Final Report

Kittitas County Critical Areas Ordinance

BEST AVAILABLE SCIENCE REVIEW AND CONSIDERATIONS FOR CODE UPDATE

Prepared for: **June 2014**

Kittitas County Community Development Services

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1.0 INTRODUCTION

In 1990, the Washington state legislature passed the Growth Management Act (GMA), which requires cities and counties to designate and protect critical areas. In 1995, the legislature amended the GMA to require that local governments include Best Available Science (BAS) in designating and protecting critical areas, and also give special conservation to the conservation and protection of anadromous fisheries (RCW 36.70A.172). BAS is defined as current scientific information produced through a valid scientific process that is peer reviewed and includes clearly stated methods, logical conclusions and reasonable inferences, quantitative analysis, proper context, and references (WAC 365-195-905). BAS does not include nonscientific information such as anecdotal information, non-expert opinion, and hearsay. This document summarizes BAS for Kittitas County critical areas and provides recommendations for updating the County's critical areas ordinance (Title 17A of the Kittitas County Code [KCC]).

This document addressed the following critical areas, as defined by RCW 36.70A.030:

- Geologically hazardous areas (Chapter 2);
- Frequently flooded areas (Chapter 3);
- Critical aquifer recharge areas (CARAs) (Chapter 4);
- Wetlands (Chapter 5); and
- Fish and wildlife habitat conservation areas (FWHCAs) (Chapter 6).

1.1 Report Background and Purpose

The information contained within this document is a summary of scientific information relating to designating and protecting critical areas, including habitat for anadromous fish species, as defined by the GMA. The information provides a basis for recommended changes and additions to the Kittitas County's critical areas regulations.[1] This is not an exhaustive summary of all the science related to critical areas, but is instead a summary of the best available scientific information that is pertinent to Kittitas County and applicable to the types of critical areas present.

Each chapter of the report is devoted to a specific critical area. In many cases, the information presented for one critical areas overlaps, complements, or is applicable to another type of critical area because these areas function as integrated components of the ecosystem. The chapters summarize the information and issues that the County is required to consider within its process for updating policies and regulations to protect the functions and values of critical areas (RCW 36.70A.17(1)). Maps of the critical areas present within Kittitas County are included in Appendix A.

In some instances the GMA and its regulations constrain the choice of science that can be used to designate or protect a particular resource (e.g., local governments are required to use a specific

[1] In some instances, the BAS review supports existing provisions of the County code and no changes are recommended.

definition of wetlands). In other cases, there may be a range of options that are supported by science (e.g., wetland buffer widths necessary to protect functions).

The State legislature and the Growth Management Hearings Boards have defined critical area "protection" to mean preservation of critical area "structure, function, and value." Local governments are not required to protect all functions and values of all critical areas, but are required to achieve "no net loss" of critical area functions and values across the jurisdictional landscape. Local governments are also required to develop regulations that reduce hazards associated with geologically hazardous areas and frequently flooded areas. The standard of protection is to prevent adverse impacts to critical areas, to mitigate adverse impacts, and/or reduce risks associated with hazard areas.

This report was prepared by qualified scientists acting as consultants for County staff, and reviewed by a Technical Advisory Committee (TAC) composed of experts from federal, state, tribal, and local agencies (see Section 1.4.3).

1.2 Relationship to Other Planning Efforts

The recommendations derived from the BAS review will be used as the basis for revising the County's development regulations and Comprehensive Plan policies that pertain to critical areas. The County is required to integrate critical areas protection into zoning regulations, stormwater management requirements, subdivision regulations, and other applicable plans and policies.

Kittitas County is simultaneously working to update its Shoreline Master Program (SMP), as required by the Shoreline Management Act (RCW 90.58) and subsequent legislation and implementing regulations (WAC 173-26). Pursuant to WAC 172-26-201(2)(c),the updated SMP must include provisions to protect critical areas that occur within shoreline jurisdiction.[2] The County has chosen to incorporate critical areas regulations directly into the updated SMP; therefore, the updated critical areas regulations of KCC Title 17A would only apply to areas outside of shoreline jurisdiction. A draft version of this BAS review, along with other scientific studies and data collected in 2012 and 2013, was used as the basis for development of the SMP critical areas regulations.

1.3 Role of the Voluntary Stewardship Program in Protecting Critical Areas

In 2011, the state adopted the Voluntary Stewardship Program (VSP) (RCW 30A.705 – 904). The purpose of the VSP is to protect natural resources, including critical areas, while maintaining and enhancing the state's agricultural uses. It encourages voluntary local stewardship efforts as an alternative to critical areas regulation under the GMA. Of the 39 counties in Washington, 28, including Kittitas County, elected to participate in the program.

Currently, the County has no funding to implement the VSP (funding is supposed to be provided by the Legislature). Counties are not required to implement the VSP until adequate state funding is available. Once this occurs, the County will designate a watershed group to lead stewardship

[2] SMP jurisdiction includes streams with a mean annual flow of 20 cubic feet per second or greater and lakes 20 acres in area or greater and, at a minimum, their adjacent shorelands extending 200 feet landward and associated wetlands and river floodways.

activities in the participating watersheds. The watershed group will draft a work plan that includes a stewardship component that protects natural resources in the participating watersheds and an enhancement component for improving the quality of critical areas. The stewardship component will include goals and monitoring measures that must be met in order for the County to remain eligible to participate in the VSP. The enhancement component will be entirely voluntary and activities will be implemented as funding is available.

If implemented in Kittitas County, the VSP would apply to lands within the Upper Yakima and Alki-Squilchuck watersheds (Figure 1-1). These watersheds are important for salmonid and wildlife habitat as well as farming, and there are numerous local and regional efforts underway to restore ecological functions in these areas. If the VSP is implemented, these two watersheds would not be subject to the revised critical areas provisions. If the state does not provide adequate funding to implement the VSP, or if the VSP is implemented but adequate progress is not made in meeting the goals of the work plan, Kittitas County will be required to either create a new work plan or adopt critical areas regulations for agricultural lands consistent with the GMA.

The third watershed in Kittitas County, the Naches, is zoned primarily for commercial forest with no existing farming or potential for future farming. Existing agricultural activities within the Naches watershed are generally limited to livestock grazing. Most of the Naches watershed is located outside Kittitas County boundaries. The County did not enroll the Naches watershed in the VSP, and these lands will be subject to the revised critical areas code (Kittitas County 2011).

1.4 History of Critical Areas Regulations in Kittitas County

1.4.1 Development of Original Critical Areas Code

As required by the 1990 GMA, Kittitas County originally enacted critical areas regulations in 1994 (Ordinance 94-22), which were codified in KCC Title 17A. Minor amendments to KCC Title 17A occurred in 1995 and 1996.

1.4.2 Updating Existing Regulations

The Washington state legislature amended the GMA in 1995 to require local governments to include BAS in designating and protecting critical areas (RCW 36.70A.172). Kittitas County began the process of updating its critical areas regulations and SMP in 2011. The first steps in the critical areas regulations update process were to develop an inventory of the critical areas found within the County (see Appendix A) and assemble and review the BAS relevant to the critical areas found within the County (this report). The information in this report was reviewed by a Technical Advisory Committee (TAC) and the County, and is presented here in final form.

The BAS information in this report will be used to support development of revised draft County critical areas regulations. The draft regulations will undergo review by a Citizen's Advisory Committee (CAC), County staff, the public at large, and other interested parties. Following this review, the draft regulations will be revised and then reviewed by the Kittitas County Planning Commission. Ultimately, the updated critical areas regulations will be reviewed and adopted by the County Board of Commissioners, and will replace the existing KCC Title 17A for land not covered by the VSP. Until the VSP is adopted, the existing critical area regulations in KCC Title 17A will continue to apply to agricultural activities in the Upper Yakima and Alki-Squilchuck watersheds.

Figure 1-1. WRIA boundaries and ecoregions in Kittitas County (ESA, 2013).

1.4.3 Role of the TAC and CAC

A Technical Advisory Committee (TAC) composed of experts from federal, state, tribal, and local agencies was convened to help focus technical discussion and identify key technical and policy issues associated with the update process. In a series of meeting in 2012, the TAC reviewed the information presented here in draft form and provided comments. In many cases, TAC members provided scientific studies and data to be included in this review.

A Citizen Advisory Committee (CAC) was established to provide assistance in preparing final recommendations on critical area goals, policies, and regulations. The CAC is scheduled to begin reviewing GMA-related critical area update materials in the summer of 2014.

Members of the public are welcome to attend the TAC and CAC meetings and address the committees with their ideas and feedback. The public is also encouraged to submit written comments.

1.5 County Setting

Kittitas County is situated in central Washington on the eastern slopes of the Cascade Mountains, between the Cascade Crest and the Columbia River in the Columbia River basin. The county is contained within three major basins: Upper Yakima (Water Resource Inventory Area [WRIA] 39), Alkali – Squilchuck (WRIA 40), and Naches basin (WRIA 38) (Figure 1-1). Of the 2,297 square miles that constitutes Kittitas County, the majority (78 percent) lies within the Upper Yakima basin (WRIA 39), which drains into the Yakima River. The Alkali – Squilchuck basin (WRIA 40) comprises 17 percent of the County in the eastern portion and drains into the Columbia River. The remaining 5 percent of the County is contained in the Naches basin (WRIA 38) on its southwestern edge and drains into the Little Naches River, which becomes the Naches River joining the Yakima River in Yakima County.

Four different ecoregions are found within Kittitas County: North Cascades, Cascades, Eastern Cascades Slopes and Foothills, and Columbia Plateau (Figure 1-1). The North Cascades ecoregion, in the northwestern portion of the county, is characterized by glaciated valleys and narrow-crested ridges punctuated by rugged, high relief peaks approaching 8,000 feet above mean sea level. It is forested with fir, hemlock, and, in the drier eastern margins, pine. The Cascades ecoregion, located in southwestern Kittitas County, is similar to the North Cascades, but in contrast has more gently undulating terrain, the climate is more temperate, and there is less occurrence of ponderosa pine. The Eastern Cascades Slopes and Foothills ecoregion bisects the central portion of the county. This ecoregion receives less precipitation than the North Cascades and Cascades and has higher temperature extremes. It is forested with open stands of ponderosa pine and some lodgepole pine. To the east of the Eastern Cascades Slopes and Foothills lies semi-arid shrub-steppe and grasslands that are part of the Columbia Plateau ecoregion. In this region, low-lying land adjacent the Yakima River valley floor has mostly been converted to irrigated agriculture. The Columbia River runs through this ecoregion on the eastern edge of the county. Its banks in the southeast section have the lowest elevation in the county at 475 feet above mean sea level.

The forest, shrub steppe, grasslands, riparian habitats, wetlands and agricultural lands within the County provide habitat for a variety of wildlife species, including listed species such as northern spotted owl, marbled murrelets, grizzly bear, gray wolf and North American wolverine. The Columbia River Gorge defines the eastern boundary of Kittitas County with grasslands, agricultural land, and shrub steppe habitat comprising the foothill areas moving westward through the County to the western boundary at the crest of the Cascade Range. The foothills provide important wintering and calving grounds for large mammals including elk, bighorn sheep. The County also supports important breeding populations of raptors including golden eagle and ferruginous hawks, and the sagebrush plains support priority species including sage sparrows, sage thrashers, and the greater sage grouse.

The aquatic habitats of Kittitas County support a number of special status species and priority habitats and species, including bull trout, Chinook salmon, and steelhead. Within the County there are over 9,270 miles of riverine/stream habitat and numerous large lakes or impoundments (Keechelus, Kachess and Cle-Elum Reservoirs). The Yakima River, and Cle Elum, Kachess and Keechelus Reservoirs are the major aquatic priority habits within the County that are not located entirely on federal land. The reservoirs identified above have blocked access to suitable habitat upstream of the reservoirs and have genetically isolated fish populations above the reservoirs. Much of the County's upper headwater tributary streams occur in forest lands managed by the U.S. Forest Service. The Columbia River system is the largest river system in the County and forms the County's eastern boundary. The Columbia River system supports Chinook salmon, coho salmon, sockeye salmon and steelhead, as well as bull trout and white sturgeon.

Kittitas County contains a mix of federal, state, and private land. Almost two-thirds (68%) of land in the county is publicly owned and managed by a variety of agencies, including the U.S. Forest Service, U.S. Department of Defense, Washington Department of Natural Resources (WDNR), and the Washington State Department of Fish and Wildlife (WDFW). Approximately one-third (32 percent) of the County consists of privately-owned land, much of which is in agricultural production.

Kittitas County has a population density of 17.8 persons per square mile, which is low compared to 101.1 for the State of Washington. The vast majority of Kittitas County's population of 40,915 resides in the Upper Yakima basin (WRIA 39) in and around the five incorporated cities in the county: Ellensburg, Cle Elum, South Cle Elum, Kittitas, and Roslyn. Of these five cities, the largest population center is Ellensburg with 18,174 residents. The city is located adjacent to the Yakima River and is surrounded by irrigated agriculture. The second largest population center in the county is the conglomeration of Cle Elum, South Cle Elum, and Roslyn, located near the Yakima River and Cle Elum River in the Cascade foothills. These three cities have a combined total of 3,222 residents. The Alkali – Squilchuck (WRIA 40) basin has approximately 192 residents, while the Naches basin is unpopulated.

2.0 GEOLOGICALLY HAZARDOUS AREAS

This chapter describes geologically hazardous areas in Kittitas County, and summarizes the scientific literature concerning various types of geologic hazards and how they can affect or be affected by land use and other human activities. The chapter also presents an overview of the management and protection tools for these areas. The purpose of this chapter is to establish a basis for recommending updates to the geologically hazardous provisions of (KCC Chapter 17A.06).

Kittitas County is a geologically active area and some areas within the County are considered to be geologically hazardous. The Growth Management Act (GMA) defines geologically hazardous areas as "areas that because of their susceptibility to erosion, sliding, earthquake, or other geological events, are not suited to the siting of commercial, residential, or industrial development consistent with public health or safety concerns" (RCW 36.70A.030[9]). Some geological hazards can be reduced or mitigated by engineering, design, or modified construction practices so that risks to health and safety are acceptable.

The GMA-specified geologically hazardous areas that are found within Kittitas County are as follows:

- <u>Erosion hazard areas</u>: Areas likely to become unstable, such as bluffs, steep slopes, and areas with unconsolidated soils.
- <u>Landslide hazard areas</u>: Areas that are potentially subject to landslides based on a combination of geologic, topographic, and hydrologic factors. They include any areas susceptible because of any combination of bedrock, soil, slope (gradient), slope aspect, structure, hydrology, or other factors. Landslide hazards include, at a minimum, the following:
    1. Areas of historic failures, such as:
        - Those areas delineated by the Natural Resource Conservation Service (NRCS) as having a "severe" limitation for building site development; or
        - Those areas mapped as class u (unstable), uos (unstable old slides), and urs (unstable recent slides) in the Department of Ecology Coastal Zone Atlas; or
        - Areas designated as quaternary slumps, earth-flows, mudflows, lahars, or landslides on maps published as the U.S. Geological Survey or Washington Department of Natural Resources (DNR) Division of Geology and Earth Resources.
    2. Areas with all three of the following characteristics:
        - Slopes steeper than 15 percent;
        - Hillsides intersecting geologic contacts with a relatively permeable sediment overlying a relatively impermeable sediment or bedrock; and
        - Springs or groundwater seepage.
    3. Areas that have shown movement during the Holocene epoch (from 10,000 years ago to the present) or which are underlain or covered by mass wastage debris of this epoch;

4. Slopes that are parallel or subparallel to planes of weakness (such as bedding planes, joint systems, and fault planes) in subsurface materials;
5. Slopes having gradients steeper than 80 percent subject to rockfall during seismic shaking;
6. Areas potentially unstable as a result of rapid stream incision, stream bank erosion, and undercutting by wave action, including stream channel migration zones;
7. Areas that show evidence of, or are at risk from, snow avalanches;
8. Areas located in a canyon or on an active alluvial fan, presently or potentially subject to inundation by debris flows or catastrophic flooding; and
9. Any area with a slope of forty percent or steeper and with a vertical relief of ten or more feet except areas composed of bedrock. A slope is delineated by establishing its toe and top and measured by averaging the inclination over at least ten feet of vertical relief.

- Seismic hazard areas: Areas subject to severe risk of damage as a result of earthquake induced ground shaking, slope failure, settlement or subsidence, soil liquefaction, or surface faulting. Settlement and soil liquefaction conditions occur in areas underlain by cohesionless soils of low density, typically in association with a shallow groundwater table. One indicator of potential for future earthquake damage is a record of earthquake damage in the past.
- Other geologically hazardous areas:
  - Volcanic hazard areas: Areas subject to pyroclastic flows, lava flows, debris avalanche, or inundation by debris flows, lahars, mudflows, or related flooding resulting from volcanic activity; and
  - Mine hazard areas: Areas underlain by, adjacent to, or affected by mine workings such as adits, gangways, tunnels, drifts, or air shafts. Factors which should be considered include: proximity to development, depth from ground surface to the mine workings, and geologic material.

2.1 Inventory of Geologically Hazardous Areas in Kittitas County

Identification of geologically hazardous areas requires analysis and understanding of surface and subsurface geology, soils, slopes, faults, watershed conditions, hydrology, streamflow records, and other landform features. Estimates of the rate and frequency of geologic change are also important because geologic processes form, modify, and erode the land surface over time. Many types of geologically hazardous areas can be identified using available geologic maps, soil surveys and/or various types of remote sensing tools such as LiDAR, but precise identification, mapping and assessment of risk generally requires site-specific data and analyses.

Not all of the geologically hazardous areas in Kittitas County have been identified or mapped. A map of known geologically hazardous areas is presented in Appendix A. The map depicts steep slopes, landslide hazard areas, and seismic hazards (derived from the Washington Department of Natural Resources (DNR) liquefaction susceptibility data) in Kittitas County. Channel migration zone (a type of landslide hazard) mapping is available from the County. Mine hazard areas have not been comprehensively inventoried or mapped, but historic maps of known mines are available on the DNR website.

2.1.1 Geologic Overview

Kittitas County is situated in central Washington on the eastern slopes of the Cascade Mountains between the Cascade Crest and the Columbia River in the Columbia River basin. The major geological features of Kittitas County are the Cascade and Wenatchee Mountains on the west and north portions, the south-central Yakima River Valley, and the Boylston and Saddle Mountains at the southeastern edge along the Columbia River. The far northern and southwestern areas of the County generally contain the steepest slopes with considerable areas that have slopes greater than 35 percent (Kittitas County, 2012a). The eastern part of the County consists more of low, rolling to moderately steep glacial terraces and long, narrow valleys. The southeast section of the County is characterized by moderately steep to steep glacial terraces and steep, rough, broken mountain foothills.

Kittitas County lies within the Yakima Fold Belt subprovince of the Columbia Plateau (Lasmanis, 1991). Slope, geologic and soil conditions vary dramatically throughout the County and include steep mountain peaks, foothills, broad alluvial valleys, and near-desert areas. A simplified geologic sequence for this subprovince includes very old basement sedimentary rocks overlain by consolidated sedimentary rocks, Columbia River basalt flows interbedded with sedimentary layers, and relatively young unconsolidated (or weakly consolidated) materials (e.g., glacial deposits, lacustrine, loess, recent alluvium, etc.). Alpine and continental glaciers moved through this region helping to shape the mountains and deposit glacial materials on older formations.

The primary types of glacial deposits in the County are outwash and till (Lasmanis, 1991). Outwash consists of unconsolidated sand, gravel and rocks and results from runoff of melting glaciers. Outwash is usually loose and highly permeable. Glacial till, or hardpan, consists of unsorted clay, sand, grave, or rock that has been compacted by the weight of the glacial ice into a highly impervious, concrete-like material.

All of these geologic units have been influenced in some way by ongoing structural faulting and folding. Folding occurred in a north-south direction in association with tectonic activity and Cascade volcanism (Lasmanis, 1991). Structural basins formed by this ongoing faulting and folding have typically been filled with un- or weakly consolidated materials.

Three faults known as the Kittitas Valley faults are located within the County. These east-striking faults collectively show a right-stepping pattern in the broad, northwest-trending Kittitas Valley (Lidke, 2002). The Kittitas Valley coincides with a broad northwest-trending syncline that is expressed mostly in Miocene rocks of the Columbia Plateau Basalt Group (Lidke, 2002).

2.1.2 Erosion Hazard Areas

Erosion hazard areas occur throughout Kittitas County and are generally associated with steep slopes and/or highly erodible soils, which are common in higher-elevation mountainous areas and canyons. Runoff and erosion can occur in these areas when vegetation or surface soil layers are removed. If left unchecked, erosion areas can grow into problem areas delivering significant amounts of sediment to lakes, streams, and wetlands and possibly leading to landslides.

Vegetation, landform shape, slope gradient, slope length, rainfall intensity, drainage conditions, and other factors can be used to identify erosion-prone landtypes. Soils surveys are very useful in identifying the main erosion hazard areas. The USDA Soil Survey of Kittitas County (NRCS, 2010) describes characteristics associated with each soil type in the County including its level of probability for erosion. The erosion estimates, based primarily on percentage of silt, sand, and organic matter and on soil structure and saturated hydraulic conductivity, are expressed as K-Factor (see Table 9 in the Kittitas County Soil Survey, 2010).

K-Factor is one of six factors used to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. Values of K range from 0.02 to 0.69. Other factors being equal, the higher the K value, the more susceptible the soil is to sheet and rill erosion by water. Soils in Kittitas County exhibit a wide range of susceptibility to erosion. Erodability may be exacerbated in high gradient areas of the upper watersheds.

2.1.3 Landslide Hazard Areas

Landslide hazard areas are those portions of the landscape that have existing landslides or are at risk of future failure. Mass movement or mass wasting is the more general classification that includes landslides. Mass wasting includes the downward and outward movement of slope-forming materials including rock, soils, artificial fills, and combinations of these materials (Gray and Sotir, 1996). Within the County, landslide hazard areas are prevalent in the higher-elevation mountainous areas, as well as canyons throughout the County.

There have been many recorded landslide events in Kittitas County, including over 20 slides in the Kittitas Valley since the 1930s (Johnson, 2010). Mass wasting events are common along Columbia River Basalts in eastern Washington (Lillquist, 2001). Slope failures are typically associated with steep slopes, inclined beds, incompetent geologic units, stream-cuts, road-cuts, and clear-cuts. In addition, extreme climatic events such as rain on snow events can activate slopes which were previously considered stable. Summer rainstorms have also caused large-scale landslides and debris flows within the County (Kaatz, 2001). For example, in the summer of 1998, a severe thunderstorm and cloudburst triggered a large debris flow along the Yakima River, which buried portions of State Route 821 (Canyon Road).

A study of the Swauk Creek watershed found that slope failures covered approximately 38 percent of the watershed (Lillquist, 2001). Translational slides were the most numerous, but complex slide-flows cover the most area. Slope failures were placed into four categories based on age: active, inactive-young, inactive-mature, and inactive-old. Rockfall deposits cover approximately 29 percent of the watershed, range from inactive to active, and are typically found on top of previous slope failures in well-jointed Columbia River Basalts.

Slope stability depends on a number of complex variables (Montgomery et al., 1998). The geology, structure, and amount of groundwater in the slope affect slope failure potential, as do external processes (i.e., climate, topography, slope geometry, and human activity). Steeper areas have more landslides because of the greater slope, more active soil processes, and surface and subsurface water conditions (Thorsen, 1989). Slopes steeper than approximately 35 percent typically have more landslides and are classified as higher risk landslide hazard areas for clearing and grading. Slopes steeper than 60 percent present an elevated slide risk with road building or tree cutting (Swanston, 1970; 1978; 1980; 1981; 1989; 1997). Slopes steeper than 35 percent are present throughout the County, concentrated primarily in mountainous areas (see map in Appendix A).

The factors that contribute to slope movements include those that decrease the resistance in the slope materials and those that increase the stresses on the slope. Slope failure under static forces occurs when those forces initiating failure overcome the forces resisting slope movement. For example, a soil slope may be considered stable until it becomes saturated with water (e.g., during heavy rains or due to a broken pipe or sewer line). Under saturated conditions, the water pressure in the individual pores within the soil increases, reducing the strength of the soil. Cutting into the slope and removing the lower portion, or slope toe, can reduce or eliminate the slope support, thereby increasing stress on the slope.

Although gravity acting on and over steepened slopes is the primary reason for a landslide, there are other contributing factors, including: erosion by rivers; soil saturation from snowmelt or heavy rains; earthquakes; and volcanic eruptions.

Landslides occur due to the downslope displacement and movement of material, either triggered by static (i.e., gravity) or dynamic (i.e., earthquake) forces. Exposed rock slopes undergo rockfalls, rockslides, or rock avalanches, while soil slopes experience shallow soil slides, rapid debris flows, and deep-seated rotational slides. Debris flows consist of a loose mass of rocks and other granular material that, if saturated and present on a steep slope, can move downslope. Landslides may occur on slopes of 15 percent or less; however, the probability is greater on steeper slopes that exhibit old landslide features such as scarps, slanted vegetation, and transverse ridges. The rate of rock and soil movement during a landslide can vary from a slow creep over many years to a sudden mass movement.

2.1.3.1 Channel Migration Hazard Areas

Channel migration is a type of landslide hazard associated with stream bank erosion, which can occur gradually over a period of years or rapidly during one high flow event. Stream channels adjust over time to the watershed, valley bottom, and flood conditions. Deposition and erosion along the streams and especially on alluvial fans can frequently adjust the stream flow and the whole stream channel can shift or jump (channel avulsion) across the channel migration zone. Channel migration can cause serious damage to people and property, especially since catastrophic events can happen with little to no warning. Channel migration is a natural process that builds the floodplain, terraces, and maintains landforms along the valley bottoms. The importance of channel migration as a habitat-forming ecological process is described in detail in the fish and wildlife habitat conservation areas chapter (Chapter 6).

Kittitas County has many areas that are potentially unstable and subject to future stream channel migration including areas located in canyons, on active alluvial fans, and/or presently or potentially subject to inundation by debris flows or catastrophic flooding. Some of the areas at risk of channel migration include portions of the Teanaway River system, Kachess River, Cabin Creek, Coleman Creek, Gold Creek, Coal Creek, Yakima River, Big Creek, Little Creek, Cle Elum River, Taneum Creek, Manastash Creek, and Naneum Creek (ESA, 2013). The Teanaway River, Manastash Creek, and Gold Creek, in particular, experience periodic significant migration events. As part of its Shoreline Master Program update, the County identified and mapped the approximate location and extent of channel migration areas for several Shoreline Management Act-designated shorelines of the state, as specified by Ecology.

The channel migration zone analysis and mapping also identified alluvial fan hazard areas. Alluvial fans are defined as fan- or cone-shaped deposits of sediment that are crossed and built up by streams. Alluvial fans are subject to flooding, debris flows, and channel avulsion. Within the County, large alluvial fans are associated with the Wilson/Naneum creek system and Manastash Creek. Major flood and erosion episodes periodically occur within the Manastash system, with the latest occurring in 2011.

Channel migration zone boundaries were delineated based upon observations of geomorphic alluvial features (e.g., abandoned channels, oxbows, depressions within valley alluvium) using aerial photography and digital elevation data, per the methodology being developed by Ecology. Using this methodology, both the Yakima and lower Cle Elum rivers were determined to have relatively wide migration zones. The hydrographs of both rivers were highly altered by the installation of the storage system (via dams), which has generally reduced the frequency and magnitude of peak flows. The changes in hydrograph may have reduced or eliminated the ability of both streams to occupy historical portions of their channel migration zones. Therefore, the channel migration zones identified for the Yakima and lower Cle Elum Rivers may be conservatively large as the mapping methods rely on landscape and geomorphic indicators that may be relict under the current hydrologic regime, which is controlled by upstream dams and reservoirs. This CMZ analysis did not include any specific modeling or quantitative assessment of current hydrologic regime, hydraulics, or stream power.

2.1.3.2 Avalanche Hazard Areas

A snow avalanche is a type of slope failure that can occur whenever snow is deposited on slopes steeper than about 20 to 30 degrees. Some parts of western Kittitas County experience avalanche hazards, particularly in the Cascade Mountains (Kittitas County, 2012b). There are two basic types of snow avalanches: point release and slab.

A point release avalanche is the result of a small amount of cohesionless snow slipping out of place, moving downslope, and encountering additional cohesionless snow, such that the failure progresses and spreads out into a characteristic inverted V-shaped pattern. Point release events typically occur either within the cohesionless near-surface layers of newly fallen snow or within the wet surface snow resulting from melt conditions. Point release events usually involve small volumes and generally present a small degree of hazard.

In contrast, a slab release avalanche occurs when a cohesive cover of snow rests above a layer of lesser strength, along which the eventual sliding failure occurs when shear stress exceeds shear resistance. Slab release typically results from a complex series of events, often originating within a snow cover creeping downslope. Direct loads due to falling cornices, passage of humans through the starting zone, rockfalls, rain-on-snow events, or elastic waves from blasting or earthquakes can trigger slab avalanches. Slab avalanches initiated within cohesive snow cover on slopes steeper than 25 degrees present the majority of avalanche hazards and are the main focus of defense and control measures. With relatively homogeneous snow properties, the fracture may spread for a great distance across a slope and may include a large volume of snow. Fractures may extend as much as several feet into the snow cover. Prediction of slab avalanches is difficult because the location of initial failure is frequently well below the surface, within the layers that accumulated weeks or months earlier. Slab avalanches present a significant hazard due to difficulty of prediction, in addition to their potential for release over large areas. The hazard to activity and structures in the avalanche run-out zone is high due to the large volumes of snow that can be activated by a slab release. Wet snow avalanches present additional problems due to their high mobility and erratic run-out style. Also important is the rapid mass movement of water-saturated snow, known as a slush flow.

Avalanche-prone areas can be delineated with some accuracy, since under normal circumstances avalanches tend to run down the same paths year after year, although exceptional weather conditions can produce avalanches that overrun normal path boundaries or create new paths. At lower elevations of the Cascades, the avalanche season begins in November and continues until the last remnants of snow have melted in early summer. In the high alpine regions, the hazard continues year-round. Hundreds of thousands of avalanches are thought to occur each year in the Cascades.

2.1.4 Seismic Hazard Areas

Seismic hazard areas are subject to a severe risk of damage as a result of ground shaking, differential settlement, or soil liquefaction or surface fault rupture caused by earthquakes. The damage caused by seismic activity is dependent upon the intensity of the earthquake, its proximity to developed areas and population centers, the slope thickness, consolidation, and moisture conditions of the surface and subsurface materials, and many other factors.

Washington is situated at a convergent continental margin where the collisional boundary between two tectonic plates occurs. The Cascadia subduction zone, which is the convergent boundary between the North America plate and the Juan de Fuca plate, lies offshore of Washington, Oregon, and northern California. The two plates are converging at a rate of about 2 inches per year; in addition, the northward-moving Pacific plate is pushing the Juan de Fuca plate north, causing complex seismic strain to accumulate. Earthquakes are caused by the abrupt release of this slowly accumulated strain.

There are three types of earthquakes found in Washington: intraplate or Benioff-zone earthquakes, shallow crustal earthquakes, and subduction zone (interplate) earthquakes (DNR, 2012).

Intraplate or Benioff-zone earthquakes occur in the subducting Juan de Fuca plate at depths of over 15 to 62 miles. As the Juan de Fuca plate subducts under the North America plate, earthquakes are caused by the abrupt release of slowly accumulated strain. Benioff-zone ruptures usually have dip-slip or normal faulting and produce no large aftershocks. These earthquakes are caused by mineral changes as the plate moves deeper into the mantle. Temperatures and pressure increase, and the minerals making up the plate alter to denser forms that are more stable at the increased temperature and pressure. The plate shrinks and stresses build up that pull the plate apart.

Shallow crustal earthquakes occur within about 30 kilometers of the surface, and are caused by the rupture of faults within the North American plate. They have the potential to be highly damaging to people and property, as they occur relatively close to the earth's surface. Shallow crustal earthquakes are the primary mechanism for earthquakes in Kittitas County.

Subduction zone (interplate) earthquakes occur along the interface, between tectonic plates. Compelling evidence for great-magnitude earthquakes along the Cascadia subduction zone has recently been discovered. These earthquakes were potentially devastating (magnitude 8.0 to 9.0+) and recurred on average every 550 years. The recurrence interval, however, has apparently been irregular, as short as about 100 years and as long as about 1,100 years. The last of these great earthquakes occurred in Washington about 300 years ago. The USGS is currently conducting studies to further understand seismic risks in Eastern Washington which may be greater than previously recognized.

Areas considered to be at high risk of earthquake damage include surface deposits of manmade fill or partially decomposed organic material, filled wetlands, and areas of alluvial deposits subject to liquefaction. However, seismic risk is very complex and site conditions vary widely throughout the County. While some areas face a greater risk than others, all of Kittitas County is potentially at risk of significant earthquake damage.

Earthquakes can trigger large and sometimes disastrous landslides. Earthquakes can also weaken dams and levees. The County's Hazard Mitigation Plan assesses risks of dam failure including failure associated with seismic events (Kittitas County, 2012b).

Kittitas County is considered to be seismically active and while no major earthquake (magnitude 7 or more) has occurred in the last 300 years there is a potential for one to occur in the future. Damage from a seismic event would most likely result from ground shaking. Ground movement during an earthquake can vary depending on the overall magnitude, distance to the fault, focus of earthquake energy, and type of underlying geologic material. The composition of underlying soils, even those relatively distant from faults, can intensify ground shaking through amplification of ground movement and prolonging ground shaking. Secondary effects such as settlement, differential settlement, liquefaction, and lateral spreading are other seismic hazards associated with earthquake events.

2.1.4.1 Ground Shaking

An earthquake is an abrupt movement of the earth's crust, caused by a sudden release of energy that has accumulated over time along a plane of movement known as a fault (USGS, 1997). Energy can be released through a sudden dislocation of fault blocks, triggered by volcanic activity, or through human made activities such as explosions. Dislocations of the crust expressed at the surface typically cause the most destruction. The crust may first bend and then, when the stress exceeds the strength of the rocks, break and snap to a new position. In the process of breaking, vibrations called seismic waves are generated. These waves travel outward from the source of the earthquake, along the surface and through the earth at varying speeds, depending on the material through which they move. The focal depth of an earthquake is the depth from the earth's surface to the region where an earthquake's energy originates (the focus).

Since 1971, a total of 33 recorded earthquakes of magnitude 3.0 or greater have occurred within the County ranging in magnitude from 3.0 to 4.3 (Kittitas County, 2012b). Earthquakes of this magnitude are considered to be generally minor to light.

2.1.4.2 Settlement

Ground settlement can occur from immediate settlement, consolidation, shrinkage of expansive soil, and liquefaction (discussed below). Immediate settlement occurs when a load from a structure or placement of new fill material is applied, causing distortion in the underlying materials. This settlement occurs quickly and is typically complete after placement of the final load. Consolidation settlement occurs in alluvial deposits such as saturated clay from the volume change caused by squeezing out water from the pore spaces. Consolidation occurs over a period of time and is followed by secondary compression, which is a continued change in void ratio under the continued application of the load. Soils tend to settle at different rates and by varying amounts depending on the load weight or changes in properties over an area, which is referred to as differential settlement.

Settlement of the ground surface can be accelerated and accentuated by earthquakes. During an earthquake, settlement can occur as a result of the relatively rapid compaction and settling of subsurface materials (particularly loose, uncompacted, and variable sandy sediments above the water table) due to the rearrangement of soil particles during prolonged ground shaking. Settlement can occur both uniformly and differentially (i.e., where adjoining areas settle at different amounts).

2.1.4.3 Liquefaction

Liquefaction is a transformation of soil from a solid to a liquefied state during which saturated soil temporarily loses strength resulting from the buildup of excess pore water pressure, especially during earthquake-induced cyclic loading. Soil susceptible to liquefaction includes loose to medium dense sand and gravel, low-plasticity silt, and some low-plasticity clay deposits that are saturated from a relatively shallow aquifer (generally less than 50 feet below ground surface). The depth to groundwater influences the potential for liquefaction, in that sediments need to be saturated to have a potential for liquefaction. Four kinds of ground failure commonly result from liquefaction: lateral spread, flow failure, ground oscillation, and loss of bearing strength. These are described below.

- Lateral spreading is the horizontal displacement of surficial blocks of sediments resulting from liquefaction in a subsurface layer that occurs on slopes ranging between 0.3 and 3 percent and commonly displaces the surface by several meters to tens of meters.
- Flow failures occur on slopes greater than 3 degrees and are primarily liquefied soil or blocks of intact material riding on a liquefied subsurface zone.
- Ground oscillation occurs on gentle slopes when liquefaction occurs at depth and no lateral displacement takes place. Soil units that are not liquefied may pull apart from each other and oscillate on the liquefied zone.
- The loss of bearing pressure can occur beneath a structure when the underlying soil loses strength and liquefies. When this occurs, the structure can settle, tip, or even become buoyant and “float” upwards. Liquefaction and associated failures could damage foundations, roads, underground cables and pipelines, and disrupt utility service.

