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# City of North Bonneville Shoreline Master Program

## Shoreline Inventory and Characterization Report

**FINAL**  
November 2012



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## Acronyms and Abbreviations

BPA	Bonneville Power Administration
City	City of North Bonneville, Washington
CAO	critical areas ordinance
cfs	cubic feet per second
CWA	Clean Water Act
Ecology	Washington Department of Ecology
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
HPA	Hydraulic Project Approval
LFA	Limiting Factor Analysis
LWD	large woody debris
NBCP	North Bonneville Comprehensive Plan
NBMC	North Bonneville Municipal Code
NMFS	National Marine Fisheries Service
NOAA Fisheries	National Oceanic and Atmospheric Administration National Marine Fisheries Service
NWI	National Wetland Inventory
NWPCC	Northwest Power and Conservation Council
OFM	Washington Office of Financial Management
OHWM	Ordinary High Water Mark
PHS	priority habitats and species
RCW	Revised Code of Washington

report	Shoreline Inventory and Characterization Report
SMA	Shoreline Management Act
SMP	Shoreline Master Program
TMDL	Total Maximum Daily Load
USACE	U.S. Army Corps of Engineers
USDA NRCS	U.S. Department of Agriculture – Natural Resources Conservation Service
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
USFWS	U.S. Fish and Wildlife Service
WAC	Washington Administrative Code
WRIA	Water Resource Inventory Area
WDFW	Washington State Department of Fish and Wildlife
WRCC	Western Regional Climate Center

## 1.0 Introduction

The City of North Bonneville, Washington (City) is conducting a Shoreline Master Program (SMP) update with assistance of a grant from the Washington Department of Ecology (Ecology). Cities and counties are required to update their SMPs to comply with the state Shoreline Management Act (SMA), Revised Code of Washington (RCW) 90.58, and Washington Administrative Code (WAC) 173.26.

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. Waterfront lands were recognized as a precious and limited resource that needed protection. 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 Act, 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 developed by Ecology. The Guidelines have specific requirements but also give local governments some discretion to adopt SMPs that reflect local circumstances

One purpose of updating a community's SMP is to better align the SMP with other local ordinances that regulate land use. The statewide policy statements of RCW 90.58.020, WAC 173-26-176, and WAC 173-26-181 are tailored to local geography and community values.

SMPs are required to have 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. This system of "shoreline environment designations" groups areas that share similar characteristics so they can be managed in a uniform and consistent manner. In a regulatory context, shoreline environment designations 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 policy and regulations that can be tailored to the designation.

This Shoreline Inventory and Characterization Report (report) provides a factual and rational basis for updating the City's shoreline environment designations. Each designation affords different levels of protection, defines what uses are appropriate, and supports the City's shoreline management goals, policies, and regulations including opportunities for public access to and restoration of the City's shorelines.

The information presented in this report is organized in the following sections:

- **Section 1** provides an introduction to the report, including definition and identification of the City's shoreline jurisdiction, and the relationship of the City's SMP to other plans and programs.
- **Section 2** provides an overview of the methods used to conduct the shoreline inventory and characterization.
- **Section 3** provides an ecosystem-wide profile of the ecological functions and processes affecting the City's shorelines.
- **Section 4** identifies shoreline reaches and provides shoreline inventory information at the reach scale for the City's shoreline jurisdiction.

- **Section 5** provides a list of references for information utilized in the shoreline inventory and characterization.
- **Appendix A** includes the City's shoreline inventory mapbook and a summary of data sources utilized in the shoreline inventory and characterization.

The City will utilize this report in the next steps of the SMP process, which include developing shoreline environment designations; preparing draft SMP goals, policies, and regulations; and developing a restoration plan to take advantage of restoration opportunities in the City's shoreline jurisdiction.

## 1.1 Shoreline Jurisdiction

### 1.1.1 Regulatory Overview and Definitions

#### Shorelines of the State

The SMP update process begins with the identification of "shorelines of the state" and associated "shorelands" which comprise the geographic area where the SMA applies within a local jurisdiction. The SMA applies to the following:

- All marine waters.
- Rivers and streams with more than 20 cubic feet per second (cfs) mean annual flow.
- Lakes and reservoirs greater than 20 acres in area.
- Associated wetlands.
- Shorelands adjacent to these water bodies.

Specific shorelines are identified by the SMA as "shorelines of statewide significance," such as the Columbia River.

#### Ordinary High Water Mark

The shoreline jurisdiction is identified using the Ordinary High Water Mark (OHWM). The OHWM is not a fixed elevation; the OHWM and shoreline jurisdiction can move over time as the shoreline changes. It is difficult to precisely map the location of the OHWM during the SMP update process, so Ecology does not require the City to show a precise location in the SMP. Therefore, the City's shoreline jurisdiction, as presented in Exhibit 1, is considered an approximate location<sup>1</sup>.

#### Shorelands

Shorelands are land areas, wetlands, river deltas, or floodplains that border shorelines of the state. The minimum shoreline jurisdiction for shorelands is the greater of the following:

- Lands extending landward 200 feet in all directions from the OHWM.
- The floodway plus contiguous floodplain 200 feet landward of the floodway.

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<sup>1</sup> The City's updated SMP will require verification of the OHWM and shoreline jurisdiction as part of the permitting process for future shoreline development.

- Associated wetlands and river deltas<sup>2</sup>.

### 1.1.2 North Bonneville Preliminary Shoreline Jurisdiction

The City's preliminary shoreline jurisdiction is identified in Exhibit 1. The City's shoreline jurisdiction includes all water bodies and land areas within the city limits that meet the definitions of "shorelines of statewide significance," "shorelines of the state," and "shorelands," as described above.

The City's shoreline jurisdiction includes the following shorelines and shorelands:

- Shorelines of the State (Greenleaf Creek, Greenleaf Lake, and Hamilton Creek) located within the city limits;
- Shorelines of Statewide Significance (Columbia River) located within the city limits; and
- Shorelands associated with the above-referenced shorelines:
  - Shorelands 200 feet from the OHWM;
  - FEMA FIRM Zone A (100-year floodplain) where the zone extends beyond 200 feet from the OHWM; and
  - Associated wetlands identified in the National Wetland Inventory (NWI) and/or field-verified.

Information collected during the September 20th field visit resulted in the following refinements to the City's preliminary shoreline jurisdiction:

- Revision of the extent of a wetland adjacent to north shoreline of Greenleaf Lake at confluence of Carpenter Creek – identification of upland plant species in some areas and wetland species in others resulted in the revision.
- Exclusion of portion of FEMA floodplain at Pacific Coast Trail trailhead on the north side of Highway 14 – much of this area has been graded and paved, and the area is completely separated from the Columbia River by the Bonneville Dam and Highway 14.

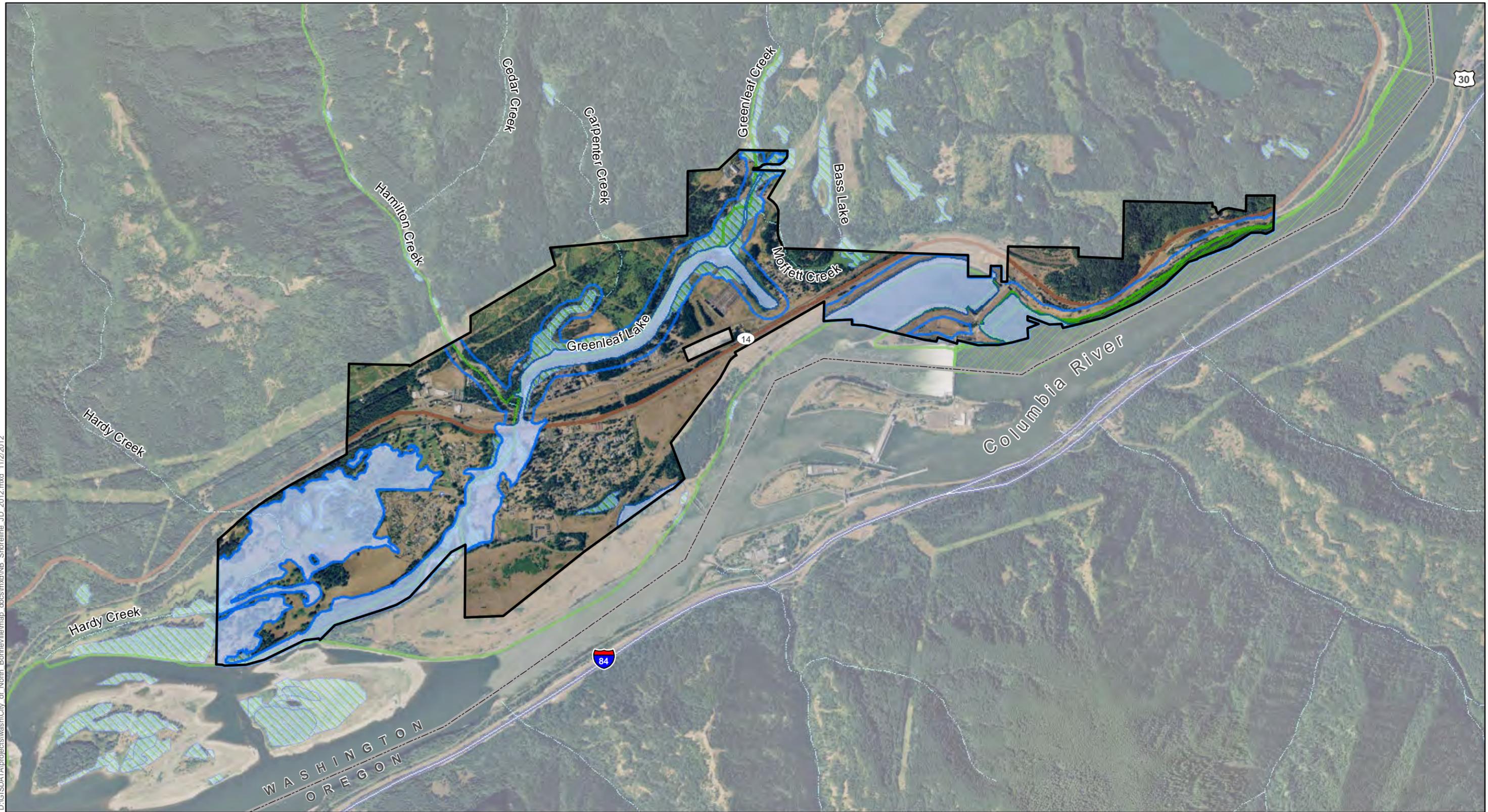
The City's preliminary shoreline jurisdiction may be modified as the City continues its SMP update process.

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<sup>2</sup> The term "associated" means wetlands or river deltas that are in proximity to and/or influenced by waters subject to the SMA. This term may also be used to describe wetlands or other critical areas located within the City's shoreline jurisdiction.

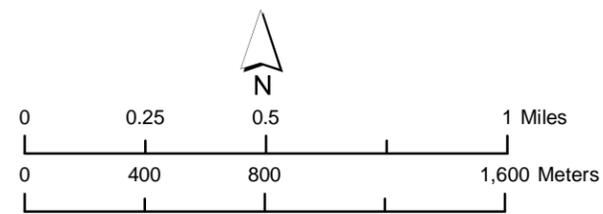
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**LEGEND**

-  City Limits
-  Shorelands
-  FEMA FIRM Zone A
-  Shorelines of the State
-  Shorelines of State-Wide Significance
-  Wetlands



**Sources:**  
 Shorelines\* - Ecology/USGS 2011;  
 FIRM data\* - City of North Bonneville 2004;  
 Hydrology - ESRI  
 Imagery - USDA 2009  
 \*Updated based on windshield survey

**Exhibit 1 – Preliminary Shoreline Jurisdiction**

City of North Bonneville  
Shoreline Master Program Update  
November 2012



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## 1.2 Relationship to Other Plans and Programs

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 to ensure they are consistent with the SMP. Waterfront lands are regulated by local as well as federal regulations, and the SMP update needs to ensure these are integrated to avoid inconsistencies or conflicts between the regulations. The City's SMP intersects with the City's comprehensive plan, municipal code, and other regulatory plans and programs to manage and regulate development in shorelines. Local plans and regulations that relate to shoreline management include the following:

- **Comprehensive Plan** – the North Bonneville Comprehensive Plan (NBCP) documents the City's vision for growth and development. 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. (See Appendix A for Land Use Designations Map).
- **Zoning districts** – The North Bonneville Municipal Code (NBMC) further defines the way in which the City's shorelines are managed. The City has created zoning districts that are consistent with the NBCP that are defined in NBMC Title 20, Zoning (see Appendix A for Zoning Map).
- **Critical areas ordinance (CAO)** – the City's critical areas ordinance, included in NBMC Title 21, was updated in 2008 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. 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.
- **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 (see maps excerpted from the Heritage Trails Plan at the end of this section).

The City's SMP must also be compatible with state and federal regulations and programs that relate to shoreline management. State and federal regulations and programs that intersect with the City's SMP include the following:

- **Hydraulic Project Approval (HPA)** – the HPA program applies to any construction activity that would alter the bed or bank of a water of the state. The program is

administered by the Washington State Department of Fish and Wildlife (WDFW). All applicable projects are required to submit permit applications to show that construction is done in a manner to prevent damage to the state's fish, and shellfish, and their habitats.

- **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.
- **Endangered Species Act (ESA)** – 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).
- **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.
- **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.
- **Pierce National Wildlife Refuge** – part of the City's shoreline jurisdiction lies within the Pierce National Wildlife Refuge. Current management emphasis for the refuge is on wetland enhancement and development, and protection and enhancement of anadromous and native fisheries resources. The refuge is not open to the general public.
- **Bonneville Lock and Dam** – the Bonneville Lock and Dam Project is located just east of the city. Parts of the dam facility, including roads and parking areas, are in City jurisdiction. The USACE operates the Lock and Dam which was completed in 1938 to improve navigation on the Columbia River and provide hydropower to the Pacific Northwest.





Detail showing the Greenleaf Trail section of the Heritage Trails system.



Detail showing the Hamilton Creek Trail section of the Heritage Trails system.

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## 2.0 Methodology

### 2.1 Study Area

The study area for this shoreline inventory and characterization includes the City's shoreline jurisdiction (see Exhibit 1). 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 as part of the analysis of the study area.

For the purpose of the shoreline inventory and characterization, the shoreline jurisdiction was divided into segments called reaches based on shoreline type. Physical and biological conditions of the shoreline were the basis for dividing the reaches. Significant changes in existing land use were also used to determine a shoreline reach break. The inventory was created by reviewing available and existing data and reports listed in Section 2.1.2. Existing geographic information system data were used to characterize shoreline conditions at the water body scale, and the mapping analysis was verified during a field visit on September 20, 2011. The City's shoreline reaches are described in detail in Section 4.

### 2.2 Data Sources

Local, regional, state and federal agency data sources, maps, and technical reports were reviewed to compile this shoreline inventory and characterization. Information pertaining to watershed conditions and ecosystem-wide processes was reviewed, as well as data on the land use patterns and ecological conditions of the City's shorelines. Appendix A provides a summary of the data sources and maps utilized in this shoreline inventory and characterization. Additional reference materials are described in Section 5, References.

### 2.3 Inventory and Characterization Approach

The analysis of ecosystem-wide processes was based on available information and reports that describe WRIA 28. The purpose of the ecosystem-wide characterization is to identify current conditions of North Bonneville shoreline areas in relation to the larger watershed and its ecological functions. An overview of key processes and aquatic resource functions in the watershed are discussed as they affect the City's shorelines. The inventory also sets the foundation for a Restoration Plan that will organize and identify strategies and potential opportunities for protecting and restoring degraded shoreline areas.

The inventory and characterization of the City's shoreline reaches was based on available data and information, including land use, zoning, water quality, priority habitats and species (PHS), and shoreline modifications. A site visit was conducted to verify this information to the extent feasible, but no special studies were conducted.

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## 3.0 Ecosystem-wide Profile

### 3.1 Introduction

The SMA requires local jurisdictions to consider the ecosystem-wide processes and conditions that affect the ecological functions of the shorelines within their jurisdiction. This section of the shoreline inventory and characterization describes current and historic ecological conditions throughout the watershed in which the City's shorelines are located. Later sections address alterations and land uses.

The City of North Bonneville has a unique history that has influenced the conditions of the City's shorelines and ecosystem as a whole. Native Americans inhabited the area for thousands of years because of the natural choke point created by the Great Rapids in this part of the Columbia River and the abundance of native food sources that it provided. Great regional landslides have additionally occurred within the last 300 years that filled, redirected and altered the shorelines. Landslides continue to cause extensive channel accretion from erosion in the upper reaches of the creeks. With development of land transportation routes along the river in the early 1900s came filling and narrowing of water channels that restricted the hydrology of Hamilton Creek, Greenleaf Lake and other streams within the City. The great flood of 1894 washed away the town of Cascades that was located within the existing city limits. This was the first non-native community founded in the region in the 1850s as a transportation hub for travelers and commerce along the river. The development of land routes around the rapids negated the need for reestablishment of Cascades. The community of North Bonneville originally developed on the shore of the Columbia River in the 1930s as a construction town for the Bonneville Dam, and the City was incorporated in 1935. Extensive river channel alteration came with the construction of Bonneville Dam (Exhibit 3) as well as the flooding of the Great Rapids by the dam's reservoir. The river was not only excavated and enlarged but reinforced along its shorelines.

The City's current SMP was adopted in 1974 and has not been updated since 1975. In 1971, the place where the City had grown was selected by federal agencies as the site for a second powerhouse to the Bonneville Dam. Citizen objections to vacating led to federal planning, funding and relocating of the entire community to its current location in 1978.

The relocation presented a unique opportunity to create a planned city, which included raising the new town site above the 100-year flood plain and maintaining federal lands as well as deed-restricted City ownership of open spaces that restricted most development within 200 feet of most shorelines to address requirements of the SMA. The shorelines were once again massively altered with excavation of the old city site and extensive shoreline filling for the new relocated city on Hamilton Creek and the Columbia River.

As part of the planning for the relocation, the optimum town plan projected that the city would need approximately 1500 residents and a destination-based tourism economy to survive. This goal has never been met. The City currently has approximately 1,000 residents, a few businesses and one hotel to generate revenue and is feeling the financial impacts of remaining under-developed. Numerous federally owned shorelines in and outside the City including Kidney Lake, Bass Lake, and the Columbia River provide water related recreational opportunities such as fishing, boating, trails, etc. There is considerable potential for additional tourism promotion, infrastructure and increasing access to area shorelines for recreation in the region as a whole.

North Bonneville's scenic location and its relation to water bodies have always played an important role in the City. The Columbia River shoreline in and around North Bonneville is

owned and controlled by the federal government. Large portions of other shorelines are owned and/or used as groomed areas for the Bonneville Power Administration (BPA) and natural gas companies. Portions of waterfront lands are also owned by the City and maintained as deed restricted open space on Hamilton Creek and Greenleaf Lake. Development along many of the developable privately owned shorelines has already occurred. With lot size restrictions within potential development can only occur in the limited remaining shoreline areas. Much of the vacant land remaining that can be developed (approximately 200 acres) in the City is along its privately owned shorelines including Greenleaf Lake, Greenleaf Creek, and a portion of Hamilton Creek. Most of this undeveloped land is zoned Commercial Recreation which provides for activities that may include marinas and dock facilities as part of a commercial or residential development. How the City manages its shorelines could drastically affect the future viability of the City.

