



Cumulative Effects Analysis

City of North Bonneville
Shoreline Management Plan Update

City of North Bonneville, WA

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1 Introduction

This report supports the City of North Bonneville (City) Shoreline Master Program (SMP) update. The City's SMP is being updated to comply with the Washington State Shoreline Management Act (SMA) requirements (Revised Code of Washington [RWC] 90.58), and the state's shoreline guidelines (Washington Administrative Code [WAC] 173-26, Part III), which were adopted in 2003.

The SMP update process involved the following steps:

1. Reviewing and revising shoreline goals and policies;
2. Inventorying and analyzing shoreline conditions;
3. Determining shoreline environment designations (SEDs);
4. Assessing cumulative impacts of shoreline development; and
5. Preparing a restoration plan.

This report assesses the potential cumulative impacts of shoreline development under the current proposed revisions to the City's SMP. This work was funded in part through a grant from the Washington State Department of Ecology (Ecology).

1.1 Report Purpose

The SMA guidelines (WAC 173-26-18683)(d) require analysis of cumulative impacts "to ensure no net loss of ecological functions and protection of other shoreline functions and/or uses." The purpose of this report is to document the City's analysis of potential cumulative impacts that could result from reasonably foreseeable future development in the City's shoreline jurisdiction.

1.2 Approach

When evaluating cumulative impacts, Ecology's shoreline guidance requires that the following factors be considered (WAC 173-26-186(6)):

- Current circumstances affecting the shorelines and relevant natural processes;
- Reasonably foreseeable future development and use of the shoreline; and
- Beneficial effects of any established regulatory programs under other local, state, and federal laws.

This cumulative impacts assessment uses these three considerations as a framework for evaluating the potential cumulative impacts on shoreline ecological functions and processes that may result from development or activities under the proposed SMP over time. The methodology used in this cumulative analysis is based on:

- Current circumstances affecting the shorelines and relevant natural processes, as documented in the Shoreline Inventory and Characterization Report prepared as part of the City's SMP update (City of North Bonneville 2012);

- Description of reasonably foreseeable future development as addressed in Section 2 of this report; and
- Beneficial effects of any established regulatory programs under other local, state, and federal laws and this SMP as described and addressed in Section 2 of this report.

Existing conditions are addressed in the landscape characterization provided in the Shoreline Inventory and Characterization Report (City of North Bonneville 2012). A brief summary of the landscape characterization methodology is provided in Section 1.4 below; please refer to Part I of the Shoreline Inventory and Characterization Report for more detail.

1.3 Study Area Characteristics

The study area for this cumulative impact assessment included the City's shoreline jurisdiction. The City's shorelines are part of Water Resource Inventory Area (WRIA) 28 (Salmon/Washougal). Information about WRIA 28, particularly with regard to the portions of Hamilton and Greenleaf Creeks that are located outside the city limits, was also considered part of the study area.

The Lower Columbia Tributaries subbasin has a drainage area of approximately 85 square miles and includes several relatively small creeks (HDR/EES 2006). The watershed is approximately 87 percent forested.

Channel Migration Zones are not a significant issue in North Bonneville because of the heavily modified levee conditions here.

The surrounding topography is relatively steep because most of the subbasin is within the Columbia River Gorge. The steep terrain causes erosion issues and this affects the stream reaches and flows in North Bonneville. Seasonal high velocity pulses alternate with low flows. There are only a small amount of low gradient stream reaches in the subbasin; the gradients quickly become too steep for fish to migrate (HDR/EES 2006).

The climate is similar to most of Western Washington and is generally characterized by mild, wet fall to spring months, and cool, dry summer months. The average monthly precipitation ranges from less than two inches in July and August up to 12 more than inches in December and January (WRCC 2011).

2 Methodology

The analysis of the cumulative effects of the SMP, together with other programs, is summarized in Table 4-1. The table summarizes the types of effects of various human activities on a cross section of ecological functions and assesses the probable beneficial effects of the City's SMP in combination with other regulatory and enhancement programs. Section 3 provides a brief discussion of the potential effects of the following:

- Land Use
- Local Regulatory Programs
- Federal and State Regulatory Programs

- Enhancement Programs
- Proposed Shoreline Master Program

This evaluation is based on the description of ecological functions in the Shoreline Inventory and Characterization Report (City of North Bonneville 2012). The landscape analysis methodology used in that analysis involves a number of processes that are important for aquatic resource management. Because that analysis provides the basis of the assessment of cumulative effects, it is summarized below.