DNR recently produced *Preliminary Liquefaction Susceptibility and NEHRP Soil Type Maps for Washington State* (DNR, 2004).[3] A liquefaction susceptibility map presents an estimate of the susceptibility of the soils to liquefy as a result of earthquake shaking. The susceptibility is a measure of the physical characteristics of a soil column, such as grain texture, compaction, and depth of groundwater, which determine the propensity of the soil to liquefy during earthquake shaking. A liquefaction susceptibility map depicts the relative hazard in terms of high, moderate, or low liquefaction susceptibility, and cannot be used to directly predict the severity of permanent ground deformation resulting from liquefaction. The DNR liquefaction maps for eastern Washington (including Kittitas County) are fairly basic and suitable for coarse-scale planning purposes only. Assessment of ground failure effects depends on local site conditions (e.g., slope steepness or the presence of free faces). The preliminary versions of the liquefaction susceptibility and NEHRP soil type maps are based on 1:100,000-scale geologic mapping.

The liquefaction susceptibility and NEHRP soil type maps are meant only as a general guide to delineate areas based on their potential for enhanced ground shaking. It is not a substitute for site-specific investigation to assess the actual ground conditions and potential for amplified ground shaking, as measured by the NEHRP soil type or other more quantitative analyses. Because the data used in producing this NEHRP soil type map is based on regional geologic mapping, this map cannot be used to make a final determination at any specific locality.

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[3] The National Earthquake Hazards Reduction Program (NEHRP) is a federal program that involves the relevant activities of four federal agencies, each of which has a distinct role in reducing earthquake risk.

2.1.4.4 Surface Fault Rupture

Seismically induced ground rupture is defined as the physical displacement of surface deposits in response to an earthquake's seismic waves. The magnitude, sense, and nature of fault rupture can vary for different faults or even along different strands of the same fault. Ground rupture is considered more likely along active faults, which are faults that have experienced rupture within the last 11,000 years. There are no active faults located within Kittitas County and the three Kittitas Valley faults have not shown any definitive displacement within the last 1.6 million years (Lidke, 2002). Therefore, the likelihood of surface fault rupture occurring within the planning area is considered very low.

2.1.5 Other Geologically Hazardous Areas

2.1.5.1 Volcanic Hazard Areas

Volcanic hazard areas are areas subject to pyroclastic flows, lava flows, debris avalanche, inundation by debris flows, mudflows, or related flooding resulting from volcanic activity. There are no active or dormant volcanoes located within Kittitas County. The nearest volcanoes - Mount Rainer and Mount St. Helens - could pose a hazard to Kittitas County residents, but the hazard from these volcanoes would be limited to ash deposition. The more devastating effects of volcanic activity, such as lava flows and lahars, would not affect Kittitas County because of intervening ridges.

2.1.5.2 Mine Hazards Areas

Mine hazard areas are underlain by abandoned mine shafts, secondary passages between shafts tunnels, or air vents. Mine hazards include subsidence, which is the uneven downward movement of the ground surface caused by underground workings caving in; contamination to ground and surface water from tailings and underground workings; concentrations of lethal or noxious gases; and underground fires. Coal and gold mining occurred historically in the Roslyn and Swauk Creek area, so there is a potential for mine hazards in these areas. Maps of known mines are available from the DNR website.

2.2 Human Activity and Geologically Hazardous Areas

Some geologic processes such as erosion and channel migration are easily influenced by human actions, while other events such as earthquakes or volcanoes occur at a scale or magnitude over which humans have limited control. Whether or not they are caused human actions, geologic events have a major effect on human health and safety and on the health of streams and other resources. Therefore, geologically hazardous areas present unique challenges for land use planning and development. This section describes some of the considerations important to land use planning in Kittitas County.

2.2.1 Erosion and Landslide Hazards

Erosion is a natural process that can be exacerbated by human activities such as vegetation clearing and grading. Erosion occurs when rainfall or accidental surface water discharges hitting a disturbed land surface cause soil particles to break away and move downslope. As water accumulates, it gains volume and energy and is able to mobilize ever larger soil particles. The eroded materials, which eventually get deposited on land or in streams, lakes or other waterbodies, can have a variety of detrimental effects on fish and wildlife and people. Eroded sediments can bury fish eggs or fill the spaces between gravel that support aquatic insects. Erosion can also impair water quality because sediments often transport nutrients such as phosphorus and other pollutants. Erosion often leads to stream channel in-fill and avulsion, blockage to fish passage, and loss of flood storage. Excessive soil erosion can lead to damage of building foundations and roadways.

Typically, erosion and landslide potential are increased with ground disturbing activities that expose soils to the effects of wind and water. Any type of soil can erode, but not all erosion is transported to adjacent properties or surface waters. Consequently, the proximity of ground disturbing activities to surface waters will often determine the type or level of risk associated with erosion and landslide hazard areas. Soils that are impermeable or minimally permeable generate surface water runoff and begin to erode sooner than very porous soils. Vegetation, the organic duff layer, small depressions, and soil density all minimize runoff and erosion.

People affect erosion and landslide hazard areas by clearing vegetation, grading and excavating soils, modifying drainage, and/or developing on steep slopes. Clearing and grading change the overall stability of a slope and often increase runoff, erosion, or landslide hazards down slope. Clearing and grading reduce interception of precipitation and remove the litter and loose surface soil layer (Konrad, 2000, 2003; Konrad and Burgess, 2001; Booth, 1990; Burgess et al. 1998). Removing vegetation, especially deep-rooted mature plants, reduces or removes the strength that roots provide to the soils on river banks and steep slopes (Bennett and Simon, 2004; Gray and Barker, 2004). Increased runoff is then concentrated directly into ditches, swales or other channels to creeks. The combined cumulative impact can lead to landslides if high risk areas are not avoided and adequate control measures are not provided and maintained.

2.2.1.1 Channel Migration Hazards

Stream and river channels change and move in response to water, sediment, wood supply, and streambank conditions. The size of the stream, watershed conditions, valley bottom materials and conditions, gradient, degree and type of encroachment into the historic channel meander zone, and many other factors cumulatively create the potential for some rivers or streams to migrate or jump across the valley bottom (Rapp and Abbe, 2003). The natural tendency of channels to migrate is also influenced by increased runoff and/or bedload sediment supply from clearing, logging, roads, agriculture, and other actions in the surrounding watershed. When increased stormflow runoff is concentrated in creeks and rivers, it increases the frequency, magnitude, and duration of flood flows. This in turn causes changes in the rate and amount of incision, deposition, increased bank erosion, and related channel migration.

Migration rates are often further increased by clearing of trees along stream banks and in the channel migration zone. Dense stream bank and overbank vegetation slows water velocity, leading to sediment deposition. When vegetation cover is removed or modified, erosion occurs (Bennett and Simon, 2004). Removal of trees and dense vegetation from the channel migration zone reduces the stream's ability to recruit woody material and reduces the quality, diversity and availability of in-stream habitat for fish and other aquatic species (Bolton and Shellberg, 2001).

People living near stream and river systems often attempt to control or mute these natural processes by armoring stream banks and/or constructing levees and other types of revetments to stop channel migration. People often assume that levees and other structures will protect them from channel migration hazards; however, these control measures can fail putting residents and property at risk.

Although levees, bank armor, and other "river training" structures sometimes do reduce or stop channel migration, these structures often reduce the quality and availability of instream and riparian habitats for fish and wildlife. River processes and aquatic habitat conditions depend on the ability of the river to change and form on its own. These functions are hampered by increased stormwater runoff, channel confinement and bank armoring, levees, or other projects designed to reduce channel migration. Bank protection projects often confine the channel and floods to a much smaller width, which can exacerbate channel changes, reduce the complexity of instream habitat, scour fish spawning beds, and cause other adverse ecological effects.

While it is important to protect the functions and values of stream corridors for water quality, quantity, and fish and wildlife habitat, it is also important to protect life and property from the natural hazards associated with the stream corridor. Alterations of stream corridors or natural drainage patterns expose areas to increased erosion that if not addressed can threaten the stability of building foundations, roads, bridges, or other developments or otherwise pose substantial risks to life and property.

Natural watershed and channel processes, forest management, roads, utilities, agriculture, and residential development can also reduce stability of valley wall slopes and streams upstream of alluvial fans. This in turn increases the natural tendency of floods to deposit sediment and change channels on alluvial fans. Clearing and excavation on alluvial fans can also alter channel migration and flooding areas. The soil strength, changes to rainfall-runoff response, and drainage patterns influence the degree and extent of instability and the subsequent occurrence of valley wall landslides and erosion. Landslides and erosion increase sediment supply and channel migration along the channel and on the alluvial fan, resulting in increased probability and magnitude of debris flows, large floods, and sediment deposition on the fan. Even moderate sized floods from an undisturbed basin can shift the main or side channels across most or all of an alluvial fan.

Not all portions of an alluvial fan are equally active at any given time, and it is difficult to identify or predict which area of an alluvial fan may be active. Relatively recent activity on one portion of a fan is no guarantee that other portions are inactive. For this reason, development on alluvial fans can be problematic and protective structures may be required to protect roads, bridges, and other structures. These measures are typically aimed at keeping the floods and debris flows on one portion of the fan.

Dredging is one means by which people often attempt to address alluvial fan hazards. Intermittent dredging following a moderate or large depositional event, or a number of smaller ones, does not guarantee adequate storage for the next flood; a large flood can still overwhelm the sediment storage capacity, ultimately sending the floodwaters or channel in alternate directions across the fan.

Critical structures like bridges can be built to survive most floods, but it is often economically and technically impractical to build houses and other facilities to those standards. Avoidance, limitations on the types of permitted development and maintenance of natural buffers along the stream channel can be used to reduce damage or losses in or near the channel migration zone of alluvial fans.

2.2.1.2 Avalanche Hazards

Avalanches occur regularly in mountainous areas as result of weather and terrain factors such as rate of snowfall, temperature, slope, aspect, and ground cover (Kittitas County, 2012b). Human actions generally do not have a direct influence on avalanche hazards, but people sometimes trigger avalanches intentionally (as a means of hazard mitigation) or unintentionally as a result of recreational activities.

Avalanches occur frequently each year and kill one to two people annually in the Northwest (about 25 to 35 deaths annually in the U.S.). Avalanches have killed more people in Washington than any other hazard during the past century. Avalanches have killed over 200 people in Washington since 1900 and 47 people between 1985 and 2009 (Kittitas County, 2012b). This exceeds the death toll of earthquakes and floods combined. In 90 percent of avalanche fatalities, the weight of the victim or someone in the victim's party triggers the slide.

Most avalanche prone areas in the County are within the Mount Baker-Snoqualmie National Forest and other protected forests, but people working in the mountains and recreational users are exposed to avalanches.

2.2.2 Seismic Hazards

Human actions have no influence on the likelihood of occurrence, timing, or severity of a seismic event. The damage caused by seismic activity is dependent upon the intensity of the earthquake, its proximity to developed areas and population centers, the slope, thickness, consolidation, and moisture conditions of the surface and subsurface materials, and many other factors. While humans cannot impact the likelihood or severity of a seismic event, human actions can mitigate the damage to life and property that occurs from such events. Avoidance of high-risk hazard areas and adherence to the County building code standards are the main vehicles for reducing risks from seismic hazards.

2.2.3 Other Geologically Hazardous Areas

2.2.3.1 Volcanic Hazard Areas

All of the property and infrastructure exposed to nature in the County are exposed to volcanic ash events. Volcanic ash fall events can harm the human respiratory system, clog waterways and machinery, cause power outages, and drift into roadways, railways, and runways. Human actions have no influence on the likelihood of occurrence, timing, or severity of volcanic hazards. There are no active or dormant volcanoes located within the County; potential volcanic hazards are limited to ash deposition.

2.2.3.2 Mine Hazards Areas

Areas over mines can experience subsidence and slumping from collapse of mine tunnels, entrances, or air shafts. Without checking maps, property owners may not even know if mine workings underlie their land. Placing structures over mines can be a risk to human safety, as well as the structure itself. Known mine entrances and vents should be properly stabilized and closed to minimize risks.

2.3 Geologically Hazardous Areas Management Tools

The most successful and ultimately least costly protection from geologic hazards is often avoidance of known hazardous areas. This includes prohibiting or restricting activities on adjacent areas that may result in an increased failure hazard that moves off site, down slope, or downstream. Other common regulatory approaches to managing hazardous areas include restrictions on the types of developments; requirements for building setbacks, buffers, and vegetation management; and adherence to building codes. This section describes some of the management tools Kittitas County can employ to mitigate risks associated with development in and around geologically hazardous areas in are described below.

2.3.1 Erosion Hazard Areas

Generally it is assumed that bare soils on constructions sites and agricultural fields will erode; temporary and permanent erosion control measures are often the best tools to reduce soil loss and delivery to surface waters. At the local level, soil erosion and surface water drainage are commonly regulated via drainage plans, grading plans, and erosion controls plans that are a part of project design, construction, and maintenance. In Washington State, a Construction General Stormwater NPDES permit must be obtained for clearing or land-disturbing activities greater than one acre. One of the main conditions of this permit is the development and implementation of a site-specific surface water pollution prevention plan. Proposed development or alteration on lands identified as having a severe risk of erosion may require additional analysis and mitigation measures to lessen potential erosion impacts.

2.3.2 Landslide Hazard Areas

To protect human safety and property investments, a qualified professional should conduct a site-specific geologic assessment for proposed projects in landslide hazard areas. Where possible, new development should be located outside of/away from existing and at-risk landslide areas; this is the most effective, and generally least expensive, management tool to mitigate landslide hazard risks. The use of buffers or setbacks from the top/toe of areas prone to landslide hazards can help ensure the safety of the development. Engineered solutions may be effective at lessening landslide risk, but these should be designed by a qualified professional on a site-specific basis.

2.3.2.1 Channel Migration Hazards

The most basic approach to reducing problems related to stream channel migration is to simply allow adequate room for stream processes, while leaving natural vegetation intact to stabilize stream banks. This approach reduces channel migration damage costs, while allowing habitat-forming migration processes to occur. As part of the County's Shoreline Master Program update, channel migration zones were identified along several Shoreline Management Act-designated shorelines of the state. However, specific areas at high risk of channel migration have not been identified at this time.

In the future, the County may wish to refine the existing channel migration zone data to specifically identify areas at high risk of channel migration. Refining the existing data would require a significantly greater effort (and cost) than the initial mapping, so focusing future mapping work on stream reaches with high potentials for both channel migration and human development could be a more cost-effective solution.

In lieu of more refined channel migration zone mapping at a reach scale, high-risk channel migration areas can be identified on a site-specific basis by a qualified professional. Areas at high risk of channel migration can be identified through mapping of landforms and vegetation associated with channel migration, analysis of historic maps and photographs, and surface and subsurface geologic studies.

2.3.2.2 Avalanche Hazards

Most areas where avalanches are likely to occur within the County are on steep slopes that are unsuitable for development. If or when new development is proposed within or near an avalanche hazard zone, a risk assessment of the site should be performed by a qualified professional.

2.3.3 Seismic Hazard Areas

Building standards that are varied by building type and use can be adopted to help reduce earthquake damage and injuries. Considerable engineering is applied to the design and review of seismic loading on critical structures. In some cases, extensive site mapping and analysis may be needed to support foundation and structure design. Avoiding high hazard site locations and conditions, and implementing building standards to minimize danger during and immediately following an earthquake, are the main approaches used to reducing damage from seismic hazards.

2.3.4 Other Geologically Hazardous Areas

2.3.4.1 Volcanic Hazard Areas

Volcanic hazards within the County are limited to ash fall events. Mitigation measures for ash falls include minimizing travel, use of dust masks, and removal of the ash. The County's Hazard Mitigation Plan (2012b)) recommends that detailed ash fall studies be conducted to reduce the hazards associated with volcanic ash falls.

2.3.4.2 Mine Hazards Areas

The stability of underground mine workings is dependent upon several factors, including surrounding geology and the conditions of support structures. Geologic and engineering studies are sometimes required to quantify the nature of the hazard and to recommend measures to mitigate the hazard.

2.4 Existing County Geologically Hazardous Area Code Provisions and BAS Recommendations

Geologically hazardous areas pose a potential threat to the health and safety of Kittitas County citizens when incompatible or poorly engineered development is constructed in hazardous areas. Many geological hazards can be reduced or even eliminated through sound engineering, design, and construction practices in accordance with current building code regulations, such that risks to human health and safety are considered acceptable. When technology cannot reduce risks to acceptable levels, building in geologically hazardous areas is best avoided.

The County code contains regulations for geologically hazardous areas in KCC Title 17A. However, the regulations are minimal and there are several opportunities to improve the management of geologically hazardous areas to be more consistent with scientific standards and commonly accepted management practices. Subsection 2.4.1 describes general code update considerations, while the following subsections summarize existing regulations, discuss best available science, and describe specific code update considerations for different types of geologically hazardous areas.

2.4.1 General Code Update Considerations

Kittitas County should revise the geologically hazardous areas designations to make them consistent with the GMA. This will ensure that all types of potentially hazardous areas are addressed during the development review process. Having accurate information about the location and extent of geologic hazards is critical for assessing and mitigating them. Many geologically hazardous areas can only be truly determined through site-specific analysis of near surface and subsurface conditions prior to commencement of construction. As a result, the code should include more specific criteria for when a hazard area delineation or assessment is required. The code should stipulate that in addition to defining the presence and/or extent of a hazard area on a development site, developers should consider activities on adjacent areas that may result in an increased hazard. Failure to consider the entire natural and built environments, including secondary impacts and downstream or down slope conditions, can lead to dangerous conditions. The code should specify that analyses of geologic hazards should be prepared by qualified professionals with the appropriate expertise, credentials/certifications and experience.

For some types of hazards, it may be appropriate to include language on the building permit, plat and/or property title concerning the location and extent of the hazard. Requiring notice on title to disclose presence of a hazard area as part of the County's permit process would ensure that future property owners are alerted to the presence of potential hazards.

2.4.2 Erosion Hazard Areas

2.4.2.1 Existing Kittitas County Code

There is not a specific code section for erosion hazard areas in KCC 17A. Existing code provisions that relate to erosion hazards include:

- KCC 17A.06.010 states that the County-adopted version of the Uniform Building Code contains provisions for geologically hazardous areas.
- KCC 17A.06.015 states that areas identified as high risk erosion/landslide hazard areas may require specialized engineering, if authorized by the director.
- KCC 17A.06.020 states that natural resource based activities shall not be "unduly restricted or prohibited" in areas of known geologic hazards.

2.4.2.2 Best Available Science Summary

Erosion hazards are closely related to drainage control, ground disturbing activities, and slope failure. Typically, soil erosion potential is reduced once the soil is graded and covered with concrete, structures, vegetation, or other slope protection methods. Incorporation of appropriate drainage and erosion control features into project design can help reduce erosion hazards.

2.4.2.3 Considerations for Code Update

The Washington Department of Ecology (Ecology) administers water quality standards related to the federal Clean Water Act, State Water Pollution Control Act (RCW 90.48), and the State Construction Stormwater General Permit. Developers are required to obtain a Construction Stormwater General Permit if they clear, grade, and excavate one or more acres or discharge stormwater to surface waters of the state. Smaller sites may also require permits if they are part of a larger of development that will ultimately disturb one acre or more. Adherence to these requirements should adequately minimize erosion risks in most areas of the County. For proposed activities within high-risk erosion areas, regardless of the total impact area, the County may consider requiring applicants to provide an erosion risk assessment prepared by a qualified professional.

2.4.3 Landslide Hazard Areas

2.4.3.1 Existing Kittitas County Code

There are not specific code sections for landslide or channel migration hazard areas in KCC 17A. Existing code provisions that relate to these hazards include:

- KCC 17A.06.010 states that the County-adopted version of the Uniform Building Code contains provisions for geologically hazardous areas.
- KCC 17A.06.015 states that areas identified as high risk erosion/landslide hazard areas may require specialized engineering, if authorized by the director.
- KCC 17A.06.020 states that natural resource based activities shall not be "unduly restricted or prohibited" in areas of known geologic hazards.

Avalanche Hazards

KCC 17A.06.025 addresses avalanche hazards and states that, in junction with the Uniform Building Code, Kittitas County shall enforce the policies contained within the Snoqualmie Pass Sub-Area Comprehensive Plan for avalanche hazard areas. Goal IV.15 in the sub-area plan states: "restrict development in geologically hazardous areas, which are subject to erosion, landslide, avalanche or subsidence. Stated avalanche-related objectives for this goal include:

- Modification of natural terrain and removal of natural vegetation should be minimized.
- Consideration should be given to the vulnerability of the site of avalanches of debris deposition in periods of rapid water runoff.
- Disturbed terrain should be restored and revegetated as soon as feasible.
- Site-specific geotechnical information should be required for construction on slopes greater than 3:1.

2.4.3.2 Best Available Science Summary

Building setbacks, vegetated buffers, terraced slope construction, and drainage guidelines reduce hazards in landslide prone areas. Because small landslide areas and many erosion areas can be developed provided that they are sited appropriately, include adequate drainage improvements and are properly designed and constructed, the code should remain adaptable to address site-specific conditions under the oversight of a licensed professional. This places considerable responsibility on site-specific geotechnical studies, design approaches, review processes, construction methods, and effective monitoring.

Channel Migration Hazards

Flood damage, degradation of stream channel or streambank stability, and development in the flood or channel migration zone are all closely related. Development in the floodway and channel migration zone creates potential risks of damage from intense storm events or long term changes in channel geomorphology. Structures intended to protect developments that encroach into the channel migration zone and floodway can cause further damage downstream as well as degrade aquatic habitat conditions.

The most basic approach to reducing problems related to stream channel migration is simply to allow adequate room for stream processes, including erosion and migration, to occur. Although this approach can put development and property within the migration zone at risk, long-term reduction of encroachment will greatly reduce flood and channel migration damage costs, protect habitat values and will allow for restoration of aquatic habitat, which is expensive and difficult to accomplish while the encroachment still exists. Long-term planning needs to account for and work with ongoing stream processes to reduce the danger from sudden channel changes, reduce flood and river management costs, and allow for aquatic habitat improvements.

Avalanche Hazards

Protection against potential avalanche hazards can be accomplished through avoidance or employment of engineering techniques. Engineering techniques such as snow sheds and wedges can be applied to modify terrain so as to divert moving snow from facilities, and various fence structures have been designed to stabilize snow on mountainsides. Artificial release techniques focus on the frequent release of small avalanches to inhibit the formation of large avalanches, and employ explosive charges. However, these artificial release techniques are generally not as effective as simple avoidance.

2.4.3.3 Considerations for Code Update

There are a number of ways in which the hazards of slope failures or landslides can be mitigated:

- Prevent building above or on the hazard area, to prevent overweighting or altering drainage patterns that might trigger the hazard area;
- Include provisions for requiring setbacks from the top and toe of landslide-prone areas where necessary;
- Implement building setbacks at the base of cliffs or steep slopes prone to rock falls;
- Include provisions to require retention of native vegetation on steep slopes to improve stability; and
- Use of timely effective vegetation control implemented immediately following construction or grading.

Appropriate mitigation measures for a given project and site should be determined by a qualified professional.

Channel Migration Hazards

Specific restrictions or limits on development within channel migration zone and avulsion hazard areas should be incorporated into the code. The code should prohibit structures within or near an active alluvial fan, and include standards to retain vegetated riparian buffers to mitigate bank erosion and channel migration.

Avalanche Hazards

The code should require a risk assessment, prepared by a qualified professional, for proposed development within or adjacent to an avalanche hazard area.

2.4.4 Seismic Hazard Areas

2.4.4.1 Existing Kittitas County Code

KCC 17A does not contain provisions for regulating development in seismic hazard areas.

2.4.4.2 Best Available Science Summary

Basic risk reduction strategies in seismically hazardous areas are intended either to limit the intensity of land use or to apply more stringent building standards for development. Building code requirements incorporate the latest scientific findings based on actual seismic events that occur throughout the world. If the seismic risk is high and cannot be reduced, then development may be prohibited or limited through zoning or other land use regulations. However, in general, most structures and improvements are feasible from a geotechnical perspective provided appropriate site preparations and foundation design measures are incorporated into construction specifications. International Building Code standards are routinely updated to incorporate the most current science regarding seismic performance of buildings, building foundations, and foundation soil preparations.

2.4.4.3 Considerations for Code Update

To respond to the evolving understanding of the seismic risk in this region, the County should link regulations to the most current version of the International Building Code and relevant local USGS or other agency documents and studies; as codes and studies change, the County code should also change.

2.4.5 Other Geologic Hazards

2.4.5.1 Existing Kittitas County Code

Volcanic Hazard Areas

KCC 17A.06.035 states that intentional disposal of volcanic ash fallout into any bodies of water shall not be allowed.

Mine Hazard Areas

KCC 17A.06.030 states that siting of structures on known mine hazard areas should be avoided.

2.4.5.2 Best Available Science Summary

Volcanic Hazard Areas

While Kittitas County is in close proximity to Mount Rainer and Mount St. Helens, the threat of volcanic hazards is minimal and limited to ash deposition. The more devastating effects of volcanic activity, such as lava flows and lahars, are not possible due to intervening ridges.

Mine Hazard Areas

Areas over mines can experience subsidence and slumping from collapse of mine tunnels, entrances, or air shafts. The stability of underground mine workings is dependent upon several factors, including surrounding geology and the conditions of support structures. Geologic and engineering studies may be necessary to quantify the nature of the hazard and to recommend measures to mitigate the hazard.

2.4.5.3 Considerations for Code Update

Volcanic Hazard Areas

No recommended changes.

Mine Hazard Areas

The County's standard to avoid siting structures in/near mine hazard areas is appropriate, but without better mapping or a mechanism for identifying these areas, the standard would be difficult to administer. Requiring developments in areas of suspected mining activity to investigate these risks would help to prevent hazardous situations. Historic maps showing the location of known coal mines are available on the DNR website.

2.5 Summary of Findings and Code Recommendations

Table 2-1 summarizes considerations for updates to Kittitas County geological hazardous areas regulations based on a review of the best available science.

Table 2-1. Summary of Considerations for Updates to Kittitas County Geological Hazard Areas Regulations.

Topic	Existing Kittitas County Code Sections (if applicable)	Potential Code Changes
General code considerations	17A.02.150 (definition)	Revise geologically hazardous areas definitions to make them consistent with the GMA.
		Include specific criteria for determining when a hazard area delineation or assessment is required.
		Require that hazard area assessments consider activities on adjacent sites that may result in increased hazards.
		Specify that geologic hazard assessments must be prepared by a qualified professional (i.e., licensed professional engineer, engineering geologist, or geologist).
Erosion hazard areas		Require an erosion risk assessment for projects within high-risk erosion areas.
Landslide hazard areas		Include regulations that prevent structures on landslide hazard areas.
		Require setbacks from the top and toe of landslide-prone areas.
		Specify that appropriate mitigation measures for development near landslide hazard areas shall be determined by a qualified professional.
Landslide hazard areas: channel migration hazards		Limit or restrict development within channel migration and avulsion hazard areas.
		Include standards to retain vegetated riparian buffers to mitigate bank erosion and channel migration.
Landslide hazard areas: avalanche hazards	17A.060.025	Require a risk assessment, prepared by a qualified professional, for proposed development within or adjacent to an avalanche hazard area.
Seismic hazard areas		Link regulations to the most current version of the International Building Code.
Mine hazard areas	17A.060.030	Require developments in areas of suspected mining activity to investigate potential risks.

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3.0 FREQUENTLY FLOODED AREAS

This chapter describes frequently flooded areas in Kittitas County and summarizes the scientific literature concerning frequently flooded areas and how they can affect or be affected by land use and other human activities. The chapter also presents an overview of the management and protection tools for these areas. The purpose of this chapter is to establish a basis for recommending updates to the frequently flooded areas provisions of Kittitas County Code (KCC) Chapter 17A.06.

Frequently flooded areas are defined as "lands in the floodplain subject to a one percent (1%) or greater chance of flooding in any given year, or within areas subject to flooding due to high groundwater" (WAC 365-190-030). At a minimum, frequently flooded areas include the 100-year floodplain designations of the Federal Emergency Management Agency (FEMA) and the National Flood Insurance Program.

Washington Administrative Code (WAC) chapter 365-190-110(2) states that counties and cities should consider the following when designating and classifying frequently flooded areas:

1. Effects of flooding on human health and safety, and to public facilities and services;

2. Available documentation including federal, state, and local laws, regulations, and programs, local studies and maps, and federal flood insurance programs, including the provisions for urban growth areas in RCW 36.70A.110;

3. The future flow floodplain, defined as the channel of the stream and that portion of the adjoining floodplain that is necessary to contain and discharge the base flood flow at build out;

4. The potential effects of tsunami, high tides with strong winds, sea level rise, and extreme weather events, including those potentially resulting from global climate change[4];

5. Greater surface runoff caused by increasing impervious surfaces.

This chapter discusses frequently flooded areas chiefly from the perspective of flood effects on human health, safety, and property, and the effects of human activities on flooding. The authors recognize that floodplain development has the potential to affect other critical areas regulated by Kittitas County. Many of the ecological issues associated with floodplain management are addressed in other chapters of this best available science report (e.g., chapters on wetlands [Chapter 5] and fish and wildlife habitat conservation areas]Chapter 6]). One important goal of these reviews is to highlight connections between frequently flooded areas and the other critical areas regulated under KCC Title 17A so that ecological impacts associated with development within frequently flooded areas can be adequately addressed, consistent with the GMA.

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[4] Not all of these concerns are pertinent in Kittitas County. High tides and Tsunamis occur in coastal areas not inland areas.

3.1 Inventory of Frequently Flooded Areas in Kittitas County

3.1.1 Mapped Floodplain Extent

Mapping of the 100-year floodplain by FEMA provides the basis for designation, protection, and regulation of frequently flooded areas (KCC17A.02.140). The 1981 Flood Insurance Rate Maps (FIRMs) for Kittitas County are the official maps for Kittitas County, every city and town in the County, and the Yakima Tribe. FEMA has commissioned a new Flood Insurance Study and Digital Flood Insurance Rate Map (DFIRM) for Kittitas County, which is currently underway. When completed (completion and adoption of the study results is anticipated to occur in the foreseeable future; however no date has been set) a new and more accurate digital version of a FIRM will provide for more powerful mapping and analysis than currently exists with the 1981 FIRMs.

According to the 1981 FEMA FIRM data, there are 7,326 acres of floodway and 48,108 acres of 100-year floodplain within Kittitas County (see map in Appendix A). The majority of this area is within and adjacent to Interstate-90 (I-90) on the mainstem of the Yakima River. Kittitas County also has extensive floodplains along the other reaches of the Yakima, as well as Cle Elum and Teanaway rivers, Manastash, Naneum, Taneum, Big, Little, Dry and Reecer creeks. There are other regulated floodplains located throughout the County associated with tributary streams. The floodplain conditions range from urban-type settings around the cities of Ellensburg and Cle Elum to the rural areas along the Teanaway and smaller streams.

Floodways are a mapped portion of the floodplain, usually associated with the river and corridor closest to the river, which are typically associated with higher and faster flood flows during flood events. The floodway area is mapped during the development of FIRMs by identifying the floodplain area that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than one foot. In Kittitas County, floodways are mapped along the Yakima River, Teanaway River (including the West, Middle, and North forks), Kachess River (below Kachess Lake), Cle Elum River (below Cle Elum Lake), Crystal Creek, and Manastash Creek. The floodway has not been identified for other rivers and streams with a mapped floodplain (per 1981 FIRMs).

Many of these rivers and streams listed above have some type of informal flood control structure along their banks, most of which were built more than 80 years ago. None of these levees are federally certified as flood control structures[5] (Personal Communication, Kirk Holmes, Kittitas County, June 2012). As such, these structures provide less than optimal protection to major population and business centers, residences, and critical public facilities such as roads, bridges, and utility treatment plants.

There are known flood problem areas in Kittitas County. Large-scale developments adjacent to the Yakima and Teanaway Rivers, specifically Elk Meadows, Elk Meadows Park, Pine Glen, Sun Island, Sun Country, Teanaway Acres, and the Teanaway Wagon Wheel have experienced substantial flood damage (Tetra Tech, 2012). The County also has numerous streams with

[5] A certified levee system meets and continues to meet minimum design, operation, and maintenance standards as specified in 44 CFR 65.10. The design criteria and structural requirements outlined in paragraphs (b)(1) through (7) must be certified by a registered professional engineer or a federal agency responsible for levee design.

unpredictable responses and dynamics during high flow events. These include, but are not limited to, Cabin, Cole, Big, Little, Silver, Gold, Manastash, Taneum, Wilson and Reecer Creeks (Tetra Tech 2012).

Within Kittitas County (as well as other areas of Washington) the extent of the 100-year floodplain as identified on existing FIRMs is sometimes inconsistent with actual (on-the-ground) 100-year flood conditions because of deficiencies in available information when FIRMs were completed, dynamic conditions inherent to riverine floodplains, and changing underlying conditions (hydrologic and sediment regimes, land cover changes, floodplain alterations). Even with new flood studies and future updated FIRMs, it is likely that some inconsistencies between mapped floodplain extent and on-the-ground conditions will persist in the future. For these reasons, it may be reasonable and necessary to consider some areas to be "frequently flooded areas" (based on flood records or other available information) even when they occur outside of the FIRM-mapped 100-year floodplain extent.

3.1.2 Floodplain Extent and Dynamics

Flooding typically occurs when runoff reaches the stream channel quickly, usually within a day or so of falling on the ground. This generally happens in response to:

- Severe but infrequent heavy winter rains resulting from warm Chinook winds;
- Rain on snow events;
- Spring rapid snow melts; or
- Short, intense thunderstorms (Kinnison and Sceva, 1963; USACOE, 1972).

Winter flooding events can occur when the soil is frozen and cannot absorb rainfall. Winter floods occur from October to March, and are historically more destructive than spring floods, but they tend to have a lower total volume due to their shorter duration (Yakima County, 2006). Spring floods, typically occurring in April through June, generally have a larger total volume but are less destructive and last for a longer time period (Tetra Tech/KCM, 2003; USACOE, 1975).

The fall/winter flood crests are reduced because flood storage is available after the irrigation season in Kachess, Keechelus, and Cle Elum Lakes. However, these reservoirs control only a small part of the runoff, and storage may not be available if two winter flood events occur in short succession. The three reservoirs have a combined storage capacity of 833,700 acre-feet (157,800 acre-feet in Keechelus Lake; 239,000 acre-feet in Kachess Lake; and 436,900 acre-feet in Cle Elum Lake). Although constructed for irrigation purposes, they are also operated for flood control on the basis of runoff forecasts (Tetra Tech, 2012).

Kittitas County experiences episodes of river flooding almost every winter. Large floods that cause property damage typically occur every three to seven years. Urban portions of the County experience nuisance flooding related to drainage issues annually. Since 1862, approximately 20 major floods have occurred on the Yakima River and its tributaries (Tetra Tech, 2012). Five of the highest peak discharges were measured at USGS Station 12484500 on the Yakima River at Umtanum in 1906, 1933, 1948, 1975, and 1977. Since 1964, nine presidential-declared flood events in the County have caused in excess of $50 million in property damage. Recent floods occurred in November 1990, November 1995 and February 1996, January 2009, January 2011 and May 2011 (Tetra Tech 2012), which caused millions of dollars in public and private property damage. During these floods many of the developments adjacent to the Yakima and Teanaway Rivers had to be evacuated.

A literature review did not indicate any known areas of frequent flooding due to high groundwater. This may be the result of the substantial alteration of pre-settlement pattern of winter/spring groundwater recharge in the Yakima basin, caused by both irrigation and operation of numerous reservoirs. Under current conditions, recharge of cold spring melt water into the aquifer systems has been replaced by recharge of warmer water derived from irrigation later in the spring and summer (Stanford et al., 2002).

3.2 Functions and Values of Frequently Flooded Areas

Floodplains perform a variety of beneficial functions which are summarized below (Kusler, 2011) and discussed in greater detail in Sections 3.2.1 through 3.2.6.

- **Flood Water Storage and Conveyance:**
    - Provide storage - Floodplains temporarily store flood waters and reduce flood heights and velocities for downstream lands.
    - Provide conveyance - Floodplains act as conveyance areas, reducing flood heights and velocities at upstream, adjacent and downstream lands.
- **Sediment Deposition and Storage:**
    - Reduce excessive erosion - Floodplains moderate erosion by reducing water velocities, binding soil and contributing to the vertical and lateral stability of stream channels (i.e., associated with dynamic equilibrium).
    - Reduce sediment loadings in lakes, reservoirs, and streams - Floodplains, and the wetlands they contain, reduce the sediment flowing into lakes and streams by intercepting and trapping sediment.
- **Groundwater Recharge and Baseflow Maintenance:**
    - Provide recharge - Some floodplains provide groundwater recharge during wet periods, although most are discharge areas much of the year.
    - Regulate discharge - Some floodplains help maintain the base flow of streams and help to reduce ground water levels by discharging groundwater during dry periods.
- **Water Quality Maintenance and Improvement:**
    - Intercept/ Treat pollution - Virtually all types of vegetated floodplains and the wetlands they contain intercept, trap and/or transform sediments, nutrients, debris, chemicals, and other pollutants from upland sources before they reach receiving waters.
- **Habitat:**
    - Fish and other aquatic species - Floodplains adjacent to lakes and streams can provide food chain support, spawning areas, rearing areas, and shelter for fish and other aquatic animals.
    - Amphibians, reptiles, mammals, and insect species - Floodplains and floodplain wetlands provide habitat for a broad range of mammals, reptiles, amphibians, and birds and corridors for migration or movement.