Most of the existing shoreline areas near the City of North Bonneville have been modified and many are actively managed by federal agencies and therefore most of the shoreline functions cannot be restored. Outside of these areas, some shorelines will be identified in the restoration plan where important habitat functions may be preserved and enhanced.

In years to come, some of these alterations will continue to cause maintenance problems for the City's infrastructure, and may require modification. The practical implications of some of these anticipated alterations could create shoreline restoration opportunities as well as resolving urban infrastructure problems.

Today, the City is mostly surrounded by federally-owned and managed land, highways, and water bodies (Columbia River). The city limits are almost completely expanded to the urban growth boundary of the Columbia River Gorge National Scenic Area. This means that North Bonneville cannot annex more lands outside its current boundary (see Appendix A for map of federal ownership). The Bonneville Power Administration and Burlington Northern Railroad also hold easements that transect the City. As a result, many of the activities and human-caused changes in the ecosystem-wide processes that affect the City's shorelines are beyond the City's control.

### **3.2 Watershed Overview**

The City is located within the Salmon/Washougal WRIA 28. WRIA 28 is divided into subbasins; the City is located within the Lower Columbia Tributaries subbasin.

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 so much an 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).

The Lower Columbia Tributaries subbasin was highlighted in the Watershed Management Plan for WRIA 28 (HDR/EES 2006) as playing an important role in salmon recovery efforts.

### 3.2.1 Fish and Wildlife

A number of fish and wildlife species use the shorelines in the Lower Columbia River Tributaries subbasin for habitat. These habitats occur in both the aquatic and terrestrial portions of the basin. This section describes some of the key habitats and the ecological functions they provide.

#### 3.2.1.1 InStream and Riparian Habitat

The most basic functions of an aquatic area are the storage, purification, or transport of water. They also function as habitat for a large number of plants and animals. The Columbia River, its tributaries, and their associated wetlands support anadromous salmon and other aquatic life. Chinook salmon (*Oncorhynchus tshawytscha*), chum salmon (*Oncorhynchus keta*), coho salmon (*Oncorhynchus kisutch*), steelhead (*Oncorhynchus mykiss*), coastal cutthroat trout (*Oncorhynchus clarkii clarkia*), Pacific eulachon (*Thaleichthys pacificus*), Pacific lamprey (*Lampetra tridentata*) are documented to utilize the rivers and streams of WRIA 28 (LCFRB 2010, Wade 2001; WDFW 2011; NMFS 2010). According to the Lower Columbia Salmon Recovery and Fish and Wildlife Subbasin Plan (2010), bull trout (*Salvelinus confluentus*) are not present in the lower Columbia Tributaries subbasin.

Fall Chinook salmon start migrating in the Columbia River from early August or September and spawn in the mainstem of the Columbia River and its tributaries between mid-October and late November. Adult chum salmon enter the lower Columbia River tributaries between mid-October and November, and spawning begins as early as November and may extend into January. Coho salmon and steelhead are known to utilize most of the major streams in WRIA 28 for spawning and rearing. Coho adults enter the Columbia River beginning in mid-September and continue through December, and tributary spawning extends from late October through March with a peak in October through December. Spawning for steelhead occurs between early March and early June (LCFRB 2010).

Within the subbasin, most stream channels are high gradient, and spawning habitat is limited to the areas in the lower reaches (LCFRB 2010). Natural flow regime in the subbasin has been altered at lower reaches by the construction of Bonneville Dam, railroad, and roadway. During summer, several Columbia River tributaries have been documented for low flows at the lower reaches, which could result in restricting fish passage and stranding juvenile fish (LCFRB 2010; NMFS 2011). Pool frequency in the Columbia River tributaries are generally limited within most of the reaches according to the stream surveys conducted by USFS from 1994 through 1998. Substrate is primarily gravel with cobbles and boulders. A large amount of fine sediments are also observed in some of the reaches that are adjacent to roadways (Wade 2001).

Riparian areas are the zones where aquatic and terrestrial ecosystems interact. Riparian vegetation provides habitat for many species of wildlife, and streamside or shoreline vegetation provides habitat functions for streams and fish, such as shade, bank stability, sediment/nutrient filtering, and organic nutrient input.

Riparian corridor continuity is particularly important in smaller headwater streams because smaller streams generally make up most of the stream length within a watershed, and the influence of riparian vegetation on some stream habitat functions is greater for small

streams (Binford and Bucheneau 1993; Wenger 1999; Beschta et al. 1987). Such areas upstream of fish-bearing waters help determine water quality, the magnitude and timing of flows, stream temperature, sediment loads, nutrient inputs, and prey production in downstream waters.

Large woody debris (LWD) in streams and shorelines can influence coarse sediment storage, create hydraulic heterogeneity, moderate flow disturbances, provide cover, and contribute to overall channel complexity. LWD can trap and accumulate sediment, small woody debris, and other organic matter (Bilby 1981). The complex, submerged structure formed by LWD and entrapped smaller woody debris can provide flow refugia and essential cover in which salmonids conceal themselves from predators and competitors and find profitable feeding positions (McMahon and Hartman 1989; Fausch 1984). The removal of riparian forest may reduce woody debris in streams, which in turn can lead to adverse changes in channel and habitat-forming processes (Heifetz et al. 1986; McDade et al. 1990; Van Sickle and Gregory 1990; Bilby and Ward 1991).

According to the Conservation Commission's Limiting Factor Analysis (LFA) Report (2001), riparian habitat along lower reaches of the streams in the project subbasin is considered poor or unknown. This is consistent with the results from the watershed process modeling in the subbasin plan, which rated the riparian habitat in the subbasin as moderately impaired (LCFRB 2010). LWD in the Lower Columbia River tributaries are relatively infrequent. Areas where LWD surveys have been conducted indicated that LWD levels are low, especially in the lower reaches, and the near-term recruitment potential is also low because of the lack of woody vegetation along the riparian corridor (Wade 2001).

### 3.2.1.2 Wetlands

The USACE (Federal Register 1982 and 1986) and the SMA define wetlands as "areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions."

Wetlands potentially perform a variety of unique physical, chemical, and biological functions which are beneficial for both the human and biological environment (NRC 1995; Brinson and Rheinhardt 1996). These functions include flood storage and retention, stream base flow maintenance and ground water support, improving water quality, shoreline protection, and biological support for fish and wildlife habitat (Null et al. 2000; Adamus et al. 1987; Hruby et al. 1999).

Existing wetlands in the subbasin are primarily associated with streams including the Columbia River and its tributaries. According to the NWI map, common wetlands found within the subbasin are palustrine and riverine wetlands (Cowardin et al. 1979). Wetlands can help streams by providing consistent baseflow during the dry part of the year as well as provide a buffer for runoff during storms. Wetlands may also filter runoff prior to discharge into streams and help maintain water quality.

### 3.2.1.3 Terrestrial Habitat

Other habitat sources within the subbasin include terrestrial forests. The lower Columbia River Tributaries subbasin is located within the western hemlock forest zone of the Puget Trough province described in *Natural Vegetation of Oregon and Washington* (Franklin and Dyrness 1988). Western hemlock and western red cedar are the dominant upland forest species in this zone, although Douglas fir is also very common. Forests provide breeding, feeding, and migration areas for a wide variety of wildlife species including, but not limited to, black bear, deer, elk, coyote, and many rodents as well as a various species of

amphibians and reptiles (Marriott et al. 2002). Within the subbasin, relatively undisturbed vegetation exists on the north side of Highway 14.

Many of the terrestrial species also rely on shorelines and their associated wetlands for breeding, rearing, foraging, and migration habitat. The lower Columbia River is one of the most important migratory corridors for shorebirds known as the Pacific Flyway, and many wildlife refuges are located along the Columbia River that provide feeding and resting areas for wintering waterfowl (Marriott et al. 2002).

The WDFW maintains a spatial database of PHS in the state of Washington. Priority habitats are those habitat types or elements with unique or significant value to a diverse assemblage of species. Priority species require protective measures for their population status, sensitivity to habitat alteration, and/or recreational, commercial, or tribal importance (WDFW 2011). Priority species include state endangered, threatened, sensitive, and candidate species; animal aggregations considered vulnerable; and those species of recreational, commercial, or tribal importance that are vulnerable.

Priority wildlife habitats mapped in the City and the adjacent areas include wetlands, riparian areas, oak woodlands, herbaceous bald, and talus slopes/cliffs. The PHS database also identifies priority species within the City and adjacent areas such as bald eagle (*Haliaeetus leucocephalus*), great blue heron (*Ardea herodias*), peregrine falcon (*Falco peregrinus*), and western toad (*Bufo boreas*) (WDFW 2011).

### 3.2.2 Land Use, Demographics, and Land Ownership

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.

Skamania County had a population of 11,066 in 2010; the large majority of the population lives in unincorporated areas (U.S. Census 2011; OFM 2011). The population of the City of North Bonneville is 956 (OFM 2011).

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.

Much of the land area in the subbasin and County is federally managed, either as part of the Gifford Pinchot National Forest, the Columbia River Gorge National Scenic Area, the Pierce National Wildlife Refuge, or areas related to operation of the Bonneville Lock and Dam. Approximately 80 percent of the County's land area is federally exempt (Skamania County 2011).

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 (see Appendix A for Open Space Map). 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.

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. Greenleaf Lake has experienced almost all of the City's shoreline development 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 private 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. As mentioned earlier, a majority of the vacant land in North Bonneville is on the north shore of Greenleaf Lake.

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.

Exhibit 2 shows the land ownership within the City and its shoreline jurisdiction. Exhibit 3 shows the locations of residential and commercial structures within the City's shoreline jurisdiction. Table 1 shows the acreage and percentage of shoreline jurisdiction by type of ownership. Table 2 shows a summary of shoreline development by shoreline reach.

The primary land uses associated with the City's shorelines are recreation, residential, and commercial uses. These uses are discussed in greater detail in subsequent sections.

**Table 1. Summary of Land Ownership in the Shoreline Jurisdiction**

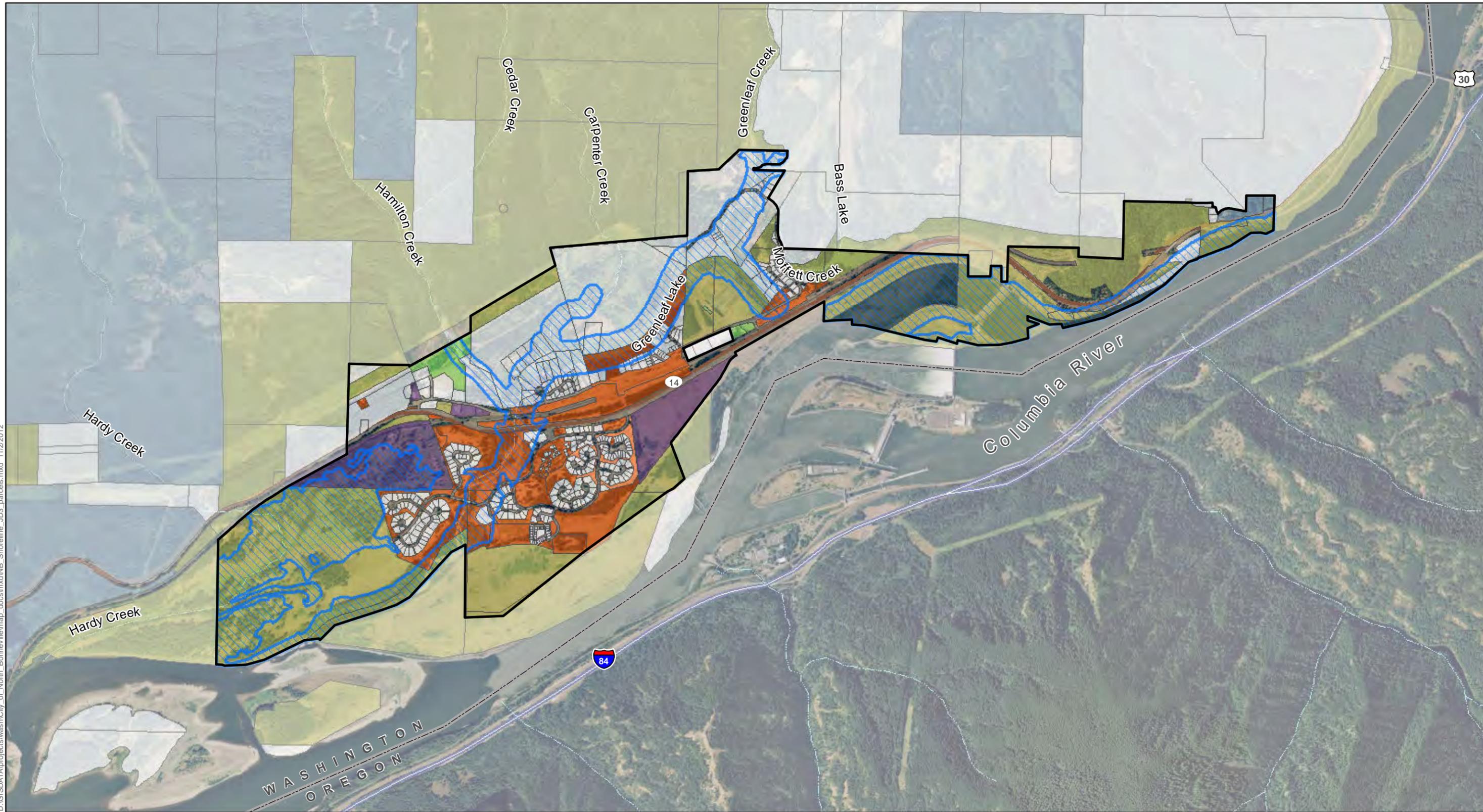
Land Ownership	Acres	Percent
Federal Government	298	53
State Government	0	0
Skamania County	4	1
Port of Skamania County	34	6
City of North Bonneville	70	12
Private	155	28
Total	561	100

**Table 2. Summary of Shoreline Development 1980 – 2012**

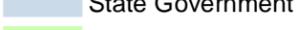
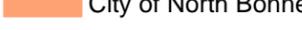
Shoreline Reach	1980			1990 – 2000			2000 – 2010			Summary 2010 – 2012			
	0-50 feet	50-100 feet	100- 200 feet	0-50 feet	50-100 feet	100-200 feet	0-50 feet	50-100 feet	100-200 feet	0-50 feet	50-100 feet	100-200 feet	
<b>Hamilton Creek Lower Channel</b>													
Residences	0	0	0	0	0	0	0	0	0	0	0	0	
Commercial	0	0	0	0	0	0	0	0	0	0	0	0	
										Change:	0	0	0
Notes:	8,800 feet shoreline within city limits and shoreline jurisdiction 3,100 feet of shoreline within city limits but outside shoreline jurisdiction (Pierce Wildlife Refuge)												
<b>Hamilton Creek Upper Channel</b>													
Residences	0	0	0	0	0	0	0	0	0	0	0	0	
Commercial	1	0	0	1	0	0	1	0	0	1	0	0	
										Change:	0	0	0
Notes:	4,100 feet of shoreline (all part of flood control dike system) BPA: 200 feet (0-50' brushed to shoreline) 5% Williams Natural Gas: 100 feet (0-50' brushed to shoreline) 2% Total: 7%												

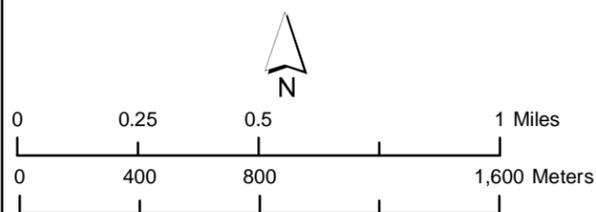
Shoreline Reach	1980			1990 – 2000			2000 – 2010			Summary 2010 – 2012			
	0-50 feet	50-100 feet	100- 200 feet	0-50 feet	50-100 feet	100-200 feet	0-50 feet	50-100 feet	100-200 feet	0-50 feet	50-100 feet	100-200 feet	
<b>Greenleaf Lake</b>													
Residences	1	5	3	1	9	3	1	14	5	1	16	5	
Commercial	0	0	0	0	0	0	0	0	0	0	0	0	
										Change:	0	11	2
Notes:	16,000 feet of shoreline including outflow channel												
	BPA:			1,800 feet (0-50' brushed to shoreline)				11%					
				1,600 feet (100-200' developed)				10%					
	City open space:			2,900 feet				18%					
	City street (East Cascade)			2,700 feet (0-50')				17%					
				300 feet (50-200')				2%					
	Total							58%					
<b>Greenleaf Creek</b>													
Residences	0	0	0	0	1	1	0	1	1	0	1	1	
Commercial	0	0	0	0	0	0	0	2	0	0	2	0	
										Change:	0	3	1
Notes:	6,400 feet of shoreline												
<b>Columbia River</b>													
N/A: All shorelines and development located within federally owned lands.													