2.1 Landscape Characterization

The landscape characterization approach used in the Shoreline Inventory and Characterization Report (City of North Bonneville 2012) examines specific processes including the hydrology, sediment transport, water quality, and organic materials that form and maintain the landscape over a large geographic scale. These processes interact with landscape features to create the structure and function of aquatic resources (Stanley et al. 2005).

The analysis uses a coarse-grained approach for integrating landscape processes into shoreline management, restoration planning, and other land use planning efforts (Stanley et al. 2005). The purposes of the analysis are to highlight the relationship between key processes and aquatic resource functions and to describe the effects of land use on those key processes. This approach is not intended to quantify landscape processes and functions. Rather, the goal is to: 1) identify and map areas on the landscape important to processes that sustain shoreline resources; 2) determine their degree of alteration; and 3) identify the potential for protecting or restoring these areas.

2.2 Existing Land Use Conditions

The land uses within the Lower Columbia Tributaries subbasin are predominantly rural in nature. North Bonneville is one of two incorporated areas in Skamania County. The large majority of the subbasin is forested. Approximately 80 percent of the County's land area is comprised of the Gifford Pinchot National Forest or the Mount St. Helens National Monument.

A significant amount of land within North Bonneville and is owned and/or controlled by the federal government including, but not limited to Bonneville Dam and the BPA transmission facilities, as well as Pierce Wildlife Refuge. The City also owns a substantial amount of land within the city limits, with 179 acres of open space, 12 acres used for municipal not counting roads and easements and 29 acres of parks. The Burlington Northern/Sante Fe Railroad, Williams Pipeline and state highway also run through the length of the City. All of the Columbia River as well as lower Hamilton Creek are either under federal control or are owned and designated open space by the City. Table 2-1 shows the acreage and percentage of shoreline jurisdiction by type of ownership.

Except for two vacant commercial lots, all of the lower Hamilton Creek shorelines are owned by the City as deed restricted open space or federal ownership. There are no structures within the 200 feet of designated shoreline. Land use is and will be maintained as open space on these shorelines. Major channel restoration related to fish

enhancement has and will occur in this reach of Hamilton Creek. Ongoing maintenance of these projects is also likely.

Upper Hamilton Creek, Greenleaf Creek and a majority of Greenleaf Lake shorelines are privately owned. However, infrastructure easements and ownership utilize 7% of the Hamilton Creek and 40% of the Greenleaf Lake shorelines. Land use on Hamilton Creek above the bridges is non water-dependent industrial and an RV park, which is the only development within the designated shoreline on the west and undeveloped Commercial Recreation zoned land on the east. A majority of the vacant land in North Bonneville is on the north shore of Greenleaf Lake.

The primary land uses associated with the City’s shorelines are recreation, residential, and commercial uses. These uses are discussed in greater detail in the Shoreline Inventory and Analysis Characterization Report (City of North Bonneville 2012) for a detailed description of existing conditions.

Table 2-1. Summary of Land Ownership in the Shoreline Jurisdiction		
Land Ownership	Acres	Percent
Federal Government	298	53
State Government	0	0
Skamania County	4	1
Port of Skamania County	34	6
City of North Bonneville	70	12
Private	155	28
Total	561	100

2.3 Reasonably Foreseeable Future Development

This section provides a qualitative summary of:

- General growth in population and employment projected to 2018, and
- Shoreline use and development trends.

2.3.1 General Population Trends

In 1998 the city had an opportunity to review population projections as a result of capital facilities planning. The city anticipated that as many as 1,528 people could reside in North Bonneville in the year 2018 based upon an aggressive build-out of essential capital facilities. The city’s April 2012 population was 1,000 as estimated by the Washington State Office of Financial Management (2015).

Future development in the subbasin will likely occur in areas along Highway 14, but the population of this subbasin is anticipated to remain small due in large part to the location of the subbasin within the Columbia River Gorge National Scenic Area (HDR/EES 2006). Because of the National Scenic Area status, and due to the physical constraints of the gorge itself, future development is expected to be quite limited in this area (HDR/EES 2006). Specifically, most growth will be confined to the few urban areas in the County, including North Bonneville and the neighboring town of Stevenson.