- Rare, endangered and threatened species - Floodplains provide food chain support, feeding, nesting, and substrates for endangered and threatened animals and plants.

- **Other Values:**
  - Recreational opportunities and scenic beauty - Floodplains provide hiking, wildlife viewing and other water and land-based recreational opportunities. Many floodplains have aesthetic value. Scenic beauty when viewed from a car, a path, a structure, or a boat may enhance real estate values, provide recreation, and provide the basis for tourism.
  - Historical, archaeological, heritage, cultural opportunities - Some floodplains have historical and/or archaeological value (e.g., shell middens, burial sites).
  - Educational and interpretive opportunities - Many floodplains and the wetlands they contain provide education and research opportunities for schools and universities and government agencies.
  - Scientific research opportunities - Schools, universities, resource agencies, and not-for-profit organizations carry out many types of scientific research in floodplains, wetlands and riparian areas.
  - Maintain carbon stores, sequester carbon, and reduce climate change - Many wetlands and floodplains store carbon in carbon-rich wetland soils and trees and vegetation. Some continue to sequester carbon from the atmosphere.

3.2.1 Flood Water Storage and Conveyance

Floodplains store flood waters, which reduces the height, areal extent, duration, and velocity of floodwaters within the floodplain. Alteration of floodplain cover and flood flow dynamics – through changes in site grading and construction of impervious surfaces – can alter flood storage functions. If the areal extent of the floodplain is constricted, greater depths will occur for a given flood. Backwatering occurs as water amasses at a location, reducing the hydraulic gradient from upstream areas, in turn reducing flow velocity and flow rate. A greater area of floodplain storage at a given location will result in lower flood depths at that point, reducing backwater effects and upstream flood heights. Flood storage provided at any point in the stream also slows the movement of water downstream, reducing flood height and extent in downstream areas.

3.2.2 Sediment Deposition and Storage

Floodplains reduce flow velocity and erosion and enhance settling of sediment. As water overflows from the main channel of a river or stream, it spreads over the land surface, resulting in a much wider flow path. Vegetation in the floodplain creates roughness. A wider flow path and increased roughness lowers flow velocity, which in turn, reduces the erosive power of flowing water. Reduced velocity and physical trapping in vegetation allow suspended sediment to settle in the floodplain. This benefits the floodplain and stream by depositing fertile soil and nutrients in the floodplain and reducing sedimentation in the stream channel.

Sediment deposition has formed an alluvial fan in several Yakima Basin floodplains – including Naneum Creek and Manastash Creek. Alluvial fans are cone-shaped deposits of sediment occurring from an upstream point (the apex of the fan). On Naneum and Manastash Creeks, fans occur as the streams emerge from mountainous canyons out into broad, flat floodplains. Alluvial fans are subject to unique flooding conditions, characterized by flow path uncertainty so significant that the uncertainty must be included in assessment of flood risk (FEMA, 2002).

3.2.3 Groundwater Recharge and Baseflow Maintenance

Floodplains are an interface between groundwater and surface water, providing areas of groundwater discharge or recharge. Recharge and discharge processes vary spatially and seasonally. For example, some areas discharge or recharge continuously, based on relatively constant groundwater levels and flow patterns. Other areas provide recharge during dry months when the water table is low and then become discharge areas during the wet season when the water table rises. Groundwater recharge and discharge are critical to maintaining baseflows, which are in turn critical to maintaining aquatic habitat and water quality during dry months (by maintaining wetted channels and delivery of cool, oxygenated water). The role that floodplains play in groundwater recharge and baseflow maintenance can be disrupted as a result of land cover change (e.g. loss of forest cover and other natural vegetation) and/or floodplain development (e.g. grading and creation of impervious surfaces).

3.2.4 Water Quality Maintenance and Improvement

Floodplains that are vegetated have the opportunity to stop pollutants from reaching surface waters and aquatic habitat, and to treat and improve water quality within water bodies that are already polluted. Water quality maintenance functions are maximized in naturally vegetated floodplain areas, including floodplain wetlands. Vegetation has the opportunity to intercept sediments, nutrients, debris, chemicals, and other pollutants before they reach down gradient rivers, streams, and lakes, and seep into groundwater. During and following flood flows, ponded water on the floodplain landscape remains, where it may infiltrate into shallow groundwater, transpire through vegetation uptake, or evaporate. Pollutants within flood water can be removed through these processes (Bolton and Shellberg, 2001). Riparian areas and wetlands commonly associated with frequently flooded areas can filter surface water pollutants during all flow regimes.

3.2.5 Floodplain Habitat

Floodplains are a setting for riparian ecosystems. Riparian ecosystems are a highly variable environment, both spatially and temporally, forming a transition between terrestrial and aquatic ecosystems. They are saturated or flooded during most of the wet season, while the water table recedes below the root surface during the summer. Riparian ecosystems typically have a high flux of energy, water, and other material (Benda et al., 2004). As such, they generally have high plant and animal species diversity, high species and biomass density, and high productivity (Mitch and Gosselink, 1993; Steiger et al., 2005). The importance of riparian areas to fish and wildlife is discussed in detail in Chapter 6.

Floodplains are also areas of active channel migration.[6] Channel migration is the process whereby streams adjust their size and location through erosion and deposition of sediments. Channel

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[6] Channel migration is a process associated with stream flows and bank erosion, with migration often occurring more rapidly during the high flows of flood events. For purposes of this Best Available Science Review and consistent with the GMA designation in WAC 365-196-200, channel migration zones are included as a type of Geologic Hazard Area under landslide hazards.

migration happens gradually over time or suddenly in response to large flow events (a process called channel avulsion). In Kittitas County, many streams or portions of streams have the potential to migrate or move across the floodplain from bank erosion – whether occurring during normal flows or flood flows. Channel migration zone inventory data for Kittitas County is presented in Chapter 2.

Channel movements, whether gradual or abrupt (avulsions) are important habitat forming processes. Channel migration results in formation of side channels, riparian wetlands, and backwater habitats that are used by salmonids for spawning, rearing, and cover, as well as other fish and wildlife. An added benefit of channel migration across the floodplain is recruitment and retention of large woody debris to the stream channel; large woody debris is critical for creating and maintaining suitable in-stream habitat for salmonids. The importance of channel migration as a habitat-forming ecological process is described in detail in Chapter 6.

Interference with natural channel migration processes (through floodplain fill, bank revetment, or floodplain confinement) often has unintended consequences such as increased or changed flood, sedimentation and erosion patterns (Rapp and Abbe, 2003). Adverse effects on fish and wildlife, through loss of critical habitat for river and riparian dependent species, are also common. Failing to recognize the process often leads to damage to, or loss of, structures and threats to life and property.

3.2.6 Other Values

The floodplain functions detailed above provide substantial value to humans by providing natural attenuation of flood flows, water quality improvements, habitat for fish and wildlife, and filtration of water supplies (used for human consumption and agricultural activates).

Frequently flooded areas provide recreational opportunities and scenic beauty. Many floodplains, including significant areas in Kittitas County, provide hiking, wildlife viewing and other water and land-based recreational opportunities. Floodplain landscapes commonly provide scenic beauty; while subjective, scenic value can enhance real estate values, enhance recreational experiences, and support tourism.

Due to the abundance of natural resources, which have provided food supplies and supported agricultural production for generations, floodplains often have historical and/or archaeological value. Historical sites and artifacts are often associated with early Anglo-American exploration and settlement. Archeological sites, which often include village and seasonal camp sites, middens, and burial sites, are recorded within Kittitas County frequently flooded areas.

Finally, floodplains can provide educational and scientific research opportunities due to the ecologically rich flora and fauna and/or culturally significant sites that occur. In Kittitas County and other areas across Washington, floodplains provide schools, universities, resource agencies, and not-for-profit organizations areas to conduct research on wetlands and riparian areas, aquatic habitats, and associated wildlife species.

3.3 Human Activity and Frequently Flooded Areas

The most common types of direct human disturbance to floodplains are filling and clearing—often associated with residential development, agriculture, forest practices, or infrastructure development (roads)—and stream channelization. These perturbations often disconnect the channel from its floodplains. Floodplains can also be affected indirectly, through alterations of flow regime resulting from flow regulation (e.g., dams and reservoirs), water withdrawals (e.g., irrigation), and even climate change. Each of these impact mechanisms is described below.

3.3.1 Floodplain Filling

Floodplain filling is typically performed to floodproof an area so that it may be developed. Large portions of the floodplains of many Washington rivers have been converted to urban and agricultural land uses (Haring, 2001). Many urban areas of the state are located in lowland floodplains, while land used for agricultural purposes is often located in floodplains because of the flat topography and rich soils deposited by the flooding rivers. Agricultural uses commonly do not require as much floodplain fill as urban development; however fill has historically been part of the strategy to elevate residences, agricultural facilities, and supporting infrastructure (roads; other utilities) above base flood elevations.

Without compensatory volume replacement, filling reduces floodplain storage and results in increased flood elevations. Depending on fill amounts and location, fill in the floodplain can increase flood frequency and flood stage within other floodplain areas. Fill within the floodway and stream side channels within the floodplain directly affects salmon and other aquatic species by converting aquatic habitat areas to uplands. Although some would argue floodplains are not lost with filling (because floodwaters are merely displaced to different locations along the river system), this logic fails to recognize that other locations may not provide the same level of habitat quality. Thus rather than inundating wetlands, oxbows, and other off-channel habitats, floodwaters are displaced to poor quality habitats such as roads, homes, and businesses (NMFS, 2008). In addition, floodplain clearing / filling reduces roughness, potentially increasing the rate of channel migration within, or downstream of, the cleared/filled areas.

Filling, paving, soil compaction, and construction of impervious surfaces increases runoff (increasing peak volumes and durations) and reduce infiltration (reducing groundwater recharge and base flows). Filling can increase surface erosion if proper best management practices (BMPs) are not in place (e.g., buffers, relay crops, etc.).

Filling also reduces the water quality maintenance function of floodplains, through loss of wetlands and floodplain vegetation that filter sediment, nutrients, and chemicals, and by reducing the volume of flood flow that interacts with the floodplain outside of the channel. Floodwater contact with human infrastructure placed within filled areas can create secondary issues for species, such as exposure to contamination from industrial pollutants and/or household hazardous materials including insecticides, herbicides and fertilizers.

Effects of fill can be mitigated using compensatory storage to maintain capacity and low impact site development techniques can help offset effects of floodplain fill on stormwater and stream flows. Maintaining or restoring natural site hydrology (both as it occurs during flood events and during non-flood conditions) maintains the ecological functions associated with floodplains.

Floodplain restoration activities can address impacts of past floodplain fill by removing material; however the impacts of allowing flood waters to return to a site must be considered with detailed analysis.

3.3.2 Floodplain Clearing

Another type of floodplain impact, related to human development and often associated with floodplain filling is the loss of natural riparian and upland vegetation (Haring, 2001). Pre-settlement floodplain vegetation in the Yakima River watershed ranged from coniferous forest at the higher/wetter elevations, to cottonwoods/willows with fewer coniferous trees in the mid-elevation watersheds, to willows/shrubs in the lower/drier elevations of the watershed. Conversion of coniferous riparian forests to deciduous trees, and conversion of wooded riparian areas to impervious surfaces, meadows, grasslands, and farmed fields has occurred as floodplains have been converted to urban and agricultural uses (Haring, 2001). Riparian forests are typically reduced or eliminated as levees and dikes are constructed.

Loss of vegetation on the floodplain reduces shading of water in floodplain channels, eliminates large woody debris contribution, reduces filtering of sediments, nutrients and toxics, and results in increased water energy and loss of bank stability during flood flows. Removal of mature native vegetation from riparian zones can increase stream temperatures, which can stress both adult and juvenile fish including priority and Endangered Species Act-listed species. Sufficiently high temperatures can increase mortality of fish and other aquatic organisms. Re-forestation can be expedited with restoration efforts (planting of native trees and shrubs). Restoration of floodplain vegetation can restore many of the beneficial effects to riparian and aquatic habitats.

3.3.3 Channelization

Stream or river channelization is the deliberate or unintended alteration of channel slope, width, depth, sediment roughness or size, or sediment load (Bolton and Shellberg, 2001). Widening, deepening, dredging, removal of live or dead vegetation, bank armoring, straightening, and construction of levees or similar structures may alter these variables. The physical effects of channelization include higher flow velocities, increased sediment transport, bank instability, loss of channel capacity, increased flood heights in downstream areas, and draining of wetlands. These effects in turn result in damage to or loss of stream and wetland habitat (Bolton and Shellberg, 2001). Higher flow velocities, bank instability, and increased flood heights resulting from channelization could all heighten risk to humans, in areas adjacent to or downstream of channelized streams or rivers..

Channelization also results in loss of natural habitat-forming processes, and even intentional homogenization of the channel. As a result of channelization, channel complexity is reduced, and specific habitat types (e.g., pool-riffle sequences, logjam-formed pools, meander pools, etc.) are reduced or eliminated. Loss of specific habitat types (e.g., pools, eddies, and off-channel areas), increases flow velocity, and longer durations of elevated flows affect fish, invertebrates, and periphyton (an important source of food) by sweeping organisms downstream, and by scouring food or redds. For example, salmon that spawn in areas with increased water velocities due to levee and dike construction may have reduced egg to fry survival due to the scour (Haring, 2001).

Installation of hydromodifications, defined as hardened features that act as barriers that restrict the movement of water, sediment, animals (e.g., fish), can result in channelization. Hydromodifications include levees, embankments, bridges and culverts, floodplain fill, bioengineering structures (cribwalls, rootwad/rock mixtures, etc.), and walls. Levees protect infrastructure from flooding. Levees also affect conveyance and storage of floodwaters in two ways: 1) levees isolate naturally occurring floodplain storage from the channel, and 2) levees constrict flows to a narrower channel, resulting in increased flow depth and velocity. This may cause increased scour, sedimentation, and transference of flooding problems to downstream areas (Hey, 1994). Other types of barriers such as bridges, culverts, fill, and embankments may impede flow, causing greater flood heights. Levees physically disconnect riparian areas, wetlands, and off-channel habitats from the main channel, which has adverse effects on natural ecological processes (Bolton and Shellberg, 2001). Restoration efforts aimed at returning a stream or river to an un-channelized condition frequently include levee breaches, new channel creation, and placement of large woody debris. Unraveling the impacts of past modifications that have resulted in channelization can be challenging and typically requires detailed analysis and engineering.

3.3.4 Floodplain Disconnection

Disconnection of channels from their floodplain can occur both laterally, as a result of the construction of dikes and levees, as well as longitudinally, as a result of the construction of road crossings. Channels can also become disconnected from their floodplains as a result of down-cutting and incision of the channel from losses of large woody debris, decreased sediment supplies, and increased high flow events. These types of disconnections:

- Reduce or eliminate off-channel habitats such as sloughs and side channels;
- Increase flow velocity during flood events due to the constriction of the channel;
- Reduce subsurface flows and groundwater contribution to the stream; and
- Simplify channels due to lack of large woody debris and channel straightening when levees are constructed (Haring, 2001).

As with channelization, increased flow velocities and diminished flood storage capacity associated with floodplain disconnection can increase risk to human health and safety in adjacent and downstream areas.

Reduced connectivity between off-channel and mainstream habitat impacts the ability of the ecosystem to support salmonid populations, including steelhead and bull trout. Access to and availability of off-channel habitat is reduced for juvenile salmonids, impacting rearing and foraging during normal flow conditions and limiting opportunities for refuge during flood flows. Sloughs and backwaters that are accessible and protected from flood flow impacts function as prime spawning habitat for coho salmon, and rearing and over-wintering habitat for spring Chinook and coho juveniles (Haring, 2001). The associated loss of large woody debris from channels also reduces the amount of rearing habitat available for Chinook juveniles. Construction of flood control dikes, levees, railroads, and highways has contributed to the loss of these historical connections (Eitemiller et al., 2002).

3.3.5 Flow Regulation and Alteration

Flow regulation (dams and reservoirs) affects several fundamental ecological principles essential to the proper functioning of riverine systems. Dams and reservoirs reduce habitat diversity and decrease native biodiversity while increasing non-native species (Stanford et al., 1996; Eitemiller et al., 2002). In Kittitas County, dams and associated reservoirs are common within the Yakima River system (Keechelus, Kachess, and Cle Elum reservoirs), and are managed to provide water resources for agriculture and other human uses while maintaining river flows for salmonid populations.

While management of existing dam and reservoir facilities is structured to reduce effects to salmonids, ecological impacts to floodplain functions and riparian habitats do occur. Winter flows in the upper Yakima and Cle Elum Rivers are generally low, potentially impacting survival of overwintering juvenile salmonids (BOR, 2008). This winter flow regulation reduces nutrient exchange between the floodplain and the river channel, due to less frequent overbank flows. Flow regulation also reduces the occurrence of frequent small-discharge flood events that are central components to maintaining habitat connectivity, resulting in altered habitat formation processes (Eitemiller et al., 2002).

Additionally, system regulation results in high flows during the summer in the upper Yakima River reaches – as well as downstream Yakima reaches outside of the County - affecting juvenile salmonid rearing habitat (BOR, 2008). These higher flows continue until late summer, when operational changes greatly reduce in-stream flow, disrupting salmonid habitat and impacting aquatic insect populations (Arango, 2001).

Stormwater runoff from impervious surfaces can increase the volume of water and the timing and size of the peak flood, resulting in alteration of predevelopment flow conditions (USDA, 1998). Stormwater runoff has greater impact on smaller streams than major rivers, which are affected more by heavy rainfall events and rapid snowmelt. Impervious surfaces (e.g., pavement) reduce water infiltration and increase runoff, thus creating greater flood hazard (Leopold, 1968). Low impact development strategies for site development and surface water runoff management may be appropriate stormwater management approaches to more closely maintain natural flow conditions, both within floodplains and through contributing watersheds (Ecology, 2013).

3.3.6 Climate Change

A recent review of the effects of climate change (ISAB, 2007) identified the following probable consequences of global warming along the Pacific coast of North America: 1) warmer temperatures will result in more precipitation falling as rain rather than snow, 2) snowpack will diminish and streamflow timing will be altered, 3) peak river flows will likely increase, and 4) water temperatures will continue to rise. Retreating winter snowpacks will run off earlier in the spring (Mote et al. 2003), summer base flows will be lower, and the network of perennially flowing streams in a drainage system will shrink during the summer dry period (Battin et al., 2006). A changing climate will alter the distribution, volume, timing, and type of precipitation, and will also likely modify the distribution and timing of water needs.

In the context of the Yakima Basin, the effects of climate change will also be influenced by dams, reservoirs, irrigation canals, and controlled releases that result in a largely regulated hydrograph (BOR and Ecology, 2012). While baseflows in smaller tributary streams will still likely be affected by climate change, the overall management approach for the Yakima Basin could potentially allow for some moderation of climate impacts on flooding within major streams and rivers. These pervasive existing alterations to Yakima Basin hydrology have already significantly altered downstream floodplain areas, as summarized in Section 3.3.5 (BOR, 2008).

The current FEMA guidelines for assessing flood frequency are based on the assumptions that flood distribution is not significantly affected by climatic trends or longer-term cycles and that historical flood behavior is representative of future events. As such, flood studies and floodplain mapping that has been or is to be developed based on FEMA guidance may not reflect future watershed and floodplain conditions as affected by climate change. Recent guidance on hydrologic and hydraulic studies (floodplain mapping) completed by FEMA for the Puget Sound region suggests that future hydrologic and floodplain conditions will be more influenced by changes in land cover and land use than by climate change (FEMA, 2010). As such, there is little concrete guidance for how to interpret best available science in determining and mapping future floodplain conditions.

3.3.7 Existing Floodplain Alterations in Kittitas County

Snyder and Stanford (2001) found that that the floodplains of the Yakima Basin are considerably altered by human structures and activities, which has degraded aquatic habitat. While conditions vary between the Basin's tributary systems, there is a pattern of decreasing water quality from upstream to downstream. Water quality impairment has been attributed to various factors, but all are related to increasing human interaction with the river and surrounding areas via urbanization, irrigation activities, grazing activities, and forestry.

Yakima River floodplains were likely historically important in providing fish habitat (Snyder and Stanford 2001), but many of these areas are now degraded (Stanford et al., 2002), with a largely controlled hydrograph and floodplain fill and alteration reducing the lateral extent and complexity of historical floodplain conditions (Eitmiller et. al., 2002).

Historically, the erosion and deposition of sediments, channel movement, and groundwater recharge from flooding events shaped the floodplain, creating a shifting mosaic of physical channel attributes and habitats. Maintaining this shifting mosaic depends on the ability of the river to move freely over the historic floodplain, and on the balance between channel movement and sediment erosion and deposition. Native aquatic species have evolved to these ongoing changes, and their alteration is likely to impact salmonids. A sufficient supply of sediment is needed to build new bars and islands, prevent channels from becoming incised, and maintain connections between surface water and groundwater (Stanford et al., 2002).

Under current conditions in the Yakima River Basin, river flows are altered substantially as a result of storing water in the reservoirs in the winter and diverting water in the spring, summer, and fall to meet entitlements, primarily for irrigation. Flow regimes that deviate substantially from the natural condition, as is currently the case in the Yakima River Basin, are well understood to produce a diverse array of ecological consequences (BOR, 2011). While a range of flows is vital to the structure and function of aquatic ecosystems, stable base flows are important in supporting high growth rates for fish that are timed with periods of high ecosystem production (i.e., late spring through early fall). Thus, natural stream flow variability has a controlling effect on the biology of native aquatic species and the physical and chemical ecosystem attributes they depend on for survival. Current conditions have inverted and truncated the natural flow regime, producing river systems that are out of phase with their natural runoff regimes.

The duration, magnitude, and spatial extent of floodplain inundation in the Yakima River basin is directly affected by the truncation of flood flows that result from reservoir storage. These actions also alter the quantity, quality, and timing of groundwater discharge to the river and diminish the availability, extent, and temporal duration of off-channel habitats for anadromous and resident fish, limiting access to complex, diverse floodplain habitats. Also, flood flows form and maintain the channel network, including side channels, which serve to increase productivity, carrying capacity, and life history diversity by providing suitable habitat for salmonids, particularly the early salmonid life stages. Stanford et al. (2002) concludes that the distribution and concentration of algae, macroinvertebrates, and fish on the five major floodplain reaches of the Yakima River basin system clearly demonstrate the importance of off-channel habitat and that that the floodplain reaches retain some ecological integrity, but are substantially degraded.

For salmonids in the Yakima River basin, floodplain disconnection combined with flow regulation has reduced river floodplain interactions and decreased habitat complexity, which directly relates to the ability of the ecosystem to support salmonid populations, including steelhead and bull trout.

Flood control dikes and levees, and railroad and highway construction have disrupted the lateral connectivity between the rivers and adjacent wetted areas. In Kittitas County, this has occurred along the Yakima River as it generally parallels Interstate 90, Highway 10 and railroad corridors along Swauk Creek as it parallels Highway 97, as well as other floodplain reaches within the County. This deprivation of lateral connectivity has resulted in loss of habitat, diminished habitat heterogeneity, reduced vertical connectivity, loss of or changes in nutrient flux, and reduction in the tempering effect of groundwater on stream temperature. The result has been a significant change, compared to pristine conditions. Loss of lateral connectivity has changed the intensity and timing of downstream flood flows; these downstream effects can also negatively impact floodplain habitats.

Agricultural activities can fill floodplain, increase the input of sediments, nutrients, or toxics during flood events, and remove native vegetation that slows the velocity of flood flows (Granger et al., 2005). Construction of agricultural drains has dewatered natural floodplain wetlands. These impacts have occurred on the Yakima River between Cle Elum and Ellensburg, as well as within floodplains associated with Wilson Creek and Naneum Creek within the Kittitas Valley (surrounding Ellensburg). Interruption of flood cycles by impoundment, along with structural exclusion of river from floodplain, has reduced riverine wetland habitats, which were the predominant predevelopment wetlands in the Yakima Valley. Loss of floodplain inundation has altered habitats by hampering the ability of native vegetation (e.g., cottonwoods) to reproduce and survive, and by reducing nutrient cycling and productivity of aquatic invertebrates and other plant and animal species that form important components of the food web.

Most of the floodplains in Kittitas County are located in agricultural, forested, or rural residential areas. According to Eitmiller et al. 2002, floodplain areas in the Easton vicinity have experienced very high development and land cover alteration, with significant additional pressure possible based on ownership, parcel patterns, and underlying zoning. Restoration of lateral floodplain extent in this area would be challenging due to these patterns. Similar challenges are noted for historic floodplains surrounding Pine Glen, Elk Meadows, and Pine Valley (areas where existing subdivisions are common in the floodplain). In contrast, historic floodplain conditions and restoration potential is identified as highest in the upper end of the Yakima Basin floodplain (development is less intense). Additionally, floodplain connectivity around convergences between the Yakima River and other streams is noted as important – Eitmiller et. al. 2002 identifies the area between the Cle Elum River and Yakima River for its importance to floodplain ecology. Riverine wetlands in the floodplain of the Yakima River and other streams are highly valuable for flood flow control because they can provide overbank storage for surface water. Depressional wetlands can contribute to this function by slowing surface runoff during summer thunderstorms (Sheldon et al., 2005). Seasonally ponded wetlands are important in removing excess nitrogen from surface water or groundwater. Riparian wetlands along the Yakima River and other streams have dense vegetation that can slow and filter surface water flows.

3.4 Frequently Flooded Areas Management Tools

There are several floodplain management tools and resources that are relevant to managing frequently flooded areas within Kittitas County; they are described below.

3.4.1 Restricted Uses

Restricting/limiting development in the floodplain has a threefold purpose: 1) to reduce risk of human health, safety, and property, 2) to prevent development activities from adversely affecting the capacity of the floodplain or floodway to convey and store floodwaters, and 3) to preserve important ecological functions of floodplains. In particular, development within the floodway should be restricted to protect floodplain storage and conveyance.

3.4.2 Floodproofing

KCC 14.08 (described below) requires floodproofing of new development and substantial improvements to existing development within the floodplain, to reduce damage to structures during floods. Key floodproofing provisions include the following:

- Anchoring to prevent floatation, lateral movement, or collapse;
- Construction of utilities to prevent entry of water during flooding;
- Elevation of residential structures to or above the base flood elevation;
- Prohibition of enclosed areas below the lowest floor, or allowance for flow of floodwaters; and
- Elevation of non-residential structures above the base flood elevation or floodproofing so that portions of the structure below the base flood elevation are watertight and non-buoyant.

3.4.3 Kittitas Flood Control Zone District

Following the large floods of January 2009, a Citizens Advisory Committee was appointed to study and analyze the feasibility of creating Flood Control Zone District (FCZD). In January 2012 the committee made a recommendation to the Board of County Commissioners (BOCC) to form a FCZD. The BOCC passed a resolution (Resolution 2012-001) which established the intent to form a county-wide FCZD in accordance with RCW 86.15. In July 2012 the BOCC passed a resolution to form the FCZD. The residents of Kittitas County voted to approve a levy to establish the FCZD, whose boundaries include all of Kittitas County including incorporated areas, on November 6, 2012. The stated purpose of the FCZD is to address the flood management needs within Kittitas County. Activities of the FCZD may include, but are not limited to, flood warning and emergency response, flood proofing and elevation of structures, property acquisition, implementation of consistent development regulations that address the impacts of flooding, basin wide corridor planning, and the identification, engineering, and construction of capital projects to mitigate and/or address flooding problems. The FCZD will also update the 1996 Comprehensive Flood Hazard Management Plan.

The FCZD has the following responsibilities and obligations under RCW 86.15.080:

- Plan, construct, acquire, repair, maintain and operate all necessary equipment, facilities, improvements, and works to control, conserve, and remove flood and storm waters;
- Control, conserve, retain, reclaim, and remove flood waters and storm waters including waters of lakes and ponds within district;
- Sue and be sued in name of the zone.
- Remove debris, log or other material which may impede the orderly flow of waters in streams or water courses.
- Acquire or reclaim lands when incidental to purposes of the zone and dispose of such lands as surplus.

The formulation of the FCZD presents an opportunity to integrate flood management within and between drainage basins, and to coordinate policy and regulations between the various jurisdictions, to provide for protection of life, property while providing for adequate levels of ecological function. The initial efforts of the FCZD will be focused on updating plans and managing activities according to the National Flood Insurance Program in 44 CFR and KCC 14.08 Flood Hazard Reduction.

3.4.4 National Flood Insurance Program and Washington's Model Flood Damage Prevention Ordinance

Kittitas County is a participating community in FEMA's National Flood Insurance Program (NFIP), which provides property owners within flood hazard areas the opportunity to buy federal flood insurance. As a condition of participation in the NFIP, communities are required to adopt and enforce a flood hazard reduction ordinance that meets the minimum federal requirements (44 CFR 60.3). Washington State law (RCW 86.16) contains some additional requirements that are more restrictive; FEMA requires that communities meet state standards, as well. FEMA and the State of Washington have a Washington Model Flood Damage Prevention Ordinance (FEMA 2004) based on 44 CFR 60.3 and RCW 86.16.

The 2004 model regulations require that the cumulative effect of a proposed development, when combined with all other existing and anticipated development, will not increase the water surface elevation of the base flood more than one foot at any point within the community. Development in the floodway (where water is likely to be deepest and fastest) will potentially create constrictions that increase flood heights. Therefore, FEMA model regulations require that proposed encroachments in the floodway not increase flood levels during the occurrence of the 100-year flood discharge (FEMA, 2004).

Kittitas County's Flood Damage Prevention ordinance (KCC 14.08) is generally consistent with the 2004 Model Ordinance and with State and Federal Requirements for flood control and protection. KCC 14.08 identifies regulated flood hazard areas, provides procedures for development permits, review, and enforcement, and details standards for floodproofing and flood control activities.

3.5 Existing County Frequently Flooded Areas Code Provisions and BAS Recommendations

Kittitas County regulates frequently flooded areas through Title 17A of the KCC, which was last updated in 1995. Frequently flooded areas are specifically addressed in KCC 17A.05.010 through 17A.05.020. In addition, the County regulates development and building activity within flood hazard areas through KCC Chapter 14.08 (Flood Damage Prevention), which is generally consistent with the State's Floodplain Management Act (RCW 86.16) and minimum criteria for participation in the NFIP.

The amount of scientific information and agency guidance on floodplain management has grown substantially since the County's frequently flooded areas (KCC 17A.05) regulations were last updated. The purpose of this section is to evaluate whether the County's existing frequently flooded area regulations incorporate the best available science and are consistent with GMA requirements and current agency guidance. Considerations for changes to the County's frequently flooded area regulations are provided where gaps or discrepancies are identified.

3.5.1 Incorporation of Floodplain Functions and Values

3.5.1.1 Existing Kittitas County Code

Currently, neither KCC Title 17A nor Title 14 reference the relationship between frequently flooded areas and flood hazards. In addition, there is currently no mention of the ecological functions that frequently flooded areas provide.

3.5.1.2 Best Available Science Summary

In addition to human health and safety, standards for use and development within frequently flooded areas should ensure protection of the ecological functions associated with floodplains. Many of the ecological functions associated with floodplains - including flood water storage and conveyance, sediment deposition and conveyance, and groundwater functions – also provide significant values to humans, including protection from flood hazards.

3.5.1.3 Considerations for Code Update

There are several opportunities to improve the frequently flooded areas sections of KCC to require protection of floodplain functions and values, and improve consistency with scientific standards and state law:

- Add a reference to KCC 17A.50 in Title 14, stating that flood damage protection activities shall conform to Chapter 17A.05.
- Consider revising KCC 17A.05 to indicate "It is the purpose of this article to reduce the risk to life, property damage, and public facilities that result from floods, and to protect fish and wildlife habitats that occur within frequently flooded areas."

3.5.2 Future Conditions, Unique Flood Hazards, and Floodplain Mapping

3.5.2.1 Existing Kittitas County Code

Currently, KCC Title 14 is consistent with NFIP minimum criteria in requiring use of base flood data as specified in the effective flood insurance study and flood insurance rate map (FIRM)[7], along with any revisions to these materials or use of "best available information" that has been produced for areas included on the FIRM or other areas that were not previously studied.

Existing KCC Title 14 does not suggest or require consideration of future conditions (based on future land cover, climate change, or otherwise) for new flood hazard area identification. Existing KCC Title 14 does not suggest or require use of guidance or best available information for mapping of alluvial fans, a unique flood hazard condition that occurs in Kittitas County.

[7] "The Flood Insurance Study for the County of Kittitas County," dated November 5, 1980, and any revisions thereto.

3.5.2.2 Best Available Science Summary

Best available science for frequently flooded areas suggests consideration and integration of future conditions and unique floodplain conditions when developing new flood data, studies, and floodplain maps. Frequently flooded area data and mapping that integrates future conditions and/or detailed understanding unique floodplain conditions (for example, alluvial fan flood hazards) may not always be available.

3.5.2.3 Considerations for Code Update

There are several opportunities to improve the frequently flooded areas sections of KCC Title 17A (or KCC Title 14 which could be incorporated by reference) and make them more consistent with scientific standards:

- Revise KCC 14.08.120 to encourage or require consideration of future conditions during investigation of base flood elevation. Updated standards should encourage or require use of other regional guidance or best practices that may emerge in the future.
- Revise KCC Title 14 (14.08.120) to encourage or require consideration of unique alluvial fan flood hazards when floodplain development occurs within or near the Naneum Creek and Manastash Creek alluvial fan areas, or other areas where alluvial fan conditions occur.

3.5.3 Reporting Requirements for Floodplain Development

3.5.3.1 Existing Kittitas County Code

Besides preparation of a standard County critical areas checklist, there are no specific reporting requirements for development within frequently flooded areas specified in KCC Title 17A.

3.5.3.2 Best Available Science Summary

When development is proposed within frequently flooded areas, best available science suggests the importance of detailed site understanding and consideration of development impacts on floodplain functions. Site and development information is necessary to ensure that the proposed development is situated as to minimize potential flood hazards to the greatest extent feasible, and to ensure that the need to for new or expanded flood control structures are avoided or minimized to the extend feasible (given the proposed use and consistency with floodplain development allowances).

3.5.3.3 Considerations for Code Update

When development will occur within a frequently flooded area, the applicant should provide adequate information to the County on existing site conditions, impacts, and mitigation. As part of a Critical Areas Study for development within a frequently flooded area, the following information should be provided:

- The nature, location, dimensions, and elevations of the property in question;
- Names and location of all lakes, water bodies, water-ways and drainage facilities within 300 feet of the site;

- The proposed drainage system including, but not limited to storm sewers, overland flow paths, detention facilities and roads;
- Existing and proposed structures, fill, pavement and other impervious surfaces, and sites for storage of materials;
- All wetlands;
- Designated fish and wildlife habitat conservation areas, and habitat areas identified for conservation or protection under state or federal or local laws or regulations (e.g., Endangered Species Act, Magnuson-Stevens Fishery Conservation and Management Act, Growth Management Act, Shorelines Management Act, Priority Habitat and Species List); and
- Existing native vegetation, proposed clearing limits, and proposed revegetation.
- If the proposed project involves grading, excavation, or filling, include proposed post-development terrain at one foot contour intervals.

3.5.4 Land Use Regulations within Frequently Flooded Areas

3.5.4.1 Existing Kittitas County Code

Currently, KCC Title 17A does not specifically reference or restrict subdivisions in frequently flooded areas. KCC 14.08 references subdivisions in regards to manufactured homes (KCC 14.08.290) and to minimizing flood damage in subdivision proposals (KCC 14.08.220). However, the language on minimizing flood damage is relatively general and does not identify specific restrictions on subdividing within a frequently flooded area. KCC 14.08.220 specifies:

1. All subdivision proposals shall be consistent with the need to minimize flood damage.
2. All subdivision proposals shall have public utilities and facilities such as sewer, gas, electrical, and water systems located and constructed to minimize flood damage.
3. All subdivision proposals shall have adequate drainage provided to reduce exposure to flood damage.
4. Where base flood elevation data has not been provided or is not available from another authoritative source, it shall be generated for subdivision proposals and other proposed developments and shall be noted on the final mylar.
5. All subdivisions shall show on the face of both the preliminary and final plat, for either short or long plats, the boundary of the 100year floodplain and floodway.

3.5.4.2 Best Available Science Summary

New residential subdivision and associated development can result in many of the human activities commonly associated with negative effects on floodplain ecological functions. These impacts most commonly include floodplain filling and vegetation clearing, and can also include floodplain disconnection and stream channelization.

Without compensatory volume replacement, filling reduces floodplain storage, and results in increased flood elevations. Depending on fill amounts and location, fill in the floodplain can increase flood frequency and flood stage within other floodplain areas. Fill within floodways and stream side channels directly affects salmon and other aquatic species by converting aquatic habitat areas to uplands. Floodplain clearing / filling reduces roughness, potentially increasing the rate of channel migration within, or downstream of, the cleared/filled areas.

Filling, paving, soil compaction, and construction of impervious surfaces increases runoff (increasing peak volumes and durations) and reduces infiltration (reducing groundwater recharge and base flows). Filling can increase surface erosion if BMPs are not in place (e.g., buffers, relay crops, etc.).

