in UGAs
Wetlands	nwi	National Wetlands Inventory (NWI) (USFWS)	2000	Downloaded by County from NWI website in 2000
WRIA	WRIA	WA Dept of Ecology	2000	WRIA polygons at 1:24000 scale
Zoning	zoning	City of Snohomish	NA	TBD - Dataset to be obtained from city and/or digitized from available official maps

APPENDIX B. PHOTOGRAPHS

SNOHOMISH RIVER

Cady Park and railroad bridge

Cady Park boat launch

Downtown Snohomish historic district

Riverfront Trail

Railroad trestle bridge

Seattle Snohomish Mill

SNOHOMISH RIVER

Looking north toward city WWTP property from Lowell-Snohomish River Road

Looking north toward city WWTP property and Cemetery Creek confluence wetland

Harvey Field airport facilities in mapped floodplain south of river

Avenue D bridge over Snohomish River

PILCHUCK RIVER

Centennial Trail

Bank erosion south of 2nd St/ 92nd St bridge

Morgantown Park

Pilchuck Park

River access at Pilchuck Park

Looking north toward 2nd St/ 92nd St bridge

BLACKMANS LAKE

Residences and docks

Ferguson Pier with Hill Park in the distance

Ferguson Park boat launch on south side of lake

Ferguson Park signs on south side of lake