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**LEGEND**

- |   |                        |   |                          |  |                         |
|---|------------------------|---|--------------------------|--|-------------------------|
|  | City Limits            |  | Federal Government       |  | Port of Skamania County |
|  | Shoreline Jurisdiction |  | State Government         |  | Private                 |
|   |                        |  | Skamania County          |  |                         |
|   |                        |  | City of North Bonneville |  |                         |



**Exhibit 2 – Land Ownership in Preliminary Shoreline Jurisdiction**

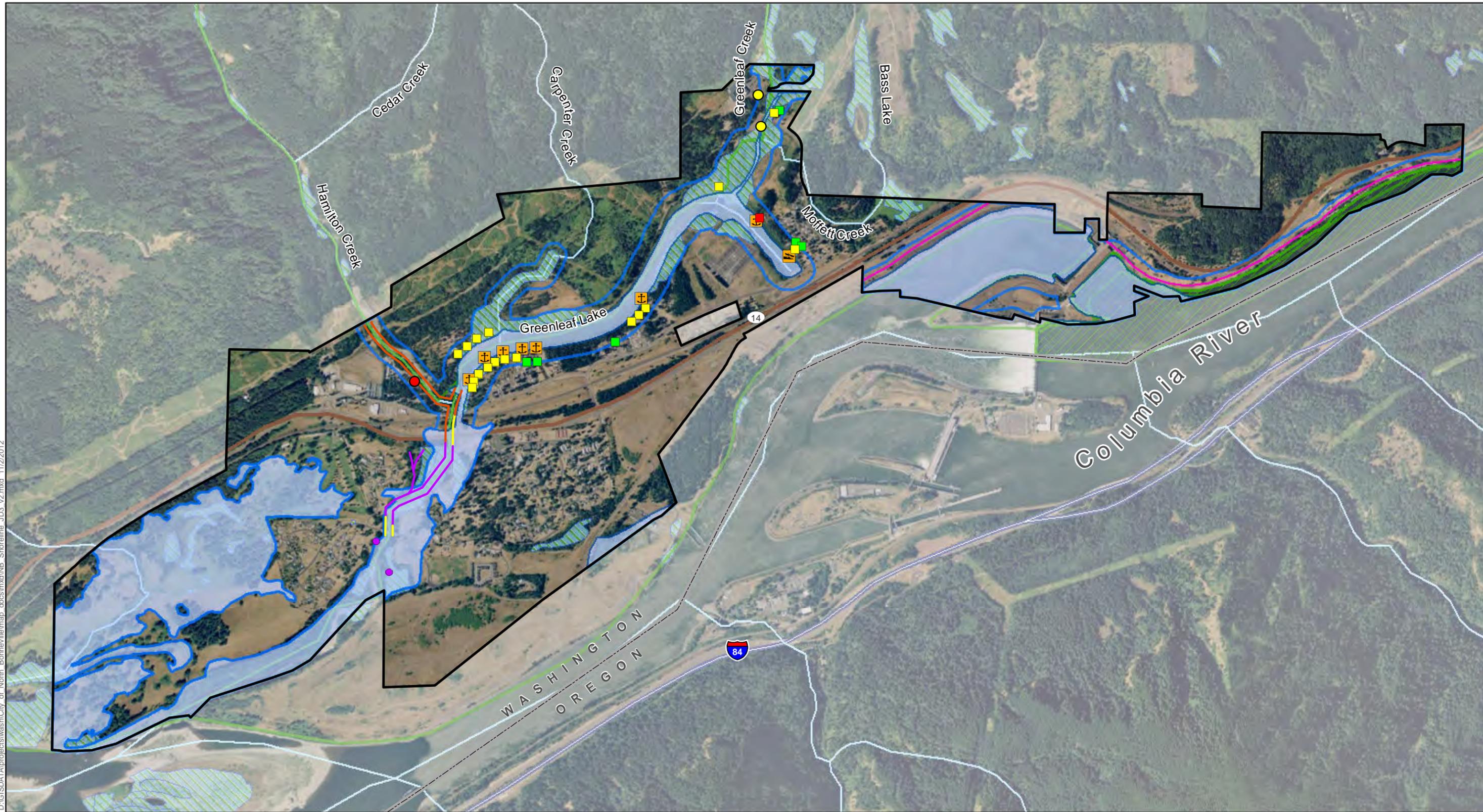
**Sources:**  
Parcel Data - Skamania County 2011 (updated by City of North Bonneville 2011);  
Hydrology - ESRI  
Imagery - USDA 2009

City of North Bonneville  
Shoreline Master Program Update  
November 2012

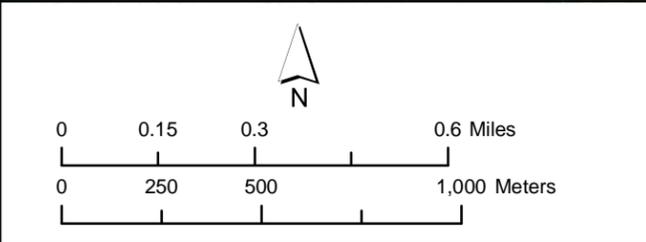


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LEGEND	
<b>Shoreline Modifications</b>	<b>Commercial Structures</b>
Yellow line: Riprap	Red circle: Within 0-50 feet from Shoreline
Purple line: Habitat Enhancement Structures	Yellow circle: Within 50-100 feet from Shoreline
Orange line: Sugar Dikes	Green circle: Within 100-200 feet from Shoreline
Pink line: Levee	<b>Residential Structures</b>
Blue line with anchor: Public Boat Launch	Red square: Within 0-50 feet from Shoreline
Blue line with cross: Private Docks	Yellow square: Within 50-100 feet from Shoreline
Purple circle: Stormwater Outfalls	Green square: Within 100-200 feet from Shoreline
	<b>Other Features</b>
	Black outline: City Limits
	Blue hatched: FEMA Floodway (FIRM Zone A)
	Light blue: Shorelands
	Green hatched: Shorelines of the State
	Dark green hatched: Shorelines of State-Wide Significance
	Blue hatched: Wetlands



**Sources:**  
 Shorelines\* - Ecology/USGS 2011;  
 FIRM data\* - City of North Bonneville 2004;  
 Hydrology - ESRI  
 Imagery - USDA 2009  
 \*Updated based on winshield survey

**Exhibit 3 –  
 Shoreline Modifications**

City of North Bonneville  
 Shoreline Master Program Update  
 November 2012

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### 3.3 Ecosystem-wide Processes and Alterations

Ecosystem-wide processes are the dynamic physical and chemical interactions that form and maintain natural landscapes within a watershed. Ecosystem processes are formed at multiple scales from watershed-scale to shoreline reaches and drive structures and functions within the shoreline. Key groups of ecosystem-wide processes include hydrology, sediment transport, water quality, and organic inputs. The following section summarizes the landscape-scale processes within the lower Columbia Tributaries subbasin.

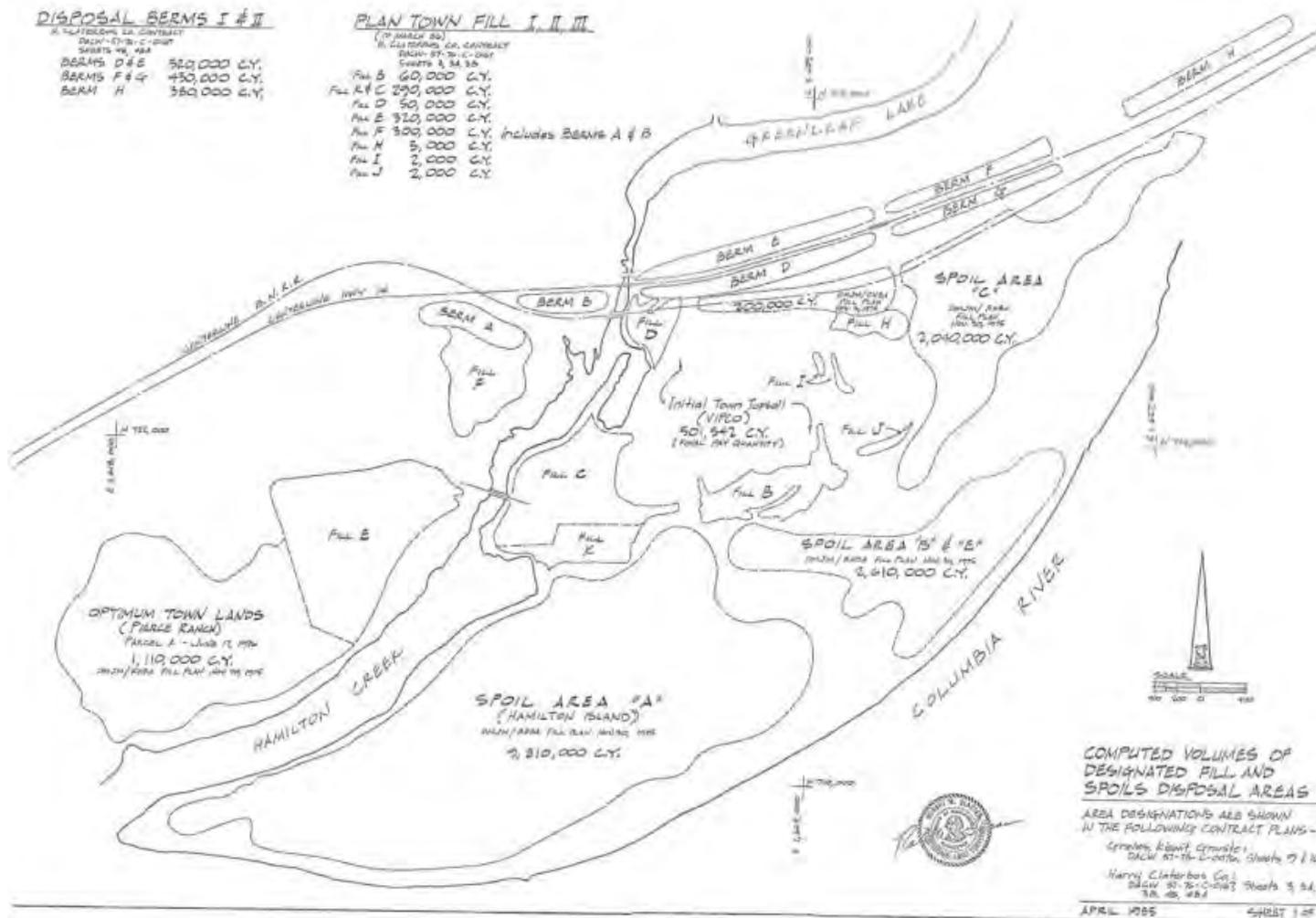
Human activities and development, throughout the watershed and within the City's shoreline jurisdiction, have resulted in alterations or modifications to shorelines. These alterations can change the way shorelines function. The Shoreline Modifications map in Appendix A identifies the shoreline modifications located within the City's shoreline jurisdiction. Manmade alterations began in the early 1900s with the opening of state highway and rail passage through the Columbia River Gorge. The channel width of Hamilton Creek was drastically reduced to allow for bridges to be installed by both the railroad and state highway. The eastern outflow of Greenleaf Lake was filled to allow crossing at that location as well. Hamilton Creek was a meandering seasonal high velocity stream that carried significant bed load that altered the channel depending on the location of the sediments. The constriction of the channel limited accretion from being washed out from the upper channel. This caused significant buildup of sediment to occur above the bridges. Greenleaf Lake once flowed from either end depending on sediment buildup; now the lake could only drain to the west through a choked Hamilton Creek. These factors have caused the creek to become even more seasonal because of the increased buildup as well as a flood hazard to up-channel and Greenleaf Lake shorelines.

Because the stream bed was drier for a longer period of time, migrating fall fish runs were also at risk because of delayed water flow. Greenleaf Lake has and will continue to have sediment buildup with only one outflow that has continued elevation increases. In recent times the Hamilton Creek upper channel has been dredged and banks stabilized to reduce flood risks and allow for stream flow to occur earlier. The lake outflow was also maintained through excavation of excess materials. These maintenance activities will be needed in the future as well if the bridges that constrict the remaining outflow channel are not removed or altered to allow a much wider channel. Hamilton Creek below the bridges has been drastically altered by the extensive filling of the creek channel, as well as the river channel around Strawberry Island for the relocation of North Bonneville in the 1970s by the Corps of Engineers (see photos below). The creek shorelines were narrowed, reinforced and crossed again by two additional bridges consisting of one bridge for the relocated state highway and a bridge for local access in the new city. Most recently, the creek has been modified by channel excavation and redirection as part of fish enhancement projects by the state. This also includes the addition of engineered log jams to recreate native channel conditions since channel widening is not an option. These projects are continuing and are expected to be done and maintained on the entire lower creek.

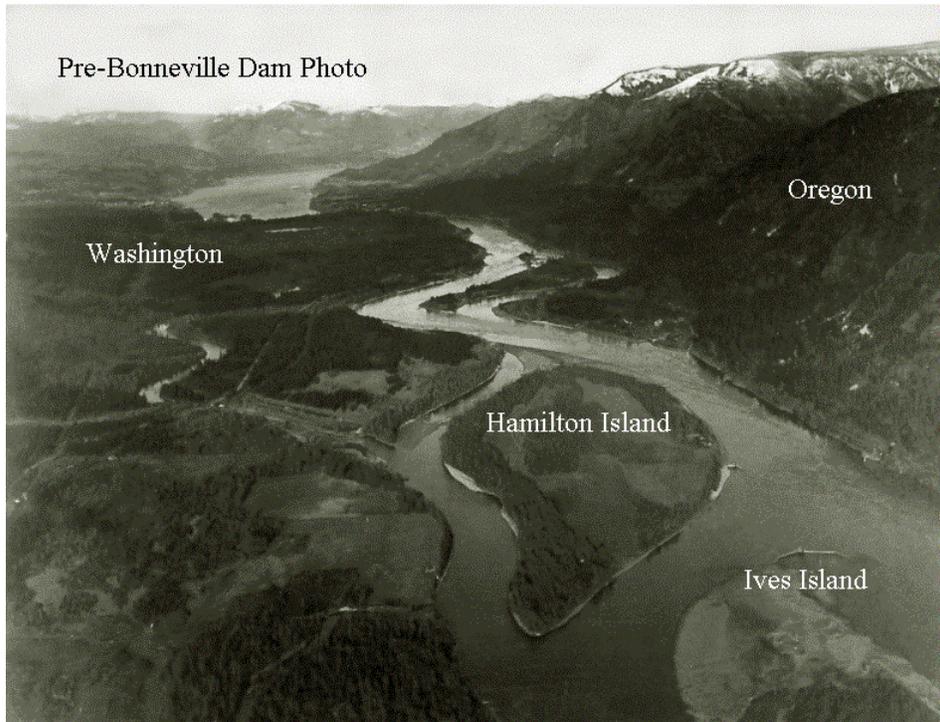
In the 1930s the construction of Bonneville Lock and Dam by the federal government drastically altered the Columbia River. The river banks and island shorelines were dredged and widened to facilitate the project.

Almost all of the shorelines of the Columbia River within the City have been reinforced. The reservoir that was created by the dam flooded numerous land areas as well as eliminating what was known as the Great Rapids just upstream from the dam. The

manmade regulation of downstream river elevations, though reducing flood potential, also negatively affects the scouring action that the native river provided for transporting excess bedload materials from the creeks. Timing of the fish runs is now dependent on when man allows water to flow rather than when nature provided in the past. Fish run mortality because of the dam is and will remain a significant issue. How this and other environmental issues are addressed will determine the future of native fish runs in the future. It is likely that continued proactive intervention to maintain and enhance these resources will be needed.



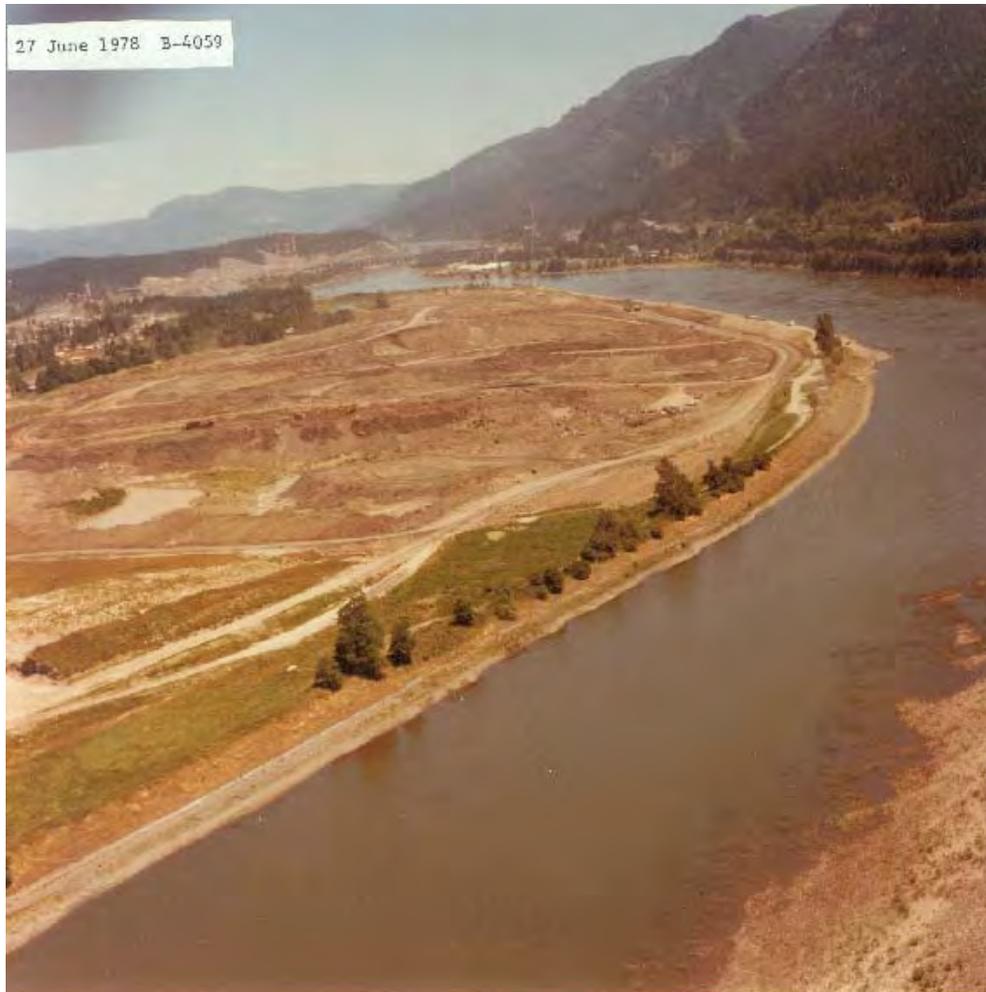
North Bonneville Town Relocation Plan Schematic – April 1965



**Columbia River before Bonneville Dam**



**Columbia River today**



**Filling of Hamilton Island and town site during relocation**

### **3.3.1 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).

### 3.3.2 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.

### 3.3.3 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.

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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).

### **3.3.4 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.

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## 4.0 Reach Inventory and Analysis

### 4.1 Reach 1 – Lower Hamilton Creek and Floodplain

#### 4.1.1 Reach Characterization

Reach 1 contains the downstream portion of Hamilton Creek from south of the railroad to the southern city boundary and the 100-year floodplain area associated with the Columbia River within the city boundary. As shown in Exhibit 4, the floodplain area in Reach 1 is bounded by the railroad to the north and the city boundary to the west. This reach contains 287 acres in shoreline jurisdiction and 2.5 miles of shoreline.

Hamilton Creek is one of the largest and most productive drainage systems in the Lower Columbia River Tributaries subbasin. Hamilton Creek originates near Three Corner Rock, a mountain pillar located in Skamania County. The creek flows south for approximately 8 miles and drains into the Columbia River at River Mile (RM) 143. Hamilton Creek has two named tributaries (Greenleaf Creek and Cedar Creek) and a number of smaller tributaries. Though almost dry in the summer months, it carries significant amounts of water during the rainy season. Over the years with transportation crossings and the relocation of the town, filling and diking have changed a wide meandering stream into a narrow channel that cannot adequately handle its peak velocities without manmade improvements. Accretion buildup within the channel and potential bank erosion are also a result of the altered channel.

Within Reach 1, Hamilton Creek runs for approximately 1.4 miles from the railroad, flowing through the residential area bordered by over 200 feet of City-owned open space along the shorelines. The Columbia River 100-year floodplain is also encompassed by shoreline jurisdiction and included in this reach. Within the floodplain area, Hardy Creek runs near the western city boundary and enters the Columbia River at RM 142.

The reach is relatively flat and separated from upstream, steeper gradient reaches by the railroad. Soils within the reach are primarily composed of McBee silt loam, Pilchuck very fine sandy loam, and Arents, 0 to 5 percent slopes (USDA NRCS 2011). Fine sediments have been observed in Hardy Creek, which has been a concern to local biologists (LCFRB 2010). According to the 2008 Washington State Water Quality Assessment (Ecology 2011), Hamilton Creek and Hardy Creek are not listed on the Category 5 [303(d)] list. However, the upstream reach of Hamilton Creek outside of the city limits has been listed as a Category 2 (water of concern) for temperature.

#### 4.1.2 Biological Resources

According to the NWI, most wetlands are located along Hamilton Creek and Hardy Creek within Reach 1. Areas along Hamilton Creek are primarily mapped as wetlands for most of the length of the stream. Wetlands found in this reach are typically riverine wetlands with palustrine emergent, scrub-shrub, and forest habitat types. Cottonwood and alder trees as well as native and non-native shrubs (Himalayan blackberry) are observed in the wetland areas. There are approximately 31 acres of wetlands that are mapped by NWI within Reach 1. Wetlands along both streams likely support aquatic habitat by providing sources of food, shelter, and refuge.



**View of Lower Hamilton Creek facing downstream (summer dry season)**



**View of Upper Hamilton Creek facing upstream (winter wet season)**

The City's critical area map classifies Hamilton Creek and Hardy Creek as fish bearing (Type F) streams. According to the PHS data, lower Hamilton Creek and Hardy Creek in Reach 1 support fall Chinook, coho, and chum salmon, winter steelhead, and resident cutthroat (WDFW 2011). Lower reaches of Hamilton Creek were reported to have minimal LWD but have relatively good pool habitat and side channel habitat, which provide good spawning and rearing habitat (Wade 2001). However, riparian condition in this reach is considered impaired in this reach due to lack of coniferous cover (LCFRB 2010).