Filling reduces the water quality maintenance function of floodplains, through loss of wetlands and floodplain vegetation that filter sediment, nutrients, and chemicals, and by reducing the volume of flood flow that interacts with the floodplain outside of the channel. Furthermore, floodwater contact with human infrastructure placed within filled areas can also create secondary issues for species, such as exposure to contamination from industrial pollutants and/or household hazardous materials including insecticides, herbicides and fertilizers.

3.5.4.3 Considerations for Code Update

Based on the discussion and analysis above, there are several opportunities to improve the frequently flooded areas sections of KCC Title 17A (or KCC Title 14 which could be incorporated by reference) and make them more consistent with scientific standards and state law:

- Consider requiring that subdivision does not result in a parcel located solely within a frequently flooded area. Title 17A or Title 14 could be updated to require that if a parcel has a buildable site outside the frequently flooded area, it should not be subdivided to create a new lot, tract, or parcel within a binding site plan that does not have a buildable site outside the frequently flooded area. This provision would not apply to lots set aside from development and preserved as open space.
- Consider revising code within KCC Title 17A or Title 14 to list specific steps to avoid flood damage to structures and other development within existing parcels or lots located within frequently flooded areas. In addition to existing standards for elevating structures above base flood elevation, the County could require one or more of the following hazard reduction measures:
    1. Locate new structures out of frequently flooded areas, when possible;
    2. When locating structures and other development out of frequently flooded areas is not possible, locate them as far from the water body as possible and on the highest existing land (on lots where higher land is located nearer the water body, determination should be made during development review to determine development area that results in greatest avoidance of flood damage); and
    3. Require a minimum building setback of 15 feet from floodways for all structures.
- In order to reduce impacts to the functions provided by frequently flooded areas, consider requiring all subdivision proposals, short subdivisions, short plats, planned developments, and new and expansions to manufactured housing parks to have one or more new lots in the frequently flooded area set aside for open space use through deed restriction, easement, subdivision covenant, or donation to a public agency. The density of the development in the portion of the development outside the frequently flooded area may then be increased to compensate for the amount of land in the frequently flooded area preserved as open space. Such a change could be done in accordance with the section of the Kittitas County zoning (or other development ordinance) that allows PUDs and/or transfers of development rights).

3.5.5 Mitigation Sequencing

3.5.5.1 Existing Kittitas County Code

Existing KCC 17A.03.075 requires "economically feasible mitigation efforts" for impacts to critical areas. Existing standards applicable to frequently flooded areas (KCC 17A.05) and flood damage prevention (KCC 14.08) do not require mitigation sequencing.

3.5.5.2 Best Available Science Summary

Mitigation sequencing is a concept defined in Washington state law (SEPA and the Shoreline Management Act, WAC 197-11-768 and 173-26). It is also part of the permit process under the federal Clean Water Act Section 404. Mitigation sequencing consists of the following steps taken in order:

1. Avoiding the impact altogether by not taking a certain action or parts of an action;
2. Minimizing impacts by limiting the degree or magnitude of the action and its implementation, by using appropriate technology, or by taking affirmative steps to avoid or reduce impacts;
3. Rectifying the impact by repairing, rehabilitating, or restoring the affected environment;
4. Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action;
5. Compensating for the impact by replacing, enhancing, or providing substitute resources or environments; and/or
6. Monitoring the impact and taking appropriate corrective measures.

Recent evaluations of the success of mitigation efforts statewide and throughout the nation have strongly recommended more emphasis on impact avoidance and mitigation, the two preferred steps in mitigation sequencing, to reduce the need for compensatory mitigation (Ecology 2008, ELI and TNC 2009). While some of this investigation is focused on wetlands and other aquatic habitats, frequently flooded areas are commonly associated with these habitats. Further, applying the mitigation sequencing approach to frequently flooded areas will discourage floodplain development and commonly associated impacts that degrade floodplain ecological functions.

3.5.5.3 Considerations for Code Update

Adding a mitigation sequencing requirement to the County's frequently flooded area regulations would increase the incentive for applicants to avoid floodplain impacts and the need for mitigation. This would reduce the potential for net loss of floodplain functions. Alternatively, a mitigation sequencing requirement applicable to all critical areas could be specified in KCC Title 17A.

3.5.6 Requirements for Compensatory Floodplain Storage

3.5.6.1 Existing Kittitas County Code

Compensation for fill placed within the 100-year floodplain is a key strategy to limit increases in flood flow elevations. The existing regulations for frequently flooded areas specifically address no net loss of floodplain storage. In addition, KCC 14.08.315 lists specific standards for filling and grading in the floodplain:

> "Filling, grading or other activity that would reduce the effective storage volume shall be mitigated by creating compensatory storage on-site, or off-site if legal arrangements can be made, to assure that the effective compensatory storage volume will be preserved over time; provided, however, that no increased upstream or downstream flood hazard shall be created by any fill authorized in the floodplain by this chapter or other applicable chapters."

Although the existing regulations for frequently flooded areas require no net loss of floodplain storage, this provision currently applies only to residential developments and associated buildings and "shorelines of the state" as defined in 90.58 RCW.

3.5.6.2 Best Available Science Summary

Not all floodplain/ flood storage features provide identical functions. For example, dynamic flood storage can occur within the floodway and/or within remnant channels such as oxbows and side channels, or ponds and depressions. These areas often support concentrations wildlife species, such as amphibians and waterfowl, and can provide important refuge habitat to aquatic species during flood flows. Other frequently flooded areas provide more passive flood storage. This often occurs occur in flatter floodplain and flood fringe areas, which serve as overbank depositional areas that provide for floodplain roughness and nutrient recruitment functions.

When floodplain filling occurs, the hydrological and habitat context of both the impact and the flood storage mitigation site should be considered. For example, the functions of a filled remnant channel or disconnected oxbow that provides aquatic and wildlife habitat cannot likely be reproduced by excavating to a minor depth within a flat, lightly vegetated floodplain, even though the total volumes of fill and excavation may be equal. Likewise, excavation of an isolated ponded area within an active floodplain may create a stranding hazard to fish during the recession of flood flows. Careful consideration of hydrologic and biological factors is an important part of mitigating for flood storage in a manner than preserves or enhances stream processes and functions.

Many of the tributaries to those waterbodies listed under KCC 17A.05 are not classified as shorelines of the state, yet support fish species (including Endangered Species Act-listed species) and provide important flood storage functions that attenuate flows downstream. Loss of floodplain storage and associated hydrologic, geomorphic, and biological functions in these smaller streams (those with mean annual flow of less than twenty cubic feet per second) is a concern. In addition, significant flood hazards exist along some of these smaller streams. *Zero-rise Flood Considerations:* No net loss of flood storage volume onsite, or within close proximity of the fill location, as specified in KCC 14.08.315, is effective in assuring no net rise of flood elevation. However, in some cases, creation of compensatory flood storage onsite may not be practicable. In these cases, where offsite floodplain storage is created as mitigation, hydrologic modeling may be required to calculate the flood storage volume necessary to ensure no net rise of flood elevations. Depending on local flow conditions and geomorphology, offsite locations may require excavation of an amount greater than the corresponding volume of fill requiring mitigation.

3.5.6.3 Considerations for Code Update

Based on the discussion and analysis above, there are several opportunities to improve the frequently flooded areas sections of KCC Title 17A (or KCC Title 14 which could be incorporated by reference) and make them more consistent with scientific standards and state law:

- Consider expanding the requirement for no net loss of floodplain storage to include more waterbodies than only those designated as "shorelines of the state." For example, requirements for required compensatory storage could be expanded to include all waters where frequently flooded areas occur. Alternatively, the County could require compensatory storage for all Type F (fish bearing) waters, or a subset of these waters based on stream use by salmonids and/or listed species at the state or federal level.
- In order to ensure no net less of floodplain storage functions, in addition to floodplain volumes, consider incorporating code language that recommends or requires compensatory flood storage mitigation activities to consider the existing and future ecological and hydrologic functions of impact and mitigation sites, and/or to ensure these functions are maintained or improved. Clarify requirements to ensure floodplain storage areas are well-vegetated with native vegetation.
- In order to ensure no increased upstream or downstream flood hazard, consider incorporating code language that recommends or requires the preferred prioritization of compensatory floodplain mitigation. An example of prioritization of preference is;
  1. Onsite flood-storage;
  2. Off-site flood storage in close proximity upstream or downstream of the floodplain fill location; and
  3. Off-site flood storage in a location further upstream or downstream of the floodplain fill location.
- In order to ensure no increased upstream or downstream in flood hazard, consider including a code provision for the requirement of no net rise of flood elevations in situations where floodplain mitigation will occur at a distance from the fill locations.
- Consider revising code language to better define compensatory floodplain storage. An example of suggested language is as follows:

  New development shall not reduce the effective flood storage volume within a frequently flooded area. A development proposal shall provide compensatory storage if grading or other activity eliminates any effective flood storage volume. Compensatory storage shall:

  a. Provide equivalent volume at equivalent elevations to that being displaced. For this purpose, "equivalent elevation" means having similar relationship to ordinary high water and to the best available 10-year, 50-year and 100-year water surface profiles;
  b. Be hydraulically connected to the source of flooding;
  c. Provide compensatory storage in the same construction season as when the displacement of flood storage volume occurs and before the flood season begins;
  d. The newly created storage area shall be graded and vegetated to allow fish access during flood events without creating fish stranding sites;

e. Occur on the site. The director may approve equivalent compensatory storage off the site if legal arrangements, acceptable to the department, are made to assure that the effective compensatory storage volume will be preserved over time. The director may approve of off-site compensatory storage through an approved compensatory storage bank.

3.6 Summary of Findings and Code Recommendations

Table 3-1 summarizes considerations for updates to Kittitas County frequently flooded areas regulations based on a review of the best available science.

Table 3-1. Summary of Considerations for Updates to Kittitas County Frequently Flooded Areas Regulations.

Topic	Existing Kittitas County Code Sections (if applicable)	Potential Code Changes
Incorporation of floodplain functions and values	KCC 17A.05 and KCC 14.08	A reference should be adopted within KCC 17A.05 (Frequently Flooded Areas), stating that all development shall conform to the provisions of KCC Title 14 (Flood Damage Prevention), Flood Damage Prevention and within Title 14, stating that flood damage protection activities shall conform to Chapter 17A.05.
	KCC 17A.05	Revise KCC 17A.05 to indicate "It is the purpose of this article to reduce the risk to life, property damage, and public facilities that result from floods, and to protect fish and wildlife habitats that occur within frequently flooded areas."
Future conditions and floodplain mapping	KCC 14.08.120	Require, or at a minimum encourage, consideration of future conditions during investigation of base flood elevation. Updated standards could reference the currently available guidance for future conditions (FEMA 2010), or other more useful and applicable guidance or methods that may become available in the future.
Unique flood hazards and floodplain mapping	KCC 14.08.120	Require, or at a minimum encourage, consideration of unique alluvial fan flood hazards when floodplain development occurs • within or near the Naneum Creek and Manastash Creek alluvial fan areas, or • other areas where alluvial fan conditions occur; or • when new flood hazard and base flood elevation study of these areas is completed.
Reporting requirements for floodplain development	KCC 17A.05	Require applicants for floodplain development to provide adequate information on existing site conditions and impacts (in addition to the information currently required in KCC14.08.110).
Land use regulations within frequently flooded areas	Title 17A or Title 14	Ensure that subdivision does not result in a parcel located solely within a frequently flooded area. If an existing parcel has a buildable site outside the frequently flooded area, it should not be subdivided to create a new lot, tract, or parcel within a binding site plan that does not have a buildable site outside the frequently flooded area. This provision would not apply to lots set aside from development and preserved as open space.

Topic	Existing Kittitas County Code Sections (if applicable)	Potential Code Changes
		Require use of additional specific actions to avoid flood damage to structures and other development within existing parcels or lots located within frequently flooded areas. In addition to existing standards for elevating structures above base flood elevation, require one or more of the following hazard reduction measures: 1) All new structures on lots that have a buildable site out of frequently flooded areas be located in that area, when possible; 2) All new structures, pavement, and other development on lots that do not have a buildable site out of frequently flooded areas be located as far from the water body as possible and on the highest existing land (on lots where higher land is located nearer the water body, determination should be made during development review to determine development area that results in greatest avoidance of flood damage); and 3) Require a minimum setback of 15 feet from floodways for all structures.
		In order to reduce impacts to the functions provided by frequently flooded areas, require all subdivision proposals, short subdivisions, short plats, planned developments, and new and expansions to manufactured housing parks to set aside open space through deed restriction, easement, subdivision covenant, or donation to a public agency. Also consider allowances to increase the density of the development in the portion of the development outside the frequently flooded area to compensate for the amount of land in the frequently flooded area preserved as open space. Such a change could be done in accordance with the section of the Kittitas County zoning (or other development ordinance) that allows development clustering, PUDs and/or transfers of development rights.
Mitigation sequencing	KCC 17A.05	Provide a mitigation sequencing requirement regulations – this would increase the incentive for applicants to avoid floodplain impacts and the need for mitigation, and would reduce the potential for net loss of floodplain functions. Alternatively, a mitigation sequencing requirement applicable to all critical areas could be specified in KCC Title 17A.

Topic	Existing Kittitas County Code Sections (if applicable)	Potential Code Changes
Compensatory flood storage	KCC 17A.05 or KCC 14.08	Implement the following options to improve protection of the storage provided by frequently flooded areas: • Expand the requirement for no net loss of floodplain storage to include more waterbodies than only those designated as “shorelines of the state”; • Incorporate code language that requires compensatory flood storage mitigation activities to consider the existing and future ecological and hydrologic functions of impact and mitigation sites, and/or to ensure these functions are maintained or improved; • Incorporate code language that requires the preferred prioritization of compensatory floodplain mitigation. Example order of prioritization: 1) Onsite flood-storage; 2) Off-site flood storage in close proximity upstream or downstream of the floodplain fill location; and 3) Off-site flood storage in a location further upstream or downstream; and • Where floodplain mitigation would occur at a distance from the fill location, require evaluation of no net rise of flood elevations in areas upstream and downstream of proposed fill.

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4.0 CRITICAL AQUIFER RECHARGE AREAS

This chapter describes critical aquifer recharge areas (CARAs) in Kittitas County, summarizes the relevant scientific literature, and describes how CARAs can be affected by land use and other human activities. This chapter also presents an overview of the management and protection tools for CARAs. The purpose of this chapter is to establish a basis for recommending updates to the CARA provisions of KCC Chapter 17A.06.

An aquifer is an underground layer of water-bearing permeable rock or unconsolidated materials from which groundwater can be extracted using a water well. CARAs are defined as "areas with a critical recharging effect on aquifers used for potable water, including areas where an aquifer that is a source of drinking water is vulnerable to contamination that would affect the potability of the water, or is susceptible to reduced discharge" (WAC 365-190-030). WAC 365-190-100 states that counties and cities must classify recharge areas for aquifers according to the aquifer vulnerability to contamination. Vulnerability is the combined effect of hydrogeological susceptibility to contamination, and the presence or absence of land uses that contribute to contamination that may degrade groundwater.

4.1 Inventory of Critical Aquifer Recharge Areas in Kittitas County

Kittitas County is located in central Washington on the eastern slopes of the Cascade Mountains between the Cascade Crest and the Columbia River. The underlying basement sedimentary rocks, consolidated sedimentary rocks, interbedded Columbia River basalt flows, and relatively young unconsolidated (or weakly consolidated) materials have been structurally altered by ongoing tectonic forces. Structural basins formed by faulting and folding have typically been filled with unconsolidated or weakly consolidated materials which have supported the development of groundwater basins.

Identification and mapping of CARAs requires analysis and understanding of the physical characteristics such as:

- Depth to groundwater;
- Aquifer properties (hydraulic conductivity, gradients, and size);
- Soil (texture, permeability, and contaminant attenuation properties);
- Characteristics of the vadose zone (permeability and attenuation properties); and
- Other relevant factors.

Vulnerability to contamination is assessed by considering:

- The contaminant loading potential;
- General land use;
- Waste disposal sites;
- Agriculture activities; and
- Well logs and water quality test results.

Kittitas County has not undertaken a comprehensive study of these characteristics in order to have a complete assessment of aquifer susceptibility. However, the County has attempted to classify areas of high, moderate, and low susceptibility and delineate such areas at a coarse scale. The boundaries do not necessarily correspond to physical changes in the landscape or reflect a precise delineation, but instead are based on the following general characteristics:

1. Recharge to an aquifer that provides potable water potentially occurs; and
2. The presence of existing surface land uses that could impact an aquifer.

CARA mapping and classification were conducted in support of this best available science review (see map in Appendix A). The general rationale for each rating category is explained below in Table 4-1.

Table 4-1. Kittitas County CARA Mapping Rationale for Aquifer Susceptibility

Susceptibility Rating	Mapping Elements	Notes
High	The Roslyn and Kittitas Structural basins plus: Alluvial sediments (Qal); Outwash (Qao), alluvial fan (Qafo), Loess (Ql), outbursts (fs(t)). Continental sedimentary (Thorp gravel)	These areas contain an unconfined, shallow aquifer and a higher density of human activity and connections to contaminant-generating surface activities.
Medium	Older bedrock in lower elevations (designated by alluvium and glacial drift Qad(e))	These areas have high groundwater recharge rates, but a modest volume of water withdrawals. There is a lower potential for groundwater contamination due to a lower degree of connection to contaminant-generating surface activities, or geologic conditions are such that surface activities are unlikely to impact the aquifer.
Low	Columbia River Basalt Group (CRBG) at higher elevations; older bedrock at higher elevations.	These areas have a low level of aquifer recharge, along with very low population densities and a low degree of connection to contaminant-generating surface activities.

There are several studies that have been complete, or are underway, that could be used to further refine CARA delineation and mapping in Kittitas County. Those studies are addressed in the following subsections.

4.1.1 Groundwater Resources in Kittitas County

Substantial investigations into the hydrogeology of the Yakima Basin have occurred to support an ongoing adjudication of surface water rights in the area (see for example Vaccaro et al., 2009). This work covers the Yakima River Basin, which occupies the majority of Kittitas County. A portion of the County that drains directly to the Columbia River near Vantage is not included in this work, but geology and groundwater in the area are dominated by Columbia River Basalts, and the hydrogeologic units are likely similar to those described for the Yakima Basin.

The U.S. Geological Survey (USGS) identified four categories of hydrogeologic units in the Yakima River Basin:

1. Unconsolidated basin fill units composed of Pliocene to recent sediments;
2. Semi consolidated to consolidated basin fill units composed of Miocene-Pliocene sediments;
3. Miocene Columbia River Basalt Group (CRBG) and interbed units; and
4. Paleozoic to Quaternary bedrock units.

All of these units are present within Kittitas County, with the older bedrock units dominating the higher elevations in the western portion of the County, basin-fills in the valleys surrounding Cle Elum and Ellensburg, and CRBG covering higher elevations in the eastern portion of the County. The basin-fill hydrogeologic units (1 and 2 in the list above) are of particular interest, as they provide relatively shallow sources of groundwater that are often used for groundwater extraction. These units are not typically confined, meaning that there are pathways that can allow for interactions of surface land uses and the underlying aquifer.

While these units are generally similar in terms of overall structure, there is a substantial amount of variation within the basin fills in terms of materials and lateral and vertical hydraulic conductivities. The Roslyn Basin includes more fine grained materials from lacustrine (lake) deposits which can have hydraulic conductivities that are many orders of magnitude less than adjacent alluvial or sand and gravel deposits (Figure 4-1). The Kittitas Basin has fewer fine grained units than the Roslyn Basin, but has more consolidated deposits.

The CRBG and older bedrock units also provide sources of groundwater in Kittitas County. The CRBG provides the most storage volume of the hydrogeologic units in the Yakima Basin, and is engaged with deeper wells (100 to 500 feet deep) in the foothills east of Ellensburg. The older bedrock is also a routine source of groundwater in the higher elevations above Cle Elum, extending up the tributaries.

4.1.1.1 Yakima River Groundwater Study

The U.S. Bureau of Reclamation, Washington Department of Ecology, and the Yakama Indian Nation contracted with the USGS to study the groundwater system in the Yakima River Basin (USGS, 2011). The study includes data collection and mapping of hydrogeologic units and groundwater levels. As part of this effort, the USGS has completed a regional groundwater modeling study of the Yakima River Basin which includes the majority of Kittitas County (USGS, 2011). The study examined groundwater data from October 1959 to September 2001. From this 41-year period, water budgets were evaluated for wet (1997), average (2000), and dry (2001) precipitation years to measure effects on outflows and inflows to the aquifer system.[8] These three years were selected to capture the hydrologic variability present and were found to be representative of existing conditions.

[8] Outflows (e.g., groundwater well pumping) represent changes in groundwater volumes that move out of the aquifer system. Inflows represent groundwater that is moving into the aquifer system such as groundwater recharge.

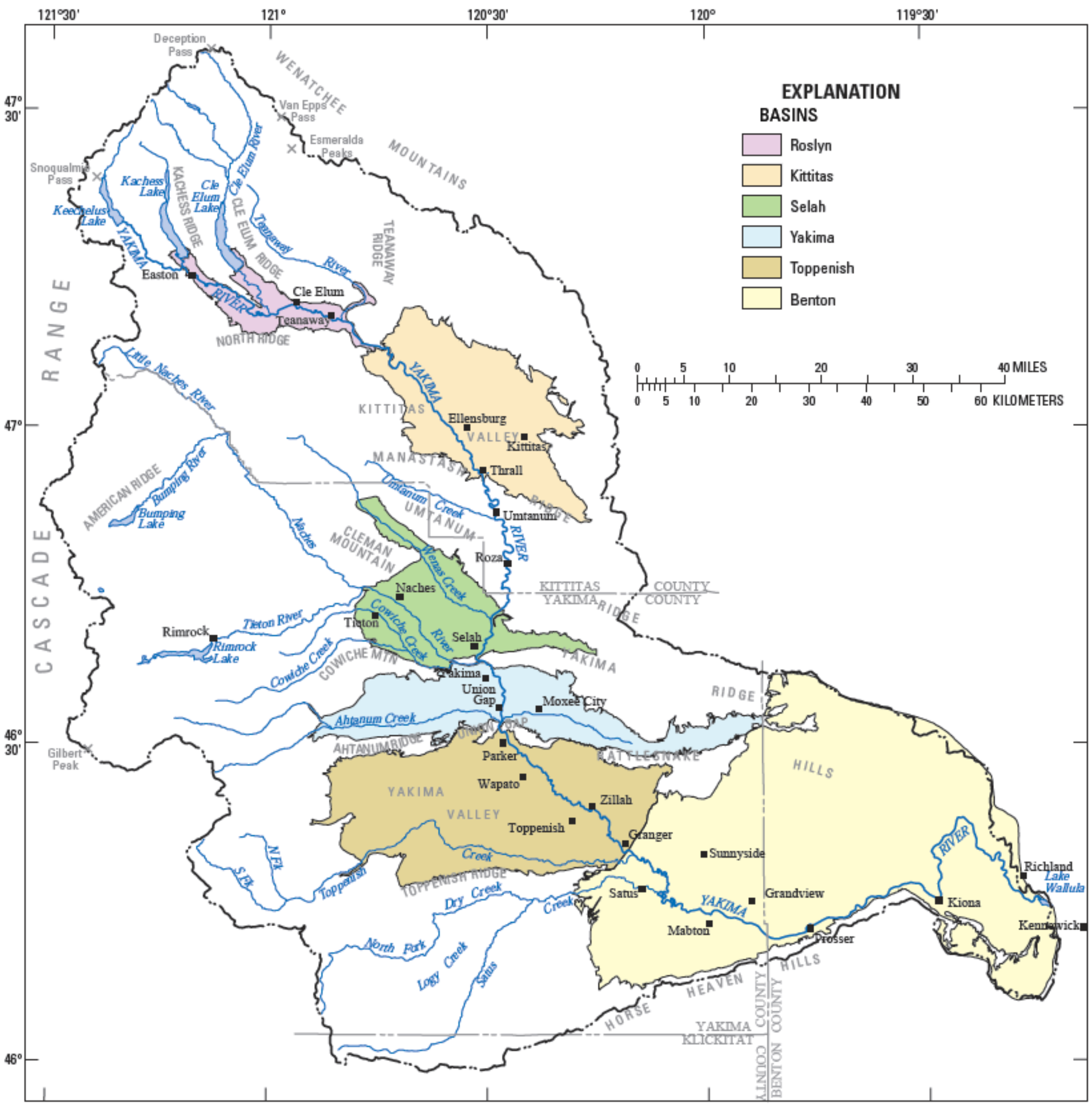

Figure 4-1. Location of six sedimentary basins, Yakima River Basin, Washington (USGS, 2006).

Groundwater recharge for the region, which drives the aquifer system, was found to range from about 3,200 cubic feet per second (cfs) in 2001 up to 9,700 cfs in 1997, a 200 percent increase between the dry and wet year (USGS, 2011). In 2000, recharge was within 3 percent of the mean annual recharge for the calibration period. Recharge to the system was found to be reasonably matched by the outflows from the aquifer system for the three example years (1997, 2000, and 2001). In 2001, less water flowed out of the groundwater flow system largely due to lower water levels. The next largest changes between years are inflows to the system from storage. In 1997 and 2000, inflows from storage are nearly the same, but inflows from storage in 2001 are about 600 cfs larger than in years 1997 and 2000. For the dry year (2001) with less recharge and additional effects of pumping, the inflow of water into the groundwater flow system from storage is clearly shown in the budget (determined from the outflow minus the inflow), where the 2001 difference is an inflow of about 2,900 cfs.

The next largest budget component is the drain flow, which is the boundary condition that accounts for the groundwater discharge which supports streamflow. The remaining factors affecting the groundwater budget include groundwater discharge to streams (stream leakage outflows), head-dependent boundary flows (flows into and out of the system dependent on groundwater levels where higher groundwater levels result in smaller inflows and vice versa), groundwater pumping wells, and contributions from the Columbia River boundary.

The model that was developed for this study can be used for examining the effects of continued or increased pumping on the regional groundwater flow system to effectively manage groundwater resources at a system level but would not be effective for evaluating impacts at a project level (USGS, 2011).

4.1.1.2 Upper Kittitas County Groundwater Study

The USGS is conducting a study of the western Kittitas County groundwater-flow system to provide current, complete scientific information for future management of groundwater. The study is in response to concerns about potential impacts of groundwater withdrawals on tributary baseflows in the western portion of Kittitas County (Ecology, 2012). The 2011 USGS study indicated that groundwater and surface water are interconnected in the Yakima River Basin. However, the hydrogeologic framework and the potential impacts of groundwater withdrawals on tributary streamflow in the bedrock system are not as well known. Results of the Upper Kittitas Groundwater Study will be used to further define the hydrogeology of the area including groundwater occurrence and availability as well as the potential impairment resulting from well use (Ecology, 2012). Some of the work performed to date includes obtaining groundwater-level data from a field inventory to document the spatial distribution of water levels in the study area during spring 2011, and will be used along with the geologic information from well drilling logs to develop a better understanding of the groundwater-flow system in the area (Fasser and Julich, 2011).

4.1.1.3 Groundwater Quality

There is limited groundwater quality information available for Kittitas County. In the mid-1990s, Ecology (1997) sampled 27 wells within a 7-mile radius of Ellensburg for pesticides and nitrate. Nitrate and pesticides were detected in 9 of the 27 study wells; however, the concentrations of all detected pesticides were below the Maximum Contaminant Level or Lifetime Health Advisory Level set by the EPA for public drinking water. One sample exceeded the drinking water standard for nitrate; however, a verification sample collected later had a much lower concentration.

The City of Ellensburg municipal water system takes water from eight different wells. The largest well is located near the Yakima River. The City issues an annual water quality report, as required by the Federal Safe Drinking Water Act, and the City has had no violations of water quality standards in recent years. The 2013 water quality report, which covers monitoring for the 2012 calendar year, states that the well water meets or exceeds state and federal standards. Nitrate was detected at a concentration of 0.5 mg/L, which is well below the acceptable state and federal standards. All other tested contaminants (besides chemicals used in the process of drinking water disinfection) were not detected.

4.1.2 Groundwater Contaminant Susceptibility

The rate and distance a contaminant travels depend on a variety of factors including the natural setting and the chemical and physical characteristics of each particular contaminant. Because there are many different chemicals with varied characteristics such as solubility and specific gravity, it is difficult to assess all of the possible scenarios. It is more feasible to characterize general levels of contaminant susceptibility by determining the physical characteristics of the area between and ground surface and the aquifer, and underlying aquifer. Susceptibility to contamination can be used as a management tool to limit or prohibit the use of high-risk contaminants within areas determined to be high priority susceptible areas. The characteristics of the vadose zone can be a key factor in determining how easily a spill of a contaminant could get to the water table. Characteristics important for susceptibility assessment include depth to water, infiltration rate, permeability, chemical retardation factors, adsorption, and the presence or absence of an impermeable layer. Susceptibility factors include:

- **Vadose zone:** the unsaturated earth materials above an aquifer. Depth to water is the distance through the vadose zone a contaminant would travel to reach the water table. The deeper the water table, the longer the travel time. A USGS field inventory of 196 wells in the Upper Kittitas County study area, with repeat measurements for a subset of 43 wells, was conducted in 2011 (Fasser and Julich, 2011). Preliminary reports show that depth to water throughout the upper Kittitas County varies significantly and can range from several feet to over 500 feet below ground surface.
- **Permeability:** the rate of infiltration in inches of water per hour. Infiltration rate is a measure of how fast water and pollutants can move downwards through the earth materials of the vadose zone. The more permeable the ground is and the faster water moves down through it, the more the underlying groundwater is susceptible to contamination. Coarse sands and gravels allow water to pass through much more quickly than fine silts and clays.
- **Soil Permeability:** Soil permeability can be estimated by using data from the *Soil Survey of Kittitas County* (NRCS, 2010), which gives the drainage class for each soil type listed. The drainage class refers to the frequency and duration of wet periods under conditions similar to those under which the soil formed (NRCS, 2010). Seven classes of natural soil drainage are recognized—*excessively drained, somewhat excessively drained, well drained, moderately well drained, somewhat poorly drained, poorly drained,* and *very poorly drained.* The soil survey also includes data on saturated soil hydraulic conductivity for the various soil types listed. Saturated hydraulic conductivity is a measure of the ease with which pores of a saturated soil transmit water. Terms describing saturated hydraulic conductivity are *very high*, (14.17 or more inches per hour); *high*, (1.417 to 14.17 inches per hour); *moderately high*, (0.1417 inch to 1.417 inches per hour); *moderately low*, (0.01417 to 0.1417 inch per hour); *low*, (0.001417 to 0.01417 inch per hour); and *very low*, (less than 0.001417 inch per hour). However, the soil survey data only covers the upper 5 feet of soil and therefore may not accurately represent actual conditions especially where depth to water is much greater than 5 feet deep. In these cases, an understanding of the permeabilities and hydraulic conductivities of underlying geologic materials would be necessary.
- **Geologic material permeability:** the Ecology CARA manual calls for using well logs to determine the underlying geologic material permeability. However, such an analysis is very challenging in Kittitas County due to the number of wells; the lack of well log data in digital format; and the amount of time required to interpret the nonstandardized geologic descriptions on the individual well logs, digitize the data, and conduct the analysis.

  In general, geologic materials such as unfractured bedrock, particularly thick igneous or metamorphic deposits as well as clays, dense sandstone or hardpan deposits will have very slow permeabilities. Glacial till, fractured igneous and metamorphic rock as well as silts, clayey sands and weathered basalts will have slow permeabilities. Unconsolidated alluvial deposits will have moderate to rapid permeabilities depending on the degree of coarseness of the materials.

- **Low permeability layers:** such as clay or glacial till, may occur between the ground surface and an aquifer, either within the vadose zone or within an aquifer system. These layers would restrict downward migration of contaminants and would provide a measure of protection to the aquifer.
- **Chemical retardation:** how clays and organic matter react with some chemicals to slow their passage or change them chemically.
- **Adsorption:** the tendency of ions dissolved in water to stick to particles of silt or clay. The particle size and the amount of organic matter affect the adsorption. Sand with no organic matter may not adsorb at all, while an organic silt or clay may adsorb well. In short, a contaminant can be captured or slowed down by sticking to clay.
- **Hydraulic conductivity:** how fast a quantity of water can move through an aquifer (for a given gradient through a unit area). The higher the hydraulic conductivity, the faster the flow.
- **Gradient:** differences in elevation between two locations of the water table or the differences in pressure between locations in a confined aquifer. The higher the gradient, the faster the flow.
- **Groundwater flow direction:** is determined by gradients, which in turn are influenced by pumping, discharge to surface water, topography, and geologic setting.
- **Groundwater flow rate:** is the rate at which groundwater flows through geologic materials. Flow rates vary depending on the nature of the geologic materials water flows through along with the pressure on the water. Coarser materials allow faster flow, and higher pressures induce faster flow.

4.2 Overview of Critical Aquifer Area Function and Values

4.2.1 Human Use of Groundwater

Groundwater is a substantial resource that is of critical importance to Kittitas County residents, businesses, and the agricultural industry. In the year 2000, approximately 40,000 wells in the Yakima Basin withdrew about 312,284 acre-feet of groundwater (Vaccaro and Sumioka, 2006). Groundwater withdrawals support a variety of users and uses: municipal, irrigation, commercial and industrial, livestock, non-municipal Group A and B systems, domestic, and groundwater claims.

4.2.2 Base Flow to Streams

Groundwater and surface water systems influence the recharge and discharge of groundwater. Groundwater discharge to streams is critical for maintaining base flows during periods of low precipitation and surface runoff. Groundwater flows also help maintain the cool water temperatures that are required for salmonids and other aquatic life (Douglas, 2006).

4.2.3 Wetland Discharge and Recharge

Shallow aquifers can be recharged by wetlands and can also discharge to wetlands. Wetlands provide habitats for vegetation and wildlife, and perform beneficial water quality functions including particulate filtration and buffering of pollutants. The interrelationships of wetlands, aquifer recharge, discharge from shallow aquifers, and water quality occurs on large (regional) and small (site-specific) scales.

4.2.4 Storage of Infiltrated Precipitation

Aquifers store the portion of precipitation that infiltrates into the ground and moves downward past the root zone (i.e., is not lost to the system through evapotranspiration). This storage can function as a detention mechanism that reduces stormwater runoff and allows delayed discharge into stream and lakes well after the precipitation event. Stored groundwater becomes a resource for water supply, base flow, and discharge to wetlands and other surface waterbodies.

4.3 Human Activity and Critical Aquifer Recharge Areas

There are a variety of ways in which humans can impact groundwater quality and quantity. The human-caused groundwater alterations that are relevant to Kittitas County are described below.

4.3.1 Groundwater Quality

Improper use and disposal of chemicals is the principal cause of adverse impacts to groundwater quality from human activities. Listed below are some of the more common contaminant sources present in Kittitas County:

- Agriculture - Irrigated agriculture has occurred in the County for over 100 years, with farmers applying fertilizers and pesticides to attempt to maximize crop yields. In particular, nitrogen fertilizers can easily pass through the soils and potentially contaminate groundwater (Nolan et al., 1998). Pesticide groundwater contamination is largely dependent upon the water solubility of the specific pesticide; more-soluble pesticides are more likely to migrate to groundwater (Ferruzzi and Gan, 2004). There have been limited groundwater studies in Kittitas County; the extent to which fertilizers and agricultural chemicals have affected groundwater within the County is not fully known.
- Septic Tanks - Septic tank systems consist of a buried tank and drainage system designed to collect waterborne wastes, remove settlable solids from liquid by gravity separation, and permit percolation into the soil of clarified effluent. They are best suited for small volumes and periodic flows. Of all the sources known to contribute to groundwater contamination, septic tank systems directly discharge the largest volume of wastewater into the subsurface. Pollution from septic systems can include bacteria, viruses, nitrates, and chemicals. Major factors affecting the potential of septic systems to contaminate groundwater in general are the density of systems per unit area, and hydrogeological conditions. Areas with a density of more than 40 systems per square mile are considered regions with potential for contamination. In general, leaking or failing septic systems pose the largest risk for groundwater contamination. Septic tanks are present throughout unincorporated Kittitas County.