2.3.2 Demands for Water-dependent Uses

The majority of the vacant land in North Bonneville is on the north shore of Greenleaf Lake. Almost all of the City's shoreline development has occurred on Greenleaf Lake, with 22 structures within the 200 feet of designated shoreline. There has been an increase of 13 structures since 1980. All are residential structures and only one is within 50 feet of the shoreline. With this development, Greenleaf Lake is almost fully developed on the south shore as large lot residential with City-owned open space and the BPA substation. The north shore has minimal development that is large lot residential and undeveloped vacant land that is zoned Commercial Recreation. Commercial Recreation zoning allows for a mix of both residential and/or commercial destination type development. There are a few privately owned small docks on the lake and a City-owned boat ramp on the eastern shore.

Carpenter and Greenleaf Creeks are privately owned, mostly undeveloped and are also zoned Commercial Recreation. Though not necessarily water dependent, both residential and commercial recreation development on the lake has and would most likely draw on at a minimum the location on the water for views if not water access.

Four structures have been added to Greenleaf Creek within the shoreline jurisdiction since 1980. These included two residential structures and two commercial developments; a hotel expansion and an RV park that was not completed. All are over 50 feet from the shoreline. Future development potential is limited mostly to parts of the western shorelines that would be outside the 50-foot setback, and would include the possible completion of commercial RV park on the upper west shoreline and residential or commercial recreational development on the lower west shoreline.

It should also be noted that significant water related activities occur just outside the city limits with fishing access on the banks and by boat on Kidney Lake, Bass Lake, and Columbia River. There are also numerous federally owned trails that access these and other water bodies in and around the city limits.

Exhibits 1 – 3 in Appendix A show the shoreline jurisdiction, land ownership, and existing structures.

3 Assessment of Cumulative Effects

3.1 Effects of Alterations Associated with Land Uses

It is important to recognize that the ecological processes and functions that occur within Shoreline jurisdiction are affected by processes within the entire watershed, not only those that take place within shorelines regulated by the SMP.

Table 4-1 provides a summary in matrix format of the types of cumulative effects produced by the processes and functions addressed in the landscape analysis and the extent to which the proposed revisions to the SMP addresses those potential effects.

Watershed physical processes deliver, transport, store, and remove materials from the ecosystem, thereby affecting the structure and biological functions of river and lake shorelines. The movement of water, sediment, chemicals, and organic material occur throughout the landscape, but these processes occur at varying intensities, depending on local geologic and climatic conditions. The following section describes ecosystem processes and identifies areas most important for supporting those processes. This section summarizes conditions broadly across the entire study area including freshwater and estuarine water.

3.1.1 Hydrology

Water is delivered to the Lower Columbia River Tributaries subbasin through rain, snowmelt, and groundwater. Water moves within a watershed as surface water when rain or snow falls on the ground or below the ground as groundwater. Water also moves below ground as surface water infiltrates or above ground as groundwater reaches the surface based on a hydrogeologic setting. Wetlands, lakes, floodplains, and aquifers have the potential to store surface water during high flooding events, and surficial deposits or aquifers provide storage of groundwater. The movement and storage of water is typically controlled and influenced by physical conditions such as climate, topography, land cover, permeability or infiltration capacity of soils, and underlying surficial geology (Stanley et al. 2005). North Bonneville also has extensive underground water sources with both hot and cold springs occurring in the area that feed all of the lakes and streams within and surrounding the city.

The construction of railroad and roads (e.g., Highway 14) has created alterations to the lower reaches of streams in the Lower Columbia Tributaries subbasin. In addition, the operation of Bonneville Dam and other Columbia River dams upstream of the project area have altered the natural flow regime in the subbasin (Wade, 2000, cited in HDR/EES 2006; LCFRB 2010). The entire subbasin is considered to be likely impaired hydrologically with respect to peak flows because of immature forest cover and low quantities of mature forest (Wade 2001; LCFRB 2010). However, the WRIA 28 Limiting Factors Analysis indicated that low flows are the more significant issue in the subbasin, specifically in Woodward, Hamilton, Hardy, and Duncan Creeks (Wade 2001).

There is a limited amount of low gradient floodplains in this subbasin. The naturally steep tributaries, Highway 14, railroads, and development have reduced or eliminated many floodplains in the subbasin (HDR/EES 2006). The 28 Watershed Management Plan recommended that low flow and habitat limitations could be improved by restoring natural

channel processes and sediment transport that has been negatively affected by Highway 14 and the railroad (HDR/EES 2006).

