City of Duvall
Shoreline Master Program Update
Final Draft Shoreline Inventory and Characterization Report

Ecology Grant No. G100025
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ESA

Duvall SMP

Reconnecting with the Riverfront.

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ACRONYMS

cfs	cubic feet per second
CMZ	channel migration zone
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FEMA	Federal Emergency Management Agency
GMA	Growth Management Act
GIS	Geographic Information Systems
HPA	Hydraulic Project Approval
km	kilometer
LWD	Large Woody Debris
NPDES	National Pollutant Discharge Elimination System
NWI	National Wetland Inventory
OHWM	ordinary high water mark
PHS	Priority Habitats and Species
RCW	Revised Code of Washington
ROS	rain-on-snow
SED	Shoreline Environment Designation
SMA	Shoreline Management Act
SMP	Shoreline Master Program
SPA	Shoreline planning area
SVT	Snoqualmie Valley Trail
UGA	Urban Growth Area
USFS	United States Forest Service
USGS	United States Geological Survey
USFWS	United States Fish and Wildlife Service
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WDNR	Washington Department of Natural Resources
WDOH	Washington Department of Health
WRIA	Water Resource Inventory Area

CHAPTER 1 INTRODUCTION

1.1 Background and Purpose

The City of Duvall (City) is conducting a comprehensive Shoreline Master Program (SMP) update with the assistance of a grant administered by the Washington State Department of Ecology (Ecology) (SMA Grant No. G100025). According to Substitute Senate Bill (SSB) 6012, passed by the 2003 Washington State Legislature, cities and counties are required to update their SMPs consistent with the state Shoreline Management Act (SMA), Revised Code of Washington (RCW) 90.58 and its implementing guidelines, Washington Administrative Code (WAC) 173-26 (also known as the State Guidelines).

An early step in the comprehensive update process is an inventory and characterization of shoreline conditions. The inventory and characterization provides a basis for updating shoreline management goals, policies, and regulations; applying shoreline environment designations; and identifying public access and shoreline restoration opportunities. For purposes of this report, the term "shorelines" refers to areas that meet the criteria for "shorelines of the state." In Duvall, the only shoreline of the state is the Snoqualmie River.

This report includes the shoreline inventory and analysis, which was completed in accordance with Task 2.2 of the City's grant agreement with Ecology. It includes a discussion of the ecosystem processes at the watershed scale that influence the Snoqualmie River, and it provides more detailed descriptions of the ecological functions and land use patterns along the shoreline. Accompanying this report, in Appendix A, is a series of maps depicting shoreline features and conditions. Map 1 depicts the regional and ecosystem context of the City's shorelines, and Map 2 displays the approximate extent of the Duvall shoreline planning area. See Table 2-1 for a list of maps in Appendix A.

Based on the findings of this report, the City will begin the next steps in the SMP update process, which include developing shoreline environment designations and updating SMP goals, policies, and regulations. The City will also prepare a separate restoration plan to more fully describe restoration goals and opportunities.

1.2 Regulatory Overview

Washington's Shoreline Management Act was passed by the State Legislature in 1971 and adopted by the public in a referendum. The SMA was created in response to growing concerns about the effects of unplanned and unregulated development on the state's shoreline resources. A central goal of the SMA is "to prevent the inherent harm in an uncoordinated and piecemeal development of the state's shorelines."

Ecology administers the SMA but gives primary permitting authority for shoreline development to local governments. Local governments are also charged with developing SMPs in accordance with the State Guidelines. The Guidelines give local governments

some 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.

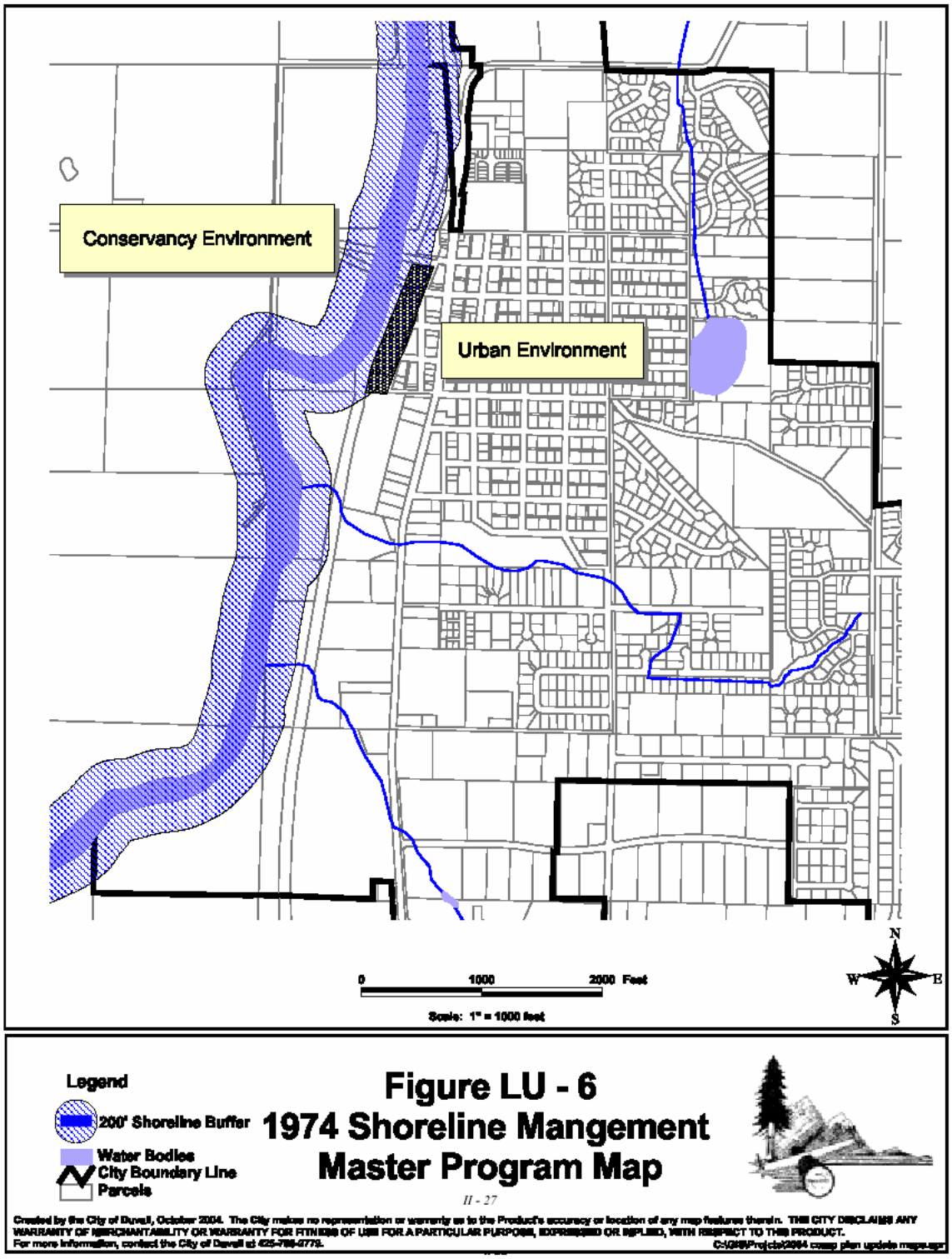
The City of Duvall adopted an SMP in 1974, three years after the SMA was passed. Rather than containing a detailed list of policies and regulations, the adopted SMP largely defers to the SMA implementing rules in WAC 173-26. However, it also has a system for classifying shoreline areas based on their biological and physical characteristics, their existing and planned land use patterns, and the goals of the community. Local SMPs are required to have such a system of "shoreline environment designations" (SEDs) to group areas that share similar characteristics so they can be managed in a uniform and consistent manner. SEDs function similarly to zoning overlays. That is, they do not change the underlying zoning or other applicable land use regulations, but provide an additional layer of policies and regulations that can be tailored to the designation. The City's current SMP describes two different environment designations. Table 1-1 shows the current SEDs and the criteria used to apply them, and Figure 1-1 shows the City's current SEDs map.

Table 1-1. Current Shoreline Environment Designations in the City of Duvall (DMC 14.78).[1]

ENVIRONMENT	DESCRIPTION
Shoreline Conservancy	All shoreline areas in the City of Duvall, including the Snoqualmie River, two hundred (200) feet on either side of the tops of the banks and their associated shorelands, exclusive of that area which is designated Urban and areas within unincorporated King County.
Urban	The area along the east bank of the Snoqualmie River within two hundred (200) feet on either side of the tops of the bank and their associated shorelands, from just north of the Depot Park building to the Woodinville-Duvall bridge.

[1] The City's current SMPs establishes a Shoreline Conservancy designation through portions of Duvall's northern urban growth area (UGA); the current King County SMP establishes a Conservancy designation for all northern UGA areas within shoreline jurisdiction.

Figure 1-1 Current City of Duvall Shoreline Environment Designations



1.3 Shoreline Jurisdiction

SMA jurisdiction includes all "shorelines of the state" as defined in RCW 90.58.030. Shorelines of the state include all of the water areas of the state and their associated "shorelands," together with the lands underlying them, except:

- Shorelines on segments of streams upstream of a point where the mean annual flow is 20 cubic feet per second (cfs) or less and the wetlands associated with such upstream segments; and

- Shorelines on lakes less than 20 acres in size and the wetlands associated with such small lakes.

The SMA further designates some shorelines as "shorelines of statewide significance." These "shorelines of statewide significance" include portions of Puget Sound and other marine water bodies, rivers with mean annual flow of 1,000 cfs or greater, and freshwater lakes 1,000 acres or larger. The mean annual flow of the Snoqualmie River through Duvall over the last 10 years is more than 3,500 cfs (USGS 1998), meaning that it meets the definition of a "shoreline of statewide significance". Consistent with RCW 90.58.020 and .090, the SMA increases the status of "shoreline of statewide significance" by establishing specific preferences for uses and calling for a higher level of effort in implementing the objectives of the SMA.

"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. In this context, "associated" wetlands means wetlands that are in proximity to shorelines or that influence or are influenced by waters subject to the SMA (WAC 173-22-030 (1)). These typically include wetlands that physically extend into the shoreline jurisdiction, and wetlands that are functionally related to the shoreline jurisdiction through a hydrologic connection and/or other factors.

SMA jurisdiction in Duvall includes the waters of the Snoqualmie River between the OHWM and the western City limits (approximately the centerline of the river) and shoreland areas lying landward (upland) of the OHWM as depicted on Map 2. The shoreland includes the large majority of the floodplain (Flood Hazard Area) associated with the river within the City, including all floodway areas. In addition, the shorelands include associated wetlands and those areas within 200 feet landward of the OHWM extending beyond the floodplain. The OHWM, which roughly corresponds to top of the east bank, was identified based on limited field investigation and Washington State Department of Natural Resources (WDNR) ShoreZone Inventory digital data (2000). A more precise depiction of the OHWM location would require field verification.

To the east and southeast of the mapped floodplain, several named streams drain across the City to the Snoqualmie River: Thayer Creek, Coe-Clemons Creek, and several

tributaries to Cherry Creek (Map 3). Cherry Creek, which drains the area to the north of the City and UGA, is also a shoreline of the state, but is located outside the City and UGA limits. Floodplain areas associated with lower Cherry Creek and the Snoqualmie River do extend into the City and UGA, and are includes as part of the Snoqualmie River shoreline planning area. Coe-Clemons and Thayer Creeks, the other tributary streams, have mean annual flows well below 20 cfs and do not qualify as shorelines of the state (USGS, 1998; King County, 2009 and RCW 90.58).

According to City and King County hydrography / water body GIS data (2005) and 2009 aerial photography, there are no large lakes in the City of Duvall. Lake Rasmussen, the largest open water feature within the City and UGA, is well below 20 acres in surface area, and is therefore not subject to the SMA.

1.4 Shoreline Planning Segments

For the purposes of this study, the City's Snoqualmie River shoreline planning area was split into three distinct segments based broadly on land uses and ecological conditions. Shoreline planning segments are described in Table 1-2, with segments depicted on Map 2.

Table 1-2. Shoreline Planning Segments in the City of Duvall

Segment	Description
South McCormick Park	The area south of the developed portions of McCormick Park and Depot Park. The area includes a wide floodplain, which is bisected by the Snoqualmie Valley Trail. Largely publicly owned with little development beyond trails and utility uses.
North McCormick Park / Depot Park Area	The active use areas of McCormick Park and Depot Park, including the shoreline at the major eastward bend in the Snoqualmie River.
Depot Village / Taylor's Landing / Northern Shoreline Area	The Snoqualmie River extending from the alignment of NE Stephens Street through to the alignment of NE Cherry Valley Road. The segment primarily includes a narrow floodplain, and is backed by the Riverside Village zoning district and Old Town areas of Duvall. This segment additionally includes open space floodplain area at the north end of the City (Dougherty Farmstead vicinity). The majority of this area is separated from the shoreline by SR 203.

1.5 Relationship to Other Plans and Programs

1.5.1 City Plans and Programs

The City's SMP works in concert with the Comprehensive Plan and a variety of other regulatory plans and programs to manage shoreline resources and regulate development near the shoreline. The Comprehensive Plan establishes the general land use pattern and provides an overall vision for growth and development for areas inside and outside shoreline jurisdiction. Various sections of the Duvall Municipal Code (DMC) also play a major role in how shorelines are managed. Some of the most important and compatible regulatory programs in Duvall include:

- **DMC Title 14 – Unified Development Regulations:**
    - **Chapter 14.10 Zoning** – Establishes zoning districts and regulates land use in the City of Duvall, including the shorelines.
    - **Chapter 14.40 Tree Protection** – Establishes regulations and standards aimed at preserving, maintaining and protecting the visual appearance and natural wooded character of the City of Duvall through protection of existing trees.
    - **Chapter 14.42 Sensitive Areas Regulations** – Establishes policies, regulations and land use controls to protect critical areas, including wetlands, fish and wildlife habitat (including streams), geologic hazards, aquifer recharge, and wellhead protection areas.
    - **Chapter 14.60 SEPA** – Establishes procedures and policies to implement the State Environmental Policy Act (SEPA). All non-exempt City actions require environmental review under SEPA.
    - **Chapter 14.84 Floodplain Regulations** – Establishes policies, regulations and land use controls to promote public health, safety and general welfare; reduce the annual cost of flood insurance; and minimize public and private losses due to flood conditions in specific areas.
- **DMC Title 9, Chapter 9.06 Storm Drainage Utility** – Establishes policies and regulations for the comprehensive management of surface and stormwater for land use proposals and development projects that could have impacts related to water quality, erosion, clearing and grading activities, flood hazard zones, or critical areas.

The SMA requires local governments and state agencies to review their plans, regulations, and ordinances that apply to areas adjacent to shoreline jurisdiction and modify those plans, regulations, and ordinances so they "achieve a consistent use policy"

in conformance with the SMA and the SMP[2]. This means that the City's Comprehensive Plan and development regulations must be consistent with the SMP overall. The City's current plan (adopted in 1974) far predates the City's Comprehensive Plan (City of Duvall, 2006). The Comprehensive Plan includes discussion, goals, and policies for protection of ecological functions, as well as for City subareas adjacent to the Snoqualmie River (including the subarea plan for Riverside Village zoning district, which was revised at roughly the same time) (City of Duvall, 2006).

One of the most important areas for consistency is between the SMP and the City's development standards and use regulations for environmentally sensitive (or critical) areas. Although sensitive areas in shoreline jurisdiction are to be identified and designated under the Growth Management Act (GMA)[3], they must also be protected under SMA. The Washington State Legislature determined that local governments must adopt SMPs that protect sensitive areas within the shoreline jurisdiction to "assure no net loss of shoreline ecological functions"[4].

1.5.2 State and Federal Programs

As stated in WAC 173-27, it is the intent of the SMA to integrate shoreline permitting into a consolidated environmental review and permit process. In achieving this goal, the shoreline policies and regulations contained in the updated SMP must work in concert with several state and federal permitting programs that relate to shorelines. These include:

- **Hydraulic Project Approval (HPA).** The HPA program applies to any construction activity in or near the waters of the state. The program is administered by the Washington State Department of Fish and Wildlife (WDFW). Permit applications must show that construction practices will prevent damage to the state's fish, and shellfish, and their habitats.

- **Clean Water Act Section 404 Dredge and Fill Requirements.** Section 404 of the federal Clean Water Act (USC 1394) regulates the discharge of dredged or fill material into waters of the United States. Any project that proposes discharging dredged or fill material into the waters of the United States, including special aquatic sites such as wetlands (non-isolated), must obtain a Section 404 permit. The U.S. Army Corps of Engineers (Corps) can authorize activities by a standard individual permit, letter-of-permission, nationwide permit, or regional permit. The Corps determines what type of permit is needed.

- **Clean Water Act Section 401 Water Quality Certification.** Applicants receiving a Section 404 permit from the Corps, a Coast Guard permit, or a license

[2] RCW 90.58.340
[3] RCW 36.70A
[4] ESHB 1933 and EHB 1653

from the Federal Energy Regulatory Commission (FERC) are required to obtain a Section 401 water quality certification from Ecology. Issuance of a certification means that Ecology anticipates that the applicant's project will comply with state water quality standards and other aquatic resource protection requirements under Ecology's authority.

- **Washington State Water Pollution Control Act.** All projects affecting surface waters in the state, including those that are not subject to the federal Clean Water Act Sections 404/401, must still comply with the provisions of the State's Water Pollution Control Act (RCW 90.48).

- **Federal Endangered Species Act (ESA).** All projects that have the potential to directly or indirectly impact wildlife species listed as endangered or threatened under ESA are subject to environmental review by the U.S. Fish and Wildlife Service (USFWS) or the National Oceanic and Atmospheric Administration Fisheries (NOAA Fisheries). Chinook salmon and bull trout are listed as threatened.

- **U.S. Army Corps of Engineers Section 10 Permit for Work in Navigable Waters.** The Corps has jurisdiction in all navigable waters of the state. Any work in, over, or under navigable waters of the U.S. requires a Section 10 permit. The purpose of Section 10 permitting is to prohibit the obstruction or alteration of navigable waters of the U.S.