- Landfills - Solid wastes deposited in landfills are generally classified either as hazardous or as nonhazardous. Considerations in the design of municipal landfills include the location, the area to be served, and plans for different stages in the filling process (e.g., land use upon completion of the fill). Types of pollution that can infiltrate into groundwater from landfills vary, depending upon what substances and materials are placed within the landfill. Groundwater contamination can be minimized by proper design, construction, and operation and maintenance of a facility. Abandoned landfills (the locations of which are not usually known to regulatory authorities) often pose a threat to groundwater quality because geologic and hydrologic characteristics were not considered in the original site selection; the same may be true for some active landfills. There is one active landfill within the County—the Ryegrass landfill located south of the Vantage Highway.
- Surface Impoundments - Surface impoundments are used by industries, agriculture, and municipalities for the retention, treatment, and/or disposal of both hazardous and nonhazardous liquid wastes, such as liquid manure, sewage, and industrial wastewater. Surface impoundments can be either natural depressions or artificial holding areas (e.g., excavations or dikes). The term pit is commonly applied to a small impoundment used by industries, municipalities, agricultural operations, or households for special purposes (e.g., farm waste storage and sludge disposal). The wastewater in impoundments is treated by chemical coagulation and precipitation, by pH adjustment, by biological oxidation, by separation of suspended solids from liquids, and by reduction in water temperature. Surface impoundments are present throughout Kittitas County, primarily in agricultural and urbanized areas.
- Vehicle Maintenance and Auto Body/Painting Shops - Auto shops utilize a variety of chemicals that can potentially degrade water quality, such as solvents, petrochemicals, and paint. Contamination pathways from auto shops include leaking chemical storage containers, stormwater runoff from facilities, and illicit direct disposal of chemicals to ground or surface waters. The potential for groundwater contamination can be minimized by working over impervious surfaces (e.g. concrete or plastic sheeting), utilizing secondary containment vessels for chemical storage, cleaning up spills immediately with absorbent wipes or granular materials, diverting storm water away from work areas, and proper collection and disposal of waste chemicals. Most auto shops in Kittitas County are located within or near the urban centers.
- Underground Storage Tanks - Underground storage tanks are used by industries, commercial establishments, agricultural operations, and individual residences for storage and treatment of products or raw materials, for waste storage and treatment, and for piping systems. Industrial use is primarily for fuel storage but also for storage of a wide range of other substances, including acids, metals, industrial solvents, technical-grade chemicals, and chemical wastes. Commercial businesses, agricultural operations, and individual homeowners use underground storage almost exclusively for fuel storage. The most numerous underground storage tanks are those used for gasoline at service stations and for fuel oil at residences. Underground storage tanks are known to have caused many cases of groundwater contamination. In particular, old corroded gasoline storage tanks are frequently cited as sources of contamination. Such corrosion can be caused by impurities in the backfill, by faulty installation involving surface abrasions and failure to remove shoring, and by certain soil conditions. Many companies have installed new tanks near old ones. When they do, a new tank often acts as a sacrificial anode (i.e., metallic ions flow from the new tank to the old tank) and it rusts faster. In addition, dispensing pumps can develop leaks in couplings and hoses, and delivery lines can corrode or break.

Although new underground tanks are usually coated with a protective or corrosion-resistant material if they are steel, or are made from relatively corrosion-resistant materials (e.g., fiberglass), they still are subject to corrosion-induced leakage. Fiberglass tanks can crack if installed incorrectly, and the polyester resins in fiberglass may be weakened by some alcohol-blend gasoline. Underground storage tanks are located throughout Kittitas County, primarily within and near urban centers.

- Pipelines - Pipelines are used to transport, collect, and/or distribute both wastes and nonwaste products. The wastes are primarily municipal sewage, most often located in densely populated areas. The primary nonwastes are petroleum products and natural gas, but ammonia, coal, sulfur, and anhydrous ammonia are also transported. Nonwaste pipelines are located throughout the nation; maps of major pipeline networks are available from the Federal Energy Regulatory Commission. Although pipelines are designed to retain their contents and thus to pose no threat to groundwater, in reality they have leakage contamination potential. The major causes of leaks are ruptures, external and internal corrosion, incorrect operating procedures, and defective welds on pipes. Other causes were surges of fluid in pipelines, breakage or heaving of lines by tree roots or earthquakes, loss of foundation support, and rupture due to other loads. Municipal sewage pipelines are located within and near the urban centers within the County, as well as natural gas piplines.
- Animal Feeding Operations - Animal feeding operations can adversely affect groundwater if leachate enters the subsurface, either directly from feedlots or from waste piles and wastewater impoundments (see surface impoundments, above). The most important potential contaminant in manure is nitrogen, but bacteria, viruses, and phosphates are also of concern. The potential for groundwater contamination is greatest in areas with high densities of animals and a shallow water table. Data are insufficient to estimate the volume of leachate and runoff that actually reaches the water table from large feedlots. In any case, because manure piles and feedlots often are near rural homes, domestic water supply wells are vulnerable. There are currently no commercial feedlots located within Kittitas County.
- Stormwater Runoff - Urbanization expands impervious areas that intercept rainfall and thus increase the amount and rate of surface runoff. The runoff, in turn, is channeled by drainage networks and carries with it the contaminants associated with urban activities (e.g., automobile emissions, litter, bacteria from pet wastes, herbicides, deposited atmospheric pollutants, and sediments). The potential for groundwater contamination from urban runoff depends on where the runoff is discharged, its proximity to aquifers, and various hydrogeologic factors. A major source of contaminants is automobile emissions, which may contribute contaminants to surface runoff in some areas. The contaminants of most concern are suspended solids and toxic substances, especially heavy metals and hydrocarbons. Runoff can also contain petroleum residues, nutrients, and other oxygen-demanding loads.
- Transportation – Petroleum and other chemicals are transported along the roads and railroads within Kittitas County. Auto and train accidents can result in spillage of these chemicals. The potential for groundwater contamination from spills varies, depending upon the specific chemical or petroleum product that is spilled, the location of the spill, and the timing and effectiveness of cleanup efforts.

4.3.2 Groundwater Quantity

Withdrawal of groundwater at rates and/or volumes exceeding natural recharge causes depletion of groundwater in aquifers. If this situation persists for an extended period of time, significant declines in groundwater levels and change of flow gradients and/or directions can occur, and damaging compaction of the aquifer matrix can result from extreme long-term water level declines. Groundwater withdrawals are regulated by the Department of Ecology through water rights, although groundwater withdrawals in lower Kittitas County that are less than 5,000 gallons per day for certain purposes (stock watering, single or group domestic purposes, industrial purposes, or watering are lawn or non-commercial garden that is not larger than one-half acre) are exempt from the water-right permitting process. Pursuant to the Upper Kittitas Ground Water Rule (WAC Chapter 173-539A), applicants for new wells in the upper County most obtain mitigation under a senior water right. Mitigation can be obtained by purchasing a share of a senior water right from a water banking program, or by transferring the use of an existing water right to the new property.

Natural groundwater recharge rates can be reduced by changes in land use. For example, drainage system associated with roads and urban areas are specifically designed and constructed to intercept water that would, in an unaltered state, discharge from the site and recharge aquifers. Similarly, installation of impervious areas (such as pavement and buildings) and soil compaction from heavy equipment, and changes in vegetation type and quantities can affect recharge rates to groundwater. Techniques to mitigate these impacts are addressed by the Stormwater Manual for Eastern Washington (Ecology, 2004).

4.4 Critical Aquifer Recharge Area Management Tools

There are several mechanisms for managing CARAs to protect groundwater and quality and quantity. When practical, land uses that store or generate hazardous substances should be located away from areas of medium or high aquifer susceptibility. Where this is not practical, there are a variety of protective measures that can be used to prevent the release of toxic substances into groundwater. Examples include:

- For above-ground tanks, the use of a perimeter barrier capable of containing the amount of liquid being stored.
- Use of non-corrosive material in the construction or lining of storage containment areas, that is compatible with the substance to be stored.
- The use of impermeable pads under vehicle repair, servicing, and salvaging facilities.

One of the most effective and documentable means of evaluating potential adverse impacts to CARAs is a site-specific evaluation of hydrogeologic conditions and potential project impacts to groundwater. This is especially important for uses and development activities that have significant potential to adversely affect groundwater quality and/or quantity, such as landfills, underground injection wells, wood treatment facilities, and facilities that store, process, or dispose of chemicals that pose a particularly high risk to human health and safety, such as perchloroethylene (PCE). Detailed hydrogeologic assessments should include information such as the following:

- Groundwater depth, flow direction, and gradient;
- Water quality data;

- Surface water locations in the site vicinity;
- Locations of existing wells in the site vicinity;
- Analysis of the effects of the proposed project on groundwater quality and quantity; and
- Recommendations on appropriate mitigation measures.

The level of assessment could be calibrated based on the potential threat of contamination.

The use of fertilizers, herbicides, and pesticides should adhere to best management practices to prevent impacts to water quality. The Washington State Department of Agriculture has developed publications that detail best management practices for a variety of fertilizers, herbicides, and pesticides. With regards to groundwater protection, key BMPs include:

- Ensure that all fertilizers are applied at agronomic rates (i.e., do apply over-apply fertilizers).
- Provide setbacks from residential wells. Adequate setback distances should be determined based upon the toxicity and solubility of the specific fertilizer, herbicide, or pesticide.

4.5 Existing County Critical Aquifer Recharge Areas Code Provisions and BAS Recommendations

The existing CARA regulations of KCC Title 17A are relatively limited. Based upon a review of the existing regulations and the information presented above, there are several opportunities to improve Kittitas County's CARA regulations to make them more consistent with scientific standards and commonly accepted management practices.

Subsection 2.5.1 describes general code update considerations, while the following subsections summarize existing regulations, discuss best available science, and describe specific code update considerations for CARAs.

4.5.1 General Code Update Considerations

Kittitas County should revise the CARA designation to make it consistent with the Growth Management Act (GMA). KCC 17A.08.010 states that no CARAs have been identified in Kittitas County, but course-scale CARA mapping is now available, as described in Section 4.1. The mapping, which identifies areas with high, moderate, and low levels of aquifer susceptibility, should be referenced in the code. In addition, the code should clearly state that a new activity or development in a CARA must not cause contaminants to enter an aquifer or significantly adversely affect the recharging of an aquifer.

4.5.2 Hydrogeologic Assessments

4.5.2.1 Existing Kittitas County Code

KCC 17A.08.010 does not contain provisions for requiring hydrogeologic assessments for high-risk activities.

4.5.2.2 Best Available Science Summary

One of the most effective and documentable means of evaluating potential adverse impacts to CARAs is a site-specific evaluation of hydrogeologic conditions and potential project impacts to groundwater. This is especially important for certain types of land uses and development activities that have significant potential to adversely affect groundwater quality and/or quantity or that occur in areas of high susceptibility.

4.5.2.3 Considerations for Code Update

Site-specific hydrogeologic assessments should be required for activities that have a high risk of adversely affecting groundwater, such as landfills, underground injection wells, wood treatment facilities, and facilities that store, process, or dispose of chemicals that pose a particularly high risk to human health and safety, such as perchloroethylene (PCE). At a minimum, a detailed hydrogeologic assessment should include the following information:

- Groundwater depth, flow direction, and gradient;
- Water quality data;
- Surface water locations in the site vicinity;
- Locations of existing wells in the site vicinity;
- Analysis of the effects of the proposed project on groundwater quality and quantity; and
- Recommendations on appropriate mitigation measures.

4.5.3 Use of Fertilizers, Herbicides, and Pesticides

4.5.3.1 Existing Kittitas County Code

KCC 17A.08 does not contain provisions for the use of fertilizers, herbicides, and pesticides within CARAs.

4.5.3.2 Best Available Science Summary

Fertilizers, herbicides, and pesticides can pass through the soils and potentially contaminate groundwater. In particular, nitrogen fertilizers can easily pass through soils and migrate to groundwater. Herbicide and pesticide groundwater contamination is largely dependent upon the water solubility of the specific chemical; more-soluble herbicides and pesticides are more likely to migrate to groundwater. Measures to mitigate the potential of groundwater contamination from fertilizers, herbicides, and pesticides include:

- Apply fertilizers at agronomic rates.
- Adhere to best management practices, such as those developed by the Washington State Department of Agriculture for fertilizer, herbicide, and pesticide use.

4.5.3.3 Considerations for Code Update

The code should encourage that the use of fertilizers, herbicides, or pesticides within CARAs should adhere to the applicable best management practices to prevent impacts to groundwater quality. The code should also recognize that the use of fertilizers, herbicides, and pesticides may be subject to existing federal and state laws.

4.6 Summary of Findings and Code Recommendations

Table 4-2 summarizes considerations for updates to Kittitas County CARA regulations based on a review of the best available science.

Table 4-2. Summary of Considerations for Updates to Kittitas County CARA Regulations.

Topic	Existing Kittitas County Code Sections (if applicable)	Potential Code Changes
General code considerations	KCC 17A.02.020 (definition)	Revise CARA definition to make it consistent with the GMA, and incorporate the results of the preliminary CARA mapping.
	KCC 17A.080.010	State that CARAs are present within the County, and reference the CARA map.
		State that new activities and developments within CARAs must not cause contaminants to enter an aquifer or significantly adversely affect the recharging of an aquifer.
Hydrogeologic assessments		Require site-specific hydrogeologic assessments for activities that have a risk of adversely affecting CARAs, and list the minimum report contents.
Fertilizers, Herbicides, and Pesticides		Encourage the use of best management practices to prevent impacts to groundwater quality. Recognize that the use of fertilizers, herbicides, and pesticides may be subject to existing federal and state laws.

4.7 References

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5.0 WETLANDS

This chapter describes wetlands in Kittitas County and summarizes the scientific literature concerning wetlands and how they can affect or be affected by land use and other human activities. The chapter also presents an overview of the management and protection tools for these areas. The purpose of this chapter is to establish a basis for recommending updates to the wetland provisions of the County's critical areas regulations (KCC Chapter 17A.04).

Wetlands are defined as:

> "…areas that are inundated or saturated by surface water or groundwater 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 generally include swamps, marshes, bogs, and similar areas. Wetlands do not include those artificial wetlands intentionally created from nonwetland sites, including, but not limited to, irrigation and drainage ditches, grass-lined swales, canals, detention facilities, wastewater treatment facilities, farm ponds, and landscape amenities, or those wetlands created after July 1, 1990, that were unintentionally created as a result of the construction of a road, street, or highway. Wetlands may include those artificial wetlands intentionally created from nonwetland areas created to mitigate conversion of wetlands" (RCW 36.70A.030).

5.1 Inventory of Wetlands in Kittitas County

Kittitas County has approximately 25,400 acres of wetland (Table 5-1). Wetlands mapped by the National Wetlands Inventory (NWI) and the National Oceanic and Atmospheric Administration (NOAA) are shown on the wetlands map in Appendix A. Both of these data sources used remote sensing methods to determine wetland presence—therefore, the maps are not entirely accurate. The NWI mapping was derived from 1981 aerial photos (1:58,000 scale). The NOAA data was created from 2006 land cover analyses. Additional wetlands are likely present in Kittitas County that do not appear on available maps. Some of the areas shown as wetland may not meet the wetland criteria.

Most of the mapped wetlands in Kittitas County fall into two types: (1) riparian forested and shrub wetlands within river floodplains (for example, along the Yakima and Cle Elum Rivers), and (2) depressional or slope emergent wetlands located in agricultural areas (for example, the area north and east of Ellensburg and Kittitas). Small wetlands, seasonal/ephemeral wetlands, and wetlands in densely forested areas including high-elevation areas are especially difficult to map without on-the-ground investigation. Yet small wetlands are known to be present along smaller tributaries, and there are seeps and springs, high-elevation wet meadows, and fringing wetlands along the shorelines of natural lakes in the upper Yakima River basin (USBR and Ecology, 2011). Numerous small wetlands have also been identified in the Teanaway River drainage basin (Central Washington University, 2013).

Table 5-1. Approximate area of wetlands (acres) in each basin and subbasin in Kittitas County

Basin	Emergent Wetland	Forested/ Shrub Wetland	Total Wetland
Alkali – Squilchuck	130	127	257
Naches	96	304	400
Upper Yakima	5,775	6,597	12,372
Burbank	5	45	50
Easton	416	2,359	2,775
Elk Heights	139	351	489
Kittitas	1,012	100	1,112
Lake Cle Elum	460	1,435	1,895
Manashtash Creek	82	178	259
Naches	96	304	400
Reecer Creek	1,035	245	1,280
Roza Creek	14	38	53
Shushuskin Creek	55	184	239
Swauk Creek	61	145	206
Taneum Creek	29	209	239
Teanaway River	130	245	375
Thorp	93	82	174
Umtanum Creek	<1	78	78
Wenas Creek	<1	6	7
Wilson Naneum	2,149	593	2,741
Total acres	**11,779**	**13,625**	**25,401**

Source: Kittitas County 2013.

5.2 Overview of Wetland Functions and Values

Wetlands provide important biological and social functions. These functions are generally grouped in terms of three broad categories (Adamus et al., 1991):

- Water quality functions, which are related to trapping and transforming chemicals to improve water quality in the watershed (e.g., denitrification, sediment retention, etc.);
- Hydrologic functions, which are related to maintaining the water regime (e.g., reducing flooding, supporting stream baseflows, etc.); and
- Food web and habitat functions (e.g., primary production, production export, etc.)

Wetlands also provide goods and services that society values. Because wetlands and their associated uplands are unique habitats, they provide opportunities for recreation and education. Wetlands are economically important as recreation areas. Wetlands are important for scientific research, education, and the preservation of cultural resources.

These wetland functions and values are briefly discussed below.

5.2.1 Water Quality

Wetlands improve water quality in surface waters through the removal of sediment and pollutants from stormwater through "biofiltration" (Mitsch and Gosselink, 2000; Cooke Scientific Services, 1995). Wetland vegetation slows the flow of water, causing sediments, nutrients (primarily nitrogen and phosphorous), petroleum products, heavy metals, pesticides, and herbicides to settle out of the water column (Sipple, 2002). Chemical and biological reactions in wetlands help to remove pollutants from water (Brettar and Hoefle, 2002; Mitsch and Gosselink, 2000; Sheldon et al., 2005). Nutrients, such as nitrogen and phosphorous, are taken up by vegetation. As the plants die, some of these nutrients are stored in wetland sediments, while some nutrients are exported from wetlands to adjacent water bodies. Wetlands can remove chemicals, such as some petroleum products, heavy metals, and some pesticides and permanently store them in wetland sediments (Gambrel and Trace, 1994). Disruption of wetland soils and increased water fluctuations in the wetland may re-suspend sediments and release buried pollutants.

Additionally, wetlands with an ash layer in the soil are thought to contribute to removal of toxics from surface water (Sheldon et al., 2005). Many wetlands in Kittitas County contain the characteristics needed for water quality functions. Seasonally ponded wetlands are important in removing excess nitrogen from surface water or groundwater. The area around Ellensburg and Kittitas, which has large areas of mapped wetlands, contains soil types with a surface layer of volcanic ash. Riparian wetlands along the Yakima River and other streams have dense vegetation that can slow and filter surface water flows.

Wetlands that drain to stream systems can play an important role in protecting water quality. Known water quality problems in Kittitas County streams include high temperatures, low dissolved oxygen, fecal coliforms, pesticides, organic compounds, and poor pH (Kittitas County, 2013).

5.2.2 Hydrologic

Wetlands intercept stormwater flow during and after storms and slowly release it to groundwater and/or to adjacent water bodies. Research has shown that this function can reduce and desynchronize peak flood crests and flow rates of floods (Novitzki, 1979 and Verry and Boelter 1979, in Mitsch and Gosselink, 2000). Wetlands positioned higher in the watershed generally provide greater flood flow attenuation because they help to prevent flooding along a longer area of river or stream reach than those wetlands located lower in the watershed, which only provide more localized flood water attenuation.

Riverine wetlands in the floodplain of the Yakima River and other streams are important for flood flow control because they can provide overbank storage for surface water. Depressional wetlands can also contribute to this function by slowing surface runoff during summer thunderstorms (Sheldon et al., 2005).

Wetlands that impound and hold surface water (i.e. depressional wetlands) have the potential to recharge groundwater. This occurs when surface water infiltrates through the soil into the groundwater system. The ability of a wetland to provide this function depends on groundwater flow rates under the wetland, the storage capacity of the wetland, water movement within the wetland, and the amount of water lost through evaporation and released from plants (Sheldon et al., 2005).

5.2.3 Food Web and Habitat Functions

Wetland habitats generally provide greater structural and plant diversity, more edge habitat (where two or more habitat types adjoin), more varied forage, and a more predictable water source compared to upland habitats (Kauffman et al., 2001; O'Connell et al., 2000). These differences increase wildlife species abundance and diversity. Wetlands provide opportunities for wildlife grazing on living plants, and for organisms that depend on detritus and/or organic debris for a food source (Sheldon et al., 2005; Sipple, 2002). Many species of waterfowl, amphibians, insects, fish, and some species of mammals (such as muskrat) depend on wetlands for foraging, breeding, and refuge. Wildlife species richness increases when wetlands are surrounded by natural undisturbed upland habitat (WDFW, 1992; Richter and Azous, 2001; Azous and Horner, 2001; Hruby et al., 1999). Forested and scrub-shrub riparian wetlands may be used by songbirds, raptors, and mammals for foraging, cover, and movement corridors. Riparian wetlands also contribute to salmonid habitat by providing off-channel refuge areas and food sources such as insects (WDFW 2009). Wetlands and surrounding upland buffers provide specialized habitat and linkages for many species of wildlife including special status species (e.g., endangered, threatened, proposed, candidate, sensitive, monitor and species of local importance) (Mitsch and Gosselink, 2000; Hruby et al., 1999).

Riparian wetland systems in semi-arid areas such as eastern Washington often provide the only structurally complex habitat in regions dominated by open land or land cleared for agriculture (Adamus et al., 1991, Sheldon et al., 2005). Wetlands in Kittitas County provide a variety of habitat types for wildlife. Emergent wetlands in open fields may be used by hawks as foraging areas. Wetlands in the Columbia River basin provide important habitat for breeding, migrating, and wintering wetland bird species such as ducks, shorebirds, and songbirds (Creighton et al., 1997).

5.2.4 Human Values of Wetlands

Because wetlands and their associated uplands are unique habitats, they provide recreational and educational opportunities. In Kittitas County some wetlands provide habitat for large numbers of migratory waterfowl and for fish that attract sport hunters and anglers, which makes them economically important. Other recreational activities popular in wetland areas include hiking, wildlife viewing, and boating.

Wetlands are also highly valued as open space. In urbanizing areas, aquatic resources and adjacent uplands may provide the foundation for greenways and open space. Property values in neighborhoods surrounding wetlands tend to be higher than those in areas with no natural open spaces (Todd, 2000).

5.2.5 Characteristics of Wetlands that Affect their Functions

The types and levels of functions performed by wetlands are controlled by several environmental factors and by human activities. Table 5-2 summarizes the "indicators" that are used in the *Washington State Rating System for Eastern Washington* (Hruby, 2007) to evaluate the wetland's potential and opportunity to provide water quality, hydrologic, and habitat functions. These indicators are physical features of the wetland and the surrounding landscape that affect how well the wetland can provide these functions. For example, a wetland in a depression with a highly constricted outlet can retain surface water for a period of time, increasing the chance for physical and biological processes within the wetland to remove sediments and pollutants (water quality function). A constricted outlet also allows a wetland to retain surface runoff and reduce downstream flooding (hydrologic function).

Wetlands in eastern Washington are divided into four types for purposes of rating: depressional, riverine, slope, and lake fringe. These types reflect the wetland's position in the landscape. When evaluating water quality and hydrologic functions, slightly different indicators are used for each of these wetland types. However, the rating system uses the same indicators of habitat functions for all four types of wetlands.

Table 5-2. Summary of Characteristics of Wetlands that Affect their Functions in Eastern Washington (Hruby, 2007, Sheldon et al., 2005)

Function	Indicators of Function by Type of Wetland			
	Depressional	**Riverine**	**Slope**	**Lake Fringe**
Water Quality	Lack of a surface outlet from wetland, or a constricted outlet, improves wetland's ability to trap particulates. Presence of clay, organic, or anoxic soils improves removal of toxics and nutrients. Persistent vegetation can trap particulates. Seasonally ponded areas allow for nitrogen removal. Human activities in the wetland's contributing basin are sources of pollutants that can be reduced by the wetland.	Extent of small depressions in the wetland that can trap sediments and pollutants. Persistent vegetation can trap particulates. Human activities in the wetland's contributing basin are sources of pollutants that can be reduced by the wetland.	Average slope of wetland (lower percent slope allows longer retention time for surface water and increased removal of pollutants). Presence of clay, organic, or anoxic soils improves removal of toxics and nutrients. Dense herbaceous vegetation resists surface flows and removes pollutants. Amount of development, agriculture, or logging present in the areas that might contribute surface water or groundwater to the wetland.	Width of wetland vegetation affects area available to retain sediments and toxic compounds. Extent of herbaceous wetland vegetation (considered most effective at improving water quality in a lake environment). Amount of pollutants discharged into the lake or watershed upstream of the lake on which the wetland is found.

Function	Indicators of Function by Type of Wetland			
	Depressional	Riverine	Slope	Lake Fringe
Hydrologic	No outflow or a constricted outlet increases the capacity to store water and reduce flooding. Depth of storage during wet periods. Wetland's position in the landscape relative to human and natural resources that can be damaged by flooding and erosion.	A wetland that is wide relative to the width of the adjacent stream is assumed to provide more storage during a flood event than a narrow wetland. Dense, rigid vegetation can reduce flow velocities and erosion. Wetland's position in the landscape relative to human and natural resources that can be damaged by flooding and erosion.	How much of the wetland is covered with plants that provide a physical barrier to sheetflow coming down the slope (dense, uncut, rigid vegetation). Extent of small depressions that can hold back surface flows. Presence of property or natural resources downgradient that can be impacted by water coming from the slope wetland.	How much of the wetland is covered with plants that provide a physical barrier to waves and protect the shore from erosion. Presence of human or natural features along the shore next to the wetland that will be impacted if the shoreline erodes.

Function	Indicators of Function by Type of Wetland			
	Depressional	Riverine	Slope	Lake Fringe
Wildlife Habitat	The following indicators are used for all hydrogeomorphic classes of wetlands: Vegetation structure (e.g., trees, shrubs, herbs of different heights). Presence of aquatic bed vegetation. Extent of open water areas in spring and fall. Presence of a stream in or adjacent to wetland. Number of plant species present. Interspersion among different physical structures and types of vegetation. Presence of special habitat features including rocks within the area of surface ponding or large downed woody debris in the wetland; cattails or bulrushes as indicators of long periods of ponding; snags; emergent or shrub vegetation in areas permanently ponded; and steep banks of fine material that might be used by aquatic mammals for denning. Condition of wetland buffers (well-vegetated, multi-structured buffers indicate higher value). Whether wetland is part of a vegetated corridor that has water for most of the year. Proximity of wetland to streams or lakes. Proximity to WDFW priority habitats. Landscape context (annual rainfall, connections to other wetlands). Absence of carp.			

5.3 Human Activity and Wetland Functions

Between 2004 and 2009, an estimated 62,300 acres of wetlands were lost in the lower 48 states. An estimated 110 million acres of wetlands still remains in the lower 48 states, representing approximately half of the wetlands that were present in the colonial era (EPA, 2013). Since the 1780s, Washington State has lost one-third of its wetlands, declining from 1.35 million acres to 938,000 acres (Ecology, undated). In Kittitas County, the most common mechanisms for wetland loss have been conservation to agriculture and filling for development.

Human activities can have both positive and negative effects on wetland functions and values. Negative effects can result from forestry, agriculture, construction of utilities, in-water structures, mining, road building, and urban development (Azous and Horner, 2001; Mitsch and Gosselink, 2000; Castelle et al., 1992a; May et al., 1997; Booth, 2000; City of Portland, 2001; Sheldon et al., 2005). In addition to direct impacts such as draining or filling of wetlands that reduce wetland quantity, human activities can have indirect impacts to wetland functions. For example, urban development can increase impervious surfaces (streets, rooftops, parking lots), resulting in more stormwater runoff reaching a wetland. Residential development near wetlands may result in more intrusion by humans or domestic pets, potentially disturbing wetland wildlife.

The types of human disturbances that negatively impact wetlands quality include (Sheldon et al., 2005):

- Changing the physical structure within a wetland (e.g., filling, removing vegetation, tilling soils, compacting soils);
- Changing the amount and velocity of water (either increasing or decreasing);
- Changing the fluctuation of water levels (frequency, duration, amplitude, direction of flow);
- Changing the amount of sediment (increasing or decreasing the amount);
- Increasing the amount of nutrients;
- Increasing the amount of toxic contaminants;
- Changing the temperature;
- Changing the acidity (acidification);
- Increasing the concentration of salt (salinization);
- Fragmentation (decreasing area of habitat and its spatial configuration); and
- Other disturbances (noise, etc.).

Depending on the type of human activity or land use, some or all of these disturbances can occur, with varying levels of impact on wetland functions.

Human activities can also benefit wetland functions. Restoration and enhancement of wetlands can improve degraded wetland functions; for example, through replanting with native vegetation or blocking unused agricultural ditches to restore wetland hydrology. Preservation (through acquisition, regulatory controls, and other types of protection) is another tool to maintain wetland areas and their functions.

5.4 Wetland Management and Protection Tools

5.4.1 Regulatory Tools

Wetlands in Kittitas County are regulated at the federal, state, and local levels. The U.S. Army Corps of Engineers regulates discharges of dredged or fill materials into waters of the United States, including wetlands, under Section 404 of the Clean Water Act.

Most routine ongoing agricultural activities do not require permits from the U.S. Army Corps of Engineers under Section 404 of the Clean Water Act. In order to be exempt, the farming activity must be part of an ongoing operation and cannot be associated with bringing a wetland into agricultural production or converting an agricultural wetland to a non-wetland area. Similarly, the federal Food Security Act (Swampbuster) allows the continuation of most farming practices as long as wetlands are not converted or wetland drainage increased. The Natural Resources Conservation Service (NRCS) implements Swampbuster. Farmers who alter wetlands risk having their federal farm program benefits withheld (EPA 2012).

Washington State has enacted numerous policies and regulations to promote protection and restoration of wetland systems. One of the first major actions in this regard occurred in 1989 when Governor Booth Gardner signed an Executive Order establishing a statewide goal to achieve “no net loss” in acreage and function of Washington’s wetlands and to increase the quantity and quality of Washington's wetlands over the long term.

State permitting for activities in wetlands is administered by the Washington State Department of Ecology (Ecology). The state certification process under Section 401 of the federal Clean Water Act is usually triggered through a Section 404 permit application. Section 401 directs each state to certify that proposed in-water activities will not adversely affect water quality or violate state aquatic protection laws. In Washington State, Ecology is responsible for administering the state certification program. Ecology may issue approval, approval with conditions, denial, or a request for delay due to lack of information. Any conditions attached to the 401 certification become part of the Corps Section 404 permit.

The following sections discuss federal, state, and local regulatory tools for wetland management.

5.4.1.1 Delineating Wetlands

State laws require that wetlands protected under the GMA and the Shoreline Management Act (RCW 90.58) must be delineated using a manual that is developed by Ecology and adopted into rules (RCW 36.70A.175; RCW 90.58.380). Ecology adopted a wetland delineation manual in 1997 (WAC 173-22-080). Subsequently the U.S. Army Corps of Engineers worked with states, federal agencies, and others to develop supplemental regional criteria to refine the 1987 delineation manual. Two regions fall within the state of Washington: the Arid West (dry lands west of the Continental Divide, from Idaho and eastern Washington south to the U.S. - Mexico border) and the Western Mountains, Valleys, and Coast. The *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region* (Corps, 2008) applies in the arid portions of eastern Washington and a large part of Kittitas County. The *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region* (Corps 2010) applies in many of the mountainous areas along the western portion of Kittitas County. Guidance in the Regional Supplements should be followed to determine which manual to use depending on site conditions.

To maintain consistency between the state and federal manuals for delineation of wetlands, Ecology repealed WAC 173-22-080 (the state delineation manual) and replaced it with a revision of WAC 173-22-035 that states delineations should be done according to the currently approved federal manual and supplements. The changes became effective March 14, 2011.

The methodology outlined in the manuals is based upon three essential characteristics of wetlands: (1) hydrophytic vegetation; (2) hydric soils; and (3) wetland hydrology. Field indicators of these three characteristics must all be present in order to determine that an area is a wetland (unless problem areas or atypical situations are encountered).

5.4.1.2 Designating Regulated Wetlands

Local jurisdictions are required to designate or define what wetland areas will be regulated. In designating wetlands for regulatory purposes, counties and cities are required to use the following definition in Washington State law:

> "[Wetlands are] areas that are inundated or saturated by surface water or groundwater 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 generally include swamps, marshes, bogs, and similar areas. Wetlands do not include those artificial wetlands intentionally created from nonwetland sites, including, but not limited to, irrigation and drainage ditches, grass-lined swales, canals, detention facilities, wastewater treatment facilities, farm ponds, and landscape amenities, or those wetlands created after July 1, 1990, that were unintentionally created as a result of the construction of a road, street, or highway. Wetlands may include those artificial wetlands intentionally created from nonwetland areas created to mitigate conversion of wetlands" (RCW 36.70A.030).

5.4.1.3 Rating and Classifying Wetlands

Rating and classifying wetlands are important wetland management tools. While local governments are not required to rate or classify wetlands, a wetland rating system can help target the appropriate level of protection for particular types of wetlands. For example, higher functioning wetlands are considered a higher priority for protection than wetlands with lesser functions. Local governments generally attempt to prioritize or rank wetlands based on function and value to develop regulatory standards and protective measures that are tailored to the relative importance of different wetlands.

While each wetland provides various beneficial functions, not all wetlands perform all functions, nor do they perform all functions equally well (Novitzski et al., 1995). The *Washington State Eastern Washington Wetland Rating System* was designed to differentiate between wetlands based on their sensitivity to disturbance, their significance, their rarity, our ability to replace them, and the functions they provide. To use the rating system, a qualified biologist assigns scores to a wetland based on indicators of how well it performs water quality, hydrologic, and wildlife habitat functions (see Table 5-2). The total function score determines the wetland category, from Category I (highest quality wetlands) to Category IV (lowest quality wetlands). In addition, certain unique types of wetlands are considered to be Category I or II. Wetlands in eastern Washington can be categorized using the Ecology rating system according to the following criteria (Hruby, 2007):

Category I wetlands represent a unique or rare wetland type; or are more sensitive to disturbance; or are relatively undisturbed and contain ecological attributes that are impossible to replace within a human lifetime; or provide a high level of functions. In eastern Washington, Category I wetlands include alkali wetlands, Washington Natural Heritage Program wetlands, bogs, mature and old-growth forested wetlands with slow-growing trees, and wetlands with aspen stands.

Category II wetlands are difficult, though not impossible, to replace, and provide high levels of some functions. In eastern Washington, Category II wetlands include forested wetlands in the floodplains of rivers, mature and old-growth forested wetlands with fast-growing trees, and vernal pools.

Category III wetlands have a moderate level of function. They have been disturbed in some ways, and are often less diverse or more isolated from other natural resources in the landscape than Category II wetlands. Isolated vernal pools are considered Category III wetlands in eastern Washington.

Category IV wetlands have the lowest levels of functions and are often heavily disturbed.

Ecology is current updating the rating system, with a revised version anticipated in spring 2014.

5.4.1.4 Wetland Buffers

Purpose of Buffers

Wetland buffers are vegetated upland areas immediately adjacent to wetlands. These buffer areas are set aside to protect the functions of the adjacent wetland.

For example, buffer areas protect wetland water quality by retaining and/or filtering sediments, nutrients, pesticides, pathogens, and other pollutants that may be present in runoff. Reduction of sediment and pollutant discharge to wetlands prevents alterations to plant and animal communities and degradation of water quality in wetlands. Depending on the type(s) of vegetation present in a buffer, they may also help control water temperatures in wetlands by providing shade and blocking wind.

Wetland buffers provide important habitat for fish and wetland-dependent wildlife species. Buffers can also serve as movement corridors for wildlife. Buffers separate and screen wetland habitats from human disturbance, lessening the effects of noise, light, and human activity upon sensitive animal species.

Wetland buffers can increase the opportunities for recreation, education, cultural resource protection, and open space by expanding the area available for these pursuits. Buffers also benefit these open space activities by supporting and maintaining other wetland functions such as fish and wildlife habitat, water quality, and shoreline protection.

Determining Buffer Widths

Several factors affect the ability of buffers to provide the functions discussed above, including not only the width of the buffer but its slope, type of vegetation, presence of sheet flow vs. concentrated flow, and other factors. Buffer width is typically the major focus of local regulations.

Ecology suggests three alternative approaches for local jurisdictions in eastern Washington to consider using to establish buffer widths (Granger et al., 2005):

- **Buffer Alternative 1.** Width based only on wetland category (Category I – IV).
- **Buffer Alternative 2**. Width based on wetland category and the intensity of impacts from proposed changes in land use.
- **Buffer Alternative 3.** Width based on wetland category, intensity of impacts, and wetland functions or special characteristics. This alternative has two options for determining the widths of buffers when they are based on the score for habitat.

Table 5-3 summarizes the ranges of buffer widths that Ecology recommends for each of these alternatives. Alternative 3 is the most consistent with the recommendations of several scientists to apply a buffer width system that incorporates site-specific factors rather than using fixed buffer widths (McMillan, 2000; Todd, 2000; Sheldon et al., 2005). The buffer width recommendations were not revised in the recent Ecology (2013) review of wetland buffer science.

Table 5-3. Ecology Recommendations for Buffer Widths in Eastern Washington (feet)

Buffer Alternative	Wetland Category			
	I	II	III	IV
Alt 1. (Width based on wetland category only)	250	200	150	50
Alt. 2 (wetland category plus land use intensity)	125-250	100-200	75-150	25-50
Alt. 3 (wetland category, land use intensity, functions scores, unique wetland types)	50-250	40-200	40-150	25-50

Source: Granger et al., 2005.

