DRAFT SKAGIT RIVER FLOOD DAMAGE REDUCTION STUDY
ENVIRONMENTAL BASELINE REPORT
UPPER BASIN

LIST OF FIGURES

LIST OF TABLES

I. INTRODUCTION

The Skagit River basin has a drainage area of 3,140 square miles (Figure 1). The northern end of the basin extends 28 miles into Canada, and covers 400 square miles. The headwaters of the Skagit arise in the steep Cascade Mountains of Canada and flow west and south into the United States. The river continues to flow through steep mountains for the next 40 miles where it passes through Ross, Diablo, and Gorge Dams owned by Seattle City Light above the town of Newhalem. The river continues for approximately 70 miles through less precipitous mountain valleys and the small towns of Marblemount (2000 population 251), Concrete (2000 population 760), Hamilton (2000 population 309) and Lyman (2000 population 409) before emerging in the vicinity of Sedro-Woolley (2000 population 8,658) (US Census Bureau, 2009). The river then meanders for about 25 miles through the coastal lowlands between the cities of Burlington (2000 population 6,757) and Mount Vernon (2000 population 26,232) before discharging into Skagit Bay (US Census Bureau, 2009). Population in the watershed is concentrated in the lowland delta area with only a few small towns in the upper basin (Sedro Woolley being the largest). Before it reaches the bay, the river crosses a broad outwash plain and divides into two principle branches, the north and south forks, which are 7.3 miles and 8.1 miles long, respectively, and which normally carry 60 percent and 40 percent of the flow, respectively. This report will focus on the portion of the watershed located above the town of Sedro Woolley. This area will be referred to as the Upper Basin of the Skagit River; however the Upper Skagit Water Resource Inventory Area (WRIA 4) does not begin until after the town of Hamilton. So the area being described in this report will incorporate two WRIAs- 3 (Lower Skagit) and 4 (Upper Skagit).

Several flood control projects provide flood protection in the Skagit basin. These include a system of levees in the lower basin, and flood control reservoirs in the upper basin which are the focus of this study. Both Ross Dam on the Skagit, and Upper Baker Dam on the Baker River, are operated on a formal basis for flood control and provide a significant reduction to large and small floods. These dams control 38 percent of the Skagit basin's drainage area; the remaining 62 percent is uncontrolled. Other hydroelectric and re-regulatory dams situated on the Skagit and Baker rivers provide incidental reduction of flood flows during smaller events.

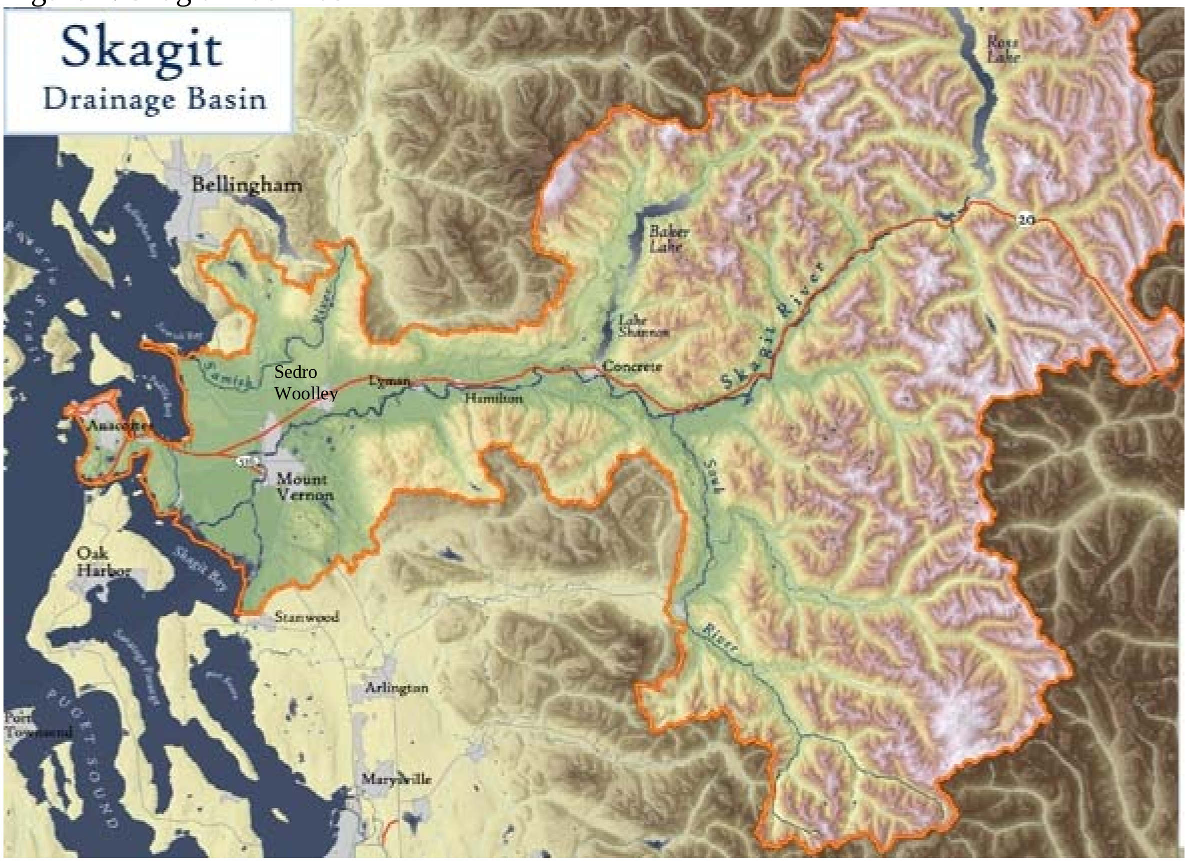
The upstream portion of the watershed is dominated by timber production and wilderness. There are five major dams in this section which provide hydroelectric generation and some flood control: Upper Baker, Lower Baker, Ross, Diablo, and Gorges. The Sauk, Suittle, and Cascade Rivers, tributaries to the Skagit River, is in the Wild and Scenic River system, as is the Skagit River from Ross Lake to Sedro-Woolley.

Flooding on the river has been a constant problem. Significant flood events in Skagit County have been estimated as early as 1815, and have occurred as recently as 2003. Flooding is somewhat less severe since the 1920s, when dams were constructed on the Baker and Skagit Rivers providing some retention and upstream storage of flood waters. There has also been an extensive program of levee construction along the Skagit River downstream from Sedro-Woolley.

Because much of the urban and agricultural land lies in the lowlands, flooding can cause significant damage. The Skagit River has occasionally overflowed the low divide between

Sedro-Woolley and Burlington, and added to the flooding in the Samish River Basin; although, that has not happened since 1921. Upriver, communities such as the towns of Lyman and Hamilton have also experienced flood problems; Hamilton was inundated with flood waters many times in the 20th century, most recently in 2003.

Figure 1. Skagit River Basin



(Pacific Coast Watershed Partnership, 2008)

Despite the major alterations in the physical and biological processes occurring in the river system, the Skagit River still remains the major producer of salmonids in the northern Puget Sound. The delta is also a major wintering area for waterfowl and raptors, as well as a migration stopover for shorebirds.

II. ENVIRONMENTAL BASELINE CONDITIONS

A. Physical Resources

1. Topography

The Skagit River originates in a network of narrow, precipitous mountain canyons in Canada and flows west and south into the United States where it continues 135 miles to Puget Sound. The crest of the Cascades forms the eastern boundary of the basin with altitudes ranging up to 8,000 feet. From the Cascades, the river flows through gorges of glacier peaks to lower mountains, where its banks are heavily wooded with conifers, then meanders around island stands of cottonwoods and alders, and then expands into the farm delta of the Skagit Valley. The valley varies in width from less than 1 mile in upper reaches to about 2 miles at Sedro-Woolley to more than 15 miles at the broad delta outwash plain, which encompasses 68,000 acres of floodplain. At Fir Island, the river divides into two principal distributaries of nearly equal length. During the usual range of river discharge, about 60 percent of the flow is carried by the North Fork and 40 percent by the South Fork. The entire floor of the Skagit River Valley and the deltas of the Samish and Skagit Rivers comprise the flood plain.

2. Geology

The eastern mountainous region of the upper Skagit Basin consists of ancient metamorphic rocks, largely phyllites, slates, shales, schists, and gneisses together with intrusive granitic rocks and later andesitic lavas and pyroclastic deposits associated with Mount Baker and Glacier Peak. The valleys are generally steep sided and frequently flat floored. Alpine glaciers have contributed to the steepness of the valley sides and to the depth of the valley bottoms. Over ten thousand years ago the upper Skagit Valley and the peaks were severely glaciated, removing not only the soil, but much of the loose rock. Glaciation exerted a powerful influence on the geomorphology of the Skagit River basin. Drainage patterns in the basin have many peculiar features, including long interconnected valleys, breached hydrologic divides, bisected valleys, and low-elevation mid-valley divides occupied by lakes and wetlands. The Skagit basin was likely much smaller prior to Quaternary glaciation. Geological evidence suggests overflow of proglacial lakes breached the North Cascades crest at Skagit Gorge and caused the lower Skagit River to capture upper Skagit valley (Riedel et al., 2007).