3.1.2 Sediment Transport

In natural river systems, sediment is delivered to aquatic ecosystems through surface erosion, mass wasting, and channel migration. Sediment delivery is a natural phenomenon with a natural range of variability; however excessive amounts of sediment can be detrimental to an ecosystem (Stanley et al. 2005). Steep slopes with erodible soils, landslide hazard areas, and unconfined channels likely provide sediment delivery.

Within the subbasin, sediments ranging from coarse gravel to fine sand is generally transported through high gradient streams and deposited in lower gradient reaches. Deposition of the fine sediment in the salmonid spawning areas can be affected by fine sediments, and coarse sediments can also alter the channel morphology through artificial obstructions such as culverts, roadways, and railroads. The analysis from LCFRB concludes that the entire subbasin is moderately impaired based on the landscape conditions and moderately high road densities (LCFRB 2010).

According to the Washington Lower Columbia Salmon Recovery and Fish and Wildlife Subbasin Plan (2010), the future sediment production and frequency of mass wasting events are anticipated to decline over the next 15 years since new forest practice standards would be implemented. Private forest roads located upstream of the subbasin would likely be updated to meet the new standards, and geotechnical review and mitigation measures would be required to minimize the impact of forest practice activities on unstable slopes. However, the upper reaches of Hamilton Creek and Greenleaf Creek are located on historical slide and erosion areas that are not related to forest practices. Mass wasting events are likely to happen in the future from time to time with resulting sedimentation transport and build up in the lower stream reaches.

3.1.3 Water Quality

Water quality is measured by the physical, chemical, and biological characteristics of the water. Movement of nutrients, toxins, and pathogens is usually constituted with the hydrologic processes in the watershed, occurring at multiple scales (Stanley et al. 2005).

The federal CWA requires that each state identify its polluted waterbody segments and submit a list of these water quality limited estuaries, lakes, and streams to the USEPA. Waterbodies that are found to be impaired are documented in Ecology's 303(d) list and the Washington Water Quality Assessment Report. The primary vehicle for achieving compliance with State criteria for surface water quality is Ecology's Total Maximum Daily Load (TMDL) program.

Overall, water quality in the subbasin is in a good condition. The 2008 303(d) list does not identify any impaired waterbodies in the Lower Columbia Tributaries subbasin; however, the Columbia River is listed at several locations in the vicinity of the City for temperature (Ecology 2011).

3.1.4 Organic Materials (Large Wood)

Large wood consists of logs or trees that have fallen into a river or stream and is primarily introduced to waterbodies by mass wasting, windthrow, or bank erosion (Stanley, et al. 2005). As described in 3.2.1.1, large wood debris (LWD) provides habitat structure, shade, and nutrients to aquatic ecosystems.

The USFS conducted stream surveys on a number of streams in this subbasin including Woodward, Duncan, Gold Bear, Hamilton, and Greenleaf creeks. Their study indicated that levels of LWD in all surveyed reaches within the subbasin are considered poor. In addition, extremely low levels of LWD were documented in Hamilton and Greenleaf creeks (Wade 2001; LCFRB 2010). Lack of mature forested riparian vegetation along the streams contributes to low levels LWD recruitment potential. The addition of engineered log jams in the lower reaches of Hamilton Creek will help provide the much of the missing organic materials. Though missing in portions of the middle reaches, Greenleaf Creek does have large canopy and organic materials within the lower reaches that are within the City jurisdiction.

3.2 Effects of Local Regulatory Programs

3.2.1 Comprehensive Plan

The North Bonneville Comprehensive Plan (NBCP) documents the City's vision for growth and development (City of North Bonneville 2013). The NBCP provides goals and policies that guide the City in creation and application of its land use regulations. The first goal of the plan directs the City to afford reasonable economic use of private properties consistent with regulations. The plan also provides guidance within the plan elements on land use, natural resources, open space, parks and recreation, public use and expansion among other elements. Development and use, while protecting private property rights, should expand shoreline opportunities but respect and protect valuable shoreline features.

3.2.2 Zoning

The North Bonneville Municipal Code (NBMC) further defines the way in which the City's shorelines are managed (City of North Bonneville 2014). The City has created zoning districts that are consistent with the NBCP that are defined in NBMC Title 20, Zoning. Title 20 of the NBMC was last updated on May 13, 2014.

3.2.3 Critical Areas Ordinance

The City's critical areas ordinance, included in NBMC Title 21, was updated in 2015 and establishes policies, regulations and land use controls to protect environmental sensitive areas including wetlands, critical aquifer recharge areas, frequently flooded areas, geologically hazardous areas, and fish and wildlife habitat conservation areas (City of North Bonneville 2015). The SMA requires that local governments adopt SMPs that protect critical areas within shoreline jurisdiction at a level that is at least equal to the level of protection provided by the local critical areas ordinance for critical areas outside shoreline jurisdiction.