5.4.1.5 Wetland Mitigation

Mitigation Sequencing

Federal and state guidelines governing wetland mitigation require that *mitigation sequencing* be used to address impacts to wetland areas. Mitigation sequencing is a concept defined in Washington state law (SEPA and the Shoreline Management Act, WAC 197-11-768 and 173-26). It is also part of the permit process under the federal Clean Water Act Section 404. Mitigation sequencing consists of the following steps taken in order:

1. Avoiding the impact altogether by not taking a certain action or parts of an action;
2. Minimizing impacts by limiting the degree or magnitude of the action and its implementation, by using appropriate technology, or by taking affirmative steps to avoid or reduce impacts;
3. Rectifying the impact by repairing, rehabilitating, or restoring the affected environment;
4. Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action;
5. Compensating for the impact by replacing, enhancing, or providing substitute resources or environments; and

6. Monitoring the impact and taking appropriate corrective measures.

Using this sequence, applicants must demonstrate that impacts of proposed projects have been avoided and minimized to the extent possible before impacts to wetlands will be permitted. Most local jurisdictions then require compensatory mitigation for unavoidable impacts to wetlands and/or their buffers resulting from development or associated activities.

Types of Wetland Mitigation

The state and federal agencies that regulate wetlands recognize four types of compensatory wetland mitigation in the following order of preference (Ecology et al., 2006a):

1. Restoration (re-establishment or rehabilitation). The manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural or historic functions to a former or degraded wetland.

2. Creation (establishment). The manipulation of the physical, chemical, or biological characteristics present to develop a wetland on an upland or deepwater site, where a wetland did not previously exist.

3. Enhancement. The manipulation of the physical, chemical, or biological characteristics of a wetland to heighten, intensify or improve specific function(s) or to change the growth stage or composition of the vegetation present.

4. Preservation (protection/maintenance). The removal of a threat to, or preventing the decline of, wetland conditions by an action in or near a wetland. Preservation is an approved method for compensatory mitigation only in limited circumstances.

Wetland Mitigation Ratios

Generally, wetland mitigation is implemented over a larger area than the wetland area adversely affected by a proposed project. The ratio between the area of wetland impact and the area of proposed mitigation is known as the “mitigation ratio.”

Mitigation ratios of greater than 1:1 are considered necessary to avoid a net loss of wetland area or functions for several reasons (Granger et al., 2005; Ecology et al., 2006a; NRC, 2001; Ecology, 2008):

- There is a risk that the mitigation project will not be entirely successful.

- There will be a temporal loss of wetland functions between the time an impact occurs and the time the functions are reestablished.

- Some types of compensation (especially enhancement and preservation) result in a net loss of wetland acreage and/or function.

- Impacts to wetlands with high levels of function should require more mitigation than impacts to low-quality wetlands.

- Additional wetland area may be required to offset losses if out-of-kind compensation is proposed or the replacement wetland is located quite a distance from the impact area.

- A permanent loss of wetlands should require more mitigation than a temporary wetland impact.

State and federal agencies (Ecology, Corps of Engineers, and EPA) have made recommendations for wetland mitigation ratios, which are summarized in Table 5-4. The ratios listed in the table are examples and do not include ratios for natural heritage wetlands or combinations of mitigation methods (e.g., enhancement plus creation).

Table 5-4. Interagency Recommendations for Wetland Mitigation Ratios (replacement area to impact area)

Wetland Category			
I	II	III	IV
4:1 creation 16:1 enhancement	3:1 creation 12:1 enhancement	2:1 creation 8:1 enhancement	1.5:1 creation 6:1 enhancement

5.4.2 Best Practices for Agricultural Uses

The WSU Kittitas County Extension office and Kittitas County Conservation District provide information to local residents on best practices to protect natural resources. These agencies offer seminars to new rural landowners on topics such as restoration of degraded pastureland, protection of water quality near livestock facilities, grazing rotation, and other topics (WSU Extension no date).

The Field Office Technical Guides adopted by the Natural Resources Conservation Service (NRCS) also address several of the issues of concern for wetlands in agricultural settings. For example, the NRCS Conservation Practice Standards for filter strips, riparian forest buffers, and herbaceous buffers can be used to protect wetlands from contaminated surface runoff, create shade, and improve wildlife habitat.

5.5 Existing County Wetlands Code Provisions and BAS Recommendations

Kittitas County regulates critical areas, including wetlands, through Title 17A of the Kittitas County Code (KCC). Title 17A was last updated in 1994 and amended by Ordinances 95-15 and 96-14. Wetlands are specifically addressed in KCC 17A.04.010 through 17A.04.050.

The amount of scientific information and agency guidance on wetland management has grown substantially since the County's wetland regulations were last updated. The purpose of this section is to evaluate whether the County's existing wetland regulations incorporate the best available science and are consistent with GMA requirements and current agency guidance. Considerations for changes to the County's wetland regulations are provided where gaps or discrepancies are identified. A detailed evaluation of every section of KCC Title 17A is beyond the scope of this report. Instead, we focus on the following major issues:

- Designating regulated wetlands;

- Delineating wetlands;
- Exemptions;
- Allowed uses;
- Wetland rating system;
- Wetland buffers; and
- Wetland mitigation.

5.5.1 Designating Regulated Wetlands

5.5.1.1 Existing Kittitas County Code

The County's definition of wetlands from KCC 17A.02.310 is different than the GMA definition in that it excludes wetlands that result from leakage or seepage from irrigation systems. The exemption for agricultural uses extends to riparian habitat that has been created by or resulted from irrigation activities and facilities (KCC 17A.03.020).

The County code also adopts the Corps of Engineers' 1990 definition of "normal circumstances" for prior converted farmland (cropland) (Corps Regulatory Guidance Letter 90-07). Under this 1990 definition, croplands that had been modified for agricultural use to the extent that they lacked wetland hydrology and vegetation were not regulated as wetlands under the federal Clean Water Act. The 1990 guidance expired in 1993 and there have since been several other federal agency memoranda and court cases on this subject.

5.5.1.2 Best Available Science

In its guidance for eastern Washington communities for wetland regulatory updates, Ecology states (Bunten et al., 2012):

> "Wetlands are subject to a local government's regulatory authority if they meet the criteria in this definition. This includes Prior Converted Croplands (PCCs) and isolated wetlands. These wetlands provide critical functions and habitat and should be regulated. **The GMA does not allow flexibility in adopting a modified definition of wetlands.**
>
> Irrigation practices, such as the Columbia Basin Project, can result in human-created, artificial wetlands. More frequently, however, irrigation practices may augment natural sources of water to a wetland. Wetlands that form along irrigation ditches that were intentionally created in uplands may be exempted from regulation. However, if a wetland is the unintentional by-product of irrigation activities, the wetland should be regulated. If a wetland disappears as the result of a change in irrigation practice, it will not be regulated in the future. However, most wetlands will not disappear completely as a result of local changes in irrigation practices because of natural sources of water or regional irrigation influences."
>
> Wetlands and Irrigation

Some agricultural communities have excluded irrigation-induced wetlands from regulation. However, Ecology has determined that some wetlands that exist because of irrigation may still be considered subject to state (and federal) regulations because they were not *intentionally* created. The GMA definition of wetlands states: "Wetlands generally include swamps, marshes, bogs, and similar areas. Wetlands do not include those artificial wetlands intentionally created from nonwetland sites, including, but not limited to, irrigation and drainage ditches, grass-lined swales, canals, detention facilities, wastewater treatment facilities, farm ponds, and landscape amenities, or those wetlands created after July 1, 1990, that were unintentionally created as a result of the construction of a road, street, or highway." (RCW 36.70A.030 (21)).

Ecology has found that wetlands resulting as a byproduct of irrigation do not meet the definition of "intentionally created" wetlands in this definition. They state:

> "The term *intentionally created* and the examples given in the [GMA] definition require that the artificial wetland not be the result of an accident or an unexpected byproduct of some other intentional act. Therefore, artificial, non-jurisdictional wetlands result from someone intentionally creating a water feature such as a ditch or pond in an area that is non-wetland. The only situation where an artificial, non-jurisdictional wetland results from an unintentional action is when construction of a road (after July 1, 1990) inadvertently creates a new wetland." (Granger et al. 2005)

Prior Converted Croplands

Prior converted croplands (PCC) are defined in federal law as administered by the U.S. Army Corps of Engineers. They are wetlands that were drained, dredged, filled, leveled, or otherwise manipulated, including the removal of woody vegetation, before December 23, 1985, to enable production of an agricultural commodity, and that: 1) have had an agricultural commodity planted or produced at least once prior to December 23, 1985; 2) do not have standing water (ponding) for more than 14 consecutive days during the growing season; and 3) have not since been abandoned.

The federal government initially exempted prior converted croplands (PCCs) from its regulation because these wetlands have been degraded by long-term agricultural use. However, these wetlands can still provide some functions and are regulated at the state level. Ecology's guidance to local governments states as follows:

> "Local governments cannot exempt wetlands that are designated as PCC in their regulations and rely on the federal exemption to satisfy the best available science requirement in the GMA. Although activities in these wetlands are not regulated under Swampbuster provisions of the federal Farm Bill or Section 404 of the federal Clean Water Act, the GMA requires local governments to regulate wetlands that meet its definition. This definition of wetlands includes PCCs that meet the three criteria in the *Washington State Wetland Identification and Delineation Manual*. It therefore does not distinguish wetlands designated as PCC from other wetlands." (Granger et al., 2005)

5.5.1.3 Considerations for Code Updates

Based on the analysis above, the wetland sections of KCC Title 17A can be made more consistent with scientific standards and state law by using the standard GMA definition of regulated wetlands. The issue of how to address agricultural activities that affect wetlands is addressed in Section 5.5.3, “Exemptions.”

5.5.2 Delineating Wetlands

5.5.2.1 Existing Kittitas County Code

Kittitas County code (KCC 17A.03.035(6)) does not require a delineation of wetland boundaries for some permit applications. The County waives the requirement for delineation if (a) staff can estimate the boundaries of critical areas without a delineation by the applicant; or (b) no structures or uses are proposed within any possible critical areas.

5.5.2.2 Best Available Science

Having accurate information about the location and extent of individual wetlands is critical for rating or categorizing them correctly. Large-scale wetland mapping is often based on interpretation of aerial photos and does not accurately reflect conditions on individual parcels. A site-specific evaluation is needed.

In addition to defining the wetland edge, a wetland delineation includes collecting data about soils, vegetation, and hydrology in order to document that an area meets the definition of a wetland. The data is also used to complete the wetland rating. The rating/category in turn determines the wetland buffer width. The precise wetland and buffer location is also necessary for projects proposing wetland/buffer impacts in order to calculate the impact area and the mitigation requirement. Applicants should understand that wetlands will be regulated as they are defined in code and designated on the site, not as they are mapped in the NWI or other sources.

5.5.2.3 Considerations for Code Update

Based on the analysis above, there are several opportunities to improve the wetland sections of KCC Title 17A and make them more consistent with scientific standards and state law:

- Require a delineation of wetland boundaries and preparation of a critical areas report for all development proposed within wetlands or wetland buffers. To avoid an unnecessary expense to project applicants while maintaining adequate wetland protections, the County could require a delineation and critical areas report if a proposed development is located within 300 feet of a known or suspected wetland.
- Require the use of the Corps of Engineers Arid West or Western Mountains, Valleys, and Coast regional supplements (and future amendments) for wetland delineations. Delineations should be completed and critical areas reports prepared by a qualified wetland biologist.

5.5.3 Exemptions

5.5.3.1 Existing Kittitas County Code

Agricultural Activities

Existing and ongoing agricultural and irrigation activities are specifically exempt from the County's wetland regulations (KCC 17A.03.020). KCC 17A.02.010 defines "agriculture" as follows:

> "Agriculture" is the grazing, feeding, and watering of livestock; plowing, seeding, cultivation, and harvesting for the production of crops and pasture; soil and water conservation practices; the creation and maintenance of farm or stock ponds, irrigation ditches, drainage ditches, underground drainage systems, fences and farm roads, the control of noxious weeds, and includes any associated structures, appurtenances, equipment, or activities.

This definition does not address what is meant by "existing and ongoing" agriculture.

Other Activities

KCC 17A.03.020 exempts several other land use activities with the potential to contribute to cumulative impacts on wetland functions, in particular the following:

- Activities that are categorically exempt from SEPA review.
- Construction, maintenance, repair, or replacement of Kittitas County permitted or franchised utility facilities.
- Emergencies that threaten the public health, safety and welfare, including private or public property.
- Existing and ongoing natural resource activities.

The exemption for "natural resource activities" is vague and does not define what activities are specifically exempt.

It is not clear whether these activities are exempt from all requirements of the critical areas code, or only from specific requirements (e.g., mitigation sequencing).

This section of the county code also states that fencing is not required for critical areas protection.

5.5.3.2 Best Available Science

Agricultural Activities

Agricultural activities can have numerous impacts on wetlands, including physical changes (filling), changes in water regime, increases in sediments and pollutants, and fragmentation of wildlife habitat (Granger et al., 2005).

Other Activities

Clearing and grading are examples of **SEPA categorically exempt** activities that can result in cumulative impacts on wetland functions. Because Kittitas County does not have a separate clearing and grading code, these smaller-scale activities could degrade wetlands and buffers without a requirement for mitigation.

Utility activities in previously undeveloped areas can result in temporary impacts to wetland and buffer functions, such as disturbance of soil and vegetation. These disturbed areas can be subject to erosion or become infested by weeds if not promptly restored. New underground utilities installed in wetlands can change the movement of groundwater through the wetland unless properly designed.

Emergency activities can also affect wetland and buffer functions. For example, emergency repair of a broken water or sewer main could require heavy-equipment access, materials staging areas, and excavation, potentially affecting soils, vegetation, wildlife habitat, and water quality.

Several studies have found that human activities tend to degrade buffer functions over time, through illicit dumping, clearing or trampling of vegetation, and soil compaction. Fencing of buffers has been found effective at reducing human impacts (Sheldon et al., 2005).

5.5.3.3 Considerations for Code Update

Agricultural Activities

As discussed in Section 1.3, the County has elected to enroll lands within the Upper Yakima and Alki-Squilchuck watersheds into the Voluntary Stewardship Program (VSP). If the VSP is funded by the state and implemented, these two watersheds would not be subject to revised critical areas provisions. Therefore, at this time, we do not recommend developing updated wetland regulations pertaining to agricultural activities in these watersheds.

Lands within the Naches watershed will not be enrolled in the VSP. Existing agricultural activities within the portion of the Naches watershed that are within County jurisdiction are generally limited to livestock grazing. The following changes are recommended to County code to protect wetlands within the Naches watershed while accommodating agricultural uses (grazing, primarily):

- The County could continue to exempt **ongoing agricultural activities** from regulation under specific conditions, for example requiring agricultural producers to use reasonable measures to protect wetland functions, such as those described in Field Office Technical Guides adopted by the Natural Resources Conservation Service.
- Revise the code definition of "agricultural activities" to be consistent with state law, and clarify what activities qualify as *new* vs. *existing and ongoing* agriculture.

Other Activities

The following updates would make KCC Title 17A clearer and more consistent with scientific recommendations as well as state and federal laws:

- Clarify that exempt activities will remain exempt only so far as they avoid and minimize impacts to wetland and buffer functions to the extent practical.
- Remove the exemption for "existing and ongoing natural resource activities."
- Emergency activities that would otherwise be subject to critical areas permit requirements under non-emergency conditions should be required to obtain an after-the-fact permit and provide appropriate mitigation for any impacts.
- Consider requiring some form of permanent marking of wetland and buffer areas to reduce the potential for impacts over the long term. This requirement could be limited to more intensive land uses such as subdivisions. While fencing and signage may be appropriate adjacent to a residential development, landowners in more rural areas may prefer less intrusive measures such as hedgerows or windbreaks.
- The presence of wetlands, buffers, and mitigation sites should be recorded with a notice on title.
- Define what types of "utility facilities" are exempt and limit the exemption to utilities with low potential impacts, such as installation within improved rights-of-way. Utility development should be required to follow the mitigation sequence and all unavoidable impacts should be offset through compensatory mitigation.
- Specify thresholds for clearing and grading activities that will trigger critical areas review.

5.5.4 Allowed Uses

5.5.4.1 Existing Kittitas County Code

KCC 17A.04.040 allows several types of activities in wetland and wetland buffer areas. The following allowed activities have the potential to cumulatively impact wetland and buffer functions:

- Mining;
- Filling, draining, or modification of up to two acres of Class IV wetlands; and
- The use of Category IV wetlands for secondary stormwater management facilities.

5.5.4.2 Best Available Science

Mining in wetlands and buffer can have negative impacts on wetland functions. In addition to disturbing soils and vegetation, mining can cause an increase in the levels of heavy metals that are toxic to many organisms, and an increase in the acidity of surface waters (Sheldon et al., 2005).

Filling, draining, or modification of up to two acres of Class IV wetlands without requiring compensatory mitigation contributes to cumulative impacts on wetland functions and the fragmentation of wildlife habitat across the landscape (Sheldon et al., 2005). A study in Maine that simulated the loss of small, unregulated wetlands found not only a decrease in overall wetland area, but a significant increase in the distance between remaining wetlands and a risk of losing local populations of turtles, small birds, and small mammals (Gibbs, 1993).

Several other studies have looked at the wildlife habitat functions of small wetlands. For example, researchers found that wetlands less than one-quarter acre in size in the Teanaway and Lower Swauk River drainages of Kittitas County provided amphibian breeding habitat (Quinn et al., 2001). Small wetlands have been found to support a diversity of amphibian species, including groups of species unique to temporarily ponded areas. The correlation of wetland size with habitat for birds is more complex. Some studies have found birds to prefer larger wetlands, but one study found waterfowl breeding use of wetlands in the Columbia Basin to be greatest in wetlands less than 1 acre in size (Sheldon et al. 2005).

There is no size threshold for regulating wetlands under the federal Clean Water Act Section 404 permit process. The federal agencies that administer Section 404 (the Corps and EPA) have a goal of no net loss of wetland functions or values (NRC 2001). Even if the County does not regulate small wetlands, they will still be subject to federal law and state water quality regulations.

There is currently no scientific basis for excluding small wetlands in Kittitas County from regulation. However, many jurisdictions do provide some sort of exemption for small, low-functioning wetlands. Ecology recommends that local jurisdictions take a conservative approach, such as exempting small wetlands from mitigation sequencing requirements while still regulating impacts. This reduces the burden on applicants to avoid low-functioning wetlands below a threshold size, but still requires the loss of small wetlands to be compensated either directly, or through a mitigation bank or an in-lieu fee program if one becomes available (Granger et al. 2005).

Kittitas County Code allows the **use of Category IV wetlands for secondary stormwater management facilities** where there is no reasonable alternative on-site location and no significant adverse impact to the functions and values of those wetlands**.** Research in the Puget Sound region has found that most wetlands are adversely impacted by stormwater discharges: through wider fluctuations in water levels, sedimentation, impacts on amphibian breeding habitat, degradation of water quality, and alterations in the vegetation community. While the hydrology and vegetation communities of Eastern Washington wetlands are different than those in Puget Sound, it is reasonable to assume that major changes in the amount, timing, or quality of surface water entering a wetland in Kittitas County could lead to similar types of impacts.

5.5.4.3 Considerations for Code Update

The following updates would make KCC Title 17A clearer and more consistent with scientific recommendations as well as state and federal laws:

- Mining should be regulated to the same level as other uses. Code revisions should specify that mining must be conducted according to state and federal laws and that appropriate steps are taken to avoid/ minimize impacts and replace wetlands during reclamation of the mine site.
- Remove the allowance for impacts to up to two acres of Category IV wetlands without mitigation. Small wetlands should be regulated but could be exempted from mitigation sequencing requirements. Compensatory mitigation would still be required for impacts to

small wetlands, potentially using a mitigation bank or in-lieu fee program if one becomes available in Kittitas County rather than requiring onsite mitigation.

- Where projects propose the use of Category IV wetlands for stormwater treatment, they should meet the requirements of the current Stormwater Management Manual for Eastern Washington, as amended.
- In addition, stormwater discharge facilities in wetland buffers should be designed to maximize the flow of runoff through buffer vegetation before stormwater enters the wetland.

5.5.5 Wetland Rating System

5.5.5.1 Existing Kittitas County Code

KCC 17A.04.010 classifies wetlands into four categories: Category I (extreme high value), Category II (high value), Category III (average value), and Category IV (less than average value). The code does not specify the methods to be used to assign wetlands to these categories. The County's 1994 *Critical Areas Interim Policy Document* recommended that the County consider adopting the state's tiered wetland rating system, which has since been replaced by the *Washington State Wetland Rating System for Eastern Washington* (Hruby, 2007).

5.5.5.2 Best Available Science

The *Washington State Wetland Rating System for Eastern Washington* (Hruby, 2007) represents the best available science because it is based on an understanding of wetland functions and what is needed to protect them (Bunten et al., 2012). Ecology is current updating the rating system, with a revised version anticipated in spring 2014. The *Washington State Wetland Rating System for Eastern Washington* has been adopted by other local jurisdictions such as Grant County, City of Ellensburg, and Douglas County.

5.5.5.3 Considerations for Code Update

Implementing the *Washington State Wetland Rating System for Eastern Washington* (Hruby, 2007 or as amended) has advantages in terms of wetland protection and management. This rating system provides an objective method to assess the characteristics of a wetland that make it likely to provide certain functions. The wetland rating is based on features that can be observed in the field and using common mapping tools, without requiring long-term studies. Therefore, using this rating system would improve consistency with best available science and help standardize the way wetlands are managed in Kittitas County based on their functions.

5.5.6 Wetland Buffers

5.5.6.1 Existing Kittitas County Code

Buffer Widths

KCC 17A.02.320 defines wetland buffers as: "areas that surround and protect a wetland from adverse impact to the natural functions and values of the designated wetland." The required buffers range from 20 to 200 feet depending on the wetland category and size (KCC 17A.04.020).

The County's wetland buffer ranges are intended to reflect the impact of land uses on wetland functions and values. KCC 17A.04.025 requires the "least restrictive" width of buffer necessary to account for the intensity of the proposed land use; the presence of sensitive species; the potential for erosion; and measures proposed by the applicant to enhance functions and values of the wetland or buffer.

Table 5-5 summarizes the existing Kittitas County buffer widths, those recommended by Ecology, and those from a few neighboring jurisdictions.

Table 5-5. Ranges of Buffer Widths (feet)

Jurisdiction	Wetland Category			
	I	II	III	IV
Kittitas County Code (KCC 17.04)	**50-200**	**25-100**	**20-80**	**≤25**
Douglas County	150	100	75	50
Grant County	100	75	50	25
Yakima County	25-200	25-100	25-75	25-50
City of Ellensburg	150	100	50	25
Ecology - Alt 1. (Width based on wetland category only)	250	200	150	50
Ecology - Alt. 2 (wetland category plus land use intensity)	125-250	100-200	75-150	25-50
Ecology - Alt. 3 (wetland category, land use intensity, functions scores, unique wetland types)	50-250	40-200	40-150	25-50

Kittitas County's existing wetland buffers are similar to those of other local jurisdictions, although Kittitas County allows smaller buffers for Category III and IV wetlands. The existing Kittitas County buffers are generally smaller than those recommended by Ecology.

Similar to Ecology's buffer width Alternatives 2 and 3, the County's regulations provide for a range of buffer widths according to the wetland category. However, County code does not specify how the buffer width is to be determined within the range of buffers listed for each wetland category. The code does not indicate how much or what type of enhancement is required to qualify for the smallest buffer width or what is considered a high-intensity vs. a low-intensity land use.

The County code does not require buffers for some wetlands based on wetland category and size. This includes Category II wetlands less than 2,000 square feet; Category III wetlands less than 10,000 square feet; and Category IV wetlands less than one acre in size.

Wetland buffer width averaging is allowed in Kittitas County if: 1) averaging is necessary to avoid an extraordinary hardship caused by circumstances peculiar to the property; 2) the wetland contains variations in sensitivity due to physical characteristics; 3) low-impact land uses would be located adjacent to areas where the buffer is reduced; and 4) buffer width averaging will not adversely impact wetland function and values (KCC 17A.04.030).

Uses in Wetland Buffers

Wetland buffer areas are to be retained in their natural condition or may be improved to enhance buffer functions and values. Where buffer disturbance has occurred during construction, revegetation with native vegetation may be required. The Kittitas County noxious weed ordinance must be followed (KCC 17A.04.035).

Although reference is made to keeping buffers in a natural condition, the County's existing regulations do not explicitly state that wetland buffers must be well vegetated. The code says that revegetation "may be" required if buffers are disturbed during construction.

5.5.6.2 Best Available Science

Buffer Widths

Scientific information shows the buffer widths needed to protect certain functions depend on numerous site-specific factors such as the plant community, aspect, slope, soil type, surface roughness, surface water and groundwater flow paths, supplies of organic materials and nutrients, and adjacent land use. The appropriate buffer width for a given wetland is specific to the environmental setting and functions to be achieved by that buffer (Castelle et al., 1992a; Castelle and Johnson, 2000; Desbonnet et al., 1994; FEMAT, 1993; Hruby, 2013). Four primary factors should be considered in determining the appropriate width and character of buffers: the quality, sensitivity, and functions of the aquatic resource; the nature of adjacent land use activity and its potential for impacts on the aquatic resource; the character of the existing buffer area (including soils, slope, vegetation, etc.); and the intended functions of the buffer (Granger et al., 2005).

Uses in Wetland Buffers

Human disturbances to buffers can reduce the effectiveness of wetland buffers over time. Common issues include clearing or trampling of buffer vegetation, compaction of soils, and inundation of sediment (thereby reducing its water and/or nutrient storage capacity) (Sheldon et al., 2005). Other issues can include trash dumping, pet waste, stormwater runoff, and introduction of non-native invasive and noxious plant species from yard waste.

The goal of regulating the types of uses allowed within wetland buffers is to ensure that the buffers serve their purpose of protecting wetland functions over time. Uses that create impervious areas, clear vegetation, or compact soils may compromise the buffer's ability to protect wetland functions, particularly habitat and water quality functions. Examples of low-impact uses that are often allowed in buffers include stormwater treatment facilities (e.g., swales or level spreaders) and pervious walking trails. Standard wetland buffer widths should be based on the assumption that the buffer is well vegetated because the presence of dense, mature vegetation is what helps perform functions such as trapping sediment and providing cover and forage for wildlife. If a buffer is not well vegetated, a wider buffer may be required to ensure the same level of effectiveness (Sheldon et al., 2005).

5.5.6.3 Considerations for Code Update

The following revisions would help ensure that County buffer requirements protect wetland functions and are more consistent with scientific information about buffer functions. These changes can also provide more certainty for applicants about what buffer widths will be applied to their projects.

- Define buffer standards for all regulated wetlands regardless of wetland size.
- Consider adopting the buffer widths in the County's Final Draft SMP update (January 2014), listed below in Table 5-6. These widths are similar to Ecology's Alternative 2 in allowing a range of buffer widths depending on the wetland category and the proposed intensity of development.

Table 5-6. Wetland Buffer Widths in Kittitas County Final Draft SMP Update (January 2014)

Wetland Category	Low to Moderate Intensity Use and Development*	High Intensity Use and Development*
Category I	150 feet	250 feet
Category II	100 feet	200 feet
Category III	75 feet	150 feet
Category IV	50 feet	50 feet

*High intensity use and developments include: commercial, urban, industrial, institutional, retail sales, residential (more than 1 unit/acre), conversion from non-agricultural lands to high intensity agriculture (dairies, animal feed lots, nurseries and green houses, and like uses), and high intensity recreation (golf courses, ball fields, and like uses). Low to moderate intensity use and development shall consist of uses and developments that do not meet the above description of high intensity use and development.

- Define what land uses are considered low vs. moderate/high impact (see Table 5-6 footnote above).
- Activities that reduce buffer functions (e.g., vegetation clearing, impervious surfaces, soil compaction) should be subject to mitigation sequencing requirements. Appropriate mitigation should be required for buffer impacts.
- Clarify requirements that wetland buffers should be well-vegetated with native vegetation.
- To ensure protection of wetland functions, specify a minimum buffer width (either in feet or percent of standard width) that is allowed for buffer width averaging.

5.5.7 Wetland Mitigation

5.5.7.1 Existing Kittitas County Code

Mitigation Sequencing

Kittitas County wetland regulations do not include a mitigation sequencing requirement. In other words, applicants are not required to document that proposed impacts to wetlands and buffers have been avoided and minimized before unavoidable impacts are allowed. This reduces the incentive for applicants to find ways to avoid impacts, and therefore it is more likely that mitigation will be required. Because many mitigation projects are unsuccessful there is no guarantee that lost functions will be replaced, especially in the short term.

Mitigation Ratios

The County's mitigation ratios vary from 1:1 for Category IV wetlands to 3:1 for Category 1 wetlands (KCC 17A.04.050). The code mentions three types of mitigation ("replacement, enhancement or rehabilitation of wetlands") but does not provide ratios specific to each type of mitigation.

For comparison, Table 5-7 lists the wetland mitigation ratios for Kittitas County, Ecology/Corps/EPA, and a few neighboring jurisdictions. Kittitas County's current mitigation ratios are lower than those recommended by the Ecology/Corps/EPA guidance, particularly for wetland restoration and enhancement.

The Kittitas County mitigation ratios for all wetland categories are lower than those for other local jurisdictions, as well as the Ecology/Corps/EPA recommended buffers.

Table 5-7. Examples of Wetland Mitigation Ratios (replacement area to impact area)

	Wetland Category			
Jurisdiction	**I**	**II**	**III**	**IV**
Kittitas County Code 17.04	3:1	2:1	1.5:1	1:1*
Douglas County	6:1	3:1	2:1	1.5:1.65
City of Ellensburg**	6:1	3:1	2:1	1.5:1
Ecology/ Corps / EPA***	4:1 creation 16:1 enhancement (based on scores for functions)	3:1 creation 12:1 enhancement	2:1 creation 8:1 enhancement	1.5:1 creation 6:1 enhancement

* For impacts exceeding 2 acres.
** Acreage requirements for enhancement are double those for restoration or creation.
*** Ecology/Corps/EPA ratios listed here are examples and do not include ratios for natural heritage wetlands or combinations of mitigation methods (e.g., enhancement plus creation).

Alternative Mitigation Approaches

Kittitas County code does not currently allow for the use of alternative mitigation approaches, such as an in-lieu fee program or use of a programmatic mitigation site.

Mitigation Plans, Monitoring, and Performance Standards

The County's existing wetland regulations do not include requirements for a mitigation plan, mitigation monitoring, or performance standards.

5.5.7.2 Best Available Science

Mitigation Sequencing

Recent evaluations of the success of mitigation efforts statewide and throughout the nation have strongly recommended more emphasis on impact avoidance and minimization (the first two preferred steps in mitigation sequencing) to reduce the need for compensatory mitigation (Ecology, 2008; ELI and TNC, 2009).

Mitigation Ratios

One of the main reasons for specifying mitigation ratios greater than 1:1 is that studies have shown that many compensatory mitigation projects have not been successful, resulting in lost wetland acreage, wetland types, and wetland functions. Common reasons for failure include the following (Granger et al., 2005, Castelle et al., 1992b):

- Poor site selection;
- Poor site design;
- Inappropriate or inadequate goals, objectives, and performance measures;
- Lack of sufficient water;
- Inappropriate water regime;
- Poor implementation and failure to implement the design;
- Inadequate maintenance, infestation by invasive species;
- Failure to protect projects from on-site and off-site impacts such as sediment and pollutant loading;
- Grazing by geese or other animals;
- Destruction by floods, erosion, fires, or other catastrophic events;
- Off-road vehicles; and
- Lack of regulatory follow-up and enforcement.

In a study of wetland mitigation sites in Washington, Ecology found that only 13 percent of the projects were fully successful based on replacement of wetland acreage, wetland functions, and achievement of project goals, objectives, and performance standards. Half of the projects failed or were minimally successful. One-third of the projects were moderately successful. Other findings of the Ecology study include the following (Johnson et al., 2000, 2002; Sheldon et al., 2005):

- Approximately half of the mitigation projects had problems with installation.
- Just over half of the projects achieved the required wetland acreage.
- While most projects had goals, objectives, and performance standards, only around a third of the projects met them.
- Only a third of the mitigation projects were monitored.
- A lack of maintenance was one of the main reasons for poor mitigation success.
- About half of compensatory wetland mitigation projects received some regulatory follow-up in the form of site visits, phone calls, or letters. All of the projects lacking regulatory follow-up were either minimally or not successful, while two-thirds of the projects receiving some kind of follow-up were either fully or moderately successful.

Buffer mitigation projects generally are affected by the same factors as wetland mitigation. Success of plant growth in the buffer depends on water, nutrient and soil requirements for plants, and controlling the invasion of non-native species (Gwin et al. 1999; Magee et al. 1999).

Different types of wetland mitigation projects (e.g., creation, restoration, and enhancement) have varying levels of success in mitigating for lost wetland acreage and functions. Restoration is considered more feasible and sustainable than creation of wetlands because a restoration site is by definition a historic or degraded wetland which may already have the appropriate substrate, seed bank, and hydrology. Wetland creation often is less likely to succeed than restoration because it begins with an upland site.

Wetland enhancement is typically more successful than wetland creation, but the use of enhancement alone for a mitigation project raises the following concerns (Ecology et al. 2006a, Johnson et al. 2002):

- Most enhancement actions focus on improving vegetation structure and ignore improving environmental processes that support wetland systems and functions.
- There is a net loss of water quality and quantity functions and only modest gains in habitat functions.
- The use of enhancement as a primary means of compensatory mitigation contributes to a loss of wetland acreage. By definition, enhancement occurs in an existing wetland and so it does not replace lost wetland area.

Alternative Mitigation Approaches

Alternative mitigation approaches, such as an in-lieu fee program or use of a programmatic mitigation site, are appropriate in jurisdictions where there are numerous small wetland impacts, and individual project-specific mitigation has a high risk of failure (Ecology et al., 2006a).

In 2008, the Corps and EPA issued revised regulations governing compensatory mitigation for authorized impacts to wetlands, streams, and other waters of the U.S. under Section 404 of the Clean Water Act. The regulations established the following order of preference for alternative mitigation approaches: (1) mitigation bank credits, (2) in-lieu fee program credits, and (3) permittee-responsible mitigation (EPA and Corps 2013). As of July 2013 there were no approved wetland mitigation banks or in-lieu fee programs serving Kittitas County.

Mitigation Plans, Monitoring, and Performance Standards

Monitoring should be tied to ecological performance standards that evaluate whether the project is replacing lost wetland functions (ELI and TNC, 2009). Because the County's existing wetland regulations do not include requirements for mitigation monitoring or performance standards, it is possible that mitigation plans will not reflect scientific studies or what practitioners have learned over the years. Without a requirement for monitoring and maintenance, it will be difficult for the County to know whether permitted mitigation projects are successful. Regulatory agency follow-up is important to ensuring mitigation success.

Monitoring is also important for knowing whether the mitigation site needs maintenance. Ongoing maintenance could include weeding, irrigation system upkeep, mulching, and removal of litter. One year of maintenance is generally part of most construction contracts. This usually includes replacement of dead or dying plants. However, experience shows that many sites may require maintenance for at least 3 to 5 years (Ecology et al., 2006a).

To help ensure the success of mitigation projects, the agencies recommend annual monitoring for at least 5 years. In some cases, longer monitoring periods may be needed, such as for projects establishing scrub-shrub or forested wetlands. Monitoring periods should be extended when the performance standards are not being met (Ecology et al., 2006b).

Wetland and buffer mitigation plans should identify the project's goals, the steps that will be taken to accomplish those goals (objectives), and measurable indicators to determine if the objectives have been achieved (performance standards). Together, the goals, objectives, and performance standards determine whether the project is successful (Ecology et al., 2006a).

Mitigation plans typically include requirements for control of nonnative invasive vegetation (weeds). Including a weed control schedule in mitigation plans could address concerns about weeds spreading between buffers and agricultural areas, and help to meet state and county requirements for control of noxious weeds.

Mitigation plans should also include a contingency plan. Contingency plans outline actions to be taken if monitoring reveals a problem that would prevent the site from attaining its performance standards (Ecology et al., 2006a).

5.5.7.3 Considerations for Code Update

To improve the success of compensatory mitigation projects and reduce the risk of a net loss of wetland functions, the following updates to County wetland regulations could be considered:

- Add a mitigation sequencing requirement to the County's wetland regulations to increase the incentive for applicants to avoid wetland and buffer impacts and the need for mitigation. This would reduce the potential for net loss of wetland functions. The mitigation sequencing requirement could be specified in a code section that applies to all critical areas.
- Define specific ratios according to the types of mitigation actions proposed (creation, restoration, enhancement). Higher ratios for enhancement would be consistent with best available science and the approach taken by other agencies and jurisdictions. The section on regulations for wetland compensatory mitigation in the County's Final Draft SMP (January 2014) provides mitigation ratios that are consistent with current interagency guidance.
- Add a section to the code allowing the use of approved alternative mitigation approaches, such as an in-lieu fee program, should such approaches become available in Kittitas County in the future.
- Add a section to the wetland regulations that requires mitigation projects to have a mitigation plan prepared by a qualified professional, including written goals, objectives, performance standards, a monitoring and maintenance plan, and a contingency plan. The project applicant is responsible for site monitoring and maintenance throughout a specified number of years.
- Encourage applicants to use the interagency guidance for developing wetland mitigation plans (Ecology et al. 2006a, 2006b). By requiring mitigation based on the guidance documents, the County will be providing consistency for applicants who must also apply

for state and federal permits. Requiring less compensatory mitigation at the county level would create unrealistic expectations for your constituents, which could create delays and cost overruns for development.