- **U.S. Federal Emergency Management Agency (FEMA) National Flood Insurance Program (NFIP).** FEMA's NFIP provides flood insurance for participating communities for structures and uses within the floodplain. Although floodplain regulations are administered at the local level, the NFIP identifies minimum standards that must be met in order to maintain program participation. The minimum NFIP standards for the Puget Sound region are in the process of being revised to provide additional protection of natural floodplain functions and ESA listed species.

- **National Pollutant Discharge Elimination System (NPDES).** Authorized by the Clean Water Act, the NPDES permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States. Individual homes that are connected to a municipal system, use a septic system, or do not have a surface discharge do not need an NPDES permit; however, industrial, municipal, and other facilities must obtain permits if their discharges go directly to surface waters. The City's Wastewater Treatment Facility maintains an NPDES permit for operation and discharge to the Snoqualmie River.

CHAPTER 2 METHODS

2.1 Determining Shoreline Planning Area Boundaries

The approximate extent of shoreline jurisdiction within the municipal limits of the City of Duvall is shown in Map 2 and is referred to as the shoreline planning area (SPA). In general this area represents:

- Lands within 200 feet of the OHWM of the Snoqualmie River within the municipal limits of the City and its UGA;
- Any mapped wetlands that lie adjacent and contiguous to the areas above;
- The floodplain associated with the Snoqualmie River within the municipal limits of the City and its UGA, including the entire extent of the mapped floodway; and
- The open water areas waterward of the OHWM to the western limits of the City (approximately the centerline of the Snoqualmie River).

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

2.2 Inventory of Data Sources

The State Guidelines establish minimum requirements for the collection and use of scientific and technical information in developing the SMP updates. The standard for collection and use of scientific information is detailed by WAC 173-26-201(2). The following are the key points of the standard:

- Identification of the most current, accurate, and complete scientific and technical information available. Information should include scientific information, aerial photography, inventory data, technical assistance materials, and manuals and services from reliable sources.
- Any scientific research that is initiated for use as a basis for master program provisions shall use accepted scientific methods, procedures and review protocols.

Consistent with the standard, a number of local, regional, state and federal agency data sources, maps, and technical reports were reviewed to compile this inventory and characterization report. This includes information pertaining to watershed conditions and ecosystem-wide processes, as well as data on the land use patterns and ecological conditions of the City's shorelines. Assessing conditions at two distinct geographic scales (the watershed scale and the shoreline reach scale) is a key requirement of the SMP update process. A complete list of data sources used to compile the report is included in

Chapter 6, References. A series of maps depicting shoreline attributes accompanies this report as Appendix A. A list of the Appendix A map themes is shown in Table 2-1.

Table 2-1 Shoreline Map List (Appendix A)

Map Title	Map No.
Regional Context	1
Shoreline Planning Area	2
Topography and Hydrology	3
Flood and Geologic Hazard Areas	4
Fish Distribution	5
Zoning and Land Use	6
Parks, Open Space and Public Access Areas	7
Shoreline Processes and Impairments – North Extent	8a
Shoreline Processes and Impairments – South Extent	8b
Potential Restoration Opportunities – North Extent	9a
Potential Restoration Opportunities – South Extent	9b

2.3 Characterizing Ecosystem-wide Processes and Shoreline Functions

The State Guidelines require local jurisdictions to evaluate ecosystem-wide processes during SMP updates. The discussion of watershed processes in this report focuses on geology, soils, topography, and land cover. These watershed processes control the amount, type and extent of the smaller scale ecosystem processes at work in the Duvall 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 Chapter 3).

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 generally at the watershed scale based on existing reports and readily available mapping information.

2.4 Inventory and Characterization Approach for Shoreline Reaches

The inventory and characterization of Duvall's SPA is intended to describe conditions at a finer scale. The inventory is based on available documents, data and plans. It represents the most current and readily available information concerning the physical habitat of the City's shoreline. It includes information on land use, zoning, public access, water quality, priority habitats and species, critical areas, and shoreline modifications.

CHAPTER 3 ECOSYSTEM-WIDE CHARACTERIZATION

The purpose of this chapter is to provide a greater context within which to understand the ecological functions that are operating at the reach scale. This chapter informs the inventory assessment of conditions and functions at a reach scale in Chapter 5. This chapter is organized to provide:

- An overview of the watershed and 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 Snoqualmie River watershed; and
- A discussion of key ecosystem processes and associated implications for assessment at a reach level and for shoreline management within the City.

3.1 Watershed and Regional Overview

The mainstem Snoqualmie River forms in the headwaters of the North, Middle, and South Forks of the Snoqualmie Rivers. The mainstem Snoqualmie River extends south and east from the City through unincorporated King County as well as the City of Carnation, the community of Fall City, and (above Snoqualmie Falls) the Cities of Snoqualmie and North Bend (Map 1).

The river branches into the three major forks to the east of North Bend. Other significant tributaries to the Snoqualmie River include (from upstream to downstream): the Raging River, which drains across the I-90 corridor through the Preston area before converging with the Snoqualmie River in Fall City; Patterson Creek, which drains the east side of the Sammamish Plateau before converging with the river between Carnation and Fall City; and the Tolt River, which converges with the mainstem within Carnation. Immediately downstream (north) of Duvall, Cherry Creek drains to the mainstem from the east. Cherry Creek is the lowest significant tributary of the Snoqualmie River, and the only significant tributary that drains areas of the City. The mainstem of Cherry Creek never passes into the City or UGA; non-shoreline tributaries to Cherry Creek drain the northeastern portion of the City.

The Snoqualmie River continues north from Duvall for approximately nine miles before joining together with the Skykomish River; downstream of the convergence, the rivers together are named the Snohomish River. The Snohomish River drains to Puget Sound at Everett. These three rivers—Snohomish, Skykomish, and Snoqualmie—and their tributaries together drain a watershed (Water Resource Inventory Area 7) of 1,856 square miles located in both Snohomish and King Counties (Snohomish County, 2006).

The geology of western King County, including the lowland areas of the Snoqualmie River, consists of bedrock underneath layers of sediments deposited by glaciers, as well as sand and gravel (alluvium) deposited recently by modern rivers (Krukeberg, 1991).

The region 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, with the area surrounding Duvall averaging nearly 50 inches (Appendix B).

Higher human population densities in the Snoqualmie River watershed are focused within and around Duvall, Carnation, Fall City, Snoqualmie and North Bend. Outside of these urban growth areas, the Snoqualmie River valley consists primarily of agricultural production districts, with surrounding portions of the watershed including rural areas, forest production districts, and open space areas (preserved lands) (King County DDES, 2009). Over 80 percent of the population of King County lives in cities and UGAs, with less than 20 percent in rural areas (King County, 2008). This trend continues throughout the Snoqualmie watershed, with the majority of the population focused in designated Urban Growth Areas and incorporated cities.

The Snoqualmie River watershed contains a wide range of vegetation types, from wetland scrub/shrub and emergent areas in the valley floodplain to forests in the Cascade foothills. In general, the largest undeveloped areas are located at higher elevation, while lower areas tend to be the most urbanized.

The City of Duvall is located on the east side of the lower Snoqualmie River valley. The centerline of the river is the approximate western boundary of the City, with unincorporated areas of King County extending through the floodplain to the south, east, and north.

Prior to European settlement, the Snoqualmie 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 Snoqualmie and Snohomish Rivers where people thrived by fishing for salmon, hunting mammals over land, and gathering native fruits, vegetables, and berries (City of Duvall, 2006).

Early Euro-American settlers were first drawn to the Duvall vicinity of the Snoqualmie River valley in the 1870s by vast timber resources, both in areas of the valley and the surrounding hills. Homesteading occurred in the region, primarily by Civil War veterans with homestead rights. The Duvall area was homesteaded and named after two brothers, Francis and James Duvall. The original town site, named Cherry Valley, occurred to the north of the existing center, near the convergence of Cherry Creek with the river. The Snoqualmie and Snohomish Rivers were used to transport logs to major downstream population centers, including Everett.

The river remained the primary means of transportation until the 1890s, at which time the construction of railroad lines through to the town of Snohomish allowed a more intensive timber industry to become established in the immediate area. The railroad was constructed along the east side of the river, adjacent to Duvall's Main Street, on a 12- to

15-foot-tall fill berm that stretches along the river valley. In the following decades, bridges over the Snoqualmie River and roads linking through to Lake Sammamish and Lake Washington were constructed. Bridges and roadways were also built on fill berms in the floodplain, in most instances stretching east-west across the valley. The developed transportation infrastructure led to rapid population growth in Duvall, as well as other valley communities. The growth of the timber industry and the expanded population brought about rapid changes in vegetative cover (forest to agricultural fields) and vegetative character (old growth forest to second growth forest) during this period. Population growth continued through the 1920s, after which the decline of the timber industry in the area minimized the need for laborers.

After the 1920s the pattern of alterations to the valley landscape was characterized by clearing of native shrub and riparian vegetation, ditching of streams and land to create pasture, and hardening of the Snoqualmie River shoreline. Shoreline hardening was in most instances informal, likely occurring as placement of hardening materials and structures along the rivers, as well as documented placement of automobiles and other structures along the banks of the river as part of public agency-sponsored efforts (see Photo 5-1 in Chapter 5, page 32).[5]

In the last 50 years, modern roadways and expanding suburban growth from the Seattle urban area has led to additional growth in the City and throughout the valley – this has primarily occurred in the last 20 years. Agricultural activities remain a significant regional economy and floodplain-wide land use, with cattle and dairy operations, produce and crop farms, and greenhouse operations extending up and down the valley. However, residential housing and associated service businesses have come to characterize Duvall and other urbanized areas of the watershed.

The Snoqualmie River watershed and the entire WRIA 7 area support a variety of fish and wildlife species. Wildlife habitat types that are common in the vicinity include freshwater aquatic areas and associated riverine habitats; wetlands and associated riparian areas; lowland conifer-hardwoods; agricultural and pasture areas; and urban areas.

The Snoqualmie 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 (City of Duvall, 2006).

Federally and state listed species known or presumed to occur in King County, although not necessarily in the Duvall area, include orca whale, spotted owl, gray wolf, grizzly

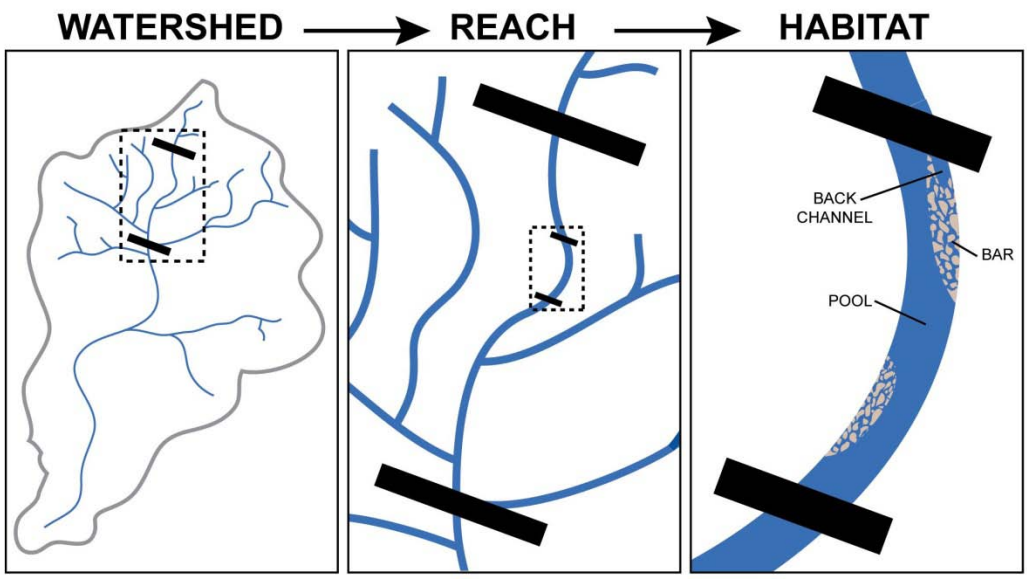
[5] The riparian corridor along the Snoqualmie River throughout McCormick Park, and much of the River reach upstream and downstream of the City, is characterized by a gradual and relatively narrow berm elevated +2 to +5 feet above the surrounding floodplain. The berm like features, while potentially modified or expanded (heightened) by historical human activities in some locations, are generally a natural formation created through sediment deposition during flood events. There is no record of levee structures, informal or otherwise, built along the Snoqualmie within Duvall.

bear, Oregon spotted frog, sandhill crane, bald eagle, marbled murrelet, bull trout, and Chinook salmon (WDFW, 2010).

3.2 Ecosystem Processes

The State Guidelines require that local jurisdictions evaluate ecosystem-wide processes and their relationship to shoreline ecological functions. 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. Ecosystem processes are formed and function at multiple scales, from the watershed to site-specific or habitat scale (Figure 3-1).

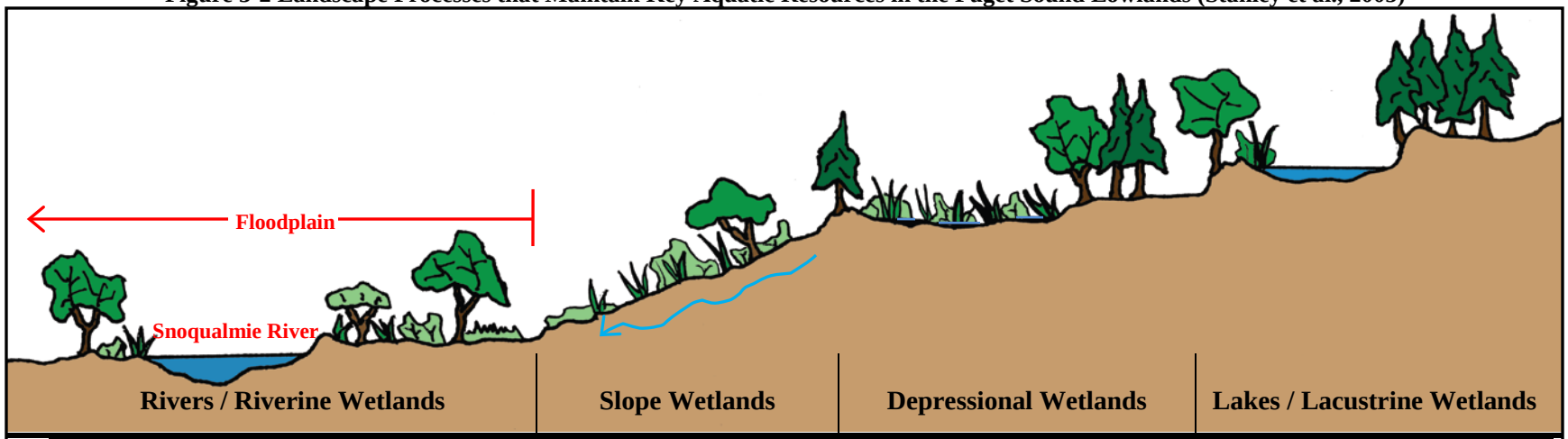
Figure 3-1 Relationship of Scales



A Landscape Analysis was developed for Duvall to support the City's sensitive area ordinance update (Parametrix, 2005; included as Appendix B). Other watershed studies and plans have been developed in the last five years, including the Snoqualmie Watershed Water Quality Synthesis Report (Kaje, 2009) and the Snohomish Basin Ecological Analysis for Salmonid Conservation (SBSRTC, 2005), developed as part of the Snohomish River Basin Salmon Conservation Plan (SBSRTC, 2005).

The City's Landscape Analysis focuses primarily on the role of water movement across the landscape and how water flow in the watershed shapes the form and functions of the shorelines. For example, the flow regime of a river, including modifications to natural flow such as levees, weirs, dams, and other devices, will determine the habitats and shoreline types in that system. Figure 3-2 identifies key landscape processes as they relate to aquatic resources within the Snoqualmie River watershed, including the subbasin areas within Duvall (adapted from Stanley et al., 2005).

Figure 3-2 Landscape Processes that Maintain Key Aquatic Resources in the Puget Sound Lowlands (Stanley et al., 2005)



Rivers / Riverine Wetlands	Slope Wetlands	Depressional Wetlands	Lakes / Lacustrine Wetlands
KEY LANDSCAPE PROCESSES[6]			
• Hydrology o **Surface water runoff (peak flow)** o **Groundwater movement** • **Sediment supply** • **Water quality (nutrients, pathogens, toxins/metals), contaminant cycling** • **Large Woody Debris (LWD) delivery**	• Hydrology: **Groundwater movement**	• Hydrology o Surface water runoff o **Groundwater movement** • **Sediment supply** • **Water quality (nitrogen and phosphorous cycling),** contaminant cycling • LWD delivery	• Hydrology o Surface water runoff o **Surface water storage** o Groundwater movement • Sediment supply • **Water quality (nitrogen and phosphorous cycling),** contaminant cycling

[6] Processes in bold are most important for maintaining the integrity of the aquatic resource.

Ecosystem processes are significantly affected by four underlying controls: geology, climate, vegetation, and land cover / use (Appendix B).

- Geology provides a foundation for landscape processes, as it influences topography, landform stability, and substrate permeability and reactivity.

- Climate determines the amount, form, and timing of water inputs. Plant cover and communities in any given habitat influence the residence time of surface water and shallow groundwater.

- The roles of vegetation as related to aquatic resources are identified in Appendix B and include: intercepting precipitation (reducing sediment transport and erosion); recirculating water through transpiration; providing shade (moderating temperature and humidity); stabilizing soil structure; and providing organic input, nutrient enrichment, and habitat structure.

- Land use activities related to agriculture, forestry, and residential/commercial development can alter vegetation and, to a lesser extent, surficial geology. These changes can in turn affect landscape processes. Land use acts as a stressor on natural processes, disrupting the interception and uptake of precipitation and nutrients and the proportion of water distributed via surface and subsurface flows (Appendix B).

Compared with geology and climate, vegetation cover and land use are easily altered. The process controls for Duvall and the Snoqualmie Watershed are summarized in Section 3.1 (Watershed and Regional Overview) and detailed in Appendix B.

3.3 Alterations to Key Ecosystem Processes

Table 3-1 summarizes the key factors or natural controls that typically contribute to these processes under natural conditions. The table also summarizes the mechanisms through which these processes act and the important locations where they occur. Important areas consist of landscape environments, typically associated with aquatic or wetland habitats, that provide a central role in maintaining landscape-scale processes. The sections following the table then provide an inventory of landscape processes and how changes to these processes have occurred in the Snoqualmie River watershed as a result of human activities. The discussion focuses on the watershed area surrounding and influencing the vicinity of Duvall. Further information can be found in Appendix B.