Spawning habitat for fall Chinook has been documented at the lower reaches of Hamilton and Hardy creeks with peak spawning occurring in October (LCFRB 2010). Hamilton and Hardy creeks in this reach are also known to support good spawning habitat for chum salmon, and the spawning areas have been monitored by USFWS and WDFW personnel every year (Wade 2001). Peak spawning for Chum salmon occurs in mid-December and continues into January (LCFRB 2010). Coho salmon and winter steelhead are also reported to utilize this reach for spawning. Adult steelhead migrate to Hamilton Creek between December and April and spawning occurs primarily in the lower 2 miles of Hamilton Creek from early March to early June (LCFRB 2010). Pacific lamprey and western toad are also reported to be present in and/or near Hardy Creek (WDFW 2011).

No bald eagle nests are located within the city limits; however, they are located in the vicinity along the Columbia River, and bald eagles likely use the area as foraging habitat. The PHS map also identifies the majority of the reach as the bald eagle regular concentration and wintering area (WDFW 2011).

The western portion for Reach 1 is located within Pierce National Wildlife Refuge, which is a 329-acre of a wildlife sanctuary along the north shore of the Columbia River. The refuge provides wintering habitat for waterfowl such as Canada geese, ducks, and other aquatic birds. Wetlands within the refuge provide habitat for western pond turtles as well.

Frequently flooded areas are defined in the City of Bonneville Municipal Code as "floodplains and other areas subject to a one (1.0) percent or greater chance of flooding in any given year (NBMC 21.10.020). These areas are typically identified on the Federal Emergency Management Agency (FEMA) flood insurance rate maps as the 100-year floodplain. Within Reach 1, the 100-year floodplain of the Columbia River extends up to the highway. The 100-year floodplain of the lower portion of Hamilton Creek is primarily confined to the river channel. Residential houses are located adjacent to the floodplain area.

#### **4.1.3 Land Use and Shoreline Modifications**

Within Reach 1, Hamilton Creek runs through the City center. Almost all of this shoreline has been altered with the filling of the area, channel alterations and infrastructure added for the relocation of North Bonneville in the 1970s. The City owns much of the land immediately adjacent to the creek; this area is zoned as Open Space Preserve (see Appendix A for open space and federal ownership maps). Beyond this open space, several public facilities are located to the east of Hamilton creek, including City Hall, the library, post office, public parks, and a senior living facility. The City's central business district is also located to the east of Hamilton Creek, outside of the shoreline jurisdiction. Two vacant commercial properties adjacent to a gas station and convenience store are located within the shoreline jurisdiction near Hamilton Creek just below the railroad bridge crossing. There are also developed residential areas located to the east and west of Hamilton Creek, with a few parcels located within the shoreline jurisdiction. Shoreline uses in this reach include residential and recreation uses. Other than the two vacant commercial lots, limited future development along this reach is expected.

Recent restoration activities were conducted by the Lower Columbia Fish Enhancement Group (LCFEG) along both sides of Hamilton Creek (see Exhibit 4). This restoration project added log jams in the stream channel to create pools and a branching island network, as well as to sort spawning gravels and stabilize eroding banks. Small areas of rip rap are located at either end of the restored shoreline area. This includes a portion recently repaired by the city to protect the path just south of the railroad bridge as well as excavation of excess channel material around and under the Highway 14 bridge. Two stormwater outfalls have also been installed at the south end of the creek as part of the USACE project.

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. The portion of this floodplain area that is outside the refuge is zoned by the City for Commercial Recreation, and is part of the Beacon Rock Golf Course.

Cascade Drive generally follows along the east side of Hamilton Creek and then crosses the creek to allow access to the residential areas on the west side of the creek. At the bridge crossing there is informal public access to the Creek on either side of the bridge. Direct and safe public access in this reach is and should be very limited due to topography, stream flows, channel makeup and the intrusion into sensitive environmental areas. The heritage trail system also provides visual access to Hamilton Creek within this reach (see Appendix A for Heritage Trails Map). Pierce National Wildlife Refuge is closed to the general public.

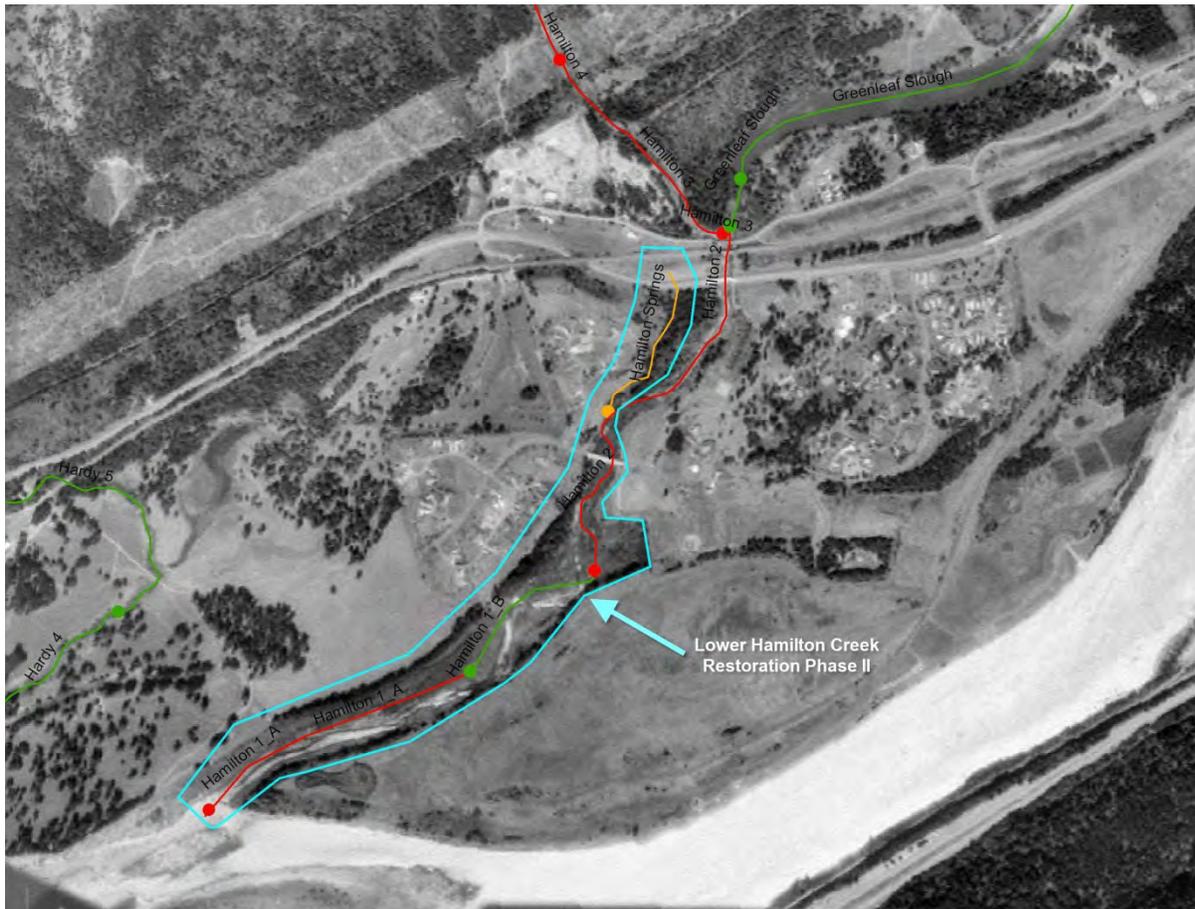
There are no known archaeological or historic resources within this reach.

#### **4.1.4 Restoration Opportunities**

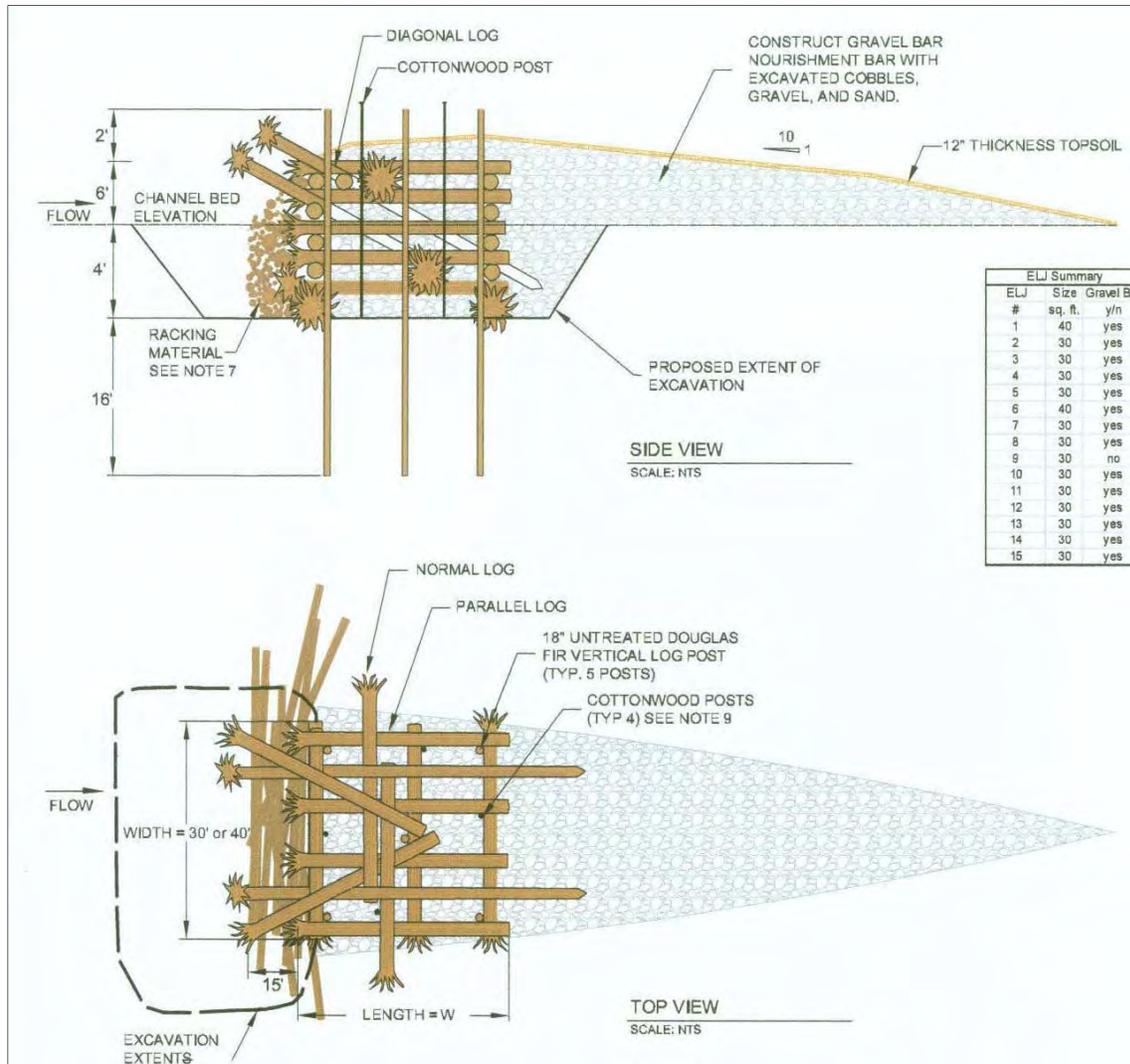
The Habitat Limiting Factors Report (2001) suggested protecting chum spawning areas in Hamilton and Hardy Creeks, and LCFRB describes both streams as one of the most productive populations for Chum salmon remaining in the Columbia basin (2010). As described above, restoration activities have been completed in 2011 by LCFEG. LCFEG was awarded a grant to restore a portion of the lower Hamilton Creek located immediately downstream from the railroad bridge. Native woody species were also planted along the channel to increase shade, help stabilize the stream bank, and promote recruitment of woody debris. Ongoing maintenance and monitoring for controlling non-native species such as Himalayan blackberry and red canarygrass and expansion of the restoration efforts would be recommended in this area.

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.



Channel Restoration Map



Typical Engineered Log Jam



### **Lower Hamilton Creek Restoration Project**

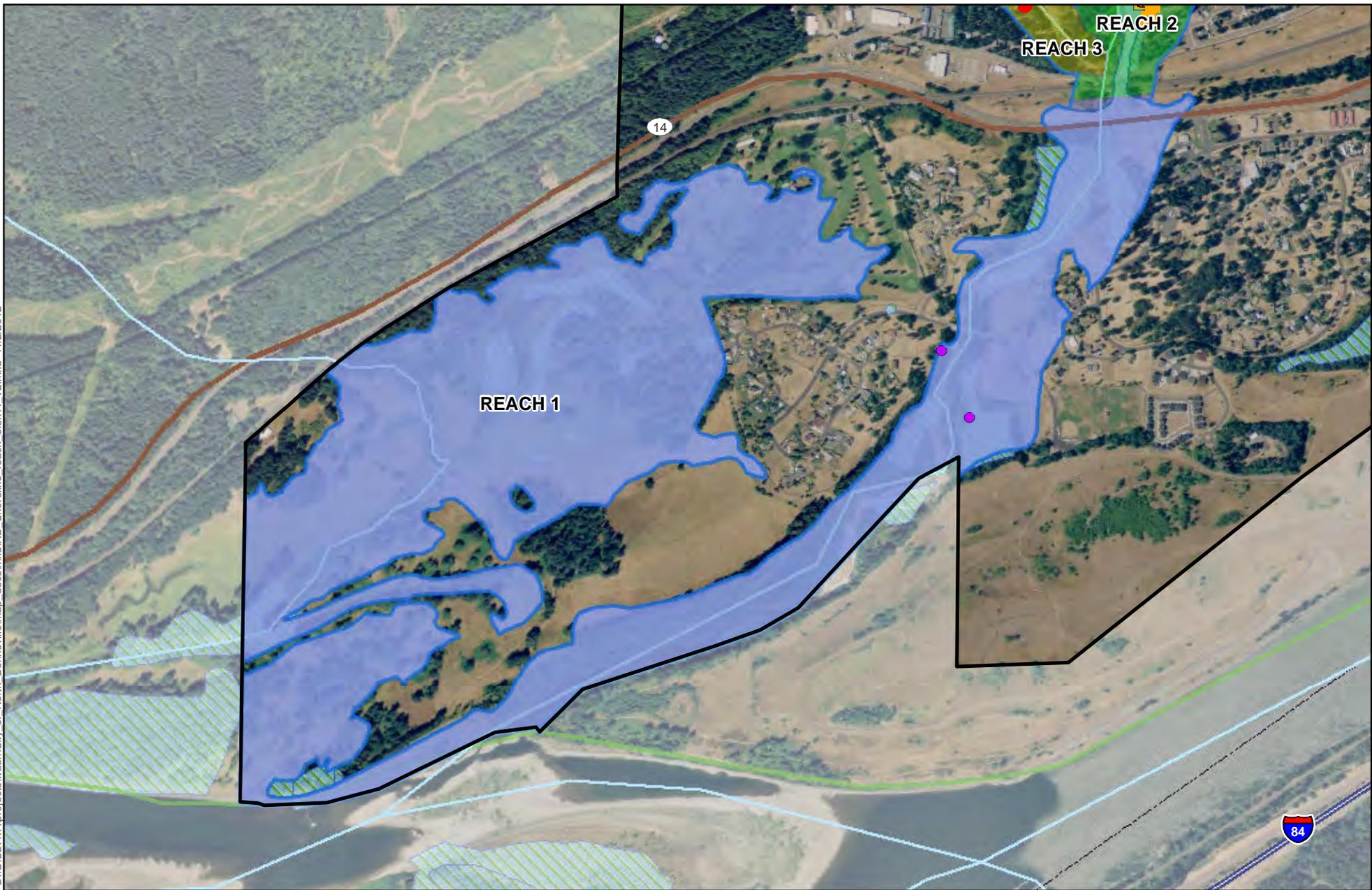
Degradation of floodplain connectivity and constriction of channel migration zones along Hamilton Creek is largely due to Highway 14 and the railroad bridge. Regulating new development activities in the floodplains would prevent further degradation of floodplain connectivity. Though there are no 303(d) listings for temperature in lower Hamilton and Hardy creeks, water temperature in both streams have been recorded to exceed the standard regularly, which are likely related to riparian degradation. Planting native woody species along the channel would improve stream temperature impairments.

Although some properties are privately owned, the City owns over 200 feet of open space from the shoreline on a majority of the reach.. The Pierce Wildlife National Refuge will continue to protect this area, and protection and enhancement of the rest of the open space including wetland areas would further help maintain good quality of refuge habitat for juvenile salmonids as well as other wildlife.

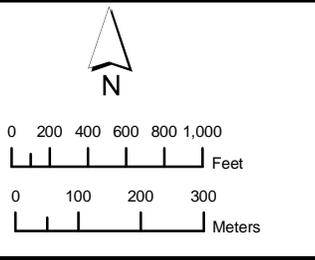
It is possible that future development of areas zoned for Commercial (only two lots over 50 feet from shoreline) and Residential uses (over 200 feet from shoreline) could result in potential impacts to shoreline functions in this reach. The use of Best Management Practices as part of future development could reduce the potential for impacts to the shoreline.

As mentioned above, a portion of this reach is part of the Pierce National Wildlife Refuge. Collaboration with the Refuge would be required for any conservation or restoration activities in this portion of the reach. 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).

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<b>LEGEND</b>	<b>Commercial Structures</b>	Within 0-50 feet from Shoreline	Outfalls	City Limits
	Within 50-100 feet from Shoreline	Private Docks	Shorelands	FEMA Floodway (FIRM Zone A)
	Within 100-200 feet from Shoreline	Public Boat Launch	Shorelines of the State	Shorelines of State-Wide Significance
	<b>Residential Structures</b>	Within 0-50 feet from Shoreline	<b>Reaches</b>	Wetlands
	Within 50-100 feet from Shoreline	Reach 1	Reach 2	
	Within 100-200 feet from Shoreline	Reach 3	Reach 4	
		Reach 5		



### Exhibit 4 – Lower Hamilton Creek and Floodplain (Reach 1)

City of North Bonneville  
Shoreline Master Program Update  
November 2012



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## 4.2 Reach 2 – Greenleaf Lake

### 4.2.1 Reach Characterization

Reach 2 consists of Greenleaf Lake from the confluence of Greenleaf Creek to the confluence of Hamilton Creek and a downstream portion of Carpenter Creek. Exhibit 5 identifies this reach. The shoreline jurisdiction of Carpenter Creek extends 2,100 feet upstream from the confluence of Greenleaf Lake. The Greenleaf Lake shoreline is approximately 150 acres in size and includes approximately 16,000 feet of shoreline.

Greenleaf Lake is located downstream of Greenleaf Creek and was likely once an overflow channel for the Columbia River that was disconnected as a result of the construction of Bonneville Dam (Wade 2001). The lake that once drained on either end now only flows west into Hamilton Creek. Because of the modification, flow within the lake is sluggish, likely contributing increase in water temperature as well as accumulated accretion.



#### View of Greenleaf Lake near the mouth of Greenleaf Creek

Soils within the reach include: Pilchuck very fine sandy loam, Bonneville stony sandy loam, and Steever stony clay loam, 30 to 65 percent slopes (USDA NRCS 2011). According to the 2008 Washington State Water Quality Assessment (Ecology 2011), Greenleaf Lake and Carpenter Creek are not listed on the Category 5 [303(d)] list. Banks range from gentle sandy slopes on the far western portion of the lake to steep sandy slopes of five to ten foot on a majority of the banks.