- Written mitigation plans should be required for both wetland and buffer mitigation projects.
- Include a requirement for a weed control schedule in wetland and buffer mitigation plans.

5.6 Summary of Findings and Code Recommendations

Table 5-8 summarizes considerations for updates to Kittitas County wetland regulations based on a review of the best available science and agency guidance documents as described above.

Table 5-8. Summary of Considerations for Updates to Kittitas County Wetland Regulations

Topic	Kittitas County Code Sections (if applicable)	Potential Code Changes
Designating regulated wetlands	KCC 17A.02.310 KCC 17A.03.020	Use the standard GMA definition of regulated wetlands.
Delineating wetlands	KCC 17A.03.035(6)	Require a delineation and critical areas report if a proposed development is located within 300 feet of a known or suspected wetland. Require the use of the Corps of Engineers Arid West or Western Mountains, Valleys, and Coast regional supplements (and future amendments) for wetland delineations. Delineations should be completed and critical areas reports prepared by a qualified wetland biologist. Clearly state that the location of wetlands for regulatory purposes will be determined based on a site-specific assessment.
Exemptions- Agricultural Activities	KCC 17A.03.020	For agricultural activities in the Naches watershed (which will not be enrolled in the VSP), require agricultural producers to use reasonable measures to protect wetland functions, such as those described in Field Office Technical Guides adopted by the Natural Resources Conservation Service. Revise the code definition of "agricultural activities" to be consistent with state law.

Topic	Kittitas County Code Sections (if applicable)	Potential Code Changes
Exemptions- Other Activities	KCC 17A.03.020	Clarify that activities listed in this section are exempt only so far as they avoid and minimize impacts to wetland and buffer functions. Remove the exemption for "existing and ongoing natural resource activities." Emergency activities that would otherwise be subject to critical areas permit requirements under non-emergency conditions should be required to obtain an after-the-fact permit and provide appropriate mitigation for any impacts. Consider requiring some form of permanent marking of wetland and buffer areas to reduce the potential for impacts over the long term. This requirement could be limited to more intensive land uses such as subdivisions. While fencing and signage may be appropriate adjacent to a residential development, landowners in more rural areas may prefer less intrusive measures such as hedgerows or windbreaks. Wetlands, buffers, and mitigation sites should be recorded with a notice on title. Define what types of "utility facilities" are exempt and limit the exemption to utilities with low potential impacts, such as installation within improved rights-of-way. Utility development should be required to follow the mitigation sequence and all unavoidable impacts should be offset through compensatory mitigation. Specify thresholds for clearing and grading activities that will trigger critical areas review.

Topic	Kittitas County Code Sections (if applicable)	Potential Code Changes
Allowed uses	KCC 17A.04.040	Mining should be regulated to the same level as other uses. Code revisions should specify that mining must be conducted according to state and federal laws and that appropriate steps are taken to avoid/ minimize impacts and replace wetlands during reclamation of the mine site. Remove the allowance for impacts to up to two acres of Category IV wetlands without mitigation. Small wetlands should be regulated but could be exempted from mitigation sequencing requirements. Compensatory mitigation would still be required for impacts to small wetlands, potentially using a mitigation bank or in-lieu fee program if one becomes available in Kittitas County rather than requiring onsite mitigation. Where projects propose the use of Category IV wetlands for stormwater treatment, they should meet the requirements of the current Stormwater Management Manual for Eastern Washington, as amended. In addition, stormwater discharge facilities in wetland buffers should be designed to maximize the flow of runoff through buffer vegetation before stormwater enters the wetland.
Wetland rating system	KCC 17A.04.010	Implement the *Washington State Wetland Rating System for Eastern Washington* (Hruby 2007 or as amended).
Wetland buffers	KCC 17A.04.020 KCC 17A.04.025 KCC 17A.04.030 KCC 17A.04.035 KCC 17A.02.320	Define buffer standards for all regulated wetlands regardless of wetland size. Consider adopting the buffer widths in the County's Final Draft SMP update (January 2014). These widths are similar to Ecology's Alternative 2 in allowing a range of buffer widths depending on the wetland category and the proposed intensity of development. Define what land uses are considered low vs. moderate/high impact (see Final Draft SMP). Activities that reduce buffer functions (e.g., vegetation clearing, impervious surfaces, soil compaction) should be subject to mitigation sequencing requirements. Appropriate mitigation should be required for buffer impacts. Clarify requirements that wetland buffers should be well-vegetated with native vegetation. To ensure protection of wetland functions, specify a minimum buffer width (either in feet or percent of standard width) that is allowed for buffer width averaging.

Topic	Kittitas County Code Sections (if applicable)	Potential Code Changes
Wetland mitigation	KCC 17A.04.050	Add a mitigation sequencing requirement to the County's wetland regulations to increase the incentive for applicants to avoid wetland and buffer impacts and the need for mitigation. This would reduce the potential for net loss of wetland functions. The mitigation sequencing requirement could be specified in a code section that applies to all critical areas. Define specific ratios according to the types of mitigation actions proposed (creation, restoration, enhancement). Higher ratios for enhancement would be consistent with best available science and the approach taken by other agencies and jurisdictions. The section on regulations for wetland compensatory mitigation in the County's Final Draft SMP (January 2014) provides mitigation ratios that are consistent with current interagency guidance. Add a section to the code allowing the use of approved alternative mitigation approaches, such as an in-lieu fee program, should such approaches become available in Kittitas County in the future. Add a section to the wetland regulations that requires mitigation projects to have a mitigation plan prepared by a qualified professional, including written goals, objectives, performance standards, a monitoring and maintenance plan, and a contingency plan. The project applicant is responsible for site monitoring and maintenance throughout a specified number of years. Encourage applicants to use the interagency guidance for developing wetland mitigation plans (Ecology et al. 2006a, 2006b). By requiring mitigation based on the guidance documents, the County will be providing consistency for applicants who must also apply for state and federal permits. Requiring less compensatory mitigation at the county level would create unrealistic expectations for your constituents, which could create delays and cost overruns for development. Written mitigation plans should be required for both wetland and buffer mitigation projects. Include a requirement for a weed control schedule in wetland and buffer mitigation plans.

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6.0 FISH AND WILDLIFE HABITAT CONSERVATION AREAS

This chapter describes fish and wildlife habitat conservation areas (FWHCAs) in Kittitas County and summarizes the scientific literature concerning how FWHCAs can be affected by land use and other human activities. This chapter also presents an overview of management and protection tools for these areas. The purpose of this chapter is to establish a basis for recommending updates to the FWHCA provisions of the Kittitas County Code.

State GMA guidelines specify the habitat types that should be designated as FWHCAs in accordance with the GMA procedural criteria for adopting comprehensive plans and development regulations (WAC 365-190). The guidelines state that jurisdictions must give special consideration to conservation or protection measures necessary to preserve or enhance anadromous fisheries (WAC 365-190-080). The GMA-specified habitat types to be designated as FWHCAs that are found within Kittitas County, or have the potential to occur in the future, include:

1. **Areas with which state or federally listed species (endangered, threatened, candidate, or sensitive) have a primary association.**

   The U.S. Fish and Wildlife Service (USFWS) and National Oceanic and Atmospheric Administration National Marine Fisheries Service (NMFS) are responsible for designating federal special status species. The Washington Department of Fish and Wildlife (WDFW) is responsible for designating state special status species (Ousley et al., 2003).

   Areas with a "primary association" to listed species are defined as areas which, if altered, may reduce the likelihood that the species will persist over the long term (WAC 365-190-130(4)).

2. **State priority habitats and areas associated with state priority species.**

   The Priority Habitats and Species (PHS) database is updated on a regular basis with input from WDFW field biologists and other scientists and represents the best available science on the distribution of special status wildlife species and habitats in Washington. The PHS habitats identified by WDFW are considered priorities for conservation and management due to their high fish and wildlife species density and/or diversity, important habitat functions, importance to priority species, limited distribution or rarity, vulnerability, or their cultural value (e.g., commercial or recreational) (Ousley et al., 2003). WDFW has designated 20 priority habitats statewide, 13 of which are known to occur in Kittitas County, Washington (Table 6-1).

3. **Habitats and species of local importance.**

   These could include a seasonal range or habitat elements with which a given species has a primary association, and which, if altered, may reduce the likelihood that the species will maintain and reproduce over the long-term. Examples are areas of high relative density or species richness, breeding habitats, winter ranges, movement corridors, and habitats that are of limited availability or high vulnerability to alteration, such as cliffs, talus, and wetlands. Local jurisdictions may designate habitats and species of local importance because of their value to the local environment (Ousley et al., 2003). Currently, there are no habitats or species of local importance designated in Kittitas County.

Table 6-1. WDFW Designated Priority Habitats that Occur in Kittitas County.

Priority Habitats		
Terrestrial	**Aquatic**	**Habitat Features**
Aspen Stands	Freshwater Wetlands & Deepwater	Caves
Biodiversity Areas and Corridors	Instream	Snags/Logs
Inland Dunes		Cliffs
Old Growth/Mature Forest		Talus
Oregon White Oak Woodlands		
Riparian		
Shrub-steppe		

SOURCE: WDFW, 2008; WDFW, 2012

4. **Naturally occurring ponds under twenty (20) acres.**

   Naturally occurring ponds and ponds created for wetland/critical areas mitigation may provide fish and wildlife habitat and other wetland functions. These ponds do not include other manmade ponds (farm ponds, detention ponds) (Ousley et al., 2003).

5. **Waters of the state.**

   Waters of the state include surface waters and watercourses within state jurisdiction under the Shoreline Management Act as defined in WAC 222-16-030 or WAC 222-16-031.

6. **Lakes, ponds, streams, and rivers planted with game fish by a government or tribal entity.**

   These waters provide a valuable public recreational and commercial resource.

7. **State natural area preserves and natural resource conservation areas.**

   Natural area preserves and natural resource conservation areas, owned and administered by the Washington State Department of Natural Resources (WDNR), represent unique or high quality undisturbed ecosystems and habitats (WDNR, 2012). Currently, there are no designated natural area preserves or natural resources conservation areas designated in Kittitas County.

8. **Areas critical for habitat connectivity.**

   To maintain viable populations of upland wildlife species, there must be adequate environmental conditions for reproduction, foraging, resting, cover, and dispersal of animals at a variety of scales across the landscape. Key factors affecting habitat quality include fragmentation, the presence of essential resources such as food, water, and nest building materials, the complexity of the environment, and the presence or absence of predator species and diseases. As a method of linking large habitat areas, migration corridors offer a means by which to connect publicly protected lands and other intact habitat areas. Maintaining habitat connectivity for upland wildlife species is necessary to sustain population viability. Habitat connectivity enables individuals to move between habitat patches to obtain needed resources, the dispersal of individuals, and genetic exchange between populations. Isolated populations are at greater risk of extinction due to natural population fluctuations, random events, and inbreeding (Morrison et al., 1998; Lemkuhl et al., 2001).

6.1 Inventory of FWHCAs in Kittitas County

6.1.1 FWHCA Overview

The vast majority of Kittitas County's land base (61 percent) is comprised of vegetated cover, either as forest, shrub steppe, grasslands, riparian habitats, wetlands or agricultural lands that provide habitat for a variety of wildlife species, including federally listed species such as northern spotted owl, marbled murrelets, grizzly bear, gray wolf and North American wolverine. The Columbia River defines the eastern boundary of Kittitas County with grasslands, agricultural land, and shrub steppe habitat comprising the foothill areas moving westward through the County to the western boundary at the crest of the Cascade Range. The foothills provide important wintering and calving grounds for large mammals including elk, bighorn sheep. The County also supports important breeding populations of raptors including golden eagle and ferruginous hawks, and the sagebrush plains support priority species including sage sparrows, sage thrashers, and the greater sage grouse.

The aquatic habitats of Kittitas County support a number of special status species and priority habitats and species, including bull trout and steelhead trout. Within the County there are over 9,270 miles of riverine/stream habitat and numerous large lakes or impoundments (Keechelus, Kachess and Cle Elum Reservoirs). The Yakima River, and Cle Elum, Kachess and Keechelus Reservoirs are the major aquatic priority habits within the County that are not located entirely on federal land. The reservoirs identified above have blocked access to suitable habitat upstream of the reservoirs and have genetically isolated fish populations above the reservoirs. Much of the County's upper headwater tributary streams occur in forest lands managed by the U.S. Forest Service. The Columbia River system is the largest river system in the County and forms the County's eastern boundary. The Columbia River system supports Chinook salmon, coho salmon, sockeye salmon and steelhead, as well as bull trout and white sturgeon (WDFW, 2012).

The WDFW and the Washington State Department of Natural Resource's Natural Heritage Program (WNHP) compile and map fish and wildlife habitats throughout the state. There are numerous studies for specific species and habitat types that apply to the County. For most priority habitats and wildlife species, the PHS database offers the best available information on their presence and distribution, including site-specific data.

6.1.2 Special Status Species and Habitats

6.1.2.1 Listed Species

Table 6-2 presents the wildlife species in Kittitas County that are listed as threatened or endangered or are candidates for listing under the federal Endangered Species Act, state species of concern, and sensitive species (definitions for each status category are provided in WAC 232-12-297 and 16 U.S.C. § 1532). The table also includes notes about the species habitat requirements and distribution.

Table 6-2. Listed, Sensitive, and Candidate Wildlife Species Known or Suspected to Occur in Kittitas County.

Species	Status (State/Federal)	Habitat Requirements and Distribution
Columbia spotted frog	Candidate/None	Aquatic habitat, especially emergent vegetation in wetlands, ponds, and streams in the Cascade Mountains and in eastern Washington (Nordstrom and Milner, 1997).
Western toad	Candidate/Species of Concern	Found near emergent wetlands and small lakes from 0 to 6,530 ft elevation (Leonard et al., 1993).
Larch mountain salamander	Sensitive/Species of Concern	Found in Cascade crest areas of Kittitas County.
Sharptail snake	Candidate/Species of Concern	Habitat includes moist situations in pastures, meadows, oak woodlands, broken chaparral, and the edges of coniferous or hardwood forests (Stebbins, 2003); also shrubby rabbitbrush-sagebrush (Weaver, 2004). This snake generally is found under logs, rocks, fallen branches, or other cover. It retreats underground during dry periods.
Striped whipsnake	Candidate/None	In Washington, striped whipsnakes inhabit relatively undisturbed native grasslands, sagebrush flats, and dry, rocky canyons with elevations up to 1,985 ft (Storm and Leonard, 1995). They require shrubs for cover, and rock crevices or rodent burrows for egg-laying and hibernation. In Washington, this snake occurs in the Columbia Basin, along the Columbia River border of Walla Walla, Benton, Franklin, Kittitas, and Grant counties.

Species	Status (State/Federal)	Habitat Requirements and Distribution
Sagebrush lizard	Candidate/Species of Concern	Habitats include sagebrush and other types of shrublands (e.g., manzanita and ceanothus brushland), also pinyon-juniper woodland and openly wooded areas of ponderosa pine or Douglas-fir; occupied areas have with open ground and some low bushes (Degenhardt et al., 1996, Hammerson, 1999, Stebbins, 2003). This is a ground dweller that regularly perches on rocks, logs, or snags; it uses rodent burrows, shrubs, logs, etc., for cover.
American white pelican	Endangered/None	Non-breeding and wintering populations occur in eastern Washington throughout the year. Regular concentrations along Columbia River corridor and below Roza Dam.
Western grebe	Candidate/None	Summer resident and breeding along Columbia River.
Bald eagle	Sensitive/Species of Concern	Numerous nest territories and foraging areas in major drainages and along the Yakima and Columbia Rivers (Rodrick and Milner, 1991).
Ferruginous hawk	Threatened/Species of Concern	Associated with open country including prairies, grasslands, and shrublands. Nest in trees, bushes or often on rocky slopes. In Kittitas County, the species is often associated with open shrub-steppe and grassland habitats between the Columbia River and foothills of the east Cascades (Udvardy and Ferrand, 1995).
Golden eagle	Candidate/None	Common raptor in eastern WA along Columbia River plateau associated with open country. Nests on cliffs or large trees (Rodrick and Milner, 1991).
Northern goshawk	Candidate/Species of Concern	Raptor that nests in relatively dense mature conifer and mixed forests. Sensitive to clear-cut timber harvest in nest and foraging stands (Larsen et al., 2004).
Peregrine falcon	Sensitive/Species of Concern	Year-round resident; nests in cliffs (> 150 ft in height); and feeds on birds, especially shorebirds and waterfowl (Larsen et al., 2004). Occurrences primarily along Columbia River.
Yellow-billed cuckoo	Candidate/Candidate	Typically associated with mature cottonwood stands in riparian areas in Washington. Requires fairly large undisturbed tracts of mature cottonwood for breeding. Rare in Washington.

Species	Status (State/Federal)	Habitat Requirements and Distribution
Burrowing owl	Candidate/Species of Concern	Typically associated with plains, deserts, fields (shrublands and shrub-steppe communities). Requires burrows dug by ground squirrels or badgers for nesting (Udvardy and Ferrand, 1995).
Flammulated owl	Candidate/None	Typically found in coniferous forest and forest edges in the Pacific Northwest. Also prefers dry ponderosa pine forest (Udvardy and Ferrand, 1995).
Northern spotted owl	Endangered/Threatened	Resident in coniferous forests below 5,000 ft elevation. Closely associated with late-successional forests (King County, 2003).
Vaux's swift	Candidate/None	A summer resident and breeder of eastern Washington closely associated with late-successional conifer forests. Requires hollow, large-diameter snags for nesting and roosting (Larsen et al., 2004).
Black-backed woodpecker	Candidate/None	Typically associated with coniferous forests in the boreal zone (Udvardy and Ferrand, 1995).
Lewis's woodpecker	Candidate/None	Typically found in pine-oak woodlands, oak or cottonwood groves in grasslands, or in ponderosa pine dominated forest (Udvardy and Ferrand, 1995).
Pileated woodpecker	Candidate/None	Large resident woodpecker of mature forests requiring trees > 17-inch diameter for nesting and roosting. Important primary excavator providing cavities for a number of species (Larsen et al., 2004).
White-headed woodpecker	Candidate/None	Typically associated with ponderosa pine forest and subalpine fir forest habitats (Udvardy and Ferrand, 1995).
Loggerhead shrike	Candidate/None	Typically occupies open country habitat with scattered trees and shrubs including grasslands, shrublands, agricultural fields, and, occasionally, open woodland; often perches on poles, wires or fenceposts (Udvardy and Ferrand, 1995).

Species	Status (State/Federal)	Habitat Requirements and Distribution
Greater sage grouse	Candidate/Candidate	Large upland game bird. This species uses a wide variety of sagebrush mosaic habitats, including (1) tall sagebrush types such as big sagebrush, three-tip sagebrush, and silver sagebrush; (2) low sagebrush types, such as low sagebrush and black sagebrush; (3) mixes of low and tall sagebrush with abundant forbs; (4) riparian and wet meadows; (5) steppe dominated by native forbs and bunchgrasses; (6) scrub-willow; and (7) sagebrush/woodland mixes with juniper, ponderosa pine, or quaking aspen (Schroeder et al., 1999).
Sage sparrow	Candidate/None	Found from sea level to 6,500 ft; strongly associated with sagebrush for breeding. Prefers semi-open habitats, shrubs 3-7 feet tall (Martin and Carlson, 1998). Positively correlated with big sagebrush, shrub cover, bare ground, above-average shrub height, and horizontal patchiness; negatively correlated with grass cover (Rotenberry and Wiens, 1980; Wiens and Rotenberry, 1981).
Sage thrasher	Candidate/None	Sagebrush plains, primarily in arid or semi-arid situations, rarely around towns (AOU, 1998). Usually breeds between 4,000 and 6,500 ft above sea level (Reynolds and Rich, 1978). In eastern Washington, showed strongest correlation to amount of sagebrush cover of all shrub-steppe birds; most abundant where sagebrush percent cover was 11% which is similar to estimated historic sagebrush cover (Dobler, 1992, Dobler et al., 1996).

Species	Status (State/Federal)	Habitat Requirements and Distribution
Merriam's shrew	Candidate/None	Merriam's shrews are estimated to occur at elevations ranging between 1200-3000 ft in elevation in the Columbia Basin. The most commonly reported habitat of this species is sagebrush-steppe, but it also has been found in semi-arid grasslands, pinyon-juniper woodlands, high elevation brushlands, and even mixed woodlands of ponderosa pine, Douglas-fir, and cottonwood (Wilson and Ruff, 1999). Big sagebrush, rabbitbrush, and bitterbrush (*Purshia tridentata*) are commonly found in areas where Merriam's shrews are present (MacCracken et al., 1985, Ports and McAdoo, 1986, Kirkland et al., 1997, Nagorsen et al., 2001). In the Pacific Northwest, Merriam's shrews are found primarily in the arid portions of the region (Verts and Carraway, 1998). Their Washington range includes portions of central and southeastern Washington (Hudson and Bacon, 1956; Johnson and Cassidy, 1997).
Preble's shrew	Candidate/Species of Concern	Recorded habitats include arid and semiarid shrub-grass associations, openings in montane coniferous forests dominated by sagebrush in Washington (Hoffman et al., 1969).
Townsend's Big-eared Bat	Candidate/Species of Concern	A year-round resident that inhabits caves and abandoned mines and buildings. Extremely sensitive to human disturbance (Graham, 1966; Barbour and Davis, 1969; Humphrey and Kunz, 1976; Perkins and Levesque, 1987; Pierson and Rainey, 1998; Ellison et al., 2003).
Black-tailed Jackrabbit	Candidate/None	Inhabits open plains, fields and deserts; open country with scattered thickets or patches of shrubs (Caire et al., 1989). Rests by day in shallow depressions.
White-tailed Jackrabbit	Candidate/None	Open grasslands and sagebrush plains. At higher elevations found in open areas adjacent to pine forests and in alpine tundra. Rests by day usually in shallow depressions at base of bush or beside or in cavity in snow. Young are born in a well concealed depression in the ground or in burrows abandoned by other animals (NatureServe, 2012).

Species	Status (State/Federal)	Habitat Requirements and Distribution
Townsend's Ground Squirrel	Candidate/Species of Concern	Common at times in sagebrush, low sagebrush, and alkali scrub. Less common in bitterbrush, and least common in pinyon-juniper habitat. May invade croplands of alfalfa and grain in winter and spring. Occurs in these habitats from Nevada north through Washington
Western Gray Squirrel	Threatened/Species of Concern	In Washington, pine and oak are especially important for their ability to produce an abundance of large-seeds. Seeds and nuts from other trees like hazelnut are also consumed. Trees >38 cm (15 in diameter at breast height (dbh) may be important for reproductive fitness, given larger trees offer greater food and cover, as reported for the closely related Abert's squirrel. Western Gray Squirrel habitat requires the presence of diverse foods such as nuts, seeds, and fungi. Higher quality habitat also has an interconnected canopy that can be used for arboreal travel (Linders et al., 2010). Historically, Washington's Western Gray Squirrels were found along the entire length of the East Cascades from southern Klickitat County up through Chelan and southern Okanogan Counties. The range of the Western Gray Squirrel has contracted significantly, leaving three isolated populations (Klickitat, Okanogan, and Puget Trough). Presence in Kittitas County is historical (Linders et al., 2010).
Cascade Red Fox	Candidate/None	The Cascade red fox is a rare, possibly extremely rare, isolated Washington endemic subspecies. It is known to occur in alpine and subalpine habitats on Mt. Rainier and Mt. Adams and may possess physiological adaptations that other populations lack (Aubry, 1984; Swanson et al., 2005). There is some verifiable evidence of their presence in the central Cascades.
Fisher	Endangered/Candidate	Very rare forest carnivore closely associated with late-successional coniferous and mixed forests of Olympic and North Cascade Mountains (Larsen et al., 2004).
Gray Wolf	Endangered/Endangered	Rare carnivore of forested and open habitat requiring adequate ungulate prey. Recent sightings have been documented near Cle Elum in the Teanaway River area.
Grizzly Bear	Endangered/Threatened	Rare omnivore of wilderness areas. Occasional recent records from North Cascades National Park (King County, 2003).

Species	Status (State/Federal)	Habitat Requirements and Distribution
Wolverine	Candidate/Candidate	A wide-ranging scavenger that requires large tracts of remote boreal or montane habitat. Rare in Washington, but records in Kittitas County.
Juniper Hairstreak	Candidate/None	The range is broadly defined as western North America, however, there are fewer than six stations known. The Washington distribution is in the Columbia Basin, and Franklin and Kittitas counties. As the name suggests this butterfly is found among junipers -- both in juniper/shrub-steppe composite, and in juniper covered hills and dunes. Host plants are Rocky Mountain juniper and western or Sierra juniper (Larsen et al., 1995).
Silver-bordered Fritillary	Candidate/None	The silver-bordered bog fritillary inhabits boggy meadows and true bogs which support violets (Pyle, 1974), usually located within low- to mid-elevation forests. Several colonies occur in wetlands located within xeric steppe habitat. Violets, most importantly the northern bog violet, are the only known larval host plants of the silver-bordered bog fritillary in Washington. Adults collect nectar from a variety of other flowering plants (Pyle, 1974). In Washington, this butterfly occurs east of the Cascade Mountains in the Columbia Basin, and in Okanogan and Pend Oreille counties. Though numerous where it occurs, the distribution of this species is disjunct, with fewer than 20 sites known (Larsen et al., 1995).

Listed fish species found within Kittitas County are listed in Subsection 6.1.4.1, Table 6-4. The following is a brief discussion of each listed salmonid documented as occurring in the Yakima Basin, which was taken from the *Yakima County Review of Best Available Science for Inclusion in Critical Areas Ordinance Update* (YCPD, 2006).

Steelhead

Current steelhead distribution in the Yakima Basin is much more restricted and more spatially variable than it was historically. It is probable that the historical spawning distribution of summer steelhead included virtually all accessible portions of the Yakima Basin, with the highest spawning densities occurring in complex, multichannel reaches of the mainstem Yakima and Naches Rivers, and in third and fourth-order tributaries with moderate (1 to 4 percent) gradients. Estimates of the size of the historical steelhead run range from 20,000 to 100,000. Historically, the upper Yakima Basin supported the largest numbers of steelhead, but it now supports the fewest. Now, Satus and Toppenish Creeks in Yakima County represent over half of the spawning, with a smaller proportion in the Naches and a much smaller proportion in the upper Yakima (the

Yakima mainstem and tributaries upstream of the Naches confluence). The average number of spawning adult steelhead in the upper Yakima between 1985 and 2000 was approximately 1,256 fish (the range being between 505 in 1996 and 2,840 in 1988), which is only about 1.3 to 6 percent of historical estimates.

The steelhead decline of the upper Basin can be attributed to alteration of stream flows due to development of irrigation systems, creation of fish passage barriers, reductions in floodplain function, impacts to riparian areas and upland hydrology, and changed ecological dynamics, including reduction in beaver populations, introduction of exotic species, and increased predation by native species (YBFWRB, 2009).

There are four genetically distinct populations of wild steelhead in the Yakima Basin: upper Yakima stock, Naches stock, Satus Creek stock, and Toppenish Creek stock. Scientific analyses indicate that wild and hatchery-raised rainbow trout and steelhead in the upper Yakima and Naches interbreed. Wild Satus and Toppenish Creek steelhead, on the other hand, show no evidence of interbreeding with hatchery trout or steelhead. Over 3 million hatchery trout (primarily South Tacoma and Goldendale stock) have been planted in the upper Yakima and Naches since 1950, and 1.6 million hatchery steelhead (primarily Skamania stock) have been planted since 1961.

Spawning steelhead begin passing Prosser Dam in the lower Basin in September, and tend to reside there during the colder parts of December and January, before resuming migration from February through June. The steelhead migration has two peaks, one in late October, and one in late February or early March. The relative numbers of wild fish returning during the fall and winter-spring migration periods varies from year to year, depending on the duration of the thermal window in the fall.

Scientific studies of steelhead migration patterns between 1990 and 1993 indicate that most fall run steelhead spawners actually overwinter in the mainstem Yakima River, in reaches with deep holes and low velocity. About 6 percent hold between Sunnyside Dam and Roza Dam. The final migration to the spawning grounds begins between January and May. There is some evidence that the cue triggering this final run is thermal, as very few fish ascended Satus Creek during midwinter floods, and virtually none of the eventual Naches spawners began moving until water temperatures reached 3°C. Most Yakima steelhead are tributary spawners; over 90 percent of the tagged steelhead spawned in the Naches River and its tributaries, in Satus Creek, or in Toppenish Creek.

In the higher-elevation tributaries of the upper Naches (the Little Naches River), spawning occurs from late April through late May, with a peak in early May.

Over 70 percent of the fish referred to as upper Yakima spawners actually spawn in the Yakima mainstem between Roza Dam and Ahtanum Creek. Of the remaining 30 percent, 14 percent spawn in the Teanaway River and its forks, and the rest spawn in various upper Yakima tributaries and mainstem reaches. As nearly as can be determined (Haring, 2001), spawning occurs in the Yakima Canyon (including Umtanum and Wilson/Naneum Creeks) late March to mid-May, with a peak in late April. Spawning occurs above Yakima Canyon from mid-April to late May, with a peak in early May.

A telemetry study conducted by the Bureau of Reclamation in 2003/2004 looked at the distribution of steelhead above Roza Dam. Of the 209 steelhead that passed over Roza Dam during the winter of 2003/2004, 117 were fitted with radio transmitters. Of the 117, only 98 were able to be tracked (some regurgitated the transmitter, some were thought to have been caught by anglers, and others possibly eaten by otters). The results of the study showed that 40 (41%) presumably spawned between Roza and Easton Dam, 38 (39%) presumably spawned in the Teanaway drainage, nine (9%) presumably spawned in Swauk Creek, seven (7%) presumably spawned in Taneum Creek, one fish each was documented as entering Naneum Creek, Wilson Creek, and the Cle Elum River (3% of total), and one fish (1%) went downstream of Roza Dam (Reclamation, 2005).

Steelhead fry emergence occurs at the following times in the following places:

- Upper Naches tributaries—late June through late July.
- Upper Yakima mainstem in Yakima Canyon (including Umtanum and Wilson/Naneum Creeks)—early June through early July.
- Upper Yakima mainstem above the Yakima Canyon—mid June through late July.
- Upper Yakima tributaries—late June through early August.

Steelhead rearing migrations are not well understood compared to spring Chinook. The presence of steelhead juveniles in small tributaries throughout the summer, sometimes in high densities, indicates that the fish are less inclined to migrate downstream for early rearing than are spring Chinook. However, steelhead juveniles are found in substantial numbers in the Yakima Canyon, far from spawning areas, so a gradual downstream dispersal obviously occurs. Juvenile steelhead may also migrate upstream in search of suitable rearing habitat. Juvenile wild steelhead typically rear in freshwater for one or more years before outmigrating to the sea.

<u>Bull Trout</u>

Historically, wild bull trout occurred throughout the Yakima River subbasin. Today they are fractured into isolated stocks. Although bull trout were likely never as abundant as other salmonids in the Yakima Basin, they were certainly more abundant and more widely distributed than they are today. In June 1998, the USFWS listed bull trout in the Columbia River Basin as threatened under the Endangered Species Act. The 2002 Draft Recovery Plan for bull trout in the Middle Columbia River Recovery Unit recognized thirteen local populations of bull trout in the Yakima Basin. Of these, seven local populations are known to be distributed in Kittitas County including the mainstem Yakima River fluvial population, Cle Elum River, Kachess River, Gold Creek, Box Canyon Creek and Waptus Lake adfluvial populations; and the North Fork Teanaway resident population. All bull trout stocks are native fish sustained by wild production; there are no hatchery bull trout stocks in Washington State.

Adfluvial stocks spawn and, in the early stage, rear in streams, with most growth and maturation occurring in lakes or reservoirs. Adults enter mainstem rivers early in summer, often holding near their natal tributaries for months before migrating upstream. Most mature adults range in size from 20 to 32 inches long.

Fluvial bull trout spawn and, in the early stage, rear in smaller tributaries, with major growth and maturation occurring in mainstem rivers. They may move randomly throughout river systems, generally congregating near spawning tributaries in the summer. Mature adults are usually smaller than anadromous or adfluvial bull trout, ranging from 16 to 26 inches long. Until information is collected to determine otherwise, all bull trout in the upper Yakima River mainstem will be considered as one stock with a fluvial life history pattern. For now, the Yakima fluvial stock is assumed to be composed of fish that inhabit the mainstem between Roza Dam and the upper reservoir dams--Cle Elum, Kachess, and Keechelus. Although the genetic characteristics of the stock have not been determined, bull trout in the mainstem of the Yakima River are considered distinct from other Yakima subbasin stocks, based on physical, geographical, and thermal isolating factors (e.g., dams, warm water temperatures, or irrigation diversions) (Reclamation, 2002).

Resident bull trout spend all life stages (spawning, rearing, growth, and maturation) in small headwater streams, often upstream from impassable barriers. Mature adults can vary in size from 8 to 15 inches, but they are seldom larger than 12 inches in total length. Resident bull trout have been observed to mix and interbreed with migratory forms unless physically separated by barriers. It is possible that anadromous forms occurred in the Yakima Basin in the past.

The run timing of the Keechelus Reservoir stock are distinct. Run timing for other Yakima stocks either is not distinct from other Washington State bull trout or is unknown. According to WDFW, the conditions of the Kachess, Kelchelus, Yakima River, and North Fork Teanaway stocks are critical; the condition of the Cle Elum stock is unknown (WDFW, 1998). An adfluvial bull trout population could still be present in the Cle Elum Reservoir; however, no spawning populations have been documented in the upper Cle Elum Basin. It is thought that the adfluvial bull trout from the Cle Elum Basin may have been replaced by nonnative lake trout, which have been naturally reproducing in the Cle Elum Reservoir since being stocked in the 1920s (Reclamation and Ecology, 2012). Additional data are needed to determine the status of these unknown stocks (YBFWRB, 2012).

Bull trout are strongly influenced by temperature and are seldom found in streams exceeding summer temperatures of 18ºC. Cool water temperatures during early life history results in higher egg survival rates, and faster growth rates in fry and possibly juveniles as well. All life history stages of bull trout are associated with complex forms of cover, including large woody debris, undercut banks, boulders, and pools. Preferred spawning habitat consists of low gradient streams with loose, clean gravel, and water temperatures of 5 to 9º C in late summer and early fall. Depending on the life-history form, rearing and overwintering habitats vary, but all require cool, clean water, with insects, macro-zooplankton, and small fish for larger adults. Slow juvenile growth delays maturation until about age five, and reproduction may only occur on alternate years. Bull trout may live for 12 or more years, and can reach over 20 pounds when adequate forage is available. Stock densities of bull trout are generally much lower than that of other native game fish such as cutthroat trout, rainbow trout, or mountain whitefish. The migratory forms of native char may travel long distances to reach spawning tributaries. Mature native char normally penetrate farther upstream than any other salmonids present in the watershed (Reclamation, 2002).

Several areas in the Yakima Basin have been identified as bull trout critical habitat (USFWS 2010) that may be candidates for bull trout reintroduction (or introduction) efforts. These areas in Kittitas County include the forks of Little Naches River and tributaries, upper Taneum Creek and Cold Creek (tributary to Keechelus Reservoir) and the Middle Fork Teanaway River. Taneum Creek and the Little Naches River forks are specifically listed in the USFWS 2002 Draft Bull Trout Recovery Plan as potential local populations, as they are thought to be areas of historic distribution and/or have high quality habitat that could support a local population of bull trout. Threats and recovery actions that would benefit these potential populations will be identified as this aspect of the USFWS Recovery Plan is further developed (YBFWRB, 2012).

6.1.2.2 State Priority Habitats and Species

Wildlife Species and Habitats

State priority habitats and habitats associated with state priority species include areas associated with high recreational value (e.g., waterfowl, deer, Rocky Mountain elk, bighorn sheep) or relatively rare species (e.g., marten, dusky grouse) (Table 6-3) (WDFW, 2008). The areas mapped as priority habitat by WDFW include elk, deer, mountain goat and bighorn sheep wintering calving, and summer ranges and breeding territories for peregrine falcons and sage grouse (leks) (WDFW, 2012). Mapped priority habitat polygons are found throughout the County in varying habitat types from the mountainous west side of the County to the shrub-steppe and grassland habitats above the Columbia River to the east. Priority habitats are identified in Table 6-1.