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

Process	Natural Controls	Mechanisms	Types of Important Areas*	Description of Important Areas in Duvall and Vicinity
Hydrology (surface and ground water)	• Climate and precipitation patterns • Timing of snowmelt • Soils and geology • Vegetation	Infiltration/ recharge	Permeable soils, ***riparian areas***, ***floodplains***	Moderate levels of infiltration and recharge are mapped as occurring primarily within the Cherry Valley floodplain, as well as within the Snoqualmie River floodplain at lower levels. Areas of significant infiltration and recharge are located in the vicinity of Fall City and above the Snoqualmie Falls.
		Surface water storage	***Depressional wetlands***, ***lakes***, ***floodplains***	As Thayer, Coe-Clemons, and Cherry Creek tributaries reach the floodplain, surface flows distribute across the valley, with surface water stored in several large depressional wetland areas. Entire Duvall floodplain area serves as storage during overbank flood events. One small (under 20 acres) lake is located within the Cherry Creek basin of Duvall; other moderately sized wetland areas also mapped outside of shoreline area in Duvall.
		Peak flows	***Impervious surfaces***, rain-on-snow (ROS) zone, ***forest cover***	Impervious surfaces limited within shoreline area, however rapid development throughout town over the last 2 decades has converted agricultural and forest land to commercial and residential development associated with moderate levels of impervious surfaces. Heightened levels of impervious surface correspond with reduced forest cover – a mechanism change that primarily occurred through logging and agricultural land use changes primarily between 1880 and 1950.
		Groundwater movement (baseflow)	**Permeable deposits**, fissured bedrock	Groundwater moves through the Duvall area hillside near the surface, encountering the surface as seeps and slope wetlands near the break between the hillside and the Snoqualmie River floodplain. Detailed assessment of bedrock conditions has not occurred in Duvall.
Sediment Supply	• Topography • Soil erodibility • Vegetation cover	Erosion	***Erodible soils (especially on steep slopes)***, ***Channel Migration Zones (CMZs)***	For purposes of SMP planning, potential CMZ and associated erosion areas extend through the Duvall shoreline area to the west of the Snoqualmie Valley Trail. Review of historical mapping and aerial photography suggest that mainstem channel migration occurs relatively slowly within the lower Snoqualmie River valley. Erodible soils along steep slopes are mapped along the reach of Coe-Clemons Creek immediately east of Main Street. Active bank failure is noted within this reach, as is resultant sedimentation within the downstream shoreline area.
		Mass wasting	***Slopes prone to landslides***	Steep slopes susceptible to landslide are mapped along the reach of Coe-Clemons Creek immediately east of Main Street. Steep slope areas are mapped along the northern boundary of the City, where tributary streams to Cherry Creek cut through the hillside to the valley to the north.
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.)	Physical properties (temperature, turbidity)	***Forest cover***, ***riparian zones***	Forest cover is largely limited within Duvall, constricted to areas at the eastern, northeastern, and southeastern limits of Duvall, small pockets, and corridors along certain reaches of mapped streams. Forest cover within the Snoqualmie River shoreline area, including the 50 to 100 foot riparian area along the river, is also significantly reduced due to historic land clearing for agricultural activities.
		Chemical properties (pH, nutrient levels)	***Depressional wetlands***, wetlands with organic soils, ***riparian zones***, ***hyporheic zones***, ***floodplains***	Depressional wetlands with significant storage capacity occur in the Duvall shoreline area, providing an environment for chemical and biotic mechanisms that improve water quality. The entire shoreline area is a floodplain, as is the shoreline area for the Snoqualmie River extending outside of Duvall into King County jurisdiction. Riparian function within the City and surrounding area function at moderate to low levels, however existing land use and development within the City's shoreline areas do not prohibit or hinder potential future enhancement of riparian functions. Hyporheic zones are assumed to extend through much of the City's Snoqualmie River floodplain area.
		Contaminants (toxins, pathogens)	***Depressional wetlands***, ***riparian zones***, ***hyporheic zones***, ***floodplains***	
Organic imputs (large wood)	• Water energy • Riparian vegetation • Soil erodibility • Topography • Climate • Biotic interactions	Riparian vegetation	***Riparian zones***, forested CMZs	Riparian function within the City and surrounding area function at moderate to low levels. Riparian vegetation generally consists of a narrow band of mixed forest backed by herbaceous and shrub vegetation communities. Existing land use and development within the shoreline areas do not prohibit or hinder potential future enhancement of riparian functions. Riparian cover along tributary streams provides moderate organic input function, including landslide and erosion hazard areas along Coe-Clemons Creek, however these sources of large woody debris are disconnected from the shoreline by undersized culverts (Main Street, Snoqualmie Valley Trail, and other transportation and trail infrastructure).
		LWD recruitment	***Riparian zones***, forested CMZs, ***landslide hazard areas***	

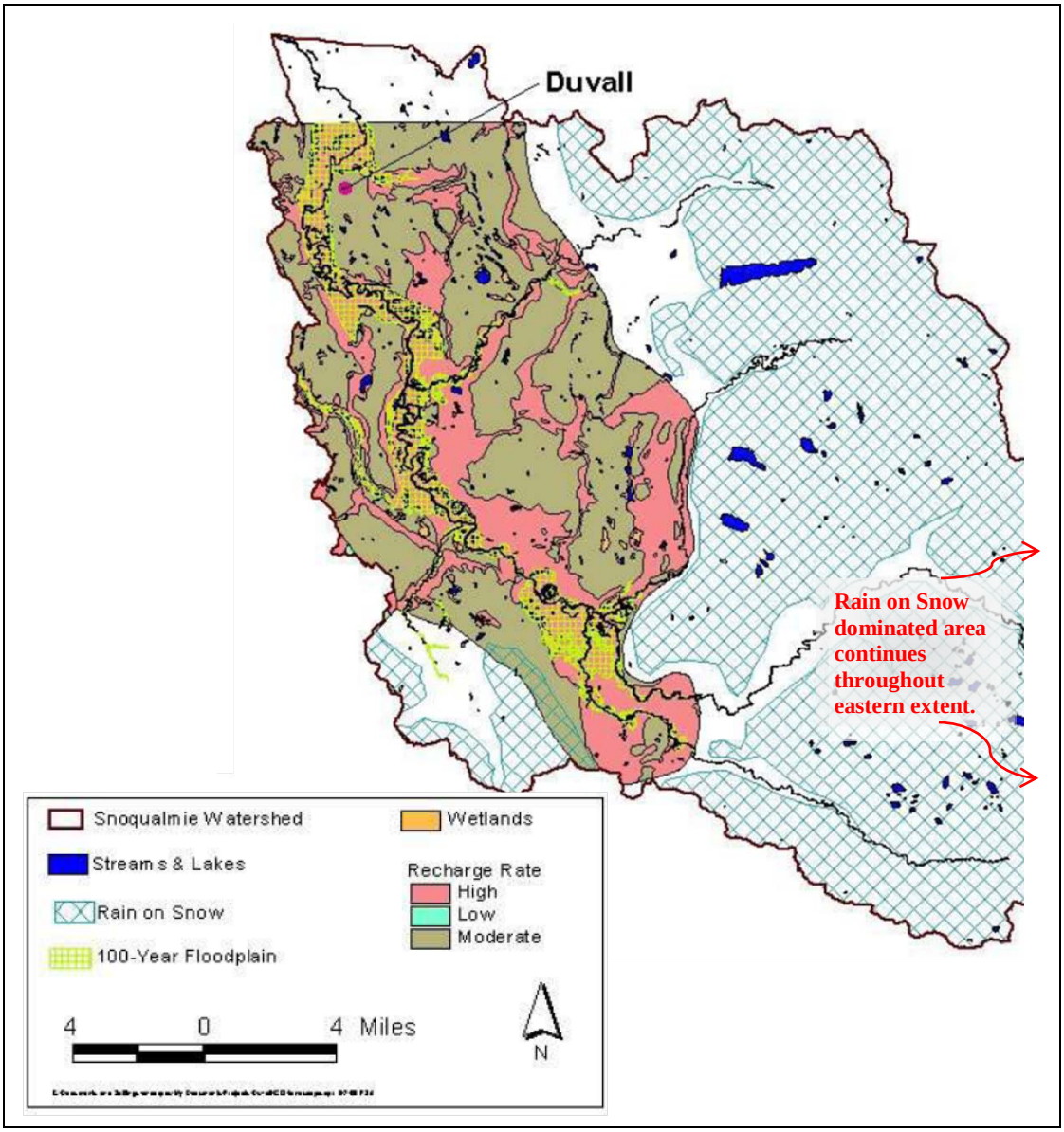
Source: Summarized from Stanley et al. (2005) and Parametrix (2005)

*Important areas in bold are those areas found within the Duvall vicinity. Important areas also in italics are found within the Duvall shoreline planning area (SPA)

3.3.1 Hydrology

The City's Landscape Analysis identifies important areas for hydrologic mechanisms across the Snoqualmie watershed (Figure 3-3; Appendix B).

Figure 3-3. Hydrologic Mechanisms and Important Areas Across the Snoqualmie Watershed – from Parametrix 2005 (Appendix B).



Water quantity functions were assessed for the Puget Sound, including basins of the Snoqualmie Watershed, by the Department of Ecology (Ecology, 2010). For purposes of the assessment, basins overlapping the City include Mainstem Cherry Creek and Mainstem Snoqualmie River. The Mainstem Snoqualmie basin combines the drainage areas of Coe-Clemons Creek, Thayer Creek, and several other relatively small basins surrounding the mainstem to the east and south of the City; as such, results for the

Mainstem Snoqualmie basin are not as applicable to the City's subbasin areas as a more refined analysis and assessment discussed in subsections below. The results of the water quality functional assessment do, however, verify the urbanizing character of Duvall. The overall water quantity functional rating for the Mainstem Snoqualmie area suggests that the basin is moderately impaired (highly impaired for groundwater recharge) with moderate to low levels of importance for functional recovery. The overall rating for the Mainstem Cherry Creek basin suggests restoration and protection as priorities both for mechanisms that are impaired (surface storage, water flow) and those that are functionally intact (recharge, discharge).

Infiltration and Recharge

Two major geologic formations in the Snoqualmie watershed create hydrologic infiltration and groundwater recharge conditions: porous soils (outwash) above relatively impermeable subsurface strata; and alluvium along major streams. Deep recharge is facilitated in areas where bedrock is fissured, including areas within and adjacent to the Snoqualmie River and tributary floodplains (Turney et al., 1995, Adolfson Associates, 2004, King County Groundwater Protection Program, 2004). A large contiguous area of recharge extends along the Snoqualmie River from the vicinity of North Bend to the King – Snohomish County boundary. Along significant tributary streams, including Cherry Creek, areas of high recharge extend out of the river floodplain into contributing basins. The entire area of the City is mapped as having a high or moderate level of recharge (primarily moderate). Compared to rates mapped in upstream areas (as high as 90 inches annually), however, the recharge rates throughout much of Duvall are relatively low (10 to 20 inches annually). Areas of high recharge in Duvall are focused in the shoreline environment, within the Snoqualmie River floodplain and the Snoqualmie / Cherry Creek floodplain extending along the north side of the City.

Groundwater Flows

Recharge replenishes deep groundwater (aquifers) with surface water and shallow groundwater. Two large aquifers have been mapped in the Snoqualmie River valley, the largest of which (the Snoqualmie Aquifer) lies beneath the North Bend area (river mile [RM] 45-50) well upstream of Duvall. The Snoqualmie Aquifer has been identified as significant enough to warrant high protection and consideration as a source of municipal water and/or low flow augmentation to the Snoqualmie River (East King County Ground Water Advisory Committee, 1998, King County Ordinance 14214, Seattle Public Utilities, 2001, Adolfson Associates, 2004). Risks of contamination to Snoqualmie watershed aquifers are most severe in areas of high infiltration well to the south and east of Duvall, although the relatively shallow groundwater table (approximately 40 feet above mean sea level within the floodplain) and higher rates of recharge in the City’s floodplain areas warrant protection (Turney et al., 1995, Parametrix, 2005).

Throughout Duvall, groundwater has been mapped as intermediate to shallow. Relatively impermeable soils through the hillside of the City (above the floodplain) do not allow high levels of infiltration and keep groundwater relatively shallow. Groundwater at intermediate to shallow levels generally follows surface topography. There are a number

of hillside seeps in Duvall where shallow groundwater surfaces at topographical breaks. (Turney et al., 1995)

Surface Water Storage

As it flows along the west side of the City, the Snoqualmie River is already carrying large volumes of water compared to quantities contributed by the Duvall area subbasins. The City landscape provides storage for river waters only during flood events, when overbank flows are detained and stored within the floodplain. At other times, storage within the Duvall landscape and other lowland areas surrounding the valley is provided by the small lakes and depressional wetlands.

Approximately 200 acres of area throughout the City (low elevation) are available for surface water storage (Appendix B). Storage areas are focused around the 100-year floodplain (133 acres), wetlands within the tributary basins above the floodplain, and Rasmussen Lake (approximately 5.3 acres).

Peak Flows

Peak flows in the Snoqualmie watershed, like other Puget Sound basin watersheds, typically occur November through January (rain on snow events) and again in May through June (snow melt). Peak flow events result in regular overbank flooding along the Snoqualmie River and the significant tributary streams. Coe-Clemons Creek and Thayer Creek have relatively small contributing basins and are rarely subject to significant overbank flows except when inundated by Snoqualmie River overbank water within the floodplain.

Influences of peak flow events on the channel of the Snoqualmie River as well as all tributary streams are significant. Along the mainstem and significant tributary streams, overbank flooding and erosion from peak flows can lead to significant channel migration events. Along smaller tributary streams, peak flows can cause bank failures and rapid channel erosion.

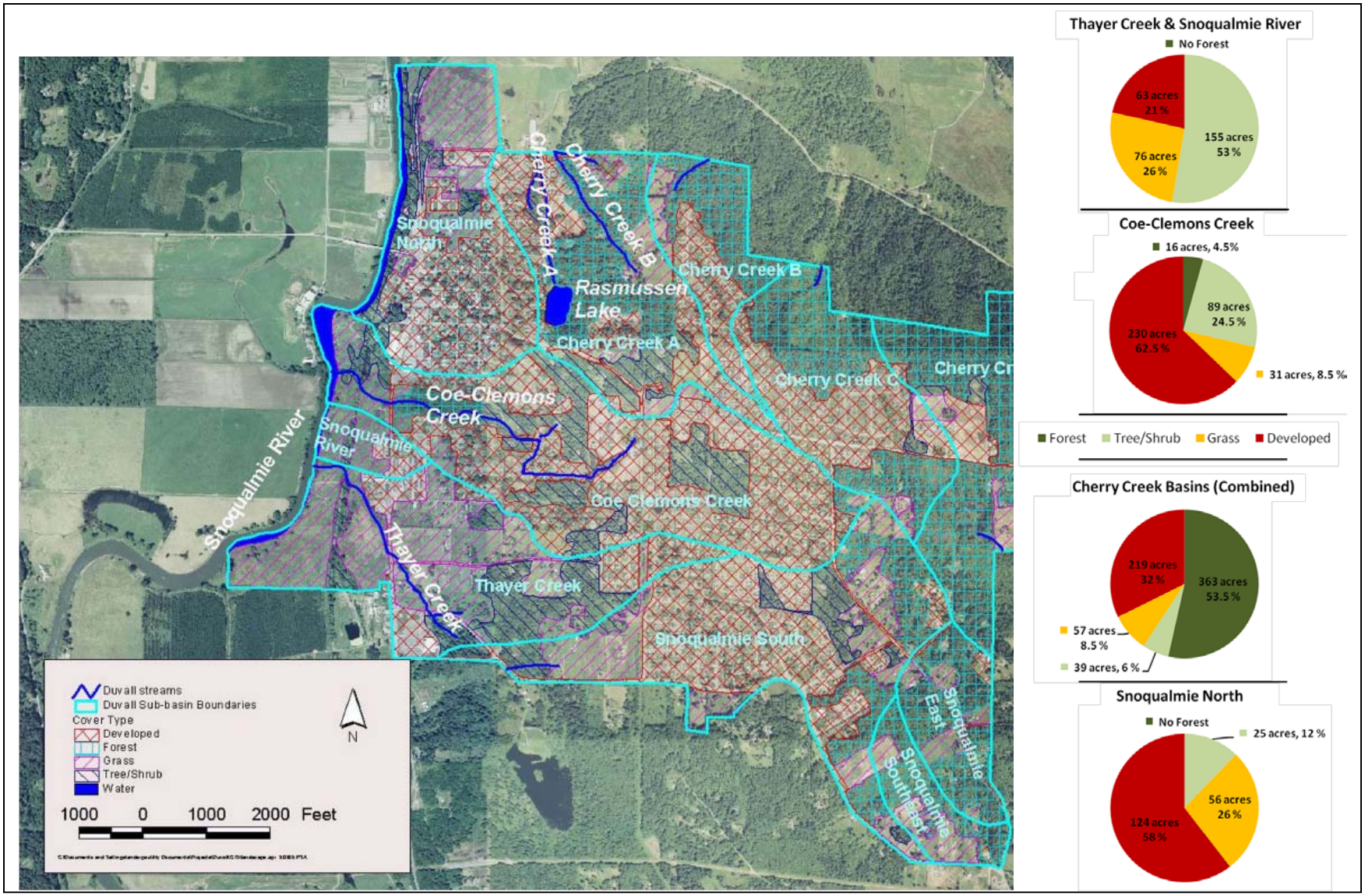
Hydrologic Alterations

Alterations to hydrologic mechanisms in the Snoqualmie watershed include decreased infiltration/recharge because of increases in impervious surface, channelization, and disconnection of streams from their floodplains; decreased storage capacity due to bank armoring, channelization, and wetland loss; increased peak flows resulting from vegetation clearing and an increase in impervious surface; and groundwater withdrawals and groundwater contamination (Parametrix, 2005, Solomon and Boles, 2002, Collins and Sheikh, 2003).