#### 4.2.2 Biological Resources

Within the Greenleaf Lake reach, there are approximately 42 acres of riverine wetlands that are associated with Greenleaf Lake and Carpenter Creek according to the NWI. Wetlands found in this reach generally include palustrine emergent, scrub-shrub, and forest habitat types. Wetlands located along Greenleaf Lake and Carpenter Creek likely support aquatic habitat by providing sources of food, shelter, and refuge. The common vegetation observed in the reach include rush, willows, Himalayan blackberry, alder and fir trees. The alder trees are quite mature and many are dead or dying with limited regrowth of new canopy.

The City's critical area map classifies Greenleaf Lake and Carpenter Creek as fish bearing (Type F) streams. Greenleaf Lake provides a transportation corridor and rearing habitat for coho and chum salmon, winter steelhead, rainbow trout, and resident cutthroat, and Carpenter Creek is documented to support resident cutthroat. However, the potential for rearing habitat in the lake is limited by resident bass, other predator species, and perhaps by temperature.

The PHS data and the City's critical area map also identify oak woodlands at the confluence of Carpenter Creek with Greenleaf Lake. The habitat is approximately 27 acres in size. Oregon white oak (*Quercus garryana*), the only native oak present in Washington, is known to provide habitat for a variety of birds, mammals, reptiles, and amphibians, as well as providing aesthetic, economic, and recreational values to the Washington citizens (Larsen and Morgan 1998). Distribution of Oregon white oak woodland is known to be limited and declining due to conversion to agriculture and urban and suburban development (Larsen and Morgan 1998; Vesely and Rosenberg 2010).



**Oak woodland at the confluence of Carpenter Creek**

Geological hazard areas are areas “that because of the susceptibility to erosion, sliding, earthquake, or other geological events, are not suited to siting commercial, residential, or industrial development consistent with public health or safety concerns”(NBMC 21.10.020). Geological hazard areas include erosion, landslide, mine, seismic, and volcanic hazard areas. According to the City of North Bonneville Critical Areas Map, Reach 2 includes approximately 13 acres of geologic hazard areas that are located north of Cascade Drive. Flood hazard areas are also mapped in the City’s Critical Areas Map, and the mapped floodplain for Greenleaf Lake is relatively narrow and confined to the channel. Development within geologic hazard areas would require special study.

#### 4.2.3 Land Use and Shoreline Modifications

The approximate 16,000-foot shoreline of Greenleaf Lake is a mixture of 42% usable private ownership, 21% federal owned and/or used by the BPA, 19% city street easement and 18% city open space.

The north shoreline of Greenleaf Lake and the portion of Carpenter Creek included in the shoreline jurisdiction are bordered by mostly private property, with the exception of the easement for the BPA transmission line that crosses the lake. Existing land use is primarily residential. Most of property on the north shoreline of the lake is vacant and zoned for Commercial Recreation, with some parcels zoned for Single Family Residential at the east end of the lake. Shoreline uses in this area include residential and recreation uses. Significant future development of the north shore is expected, but the mix of residential to commercial recreation is unknown.

On the south shoreline of Greenleaf Lake, the City owns approximately 2,400 feet of the shoreline; this area is zoned as Open Space. Another portion of the south shoreline toward the east end of the lake is federally owned and occupied by BPA substation. There are also private residential lots located on the south shoreline toward the west end of the lake. This area is zoned for Mixed Use and is almost fully developed. Private shoreline uses in this area include residential and recreation uses.

Private shoreline modifications in this reach consist primarily of private residential docks on the lake, and residential landscaping near the shoreline. Most of the shoreline development in North Bonneville has occurred on Greenleaf Lake (see Exhibit 5) with residences increasing from 9 in 1980 to 22 currently. All but one is located over 50 feet from the shoreline.

Extensive shoreline clearing is maintained by the BPA for transmission lines with over 1800 feet of the shoreline brushed and shoreline development from 50 feet to 200 feet accounting for an additional 1,600 feet. The city road East Cascade Drive runs along 3,000 feet of the shoreline on the north side of the lake. There are some sugar dikes located at the south end of the lake at the confluence with Hamilton Creek.

The City owns a parcel at the eastern end of Greenleaf Lake which is used as a public access boat launch and for access for fishing in the lake (see Exhibit 5). This parcel provides the primary public access point to Greenleaf Lake. The active use of the lake is primarily by paddlers and fishermen. Concern about conflict with sensitive shoreline habitat areas and users has been an issue. The heritage trail system also provides access to the boat launch (see Appendix A for Heritage Trails Map). The City owns another parcel on the south shoreline of the lake that could potentially be developed for public access in the future as a fishing dock. City code prohibits motorized watercraft (excepting electric trolling motors) from use on Greenleaf Lake.

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There are known archaeological sites within this reach. It is possible that some portion of these sites may extend into the shoreline jurisdiction.

#### **4.2.4 Restoration Opportunities**

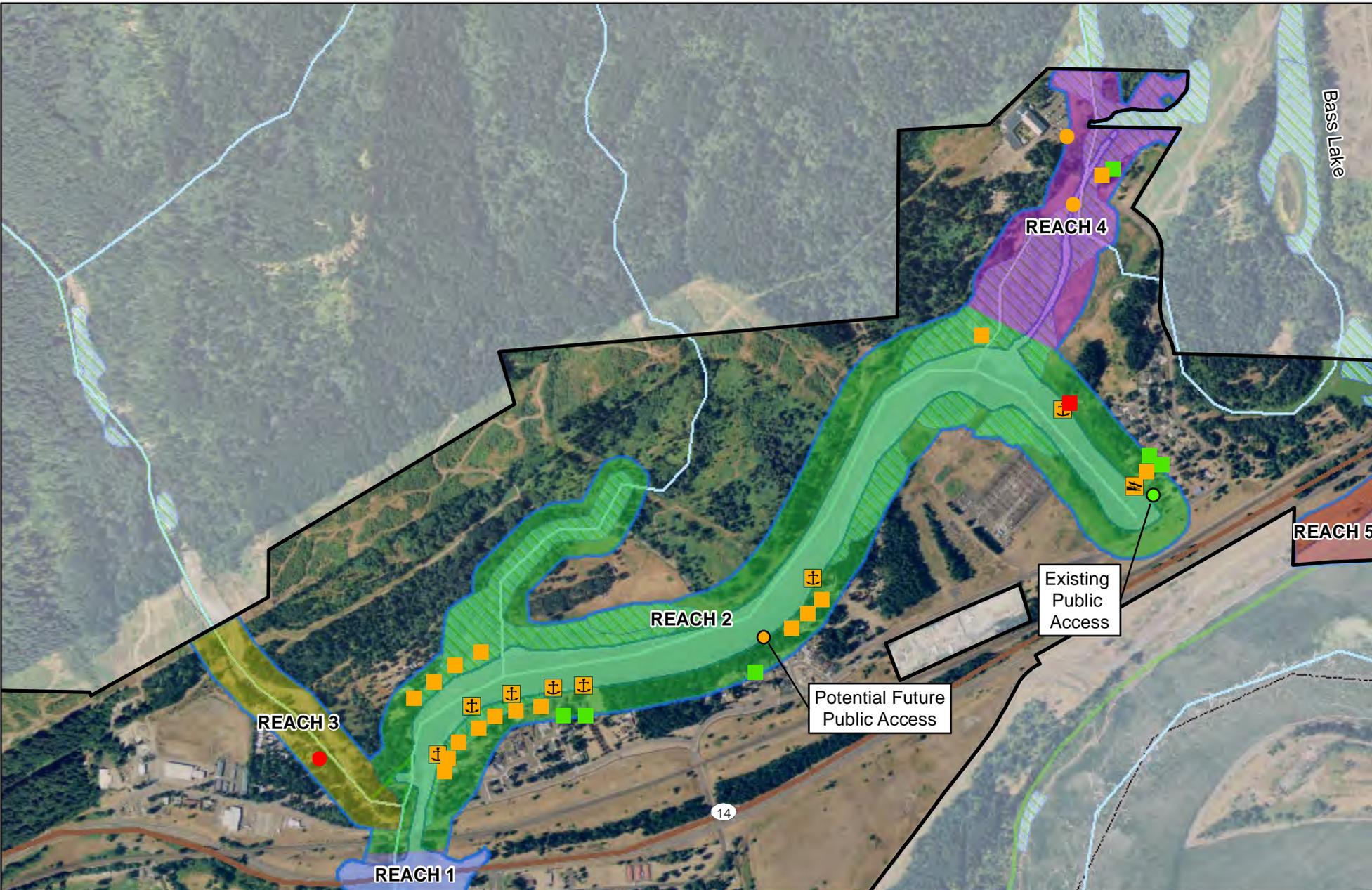
There are no proposed restoration sites along the Greenleaf Lake. Because most properties within this reach are privately owned and occupied, opportunities for restoration are limited without property owner's involvement or property acquisition. Conservation or restoration activities, especially for oak woodlands areas, would be recommended through a community education and incentive program to inform property owners on ways to minimize impacts to fish and wildlife habitat areas or enhance the reach with native landscaping and invasive species removal. Conservation or restoration activities for in-stream habitat, riparian buffer, floodplain, and wetlands are also encouraged in this reach.

Protection and restoration of forested riparian areas and existing wetland habitat within the reach would also be recommended to minimize sedimentation and water quality concerns downstream. Protecting the existing wetlands in Reach 2 would help maintain summer base flow and flood storage as well as preserving habitat for wildlife.

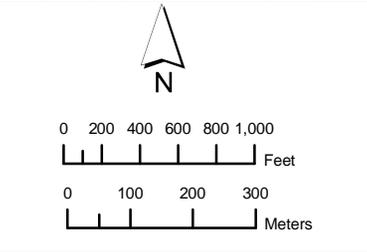
It is possible that future development of areas zoned for Commercial Recreation and Residential uses could result in potential impacts to shoreline functions in this reach. The use of Best Management Practices buffer exchanges and enhancements as part of future development could reduce the potential for impacts to the shoreline.

As described above, 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.

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LEGEND	
<b>Commercial Structures</b>	<b>Reaches</b>
● Within 0-50 feet from Shoreline	Reach 1
● Within 50-100 feet from Shoreline	Reach 2
● Within 100-200 feet from Shoreline	Reach 3
<b>Residential Structures</b>	Reach 4
■ Within 0-50 feet from Shoreline	Reach 5
■ Within 50-100 feet from Shoreline	
■ Within 100-200 feet from Shoreline	
● Outfalls	City Limits
⚓ Private Docks	Shorelands
⚓ Public Boat Launch	FEMA Floodway (FIRM Zone A)
	Shorelines of the State
	Shorelines of State-Wide Significance
	Wetlands



**Exhibit 5 – Greenleaf Lake, Upper Hamilton Creek, and Greenleaf Creek (Reaches 2, 3, and 4)**  
 City of North Bonneville  
 Shoreline Master Program Update  
 November 2012  


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## 4.3 Reach 3 – Upper Hamilton Creek

### 4.3.1 Reach Characterization

Reach 3 includes the upper Hamilton Creek area extending upstream from the confluence of Greenleaf Lake to the northern city boundary (Exhibit 5). The Upper Hamilton Creek reach contains approximately 18 acres in shoreline jurisdiction and 4,100 feet of shoreline, primarily between the BPA transmission line and the railroad.

Hamilton Creek is one of the tributaries of the Columbia River that are intermittent or have subsurface flow during summer months (Wade 2001). However, steep upper reaches of the creek create high water flows during the heavy rain seasons. During the site visit in September 2011, no surface water was observed within this reach of Hamilton Creek. However, water flow was observed later of the year in December 2011.



**View of Upper Reach of Hamilton Creek facing upstream from the road bridge (September 20, 2011)**



**View of Upper Reach of Hamilton Creek facing upstream from the road bridge  
(December 9, 2011)**

This reach of Hamilton Creek has been diked and disconnected from its floodplain due to the need to protect existing infrastructure. Historically, alterations of the stream channel and riparian conditions upstream of the highway have caused accumulation of sediments and large bedloads. In the late 1970s, containment levees were constructed along Hamilton Creek upstream from the railroad bridge (LCFEG 2010). According to the Habitat Limiting Factors Report (2001); there are over 17 miles of roadways located adjacent to streams, which are also likely the cause of fine sediment inputs downstream. The stream channel in this reach has historically been dredged to prevent downstream flooding (LCFEG 2010). In addition, narrowed channels along SR 14 and the railroad restrict the movement of coarse sediments downstream. Sedimentation presents an ongoing threat to infrastructure in this reach.



**Upper Creek Flooding 2006 Prior to Dredging**



**Lake Flooding 2006 Prior to Dredging of Channel**

Soils within the reach are primarily Bonneville stony sandy loam (USDA NRCS 2011). According to the 2008 Washington State Water Quality Assessment (Ecology 2011), Hamilton Creek is not listed on the Category 5 [303(d)] list. However, the upstream reach of Hamilton Creek outside of the city limits has been listed as a Category 2 (water of concern) for temperature.

#### 4.3.2 Biological Resources

The City's critical area map classifies Hamilton Creek as a fish bearing (Type F) stream. Hamilton Creek in Reach 3 provides rearing habitat for Chinook, coho, and chum salmon, winter steelhead, and resident cutthroat (WDFW 2011). This reach of Hamilton Creek has also been documented to support spawning habitat for coho salmon and winter steelhead, and LCFRB described the upper Hamilton reach is in relatively good condition (LCFRB 2010). No other priority habitat or species are identified in this reach.

Early coho spawning have been documented to occur from mid-October to mid-November and late coho from mid-November to March. Peak spawning occurs in December to early January for late stock coho and from late October to mid-November for early stock coho (LCFRB 2010). Winter steelhead is also documented to spawn in lower 2 miles of Hamilton Creek from early March to early June (LCFRB 2010). LWD levels in this reach are reported to be low although riparian conditions in this reach are rated as functional (LCFRB 2010).

The NWI shows this reach as riverine upper perennial unconsolidated shore system; however, HDR biologist did not see any characteristic of a wetland in this reach. With the exception of some fir and cedar trees, alder and cottonwood trees with native and non-native shrubs (Himalayan blackberry) are commonly observed in this reach.

According to the City's Critical Areas Map, Reach 3 includes approximately 0.8 acre of geologic hazard areas that are located on the east bank of the stream channel and north of the transmission line corridor.

#### 4.3.3 Land Use and Shoreline Modifications

The upper portion of Hamilton Creek runs through mostly private land, with one shoreline parcel at the northwest end of the reach owned by Skamania County. Most of the land in this reach is zoned for Commercial Recreation; the County parcel is zoned for Industrial/Business Park (see Appendix A for zoning map). A recreational vehicle park is located adjacent to the shoreline. The shoreline in this reach has been modified by the installation of sugar dikes to control flooding. These dikes were developed to protect existing infrastructure. Channel maintenance by dredging of excess bed materials in this reach has also been performed periodically over the last 40 years. The BPA and gas company also maintain 300feet of the shoreline as cleared utility easement. The reach extends to Evergreen Drive and the railroad bridge crossings to the south. Existing shoreline use in this reach is commercial recreation that is not necessarily water dependent, but utilizes the shoreline location as a draw. Future industrial or commercial development could result in additional shoreline uses on the west bank. Future development on the east bank could consist of residential and/or commercial recreation.

At the Evergreen Drive bridge crossing there is informal public access to the Creek on either side of the bridge. However, the high channel banks, as well as loose cobble materials makes public access hazardous. The drastic difference between stream flows and channel depths also creates little opportunity for uses other than viewing and some limited fishing along the reach. The heritage trail system does provide visual access to Hamilton Creek within this reach (see Appendix A for Heritage Trails Map).

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There are no known archaeological or historic resources within this reach.

#### **4.3.4 Restoration Opportunities**

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. However, potential opportunities for restoration in reach 3 are still available within the city, which include, but are not limited to, restoring riparian buffer with native trees and shrubs and remove non-native species. Potential buffer plant species are limited due to the nature of the bank composition.

As well as Reach 1, restoration of floodplain functions and channel migration processes are recommended in Reach 2. The levee along the stream channel can be set back or removed to allow for channel migration and to improve connection between the stream channel and the downstream floodplain. Within this reach, floodplain restoration would not be feasible without also removing the existing stream restrictions such as the transportation bridges.

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.

## 4.4 Reach 4 – Greenleaf Creek

### 4.4.1 Reach Characterization

Reach 4 extends from the northern city boundary along Greenleaf Creek to the confluence of Greenleaf Lake (Exhibit 5). This reach contains approximately 31 acres in shoreline jurisdiction and approximately 6,400 feet of shoreline. Reach 4 contains a mature forested riparian corridor with relatively good pool habitat and substrate conditions.

Greenleaf Creek originates near Greenleaf Peak and Table Mountain located in Skamania County. The creek flows south for approximately 2.8 miles and enters Greenleaf Lake. Several small lakes outside the city limits drain to Moffett Creek, which is tributary to Greenleaf Creek. Within Reach 4, Greenleaf Creek runs for approximately 3,200 feet from the northern city limits. Greenleaf Creek is the largest tributary of Hamilton Creek.

Soils within the reach are primarily stony clay loam, 2 to 30 percent slopes (USDA NRCS 2011). Steep slopes occur upstream of the city limits, where Greenleaf Creek crosses a series of falls before entering the city; the falls present a natural fish passage barrier. According to the 2008 Washington State Water Quality Assessment (Ecology 2011), Greenleaf Creek is not listed on the Category 5 [303(d)] list. Stream banks are steep with elevations from 4-10 feet in the lower channel. The stream runs all year with high water during the wet season. High water erosion is an issue but there is woody debris and beaver dams in the lower channel that helps dissipate the flow. Sedimentation buildup has also occurred in recent years due to slides in the far upper reaches outside the city limits.



**Greenleaf Creek looking downstream from Bridge**

#### 4.4.2 Biological Resources

Within Reach 4, there are approximately 21 acres of riverine wetlands that are associated with Greenleaf Creek according to the NWI. Wetlands found in this reach are typically forest habitat types and likely support habitat for salmonid species that utilize Greenleaf Creek in this reach. The common vegetation observed in this reach are alder trees, willows, and native and non-native shrubs.

The City's critical area map classifies Greenleaf Creek as a fish bearing (Type F) stream. Greenleaf Creek provides rearing habitat for coho and chum salmon, winter steelhead, rainbow trout, and resident cutthroat. Spawning habitat for coho salmon and winter steelhead are also documented to occur in Greenleaf Creek, and according to LCFRB the Greenleaf Creek contains good quality habitat (LCFRB 2010). No other priority habitat or species are identified in this reach.

According to the Habitat Limiting Factors Report (2001), substrates in Greenleaf Creek are in fair to good condition. Most parts of the Greenleaf Creek banks appear to be stable; however, there are some unstable areas at the upper reaches of Greenleaf Creek. Riparian conditions of Greenleaf Creek are relatively good, but LWD levels are documented to be low at this reach. Large Woody Debris and side channel habitat is limited within the upper reaches of Greenleaf Creek outside the city limits (Wade 2001).

The 100-year floodplain of Greenleaf Creek extends approximately 1,800 feet upstream from the confluence of Greenleaf Lake. It is relatively confined to the stream channel.