Many river channels created during the glacial melt have continued to aggrade, and as a result of that glacial action, the bedrock bottoms of most canyons are covered with glacial alluvium. These deposits are a heterogeneous mixture of sand and gravel together with variable quantities of silt and clay depending on the mode of deposition. Some of these deposits are highly susceptible to land sliding when saturated. The floodplain of the Skagit River below Concrete is composed of sands and gravels that diminish to sands, silts, and some clays further downstream. Below Hamilton, fine-grained floodplain sediments predominate.

Two volcanoes, Glacier Peak and Mt. Baker, are located in the upper watershed. Previous eruptions of Glacier Peak have generated lahars that traveled through the Skagit River to Puget Sound. Mt. Baker eruptions have deposited pyroclastic and lahar material in the Baker River watershed, but have not deposited substantial volumes material in the Skagit River floodplain (Gardner, et al, 1995). Future large eruptions could form thick fills of lahars and pyroclastic-flow deposits in the upper valleys near the volcano. Lahars from Glacier Peak could reach the delta, or there could be induced flooding due to temporary damming of watercourses in the upper watershed. Subsequent incision of volcanic deposits could fill riverbeds farther downstream with sediment for many years after the eruption, thereby affecting the capacity of stream channels and locally increasing flood heights (Waitt, et al, 1995).

3. Soils

The Skagit River basin from the delta to just above Marblemount (RM 78) can be divided into four broad physiographic areas: (1) the low precipitation uplands, which include several islands; (2) the flood plain-delta; (3) the high precipitation uplands; and (4) the mountains. These areas are further subdivided into nine general soil map units: (1) Skagit-Sumas-Field; (2) Larush-Pilchuck; (3) Barneston-Dystric Xerorthents-Indinaola; (4) Tokul-Skipopa-Dystric Xerorchrepts; (5) Vanzandt-Montborne-Squires; (6) Chuckanut-Cathcart; (7) Bow-Coveland-Swinomish; (8) Skykomish-Jug-Saxon; and (9) Wollard-Kindy-Diobsud. No survey has been conducted upstream of RM 78 to the Canadian border in the Mount Baker-Snoqualmie National Forest; therefore no soil data is available.

The soils in the surveyed area range widely in texture, drainage, and other characteristics. The physiographic areas and associated soils in the upper basin subject to this report include: the floodplain with associated map unit 2; the high precipitation uplands with associated map units 3 and 5; and the mountains with associated map units 8 and 9.

General map unit 2 is comprised primarily of Larush and Pilchuck soils. This map unit is in the central and eastern parts of the survey area in the immediate floodplain of the Skagit River. Slope is 0 to 5 percent. Elevation is 20 to 500 feet. The average annual precipitation is 55 to 70 inches, the average annual air temperature is about 52 degrees F, and the average frost-free season is 160 to 220 days.

> Larush soils are occasionally flooded flood plains and low terraces along the Skagit and Sauk Rivers. The soils are very deep and well drained, and formed in alluvium. Generally, the surface is covered with a mat of needles, leaves, and twigs. The surface layer is fine sandy loam or silt loam about 15 inches thick. The subsoil is very fine sandy loam and silt loam about 19 inches thick. The substratum to a depth of 60 inches or more is fine sand and silt loam.
>
> Pilchuck soils are on frequently flooded flood plains along the Skagit and Sauk Rivers. These soils are very deep, excessively drained and were formed in alluvium. The surface layer is loamy sand about 3 inches thick. The upper 40 inches of the underlying material is fine sand and sand, and the lower part to a depth of 60 inches or more is gravelly sand.

General map unit 3 is comprised primarily of Barneston, Dystric Xerorthents, and Indinaola soils. This map unit is in the central and eastern parts of the survey area, along the major drainage ways of the Skagit River from approximately the confluence of Grandy Creek (RM45) upstream past the confluence with the Suak River (RM71). Slope is 0 to 80 percent. Elevation is 200 to 1,200 feet. The average annual precipitation is 50 to 70 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 160 to 220 days.

> Barneston soils are on glacial outwash terraces and terrace escarpments. The soils are very deep and somewhat excessively drained. They formed in loess and volcanic ash underlain by glacial outwash. The surface is covered with a mat of needles and twigs. The surface layer and subsoil are gravelly loam, very gravelly sandy loam, or very cobbly sandy loam about 20 inches thick. The substratum to a depth of 60 inches or more is very cobbly loamy sand, very gravelly loamy coarse sand, or extremely gravelly sand.
>
> Dystric Xerorthents are on steep to extremely steep terrace escarpments. The soils are very deep and excessively drained. They formed in glacial outwash. The surface is

covered with a mat of needles, leaves, and twigs. The surface layer is gravelly sandy loam about 4 inches thick. The subsoil is gravelly loamy sand about 31 inches thick. The substratum to a depth of 60 inches or more is stratified very gravelly sand and gravelly sand.

Indianola soils are on terraces. The soils are very deep and somewhat excessively drained. They formed in sandy glacial outwash. The surface is covered with a mat of needles, leaves, and twigs. The surface layer is dark brown sandy loam about 6 inches thick. The upper 25 inches of the subsoil is loamy sand. The lower 24 inches of the subsoil and the substratum to a depth of 60 inches or more are sand.

General map unit 5 is comprised primarily of Vanzandt, Montborne, and Squires soils. This map unit is in the central and eastern parts of the survey area, found throughout the subject area. Slope is 0 to 65 percent. Elevation is 250 to 1,500 feet. The average annual precipitation is 55 to 75 inches, the average annual air temperature is 43 to 50 degrees F, and the average frost-free season is 120 to 200 days.

Vanzandt soils are on glacially modified plains and low mountainsides. The soils are moderately deep and moderately well drained. They formed in volcanic ash and glacial till. The surface is covered with a mat of needles, leaves, and twigs. The surface layer and subsoil are very gravelly loam about 25 inches thick. The substratum is very gravelly sandy loam about 11 inches thick over dense glacial till. Depth to dense glacial till ranges from 20 to 40 inches.

Montborne soils are on glaciated mountainsides. The soils are moderately deep and moderately well drained. They formed in glacial till and volcanic ash. The surface is covered with a mat of needles, leaves, and twigs. The surface layer is very gravelly loam about 6 inches thick. The subsoil and substratum are extremely gravelly loam about 26 inches thick over dense glacial till. Depth to dense glacial till ranges from 20 to 40 inches.

Squires soils are on glacially modified mountainsides. The soils are moderately deep and well drained. They formed in colluvium derived from phyllite, volcanic ash, and glacial till. The surface is covered with a mat of needles, leaves, and twigs. The surface layer and subsoil are very gravelly silt loam about 17 inches thick. The substratum is very gravelly loam 15 inches thick over phyllite. Depth to phyllite ranges from 20 to 40 inches.

General map unit 8 is comprised primarily of Skykomish, Jug and Saxon soils. This map unit is in the south-central and north-central parts of the survey area, in particular north of Concrete and south of Lyman. Slope is 0 to 65 percent. Elevation is 800 to 2,000 feet. The average annual precipitation is 70 to 75 inches, the average annual air temperature is 43 or 44 degrees F, and the average frost-free season is 100 to 125 days.

Skykomish soils are on terraces, terrace escarpments, and hills. The soils are very deep and somewhat excessively drained. They formed in volcanic ash and glacial outwash. The surface is covered with a mat of needles, leaves, and twigs. The surface layer and subsoil are very gravelly sandy loam about 17 inches thick. The substratum to a depth of 60 inches or more is very gravelly loamy sand.

Jug soils are on terraces. The soils are very deep and somewhat excessively drained. They formed in volcanic ash and glacial outwash. The surface is covered with a mat of needles, leaves, and twigs. The surface layer is very gravelly loam about 7 inches thick. The subsoil is extremely cobbly sandy loam over extremely cobbly loamy sand about 34 inches thick. The substratum to a depth of 60 inches or more is extremely cobbly sand.

Saxon soils are on terraces and hills. The soils are very deep and moderately well drained. They formed in volcanic ash underlain by glaciolacustrine sediment. The surface is covered with a mat of needles. leaves. and twigs. The surface layer, subsoil, and upper part of the substratum are silt loam about 21 inches thick. The lower part of the substratum to a depth of 60 inches or more is silty clay loam.