3.2.4 Heritage Trails Plan

The City's Heritage Trails Plan, part of the NBCP, is designed to unite the City's trails, history, and environment to create a central identity for the City. Informational signage is located along the routes at key viewing areas. The City's heritage trails provide public access to many of the City's shorelines. Many of these shoreline viewing areas are located where active human intrusion is either not possible or is unwanted due to safety concerns. At the present time three trails have been completed with three additional trails planned. The Greenleaf and Hamilton Trails both provide informational signage and viewing areas for the public.

3.3 Effects of Federal and State Regulatory Programs

3.3.1 Hydraulic Project Approval

The Washington Department of Fish and Wildlife (WDFW) regulates activities that use, divert, obstruct, or change the natural flow of the beds or banks of waters of the state and may affect fish habitat. Projects in the shoreline jurisdiction requiring construction below the ordinary high water mark of streams in the city could require a Hydraulic Project Approval (HPA) from WDFW. Projects creating new impervious surface that could substantially increase stormwater runoff to waters of the state may also require approval.

3.3.2 Clean Water Act (CWA)

Section 404 of the CWA 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, must get a Section 404 permit. The U.S. Army Corps of Engineers (USACE) administers the Section 404 permitting process. Applicants receiving a section 404 permit are also required to obtain a section 401 water quality certification from Ecology to certify that the project will comply with state water quality standards and other aquatic resource protection requirements under Ecology's authority. In addition, applicants for projects including any work in navigable waters of the U.S must apply to the USACE for a Section 10 permit. The purpose of Section 10 permitting is to prohibit the obstruction or alteration of navigable waters of the U.S.

3.3.3 Endangered Species Act

All projects that have a federal nexus and 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).

3.3.4 Water Pollution Control Act

All projects effecting surface waters in the state, including those that are not subject to the CWA Sections 404/401 must still comply with the provisions of the state's Water Pollution Control Act.

3.3.5 Columbia River Gorge National Scenic Area

The upper reaches of the streams that comprise the City's shoreline jurisdiction are part of the Columbia River Gorge National Scenic Area, managed by the Columbia River Gorge Commission as authorized under the Columbia River Gorge Scenic Act. The National Scenic Area jurisdiction ends at the city limits. The Columbia River Gorge Commission was established in 1987 to develop and implement policies and programs that protect and enhance the scenic, natural, cultural and recreational resources of the Gorge, while encouraging growth within existing urban areas of the Gorge and allowing development outside urban areas consistent with resource protection. The SMP is therefore not directly affected by Scenic Area regulations, but is affected by Scenic Area regulation outside the City jurisdiction but within its watershed.

3.3.6 Section 404 Permit

The Clean Water Act also regulates excavation and dredging in Waters of the United States, including wetlands. Certain activities in Waters of the United States, including wetlands and streams, may require a permit from the Corps. This requirement is administered by the Corps in conjunction with Section 10 of the Rivers and Harbors Act. As part of the program, Ecology is required to certify compliance with water quality standards under Section 401 of the Clean Water Act.

3.4 Enhancement Programs

3.4.1 Hamilton Creek

As part of the subbasin management plan, LCFRB developed specific habitat measures for streams in the subbasin (2010). Some of them are specific to Hardy and Hamilton creeks, and these identified measures include; 1). Restore floodplain function and channel migration processes in the lower reaches of the primary streams, and 2). Restore degraded water quality with an emphasis on stream temperature impairments.

The extensive man-made alterations of this reach will most likely also require ongoing channel and bank maintenance to sustain the needed functions of the stream in relation to environmental as well as flood hazard protection.

3.5 Effects of Proposed Shoreline Master Program

The development and performance standards outlined by the SMP set forth requirements for shoreline modifications such as bulkheads and stabilization measures, piers and docks, jetties and groins, dredging, fill, flood control, and land clearing and grading. These standards are intended to protect the shoreline, while allowing for the development of water dependent uses. The following sections describe each standard and its potential impact on the designated shoreline jurisdiction.

3.5.1 Development Standards

The development standards include building setbacks, maximum building height, maximum density or building lot coverage. Each standard is dependent on the shoreline

designation as outlined in Table 6-1 in the SMP. Adjustments to setbacks may be granted through a Variance Permit when all criteria listed in WAC-173-27-170 are met.