#### 4.4.3 Land Use and Shoreline Modifications

Greenleaf Creek runs through private land that is zoned primarily for Commercial Recreation; one small area on the east side of the creek is zoned for Single Family Residential and has two residences within the shoreline (see Appendix A for zoning map). Parts of the Bonneville Hot Springs Resort are located within the shorelines on the west bank near the north end of this reach. There has been extensive canopy removal and some filling of wetland just below the bridge that was done as part of an incomplete commercial development. Shoreline uses in this reach include residential and commercial recreation uses. A majority of the reach is undeveloped canopied wetland and will remain as such with existing regulations.

East Cascade Drive crosses Greenleaf Creek near Bonneville Hot Springs Resort. There are no other identified shoreline modifications in this reach. The heritage trail system provides visual access to Greenleaf Creek within this reach at the bridge (see Appendix A for Heritage Trails Map).

There are no known archaeological or historic resources within this reach.

#### 4.4.4 Restoration Opportunities

Similar to Reach 2, 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. Conservation or restoration activities for in-stream habitat, riparian buffer, floodplain, and wetlands, would be recommended through a community education and incentive program to inform property owners on ways to minimize impacts to fish and wildlife habitat areas or enhance the reach with native landscaping and invasive species removal.

Protection and restoration of forested riparian areas and existing wetland habitat within the reach would also be recommended to minimize sedimentation and water quality

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concerns downstream as well as preservation of habitat. Protecting the existing wetlands in Reach 2 would help maintain summer base flow and flood storage as well as preserving habitat for wildlife.

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.

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## 4.5 Reach 5 – Columbia River

### 4.5.1 Reach Characterization

Reach 5 contains a portion of the Columbia River at the Bonneville Dam (Exhibit 6). This reach contains approximately 31 acres in shoreline jurisdiction and approximately 1.9 miles of shoreline. Reach 5 is located within the city limits; however, the USACE owns and manages the entire reach.

Soils within the reach include: Arents, 0 to 5 percent slopes, Bonneville stony sandy loam, and Steever stony clay loam, 30 to 65 percent slopes (USDA NRCS 2011). According to the 2008 Washington State Water Quality Assessment (Ecology 2011), this portion of the Columbia River listed on the Category 5 [303(d)] list for temperature.

The Columbia River is one of the largest rivers in North America, draining 258,000 square miles in Washington and Canada to its mouth on the Pacific Ocean near Astoria, Oregon (NWPPCC 2011). The portion of the Columbia River that lies within the city is a 4,300-foot stretch between approximately river miles (RM) 145 and 148 at the Bonneville Dam. Exhibit 6 identifies this reach. Upstream of the dam, the river flows through a gorge, and it opens up to a wide estuary at downstream of the dam. As mentioned and detailed earlier in this document, this portion of the river has had extensive alteration by man in the last one hundred years. It doesn't resemble what was here before the alterations. The river shoreline development, banks, channels, flows and habitat are controlled by man through the federal government. River flows have been maintained and regulated at the Bonneville Dam, which have been reported to result in changes to mean flow and peak flow values over time (NMFS 2011).

### 4.5.2 Biological Resources

The Columbia River provides habitat for Chinook salmon, chum salmon, coho salmon, sockeye salmon, and Pacific eulachon. The Columbia River within the study area is designated critical habitat for all of the anadromous salmonid populations, except for coho salmon. Critical habitat for the lower Columbia River coho salmon has not been designated at this time and is currently under review. These anadromous fish primarily use the Columbia River as rearing and migration.

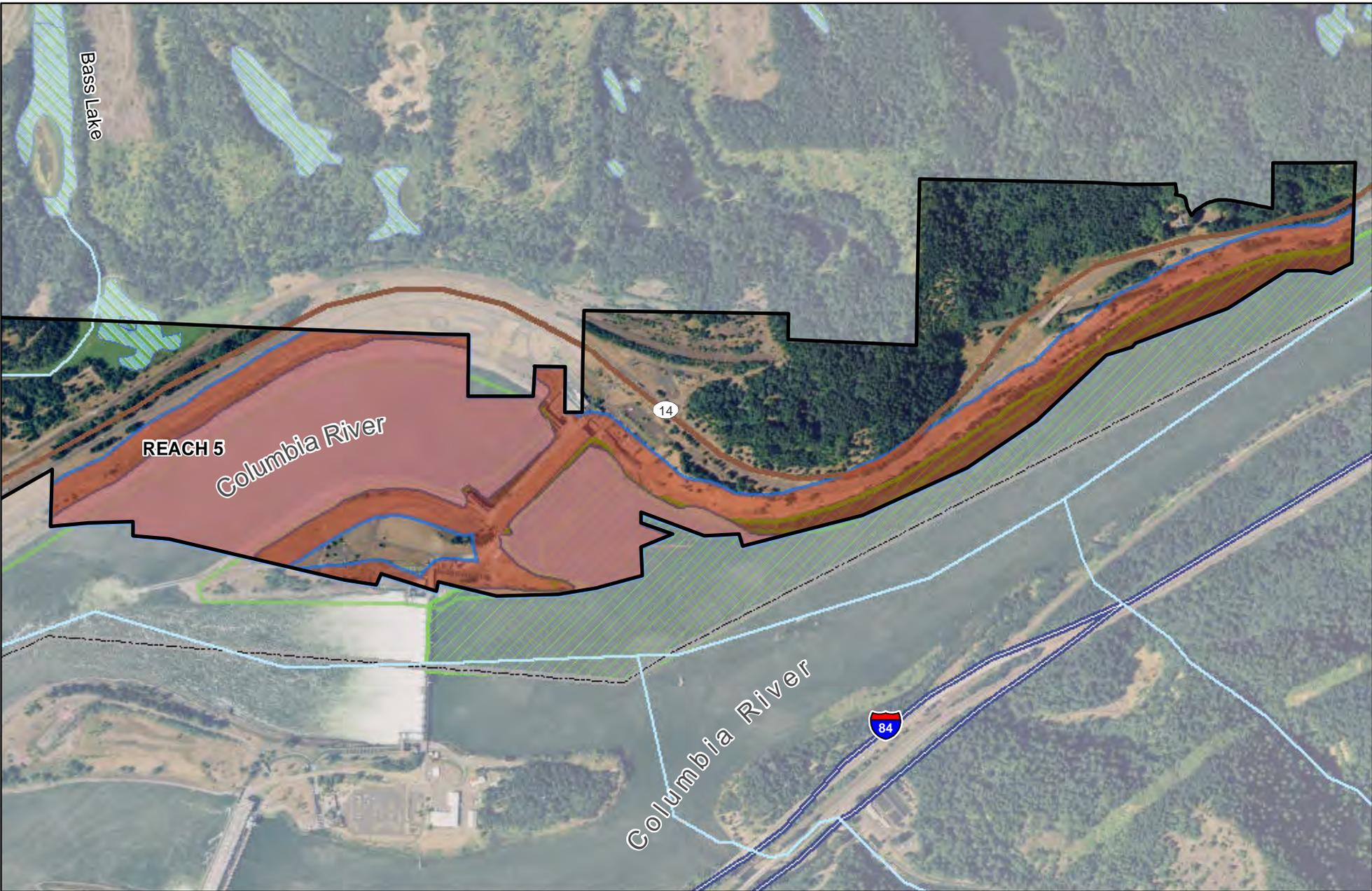
Fall chum salmon are known to spawn in the reach of Columbia River near Ives and Pierce islands located west of the city (WDFW 2011; LCFRB 2010). Alterations to the Columbia River at the Bonneville Dam could affect salmonids in different life stages; however, a minimum flow has been established from November through April to reduce the potential harm for dewatering chum redds below the dam (NMFS 2011). No wetlands are identified within this reach.

Within Reach 5, the river channel has been significantly altered due to the construction of the Bonneville Dam; therefore, the 100-year floodplain for the Columbia River in this reach is primarily confined to the river channel and does not extend beyond the embankment along the channel.

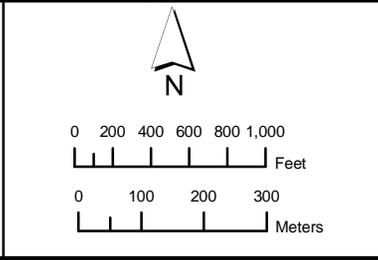


**Typical shoreline condition of Reach 5 along Columbia River, including view of the Bonneville Dam downstream**

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<b>LEGEND</b>	<b>Commercial Structures</b>	<span style="color: purple;">●</span> Outfalls	City Limits
	<span style="color: red;">●</span> Within 0-50 feet from Shoreline	Private Docks	Shorelands
	<span style="color: orange;">●</span> Within 50-100 feet from Shoreline	Public Boat Launch	FEMA Floodway (FIRM Zone A)
	<span style="color: green;">●</span> Within 100-200 feet from Shoreline	<b>Reaches</b>	Shorelines of the State
	<b>Residential Structures</b>	Reach 1	Shorelines of State-Wide Significance
<span style="color: red;">■</span> Within 0-50 feet from Shoreline	Reach 2	Wetlands	
<span style="color: orange;">■</span> Within 50-100 feet from Shoreline	Reach 3		
<span style="color: yellow;">■</span> Within 100-200 feet from Shoreline	Reach 4		
<span style="color: green;">■</span> Within 100-200 feet from Shoreline	Reach 5		



**Exhibit 6 – Columbia River  
(Reach 5)**

City of North Bonneville  
Shoreline Master Program Update  
November 2012

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### 4.5.3 Land Use and Shoreline Modifications

The land within this reach is entirely federally owned and managed. This entire reach has been extensively modified through dredging, fill and bank modifications (see Exhibit 3). The USACE operates the Bonneville Lock and Dam and thus would manage any activities associated with the shoreline of the Columbia River located within this reach.

The USACE maintains the levee for the entire extent of this reach. There is a visitor center at the dam powerhouse off Highway 14 where the public can view the powerhouse and dam. Visual access is available along Highway 14. As well as fishing access along the downstream shoreline of Bonneville Dam, the Corps of Engineers provides a boat launch on the Columbia River just outside the city limits on Fort Cascades Drive.

There are no known archaeological or historic resources within this reach. The Bonneville Dam is designated a National Historic Landmark.

### 4.5.4 Restoration Opportunities

As mentioned above, this reach is owned and managed by the USACE. Collaboration with the USACE would be required for any conservation or restoration activities in this reach. Currently, there are no known proposed restoration sites along this reach.

## 4.6 Summary of Ecological Functions, Issues, and Opportunities

### 4.6.1 Assessment of Ecological Functions

Table 3 provides a summary of functions, the level of alterations, and restoration opportunities for each reach based on the reach assessment provided in the previous sections.

### 4.6.2 Shoreline Management Issues and Opportunities

Key management issues within the shoreline reaches include the following:

- Construction of the Bonneville Dam, railroad, and Highway 14 have disconnected the stream channels from historical floodplains and channel migration zones. There are no opportunities available along the Columbia River at the Bonneville Dam since the area is federally owned and managed by the USACE, and restoration of floodplain habitat within Upper Hamilton Creek would require removal of existing public infrastructure.
- Sediment input from upstream reaches is a limiting factor for fish spawning areas in lower reaches of the streams. However, this is likely caused from activities at upstream reaches outside of the City's jurisdiction.
- Based on the available studies in the area, riparian habitat is reported to be limited in all the reaches. Areas with adequate riparian vegetation should be preserved as much as possible, and areas lacking riparian vegetation should be restored with native woody vegetation.
- Undeveloped areas along the shoreline should be preserved and protected through regulation, public outreach, and property acquisition.
- Best management practices should be required for future development in the shoreline jurisdiction.

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**Table 3. Summary Assessment of Shoreline Functions**

	Features	Reach 1 - Lower Hamilton Creek and Floodplain		Reach 2 - Greenleaf Lake		Reach 3 - Upper Hamilton Creek		Reach 4 - Greenleaf Creek		Reach 5 - Columbia River	
		Alteration	Restoration Opportunities	Alteration	Restoration Opportunities	Alteration	Restoration Opportunities	Alteration	Restoration Opportunities	Alteration	Restoration Opportunities
<b>Physical Characteristics</b>	<b>Stream Flow</b>	Impaired due to filling and town relocation as well as location of bridges	Enhance and maintain stream flow restoration projects  Coordinate with Pierce WR for any activities in Hardy Creek, Corps on federal properties	Channel disconnected from the Columbia River as a result of the construction of the Bonneville Dam	Protect and restore wetlands in this reach to maintain summer base flow	Construction of existing bridges and dikes has disconnected the channel from its migration zone.	Remove or alter bridges to improve connection between the stream channel and the downstream floodplain  Perform maintenance on channel and dikes as needed	Some accretion due to slides (upper reaches outside shoreline jurisdiction)	Maintain floodplain functions and protect and restore wetlands in this reach to maintain summer base flow	Impaired due to the construction/operation of the Bonneville Dam	Coordinate with USACE for any restoration activities in this reach
	<b>Floodplain</b>	Floodplain area and connectivity has been modified by construction of the Bonneville Dam and the filling for town relocation  Water levels are also controlled by the dam	Enhance and protect existing floodplain functions and channel migration process and protect and enhance remaining wetlands to help maintain flood storage  Coordinate with Pierce WR for any activities in Hardy Creek	Floodplain connectivity has been modified by the construction of the Bonneville Dam  Hamilton Creek channel migration can raise lake high water elevations and cause flooding	Protect and restore wetlands in this reach to maintain flood storage  Perform maintenance on lake outflow channel and Hamilton Creek channel as needed	This reach has been diked and disconnected from floodplain	Restore and protect floodplain function and channel migration process  Perform maintenance on channel and dikes as needed	Some commercial developments are located near the floodplain areas	Maintain floodplain functions and protect and restore wetlands in this reach to maintain flood storage	Floodplain connectivity has been modified by the construction of the Bonneville Dam	Coordinate with USACE for any restoration activities in this reach
	<b>Substrate and Sediment</b>	Current and historical accretion from erosion in upper reaches of creek  Fine sediments in Hardy Creek	Upgrade and widen transportation crossings upstream  Manage development to minimize impact to sediment supply process  Continue to remove excess bed materials in reach above bridges  Coordinate with Pierce WR for any activities in Hardy Creek, Corps on federal properties	Substrate appears to be functional in this reach  Hamilton Creek channel migration causes extensive accretion and choking at the lake outflow	Manage growth and development to maintain the current condition and minimize impact to sediment supply process  Perform maintenance on lake outflow channel and Hamilton Creek channel as needed	Accumulation of sediments and large bedloads have been issues in this reach	Manage growth and development to minimize impact to sediment supply process  Add Large Woody Debris  Perform maintenance on channel and dikes as needed	Substrate appears to be functional in this reach	Manage growth and development to maintain the current condition and minimize impact to sediment supply process	Substrates and sediment conditions in this reach are not listed as a limiting factor.	Coordinate with USACE for any restoration activities in this reach
	<b>Water Quality</b>	High temperature recorded in the lower reaches of Hamilton and Hardy creeks	Increase riparian shading  Coordinate with Pierce WR for any activities in Hardy Creek, Corps on federal properties	Water quality appears to be functional in this reach	Increase riparian shading to maintain the current condition and minimize impact	High temperature recorded in the lower reaches of Hamilton and Hardy creeks	Increase riparian shading	Water quality appears to be functional in this reach	Increase riparian shading to maintain the current condition and minimize impact	This reach is listed on the 303(d) list for temperature	Coordinate with USACE for any restoration activities in this reach
<b>Biological Characteristics</b>	<b>Riparian Habitat</b>	Riparian habitat is limited in this reach since the areas are dominated by native and non-native shrub species.  Limited but relatively good pool habitat and side channel habitat are present in this reach.	Plant native woody vegetation and control non-native species  Expand and maintain restoration efforts of off-channel habitat for Chum  Protect and restore wetlands to preserve habitat for wildlife  Coordinate with Pierce WR for any activities in Hardy Creek Corps on federal properties	Riparian condition is moderately impaired in this reach.	Plant native woody vegetation in the riparian corridor  Protect and restore wetlands in this reach to preserve habitat for wildlife  Control non-native species	Upper Hamilton Creek is considered to have functional riparian habitat	Plant and maintain native woody vegetation in the riparian corridor to maintain the current condition  Control non-native species	Greenleaf Creek is considered to have functional riparian habitat	Plant and maintain native woody vegetation in the riparian corridor to maintain and enhance the current condition  Control non-native species	Riparian habitat is limited in this reach	Coordinate with USACE for any restoration activities in this reach

	Features	Reach 1 - Lower Hamilton Creek and Floodplain		Reach 2 - Greenleaf Lake		Reach 3 - Upper Hamilton Creek		Reach 4 - Greenleaf Creek		Reach 5 - Columbia River	
		Alteration	Restoration Opportunities	Alteration	Restoration Opportunities	Alteration	Restoration Opportunities	Alteration	Restoration Opportunities	Alteration	Restoration Opportunities
	<b>Large Woody Debris</b>	Minimal woody recruitment is reported in this reach	Place and maintain stable woody debris in streams  Plant native woody vegetation in the riparian corridor  Coordinate with Pierce WR for any activities in Hardy Creek, Corps on federal properties	LWD level is reported to be low in this reach	Plant native woody vegetation in the riparian corridor	LWD level is reported to be low in this reach	Plant native woody vegetation in the riparian corridor	LWD level is reported to be low in this reach	Plant native woody vegetation in the riparian corridor	LWD is limited in this reach	Coordinate with USACE for any restoration activities in this reach
<b>Land Use</b>	<b>Shoreline Modifications and Public Access</b>	Extensive channel reduction and modification by the filling for town relocation  Residential use occurs in the shoreline jurisdiction / floodplain  Public access is limited but Heritage Trail provides viewing areas	Employ best management practices in future development  Consider safe public access opportunities  Coordinate with Pierce WR for any activities in Hardy Creek, Corps on federal properties	Private docks and potential for future commercial docks exist  Formal public access is limited to boat launch but Heritage Trail provides viewing areas	Employ best management practices in future development  Consider expanding formal public access with fishing dock	This reach has been filled and diked  Commercial and industrial uses near shoreline  Public access is limited except Heritage Trail viewpoint	Employ best management practices in future development  Perform maintenance on channel and dikes as needed  Consider safe public access opportunities	Commercial and residential uses near shoreline  Heritage Trail passes over creek near developed area	Employ best management practices in future development  Consider public access opportunities if determined not intrusive to critical environment	Extensive shoreline modifications  City does not have control over land use in this reach	Coordinate with USACE for any restoration activities in this reach

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## 5.0 References

- Adamus, P., E. Clairan, R. Smith, and R. Young. 1987. Wetland Evaluation Technique (WET).
- Beschta, R., R. Bilby, G. Brown, L. Holtby, and T. Hofstra. 1987. Stream Temperature and Aquatic Habitat: Fisheries and Forestry Interactions. In: Streamside Management: Forestry and Fishery Interactions. Edited by E. Salo and T. Cundy. Seattle, WA, University of Washington.
- Bilby, R. 1981. Role of Organic Debris Dams in Regulating the Export of Dissolved and Particulate Matter from a Forested Watershed. *Ecology* 62: 1234-1243.
- Bilby, R. and J. Ward. 1991. Characteristics and Function of Large Woody Debris in Streams Draining Old-Growth, Clear-Cut, and Second-Growth Forests in Southwestern Washington. *Canadian Journal of Fisheries and Aquatic Sciences*, 48: 2499-2508.
- Binford, M. and M. Bucheneau. 1993. Riparian Greenways and Water Resources. In: *Ecology of Greenways*. Edited by D. Smith and P. Cawood. Minneapolis, MN, University of Press.
- Brinson, M. and R. Rheinhardt. 1996. The Role of Reference Wetlands in Functional Assessment and Mitigation. *Ecological Applications*, (6):69-76.
- City of North Bonneville. 2012. History of North Bonneville. Accessed on May 3, 2012 at: <http://www.northbonneville.net/history.html>.
- Clapp, Jim. 2011. Personal communication with Jim Clapp, Refuge Manager, Pierce National Wildlife Refuge. December 5, 2011.
- Cowardin, L., V. Carter, F. Golet, and E. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. Washington, DC, U.S. Fish and Wildlife Service.
- Ecology (Washington Department of Ecology). 2011. 2008 Water Quality Assessment for Washington. Accessed on November 15, 2011 at: <http://www.ecy.wa.gov/programs/wq/303d/2008/index.html>.
- Fausch, K. 1984. Profitable Stream Positions for Salmonids: Relating Specific Growth Rate To Net Energy Gain. *Canadian Journal of Zoology*, 62: 441-451.
- Federal Register. 1982. "Title 33: Navigation and Navigable Watershed; Chapter II, Regulatory Programs of the Corps of Engineers," vol.47, no.138, p.31810, U.S. Government Printing Office, Washington, D.C.
- Federal Register. 1986. 40 CFR Parts 320 through 330: Regulatory Programs of the Corps of Engineers. Final Rule. vol. 51. no. 219. pp. 41206-41260, U.S. Government Printing Office, Washington, D.C.