General map unit 9 is comprised primarily of Wollard, Kindy, and Diobsud soils. This map unit is in the central and eastern parts of the survey area on higher elevation slopes and terraces. Slope is 3 to 65 percent. Elevation is mainly 1,800 to 4,200 feet. The average annual precipitation is 80 to 90 inches, the average annual air temperature is 38 to 43 degrees F, and the average frost-free season is 90 to 120 days.

Wollard soils are on glacially modified mountainsides. The soils are moderately deep and moderately well drained. They formed in volcanic ash and glacial till derived dominantly from phyllite. The surface is covered with a mat of needles, leaves, and twigs. The surface layer and upper part of the subsoil are gravelly silt loam about 8 inches thick. The lower part of the subsoil and the substratum are gravelly loam 24 inches thick over dense glacial till. Depth to dense glacial till ranges from 20 to 40 inches.

Kindy soils are on glacially modified mountainsides. The soils are moderately deep and moderately well drained. They formed in volcanic ash, loess, and glacial till. The surface is covered with a mat of leaves, needles, and twigs. The surface layer is gravelly silt loam about 4 inches thick. The subsoil is very gravelly silt loam 15 inches thick. The substratum is very gravelly loam 7 inches thick over dense glacial till. Depth to dense glacial till ranges from 20 to 40 inches.

Diobsud soils are on glacially modified mountainsides. The soils are moderately deep and moderately well drained. They formed in volcanic ash and glacial till derived dominantly from phyllite. The surface is covered with a mat of needles, leaves, and twigs. The surface layer is gravelly silt loam about 4 inches thick. The subsoil and substratum to a depth of 28 inches are gravelly loam over dense glacial till. Depth to dense glacial till ranges from 20 to 40 inches.

There is documented evidence of volcanic lahar material underlying the towns of Lyman, Hamilton, Sedro-Woolley, Burlington and La Conner. Primary uses for these soils are residential, small farms and recreation.

4. Geomorphology

A major portion of the Skagit River basin lies on the western slopes of the Cascade Range. Most of the eastern basin is mountainous, with 22 peaks higher than 8000 ft. Many of those peaks are topped by glaciers. The two most prominent topographical features in the basin are Mount Baker at an elevation of l0,778 feet on the western boundary of the Baker River basin, and Glacier Peak at an elevation of l0,568 ft in the Sauk River basin.

The Skagit River can be divided into five geomorphic reaches. In the upper basin the Skagit River occupies the narrow, steep-walled canyon upstream of the Cascade River. The middle river extends from the confluence of the Cascade River downstream to Sedro-Woolley. As the valley floor widens through this reach and the channel becomes more sinuous and complex. The lower river runs from Sedro-Woolley to the estuary. The lower river is confined to a single channel with hardened banklines. Downstream of Mount Vernon, the river splits into two distributary estuary channels, before discharging into Skagit Bay on Puget Sound.

The upper reach covers the channel upstream of the Cascade River (RM 78). The channel form in this reach is controlled by the steep North Cascade Mountain geology. Most of the channel upstream of Gorge Dam (RM 97) is submerged by reservoirs. From Gorge Dam downstream to the Cascade River (RM 78), the river flows freely through a narrow bedrock confined channel in a series of rapids and deep pools. The Skagit River has a slope of 10 ft/mi in this lower reach. The riverbed is composed of bedrock, boulders, cobbles and gravel.

The middle reach extends from the Cascade River downstream to near Burlington (approximately RM 19). This is the most active stretch of the river, with complex channel forms and only intermittent bank protection. The lower part of this reach was described by Pentec (2002) in the Phase 1 geomorphology report for this Skagit River Flood Damage Reduction Feasibility Study. In this reach the river flows on a mountain valley floor that gradually widens in the downstream direction. The Cascade and Sauk rivers contribute large sediment loads to this reach of the Skagit River. The riverbed in the Cascade-Baker river reach is composed of boulders, cobbles, and gravel. The stream gradient falls from over 6 ft/mi upstream of Concrete to about 2 ft/mi upstream of Sedro-Woolley (approximately RM 23) and then steepens again to around 5 ft/mi at the downstream end of the reach. The bed becomes finer downstream and is mostly gravel with some sand near Sedro-Woolley. The floodplain soils tend to be sand, silt and clay.

The channel begins to meander and becomes more complex downstream of the Sauk River. Side channels become more frequent as the valley widens and the slope flattens between Hamilton and Sedro-Woolley. There are numerous side channels, oxbows and overbank erosion scars created during large floods of the past. Some meanders have been cutoff. Bank protection is intermittent throughout the entire reach, generally occurring along Highway 20 or adjacent to riverside communities.

5. Climate.

Precipitation over the basin varies greatly from a mean annual amount of 32 inches in the vicinity of the mouth of the Skagit River which lies in a topographical rain shadow, to an average of 180 inches or more on the higher elevations of the Cascade Range. Mean annual snowfall varies from 4.4 inches at Anacortes to 647 inches at Mount Baker Lodge. Average winter temperatures vary from 26.9°F at Mt. Baker Lodge (4,150 feet) to 34.5°F at La Conner, and average summer temperatures vary from 56.7°F at Mt. Baker Lodge to 61.7°F at La Conner.

Models from the UW Climate Impacts Group indicate that over the next century the Pacific Northwest area will likely see a trend toward wetter warmer winters and hotter dryer summers in response to climate change. However, these large scale models have difficulty resolving mountain climates such as the Cascades so exact scenerios are difficult to predict. Currently the UW climate group is working on meso-scale models that may be able to resolve smaller scale climates (UW Climate Impacts Group, 2008).

It is speculated that the Skagit River system may see higher flows in the winter as the majority of the precipitation would fall as rain and not snow, and lower flows in the summer due to lack of rain and snow melt. Initially, glacial melt would increase, but over time would decrease as the glacier retreats. Not only would this scenario lead to a different flow regime then what is seen in the Skagit today, but will likely lead to increases in water temperatures within the river (Hamlet and Lumberd, UW Climate Impacts Group, pers. comm.).

B. Biological Resources

6. Vegetation

a. Basin Vegetation

Almost 90 % of the Upper Skagit basin above Sedro Woolley is either designated as national forest or national park. Approximately 56% of WRIA 4 (Upper Skagit) and 2% of WRIA 3 (Lower Skagit) lies within the boundaries of Mount Baker National Forest. Another 31% of WRIA 4 lies within the boundaries of North Cascades National Park. Large tracks of both old-growth and secondary growth coniferous forests dominate the landscape. North Cascades National Park classifies forests found on the western slopes of the Cascades into four major types: Western Hemlock Forest at 0-2000 feet, Pacific Silver Fir Forest at 2000-4000 feet, Mountain Hemlock Forest at 4000-5500 feet, and Subalpine at 5000-7000+ feet. Trees found within the park boundaries include mostly conifers such as western hemlock, western red cedar, pacific silver fir, Douglas fir, western white pine, and sitka spruce, and some deciduous species such as cottonwood, Alpine willow, cascade willow, Northwestern paper birch, big leaf maple, bitter cherry, sitka and red alder, and red osier dogwood (NPS, 2008).

As the overall upper basin is heavily forested, climate change could have a significant effect on forest species composition and fire regimes. Under current models, wetter winters and dryer summers are predicted in the Pacific Northwest region. Climate warming may first show up in forests as increased growth, which occurs as warmer temperatures, increased carbon dioxide, and more precipitation encourage higher rates of photosynthesis (Rapp, 2004). This increased woody vegetation expansion and growth may lead to higher fire occurrence, as the increased amount of fuel load cures through the longer, drier, and warmer summers.

b. Riparian Vegetation

Since the northwestern portion of the Upper Skagit basin lies in either national park or national forest, the riparian corridor from Marblemount upstream to Ross dam consists almost entirely of conifer dominated forest, with deciduous trees and shrubs the primary cover along the river and on sand bars. Above Ross dam is Ross Lake which falls completely within the boundries of North Cascades National Park, and therefore its shores also consists of conifer dominated forest. From Sedro Woolley to Marblemount the riparian area alternates from patches of agriculture and small towns with narrow strips of trees along the river bank to larger patches of primarily deciduous forests typical of the lowland floodplain. Deciduous trees, such as black cottonwood and big leaf maple, and shrub habitat, such as willows and salmonberry, are more prevalent in these disturbed areas of the riparian zone where the gradient is lower and coniferous stands increase as disturbance decreases and the gradient is higher. Agriculture and small towns become less common in this stretch with increasing river mile. The three major tributaries of the Upper Skagit River, the Baker River (including Lake Shannon and Baker Lake), the Sauk River, and the Cascade River, also have riparian areas that are lined with deciduous tree and shrub riparian zones.