3.5.2 Vegetation Conservation

The vegetation conservation standards outline the requirements to retain existing native species in shoreline and critical area buffers and remove and replace non-native species to the maximum extent feasible. Maintenance practices within the buffers are clearly defined to limit disturbance to the shoreline area.

3.5.3 Environmental Impact Mitigation

All shoreline development and uses shall occur in a manner that results in no net loss of shoreline ecological functions. Where impacts to shoreline ecological functions can not be avoided during project design, impacts shall be mitigated in accordance with the SMP.

3.5.4 Critical Areas Development and Performance Standards

The provisions of the North Bonneville Critical Areas Regulations (NBMC 21.10) shall apply to any use, alteration, or development where designated critical areas are physically located within the shoreline jurisdiction, in addition to a shoreline permit or written statement of exemption.

3.5.5 Water Quality, Stormwater, and Nonpoint Pollution

The water quality standards state that shoreline development and use shall incorporate measures to protect and maintain surface and ground water quality in accordance with all applicable laws. Additional provisions include appropriate building materials, disposal of solid and liquid wastes and untreated effluents, and City enforcement of surface water pollution in accordance with state and federal laws.

3.5.6 Archaeological, Historic, and Cultural Resources

The SMP outlines requirements related historic resources located within the shoreline area. These standards are intended to protect resources during construction and development activities.

3.5.7 Public Access

The public access standards are intended to include access to shorelines for proposed developments on public lands, all public and private commercial developments, and all residential subdivisions of greater than four (4) lots. The standard also retains existing shoreline access provided by shoreline street ends, public utilities, and rights-of-way. Requirements and provisions are included in the SMP.

4 Reach Description of Cumulative Effects

Reasonably foreseeable future uses in the shoreline jurisdiction are addressed through the policies and regulations of the City's Shoreline Master Program, the City's Critical Areas Ordinance (City of North Bonneville 2015), or other local, state, and federal laws and regulations. The matrix in Table 4-1 provides a discussion of the cumulative effects of the SMP and other development and restoration activities by reach. It also indicates the extent to which benefits of the proposed SMP and other programs would result in potential ecological changes. Overall, implementation of the SMP is expected to minimize cumulative effects of reasonably foreseeable future development in most of the shoreline jurisdiction, and in some areas conditions are expected to improve.

Table 4-1. Cumulative Impact Analysis

Shoreline Reach	SMP Designation	Existing Ecological Functions	Likely Development/Functions or Processes Potentially Impacted	Effect of SMP Provisions	Effects of Other Development and Restoration Activities/Programs	Cumulative Effect
1-A Western shoreline of Hamilton Creek south from Evergreen Bridge to Columbia River. FEMA Floodway (Firm Zone A) located in the Pierce Wildlife Refuge	Natural	Area managed to promote wildlife use. Riparian functions important for resident and migratory fish and wildlife. Sediment and organic material passage help support anadromous fish in Lower Hamilton Creek. Wildlife refuge managed to support migratory waterfowl, amphibians, and aquatic reptiles. Floodplain wetlands are supported by existing land use. Functions are limited by invasive species and flow modifications.	The city owns and maintains a minimum 200' shoreline as open space along most of this portion of Hamilton Creek. Limited future development is expected.	The purpose of the Natural shoreline designation is to protect those shoreline areas that are relatively free of human influence or that include intact or minimally degraded shoreline functions intolerant to human use. Because limited development is anticipated, the SMP will have minor effects on the reach.	The portion of Reach 1 located to the west in the Columbia River floodplain is located almost entirely within the Pierce National Wildlife Refuge. This area is federally owned and managed with limited future development expected. Staff from the Pierce Refuge is in contact with the Lower Columbia Fish Enhancement Group regarding potential projects to enhance Hardy Creek for chum salmon, but no definite plans have been made (Clapp 2011).	Because future development will be limited, the cumulative effects of the SMP and other programs will be minimized.
1-B Northern portion of FEMA Floodway (FIRM Zone A)	Urban Conservancy	Floodplain wetlands are supported by existing land uses and landscaping. Functions are limited by invasive species and flow modifications.	This floodplain area is zoned by the City for Commercial Recreation, and is part of the Beacon Rock Golf Course. Limited future development is expected.	The Urban Conservancy designation is to protect and restore ecological functions of open space, flood plain and other sensitive lands where they exist in urban and developed settings, while allowing a limited variety of compatible uses and development. Because limited development is anticipated, the SMP will have minor effects on the reach.	This part of the floodway is in non-federal ownership and part of the Beacon Rock Golf Course which is owned by the Port of Skamania County and used as commercial recreation. Limited future development is expected, and there are no proposed restoration sites along the shoreline.	Because future development will be limited, the cumulative effects of the SMP and other programs will be minimized.
1-C East shoreline of Hamilton Creek ~ 1000' south from the Evergreen Bridge	Urban	Riparian functions important for resident and migratory fish and wildlife. Sediment and organic material passage help support anadromous fish in Lower Hamilton Creek. Functions are limited by invasive species and flow modifications.	City owns and maintains the direct shoreline as open space with a paved pathway running along the shoreline. Lands adjacent are privately owned and zoned as Commercial. Limited future development is expected.	Urban designation provides for high intensity water-oriented commercial, transportation, and industrial uses while protecting existing ecological functions and restoring previously degraded ecological functions. Because limited development is anticipated, the SMP will have minor effects on the reach.	Limited future development is expected, and there are no proposed restoration sites along the shoreline.	Because future development will be limited, the cumulative effects of the SMP and other programs will be minimized.