- Franklin, J.F. and C.T. Dyrness. 1988. Natural vegetation of Oregon and Washington. Corvallis, OR: Oregon State University Press.
- HDR/EES (HDR Engineering, Inc. / Economic and Engineering Services, Inc.). 2006. Salmon-Washougal & Lewis Watershed Management Plan – WRIAS 27 and 28. Prepared for the Lower Columbia Fish Recovery Board for submission to the Planning Area Counties. Adopted by Clark, Cowlitz, and Skamania Counties, July 21, 2006.
- Heifetz, J., M. Murphy, et al. 1986. Effects of Logging on Winter Habitat of Juvenile Salmonids in Alaskan Streams. *North American Journal of Fisheries Management*, 6:52-58.
- Hruby, T., T. Granger, K. Brunner, S. Cooke, K. Dublanica, R. Gersib, L. Reinelt, K. Richter, D. Sheldon, E. Teachout, A. Wald, and F. Weinmann. 1999. *Methods for Assessing Wetland Functions, Volume I: Riverine and Depressional Wetlands in the Lowlands of Western Washington*. 2 Parts, Publication #99-115 and #99-116. Olympia, WA, Washington State Department of Ecology.
- Kruckeberg, A. R. 1991. The Natural History of Puget Sound Country. University of Washington Press, Seattle, WA.
- Larsen, E.M., and J.T. Morgan. 1998. Management recommendations for Washington's priority habitats: Oregon white oak woodlands. Wash. Dept. Fish and Wildlife, Olympia. 37pp.
- LCFEG (Lower Columbia Fish Enhancement Group). 2010. Project Proposal: Restoration, Acquisition, and Combination (Restoration and Acquisition) Projects for Lower Hamilton Creek Restoration Project. March 2010.
- LCFRB (Lower Columbia Fish Recovery Board). 2010. Washington Lower Columbia Salmon Recovery and Fish and Wildlife Subbasin Plan. Volume II Subbasin Chapters. May 2010.
- Marriott, D. et al. 2002. Draft Lower Columbia River and Columbia River Estuary Subbasin Summary. Prepared for the Northwest Power Planning Council.
- McDade, M., F. Swanson, et al. 1990. Source Distances for Coarse Woody Debris entering Small Streams in Western Oregon and Washington. *Canadian Journal of Forest Sciences*, 20:326-330.
- McMahon, T. and G. Hartman. 1989. Influence of Cover Complexity and Current Velocity in Winter Habitat use by Juvenile Coho Salmon (*Oncorhynchus kisutch*). *Canadian Journal of Fisheries and Aquatic Sciences*, 46:1551-1557.
- NMFS (National Marine Fisheries Service). 2010. 50 CFR Part 223. Endangered and Threatened Wildlife and Plants: Threatened Status for Southern Distinct Population Segment of Eulachon. Available at: <http://www.nwr.noaa.gov/Publications/FR-Notices/2010/upload/75FR13012.pdf>

- NMFS (National Marine Fisheries Service). 2011. Columbia River Estuary: ESA Recovery Plan Module for Salmon and Steelhead. Prepared for NMFS by the Lower Columbia River Estuary Partnership and PC Trask and Associates, Inc. January 2011.
- NRC (National Research Council). 1995. Wetlands: Characteristics and Boundaries. Washington D.C., National Academy Press.
- Null, W., G. Skinner and W. Leonard. 2000. Wetland Functions Characterization Tool for Linear Projects. Olympia, WA, Washington State Department of Transportation, Environmental Affairs Office.
- NWPCC (Northwest Power and Conservation Council). Undated. Columbia River: Description, Creation, and Discovery. Available: <http://www.nwcouncil.org/history/ColumbiaRiver.asp>. Accessed October 2011.
- OFM (Washington Office of Financial Management). 2011. April 1, 2011 Population of Cities, Towns, and Counties Used for Allocation of Selected State Revenues. Accessed on November 4, 2011 at: <http://www.ofm.wa.gov/pop/april1/finalpop.pdf>.
- Skamania County (Skamania County, Washington). 2011. Skamania County Acreage Breakdown – updated 4/30/10. Accessed on November 4, 2011 at: <http://www.skamaniacounty.org/assessor/assessor/skamania-county-acreage-breakdown/>.
- Stanley, S., J. Brown, and S. Grisbey. 2005. Protecting Aquatic Ecosystems: A Guide for Puget Sound Planners to Understand Watershed Processes. Washington State Department of Ecology.
- Taylor, R.J. and T.R. Boss. 1975. Biosystematics of *Quercus garryana* in relation to its distribution in the state of Washington. Northwest Sci. 49:48-57
- U.S. Census. 2011. 2010 State & County Quick Facts for Skamania County, Washington. Accessed on November 4, 2011 at: <http://quickfacts.census.gov/qfd/states/53/53059.html>
- USDA NRCS (Natural Resource Conservation Service). 2011. Web soil survey. Available at: <http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm>. Accessed November 2011.
- USGS 2011. National Elevation Dataset. Available at: <http://seamless.usgs.gov/>. Accessed November 2011.
- Van Sickle, J. and S. Gregory. 1990. Modeling Inputs of Large Woody Debris to Streams from Falling Trees. *Canadian Journal of Forest Research*, 20:1593-1601.
- Vesely, D.G. and D.K. Rosenberg. 2010. Wildlife conservation in the Willamette Valley's remnant prairie and oak habitats. Oregon Wildlife Institute. Corvallis, OR.

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- Wade, G. 2001. Salmon and Steelhead Habitat Limiting Factors: Water Resource Inventory Area 28. Washington State Conservation Commission. Olympia, Washington.
- WDFW (Washington State Department of Fish and Wildlife). 2011 Priority Habitats and Species Database for North Bonneville. Letter dated October 14, 2011. From Lori Guggenmos, Washington Department of Fish and Wildlife, to Maki Dalzell, HDR Engineering, Inc.
- Wenger, S. 1999. A Review of the Scientific Literature on Riparian Buffer Width, Extent, and Vegetation. Athens, GA, Office of Public Service and Outreach, Institute of Ecology, University of Georgia.
- WRCC (Western Regional Climate Center). 2011. Washington Climate Summary for Skamania Fish Hatchery, Washington. Accessed on November 4, 2011 at: <http://www.wrcc.dri.edu/summary/climsmwa.html>.

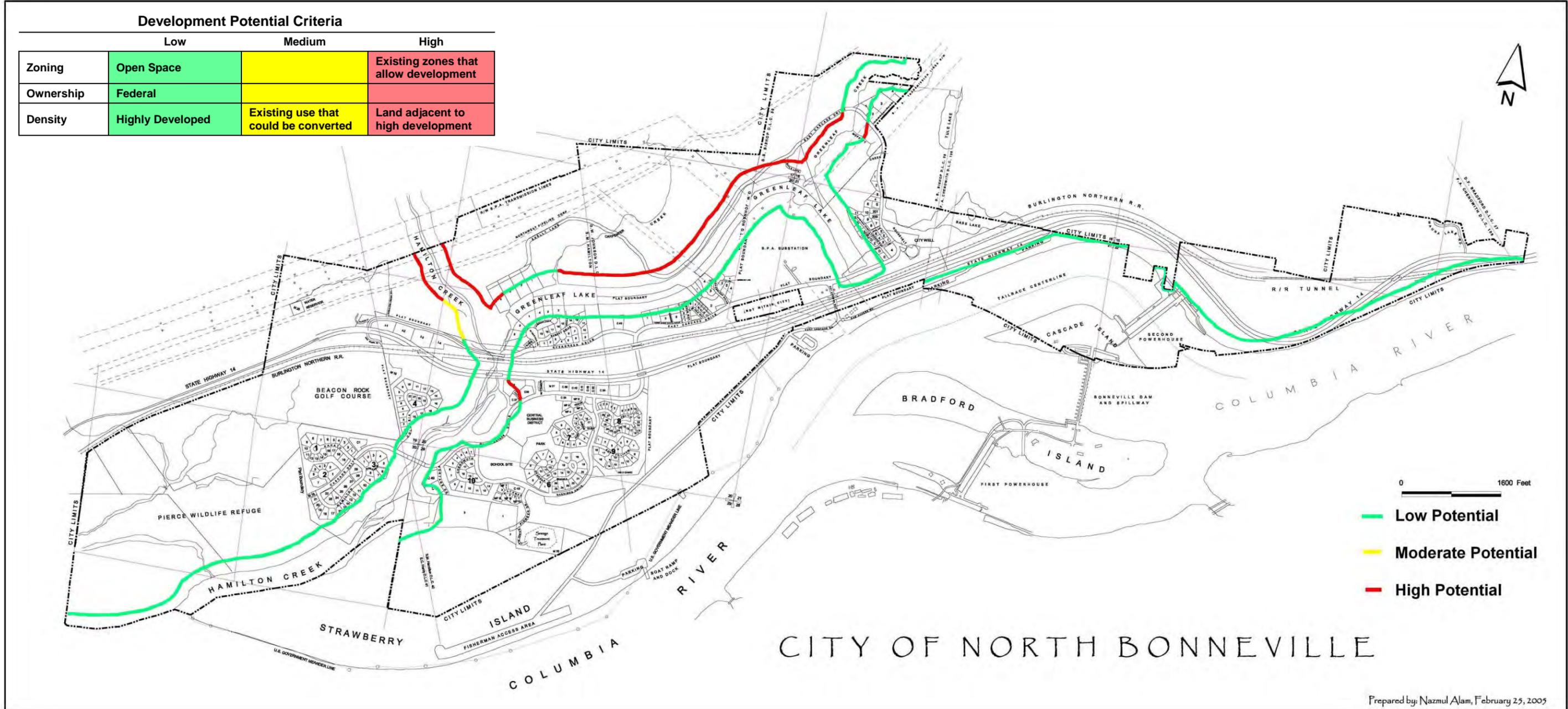
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## **Appendix A: Shoreline Inventory Mapbook and Data Sources**

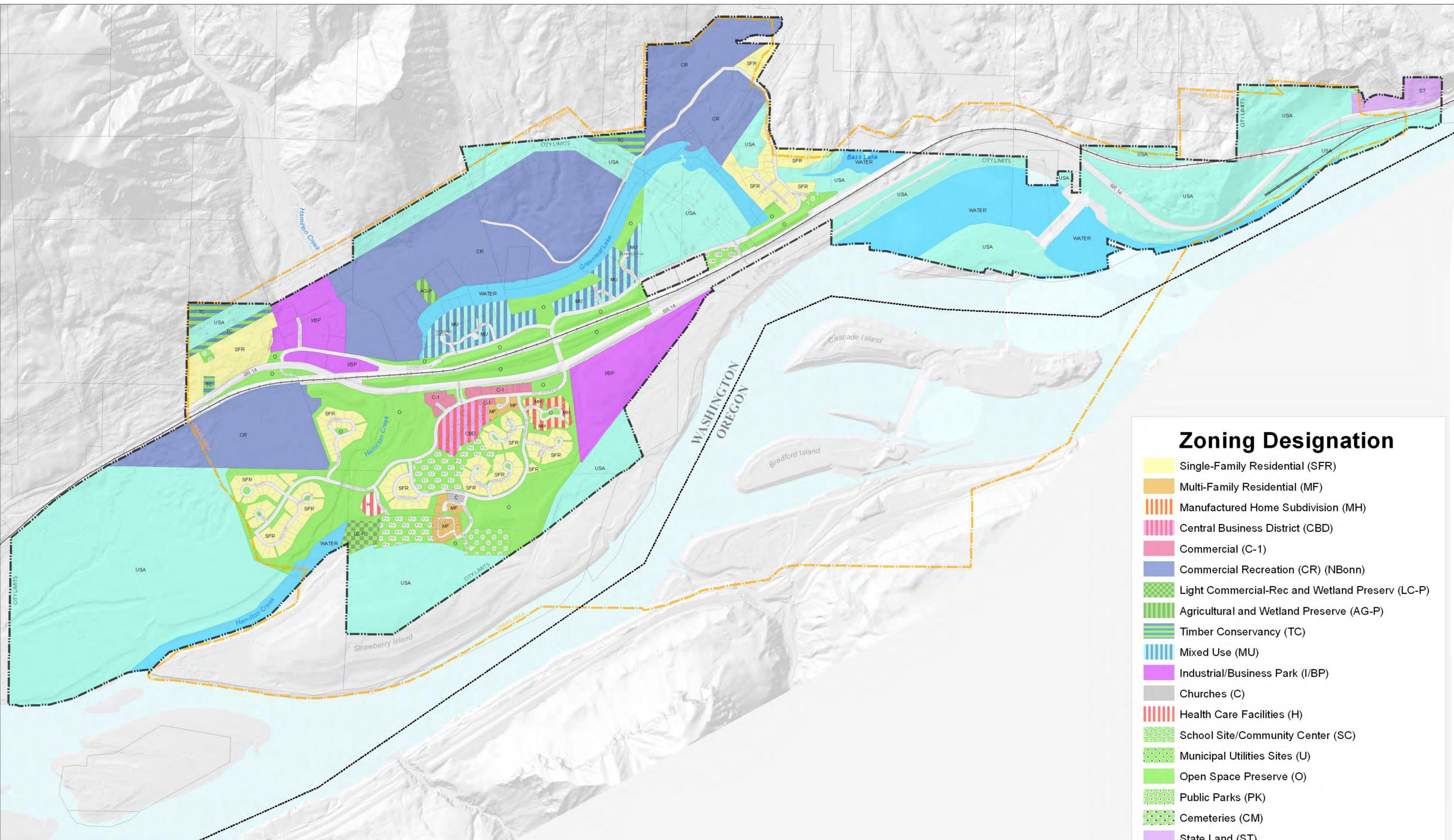
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Map of potential shoreline development



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### Zoning Designation

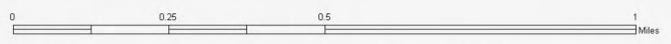
- Single-Family Residential (SFR)
- Multi-Family Residential (MF)
- Manufactured Home Subdivision (MH)
- Central Business District (CBD)
- Commercial (C-1)
- Commercial Recreation (CR) (NBonn)
- Light Commercial-Rec and Wetland Preserv (LC-P)
- Agricultural and Wetland Preserve (AG-P)
- Timber Conservancy (TC)
- Mixed Use (MU)
- Industrial/Business Park (I/BP)
- Churches (C)
- Health Care Facilities (H)
- School Site/Community Center (SC)
- Municipal Utilities Sites (U)
- Open Space Preserve (O)
- Public Parks (PK)
- Cemeteries (CM)
- State Land (ST)
- Federal Ownership Areas (USA)
- Water (Zoning not defined)

### Other Map Symbols

- City Limits Boundary
- Urban Area Boundary (Nat'l Scenic Area)
- Parcel
- Columbia River



# CITY OF NORTH BONNEVILLE ZONING MAP



**Data Credits:**  
Shaded relief derived from DNR and DOI LIDAR data flown in 2005-2006. National Scenic Area Urban Area boundary from Columbia River Gorge Commission. All other data was developed by Skamania County. Zoning data was developed while referencing the City's zoning maps, with assistance and cross-checking by the City of North Bonneville.

**LIDAR Note:**  
Areas of the water surface of the Columbia River near the dam show 'holes' in the LIDAR data where the reflective nature of the water surface caused the LIDAR capture to fail.

**Projected Coordinate System:**  
NAD 1983 HARN StatePlane Washington FIPS 4602 Feet  
**Projection Name:**  
Lambert Conformal Conic  
**Planar Units:**  
US Survey Feet  
**Absolute Scale:**  
1 inch = 550 feet

**SKAMANIA COUNTY**  
Department of Assessment (GIS)  
Map Created by: Rick Holbert  
Creation date: 10/24/2011

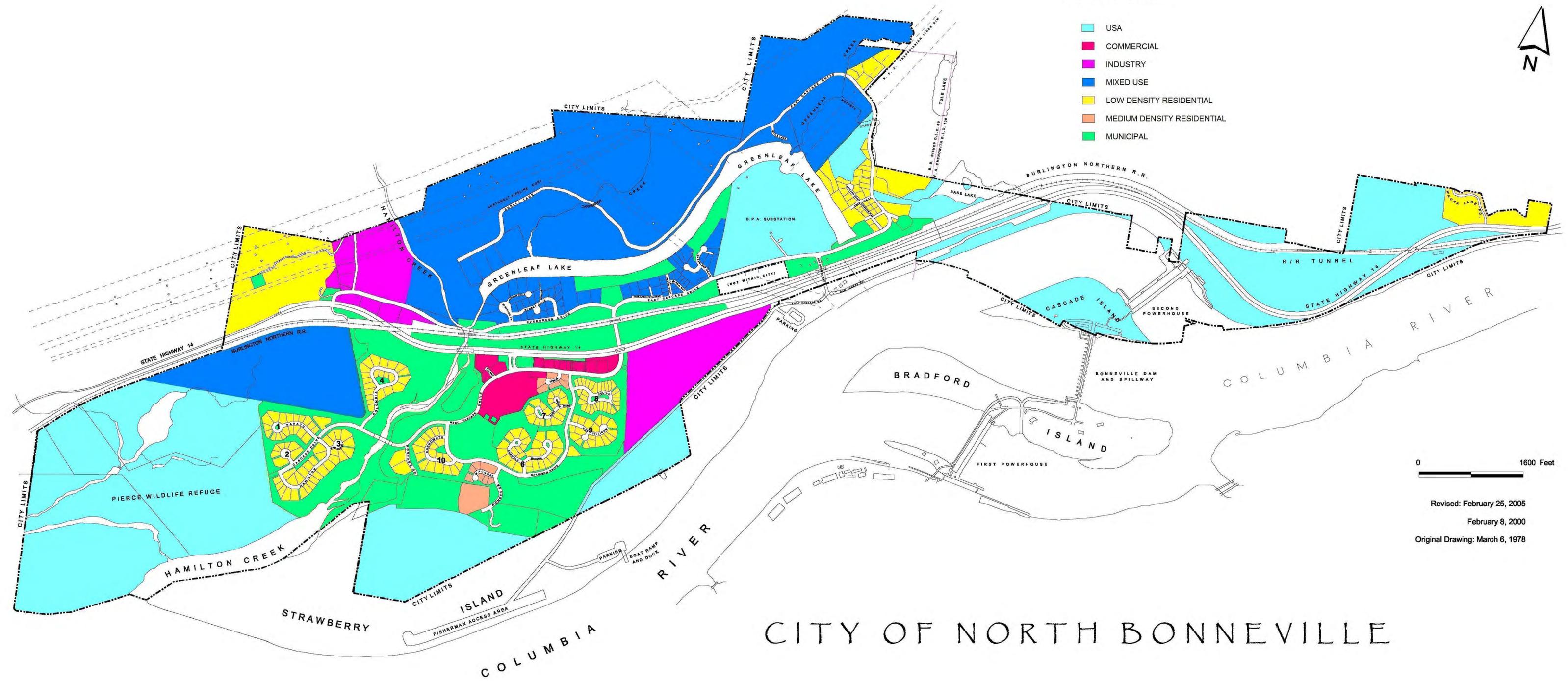
DISCLAIMER: This map product was prepared by Skamania County and is for information purposes only. It may not have been prepared for, or be suitable for, legal, engineering, or planning purposes. Users of this information should review or consult the primary data and information sources to ascertain the usability of the information.