Climate change may greatly alter the vegetation communities in the Upper Skagit basin. Increased winter precipitation and summer drought, longer growing seasons, and warmer temperatures may result in changes in plant species and increased pest populations throughout the basin. Invasive species may proliferate and fill previously unaffected niches as native species are stressed and displaced by more generalist species.

c. Large Woody Debris

Large woody debris (LWD) is common in the middle river reach (Pentec, 2002). There is no transport of LWD from above the dams by either natural or human processes. LWD exists along the shoreline, both in water and as recruitable trees. Concentrations of LWD can be found at the upstream end of islands, such as those at RM's 35 and 58, or the entrance to side channels, such as at RM 64.

d. Off-Channel Habitat

In general, off-channel habitat becomes scarce further up into the watershed due to increases in the slope of the valley walls and increased gradient. Upstream of the town of Concrete there is a braided section of river before the river morphology transitions almost solely to primary channel extending up to Diablo, Gorges, and Ross dams. Sections of braided channel and secondary off channel habitat are present between the towns of Concrete and Sedro Woolley, with increasing occurrence as the river progresses downstream. Over the last century the Skagit River has lost a large proportion of it's off channel habitat due to the diking of the river and land use practices, most of this loss has been in the lower Skagit Basin in the floodplain and delta area (Beamer et. al., 2002; Beechie, 1994; Collins and Sheikh, 2002). However, agriculture does occur along the banks of the Skagit River above Sedro Woolley and it is likely that some off channel habitat has been lost as a result.

7. Wildlife

Large mammals found in the Upper Skagit Basin include elk, black-tailed deer, black bear, mountain lion, coyote mountain goat, and wolverine. Federally listed grizzly bear, gray wolf, and Canada lynx are also known to inhabit the area (see "Threatened and Endangered Species" for more details). Other mammal species such as river otter, beaver, raccoon, American marten, mink, and the occasional harbor seal also utilize the Upper Skagit basin. Common small mammals are Townsend chipmunks, trowbridge shrew, deer mouse, snowshoe hare, Douglas squirrel, and a variety of bats.

There are numerous species of birds that use the Skagit Basin as either over-wintering grounds or as permanent residents which are composed of raptors, waterfowl, shorebirds, game birds, and songbirds. A subset of these birds include snow geese, common mergansers, buffleheads, trumpeter swans, belted kingfishers, great blue herons, double crested cormorants, ring-billed gulls, ruffed grouse, osprey, golden and bald eagles, many species of owls, and at least 87 species of song birds. Federally listed marbled murrelets and northern spotted owls also utilize the forests of the Upper Skagit (see “Threatened and Endangered Species” for more details).

A large population of bald eagles over winters along the upper Skagit River, making up one of the two largest seasonal concentrations of bald eagles in the lower 48 states. In general, the bald eagle wintering season extends peaks along the Skagit from mid December to late January. The eagles are drawn to the area by the large numbers of spawned out salmon in the upper Skagit watershed. Up to 579 eagles were counted in the upper Skagit River area (Skagit River Bald Eagle Awareness Team, 2006). Most of the area eagles are migrants; however, resident bald eagles do occur in the areas. Bald eagle nesting typically occurs between early January and mid-August.

Reptile and amphibian species in the Upper Skagit basin include western terrestrial garter snake, common garter snake, northern alligator lizard, Cascade frog, Oregon spotted frog (a Federal species of concern), northern red legged frog, Pacific chorus frog, tailed frog, western toad, northwestern salamander, and northern rough-skinned newt.

Climate change may lead to a much different microclimate and river system then what is seen today (as discussed in section A5 “Climate”). Alteration in vegetation communities due to changes in precipitation, temperature, pest and forest fire regimes are possible. Not only would this change affect the physical habitat that wildlife in the upper Skagit currently occupy but it could also further decrease populations of already declining anadromous fish, which will in turn impact a variety of marine and freshwater fish, birds, and mammals which are reliant upon them. It will also affect the distribution and abundance of benthic invertebrates within the river due to changes in flow and temperature. Details about specific impacts of climate change on fish populations in the Skagit are discussed below.

8. Fish

The Skagit River and the Skagit Estuary are critically important to all five species of Pacific salmon as well as steelhead and sea-run cutthroat (Table 1). There are numerous runs that utilize both the mainstem Skagit and several of its tributaries, most of which spawn in the reaches above Sedro Woolley. The Skagit River and its tributaries also host the largest population of Puget Sound bull trout in Puget Sound Basin (Conner, Seattle City Light, pers. comm.). The lower reaches of the Skagit River serves as a transportation route for spawning adults and provides rearing environment for juvenile anadromous species during their outmigration to the sea, while the upper reaches of the Skagit River from Sedro Woolley up to Gorges dam, the Sauk River, the

Cascade River, Lake Shannon and Lake Baker along with other upper tributaries compromise the majority of the spawning habitat. In these more natural upper sections of the river, suitable habitat features are still available for spawning and rearing, however the historic loss of tidal wetland and channel habitat has been identified as one of the most significant limiting factors in the recovery of Skagit Chinook (SWC, 2005; WCC, 2003). Research by the Skagit River System Cooperative and others has shown that the reduced amount of estuarine habitat is likely limiting the production of Chinook (Beamer et al., 2003; Beamer et al., 2002; Beamer et al., 2000; Congleton et al., 1981). Today, less than 27% of estuarine habitat remains (SWC, 2004; WCC, 2003), with the greatest loss being in riverine tidal habitat (less than 16% remaining). Most of the historic estuarine habitat was lost after diking isolated the habitat from riverine and tidal processes

Resident fish species found in the Skagit river system include rainbow trout, kokanee, mountain whitefish, salish and largescale suckers, three-spine sticklebacks, brown trout, brook tout, lake trout, western brook lamprey, and torrent, prickley, and coastrange sculpin.

With impending climate change in the Skagit Basin (discussed in section, A5, “Climate”) it is likely that future obstacles for salmonids in the Skagit system may be sever. Skagit River salmonids have already experienced a variety of pressures caused by the diking of the river, construction of dams, insufficient riparian vegetation and large woody debris recruitment, and the development of the floodplain. The combination of these existing pressures with the scenario of warmer wetter winters and hotter dryer summers could lead to elevated summer and early fall water temperatures due to a lack of buffering from snow and glacial melt. These increased temperatures may be intolerable to salmonids, Bull trout populations in the Skagit River system would be particularly affected by these elevated temperatures since they require water no warmer than 48˚C for spawning and no warmer than 53˚C for rearing (WDOE, 2008).

Predicted sea level rise would cause the freshwater and brackish marshes to retreat landward due to saltwater intrusion with little room to encroach on already developed land. This additional reduction of brackish habitat, required for smoltification and acclimation to changes in salinity, is estimated to range from 77%-97% (Glick et.al, 2007); further limiting the production of anadramous fish in the Skagit Basin.

Table 1: Summary of Salmon Data for WRIAs 3 and 4
(WDFW and WWTIT, 2003 draft; SWC 2005)

Stock	Origin	Production Type	Stock Status
CHINOOK			
Lower Skagit Mainstem/Tribs	Native	Wild	Depressed
Upper Skagit Mainstem/Tribs	Native	Wild	Depressed
Lower Sauk	Native	Wild	Depressed
Upper Sauk	Native	Wild	Depressed
Suiattle	Native	Wild	Healthy
Upper Cascade	Native	Wild	Depressed
COHO			
Skagit	Native	Composite	Healthy
Baker	Mixed	Composite	Healthy
CHUM-FALL			
Mainstem Skagit	Native	Wild	Healthy
Sauk	Native	Wild	Healthy
Lower Skagit Tribs	Native	Wild	Unknown
PINK			
Skagit	Native	Wild	Healthy
SOCKEYE			
Baker	Native	Cultured	Healthy
STEELHEAD-SUMMER			
Finney Creek	Native	Wild	Unknown
Sauk	Native	Wild	Unknown
Cascade	Unknown	Wild	Unknown
STEELHEAD-WINTER			
Mainstem Skagit/ Tribs	Native	Wild	Depressed
Sauk	Native	Wild	Unknown
Cascade	Native	Wild	Unknown

9. Invertebrate Communities

According to Plotnikoff, 1992, benthic invertebrate communities typical of rivers in the Cascade regions are dominated by stonefly and mayfly larvae, with very limited representation by other taxa. These Cascade invertebrate assemblages are characterized as scraper-collector-gather communities.

Communities typical of rivers in the Puget Sound lowlands are dominated by stonefly, caddisfly, and common midge, mosquito, and blackfly larvae. Other taxa present include beetle larvae, amphipods, and aquatic isopods. These lowland invertebrate assemblages are characterized as shredder-gatherer communities.

10. Threatened and Endangered Species

Numerous species of plant, fish and wildlife species occur in the Skagit Basin including several threatened and endangered species that have the potential to occur in the project areas (Table 2).