As assessed from 2002 aerial photography in the City's Landscape Analysis, developed land use in the Coe-Clemons and Cherry Creek tributary subbasins exceeds 35 percent of land cover and is 20 percent of the Thayer Creek subbasin (Figure 3-4). Forest cover is also low (less than 50 percent) in all of the City's primary subbasins, and is less than 20

percent (0 percent for Thayer Creek) of the mapped cover within 200 feet of mapped streams.

Figure 3-4. 2002 Land Cover by Subbasin within Duvall – Map and Data (Parametrix, 2005.)



Decreasing proportions of forest cover and increasing development (impervious surfaces) are associated with higher peak flows; increased peak flow frequency and duration affects channel morphology. Herrera Environmental Consultants (2002) assessed stream habitat in Thayer, Coe-Clemons, and two Cherry Creek tributaries within the city limits and identified reaches within all of these streams with deeply incised channels and bank failures caused by altered runoff patterns. Excessive sedimentation was also seen in reaches of Thayer Creek and Cherry Creek Tributary B system (see Figure 3-4 for approximate location).

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. Bank erosion above a natural background level can indicate hydrologic or sediment conditions that are out of balance.

Sediment is generally transported through high gradient (steeply sloping) streams and deposited in lower gradient reaches. Other areas where erosion naturally occurs at high rates include transitions from plateaus to terraces, alluvial fans, and upland canyons formed by streams. Areas of sediment supply and deposit within and in the vicinity of Duvall include the Coe-Clemons Creek riparian corridor and areas of the Cherry Creek basin on the northern edge of the City.

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).

In Duvall, primary water quality concerns include: surface water temperature within tributary streams, especially as they flow into the large wetland areas within the shoreline environment; fecal coliform levels within the Snoqualmie River, likely primarily from agricultural uses of the floodplain outside of Duvall; and the potential for elevated levels of key nutrients, including phosphorus and nitrogen. Runoff from agricultural and residential areas is a significant source of fecal coliform bacteria and nutrients entering rivers and streams in the Snoqualmie 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 water bodies. The

mainstem reach extending through and upstream of the City has been listed on the Ecology 303(d) list as a Category 4(a) water for fecal coliform for more than a decade. A Category 4(a) listing indicates that tested levels have been in excess of water quality standards and that a total maximum daily load (TMDL) plan is in place to maintain or improve water quality within the listed water.

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 Snoqualmie valley 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 Snoqualmie 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.

The loss of riparian vegetation on the Snoqualmie River has impacted salmonid habitat by reducing the food supply for fry, increasing solar heating of the water, and reducing cover and refuge habitat. Fish habitat features such as complex channels, overhanging cover, and pools have declined in the lower Snoqualmie watershed, including contributing basins. This is due in part to the loss of LWD in the river, which has reduced the amount of wood available to create pools and to collect sediment and gravels.

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).

CHAPTER 4 LAND USE ANALYSIS

This chapter describes land use trends and plans in and near the shorelines of the City of Duvall.

4.1 Shoreline Development Trends

The City has issued fewer than four shoreline substantial development permits in the last decade, and very few exempt shoreline development projects have occurred during this timeframe. The large majority of the shoreline area is publicly owned; as such private development has been extremely limited. Permits have been issued for relatively small parks development projects involving enhancement of upland (non-shoreline) facilities, and for construction of utility easements (primarily stormwater) through the shoreline environment.

The City has undertaken significant planning for parks, trails, and open space areas involving public recreation areas along the shoreline (EDAW / AECOM, 2008). Projects and improvements to McCormick Park, Depot Park, and Taylor's Landing are identified in the City's Parks, Trails and Open Space Plan, including refurbishment and development of water dependant uses, specifically boat launches and other recreational access facilities. None of these water dependent projects are anticipated or planned for the near future.

4.2 Anticipated Future Development and Use

Parks and open space planning within publicly owned lands are the most significant and likely anticipated future development and use. Areas of active park use and recreation within the SPA are maintained with trails, lawn, benches, picnic tables, and interpretive signage. Depot Park provides additional community meeting space and wildlife viewing platforms, and Taylor's Landing provides direct access to the Snoqualmie River via a boat ramp. Enhancement of existing shoreline recreation opportunities and park facilities is identified in the Parks, Trails and Open Space Plan (see Chapter 6 for more details). The City has no recreation development projects within the SPA that are currently underway or immediately anticipated.

In addition to active parks areas, there are significant City and County owned open space areas within the Duvall SPA. Duvall has prioritized conservation and restoration of publicly owned shoreline areas and has undertaken comprehensive stream habitat restoration planning (Herrera, 2002) and is implementing several mitigation /restoration projects within the SPA (ESA Adolfson, 2009).

Outside of publicly owned parks and open space areas, the most significant existing land use is within the Riverside Village zoning subarea. The Comprehensive Plan establishes the subarea as a linear strip between the Snoqualmie Valley Trail and the mixed uses associated with the Main Street corridor immediately to the east. Specific land use plan and zoning standards are used for planning and permitting development within this area

(Map 6, DMC 14.24). Although Depot Village is only partially within the SPA, redevelopment of this area under the Riverside Village zoning district standards could substantially change and intensify land use patterns.

Of the few shoreline substantial development permits that have been issued in the last 10 years, the majority were for utility rights-of-way. A new utility use is currently in permit review by the City (stormwater conveyance). Many of the existing utility uses and corridors in the shoreline drain to the Snoqualmie River. The City's Wastewater Treatment Plant discharges treated effluent directly to the river. Several stormwater outfalls additionally discharge to the river, as well as to the tributary streams within shoreline jurisdiction (Maps 9a and 9b). Stormwater discharge without discharge directly to the Snoqualmie River is permitted by Duvall stormwater utility regulations[7].

Limited utility uses of the Snoqualmie River SPA are anticipated in the near future. Land use changes to the east, and in limited instances west, of Main Street NE are expected. Although subdivision and development will primarily be outside of the SPA, the proximity of land uses to the river would allow for additional discharge of treated stormwater.

Duvall Public Works maintains the municipal wastewater effluent conveyance and outfall. No expansions or changes to this facility are anticipated within the next decade.

4.3 Potential Use Conflicts

Potential use conflicts are identified for each shoreline area in Chapter 6.

[7] The City's Stormwater Regulations adopt the King County Stormwater Manual by reference, which includes the Snoqualmie River as a receiving body for direct discharge for uses within a specified proximity of the river.

CHAPTER 5 REACH SCALE INVENTORY AND ANALYSIS

5.1 Shoreline Conditions

This chapter identifies existing conditions within the Snoqualmie River shoreline area of Duvall and describes attributes of the shoreline that inform SMP management decisions. Inventory and analysis of the shoreline environment is focused on three major elements:

- Physical Characteristics – detailing the physical setting and processes, including water quality;
- Biological Resources – detailing the flora, fauna, and habitats;
- Shoreline Modifications – detailing how the shoreline bank and riparian area have been modified to support historic and existing land uses; and
- Land Use – detailing existing land use, anticipated land use, public access, and infrastructure.

Throughout the City's shoreline area, many of these key elements are largely uniform. Common conditions are highlighted in this section (5.1.1 and 5.1.2). In addition, three geographic areas were differentiated by physical characteristics, existing land uses, and anticipated future development. These include: (1) the South McCormick Park area; (2) the North McCormick Park / Depot Park Area; and (3) the Depot Village / Taylor's Landing / Northern Shoreline Area. Specific conditions for each area are described where appropriate.

5.1.1 Physical and Biological Characterization

Channel Form and Bank Conditions

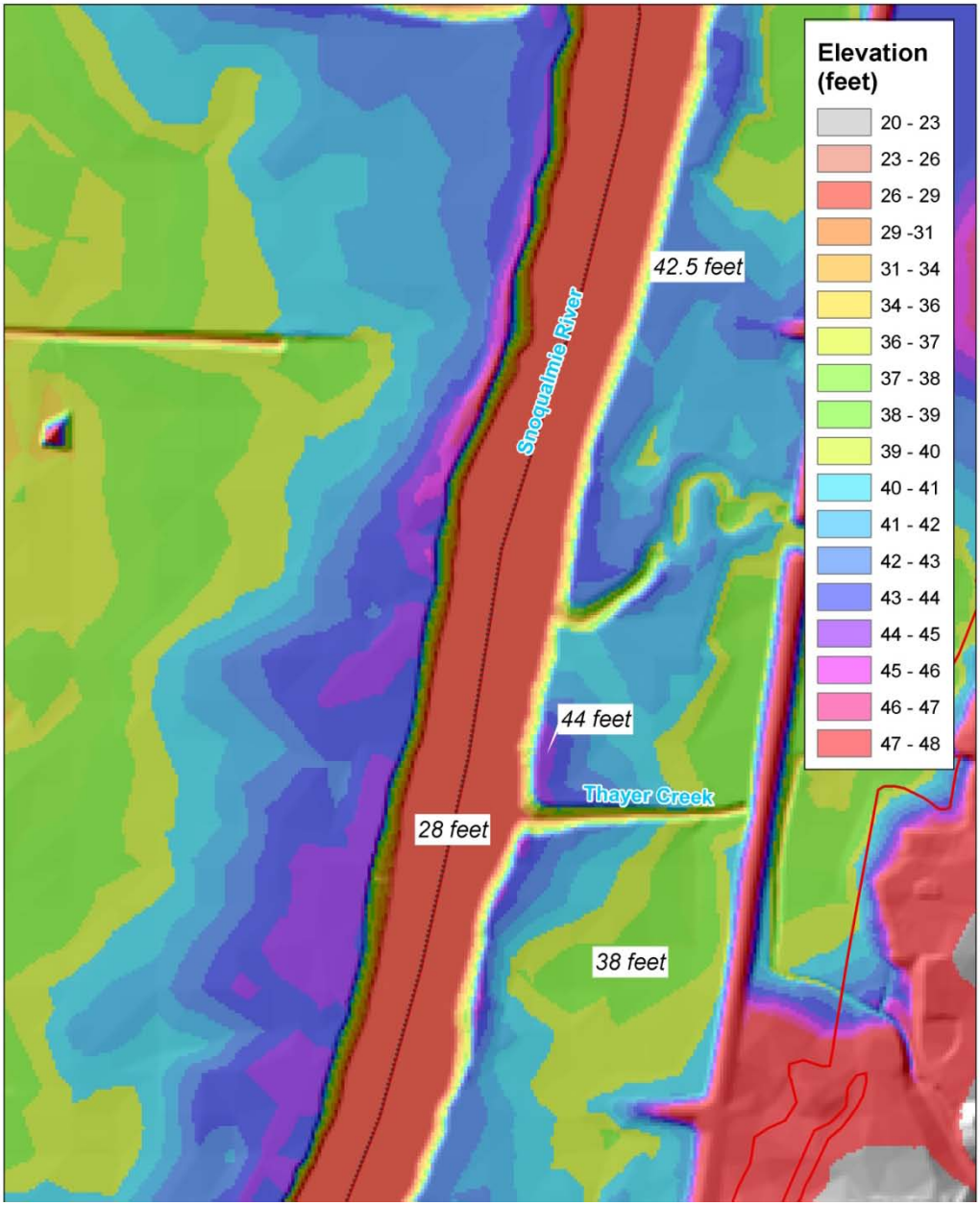
The Snoqualmie River along its entire extent through the City is incised into the alluvial valley (Figures 5-1 and 5-3; Photo 5-1). During normal flows, the river is a low energy system characterized as a glide stream environment with a relatively slow flow rate and no pooling or riffle area (ESA Adolfson, 2009 – *Draft McCormick Park Reconnaissance and Opportunities and Constraints Assessment*, included as Appendix C).

The Snoqualmie River riparian corridor is characterized by a steep bank (due to the incised river) backed generally by a narrow deciduous forest corridor. The bank is vegetated with herbaceous trees and shrub species, with Himalayan blackberry as the dominant (invasive) shrub growing along most of the bank. The forested community ranges from 20 to 30 feet wide from the bank in the south-end open space area to 50 to 150 feet wide within portions of McCormick Park and Taylor's Landing.

Gradual, irregular and relatively narrow berms elevated +2 to +5 feet above the surrounding floodplain extend along both banks of the Snoqualmie in the vicinity of the City (Figure 5-1). The berms are natural formations (fluvial levees) created by rapid

sediment deposition during flood events. While modification and expansion (heightening) of fluvia l levees during past human development was common in many locations along the river corridor, there is no record of levee structures, informal or otherwise, built along the Snoqualmie within Duvall.

Figure 5-1. Snoqualmie River floodplain elevations from 2010 LiDAR data surrounding the Thayer Creek confluence; elevation information depicts incised river channel and fluvial levee formations along both banks of the river.within.



Floodplain, Floodway, and Channel Migration Areas

During significant flood events, the Snoqualmie River engages much of the valley, including most of the City's shoreline area. During a 2009 reconnaissance of the City's shoreline area, there was substantial evidence of the most recent significant flood event, which occurred in January 2009 (Photos 3 and 7 in Appendix C). The winter 2009 flood inundated the majority of the shoreline area throughout the City and included significant overbank flow emanating from the main channel approximately 5,000 feet south of the southern City limits. This flow continued north across the Snoqualmie River valley then spilled back into the main channel as flows receded, as evidenced by significant wrack deposition on the floodplain and on the floodplain (landward) side of riparian vegetation. This spill back was most evident within the northern portion of McCormick Park, where the river's eastern floodplain in Duvall narrows from a wide corridor (700 to 1,200 feet) to a relatively narrow corridor (100 feet wide) as the shoreline continues north into the Depot Village / Taylor's Landing reach. Local records of flood events indicate that the floodplain, extending through the south-end open space area into the developed portion of McCormick Park, is engaged, at least partially, in 50 percent of years. An interpretive flood pole in McCormick Park documents flood events over the last half-century, with detailed documentation over the last 20 years.

The 1 percent annual chance (100-year) floodplain and floodway area has recently been mapped for Duvall, and throughout the Snoqualmie River (FEMA Preliminary DFIRM, November 2010). In the Duvall vicinity the preliminary DFIRMs show an approximate 100-year flood elevation of 51 feet NAVD 88 (FEMA, 2010). The mapped floodplain extends to the edge of the Snoqualmie valley through the City, including the Snoqualmie River / Cherry Creek associated floodplain at the north end of the City within Dougherty Farmstead.

The floodway extends from the river to the Snoqualmie Valley Trail through the wide, southern half of the City's shoreline, and narrows through the vicinity of Depot Village / Taylor's Landing reach along the north edge of the City (Map 4; see Figures 5-3, 5-5, and 5-7 in the following sections).

For purposes of SMP planning, the approximate extent of potential channel migration is mapped as extending throughout floodplain areas to the west of the Snoqualmie Valley Trail (Map 4). Mapping of potential channel migration areas was completed consistent with Ecology guidance (summer 2010 Quarterly Shoreline Planners Meeting), but it does not represent a full channel migration study consistent with Ecology's *Framework for Delineating Channel Migration Zones* (Rapp and Abbe, 2003) or any other adopted method or manual. For purposes of SMP planning, the Snoqualmie Valley Trail is assumed to represent a barrier to channel migration; however, it is not a certified levee and is unpaved. The trail was historically constructed as a railroad corridor, occurs at or near the 100-year floodplain elevation, and is owned and maintained by King County as a regional transportation and recreational facility..

During investigation of the greater McCormick Park area in 2009, historic aerial photography (1936) and General Land Office (GLO) mapping (1870s) were assessed to

investigate the extent of channel movement over the last 130 years (Appendix C). Based on this assessment, limited east-trending channel migration has occurred in the south-end open space area, with channel migration apparent more extensively downstream within the developed portion of McCormick Park (see Figure 3 in Appendix C and Section 5.3).

Tributary Streams and Associated Wetlands

Existing conditions throughout Duvall on Thayer Creek, Coe-Clemons Creek, and Cherry Creek tributary streams were inventoried in 2006 (Herrera, 2006). The assessment included a detailed examination of the lower reaches of Thayer and Coe-Clemons Creeks within the SPA. Additional assessment was conducted in 2009 as part of the McCormick Park Reconnaissance and Assessment (Appendix C). Specifics on stream segments are provided within the reach summaries of this chapter.

Wetlands within Duvall's Snoqualmie River floodplain are limited to areas that receive surface and shallow subsurface flow from the tributary channels. Several small wetlands located on the slope above the Snoqualmie valley, immediately west of Main Street, receive shallow groundwater from hillside seeps (Map 3). Much of the shoreline area is dominated by relatively coarse soils that allow for rapid infiltration and percolation, which prevents development of wetland conditions. Some of the North McCormick / Depot Park areas and South McCormick Park area appear to have finer surface deposits, which result in perched water tables supporting several large depressional wetlands (see Appendix C, Table 1 for additional detail on inventoried wetland areas). Likewise, depressional wetlands are mapped within the floodplain within and around Dougherty Farmstead at the north end of the City.

The vegetation across all of the wetlands is similar, consisting of primarily herbaceous communities dominated by common velvetgrass, cattail, and soft rush. Reed canarygrass is a dominant invasive species throughout all of the palustrine emergent wetland areas. Limited areas of scrub/shrub and forest communities occur on the edges of wetland areas (along the edge of the floodplain, on both sides of the Snoqualmie Valley Trail, and along tributary streams). Shrub and tree communities are dominated by red alder and black cottonwood, salmonberry, vine maple, and willow species with an understory of soft rush, trailing blackberry, giant horsetail, skunk cabbage and lady fern. Himalayan blackberry is the primary invasive species in these areas, although Japanese knotweed also occurs.

Fish and Wildlife Use and Habitat

The Snoqualmie River in the vicinity of the City supports several salmonid species, including Chinook salmon (federally listed as threatened), coho salmon, chum salmon, pink salmon, sockeye salmon, bull trout/Dolly Varden (federally listed as threatened), and steelhead (federally listed as threatened) (Map 5). For all of these species, the mainstem river is used as a migratory corridor and habitat for juvenile rearing and outmigration (WDFW, 2010, Snohomish Salmon Recovery Forum, 2005). Due to the incised channel and lack of habitat complexity and/or significant overhanging vegetation, spawning habitat in the Snoqualmie River throughout the City is limited.