Table 4-1. Cumulative Impact Analysis

Shoreline Reach	SMP Designation	Existing Ecological Functions	Likely Development/Functions or Processes Potentially Impacted	Effect of SMP Provisions	Effects of Other Development and Restoration Activities/Programs	Cumulative Effect
1-D Remaining east shoreline of Hamilton Creek south to the city limits.	Shoreline Residential	Riparian functions important for resident and migratory fish and wildlife. Sediment and organic material passage help support anadromous fish in Lower Hamilton Creek. Functions are limited by invasive species and flow modifications.	City owns and maintains the direct shoreline as open space. Lands adjacent are developed as residential on the north with a large vacant city and federal owned lands on the south. It is possible that future development of areas zoned for Commercial (only two lots over 50 feet from shoreline) and Residential uses (over 200 feet from shoreline) could result in potential impacts to shoreline functions in this reach. The use of Best Management Practices as part of future development could reduce the potential for impacts to the shoreline.	Shoreline Residential designation accommodates residential development and associated structures that are consistent with the Shoreline Management Act (RCW 90.58). The SMP will minimize impacts to the reach from future developments.	Limited future development is expected, and there are no proposed restoration sites along the shoreline.	Unmitigated new development has the potential to further degrade the baseline conditions, Strict implementation of the SMP and the critical areas regulations will be needed to minimize impacts and is expected to result in the long-term improvement in ecological function. Shoreline development could be mitigated for by implementing restoration activities in reaches 1-A and 1-B.
2-A North shoreline of Greenleaf Lake east to Greenleaf Creek and the portions of Carpenter Creek that are part of the OHW of the lake.	Urban	Riparian wetlands and Oregon white oak woodlands provide shade and riparian habitat for Greenleaf Lake. Reach is used by resident and anadromous fish and riparian areas provide habitat for neotropical migrant songbirds. Habitat functions are limited by some residential development, road and utility right of ways and uncontrolled human access.	It is possible that future development of areas zoned for Commercial Recreation and Residential uses could result in potential impacts to shoreline functions in this reach. The use of Best Management Practices buffer exchanges and enhancements as part of future development could reduce the potential for impacts to the shoreline.	Urban designation provides for high intensity water-oriented commercial, transportation, and industrial uses while protecting existing ecological functions and restoring previously degraded ecological functions. The SMP will minimize impacts to the reach from future developments.	There are no proposed restoration sites along the Greenleaf Lake. Because most properties within this reach are privately owned and occupied, opportunities for restoration are limited without property owner's involvement or property acquisition.	Unmitigated new development has the potential to further degrade the baseline conditions, Strict implementation of the SMP and the critical areas regulations will be needed to minimize impacts and is expected to result in the long-term improvement in ecological function. Shoreline development could be mitigated for by implementing restoration activities in reaches 1-A and 1-B.
2-B South and east shorelines of Greenleaf Lake to Greenleaf Creek	Shoreline Residential	Small Riparian wetland and limited shoreline canopy provide shade and riparian habitat for Greenleaf Lake. Lake is used by resident and migratory fish and riparian areas provide habitat for Neotropical migrant songbirds. Habitat functions are limited by residential uses, existing landscaping, BPA development, and uncontrolled human access.	The City has identified a potential site for a public fishing dock to be constructed in the future. The addition of a formal site for public fishing could reduce the use of other areas of the lake as informal fishing sites, thereby reducing potential impacts to other areas of the shoreline. Recognizing the special character of Greenleaf Lake, ongoing human intrusion within the natural environment could be managed through controlled public access and continued management of boat use at the lake.	Shoreline Residential designation accommodates residential development and associated structures that are consistent with the Shoreline Management Act (RCW 90.58). The SMP will minimize impacts to the reach from future developments.	There are no proposed restoration sites along the Greenleaf Lake. Because most properties within this reach are privately owned and occupied, opportunities for restoration are limited without property owner's involvement or property acquisition.	Unmitigated new development has the potential to further degrade the baseline conditions, Strict implementation of the SMP and the critical areas regulations will be needed to minimize impacts and is expected to result in the long-term improvement in ecological function. Shoreline development could be mitigated for by implementing restoration activities in reaches 1-A and 1-B.