Table 2: Listed Species

SPECIES	SCIENTIFIC NAME	STATUS
Puget Sound Steelhead	*Oncorhynchus mykiss*	Threatened
Puget Sound Chinook Salmon	*Oncorhynchus tshawytscha*	Threatened
Coastal/Puget Sound Bull Trout	*Salvelinus confluentus*	Threatened
Marbled Murrelet	*Brachyramphus marmoratus*	Threatened
Northern Spotted Owl	*Strix occidentalis*	Threatened
Grizzly Bear	*Ursus arctos*	Threatened
Canada Lynx	*Lynx canadensis*	Threatened
Gray Wolf	*Canis lupus*	Threatened

a. Puget Sound Chinook Salmon

Six stocks of Puget Sound Chinook Salmon occur in the upper Skagit most of which are ocean type. The lower Skagit Chinook population was classified as depressed in both the 1992 SASSI and the 2002 SaSI. Spawning occurs from early September to mid-November (WDFW and WWTIT, 1994; WDFW and WWTIT, 2003 draft). The lower Skagit Chinook spawns in the mainstem Skagit River and in tributaries downstream of the Sauk River confluence; most of the spawning occurs in the mainstem Skagit River between Sedro-Woolley and the Sauk River (WDFW and WWTIT, 2003 draft). Upper Skagit Chinook spawn in the mainstem Skagit River and in tributaries upstream of the Sauk confluence up to Newhalem. The upper Skagit stock status went from healthy in 1992 to depressed in 2002. Spawning occurs mid-August through October. The lower Sauk Chinook population spawns in the Sauk River from the mouth upstream to the Darrington Bridge (RM 21.2). Its status was classified as depressed in both the 1992 and 2002 population inventories (WDFW and WWTIT, 1994; WDFW and WWTIT, 2003 draft). The lower Sauk population spawns earlier, beginning in late August and continuing to early October, than the mainstem Skagit populations. Upper Sauk Chinook spawn upstream of the Darrington Bridge and into the North and South Forks of the Sauk River. The status changed from healthy in 1992, to depressed in 2003 (WDFW and WWTIT, 1994; WDFW and WWTIT, 2003 draft). Spawning occurs from late July through early September. Suiattle Chinook have the same early spawn timing as upper Sauk Chinook. The Suiattle population spawns in the mainstem Suiattle River, and in the Big, Tenas, Straight, Circle, Buck, Lime, Downey, Sulphur, and Milk Creeks. Its population status changed from depressed in 1992, to healthy in 2003. Upper Cascade Chinook spawn in the mainstem Cascade River above RM 7.8, in the lower reaches of the North and South Forks of the Cascade River, and in Marble, Found, Kindy, and Sonny Boy Creeks. Its population status changed from unknown in 1992, to depressed in 2003. Spawning occurs from late July through early September.

Critical habitat has been designated for the entire Lower Skagit and Upper Skagit River. Critical habitat primary constituent elements (PCEs) include freshwater spawning sites, freshwater rearing sites, and freshwater migration corridors. Additional PCEs were developed for estuarine and marine habitats.

b. Coastal/Puget Sound Bull Trout

The Skagit River supports the largest natural population of bull trout/Dolly Varden in Puget Sound. Of this population, lower Skagit bull trout were identified as a distinct stock based on their geographic location; an area which includes all of the Skagit River and its tributaries located below the Gorge Dam, excluding the Baker River (WDFW, 1998). Anadromous, fluvial, adfluvial, and resident life history forms are all found in the Skagit River system, at times spawning at the same time and place. Spawning usually takes place during September and October, and occurs in upriver areas that are less than 8°C (WDFW, 1998). Bull trout are apex predators that locate where prey is abundant. Bull trout will also follow prey around, such as migrating juvenile salmon.

Based on sampling by the Skagit River System Cooperative (Beamer and Henderson, 2004), bull trout were found to use delta blind tidal channels, but did not directly use smaller and shallower channels, or channels more distant from river distributaries. Trends in annual abundance remained constant. The presence of bull trout varies significantly throughout the year, with the primary period from April through August, with a peak in June. Bull trout in the Skagit are known to migrate to both Puget Sound and other river systems, including the Stillaguamish and Snohomish, in search of food, although the majority of these migrants return to the Skagit to spawn (Geotz, per. comm., 2008).

Bull trout are also present in Skagit Bay; however, their presence in shallow intertidal habitat was very low compared to the deeper intertidal-subtidal fringe. Bull trout are present in the deeper intertidal-subtidal habitats year round. Peak abundance in the bay occurs in May or June, with recent data showing a second peak in fall.

Critical habitat was designated for the entire Lower Skagit and Upper Skagit River to the portions of Ross Lake and its tributaries that lie within the boundaries of the United States. Critical habitat PCEs determined essential to the conservation of bull trout include water temperatures between 36°F and 59°F, complex stream channels, appropriate substrate for spawning and rearing success, a natural hydrograph, sufficient water quality and quantity including subsurface connectivity, migratory corridors, abundant food base, and lack of nonnative predatory or competitive species.

c. Puget Sound Steelhead

All six stocks of Skagit River steelhead (3 summer and 3 winter) utilize the project area. All but one of these stocks are native, and considered to be distinct based on geographic separation (WDFW and WWTIT, 1994; WDFW and WWTIT, 2003 draft). Steelhead in the Skagit River system spawn in both the mainstem and tributaries from the anadramous zones to the headwaters. Skagit mainstem winter steelhead spawning takes place in the mainstem Skagit from just above Mount Vernon up to Gorges Dam and all the major tributaries in between including the Nookachamps, Sauk and Cascade Rivers, and Lake Shannon and Baker Lake. Spawning occurs from early March to early June. Mainstem Skagit winter steelhead stock status has gone from healthy in 1992 to depressed in 2002 (WDFW and WWTIT, 1994; WDFW and WWTIT, 2003 draft). Finney Creek summer steelhead are thought to spawn in Finney Creek up to the falls at river mile 11.7, however, precise location are unknown. Spawn timing and stock status are also unknown. Sauk summer run steelhead spawn in the North Fork and South Fork of the Sauk River to just below the forks. Spawning occurs from mid-April to early June, and stock status in unknown. Sauk winter run steelhead takes place in the Sauk, Suiattle, and Whitechuck rivers and their tributaries. Spawn time occurs from mid-March to mid-July and the stock status in unknown Although, there is some fishing pressure on wild steelhead stocks the majority lies on hatchery fish that are planted in the river annually. Cascade summer run steelhead is thought to take place in the upper reaches of the Cascade river and its forks, however exact location are unknown. Spawning occurs from mid-January to early May, and stock status is unknown. Cascade winter run steelhead spawning locations are unknown, as is the spawning time (although it is thought to occur in early March through late June. The stock status is also unknown (WDFW and WWTIT, 1994; WDFW and WWTIT, 2003 draft). Although there is some fishing pressure on wild stocks of Skagit River steelhead the majority lies on hatchery stocked fish. Critical habitat has not yet been designated for Puget Sound Steelhead

e. Marbled Murrelet

Murrelets inhabit shallow marine waters and nest in mature old-growth forests. Critical habitat has been designated to include upland forested stands containing large trees (greater than 32 inches) in diameter with potential platforms for nesting (greater than 33 feet) and the surrounding forested areas within 0.5 mile of these stands with a canopy height of at least 1/2 the site-potential height (USFWS, 1996). All nest locations in Washington have been located in old-growth trees that were greater than 32 inches in diameter at breast height (dbh) (Ralph et al., 1995). Nest stand characteristics generally include a second story of the forest canopy that reaches or exceeds the height of the nest limb, thereby providing a protective enclosure surrounding the nest site. A single, large, closed-crowned tree, which provides its own protective cover over the nest site may also be used by murrelets (Ralph et al., 1995). Large, moss-covered limbs (greater than 7 inches diameter) in tall trees are utilized for egg-laying. Marbled murrelet nests have been located in stands as small as approximately seven acres (Hamer and Nelson, 1995) and are generally within 50 miles of marine waters. In Washington, marbled murrelet abundance was found to be highest in areas where old-growth/mature forest comprised more than 30 percent of the landscape. Murrelet nesting habitat is characteristic of the forested mountain landscape in the upper Skagit basin. Critical habitat for the marbled murrelet has been designated throughout the Upper Skagit basin (USFWS, 2006). US Forest surveys indicate that the northern half of the Mount Baker-Snoqualmie National Forest accounts for 50 percent of the nesting habitat and 85 percent of the detections in the entire forest (USFS, 2002). Numerous confirmed occurrences of marbles murrelets have occurred over the past two decades in both Whatcom and Skagit counties (WDFW, 2008).