Rearing habitat for Chinook and coho salmon has been somewhat degraded by the reduction in accessible floodplain area due to channelization of tributary streams and historical shoreline armoring (conducted informally and/or through largely undocumented Corps projects) (Photo 5-4). Mapped use of tributary streams within the City's shoreline area is limited to the presence / migration of coho salmon within Coe-Clemons and Thayer Creeks (Map 5).

The 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, 2008). Priority wildlife habitats mapped in the SPA of the Snoqulmie River and the adjacent floodplain include wetlands and riparian zones. 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. Beaver, mountain beaver, rabbit, skunk, black-tailed deer, black bear, and numerous other bird, resident fish, and amphibian species are assumed to use the south-end open space area.

5.1.2 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 Snoqualmie River shoreline area, throughout the City, was modified through historic land clearing and decades of agricultural use (Map 8b). King County Eastside Heritage Center historic photos include a 1955 picture of automobiles being used as shoreline armoring along the banks of the Snoqualmie River in Duvall (Photo 5-1). There is no current evidence of automobiles or other foreign debris used to stabilize the river shoreline.

Photo 5-1. Car bodies used as shoreline armoring along the banks of the Snoqualmie River in Duvall, noted by source as an Army Corps of Engineers project (King County, 2010).

From the Collections of Eastside Heritage Center

The south-end open space shoreline area contains a narrow forested riparian corridor, another result of historic agricultural uses. In 2006 the Stilly Snohomish Fisheries

Enhancement Task Force completed a series of riparian restoration projects, planting native plants along the shoreline (ESA Adolfson, 2009).

Other modifications to the Snoqualmie River within the south-end area are limited to several piped outfalls. A comprehensive assessment of shoreline outfalls has not occurred in the City, although stormwater outfalls and the wastewater treatment plant outfall are known to be located along this reach. The treatment plant outfall was constructed in the 1990s with updates completed in 2001, and enters the river below normal low flow water levels. The locations of known stormwater outfalls are included on Map 8b.

5.1.3 Land Use

Existing Land Use

Much of the eastern Snoqualmie River floodplain was used for agricultural activities though at least the first half of the 1900s. Currently, Duvall shoreline area is largely publicly owned open space and park lands, with limited development other than impervious surface trails, some of which additionally serve as access roads for utility maintenance and open space restoration activities. Trails through the open space areas are contiguous with developed park areas immediately to the north and Snoqualmie Valley Trail access points to the south, outside of the City. The open space area is actively used for walking, dog walking, and wildlife watching.

The most significant trail throughout the City's shoreline area is the Snoqualmie Valley Trail, a regionally significant facility linking Duvall with Fall City and beyond. The trail is built on the historic railroad corridor on a fill berm elevated 8 to 12 feet above the adjacent floodplain (Map 8b), and ends at Taylor's Landing park.

Construction of the railroad corridor through the floodplain significantly altered the interaction of the river and the floodplain during overbank flood events. The floodway is now constricted between the river and the railroad corridor. The railroad corridor berm also separates floodplain wetland areas that were historically linked, and constricts tributary streams to culverts and bridge crossings.

Other significant uses of the City's shoreline area include utility corridors throughout, as well as the Depot Village residential community and Duvall park-and-ride facility extending between Depot Park and Taylor's Landing, both to the east of the railroad tracks. Existing utilities are known to include stormwater outfall corridors, a wastewater outfall corridor, a gas main under the river at Woodinville Duvall Road, and high-voltage overhead electrical corridors.

Essential public facilities are detailed by Map 6 to highlight those facilities providing significant transportation, safety, and critical municipal services to the community that occur within or partially within the SPA. The Main Street (State Route 203) corridor is the only one of these listed facilities that extends adjacent to or within the entire length of the Duvall SPA. Other essential public facilities are detailed in the reach summaries of this chapter.

Shoreline Environment and Zoning Designations

The current SEDs and land use designations for the City's shoreline areas are shown in Table 1-1, as well as Figure 1-1 (current SEDs) and Map 6 (zoning and land use). The current SED for most of Duvall's shoreline area is designated Conservancy, with the Riverside Village zoning area (existing Depot Village development) designated Urban (City of Duvall, 1974).

The zoning designations, established by DMC 14.10, establish a Public Facility designation for the entire area to the west of the Snoqualmie Valley Trail. To the east of the trail, zoning is established based on existing or planned land uses fronting Main Street. Many of these areas are also zoned Public Facility. Other designations included Mixed Use (MU12), Light Industrial, a small area of Midtown, and Riverside Village. With the exception of developed areas of the Riverside Village subarea, existing primary uses associated and consistent with these zoning designations to the east of the trail corridor do not extend west into the floodplain and shoreline environment.

Existing Public Access

The large majority of the Duvall shoreline area is publicly owned recreation and open space and is generally accessible to the public for active uses (shoreline access, picnics and gatherings, wading, swimming, boating) and passive uses (walking / dog walking, horse / equestrian uses, wildlife observation, meditation) (Map 7). The King County owned and managed Snoqualmie Valley Trail extends through most of the shoreline area, linking many of the City owned parks and open spaces together, as well as to additional facilities to the south of Duvall. Specifics of existing public access areas and facilities are provided in the reach summaries of this chapter.

Historical and Cultural Resources

Historic and cultural resources are documented through a variety of sources. Official registers include the National Register of Historic Places, the Washington State Heritage Register, and the King County Landmarks and Heritage Commission. In 1996, the City adopted an ordinance to protect historic sites, buildings and structures through use of the County designation system (DMC 10.61). See reach description sections below for listed / catalogued sites within each reach. Cultural and historic use of the entire Snoqualmie River shoreline area is well documented.

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 5.1.2. Eroding shorelines are described in the context of channel and bank form also in Section 5.1.2. No developing or redeveloping harbors or waterfronts, dredge disposal sites, or toxic or hazardous waste clean-up sites are located within the Duvall shoreline area.

5.2 Reach Descriptions

5.2.1 South McCormick Park

South McCormick Park is largely made up of City-owned land within the Snoqualmie River floodplain (Figure 5-2). The area extends from the mouth of Coe-Clemons Creek to the southern city limits and is bisected by the Snoqualmie Valley Trail.

Figure 5-2. Aerial Photography (2009) of South McCormick Park; photo points shown for photos included in this section.

The entire area to the west of the Snoqualmie Valley Trail is generally described as McCormick Park. For purposes of this inventory, the largely undeveloped portion of McCormick Park is described separately from the active park area (discussed in Section 5.2.2). South McCormick Park includes the widest floodplain area within the City, between 700 and 1,200 feet wide.

Specific conditions that differentiate the south end open space area from overall reach conditions are illustrated in Figure 5-3 and detailed in Table 5-1.

Figure 5-3. Section across the Snoqualmie River SPA within South McCormick Park. Section location shown on Map 3 as Section C; elevation data from King County topographic information.

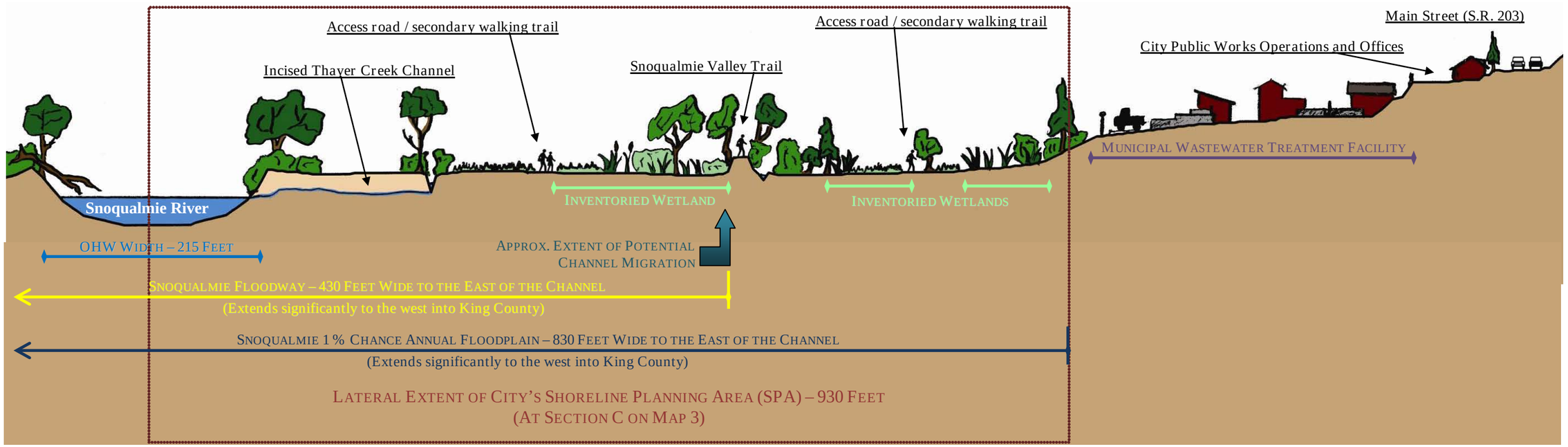


Photo 5-2. Steep banks and incised channel of the Snoqualmie River, facing south from South McCormick Park; photo location shown on Figure 5-1 (April 2009).

Photo 5-3. Steep banks and incised channel of Coe-Clemons Creek, immediately upstream of convergence with Snoqualmie River; photo location shown on Figure 5-1 (April 2009).

Photo 5-4. View across wetland and meandering Coe-Clemons channel to the west of trail corridor; significant wracked flood debris; photo location shown on Figure 5-1 (April 2009).

Table 5-1. Summary of reach conditions within South McCormick Park.

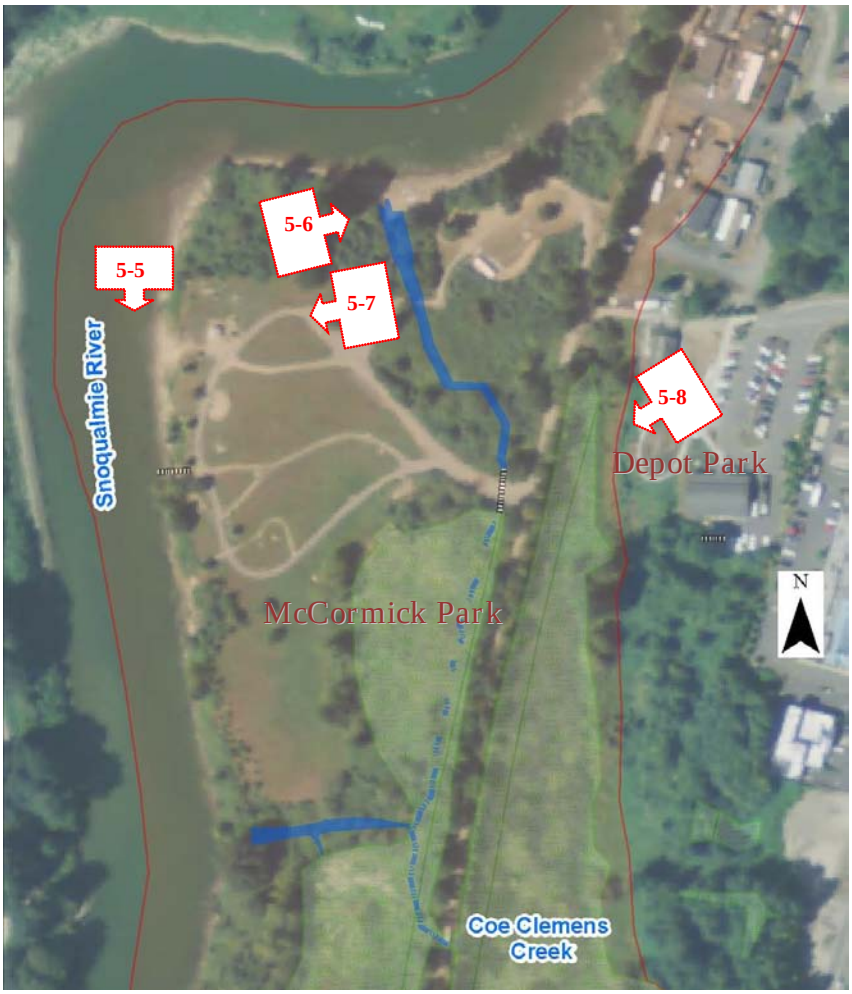
	Summary of Reach Condition
Physical and Biological Characterization	
Channel and Bank Form	Steep bank (due to incised river) as elsewhere in Duvall's shoreline reach.
Riparian Condition	Narrow (20 to 30 foot wide) deciduous forest corridor; the bank is vegetated with herbaceous trees and shrub species, with Himalayan blackberry as the dominant (invasive) shrub growing along most of the bank. Riparian forest 50 to 100 feet wide around the confluences with the Thayer and Coe-Clemons (southern) tributary channels, and in other short segments.
Floodplain, Floodway, and CMZ Areas	The mapped floodplain extends to the edge of the Snoqualmie valley through the south-end open space area, and the floodway extends from the river to the SVT (Map 4, Figure 5-2). Limited east-trending channel migration has occurred in the south-end open space area (see Figure 3 in Appendix C). Channel migration is apparent more extensively downstream within the developed portion of McCormick Park (Section 5.3).
Tributary Streams & Associated Wetlands	To the west of the SVT, segments of Thayer and Coe-Clemons Creeks consist of a series of runs, low gradient riffles, plunge pools formed by a clay layer, and dammed pools formed by small woody debris jams (Herrera, 2006). The lowest segments of both streams are confined through incised ravines that drop the tributaries to the normal surface flow elevation (approximately 30 feet above sea level) of the Snoqualmie River (Figure 5-2, Photo 5-3, Maps 2 and 3). Thayer Creek passes under a narrow bridge (for an access road) and through a culvert under the Snoqualmie Valley Trail approximately 370 feet and 430 above the confluence, respectively. To the east of the valley trail berm, the creek channel is straight, and flows directly along the toe of the trail berm for approximately 200 feet. Herrera (2006) notes this segment as the best Thayer Creek fish habitat within the shoreline area, although access to salmonid species except coho salmon is limited by the partial barrier created by the incised confluence channel. Thayer Creek enters the shoreline area from the southeast, where it passes near the southern and western edges of the City's wastewater treatment facility. Flow from Coe-Clemons Creek enters the shoreline area through a highly impounded culvert beneath Main Street. The channel meanders through a large wetland area, becoming braided, poorly defined, and intermittent to the east of the SVT (Maps 2 and 3). Flow from the creek disperses to the north, toward the ponded area immediately west of Depot Park (further discussed in Section 5.2.2), as well as to the south, where surface water eventually converges with Thayer Creek (see wetland and stream mapping on Map 3). The majority of flows from Coe-Clemons Creek spill over a beaver dam that has been augmented with an artificial inlet structure, both located directly below a bridge along the SVT corridor. There are additional beaver dams and inlet structures on the west side of the trail berm along the stream corridor. On the west side of the SVT, surface flow reaches the river via two channels. The northern channel, which flows north across the developed portion of McCormick Park, appears to be the mouth shown on the 1936 photo and the GLO maps (see Appendix C, Figures 4 and 5). The southern channel, at the northern edge of the south-end open space area, carries water directly west; this straightened channel was likely created during the land conversion to agriculture. Both channels are influenced by beaver activity. Both channels flow through the largest wetland area in the shoreline environment to the west of the trail corridor (Photo 5-2). Water levels in this wetland and relative outflow to the two convergence channels are likely dependent on flows from the upper (eastern) pond, and elevation controls at beaver dams within the west channel. An unnamed channel flows into the Snoqualmie River within South McCormick Park (Maps 2 and 3). This unnamed feature is a blind channel that extends for approximately 400 linear feet, but may have historically extended further to the south according to GLO mapping (Appendix C, Figure 4). The uppermost stretch of the channel is very narrow and ditched, widening and becoming incised closer to the Snoqualmie River. There was no flow within the channel during our site visit. The vegetation across all of the south-end wetlands (Map 3) is similar, consisting of primarily herbaceous communities dominated by common velvetgrass, cattail, and soft rush. Reed canarygrass is a dominant invasive species throughout all of the palustrine emergent wetland areas. Limited areas of scrub/shrub and forest communities occur on the edges of wetland areas (along the edge of the floodplain, on both sides of the Snoqualmie Valley Trail, and along tributary streams). Shrub and tree communities are dominated by red alder and black cottonwood, salmonberry, vine maple, and willow species with an understory of soft rush, trailing blackberry, giant horsetail, skunk cabbage and lady fern. Himalayan blackberry is the primary invasive species in these areas, although Japanese knotweed also occurs (Appendix C).
Fish and Wildlife Use and Habitat	Rearing habitat for Chinook and coho salmon has been somewhat degraded by the reduction in accessible floodplain area due to channelization of tributary streams and historical hardening of the shoreline (push-up levies above the banks and documented use of auto bodies as shoreline armoring, shown in Photo 5-1). Mapped use of tributary streams within South McCormick Park is limited to the presence / migration of coho salmon within Coe-Clemons and Thayer Creeks (Map 5). Section 5.1.3 of this chapter further details fish and wildlife use and habitat.

	Summary of Reach Condition
Shoreline Modifications	
Armoring	Shoreline armoring or hardening is minimal, and includes informal alteration associated with historical agricultural land uses; no maintained or formal armoring present (Map 8b).
Outfalls	Several piped outfalls, including stormwater outfalls and wastewater treatment plant outfall. The treatment plant outfall was constructed in the 1990s with updates in 2001 and enters the river below normal low flow water levels. The wastewater outfall receives treated effluent from the treatment plant (total rebuild completed in 2005). Locations of known stormwater outfalls are included on Map 8b.
Land Use	
Existing Land Use	Largely publicly owned open space with limited development beyond impervious surface trails. Some trails (with several small bridges over tributary streams) serve as access roads for utility maintenance and open space restoration activities. Trails through the open space areas are contiguous with the SVT. The open space area is actively used for walking, dog walking, and wildlife watching. Other uses of South McCormick Park include utility corridors and outfalls.
Current SED	Current SED is Conservancy for the entire area (City of Duvall, 1974) (Figure 1-1).
Zoning and Comp Plan Designations	Zoning for the area to the west of the SVT is Public Facility (DMC 14.10). To the east of the trail, zoning is established based on existing or planned land uses fronting Main Street. Designations included Mixed Use (MU12), Light Industrial, and a small area of Midtown. (Map 7) Comprehensive Plan designations are consistent with zoning.
Existing Public Access	Largely publicly owned open space – generally accessible to the public for passive recreation (Map 7). This includes all but one parcel between the Snoqualmie River shoreline and the SVT, and all parcels immediately adjoining the shoreline (Map 2). The open space area is bisected by the SVT (Figure 5-3). Additional improvements open to and used by the public include minimally maintained trails (also used as public works maintenance roads) passing through the open space area. Trails are contiguous to the SVT; open space area is actively used for walking, dog walking, and wildlife watching (including views of the Snoqualmie River); no physical shoreline access within reach.