PLAN DESIGNATIONS

- USA
- COMMERCIAL
- INDUSTRY
- MIXED USE
- LOW DENSITY RESIDENTIAL
- MEDIUM DENSITY RESIDENTIAL
- MUNICIPAL



0 1600 Feet

Revised: February 25, 2005

February 8, 2000

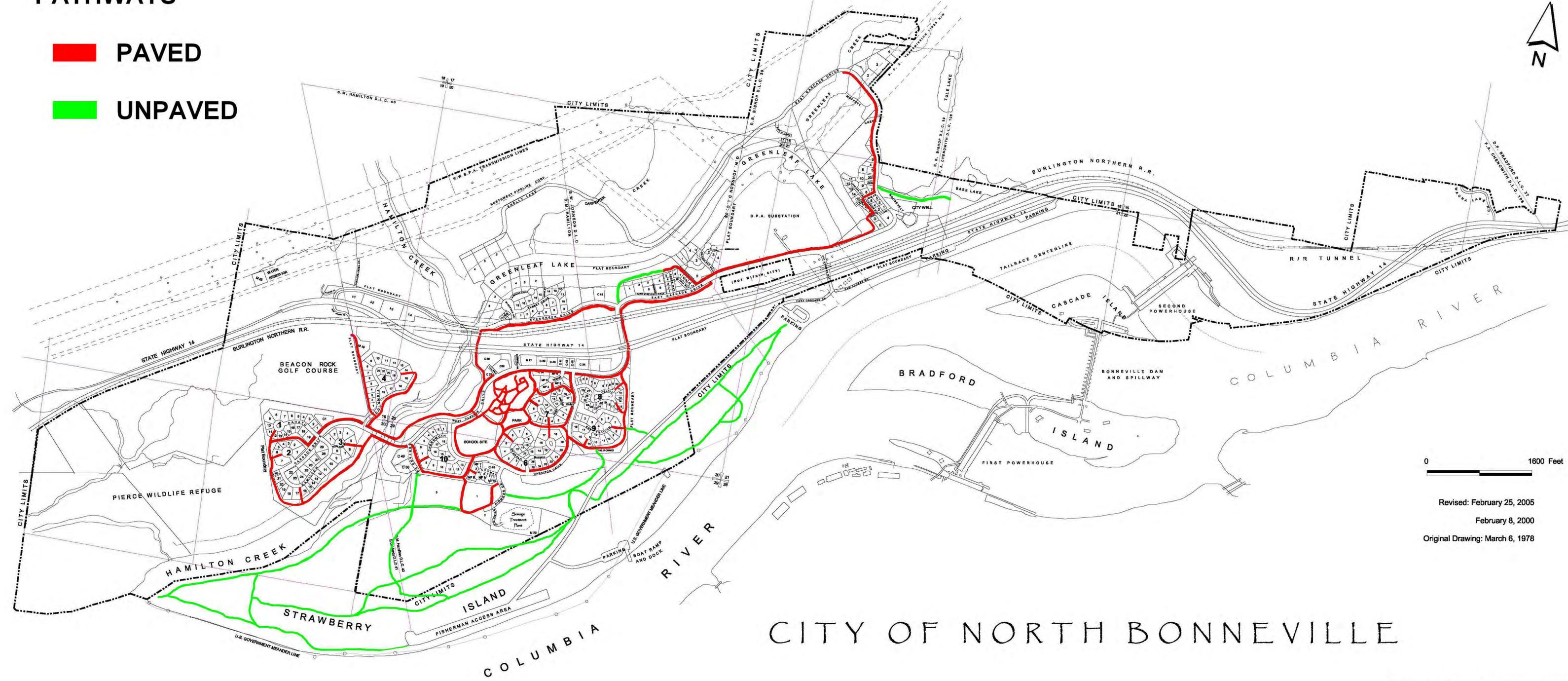
Original Drawing: March 6, 1978

CITY OF NORTH BONNEVILLE



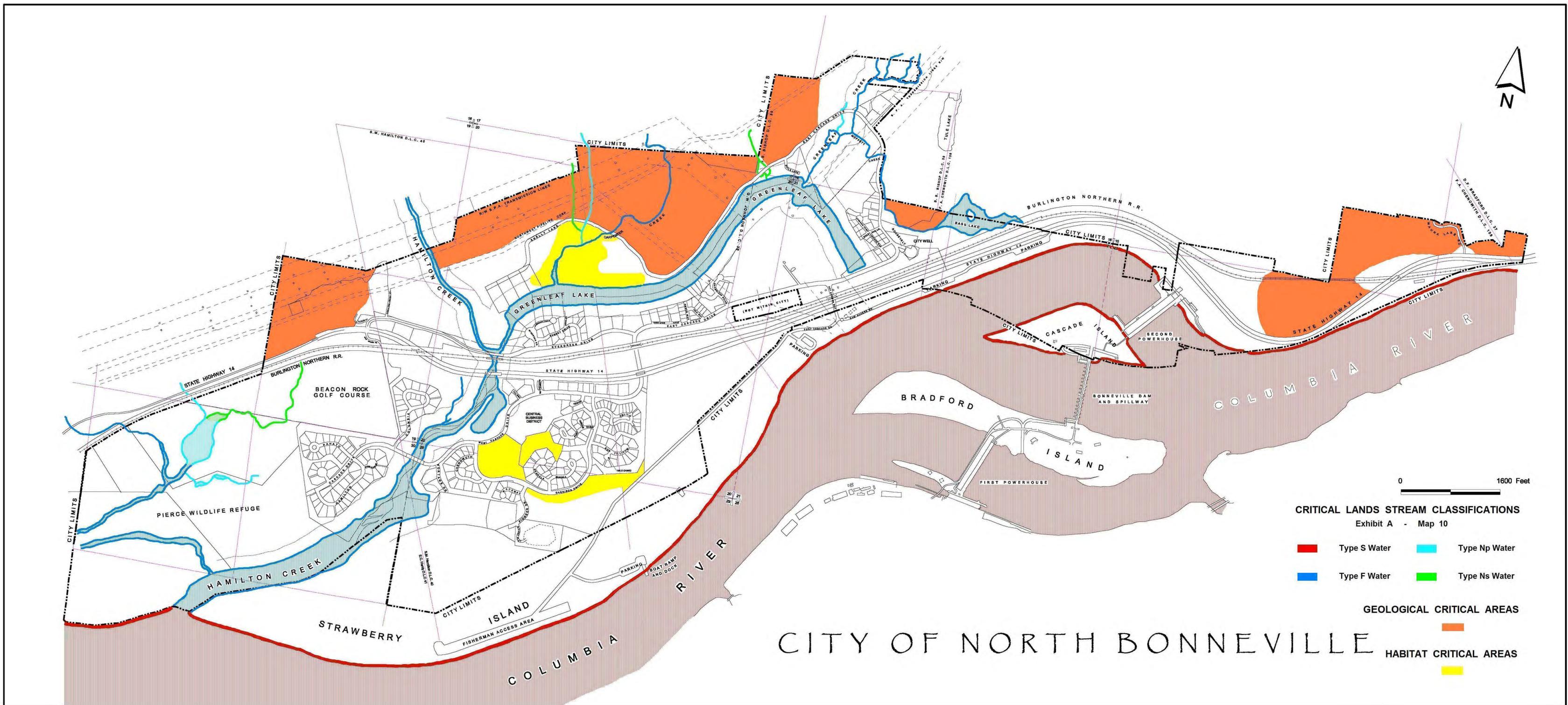
# PATHWAYS

- █ PAVED
- █ UNPAVED



Revised: February 25, 2005  
February 8, 2000  
Original Drawing: March 6, 1978

# CITY OF NORTH BONNEVILLE



**CRITICAL LANDS STREAM CLASSIFICATIONS**  
Exhibit A - Map 10

- |   |              |   |               |
|---|--------------|---|---------------|
|  | Type S Water |  | Type Np Water |
|  | Type F Water |  | Type Ns Water |

**GEOLOGICAL CRITICAL AREAS**



**HABITAT CRITICAL AREAS**



# CITY OF NORTH BONNEVILLE



# City of North Bonneville SMP Update List of Inventory Data Sources

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## Overview

As part of Ecology Task Item 2.1 Conduct Shoreline Inventory, this inventory of data sources summarizes the Geographic Information Systems (GIS) data gathered for the City of North Bonneville's Shoreline Inventory and Characterization. Additional information sources that were not in GIS format are listed in the References section of the Shoreline Inventory and Characterization Report.

Most of the data listed below was acquired from Skamania County in July 2011. Metadata was not available for all data.

A windshield survey was conducted in September 2011 by a Habitat Biologist. Floodplain, wetland, and shoreland GIS layers were updated based on the windshield survey.

## GIS Data Sources and Description

Table 1 below summarizes GIS data sources, a description of the data, and any updates to the data that were made based on the windshield survey. The table is organized mainly by data type.

Table 2 summarizes the Priority Habitat and Species (PHS) data specifically requested from WDFW for this project. All of the data were reviewed. Most of the data did not have any records or other information that fell within the City's SMP study area. Table 2 describes the data sets having records within the study area and summarizes the remaining data layers, documenting their inclusion in the data inventory.

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**Table 1. List of GIS Data Sources**

DATA TYPE	DESCRIPTION/UPDATES	DATA CONTENT DATE	DATA RECEIVED	SOURCE
Floodplain	Polygons digitized from scanned DFIRM map dated 2004 and updated after 9/20/2011 windshield survey	2004 data digitized/ Updated 9/20/11	7/2011	City of North Bonneville/Federal Emergency Management Agency /HDR (modified by Mike Witter, PWS)
Floodplain	FEMA Flood Insurance Rate Maps data - Zone A	1998	7/2011	Skamania County/FEMA
Wetlands	NWI polygons updated after 9/20/2011 windshield survey	6/9/2008/Updated 9/20/11	7/2011	Skamania County/U.S. Fish and Wildlife Service/HDR (modified by Mike Witter, PWS)
Wetlands	Reach polygons delineated from shorelands and 9/20/2011 windshield survey	Original 1997 - 2004/Updated 9/20/11	7/2011	Washington Department of Ecology/HDR (modified by Mike Witter, PWS)
Aerial Imagery	2008 1-ft DNR Aerial Photo	2008	7/2011	Skamania County/Washington Department of Natural Resources
Shorelines	Shorelands delineation updated after 9/20/2011 windshield survey	Original 1997 - 2004/Updated 9/20/11	7/2011	Washington Department of Ecology/HDR (modified by Mike Witter, PWS)
Shorelines	Shorelines of the state listed in Chapter 173-20 Washington Administrative Code were selected from a Water Body layer mapped at 1:24,000 scale. (poly)	2009	8/2011	Washington Department of Ecology
Shorelines	Those portions of streams and rivers constituting "Shorelines of the State" as defined by the Shoreline Management Act, RCW 90.58 and listed in WAC 173-18. (arc)	2009	8/2011	Washington Department of Ecology
Shorelines	Streams & rivers regulated by the Shoreline Management Act, Chapter 90.58 RCW, as reported to Ecology by local governments. (poly)	2009	8/2011	Washington Department of Ecology

DATA TYPE	DESCRIPTION/UPDATES	DATA CONTENT DATE	DATA RECEIVED	SOURCE
Shorelines	Streams and rivers likely to qualify as "shorelines of the state" as defined in the Shoreline Management Act Chapter 90.58.030 RCW. (suggested arc and poly)	11/2010	8/2011	Washington Department of Ecology
Hydrology	Hydro feature data from WA Dept of Nat. Resources	2005	7/2011	Skamania County/Washington Department of Natural Resources
Hydrology	Boundary of Columbia River and adjacent water in vicinity of Skamania County	Digitized based on 2008 aerial photos	7/2011	Skamania County
Hydrology	Boundary of Swift Reservoir	Digitized based on 2008 aerial photos	7/2011	Skamania County
Hydrology	Estimated flow points on streams and rivers likely to qualify as "shorelines of the state" as defined in Chapter 90.58.030 RCW. Jurisdiction begins where stream flow exceeds 20 cubic feet per second mean annual flow (cfsmaf).	11/2010	8/2011	Washington Department of Ecology
Hydrology	Lakes, reservoirs and similar water areas of the state under the jurisdiction of the Shoreline Management Act, as reported to Ecology by local governments.	1/2011	8/2011	Washington Department of Ecology
Hydrology	Lakes, reservoirs and similar water areas of the state likely to qualify as "shorelines of the state" as defined by Chapter 90.58.030 RCW.	1/2011	8/2011	Washington Department of Ecology
Aerial Imagery	Index of coverage area (tiles) of 12-inch resolution aerial	Unknown	7/2011	Skamania County
Aerial Imagery	Boundaries of the Yaocolt (DNR) and Columbia River (DOI) coverage areas	2008	7/2011	Skamania County
Aerial Imagery	Boundary of City of Stevenson flight of 6-inch resolution aerial	Unknown	7/2011	Skamania County
National Scenic Area	General Management Areas and Special Management Areas (GMA/SMA)	Last updated 11/10/2009	7/2011	Skamania County

DATA TYPE	DESCRIPTION/UPDATES	DATA CONTENT DATE	DATA RECEIVED	SOURCE
National Scenic Area	Key Viewing Areas points	6/16/2008	7/2011	Skamania County
National Scenic Area	Key Viewing Areas roads	6/16/2008	7/2011	Skamania County
National Scenic Area	Key Viewing Areas trails	6/16/2008	7/2011	Skamania County
National Scenic Area	Boundaries of Landscape Settings	2008	7/2011	Skamania County
National Scenic Area	Boundaries of Land Use Designations	2008	7/2011	Skamania County
National Scenic Area	Boundary of the National Scenic Area	2008	7/2011	Skamania County
National Scenic Area	Angle points used in generation of the NSA boundary	2008	7/2011	Skamania County
National Scenic Area	Boundaries of Recreation Intensity Classes	2008	7/2011	Skamania County
National Scenic Area	Boundaries of Urban Areas	2008	7/2011	Skamania County
National Scenic Area	Angle points used in generation of the NSA boundary	2008	7/2011	Skamania County
Political Boundary	Skamania County boundary	2010	7/2011	Skamania County/Washington State Department of Transportation
Political Boundary	Washington Counties boundaries	2010	7/2011	Skamania County/Washington State Department of Transportation
Political Boundary	City of North Bonneville city limits	2010	7/2011	Skamania County/Washington State Department of Transportation
Political Boundary	City of Stevenson city limits (2006)	2006	7/2011	Skamania County
Political Boundary	City of Stevenson city limits (2008)	2008	7/2011	Skamania County

DATA TYPE	DESCRIPTION/UPDATES	DATA CONTENT DATE	DATA RECEIVED	SOURCE
Parcel	PLSS Sections	2008	7/2011	Skamania County
Parcel	PLSS Townships	2008	7/2011	Skamania County
Parcel	Assessor's parcels.	6/13/2011	7/2011	Skamania County
Places	Points representing cities, towns, places	2010	7/2011	Skamania County
Places	Polygons representing places of interest like government facilities, golf course; some building footprints	2010	7/2011	Skamania County
Zoning	Areas zoned by Skamania County with their zoning designation	6/2010	7/2011	Skamania County
Soils	Soils for portions of Skamania County, originally developed by NRCS and USFS	NRCS (2004-2009)/USFS Pending	7/2011	Skamania County/Natural Resources Conservation Service/U.S. Forest Service
Transportation	County and City roads, State highway, registered private roads, some major USFS and DNR forest roads. Several separate datasets.	2006	7/2011	Skamania County/Census Tiger/U.S. Forest Service/Washington Department of Natural Resources/Washington State Department of Transportation
Transportation	Burlington Northern Santa Fe railroad centerline	2006	7/2011	Skamania County
Transportation	Burlington Northern Santa Fe railroad milepost	2006	7/2011	Skamania County
Fish and Wildlife Habitat	Fish passage barriers repaired or approved to be repaired.	4/30/2004	10/2011	Washington Department of Fish and Wildlife
Fish and Wildlife Habitat	The 1:24,000 scale Ecosystem Diagnosis and Treatment (EDT) preservation layer contains stream reaches that are ranked for preservation priorities based on current habitat conditions.	2002	10/2011	Washington Department of Fish and Wildlife

DATA TYPE	DESCRIPTION/UPDATES	DATA CONTENT DATE	DATA RECEIVED	SOURCE
Fish and Wildlife Habitat	The 1:24,000 scale Ecosystem Diagnosis and Treatment (EDT) restoration layer contains stream reaches that are ranked for restoration priorities based on comparisons between current and historic habitat conditions.	2002	10/2011	Washington Department of Fish and Wildlife
Fish and Wildlife Habitat	1:24,000 Anadromous Fish Distribution of Washington State	2008	10/2011	Washington Department of Fish and Wildlife
Fish and Wildlife Habitat	Salmonid Stock Inventory (SASI)	1/1/2002	10/2011	Washington Department of Fish and Wildlife
Fish and Wildlife Habitat	The 1:24,000 scale stream segment layer contains gradient categories, water body type, naturally occurring confinement, and Rosgen channel type delineation.	2002	10/2011	Washington Department of Fish and Wildlife
Fish and Wildlife Habitat	Washington Department of Fish and Wildlife (WDFW) 1:24,000 scale or higher resolution hydrography.	2002	10/2011	Washington Department of Fish and Wildlife
Fish and Wildlife Habitat	Washington Department of Fish and Wildlife (WDFW) 1:24,000 scale or higher resolution water bodies.	2002	10/2011	Washington Department of Fish and Wildlife

**Table 2. List of PHS GIS Data (Source: Washington Department of Fish and Wildlife, October 2011)**

<b>DESCRIPTION OF PHS DATA USED IN THE INVENTORY</b>
Buffers of bald eagle nests, communal roosts, and shorelines that fall within a half-mile of nests
Overlapping polygons that describe occurrences of priority habitats and species
WDFW designated priority species. Documented point and polygon observations for state and federal listed species including those designated as endangered, threatened, sensitive, candidate and monitor are included
Territorial, non-territorial and historic spotted owl sites
Spatial representation of anadromous and resident fish distribution
<b>DESCRIPTION OF INVENTORIED PHS DATA SETS CONTAINING NO FEATURES IN THE STUDY AREA</b>
Public land survey sections containing murrelet detection locations
Murrelet detection and surrounding public land survey sections which fall within a 3/4 mile buffer around the detection section
Locations of spotted owl sites
Information on documented priority habitat sites