f. Spotted Owl

Spotted owls can be found throughout the west slope of the Washington Cascades below elevations of 4,200 feet. Preferred owl habitat is composed of closed-canopy coniferous forests with multi-layered, multi-species canopies dominated by mature and/or old-growth trees (USFWS, 2007). Habitat characteristics include moderate to high canopy closure (60-80%); large (greater than 30" dbh) overstory trees; substantial amounts of standing snags, in-stand decadence, and coarse woody debris of various sizes and decay classes scattered on the forest floor (Gore et al. 1987; Thomas et al. 1990). Critical habitat is characterized as large continuous blocks of coniferous/mixed-hardwood forests that contained one or more of the primary constituent elements (primarily nesting and roosting, but also foraging and dispersal). It is usually equivalent to structures of Douglas fir stands 80 or more years of age (USFWS, 1992). Designated critical habitat for the northern spotted owl is found throughout the upper Skagit basin. Numerous confirmed occurrences of the spotted owl over the past two decades are documented in both Whatcom and Skagit counties (WDFW, 2008).

g. Grizzly Bear

Estimates according to Ingles, 1974, were approximately 10 grizzlies in Washington State with these few remaining in remote areas of the North Cascades. WDFW priority habitat lists both Whatcom and Skagit (both of which encompass the upper Skagit basin) along with all their neighboring habitats as potential grizzly bear habitat (WDFW, 2008). Recent estimates of grizzly bear population in the North Cascades range from 12 to 50 individuals (Almack et. al., 1993; MacCracken and O'Laughlin, 1998). According to the National Park Service approximately 10 - 20 grizzly bears live within Washington's North Cascades Grizzly Bear Recovery Area, *roughly* defined as the area between Interstate 90 in the south, up the Columbia and Okanogan Rivers on the east to the international boundary; then back south generally along the Mount Baker-Snoqualmie National Forest's western boundary (which is the western portion of both Skagit and Whatcom counties beginning just east of the towns of Lyman and Glacier). All five of the major dams on the Skagit River system fall within this recovery area. In British Columbia's North Cascades Grizzly Bear Population Unit (bounded by the Trans-Canada Highway, Highways 8, 5A and 3 and the international border), the minimum population estimate is 17 grizzly bears (NPS, 2008a). However, it is difficult to get exact estimates of grizzly bears as their territories can be several hundred square miles and their behavior is secretive. A study using DNA analysis of fur snags via barbed wire and scent lures showed only one grizzly present at the snag sites over the course of three years in the North Cascades and suggested that natural recovery seemed unlikely (Romain-Bondi et.al., 2004).

Grizzly bear sightings in the North Cascades Ecosystem are classified as categories 1-4, with class 1 being the most reliable (verified by a biologist, photograph, and/or carcass) and 4 being the least (a sighting initially reported as a grizzly but later confirmed to be another species). Between 1983 and 1991, there were 20 Class 1 sightings, 82 Class 2 sightings, and 102 Class 3 sightings. In 1996, a bear biologist saw a grizzly bear on the south side of Glacier Peak in the Glacier Peak Wilderness Area. This is the last recorded Class 1 observation (Grizzly Bear Outreach Project, 2008). According to the WDFW priority habitat database confirmed grizzly bear occurrences have been reported numerous times around Ross Lake in the 1970's, 80's, and 90's. They have also been occurrences at Diablo Dam in 1983, 1987, 1992, and 1993. The database also reports single confirmed occurrences near the North Fork Sauk river, the Cascade River, Bacon Creek west of Baker Lake, and Ruby Creek near the Okanogan county border (WDFW, 2008).

h. Gray Wolf

According to Ingles, 1974, the gray wolf is present in a small area in the North cascades, although rare, and in hard, cold winters they may come down to lower elevations for food. The northern part of the Upper Skagit Basin falls within this distribution. Washington Department of Fish and Wildlife also confirm the presence of wolves in the North Cascades. They are regularly sighted in southern British Columbia just north of North Cascades National Park. WDFW lists both Whatcom and Skagit County (both of which encompass the Upper Skagit watershed) along with all their neighboring counties as priority habitat for wolves (WDFW, 2008). The data base indicates many occurrences of gray wolves over the last two decades, many of which were within close proximity of Ross Lake. In 1991, wolves with pups were observed near Hozomeen at the north end of Ross Lake. Other confirmed occurrences in the watershed include Baker Lake in 1984 and 1992, the Sauk River in 1992, Suiattle River in 1989, and the mainstem Skagit near Briar and Copper Creeks in 1988 and 1992, respectively (WDFW, 2008). Locations of other sightings in the North Cascades include McAlester Pass, Pasayten Wilderness and Twisp River drainage of the Okanogan National Forest, Glacier Peak Wilderness, and Stevens Pass (NPS, 2008b). A more recent sighting of a grey wolf pair and pups, and howling surveys in July of 2008 have verified their presence in western Okanogon County just adjacent to Skagit and Whatcom counties (WDFW, 2008).

i. Canada Lynx

Lynx require dry forests where lodgepole pine is the dominant tree species. These areas are more typical of the east slopes of the Cascades. Lynx are rarely found below elevations of 4,000 feet, which is well above the elevations of the five major dams in the Upper Skagit Basin. In 2001, the population of lynx in Washington State was estimated at fewer than 100 individuals (Stinson, 2001). A small population of lynx inhabits the Pasayten Wilderness east of Ross Lake in the Okanogan National Forest (NPS, 2007). Critical habitat for Cananda Lynx has been designated on the eastern slopes of the Cascades in Okanogon County- just east of Skagit and Whatcom counties (USFWS, 2008). However, the WDFW priority habitat and species list includes both Whatcom and Skagit counties as priority habitat for Lynx and there are several confirmed occurences most if which are along the eastern most portions of the two counties along the Okanogon county border. In 2000 there were confirmed lynx occurrences on the west slopes of the cascades near Devils Dome and Buckskin Ridge just four miles and seven miles east of Ross Lake, respectively (WDFW, 2008). Numerous anecdotal reports of lynx have occurred around Baker Lake and Mount Baker (USFWS, 2001).

Climate change will have the same impacts on listed species as described in sections B7 and B8 under “Wildlife” and “Fish”. However, impacts to listed species may be more severe due to low population numbers.

11. Wetlands and Other Waters of the U.S.

National Wetland Inventory (NWI) maps identify many wetlands adjacent to the Upper Skagit River and at the confluences of tributaries (Sauk and Cascade Rivers and smaller creeks), as is to be expected. Primarily these wetlands are mapped as palustrine emergent (PEM), scrub-shrub (PSS) or forested (PFO) wetlands depending on location. In addition, pockets of wetlands are mapped in the surrounding landscape (away from the river) throughout the upper basin. Of particular note is a large complex which extends from south of Minkler (near Ross and Skiyou Islands) to south of Lyman to Hamilton. Additionally, in the areas south of Rockport to Marblemount and around the Sauk confluence a large wetland complex is identified, composed of remnant meanders and channels. Upstream of Marblemount fewer wetlands are mapped, whether this is a function of steeper terrain resulting in formation of fewer hydrologic processes leading to wetland formation or simply lack of wetland determination/delineation data is unknown. Those wetlands that are mapped upstream of Marblemount are primarily adjacent to lakes or streams which flow into Ross or Diablo Lakes, in particular Big Beaver and Goodell Creek. (USFWS, 2006)

In general, NWI maps were drawn using aerial photo analysis of vegetation patterns, visible hydrology and geographic position. Due to limitations of this type of aerial photo interpretation inaccuracies are common – often wetlands exist in areas not identified by NWI maps. This is particularly common in areas where human disturbance (agricultural practices or development) dominate the landscape, in the Upper Skagit this would be around the towns of Sedro Woolley, Lyman, Hamilton, Concrete, Rockport and Marblemount. In light of these possible errors, field verification of NWI maps is required to accurately identify wetlands throughout the Upper Skagit basin since no other region-wide wetland inventory has been conducted to date.

Climate change, and the associated changes in precipitation and groundwater patterns, may result in large scale changes to wetland complexes and the functions they provide. Increased intensity of flood events may alter the sedimentation deposition and erosion patterns. Changes in precipitation patterns may alter groundwater recharge/discharge rates and locations, and reduced summer river flow may alter the vegetation communities and animal habitats in these wetlands. (Kusler, 2005)

C. Water Resources

12. Water Quantity

a. Flood Characteristics

Because of its geographic location, the Skagit River Basin is subject to winter rain floods and annual high water due to snowmelt runoff during the spring or early summer as a result of a seasonal rise in temperatures. The snowmelt is characterized by its relatively slow rise and long duration. High water from snowmelt reached damage flood stage in 1937, 1939, and 1959. During the snowmelts, reservoirs that are used for power fill, frequently reducing the peak discharges. Floods resulting from severe rain events usually occur in November or December, but may occur as early as October or as late as February. In the winter, a light snowpack is frequently formed over most of the basin with heavier snowpack at higher altitudes. A heavy rain fall, accompanied by warm winds, completes the sequence which produces major floods. The heavy rain fall and accompanying snowmelt result in a high rate of runoff, as the ground is already nearly saturated from earlier precipitation.