5.2.2 North McCormick Park / Depot Park Area

The North McCormick Park / Depot Park area consists of two City-owned properties on opposite sides of the Snoqualmie Valley Trail within the Snoqualmie River floodplain (Figure 5-4). The area extends from the southern mouth of Coe-Clemons Creek to the north end of McCormick Park, with Depot Park to the east of the trail and McCormick Park to the west of the trail (along the river shoreline).

Figure 5-4. Aerial Photography (2009) of the McCormick Park / Depot Park Area; photo points shown for photos included in this section.



The entire area to the west of the Snoqualmie Valley Trail is generally described as McCormick Park. For purposes of this inventory, the active park area is described separately from the largely undeveloped open space extending to the south (discussed in Section 5.2). The floodplain in this area is narrower than in the south-end open space area, narrowing from approximately 700 feet wide at the south end of McCormick Park / Depot Park to less than 150 feet wide at the north end of the segment.

Specific conditions that differentiate the North McCormick Park / Depot Park area from overall reach conditions are illustrated in Figure 5-5 and detailed in Table 5-2.

Figure 5-5. Section across the Snoqualmie River SPA within the North McCormick Park / Depot Park area. Section location shown on Map 3 as Section B; elevation data from King County topographic information.

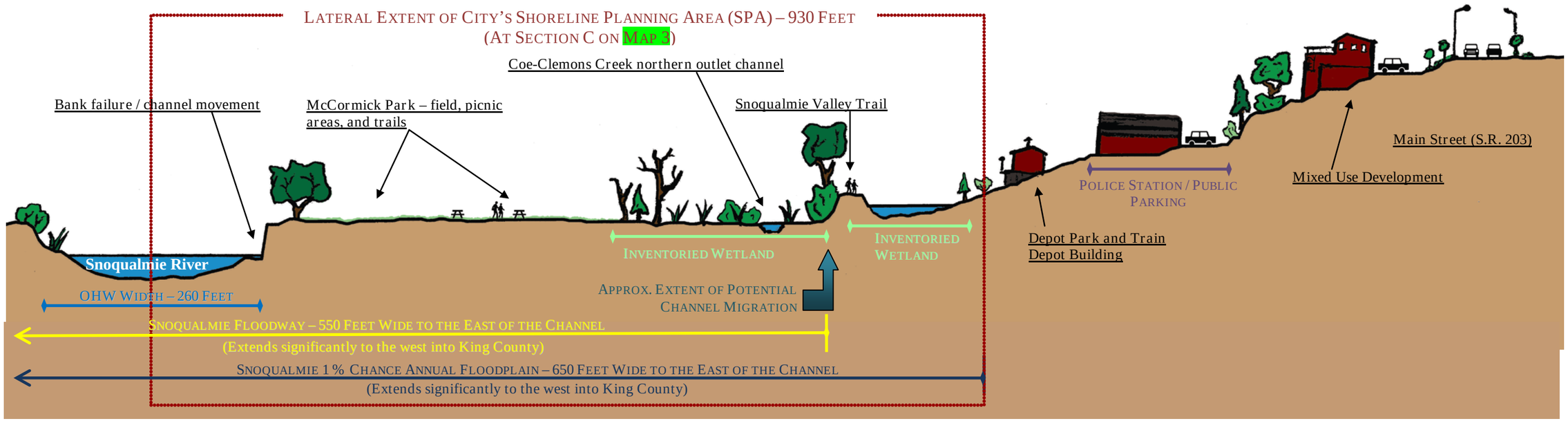


Photo 5-5. Failing banks along the Snoqualmie River, facing south at McCormick Park shoreline; photo location shown on Figure 5-3 (February 2010).

Photo 5-6. North shoreline of McCormick Park with sandy beach used for swimming and wading; photo location shown on Figure 5-3 (City of Duvall, 2008).

Photo 5-7. Interpretive flood elevation pole in lawn area of McCormick Park – red arrow notes the approx. height of the winter 2009 flood; photo location shown on Figure 5-3 (February 2010).

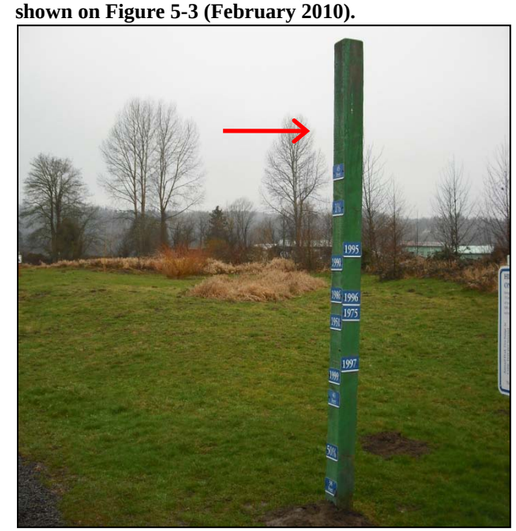


Table 5-2. Summary of reach conditions within the North McCormick Park / Depot Park area.

	Summary of Reach Condition
Physical and Biological Characterization	
Channel and Bank Form	Steep, failing bank (due to the incised river with east trending bank scour) backed by little to no forest cover (Photo 5-5; Appendix C). Where failure has not occurred, the bank is vegetated with shrub species. The area immediately surrounding the Coe-Clemons confluence consists of a narrow, sandy beach that is used in summer for swimming and wading (Photo 5-6).
Riparian Condition	Where bank failure has not occurred, the bank is vegetated with shrub species, with Himalayan blackberry as the dominant (invasive) shrub. Areas of riparian forest include canopy generally only 10 to 20 feet wide from the bank. Northwest and north shorelines of McCormick Park include a forest / shrub riparian area 50 to 150 feet wide, extending to the area around the Coe-Clemons (northern) tributary channel confluence
Floodplain, Floodway, and CMZ Areas	The mapped floodplain extends to the edge of the Snoqualmie valley through the park area, generally following the hillslope immediately west of the Depot Park / Police Station parking lot (Map 4, Figure 5-5). During investigation of the greater McCormick Park area in 2009, historic aerial photography (1936) and GLO mapping (1870s) were assessed to investigate the extent of channel movement over the last 130 years (Appendix C). Based on this assessment, east-trending **c**hannel migration has occurred along the west and northwest facing shorelines within McCormick Park (see Appendix C Figures 4 and 5, Map 8b). Bank scour and general eastward progression of the river's right bank is evident through recent observations of bank failure along this shoreline (Photo 5-7), and could potentially be exacerbated by the loss of the riparian forest / shrub zone.
Tributary Streams & Associated Wetlands	Coe-Clemons Creek is braided and contains multiple channels as it flows into the Snoqualmie valley (Maps 2 and 3). Enters the SPA within the south-end open space area and then disperses across floodplain, including to the north toward ponded area immediately west of Depot Park. Pond elevation largely controlled by beaver activity (damming) and the bypass structure located at the outlet through the SVT corridor. Pond (significant areas of open water and little overhanging vegetation) likely elevates Coe-Clemons Creek water temperatures during the summer; Snoqualmie River is listed on the 303(d) list for fecal coliform (with TMDL implemented), so reducing summer temperatures should be an overall goal. West of the SVT, Coe-Clemons Creek branches into two channels that converge separately with mainstem river. The northern channel flows across the developed portion of McCormick Park and appears to be the mouth shown on the 1936 photo and the GLO maps (see Appendix C). Wetlands within the McCormick Park / Depot Park area receive surface and shallow subsurface flow from Coe-Clemons Creek, and occasionally (once every 2-3 years) receive overbank floodwaters from river (Map 3). Wetland vegetation is consistent with communities seen across the Duvall shoreline area.
Fish and Wildlife Use and Habitat	Fish and wildlife use in the McCormick Park / Depot Park area is consistent with the use patterns across Duvall shoreline area (Section 5.1.1). See Map 5 for salmonid distribution and the City's 2006 Existing Stream Habitat Report for a detailed assessment of existing conditions within Coe-Clemons Creek (Herrera, 2006).
Shoreline Modifications	
Armoring	Shoreline armoring or hardening is minimal, and includes informal alteration associated with historical agricultural land uses; no maintained or formal armoring present (Map 8b).
Outfalls	One piped stormwater outfall is known to occur within the McCormick Park (Map 8b).
Land Use	
Existing Land Use	Used for agricultural activities though at least the first half of the 1900s; aerial photography from 1936 shows that the Depot Park area was largely open space through that period (Appendix C). Development of this area was probably challenging due to Coe-Clemons Creek and associated wetlands, as remains the case today. McCormick Park is one of the larger parks in Duvall (Map 7). The open field area is the site of several summer community events, and provides active and passive recreation activities year-round. The park is accessed by the public only on foot, horse, or bicycle through Depot Park and/or the SVT; includes open field areas, trails (with one small bridge over Coe-Clemons Creek), benches, picnic tables, shoreline access through the swim beach, interpretive signs about flooding and wildlife, as well as open space areas. Depot Park is partially within shoreline area, extending to the east up the hillside and out of the floodplain. Within the shoreline the park is largely open space; includes large ponded area in-line with Coe-Clemons Creek (Photo 5-8). Duvall's historic rail depot is located in the park, moved from the original location adjacent to the railroad corridor. The depot building, which is owned by the City, is used for community and private meetings and activities. Other park structures to the east of the shoreline area include a wildlife viewing platform / community deck, and a parking lot for both the park areas and the adjacent Police Station. The Duvall Police Station is the only essential public facility near the McCormick Park / Depot Park shoreline area, but it is entirely outside of shoreline jurisdiction (Map 6).

	Summary of Reach Condition
Land Use, Continued	
Current SED	The current SED for the entire area is Conservancy (City of Duvall, 1974). (Figure 1-1)
Zoning and Comp Plan Designations	Zoning designation is Public Facility for the entire shoreline extent of the McCormick and Depot Park areas (DMC 14.10) (Map 7). Comprehensive Plan designations are consistent with zoning.
Existing Public Access	The McCormick Park / Depot Park area is entirely publicly owned park and open space and is generally accessible to the public for active and passive recreation activities (Map 7). Parks are split by the SVT. A swimming and wading beach provides direct access to the Snoqualmie River shoreline along the northern edge of McCormick Park (Photo 5-6). McCormick Park also provides fishing access to the Snoqualmie River.
Historical and Cultural Resources	The Duvall Train Depot is documented as a historic structure (City of Duvall, 2010). The depot is directly adjacent to the shoreline area, but located east of the Snoqualmie River floodplain and all associated wetlands. See Section 3.1 of this report for cultural and historical background.

Photo 5-8. Depot Park open space area, including Coe-Clemons beaver pond, with Snoqualmie Valley Trail in the background, facing southwest; photo location shown on Figure 5-3 (February 2010).

5.2.3 Riverside Village, Taylor's Landing, and Northern Shoreline Area

The Riverside Village, Taylor's Landing, and Northern Shoreline area (called collectively the northern shoreline area) consists of a narrow corridor along the historic town frontage. The shoreline length is approximately 2,500 linear feet within the City, and approximately 1,400 linear feet within the Duvall UGA to the north of the City (Figure 5-6). The river channel is near the eastern edge of the valley through the northern shoreline area, resulting in a narrow floodplain (Map 4). At the northwestern extent of Duvall, the river enters the valley formed by the convergence with Cherry Creek, a significant tributary to the Snoqualmie River mainstem. In this area, the SPA extends over a wide floodplain to the east.

Specific conditions that differentiate the northern shoreline area from overall reach conditions are illustrated in Figure 5-7 and detailed in Table 5-3.

Figure 5-6. Aerial Photography (2009) of the Riverside Village, Taylor's Landing, and Northern Shoreline Area; photo points shown for photos included in this section.

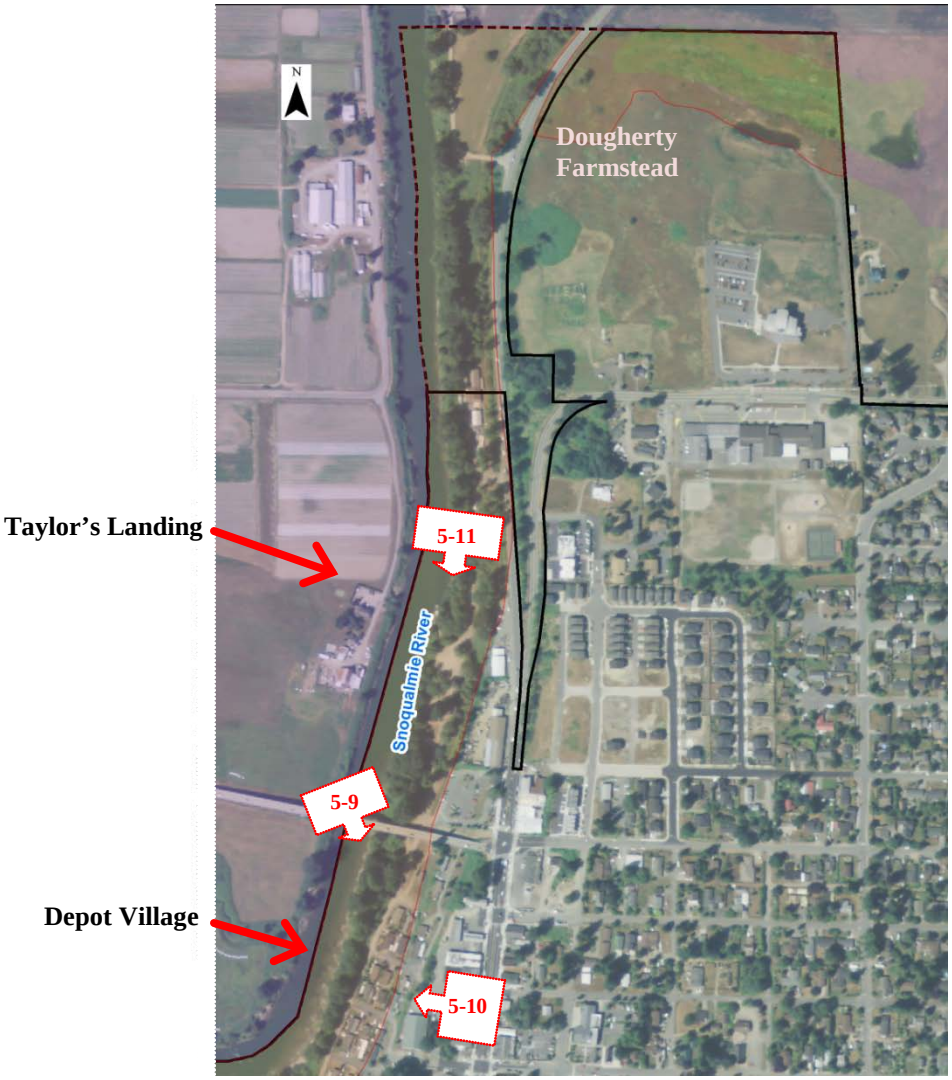


Figure 5-7. Section across the Snoqualmie River SPA within the Depot Village / Taylor's Landing / Northern Shoreline Area. Section location shown on Map 3 as Section B; elevation data from King County topographic information.

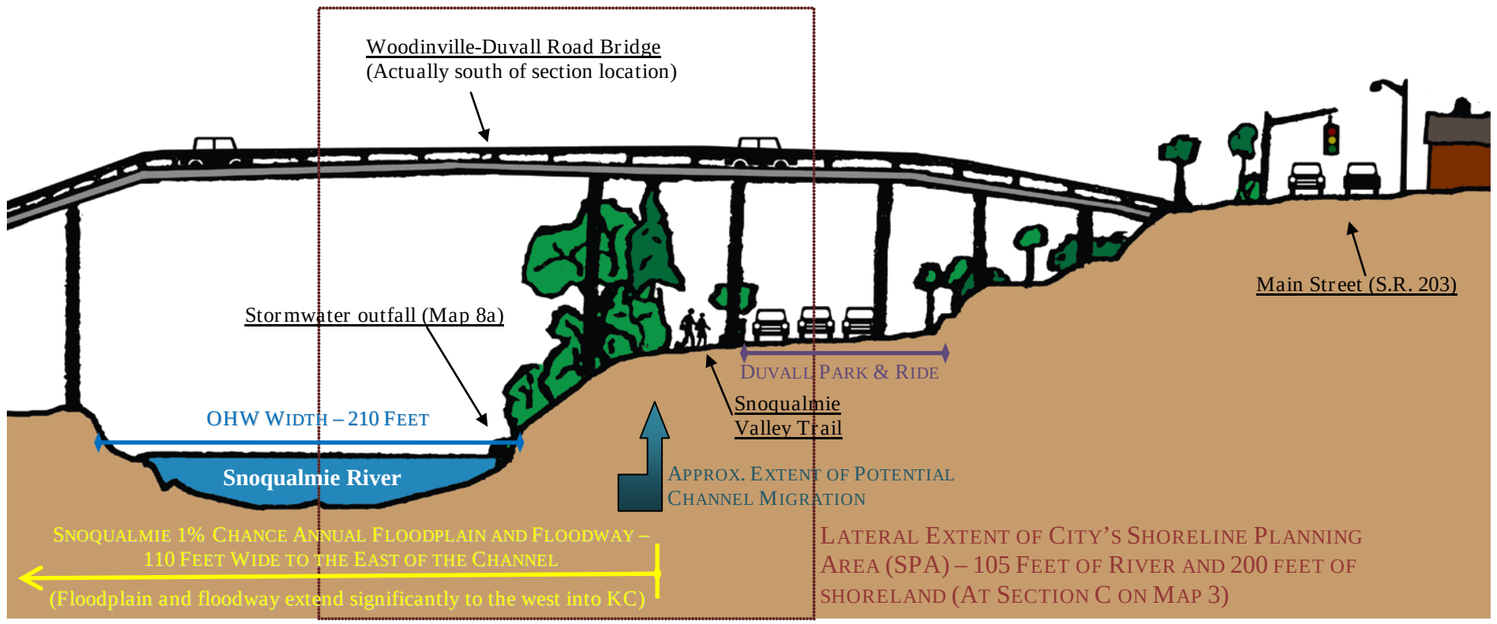


Photo 5-9. Snoqualmie River shoreline at Woodinville-Duvall Road Bridge. Note Riverside Village, Snoqualmie Valley Trail, and historic bridge footings; photo location shown on Figure 5-5 (King County, 2001).