Table 4-1. Cumulative Impact Analysis

Shoreline Reach	SMP Designation	Existing Ecological Functions	Likely Development/Functions or Processes Potentially Impacted	Effect of SMP Provisions	Effects of Other Development and Restoration Activities/Programs	Cumulative Effect
3 Hamilton Creek from the Evergreen Bridge north to the city limits	Urban	Sediment and organic transport services to downstream resources and deciduous riparian habitat are the most significant ecological resources within this reach. Functions are limited in this area by the past impacts within the upper watershed that have impaired stream functions and simplified in-stream resources. Levees have also limited riparian functions.	It is possible that future development of areas zoned for Commercial Recreation and Industrial uses could result in potential impacts to shoreline functions in this reach. The use of Best Management Practices as part of future development could reduce the potential for impacts to the shoreline.	Urban designation provides for high intensity water-oriented commercial, transportation, and industrial uses while protecting existing ecological functions and restoring previously degraded ecological functions. The SMP will minimize impacts to the reach from future developments.	Some of the conditions in this reach are largely caused by factors outside of the City's jurisdiction, which include upstream land use and alterations to hydrology. Currently, there are no known proposed restoration sites along this reach.	Unmitigated new development has the potential to further degrade the baseline conditions, Strict implementation of the SMP and the critical areas regulations will be needed to minimize impacts and is expected to result in the long-term improvement in ecological function. Shoreline development could be mitigated for by implementing restoration activities in reaches 1-A and 1-B.
4 Greenleaf Creek from OHW of Greenleaf Lake north to the city limits	Urban	Riparian habitat support services are functioning at fair to good levels for this reach. Wetland resources also provide off-channel resources for fish and wildlife. The reach is limited by the levels of in-stream channel habitat complexity.	Most of this reach is undeveloped with the only potential commercial recreation development on the north and south parts of the reach within the city. It is possible that future development of areas zoned for Commercial Recreation and Residential uses could result in potential impacts to shoreline functions in this reach. The use of Best Management Practices and buffer averaging as part of future development could reduce the potential for impacts to the shoreline.	Urban designation provides for high intensity water-oriented commercial, transportation, and industrial uses while protecting existing ecological functions and restoring previously degraded ecological functions. The SMP will minimize impacts to the reach from future development.	A majority of the reach is undeveloped canopied wetland and will remain as such with existing regulations. Most properties within the Greenleaf Creek reach are privately owned. Therefore, opportunities for restoration are limited in this reach without property owner's involvement or property acquisition.	Unmitigated new development has the potential to further degrade the baseline conditions, Strict implementation of the SMP and the critical areas regulations will be needed to minimize impacts and is expected to result in the long-term improvement in ecological function. Shoreline development could be mitigated for by implementing restoration activities in reaches 1-A and 1-B.
5 Columbia River within the city limits at Bonneville Dam	Urban Conservancy	Shorelines in this reach are highly modified and managed by the Corps of Engineers. Maintenance of connections to terrestrial habitats should be a priority.	This reach is owned and managed by the USACE. Limited future development is expected.	The Urban Conservancy designation is to protect and restore ecological functions of open space, flood plain and other sensitive lands where they exist in urban and developed settings, while allowing a limited variety of compatible uses and development. Because limited development is anticipated, the SMP will have minor impacts on the reach.	Currently, there are no known proposed restoration sites along this reach.	Because future development will be limited, the cumulative effects of the SMP and other programs will be minimized.

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Appendix A. Exhibits from Shoreline Inventory and Characterization Report