Runoff patterns were fundamentally altered in many portions of the basin due to urbanization, road building, near-eradication of beaver populations, and timber harvesting. All of these activities tend to change water infiltration and storage within the watershed such that high flows become flashier, and low flow conditions are exacerbated. Widespread logging, particularly in the headwaters, appears to have contributed to more severe effects of rain-on-snow events that have repercussions throughout the channel systems and floodplains of the basin. Many smaller flood events that once scoured the river and inundated the adjacent flood plain no longer occur (Collins, 2000). Expected changes in precipitation due to climate changed, as described above in section A5 “Climate”, could intensify the pattern of flooding in the fall and winter and extreme low flow conditions in the summer.

b. Water Rights

In 2001, the Washington State Department of Ecology (Ecology) adopted an in-stream flow rule for the Skagit River basin that establishes minimum flows for the Skagit River at the Mount Vernon gauge. The minimum flows vary from 10,000 cfs to 13,000 cfs, depending on the time of year. The rule requires all surface water and groundwater users in the Skagit Basin, with a priority date later than the effective rule date, to curtail water use during times of year when the minimum flows are not achieved, unless it can be shown that such diversions or withdrawals do not affect flows in the Skagit River. These minimum flows are commonly not achieved during various times of the year, particularly in late summer and early fall. The rule effectively prohibits all new water uses throughout much of Skagit County. This rule was appealed in Thurston County Superior Court. By court order, Ecology issued two proposed amendments to the rule to address future water needs in the County. An amended rule was adopted in May 2006 calling for the creation of reservations of a limited amount of water for specific future uses that are not subject to the existing instream flows and allowing for future withdrawal even when minimum flows are exceeded (WDOE, 2006).

c. Water Quality

The Skagit River is designed for aquatic life uses as core summer salmonid habitat (WAC 173-201A-602). This use is characterized by use from June 15 to September for salmonid spawning or emergence, or adult holding; use as important summer rearing habitat by one or more salmonids; or foraging by adult and sub-adult native char. Other common characteristic aquatic life uses for waters in this category include spawning outside of the summer season, rearing, and migration by salmonids. Water quality standards (i.e., temperature, dissolved oxygen, and turbidity) are established based on this aquatic life use designation. In addition, the Skagit River is designated for primary contact recreational uses, all water supply uses, and all miscellaneous uses. (WDOE, 2008)

In general the upper reaches of the Skagit meet state water quality standards. There are two areas in the upper Skagit basin that are on the Ecology’s 303d list for temperature and fecal coliform (WDOE, 2008a).

i. Temperature

The Ecology’s 2008 303d list (designated as a category 5) includes the mainstem Skagit within WRIA 4 (Upper Skagit) for temperature near river mile 55. Also, Finney and Jackman Creeks were listed as a waters of concern (category 2) for temperature. According to the Skagit County 2007 Water Quality Monitoring Report 5 out of the 8 sites that were monitored above Sedro Woolley exceeded state standards of a 7 day maximum of 16C, all of these sites are tributaries. The mainstem Skagit monitoring station in this station did not exceed the 7 day maximum.

ii. Fecal coliform

The Ecology’s 2008 303d list includes Prairie Creek for fecal coliform. Prairie Creek is a tributary of the Sauk River near the town of Darrington. Another tributary, Red Cabin Creek, has been designated as a category 2 (waters of concern). According to the Skagit County 2007

Water Quality Monitoring Plan 2 out of the 8 sites exceeded state standards for fecal coliform. Both of these sites are tributaries.

iii. Dissolved Oxygen

There a no waters in above Sedro Woolley designated as category 5 (303d list) by Ecology for dissolved oxygen, however there are three small tributary creeks, Finney, Siuattle, and Goodell, designated as a category 2 (waters of concern). According to the Skagit County 2007 Water Quality Monitoring Plan only one of the monitoring sites, which was on a tributary, upstream of Sedro Woolley had an average DO that fell below the state standard of 9.5 mg/L.

iv. Sediment/Turbidity

There are no 303d listings or category 2 designations for the Upper Skagit Basin by Ecology for turbidity. However, logging practices in the Upper watershed contribute, along with other other landuse factors, contribute to turbidity both downstream and in Skagit Bay. The SWC's Strategy Application found degraded conditions in the Upper Skagit sub-basins, particularly for sediment supply and riparian conditions, but not to the same extent as the lower Skagit, primarily because of less intense human development and the extensive amount of federally protected land. During periods of summer warm temperatures and rain, high turbidity in the Skagit River can be attributed further to a natural condition of "glacial flour". Glacial flour consists of clay-sized particles of rock suspended in the river water, giving the water a cloudy appearance. Heavy turbidity in Skagit Bay is largely due to excessive siltation from the surface water runoff of the Skagit and Samish Rivers that results from flood events and glacial melt.

v. Chemical Contamination/Nutrients

There are no 303d listings or category 2 designations for chemical contamination (which are mainly pesticides) and/or nutrients by Ecology for the Upper Skagit River or any of its tributaries. However, plots of agricultural land occur along the Upper Skagit River from Sedro Woolley to Marblemount (just upstream of the confluence with the Cascade River) so elevated nutrient loads are likely. The Skagit County 2007 Annual Monitoring Report's most upstream station is just upstream of the town of Hamilton. Values of total nitrogen, total phosphorus, and ammonia are 0.08, 0.02, and 0.02 mg/l respectively, which is quite low in comparison with some of the downstream monitoring sites on the mainstem Skagit and its tributaries and sloughs.

D. Cultural Resources

The Skagit Delta contains important cultural resources representing the original native use of the region, potentially represented in archaeological sites and traditional cultural properties, as well as historic hydroelectric facilities, and white settlement patterns expressed primarily as domestic, agricultural, and commercial buildings and structures.

The Delta and adjacent uplands have been used and occupied by human populations for a considerable span of time. Although the exact duration is not known precisely, evidence that supports an estimate of 12,000 years was discovered elsewhere in the Puget Sound region and on the Olympic Peninsula. The oldest cultural resources found in the Skagit Delta area date to less than 5,000 years ago.

Before the 1850s, the Skagit Delta constituted a part of the territory associated with several culturally similar Indian groups. The northern delta was occupied by the Swinomish and Samish. The North Fork and adjacent areas were inhabited by the Lower Skagits. The South Fork was Kikiallu territory. The Upper Skagits resided in the area north and east of Mount Vernon. Euro-American settlement and dislocation of the resident Indian populations did not begin until the late 1850s. The Point Elliot Treaty of 1855 required most of the local Indians to resettle outside the delta on either the Swinomish or Tulalip Reservations.

The first Euro-American homestead along the Skagit River was settled in 1859. In 1863, the first trading post in the delta was opened at the point of divergence between the North and South Forks of the river. Six years later, the post became the site of Skagit City, the earliest river town. As the area's population grew, many additional towns were founded. Today, Mount Vernon, Burlington, and Sedro-Woolley remain as important centers of population and commerce. The early settlers quickly recognized the need for dikes to protect their holdings against the Skagit River’s frequent floods. Initially, levees were the responsibility of individual land owners, but the magnitude of the task soon prompted collective action and diking districts were formed in the late 1890s. As the levee system developed, the crests of these structures served as paths and later roads. Private ferries provided cross river transport. The Great Northern Railroad, now the Burlington Northern Santa Fe, was extended to Conway in 1889. Agriculture was initially, and continues to be, the principal economic activity in the delta. Logging operations began around 1865, but on the lowlands the resource was expended before 1920.

Reconnaissance, survey, and excavation of prehistoric cultural resources have been carried out sporadically in the Skagit Delta, although the vast potential of the delta's cultural resources, both prehistoric and historic, has largely remained unexplored. Although numerous project-related cultural resources projects have occurred in the Skagit Valley, no systematic survey has produced a comprehensive inventory of prehistoric or historic archaeological sites, or traditional cultural properties. Owing to cultural resources work associated with a prior Corps study and other work along the river, more sites have been recorded along the river downstream of Mt. Vernon on the North and South Forks than in other reaches or in proposed diversion areas. Currently, two properties within the Skagit Delta are listed in the National Register of Historic Places: the town of La Conner and the Skagit City School. In addition, the Fishtown Archeological District, a constellation of three prehistoric sites at the mouth of the North Fork, was nominated to the register. The Washington State Register of Historic Places includes the Old Skagit County Courthouse in Mount Vernon and the Methodist Church in Fir. The Washington State Inventory of Historic Places includes the town sites of Fir, Sterling, and Skagit City. During the summer and fall of 1978, the Corps contracted with Seattle Central Community College to conduct a cultural resources reconnaissance of the project area of the proposed Skagit River Levee Project. The reconnaissance identified 54 cultural resource sites, 20 prehistoric sites, and 34 historic sites. The prehistoric sites are largely habitation shell middens; the historic sites include elements of towns, farms, refuse areas, a cemetery, granary, and logging establishments.