Photo 5-10. Depot Village residential neighborhood immediately east of the Snoqualmie Valley Trail; photo location shown on Figure 5-5 (February 2010).

Photo 5-11. Taylor's Landing boat launch; ramp cuts into the bank, angling downriver to the north; photo location shown on Figure 5-5 (February 2010).

Table 5-3. Summary of reach conditions within the Riverside Village, Taylor's Landing, and Northern Shoreline area.

	Summary of Reach Condition
Physical and Biological Characterization	
Channel and Bank Form	Steep bank (due to the incised river) backed by little to no forest cover (Photo 5-5; Appendix C). Footings for the Woodinville-Duvall Road Bridge land at the edge of the OHWM on both sides of the river, modifying the bank form.
Riparian Condition	50- to 150-foot-wide riparian corridor (Photo 5-9). Limited overhanging vegetation is present along the northern shoreline, and several downed trees hanging into the river were noted during site reconnaissance. Bank understory is vegetated with shrub species, with Himalayan blackberry as the dominant (invasive) shrub. Areas of riparian forest include canopy generally only 10 to 20 feet wide from the bank. Northwest and north shorelines of McCormick Park include a forest / shrub riparian area 50 to 150 feet wide, extending to the area around the Coe-Clemons (northern) tributary channel confluence
Floodplain, Floodway, and CMZ Areas	Snoqualmie River channel is near the eastern edge of the valley through the northern area, resulting in a confined floodplain (Figure 5-7; Map 4). Compared with the wide floodplain and floodways associated with the southern open-space area and McCormick Park (500 to 1,200 feet wide), the northern shoreline area floodplain is narrow (ranging between 75 feet and 150 feet wide to the east of the river). Recent flood events have resulted in shallow floodwaters engaging the eastern edge of the Depot Village residential area (Photo 5-10). At the northern extent of Duvall's shoreline area, the Snoqualmie River engages with the Cherry Creek valley, creating a wide floodplain that extends to the east of SR 203 across the northern portion of the Dougherty Farmstead and Holy Innocents Catholic Church properties. The potential channel migration area is narrow along the northern extent of the shoreline, confined by the relatively narrow eastern floodplain corridor (Map 4). The potential channel migration area does not extend to the east of State Route 203 into the floodplain area at the northern end of the City.
Tributary Streams & Associated Wetlands	There are no mapped tributary streams within the northern shoreline area (Herrera, 2006). The floodplain shoreline area at the northern edge of the City is associated with Cherry Creek as well as the Snoqualmie River. No portions of the Cherry Creek mainstem or tributaries pass within the City's shoreline planning area, however depressional wetlands have been inventoried in this area (Map 3).
Fish and Wildlife Use and Habitat	Fish and wildlife use in the northern shoreline area is consistent with the use patterns across Duvall shoreline area (Section 5.1.1), although no tributary fish habitat occurs within the reach. See Map 5 for salmonid distribution.
Shoreline Modifications	
Armoring	Three primary structural modifications to east-bank shoreline through the northern shoreline area: (1) historic bridge supports located immediately south of the existing bridge; (2) current bridge supports landing at or near the OHWM of the river; and (3) a boat ramp angling downstream into the river at Taylor's Landing. Both the historic bridge and the current bridge supports are concrete (Photo 5-8). The boat ramp is one lane wide and is paved with rutted and cracked concrete. The shoreline immediately surrounding the ramp is armored with riprap (Photo 5-10). During storm events, it appears that sheet flow from the ramp approach and ramp runs directly down the ramp into the river.
Outfalls	Four piped stormwater outfalls are known to occur within the northern shoreline area (Map 8a).
Land Use	
Existing Land Use	Most of the northern shoreline area is publicly owned open space and park lands. Moving north from McCormick Park, the Snoqualmie Valley Trail extends along the shoreline to Taylor's Landing. The trail corridor fronts the shoreline, with the riparian open space area extending from the trail to the river within the trail right-of-way (Map 6). The Depot Village area is immediately east of the trail and south of the Woodinville-Duvall Road bridge. The Depot Village is one large (4.34 acre) parcel only partially within the SPA that is currently developed with 26 manufactured homes (Photo 5-9). Homes are generally located in three rows paralleling the shoreline, the lower two rows of existing structures within shoreline jurisdiction. A series of narrow private roads provide access to the residences. The Woodinville-Duvall Road bridge is located on a corridor of public right-of-way crossing the shoreline area; an additional right-of-way corridor approximately parallels the bridge corridor to the south, along the alignment of the historic Snoqualmie River bridge (Photo 5-9). The Duvall Park-and-Ride facility is located immediately north of the bridge (east of the trail corridor); owned by the City and is only partially within the shoreline area (Figure 5-7), the lot provides commuter parking. Taylor's Landing (2.2 acres) is the northern terminus of the SVT (Map 7). Along with McCormick Park, Taylor's Landing is the only public space that provides direct access to the Snoqualmie River within Duvall. The park includes a large parking area for park and trail users, as well as for boaters utilizing the boat ramp. See Existing Public Access in this table, below. North of Taylor's Landing, King County owned historic railroad corridor extends to the northern City limits. The corridor does not contain a developed trail to the north of Taylor's Landing; this undeveloped County corridor continues into the UGA directly north of the City, swinging to the east away from the river and paralleling SR 203. One large (7.61 acre) residential / agricultural property is located along the shoreline, extending to the northern limits of the UGA. This property is accessed by a private road extending from SR 203. To the east of SR 203, the northern portions of Dougherty Farmstead (publicly owned) and Holy Innocents Catholic Church (both properties within City limits) extend into the floodplain of the Snoqualmie River.

	Summary of Reach Condition
Land Use, Continued	
Current SED	The current SED for most of the northern shoreline area is Conservancy, with the segment around Depot Village designated Urban (City of Duvall, 1974) (Figure 1-1).
Zoning and Comp Plan Designations	Consistent with park, open space, and park-and-ride uses, the zoning and Comprehensive Plan land use designation for most of the northern shoreline area is Public Facility (DMC 14.10, City of Duvall, 2006). The Depot Village residential area is designated Riverside Village.
Existing Public Access	Taylor's Landing is designated as a Community Park within the City's Parks Plan (EDAW / AECOM, 2008) and provides significant public access to the Snoqualmie River shoreline (Map 7). The park is linked to the Snoqualmie Valley Trail, a regionally significant pedestrian, bicycle, and equestrian facility linking Duvall, Carnation, and Fall City. The trail also connects Taylor's Landing with McCormick and Depot Parks to the south. A boat ramp and associated facilities provide direct access to the Snoqualmie River shoreline within Taylor's Landing (Photo 5-10). The park also provides fishing access to the Snoqualmie River.
Historical and Cultural Resources	The Dougherty Farmstead is documented as a historic property, with the Duvall Historical Society providing guided public tours through the farmhouse and outbuildings (City of Duvall, 2010). See Section 3.1 of this report for cultural and historical background.

CHAPTER 6 SUMMARY OF SHORELINE MANAGEMENT ISSUES AND OPPORTUNITIES

The state Shoreline Guidelines require local jurisdictions to identify general opportunities for shoreline protection, enhancement and restoration, and potential impediments to the protection and restoration of ecological functions.[8] In addition, local governments are required to analyze current and projected shoreline use patterns, potential use conflicts, and current and potential future public access sites. This chapter summarizes overall protection, restoration and development potential at the watershed scale and describes specific management issues, use patterns and conflicts, restoration opportunities, and public access opportunities for each of the City's three shoreline areas.

6.1 Overall Protection, Restoration and Development Potential

There are numerous opportunities to protect, restore, and enhance shorelines throughout Duvall, including areas within and outside of shoreline jurisdiction. Many site-specific opportunities have been identified and discussed as part of past efforts, including: the 2006 Stream Habitat Assessment (Herrera, 2006); the 2002 Fish Habitat Restoration Plan (Herrera, 2002); the 2005 Landscape Analysis (Parametrix, 2005); and the 2010 McCormick Park draft assessment (ESA Adolfson, 2009). Examples of identified restoration opportunities include:

- Modifications to existing stormwater systems to improve integration with the City's natural drainage networks, with project identification in the upper and central Coe-Clemons basins;
- Riparian restoration along the Snoqualmie River mainstem, with plantings completed by the Stilly-Snohomish Task Force along portions of the McCormick Park and south open space area shorelines; and
- Removal of fish passage barriers along Thayer and Coe-Clemons Creeks, as identified in the Fish Habitat Restoration Plan.

The Landscape Analysis identified the important areas for ecosystem processes and the level of alteration present in each subbasin within the study area (see Chapter 3 and Appendix B). In addition, Ecology's Puget Sound-wide analysis provides further assessment of hydrologic conditions in Snoqualmie mainstem subbasins, verifying the 2005 assessment (Ecology, 2010, Parametrix, 2005). These analyses provide a framework for determining how development, protection and restoration could be prioritized throughout the subbasins in Duvall. Although a synthesis has not been fully completed, identification / mapping of important areas and alterations (Figures 3-5 and 3-6 in Appendix B) could be used to create a relative ranking of where development, protection and restoration should occur at the subbasin scale. Preliminary ranking will be applied to restoration and conservation opportunities during development of the full SMP restoration plan.

[8] The Guidelines also require a Restoration Plan, which will be prepared in a subsequent SMP update step.

The categories are not absolute or exclusionary, meaning that it is possible for development to occur within a protection area and for restoration to occur in a development area, and so forth. Within any subbasin there may be smaller areas that do not match the overall management recommendation. It is also important to note that the categories are not discreet but occur along a continuum from protection (highest ecological value, least altered) to development (lowest ecological value, most altered).

6.2 Reach-scale Management Summaries

Table 6-1 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, 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. The summary table 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 SMP by identifying: (1) opportunities for ecological conservation and restoration, and (2) policy issues related to future shoreline use and development. Following the table, management issues and opportunities are identified for each of the three shoreline segments along the Snoqualmie River.

Table 6-1. Summary of Impairments to Shoreline Ecosystem Processes and Management Opportunities

Ecosystem Process	Causes of Impairment to Ecosystem Process	Scale of Alterations	Protection and Restoration Opportunities
Water Quality	Loss of riparian canopy has affected river temperature. Modifications to Coe-Clemons tributary stream has created pond, affecting tributary and localized water temperature. Changes in land use have increased input of pollutants to the river, including metals (roadway runoff) and potentially phenols and other pollutants. Fecal coliform and excess nutrients in runoff from agricultural and residential areas are likely due to livestock and possibly septic system sources outside of the City.	Basin and Reach Reach Watershed, Basin, and Reach Watershed	• Encourage low impact development during development and redevelopment activities throughout Duvall. LID strategies should focus on retrofit of existing residential stormwater systems, many of which are in-line with or discharge to tributary streams draining to the shoreline area. Additional focus areas should include management of land cover change in design of subdivisions and other major redevelopments that significantly alter land use. • Restore tributary streams within shoreline area to improve water quality functions; primarily focus on water temperature issues associated with the large open water (pond) areas to the east of the Snoqualmie Valley Trail. • Continue to seek funding sources for upgrades to the City's stormwater utilities, focusing on existing systems that drain into key tributary streams. Develop a comprehensive list of under-functioning systems, including prioritization for retrofit. • Provide education and incentives to property owners to address non-point water quality issues, including promoting use of commercial car-washes, development of rain gardens and/or rain barrels from roof downspouts, lawn and fertilizer alternatives, and reduction in property area impervious surface coverage. • Protect and restore riparian vegetation by enforcing critical areas regulations and implementing protection incentives and flexible development tools. • Explore creation of additional wetland areas within the shoreline environment to maximize surface water storage. • As feasible, support the County in partnering with agricultural properties on adjacent (western) Snoqualmie shoreline to promote better management of agricultural activities within the riparian buffer; potentially promote these partnerships as a regional example of stewardship.

Ecosystem Process	Causes of Impairment to Ecosystem Process	Scale of Alterations	Protection and Restoration Opportunities
Biological Resources	Historic and current development and bank stabilization have reduced shoreline vegetation and large woody debris. Loss of riparian canopy upstream and within City shoreline has affected river temperature and reduced quality of salmonid habitat. Water temperature problems (Coe-Clemons Pond) and physical barriers (channel incision and culverts) 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 upstream of the City has disconnected the river from its floodplain and reduced off-channel habitat. There is no record of levee structures built along the Snoqualmie within Duvall. Beaver dams along tributary streams have resulted in impoundments, creating partial salmon migration barriers and altering habitat patterns (exaserbated especially when coinciding with human modification (for example, culverts under the Snoqualmie Valley Trail).	Basin and Reach Basin and Reach Reach Reach (likely Basin as well) Basin Reach (likely Basin as well)	• Restoration and enhancement of existing tributary • Restoration of the riparian zone along the Snoqualmie River and tributaries; focus of restoration should be establishment of a dense riparian corridor of native forest cover. Riparian plantings should fit within overall framework of restoration, allowing for structural and physical restoration activities to occur in identified areas. • 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 well above Duvall and other upstream basin development may have caused incision of the riverbed. Increased impervious surfaces in	Basin	• Identify and work with regional partners to restrict basin activities that may be causing changes to riverbed form. • Protect and restore riparian and upland wetlands by enforcing critical areas regulations and implementing protection incentives and

Ecosystem Process	Causes of Impairment to Ecosystem Process	Scale of Alterations	Protection and Restoration Opportunities
	developed areas have increased surface runoff and sedimentation. Construction of levees and dikes upstream of the City (both formal and informal) has disconnected the river from its floodplain and reduced off-channel habitat. There is no record of levee structures built along the Snoqualmie within Duvall.	Basin and Reach Basin	flexible development tools.
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 through tributary systems.	Basin Basin and Reach	• 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,

6.2.1 South-end Open Space Areas

6.2.1.1 Summary of Ecological Functions and Management Issues

Urban development within the Thayer Creek and Coe-Clemons Creek contributing basins, and historical agricultural and transportation infrastructure development within the SPA, have impaired functions and degraded shoreline habitat. Five primary factors are driving the loss of functions:

1) Lack of riparian vegetation (primarily along Snoqualmie River mainstem)

2) Lack of large woody debris (along Snoqualmie River mainstem and lower tributary streams)

3) Lack of channel complexity (along mainstem and lower tributary streams)

4) High sediment loads (a subbasin impairment for both Thayer and Coe-Clemons Creeks)

5) Increased hydrologic disturbance (primarily a subbasin impairment for both Thayer and Coe-Clemons Creeks)

The riparian corridor along the Snoqualmie River mainstem has been moderately altered by historic agricultural development. The river lacks significant woody debris needed for forming pools and cover used by salmonid species for holding and rearing habitat. The lack of a well vegetated riparian corridor limits the ability of the river to recruit new woody material over time. Lack of riparian vegetation also allows increased water temperature. Historic and informal bank armoring has reduced channel complexity, concentrated flows, decreased floodplain connectivity, and caused higher flow velocity and water depths. On a watershed scale, this has likely caused some degree of channel incision through Duvall.

While the primary impairments along Coe-Clemons Creek and Thayer Creek extend throughout the subbasins, impacts on habitat, water quality, and hydrologic functions are most pronounced in the lower reaches of the streams. Urban density is most pronounced in the areas immediately upstream of the shoreline area. Upstream erosion and sediment loading have caused significant channel erosion and bank destabilization. This is primarily an issue in Coe-Clemons Creek; some areas of the south-end open space include habitats that are more intact, resulting in tributary systems that function somewhat better (Herrera, 2006).

Based on these existing conditions, the important management issues for the south-end shoreline area are:

- Application of a shoreline environment designation that:

    1) Establishes standards for activities within the south-end area that consider and appropriately restrict impacts associated with land clearing and grading, floodplain fill, and creation of impervious surface (especially pollution generating surfaces).

2) Provides standards to ensure allowed uses are consistent with overall goals of open space conservation, enhancement, and passive recreation.

3) Allows soft surface trails, certain utilities, pedestrian facilities (9 footbridges), and other uses deemed to be appropriate, and provides standards for allowed uses to ensure that design, location, and ongoing use are appropriate with overall goals.

- Inclusion of goals, policies, and standards within the SMP that will facilitate restoration and enhancement of the south-end shoreline area, consistent with restoration activities detailed by the SMP Restoration Plan (to be completed) and existing City environmental restoration plans.

- Preservation of riparian vegetation using setbacks, buffers, and / or restrictions on almost all uses within the floodway area.

- Vegetation and open space conservation standards through incorporation of existing City Sensitive Areas regulations (DMC 14.42).

- Inclusion of public access standards within the SMP intended to enhance appropriate (passive) access to the south-end area, by:

    1) Encouraging use of interpretive signs and sculpture intended to facilitate appreciation and understanding of open space functions while planning for restoration projects.

    2) Requiring enhancement of existing public access locations linking the Snoqualmie Valley Trail and south-end area directly to Main Street.

    3) Prioritizing trail improvement projects where they are necessary to meet open space restoration priorities, including improvement of stream crossings (especially culverts).

6.2.1.2 Future Use Patterns and Potential Use Conflicts

Current land use in the south-end shoreline area is dominated by publicly owned open space areas and trail corridors. Limited areas of open space also occur on privately owned properties used for light industry outside of shoreline jurisdiction.

There are no plans to significantly alter the existing open space use of City owned properties. Development of privately owned open space could occur, although there are significant existing regulatory challenges due to floodplain and wetland protections. Anticipated future development includes utility uses and further development of soft surface trails and boardwalks through the open space areas, with potential development of an off-leash dog park utilizing some of the south-end area. Additional access to the Snoqualmie Valley Trail and other south end trails may be provided during development of adjacent properties along State Route 203. New access points would likely include parking areas (most likely outside of the shoreline area) and connector trails. The SMP update should include goals and standards to minimize the potential adverse

effects that utility and trail development could have on shoreline functions. Potential impacts associated with land and hydrologic disturbance would have to be assessed and mitigated as part of park development planning, design, and construction in order to avoid conflicts with identified open space conservation and restoration goals.

Additional restoration activities are also anticipated. Restoration activities should be planned and prioritized in order to maximize benefits and implement restoration projects in a way that minimizes unintended impacts to resources.

6.2.1.3 Opportunities for Enhancing and/or Restoring Ecological Functions

The McCormick Park Reconnaissance and Assessment (ESA Adolfson, 2009) identified a series of conceptual restoration options intended to enhance wildlife habitat and functions (Appendix C). The assessment captures restoration options that span different levels of effort, and could be installed either all at once, or using a phased approach. Potential restoration opportunities identified for the south-end open space area are identified on Map 9b and include the following.

Coe-Clemons and Thayer Creek Channel Restoration

By creating new stream corridors with greater sinuosity and rerouting at least portions of the tributary channels through the site to the west of the trail corridor, the City could achieve the following goals:

- Increase channel length;
- Potentially increase wetland area;
- Increase channel stability; and
- Restore native riparian forest.

ESA Adolfson (2009) suggests that restoration of the Thayer Creek channel would be, in general, easier than restoration of the Coe-Clemons Creek channel. Coe-Clemons is more challenging as it is constrained by the existing developed portion of the park to the north, and it flows through the most significant wetland in the project area (the wetland complex to the east of the trail, including the ponded area; see Map 3).

Challenges with this option would include design of the SR-203 Crossing and the transition from the tributary to the river and the costs associated with significant excavation. See Appendix C for more details.

Southern Wetland Swale and Depressional Wetlands

Hydrology from the primary south-end wetland and tributary area (Wetland B on maps in Appendix C) supports the depressional wetland complex along the Snoqualmie Valley Trail berm. Hydrologically, this area appears to function at a high level. This area is noted as a potential area for wetland creation and/or restoration of more complex aquatic floodplain habitat.

Challenges associated with wetland creation due to existing system hydrology may suggest that enhancement of existing wetland areas through installation of native vegetation and habitat features may be a more successful approach.

Non-Native Plant Control

Non-native invasive plant species, most notably Himalayan blackberry and reed canarygrass, occupy significant portions of the south-end open space area; Japanese knotweed has also been identified along the shoreline and tributary streams. Managing these infestations will be key in the long-term success of native plantings.

One method for control of reed canarygrass is to establish dense "islands" of native tree and shrub vegetation in areas dominated by the invasive weed. This technique requires less soil disturbance than removal (eradication) of reed canarygrass and its root layer. Native plantings would not eradicate canarygrass, but over time they shade out the grass and create an opportunity for native vegetation to become established and successfully compete in the project area. This strategy is additionally recommended due to the large canarygrass seed sources from adjacent properties, which would limit the effectiveness of eradication.

Off-Channel Habitat

In general terms, the amount and quality of off-channel habitat all along this stretch has been reduced. Three ways that off-channel habitat could be created or enhanced through the south-end open space area are suggested:

- Enhance riparian vegetation throughout;
- Focus off-channel habitat at tributary confluences; and/or
- Excavate new off-channel features (e.g., oxbows).

The first option is by far the easiest, with initial implementation already begun by the Stillaguamish – Snoqualmie Task Force. Continued restoration of riparian vegetation should be included under any approach.

The second option could relatively easily be incorporated into the design of the tributary channel realignment. Under such an effort, the existing mouths could be left as off-channel habitat, rather than filling the entire existing channels. Excavating an entirely new off-channel feature, such as a secondary channel or an oxbow, would require the most design and construction effort.

Significant design challenges are associated with the second or third options. Additional feasibility-level design would be necessary and would need to assess river gauge data to determine elevation ranges where off-channel habitat creation efforts may be effective, and investigate reference standards to determine what parameters should be the design focus. See Appendix C for more details.

6.2.1.4 Public Access Opportunities

Significant existing open spaces along the south-end shoreline offer public access to the shoreline area and visual access to the shoreline (Section 4.2.2). Enhancement of public access to the shoreline in the south-end open space areas is identified in the 2008 Parks, Trails, and Open Space Plan (EDAW / AECOM, 2008). Improvements are limited to enhancement of existing

secondary trails and potential development of new trails (including boardwalks) to provide further passive recreation and wildlife viewing opportunities.

6.2.2 McCormick Park / Depot Park Area

6.2.2.1 Summary of Ecological Functions and Management Issues

Urban development within the Coe-Clemons Creek contributing basin has impaired functions and degraded shoreline habitat within the McCormick Park / Depot Park area. In addition, historical agricultural and transportation infrastructure development, as well as more recent development of park areas, have further impaired shoreline functions.

Based on these existing conditions, the important management issues for McCormick Park / Depot Park shoreline area are:

- Application of a shoreline environment designation (or designations) that:

    1) Establishes appropriate uses for park areas within the floodway, including recreational uses (including but not limited to river access, trails, multi-use lawn areas) that are compatible with the hazardous and dynamic environment.

    2) Provides standards to ensure allowed uses are consistent with overall goals of recreation and open space conservation and enhancement, as detailed in the City's Parks, Trails, and Open Space Plan (2008).

    3) Allows trails, certain utilities and other uses and structures deemed to be appropriate within the Depot Park area and other areas outside of the floodway, and provides standards for allowed uses to ensure that design, location, and ongoing use are appropriate with overall goals.

- Inclusion of public access standards within the SMP intended to enhance appropriate access and recreation within the Depot Park and McCormick Park area, by:

    1) Identifying recreational use types that will be appropriate within different zones of the shoreline area (ie: within the riparian buffer of the river, within the floodway, and within the remaining floodplain).

    2) Assessment and inclusion of goals and priorities from the 2008 parks plan.

    3) Encouraging use of interpretive signs and sculpture intended to facilitate appreciation and understanding of floodplain and shoreline functions while planning for parks improvements projects.

- Specification of bank stability strategies that facilitate development of bank protection along the Snoqualmie River, especially along the eroding portions of the shoreline; strategies should include consideration of water dependent shoreline recreation activities as well as channel dynamics and soft-shoreline armoring techniques.

- Prioritization of restoration of the ponded area of Coe-Clemons Creek to address potential water quality, water temperature, and habitat issues.

6.2.2.2 Future Use Patterns and Potential Use Conflicts

Current land use in the McCormick Park / Depot Park area is dominated by publicly owned park spaces and trail corridors.

There are no plans to significantly alter the existing recreation uses of McCormick and Depot Parks. Development of additional park facilities within McCormick Park could create a use conflict, as the entire area is within the river floodway. Anticipated future near-term development includes further development of soft surface trails, trail bridges across tributary streams, and potential development of a community stage area (EDAW / AECOM, 2008). The SMP update should consider how to minimize the potential adverse effects that trail and park developments may have on shoreline functions, and identify what park uses should be prohibited or significantly restricted within the floodway area.

Additional restoration activities are also anticipated. Restoration activities should be planned and prioritized in order to maximize benefits and implement restoration projects in a way that minimizes unintended impacts to resources.

6.2.2.3 Opportunities for Enhancing and/or Restoring Ecological Functions

Several conceptual restoration options intended to enhance wildlife habitat and functions within McCormick and Depot Parks are identified in Appendix C. Restoration options that span different levels of effort, and could be installed either all at once or using a phased approach are identified. Potential restoration opportunities identified for the McCormick Park / Depot Park area are identified on Map 9b and include the following:

Coe-Clemons and Thayer Creek Channel Restoration

By creating new stream corridors with greater sinuosity and rerouting at least portions of the tributary channels through the site to the west of the trail corridor, the City could achieve the following goals:

- Increase channel length;
- Potentially increase wetland area;
- Increase channel stability; and
- Restore native riparian forest.

ESA Adolfson (2009) suggests that restoration of the Thayer Creek channel would be, in general, easier than restoration of the Coe-Clemons Creek channel. Coe-Clemons is more challenging as it is constrained by the existing developed portion of the park to the north, and it flows through the most significant wetland in the project area (the wetland complex to the east of the trail, including the ponded area; see Map 3).

Challenges with this option would include design of the transition from the tributary to the river and the costs associated with significant excavation. See Appendix C for more details.

Snoqualmie River Bank Stabilization

A long stretch of the river shoreline within McCormick Park (the west facing shoreline) is actively failing. This appears to be part of a longer-term process where the river is migrating east in this location. The river migration process will likely continue. A successful strategy to stabilize the shoreline along this reach could include grading back the banks and planting the banks and riparian area with native vegetation. Shoreline stabilization in the northern portion of the project area would provide an additional buffer between the developed park and the river, reduce fine sediment loading from the failing banks, and improve riparian cover.

Coe-Clemons Pond

Installing trees around the pond, and placing shallow mounds of fill in the pond to allow shrubs and trees to grow, could help reduce water temperatures. The pond is also currently at least a partial migration barrier for fish (Herrera, 2002 and 2006).

The assessment recommended installing and monitoring temperature loggers through a spring and summer period to determine the magnitude of the temperature issue. If temperature is identified to occur at elevated levels that could impact salmonid use, restoration of the pond area by enhancing riparian conditions should be completed with a monitoring and adaptive management plan to ensure temperature issues are addressed.

Non-Native Plant Control

Non-native invasive plant species, most notably Himalayan blackberry and reed canarygrass, occupy significant portions of the project area. Managing these infestations will be key in the long-term success of native plantings.

One method for control of reed canarygrass is to establish dense “islands” of native tree and shrub vegetation in areas dominated by the invasive weed. This technique requires less soil disturbance than removal (eradication) of reed canarygrass and its root layer. Native plantings would not eradicate canarygrass, but over time they shade out the grass and create an opportunity for native vegetation to become established and successfully compete in the project area. This strategy is additionally recommended due to the large canarygrass seed sources from adjacent properties, which would limit the effectiveness of eradication.

6.2.2.4 Public Access Opportunities

As described in Section 4.3.2, McCormick Park and Depot Park offer significant public access to the shoreline area, as well as direct access to the shoreline at the McCormick Park swimming and wading beach. Enhancement of public access to the shoreline in the McCormick Park / Depot Park area is identified in the 2008 Parks, Trails, and Open Space Plan (EDAW / AECOM, 2008). Improvements include development of a boat launch, an environmental education center, enhancement of existing secondary trails, and other potential facilities not directly related to shoreline access.

6.2.3 Riverside Village, Taylor's Landing, and Northern Shoreline Areas

6.2.3.1 Summary of Ecological Functions and Management Issues

Inventory information highlights four primary factors driving the loss of functions:

1) Impervious coverage and urban development within areas fringing on the shoreline area and extending up the City hillside to the east.

2) Lack of large woody debris (along Snoqualmie River mainstem and lower tributary streams) and complex habitat / vegetation within the riparian corridor.

3) Lack of channel complexity (along mainstem).

4) Shoreline modification at the Taylor's Landing boat ramp.

The riparian corridor along the Snoqualmie River mainstem has been moderately altered by historic agricultural development and construction of the Snoqualmie Valley Railroad. Land uses within Depot Village and other areas east of the trail further degrade riparian habitat, although the trail corridor provides a riparian buffer. The river lacks significant woody debris needed for forming pools and cover used by salmonid species for holding and rearing habitat. The lack of a well vegetated, mature riparian corridor limits the ability of the river to recruit new woody material over time. Lack of riparian vegetation also allows increased water temperature. Historic and informal bank armoring has reduced channel complexity, concentrated flows, decreased floodplain connectivity, and caused higher flow velocity and water depths. On a watershed scale, this has likely caused some degree of channel incision through Duvall.

Urban density is most pronounced in the areas immediately upslope (east) of the shoreline area. Urban runoff and sediment drain to the river through sheet flow and stormwater discharge (see Map 8a). Based on these existing conditions, the important management issues for the northern shoreline areas are:

- Establishment of a shoreline environment designation (or designations) that preserve existing riparian vegetation and allow for the variety of existing and desired uses in the area to the east of the trail.

- Including polices and standards within the SMP that ensure preservation and encourage long term enhancement of riparian vegetation using setbacks and buffers along the mainstem.

- Detailing goals and policies within the SMP to encourage identification of basin stormwater system impairments and prioritization of system improvements.

- Detailing goals and policies which promote clearing, grading and developments resulting in loss of forest and/or increases in impervious surfaces in order to minimize downstream impacts to hydrology and sediment processes.

- Establishing standards for trail and park uses that allow for desired improvements to Taylor's Landing and extension of the Snoqualmie Valley Trail while ensuring potential impacts are mitigated.

6.2.3.2 Future Use Patterns and Potential Use Conflicts

Current land use in the northern shoreline area is dominated by publicly owned park spaces and trail corridors. Allowed uses within the Riverside Village area are detailed by DMC 14.10, and could include a variety of commercial and residential (upper floor) use types if redeveloped. There are no anticipated plans for redevelopment of the Depot Village. Any redevelopment would need to assess impacts on public access via the adjacent Snoqualmie Valley Trail. Environmental considerations would also be required, including the river floodplain and floodway areas.

There are no plans to significantly alter the existing recreation uses of Taylor's Landing, although remodel and enhancement of existing facilities is highlighted in the City's Parks Plan. The SMP update should consider how to minimize the potential adverse effects that trail and park developments may have on shoreline functions, and identify what park uses should be prohibited or significantly restricted within the floodway area.

6.2.3.3 Opportunities for Enhancing and/or Restoring Ecological Functions

Potential restoration opportunities identified for the northern shoreline area are identified on Map 9a and include the following:

Riparian Enhancement

Restoration of riparian vegetation to establish a mixed-forest native community should be a priority throughout the City's Snoqualmie River shoreline, including the northern shoreline areas. Open space areas of Taylor's Landing and adjacent to the Snoqualmie Valley Trail should be targeted for riparian enhancement.

Non-Native Plant Control

Non-native invasive plant species, most notably Himalayan blackberry and reed canarygrass, occupy significant portions of the project area. Managing these infestations will be key in the long-term success of native plantings.

One method for control of reed canarygrass is to establish dense "islands" of native tree and shrub vegetation in areas dominated by the invasive weed. This technique requires less soil disturbance than removal (eradication) of reed canarygrass and its root layer. Native plantings would not eradicate canarygrass, but over time they shade out the grass and create an opportunity for native vegetation to become established and successfully compete in the project area. This strategy is additionally recommended due to the large canarygrass seed sources from adjacent properties, which would limit the effectiveness of eradication.

6.2.3.4 Public Access Opportunities

Taylor's Landing offers significant public access to the shoreline area, as well as direct access to the shoreline via the boat ramp (Section 4.4.2). Enhancement of public access to the shoreline is identified in the City's 2008 Parks Plan, including retrofit of the deteriorating boat ramp, parking area, and other park facilities.

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City of Duvall Downtown Sub-Area Plan	Makers Architecture and Urban Design, 2004	http://www.duvallwa.gov/appsformspubs/Final_Document.pdf
City of Duvall Parks, Trails and Open Space Plan	EDAW, AECOM, 2008.	http://www.duvallwa.gov/appsformspubs/planningappsformspubs.html
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Map Folio Data Themes	Data Source
Soils	NRCS: Digital Soil Survey data for King County
Geology	King County: Digital surface geology layer for (100K scale mapping from WDNR)
Critical Areas (wetlands, geologic hazard areas, flood hazard areas, aquifer recharge)	King County GIS data for geological hazards - published by KC 1997; City of Duvall GIS data for wetlands, Floodway, Aquifer Recharge Areas and Floodplain; Detailed wetland reconnaissance of McCormick Park area
Hydrography	USGS: 20 cfs points King County GIS data (streams, rivers, lakes); rivers, water bodies; WA Dept. of Ecology: WRIA boundaries; City of Issaquah: GIS data: Hydro, floodways, floodplains, and OHWM (partial, from McCormick Park Reconnaissance); FEMA, 2010 – Preliminary DFIRMs, including floodplains, floodways for Snoqualmie River
Drainage basin boundaries (surface water and or storm water basins)	King County GIS data: Basins update published KC 2006; City of Issaquah: Drainage Basins
Topography	Puget Sound LIDAR Consortium (PSLC) data 2005; King County 100' topographic contours. published KC 2002 ; USGS topographic maps; WDNR DEMs for King/Snohomish counties
Air Photos / Orthophotography	King County/USGS: NAIP imagery from (1ft) 2009
Historic air photos or scanned GLO maps (T-sheets)	UW River History Project
WDFW PHS / Streamnet	Included in ESA Adolfson on-call area
Parcels	King County GIS data: Tax parcels. Published 2009

Map Folio Data Themes	Data Source
	City data: parcels
Existing Land Use / Assessor data	King County Assessors Data, 2009
Zoning	City of Duvall: zoning data
Future Land Use / Comp Plan Land Use Designations	City of Duvall: Comprehensive Plan land use data
Shoreline Planning Area	ESA Adolfson derived, 2009
Impervious Area	NOAA (CCAP/NLCD), 2006
Vegetation / Land Cover	Land Cover data associated with NOAA (CCAP/NLCD), 2006
Utility lines (stormwater, sewer outfall, water, electric, natural gas, etc.)	DATA GAP
Contaminated Sites	Some data available from Ecology
2008 Water Quality Assessment (303d list)	WA Dept. of Ecology: 303d list
Historic / Cultural Resources	King County: 2004 Historic sites; Additional info. available from State through DAHP webportal.
Parks, Trails, Playfields, Designated Open Space (any public access location to the shoreline)	King County parks, park facilities, park property interests, trails, (2006); publicly-owned lands (*See Parcels* published 2009) City of Duvall: PTOS
Fish Usage (Fish Passage/Barriers)	SSHIAP (WDFW) City of Duvall
Transportation	King County: Major/Minor Roads - WSDOT

APPENDIX A: CITY OF DUVALL SHORELINE MAP FOLIO

APPENDIX B: CITY OF DUVALL *LANDSCAPE ANALYSIS FOR CRITICAL AREAS ORDINANCE UPDATE*
PARAMETRIX 2005

APPENDIX C: CITY OF DUVALL *DRAFT MCCORMICK PARK RECONNAISSANCE / OPPORTUNITIES AND CONSTRAINTS ASSESSMENT*
ESA ADOLFSON 2009