Delta formation processes of meandering and progradation and other land forming processes have been active since human occupation of the region first began after the glaciers departed from the lowlands. Shifting of the river channel and deposition of sediment mean that sites on older buried landforms and surfaces can be expected nearly anywhere within the floodplain. Given the incomplete coverage of the Skagit Valley, there is a high likelihood that additional sites will be discovered. Due to the counterclockwise migration of the main channel from north to south, the northern portion of the delta potentially contains a greater age range of sites (e.g., older lithic sites on ridges and terraces and older buried sites near the Samish River) than the relatively younger deposits associated with the current North and South Fork. In addition, there is the potential for well preserved sites capped by lahars from Glacier Peak and sites with important information about paleo-seismic events (Salo, L., pers. comm. 2001).

Regarding historic era resources, some inventory work has been undertaken in the County, and some investigations have been conducted by Certified Local Governments. While historic property inventories – and register listings – have mostly targeted hydroelectric operations in the upper watershed, little attention has been focused outside these areas and on rural agricultural properties. A significant oral history project on historic land use in the Skagit watershed was undertaken with a series of volunteers provided through the Earthwatch Institute, and with the support of the Skagit Environmental Endowment Commission. This study produced audio and transcript records of these interviews.

E. Socioeconomics

Data from 2006 identified that 84.4 % of the Skagit County population is white. The remainder of the population identified themselves as black, American Indian, Alaska Native, Native Hawaiian, Pacific Islander, Asian, Hispanic or a combination. In 2000, the largest population centers in the study area were Mt. Vernon (26,232), Burlington (6,757) and Sedro-Woolley (8,658). Total county population in 2007 was estimated to be 116,397 (U.S. Census Bureau, 2009).

Population in the upper basin is sparse and centered around the small towns which line Highway 20, including Lyman, Hamilton, Concrete, Marblemount and Newhalem. Agriculture and logging are the primary activities around these small towns, with the exception of Newhalem which is composed of Seattle City Light employees who maintain the dams. The vast majority of land above Marblemount is heavily forested and used primarily for recreation. Most of this land is protected as either National Forest or National Park.

F. Air Quality and Noise

9. Air Quality

According to Environmental Protection Agency (EPA) Region 10 records, Skagit County is in attainment for the six criteria air pollutants. Although Skagit County has good air quality, there are periods when localized air quality can deteriorate. This usually occurs during times of stable weather when there is an absence of wind. Periodically, particulates can become an air pollutant of concern. (EPA, 2007 and 2007a).

10. Noise

Noise levels in the project area vary widely. The urban area of Sedro-Woolley, and smaller towns of Hamilton, Concrete, and Lyman have higher noise levels associated with higher density populations and associated commercial and residential development and traffic. The forested areas in the Upper Basin have lower noise levels.

G. Solid and Hazardous Waste (HTRW)

According to the Ecology there are several sites identified in both Sedro Woolley and Hamilton that have been identified as a "leaking underground tank site", many of which are gas stations. The majority of these sites are in the "cleanup started" status which means that the responsible party has initiated cleanup , but full cleanup has not yet occurred. Proximity of these sites to the river is not disclosed. There are many state listed confirmed and suspected hazardous waste sites, mostly confined to the towns of Sedro Woolley, Hamilton, and Lyman. None of these sites are directly on the Skagit River or any of its tributaries, with the exception of Puget Sound Energy's Upper Baker River Generation Station located on the Baker River. These sites are all either in the process remediation or have initiated a remediation plan (WDOE, 2008b).

No US EPA superfund sites are located in the Skagit River Basin.

III. DATA GAPS

Existing wetland inventories of the Upper Skagit Basin are deficient and need to be updated. The only existing surveys were conducted by the U.S. Fish and Wildlife Service National Wetland Inventory program using aerial photographs. No field verifications of mapped wetland locations has been documented.

No soil survey has been conducted by NRCS in areas designated as National Park or Forest in the upper basin, all areas upstream of RM 78.

Sediment data is lacking for high flow events. This information needs to be collected to help refine the sediment budget for the river and the geomorphic and hydraulic analysis of the system.

A cultural resources inventory will need to be conducted along project alignments to compensate for gaps in existing surveys. The likelihood of finding significant cultural resources will be high. Historic structures in the project area will also have to be identified in the inventory.

IV. EXPECTED WITHOUT-PROJECT FUTURE CONDITIONS - ENVIRONMENTAL

Estimation of future without project conditions is based on extrapolation of current trends, and does not account for changes in policy. Environmental change (e.g. climate change) will have to be considered in flood damage reduction planning as it impacts flow regime, major flooding events, and restoration strategies.

The county population will continue to increase. Currently the population of Skagit County is 116,397, most of which is located within the lower basin (Sedro Woolley and below). By 2030 the population is projected to range from 140,000-220,000 (Washington Office of Financial Management, 2007). The majority of this increase will likely take place in the lower basin due to the presence of North Cascades National Park and Mount Baker-Snoqualmie National Forest in the upper basin. However, due to the location of Mt. Vernon and Burlington, and the lack of an endless supply of developable land in the lower basin it is expected urbanization pressure will be felt in non-protected areas of the upper basin. Ultimately growth rates will be determined by availability of natural resources (i.e. water) and infrastructure. The recent Biological Opinion issued by the National Marine Fisheries Service regarding FEMA's flood insurance may play a role in development as well. In this Biological Opinion NFMS lists several "reasonable and prudent measures" in which FEMA's current flood insurance program (which has been determined to enable floodplain development) should be altered such that it doesn't jeopardize the continued existence of Puget Sound Chinook salmon, Puget Sound steelhead, Hood Canal summer chum, and Southern resident killer whales. If FEMA chooses to comply with these measures issued by NFMS, further development in the floodplain may slow down significantly as the costs associated with building in the floodplain could increase dramatically. If FEMA does not comply then agricultural land is at risk due to urbanization pressures and wetlands are also at risk, despite restoration actions. Increased urbanization will create more air and noise pollution; create the need for more infrastructure (including roads, water and electrical supply) and likely result in further fill of wetlands and deforestation of surrounding lands.

The result of this expected development will likely negatively effect the existing environment. Agricultural land may be converted to residential or commercial use creating more stormwater runoff and declines in water quality. Development in rural areas could lead to additional septic systems which often contribute to poor water quality in streams and tributaries that drain into the Skagit. Wetlands may be filled for development and all their associated functions lost including, flood attenuation and storage, water quality improvements, and wildlife and fish habitat. Loss of riparian vegetation in the upper basin will result in loss of wildlife and fish habitat, higher water temperatures, less organic river input which provides fish food, less recruitable LWD, and an increase in the presence of invasive species. Continued maintenance and construction of levees as it exists now, by both the Corps and the County, will further constrain the river, possibly in higher reaches of the upper basin. Additional or rehabilitated levees may create less bank complexity, eliminate benthic invertebrate habitat, increase scarcity of off-channel habitat, increase river speeds during high flow events, further reduce LWD retention and create shorter and thinner riparian corridors, particularly if existing Corps levee vegetation standards are continued. This will directly affect ESA listed species that depend on cold, clean water, organic detritus and benthic invertebrates for food, and LWD and bank complexity for cover. There will continue to be losses of salmonids due to high regulated flows and existing pressures present in the floodplain, estuary, and marine environments that are likely to persist, if not worsen due to human population growth and the effects of climate change discussed previously.

As stated previously, models from the UW Climate Impacts Group indicate that over the next century the Pacific Northwest area will likely see a trend toward wetter warmer winters and hotter dryer summers in response to climate change. However, these large scale models have difficulty resolving mountain climates such as the Cascades and the Upper Skagit basin so exact scenarios are difficult to predict. It is speculated that the Skagit River system may see higher flows in the winter as the majority of the precipitation would fall as rain and not snow, and lower flows in the summer due to lack of rain and snow melt. Initially, glacial melt would increase, but over time would decrease as the glacier retreats. These changes would greatly affect the upper basin ecosystems. Forest species composition may be altered due to changes in seasonal water availability, warmer air temperatures, increased pest occurrence and invasive species colonization, and changes to fire regimes. Changes in forest species composition will directly affect wildlife and fish through modification to habitat and food sources.

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