Table 6-3. Priority Species Known or Suspected to Occur in Kittitas County

Species/Sites	Criteria[1]
Eastern Washington breeding concentrations of Grebes and Cormorants	VA
Eastern Washington breeding terns	VA
Black-crowned night heron	VA
Great blue heron	VA
Cavity-nesting ducks: Wood Duck, Barrow's Goldeneye, Common Goldeneye, Bufflehead, Hooded Merganser	RCT
Harlequin Duck	VA/RCT
Tundra Swan	VA/RCT
Waterfowl Concentrations	VA/RCT
Prairie Falcon	RCT
Chukar	RCT
Dusky Grouse	RCT
Sooty Grouse	RCT
Wild Turkey	RCT
E WA breeding occurrences of: Phalaropes, Stilts and Avocets	VA
Roosting Concentrations of: Big-brown Bat, Myotis bats, Pallid Bat	VA
Marten	RCT
Bighorn Sheep	RCT
Mountain Goat	RCT
Northwest White-tailed Deer	RCT
Elk	RCT
Rocky Mountain Mule Deer	RCT

[1] VA = vulnerable aggregations, RCT = recreational, commercial, or tribal importance vulnerable to habitat loss or degradation (WDFW, 2008).

Fish Species and Habitats

State priority habitats and habitats associated with state priority species include areas having high recreational value or relatively rare species. Of particular importance or concern in Kittitas County are salmonids listed as state priority species. Salmonid-bearing streams in Kittitas County generally contain several anadromous and/or resident priority salmonid species that include Chinook, coho, and sockeye salmon (including kokanee), bull trout, rainbow/steelhead trout, and westslope cutthroat trout. Salmon are also associated with other types of priority habitats and species, particularly in relation to riparian areas, so the protection of salmonid habitats serves to protect other species dependent on similar or associated habitats. Resident rainbow trout and westslope cutthroat trout provide recreational fishing opportunities in Kittitas County and are important to both the tourism industry and the local economy, particularly the rainbow trout fishery in the Yakima River.

Cle Elum, Kachess, and Keechelus Reservoirs were once natural glacial lakes that supported sockeye salmon. With construction of dams at the outlet of these reservoirs in the early 1900s, sockeye became extirpated from the Yakima Basin due to lack of access to spawning habitat and the loss of essential lake rearing habitat. The reintroduction of sockeye salmon into Cle Elum Reservoir began in 2009 with the release by the Yakama Nation of 1,000 adult sockeye (Wenatchee and Lake Osoyoos stocks), 1,500 adults in 2010, and 4,800 adults in 2011 (Reclamation and Ecology, 2012; Johnston, 2012).

The dams on the mainstem Columbia River, lack of passage at Roza Dam on the mainstem Yakima River, unscreened irrigation diversions in primary rearing habitat, and overharvest of wild stocks contributed to the extirpation of coho salmon from the Yakima River Basin. Although endemic coho salmon were extirpated from the Yakima River Basin in the early 1980s, natural reproduction of hatchery-reared coho is now occurring in the Yakima River. The Yakama Nation currently releases approximately 1.0 to 1.7 million coho smolts in the Yakima Basin annually from both in-basin and out-of-basin broodstocks (Newsome, 2012).

Pacific and river lamprey are other priority anadromous species potentially found in Kittitas County streams. However, not much is known about their life history, historic distribution, or current limiting factors in the Yakima Basin. Both species are considered extremely rare. Approximately five adult Pacific lamprey have been observed at Prosser Dam on the lower Yakima River on an annual basis since 1985 (Johnston, 2009). Other priority habitats and fish species include mountain sucker, leopard dace, Umatilla dace, pygmy whitefish, and white sturgeon (Table 6-4).

6.1.2.3 Naturally Occurring Ponds

Naturally occurring ponds less than 20 acres are found throughout the lowlands of the western portion of the County. Ponds provide critical breeding habitat for a number of Pacific Northwest amphibians (Leonard et al. 1993). In Kittitas County, naturally occurring ponds located outside of shoreline jurisdiction are currently protected as wetlands and are not specifically called out for protection as a FWHCA, which is inconsistent with the GMA.

6.1.2.4 Waters of the State

Waters of the state within Kittitas County include streams with a mean annual flow of 20 cubic feet per second (cfs) or greater and lakes 20 acres or greater in areas. There are many waters of the state located within the County.

6.1.2.5 Waters Planted with Game Fish

Information on water bodies with planted game fish is not available in the PHS data. In 2012, WDFW's Spring Hatchery Trout Stocking Plan for Lakes and Streams included plantings of catchable trout in Cooper, Mattoon, Lost, and North Fio Rito Lakes and numerous ponds including Easton Ponds, Kiwanis Pond, Lavender Pond, Woodhouse Ponds, Naneum Pond, and McCabe Pond (WDFW, 2012b). In eastern Washington, WDFW does not typically plant other game fish species or trout fry (WDFW, 2012b).

6.1.2.6 Lands Essential for Habitat Connectivity

Kittitas County has not designated any lands essential for habitat connectivity; however, WDFW PHS data have identified Biodiversity Areas and Corridors as a priority habitat in Kittitas County (WDFW, 2012). As part of improvements to Interstate 90 between Hyak and Lake Easton, the Washington State Department of Transportation (WSDOT) is constructing "connectivity emphasis areas" or CEAs at several locations. The purpose of the CEAs is to restore or enhance connections between habitats on both sides of I-90 to benefit fish, wildlife, and hydrologic functions. CEAs are planned along Keechelus Lake at several stream crossings: Gold Creek, Rocky Run Creek, Wolf Creek, Resort Creek, Townsend Creek, and Price/Noble Creeks (WSDOT 2011).

6.1.3 Wildlife Habitat Evaluation of Kittitas County

The ultimate aim of habitat protection is the conservation of fish and wildlife species. Three main elements determine whether species are conserved:

- Availability of habitat,
- Behavior of individual animal species, and
- Dynamics of populations.

Availability of habitat determines what resources and environments are accessible. Behavior establishes how animals select their resources and interact with the environment. Population dynamics dictate how the habitats are occupied. To maintain viable populations of wildlife species, there must be adequate environmental conditions for reproduction, foraging, resting, cover, and dispersal of animals at a variety of scales across the landscape.

One important aspect of habitat that has a significant effect on species persistence is fragmentation, or the increase in isolation and decrease in the size of habitat areas. Fragmentation affects the quality of habitat of a given species in numerous ways. It alters the quality and type of the food base. Fragmentation changes microclimates by altering temperature and moisture regimes. It alters the availability of cover and brings species together that normally would have little interaction, and thus may increase the rate of nest parasitism, competition, and predation. Fragmentation can also increase contact with and exploitation by humans.

Other key factors affecting habitat quality include the presence of essential resources such as food, water, nest building materials, the complexity of the environment, and the presence or absence of predator species and diseases. These factors are often influenced by elements outside the habitat area (Kagen et al., 2000; Morrison et al., 1992).

Riparian corridors offer a natural system of linkages between intact habitat areas. The value of riparian corridors varies from species to species, and also varies depending on the width of the riparian corridor. Large mammals require widths of several hundred feet for migration whereas amphibian and reptile species may require widths less than 50 feet. In semi-arid regions such as Kittitas County, riparian corridors not only offer migratory linkages between large habitat areas, but also offer important refuge and habitat for numerous species that rely on the riparian areas for their existence. Of the numerous vertebrate species that are known to occur within Kittitas County, over half use the riparian corridors as their primary habitat. Species that use riparian areas for some portion of their life cycle represent up to 80 percent of all species (Kagen et al., 2000; Morrison et al., 1992).

Cliffs, steep slope areas, and ravines can also serve as corridors for species movement and in some cases can also effectively add to the width of relatively narrow riparian areas adjacent to them. These non-riparian corridors are essential to connecting some of the shrub-steppe habitat areas in the eastern portion of the county (Morrison et al., 1992).

In providing for adequate distribution of habitat within and across landscapes, a clear understanding of the elements that change the landscape is necessary. Some of these elements include loss of vegetative cover, erosion, and the alteration or disruption of a water supply, to name just a few. Managing a natural landscape for both human presence and ecological objectives depends on keeping human activity inversely proportional to the sensitivity of landscape elements, protecting the areas of major animal movement, and maintaining natural disturbance regimes. Managing a remnant of a natural landscape focuses on these same three objectives, plus two more: minimizing isolation and minimizing human impacts on the surrounding matrix (Morrison et al., 1992).

6.1.3.1 Kittitas County Vegetation Cover Types

Kittitas County has a diversity of vegetation types/cover types that offer habitat for a wide variety of vertebrate species. This habitat ranges from the permanent snow and alpine areas in the upper Cascades to the arid steppe regions in the eastern half of the County. Although much of this varying landscape and its wide range of species habitat still survive to a significant degree, much is threatened by nonnative plant species or by incompatible land uses. Johnson and O'Neil (2003) provide detailed information regarding the description, extent, condition, and species of the major habitat classifications in Kittitas County.

Alpine Grasslands and Shrublands

Alpine grassland and shrubland habitat occurs above the upper tree line in the mountains, or a short distance below it. Typically, it occurs adjacent to or in a mosaic with subalpine parkland. The vegetation classifications within this habitat include alpine and permanent snow/ice. This habitat is naturally very limited in extent. In Kittitas County, most of this habitat is still in good condition and is dominated by native species. Some vertebrate species that are known to occur within this vegetation class include:

Mammals		
broad-footed mole	northern pocket gopher	coyote
American pika	deer mouse	red fox
yellow-pine chipmunk	bushy-tailed woodrat	black bear
yellow-bellied marmot	southern red-backed	American marten
hoary marmot	vole	long-tailed weasel
Olympic marmot	heather vole	mountain lion

Belding's ground squirrel Columbian ground squirrel Cascade goldenmantled ground Douglas' squirrel	long-tailed vole creeping vole water vole western jumping mouse Pacific jumping mouse	bobcat black-tailed deer mule deer mountain goat bighorn sheep
Amphibians and Reptiles		
long-toed salamander western toad	Pacific chorus (tree) frog	common garter snake
Birds		
turkey vulture mallard green-winged teal Barrow's goldeneye northern harrier sharp-shinned hawk Cooper's hawk golden eagle American kestrel prairie falcon white-tailed ptarmigan dusky grouse spotted sandpiper great horned owl rufous hummingbird gray jay Clark's nutcracker common raven	horned lark violet-green swallow black-capped chickadee mountain chickadee chestnut-back chickadee red-breasted nuthatch canyon wren winter wren golden-crowned kinglet ruby-crowned kinglet hermit thrush varied thrush European starling American pipit cedar waxwing	Nashville warbler yellow-rumped warbler MacGillivray's warbler Wilson's warbler chipping sparrow vesper sparrow savannah sparrow fox sparrow song sparrow white-crowned sparrow dark-eyed junco brewer's blackbird pine grosbeak red crossbill pine siskin evening grosbeak

<u>Subalpine Parkland</u>

The subalpine parkland habitat lies above the mixed montane conifer forest or lodgepole pine forest habitats and below the alpine grassland and shrubland habitats, between 5,000 and 8,000 feet elevation. The vegetation zones that fall within this category include alpine parkland and subalpine fir. Wind blasting by ice and snow plays a critical role in this zone. Shifts in climate factors, such as drought, snow pack depth, or duration either allow tree invasions into meadows and shrublands or retard tree growth. Land uses within this zone include recreation and grazing. This habitat is generally considered fairly stable with some possible future impacts associated with global warming. Some species that are known to occur within this vegetation class include:

Mammals		
masked shrew Trowbridge's shrew shrew-mole Yuma myotis little brown myotis long-legged myotis long-eared myotis Townsend's big-eared bat American marten ermine long-tailed weasel mule deer	American pika snowshoe hare Townsend's chipmunk yellow-bellied marmot hoary marmot golden-mantled ground squirrel northern pocket gopher American beaver deer mouse mountain lion bobcat	bushy-tailed woodrat heather vole long-tailed vole creeping vole Pacific jumping mouse common porcupine coyote red fox mountain goat bighorn sheep
Amphibians and Reptiles		
common garter snake northwestern	Cope's giant salamander Pacific giant salamander	Pacific chorus (tree) frog Cascades frog

salamander	rough-skinned newt	Columbia spotted frog
long-toed salamander	western toad	
Birds		
turkey vulture	northern flicker	American pipit
mallard	olive-sided flycatcher	cedar waxwing
Barrow's goldeneye	dusky flycatcher	orange-crowned warbler
osprey	gray jay	Nashville warbler
northern harrier	Steller's jay	yellow-rumped warbler
sharp-shinned hawk	Clark's nutcracker	Townsend's warbler
Cooper's hawk	black-billed magpie	hermit warbler
northern goshawk	American crow	MacGillivray's warbler
golden eagle	common raven	western tanager
American kestrel	horned lark	chipping sparrow
prairie falcon	violet-green swallow	vesper sparrow
ruffed grouse	barn swallow	savannah sparrow
spruce grouse	black-capped	fox sparrow
dusky grouse	chickadee	song sparrow
spotted sandpiper	mountain chickadee	Lincoln's sparrow
band-tailed pigeon	red-breasted nuthatch	golden-crowned sparrow
great horned owl	canyon wren	dark-eyed junco
northern pygmy owl	winter wren	brown-headed cowbird
vaux's swift	American dipper	pine grosbeak
black-chinned hummingbird	golden-crowned kinglet	purple finch
calliope hummingbird	ruby-crowned kinglet	Cassin's finch
rufous hummingbird	western bluebird	white-winged crossbill
Lewis's woodpecker	Townsend's solitaire	pine siskin
Williamson's sapsucker	Swainson's thrush	evening grosbeak
red-naped sapsucker	hermit thrush	European starling
three-toed woodpecker	American robin	
black-backed woodpecker	varied thrush	

<u>Montane Mixed Conifer Forest</u>

The montane mixed conifer forest habitat is typified by a moderate-to-deep winter snow pack that persists for 3 to 9 months. On the east side of the Cascade Range it occupies a narrow zone of about 1,500 vertical feet. The topography is generally mountainous. The dominant plant species within this habitat include mountain hemlock, interior Douglas fir, grand fir and subalpine fir. The typical land use is forestry or recreation. Most of this vegetation type is found on public lands managed for timber, and much of it has been harvested in a dispersed-patch pattern. Within Kittitas County, there has been little or no decline in the extent of this type over time. Large areas of this habitat are relatively undisturbed by humans and include significant old-growth stands, while other areas have been extensively affected by logging, especially clear-cut areas. Some species that are known to occur within this vegetation class include:

Mammals		
masked shrew	American pika	long-tailed vole
vagrant shrew	snowshoe hare	creeping vole
montane shrew	mountain beaver	Pacific jumping mouse
Trowbridge's shrew	yellow-pine chipmunk	common porcupine
shrew-mole	Townsend's chipmunk	coyote
coast mole	golden-mantled	black bear
California myotis	ground squirrel	American marten
Yuma myotis	Douglas' squirrel	ermine
little brown myotis	northern flying squirrel	long-tailed weasel
long-legged myotis	northern pocket	mink

fringed myotis	gopher	mountain lion
long-eared myotis	American beaver	bobcat
silver-haired bat	deer mouse	mule deer
big brown bat	bushy-tailed woodrat	white-tailed deer
hoary bat	heather vole	mountain goat
Townsend's big-eared bat	montane vole	
Amphibians and Reptiles		
northwestern salamander	Cascade torrent salamander	ensatina
long-toed salamander	rough-skinned newt	California slender
Pacific giant salamander	Dunn's salamander	Cascades frog
Olympic torrent salamander	Larch Mountain salamander	salamander
Columbia torrent salamander	Van Dyke's salamander	tailed frog
southern torrent salamander	western red-backed salamander	western toad
clouded salamander	red-legged frog	Pacific chorus (tree)
Siskiyou mountains salamander	Del Norte salamander	Oregon spotted frog
common garter snake	rubber boa	Columbia spotted frog
western skink	northern alligator lizard	
Birds		
turkey vulture	black-backed woodpecker	varied thrush
Barrow's goldeneye	northern flicker	European starling
osprey	pileated woodpecker	cedar waxwing
bald eagle	olive-sided flycatcher	orange-crowned warbler
sharp-shinned hawk	western wood-pewee	Nashville warbler
Cooper's hawk	willow flycatcher	yellow-rumped warbler
northern goshawk	Hammond's flycatcher	Townsend's warbler
red-tailed hawk	dusky flycatcher	hermit warbler
golden eagle	Pacific-slope flycatcher	MacGillivray's warbler
American kestrel	warbling vireo	Wilson's warbler
prairie falcon	gray jay	western tanager
ruffed grouse	Steller's jay	chipping sparrow
dusky grouse	Clark's nutcracker	fox sparrow
killdeer	common raven	song sparrow
band-tailed pigeon	tree swallow	white-crowned
flammulated owl	violet-green swallow	sparrow
great horned owl	northern winged swallow	dark-eyed junco
northern pygmy-owl	barn swallow	brown-headed cowbird
northern spotted owl	mountain chickadee	pine grosbeak
long-eared owl	chestnut-backed chickadee	purple finch
northern saw-whet owl	red-breasted nuthatch	Cassin's finch
common nighthawk	brown creeper	red crossbill
Vaux's swift	canyon wren	pine siskin
rufous hummingbird	house wren	evening grosbeak
Lewis's woodpecker	mountain bluebird	American robin
Williamson's sapsucker	Townsend's solitaire	
red-naped sapsucker	Swainson's thrush	
red-breasted sapsucker	hermit thrush	
hairy woodpecker	golden-crowned kinglet	
three-toed woodpecker	ruby-crowned kinglet	

Eastside Mixed Conifer Forest

The eastside mixed conifer forest habitat is primarily mid-montane, with an elevation range between 3,000 and 5,500 feet. Eastside mixed conifer habitats are montane forests and woodlands. This habitat contains various vegetation classifications including interior Douglas fir, ponderosa pine, whitebark pine, grand fir, western hemlock and subalpine fir. Stand canopy structure is generally diverse, although single-layer forest canopies are currently more common than multilayered forests with snags and large woody debris. The tree layer varies from closed forests to more open-canopy forests or woodlands. This habitat may include very open stands. The undergrowth is complex and diverse. Tall shrubs, low shrubs, forbs, or any combination may dominate stands. Deciduous shrubs typify shrub layers. Prolonged canopy closure may lead to development of sparsely vegetated undergrowth. Roads, timber harvest, periodic grazing, and fire suppression have compromised these forests. Even though this habitat is more extensive than it was prior to 1900, natural processes and habitat functions have been modified and degraded to some degree. Some species known to occur within this vegetation class include:

Mammals		
masked shrew	snowshoe hare	Pacific jumping mouse
vagrant shrew	yellow-pine chipmunk	common porcupine
montane shrew	Townsend's chipmunk	coyote
Trowbridge's shrew	yellow-bellied marmot	black bear
shrew-mole	golden-mantled ground squirrel	American marten
coast mole	Douglas' squirrel	ermine
California myotis	northern flying squirrel	long-tailed weasel
Yuma myotis	northern pocket	mink
little brown myotis	gopher	American badger
long-legged myotis	American beaver	striped skunk
long-eared myotis	deer mouse	mountain lion
silver-haired bat	bushy-tailed woodrat	bobcat
big brown bat	heather vole	mule deer
hoary bat	montane vole	white-tailed deer
Townsend's big-eared bat	long-tailed vole	bighorn sheep
Amphibians and Reptiles		
northwestern salamander	tailed frog	red-legged frog
long-toed salamander	great basin spadefoot	Cascades frog
Pacific giant salamander	western toad	Columbia spotted frog
rough-skinned newt	Pacific chorus (tree) frog	
Birds		
turkey vulture	northern rough-winged swallow	Nashville warbler
osprey	American kestrel	yellow-rumped warbler
bald eagle	prairie falcon	western screech-owl
sharp-shinned hawk	ruffed grouse	great horned owl
Cooper's hawk	dusky grouse	northern pygmy-owl
northern goshawk	wild turkey	*spotted owl
red-tailed hawk	killdeer	barred owl
golden eagle	band-tailed pigeon	long-eared owl
white-throated swift	flammulated owl	northern saw-whet owl
rufous hummingbird	bank swallow	common nighthawk
Lewis's woodpecker	cliff swallow	black-throated gray warbler
Williamson's sapsucker	barn swallow	Townsend's warbler
red-naped sapsucker	mountain chickadee	hermit warbler
hairy woodpecker	chestnut-backed	MacGillivray's warbler
white-headed	chickadee	Wilson's warbler
woodpecker	red-breasted nuthatch	western tanager
three-toed woodpecker	brown creeper	spotted towhee
black-backed woodpecker	canyon wren	chipping sparrow
northern flicker	house wren	fox sparrow
pileated woodpecker	winter wren	song sparrow
olive-sided flycatcher	golden-crowned kinglet	white-crowned sparrow
western wood-pewee	ruby-crowned kinglet	dark-eyed junco
willow flycatcher	western bluebird	black-headed grosbeak
Hammond's flycatcher	mountain bluebird	pine grosbeak
dusky flycatcher	Townsend's solitaire	purple finch
warbling vireo	Swainson's thrush	Cassin's finch

gray jay Steller's jay Clark's nutcracker common raven violet-green swallow	hermit thrush American robin varied thrush European starling orange-crowned warbler	red crossbill pine siskin American goldfinch evening grosbeak

Ponderosa Pine Forest and Woodlands

The ponderosa pine forest habitat generally occurs on the driest sites supporting conifers. It is widespread and variable, appearing on moderate-to-steep slopes in canyons, foothills, and on plateaus or plains near mountains. This habitat represents the lower tree line zone, forming a transition with the eastside mixed conifer forest habitat. Tall ponderosa pine over Oregon white oak trees form stands along part of the east Cascades. Oregon white oak dominates limited areas of open woodlands. Much of this habitat is degraded because of increased numbers of exotic plants and decreased native bunchgrasses. Some species known to occur within this vegetation class include:

Mammals		
masked shrew vagrant shrew Trowbridge's shrew coast mole California myotis Yuma myotis little brown myotis long-legged myotis long-eared myotis silver-haired bat big brown bat hoary bat spotted bat Townsend's big-eared bat pallid bat	snowshoe hare least chipmunk yellow-pine chipmunk yellow-bellied marmot golden-mantled ground squirrel *western gray squirrel Douglas' squirrel northern flying squirrel northern pocket gopher American beaver deer mouse montane vole long-tailed vole Pacific jumping mouse	common porcupine coyote black bear ermine long-tailed weasel mink American badger striped skunk mountain lion bobcat mule deer white-tailed deer bighorn sheep
Amphibians and Reptiles		
long-toed salamander rough-skinned newt Larch Mountain salamander ensatina tailed frog Great Basin spadefoot western toad Pacific tree frog Columbia spotted frog bullfrog	painted turtle northern alligator lizard southern alligator lizard short-horned lizard sagebrush lizard western fence lizard western skink rubber boa racer	sharptail snake ringneck snake night snake striped whipsnake western terrestrial garter northwestern garter snake common garter snake western rattlesnake
Birds		
turkey vulture osprey bald eagle sharp-shinned hawk Cooper's hawk northern goshawk red-tailed hawk golden eagle American kestrel merlin	California quail killdeer band-tailed pigeon mourning dove flammulated owl western screech-owl great horned owl northern pygmy-owl *spotted owl barred owl	red-naped sapsucker hairy woodpecker white-headed woodpecker three-toed woodpecker black-backed woodpecker northern flicker pileated woodpecker olive-sided flycatcher

prairie falcon	long-eared owl	western wood-pewee
ring-necked pheasant	northern saw-whet owl	willow flycatcher
ruffed grouse	common nighthawk	Hammond's flycatcher
dusky grouse	rufous hummingbird	gray flycatcher
wild turkey	Lewis's woodpecker	Townsend's warbler
dusky flycatcher	brown creeper	Macgillivray's warbler
say's phoebe	rock wren	Wilson's warbler
ash-throated flycatcher	canyon wren	western tanager
western kingbird	house wren	spotted towhee
eastern kingbird	golden-crowned kinglet	chipping sparrow
warbling vireo	ruby-crowned kinglet	lark sparrow
gray jay	western bluebird	fox sparrow
Steller's jay	mountain bluebird	song sparrow
Clark's nutcracker	Townsend's solitaire	white-crowned sparrow
black-billed magpie	hermit thrush	dark-eyed junco
common raven	American robin	black-headed grosbeak
violet-green swallow	varied thrush	lazuli bunting
northern rough-winged swallow	European starling	purple finch
cliff swallow	cedar waxwing	Cassin's finch
barn swallow	orange-crowned warbler	house finch
mountain chickadee	Nashville warbler	red crossbill
red-breasted nuthatch	yellow-rumped warbler	pine siskin
white-breasted nuthatch	black-throated gray warbler	American goldfinch
pygmy nuthatch	Williamson's sapsucker	Evening grosbeak

Eastside Riparian – Wetlands

Riparian habitat is located within all vegetation zones. Riparian habitats appear along perennial and intermittent rivers and streams. This habitat also appears in impounded wetlands and along lakes and ponds. The riparian and wetland areas usually are in fairly narrow bands along valley streams. In Kittitas County, riparian habitat has been significantly reduced in some areas, particularly in valley bottoms. This change reflects displacement of lowland riparian areas by agricultural development, roads, dams, and other developments. Some species known to occur within the riparian areas include:

Mammals		
masked shrew	long-eared myotis	yellow-pine chipmunk
vagrant shrew	silver-haired bat	yellow-bellied marmot
montane shrew	western pipistrelle	northern flying squirrel
Trowbridge's shrew	big brown bat	northern pocket gopher
shrew-mole	hoary bat	American beaver
coast mole	spotted bat	western harvest mouse
California myotis	Townsend's big-eared bat	deer mouse
Uuma myotis	pallid bat	American badger
little brown myotis	snowshoe hare	mountain lion
long-legged myotis	common porcupine	bobcat
bushy-tailed woodrat	coyote	mule deer
heather vole	black bear	white-tailed deer
montane vole	raccoon	
long-tailed vole	American marten	
creeping vole	long-tailed weasel	
muskrat	mink	
Pacific jumping mouse	white-tailed jackrabbit	
Amphibians and Reptiles		
northwestern salamander	Pacific tree frog	rubber boa
long-toed salamander	red-legged frog	racer

rough-skinned newt	Cascades frog	sharptail snake
tailed frog	Columbia spotted frog	western terrestrial garter
Great Basin spadefoot	bullfrog	common garter snake
western toad	painted turtle	western rattlesnake
Woodhouse's toad	northern alligator lizard	
Birds		
pied-billed grebe	California quail	Lincoln's sparrow
great blue heron	sandhill crane	white-crowned sparrow
black-crowned night heron	killdeer	golden-crowned sparrow
wood duck	spotted sandpiper	olive-sided flycatcher
mallard	band-tailed pigeon	western wood-pewee
green-winged teal	mourning dove	willow flycatcher
ring-necked duck	barn owl	dusky flycatcher
harlequin duck	flammulated owl	Say's phoebe
hooded merganser	western screech-owl	eastern kingbird
common merganser	great horned owl	Cassin's vireo
osprey	northern pygmy-owl	warbling vireo
bald eagle	barred owl	gray jay
northern harrier	long-eared owl	Steller's jay
Cooper's hawk	northern saw-whet owl	black-billed magpie
northern goshawk	common nighthawk	common raven
Swainson's hawk	calliope hummingbird	tree swallow
red-tailed hawk	rufous hummingbird	violet-green swallow
golden eagle	belted kingfisher	northern roughwinged
American kestrel	Lewis's woodpecker	bank swallow
prairie falcon	red-naped sapsucker	cliff swallow
chukar	red-breasted sapsucker	barn swallow
ring-necked pheasant	downy woodpecker	black-capped
ruffed grouse	hairy woodpecker	chickadee
dusky grouse	three-toed woodpecker	mountain chickadee
wild turkey	black-backed woodpecker	red-breasted nuthatch
brown creeper	northern flicker	white-breasted nuthatch
canyon wren	pileated woodpecker	pygmy nuthatch
house wren	orange-crowned warbler	dark-eyed junco
winter wren	Nashville warbler	black-headed
American dipper	yellow warbler	grosbeak
golden-crowned kinglet	yellow-rumped warbler	lazuli bunting
ruby-crowned kinglet	MacGillivray's warbler	bobolink
western bluebird	common yellowthroat	red-winged blackbird
mountain bluebird	Wilson's warbler	brewer's blackbird
Townsend's solitaire	yellow-breasted chat	brown-headed
veery	western tanager	cowbird
Swainson's thrush	spotted towhee	Bullock's oriole
hermit thrush	American tree sparrow	Cassin's finch
American robin	chipping sparrow	house finch
gray catbird	savannah sparrow	pine siskin
European starling	fox sparrow	American goldfinch
cedar waxwing	song sparrow	evening grosbeak

Shrub-Steppe

The WDFW Priority Habitat and Species List defines shrub steppe as:

> A non-forested vegetation type consisting of one or more layers of perennial bunchgrasses and a conspicuous but discontinuous layer of shrubs. Although big sagebrush is the most widespread shrub-steppe shrub, other dominant (or co-dominant)

shrubs include antelope bitterbrush, three-tip sagebrush, scabland sagebrush, and dwarf sagebrush. Dominant bunchgrasses include (but are not limited to) Idaho fescue, bluebunch wheatgrass, Sandberg bluegrass, Thurber's needlegrass, and needle-and-thread. In areas with greater precipitation or on soils with higher moisture-holding capacity, shrub-steppe can also support a dense layer of forbs (i.e., broadleaf herbaceous flora). Shrub-steppe contains various habitat features, including diverse topography, riparian areas, and canyons. Another important component is habitat quality (i.e., degree to which a tract resembles a site potential natural community), which may be influenced by soil condition and erosion; and the distribution, coverage, and vigor of native shrubs, forbs, and grasses. Sites with less disturbed soils often have a layer of algae, mosses, or lichens. At some more disturbed sites, non-natives such as cheatgrass or crested wheatgrass may be co-dominant species.

Shrub-steppe habitat can appear in large landscape patches. Three-tip sage, bitterbrush, and central arid steppe are three vegetation classifications that fall into this broad vegetation class. Livestock grazing is the primary land use in the shrub-steppe, although much has been converted to irrigation or dryland agriculture. Large areas also occur within the Department of Defense's Yakima Training Center. Burrowing animals and their predators likely play important roles in creating small scale patch patterns. Much of the historic shrub-steppe habitat in Kittitas County was converted to agriculture, and the remaining habitat has seen an increase in exotic plants (such as cheatgrass) and a decrease in native bunchgrasses. Some species that are known to occur within this vegetation class include:

Mammals		
California myotis	pallid bat	bushy-tailed woodrat
Yuma myotis	black-tailed jackrabbit	montane vole
little brown myotis	least chipmunk	sagebrush vole
long-legged myotis	Townsend's ground squirrel	coyote
long-eared myotis	Great Basin pocket mouse	mule deer
big brown bat	western harvest mouse	
spotted bat	deer mouse	
Townsend's big-eared bat	northern grasshopper mouse	
Amphibians and Reptiles		
rough-skinned newt	short-horned lizard	ringneck snake
Great Basin spadefoot	sagebrush lizard	night snake
western toad	western fence lizard	striped whipsnake
Woodhouse's toad	side-blotched lizard	western terrestrial garter
Columbia spotted frog	western skink	common garter snake
bullfrog	rubber boa	western rattlesnake
painted turtle	racer	
Birds		
turkey vulture	long-billed curlew	rock wren
mallard	rock dove	canyon wren
Barrow's goldeneye	mourning dove	Townsend's solitaire
osprey	barn owl	American robin
bald eagle	great horned owl	sage thrasher
northern harrier	burrowing owl	European starling
sharp-shinned hawk	long-eared owl	Nashville warbler
Cooper's hawk	short-eared owl	chipping sparrow
northern goshawk	common nighthawk	Brewer's sparrow
Swainson's hawk	common poorwill	vesper sparrow
red-tailed hawk	white-throated swift	lark sparrow
ferruginous hawk	black-chinned hummingbird	sage sparrow
golden eagle	northern flicker	savannah sparrow

American kestrel	gray flycatcher	grasshopper sparrow
prairie falcon	Say's phoebe	white-crowned sparrow
chukar	western kingbird	western meadowlark
gray partridge	eastern kingbird	Brewer's blackbird
ring-necked pheasant	loggerhead shrike	brown-headed cowbird
greater sage grouse	black-billed magpie	American goldfinch
dusky grouse	common raven	
California quail	horned lark	
killdeer	northern rough-winged swallow	
black-necked stilt	bank swallow	
American avocet	cliff swallow	
spotted sandpiper	barn swallow	

Upland Aspen Forest Habitat

This habitat generally occurs on well-drained mountain slopes or canyon walls that have moisture. Rockfalls, talus slopes, or stony north slopes are often typical sites. These sites may occur in steppe habitat on moist microsites; however, they are not associated with streams, ponds, or wetlands. The habitats are generally found from 2,000 to 9,500 feet in elevation. None of the five Pacific Northwest upland quaking aspen community types in the National Vegetation Classification are considered imperiled. Some species that are known to occur within this vegetation class include:

Mammals		
Preble's shrew	white-tailed jackrabbit	white-tailed deer
vagrant shrew	Nuttall's mountain cottontail	bushy-tailed woodrat
montane shrew	snowshoe hare	Belding's ground squirrel
Trowbridge's shrew	coyote	Pacific jumping mouse
shrew-mole	gray wolf	deer mouse
coast mole	grizzly bear	yellow-bellied marmot
California myotis	ermine	northern flying squirrel
little brown myotis	long-tailed weasel	northern pocket gopher
big brown bat	mink	American beaver
hoary bat	American badger	western harvest mouse
creeping vole	mountain lion	common porcupine
montane vole	bobcat	least chipmunk
long-tailed vole	Rocky Mountain elk	
southern red-backed vole	mule deer	
Amphibians and Reptiles		
Columbia spotted frog	Pacific tree frog	western terrestrial garter snake
long-toed salamander	northern alligator lizard	common garter snake
western toad	rubber boa	western rattlesnake
Birds		
Turkey vulture	flammulated owl	chipping sparrow
Sharp-shinned hawk	western screech-owl	song sparrow
Cooper's hawk	great horned owl	White-crowned sparrow
northern goshawk	long-eared owl	dark-eyed junco
red-tailed hawk	northern saw-whet owl	Cassin's vireo
golden eagle	common nighthawk	warbling vireo
American kestrel	Williamson's sapsucker	mountain chickadee
peregrine falcon	red-naped sapsucker	white-breasted nuthatch
prairie falcon	downy woodpecker	black-headed grosbeak
ruffed grouse	hairy woodpecker	brewer's blackbird
dusky grouse	three-toed woodpecker	brown-headed cowbird
spruce grouse	black-backed woodpecker	Cassin's finch

wild turkey	northern flicker	house finch
brown creeper	pileated woodpecker	pine siskin
house wren	tree swallow	American goldfinch
ruby-crowned kinglet	violet-green swallow	red crossbill
mountain bluebird	bank swallow	Vaux's swift
Townsend's solitaire	cliff swallow	lazuli bunting
Swainson's thrush	barn swallow	orange-crowned warbler
American robin	American crow	Nashville warbler
European starling	common raven	yellow warbler
cedar waxwing	Clark's nutcracker	yellow-rumped warbler
calliope hummingbird	dusky flycatcher	MacGillivray's warbler
rufous hummingbird	western wood-pewee	Townsend's warbler
		Western tanager

Lodgepole Pine Forest and Woodland Habitat

This habitat is located mostly at mid- to higher elevations (3,000 to 9,000 feet). These environments can be cold and relatively dry with regular and persistent snow-pack. The tree layer is typically dominated by lodgepole pine; however, other associated montane species such as grand fir, western larch, Douglas fir, mountain hemlock, Engelmann spruce, and ponderosa pine can also be found in these habitats. The extent of lodgepole pine cover type in Washington has changed little since 1900 and may have even expanded its historical extent. Some species that are known to occur within this vegetation class include:

Mammals		
masked shrew	golden-mantled ground squirrel	black bear
vagrant shrew	Columbia ground squirrel	grizzly bear
montane shrew	red squirrel	ermine
Trowbridge's shrew	Douglas' squirrel	long-tailed weasel
coast mole	northern flying squirrel	American marten
broad-footed mole	northern pocket gopher	American badger
California myotis	American beaver	gray wolf
Yuma myotis	deer mouse	Canada lynx
little brown myotis	bushy-tailed woodrat	mountain lion
long-legged myotis	southern red-bellied vole	bobcat
long-eared myotis	western red-bellied vole	mule deer
silver-haired bat	heather vole	white-tailed deer
big brown bat	long-tailed vole	bighorn sheep
hoary bat	creeping vole	mink
Townsend's big-eared bat	northern bog lemming	pronghorn antelope
snowshoe hare	Pacific jumping mouse	black-tailed deer
yellow-pine chipmunk	common porcupine	Rocky Mountain elk
yellow-bellied marmot	coyote	
Amphibians and Reptiles		
long-toed salamander	Oregon spotted frog	racer
rough-skinned newt	northern alligator lizard	night snake
tailed frog	short-horned lizard	gopher
Great Basin spadefoot	sagebrush lizard	western terrestrial garter snake
western toad	western fence lizard	common garter snake
Pacific tree frog	western skink	western rattlesnake
Columbia spotted frog	rubber boa	
Birds		
turkey vulture	rufous hummingbird	hermit thrush
osprey	calliope hummingbird	American robin
bald eagle	Vaux's swift	European starling

sharp-shinned hawk	black swift	cedar waxwing
Cooper's hawk	tree swallow	orange-crowned warbler
northern goshawk	violet-green swallow	Nashville warbler
red-tailed hawk	bank swallow	yellow-rumped warbler
golden eagle	cliff swallow	MacGillivray's warbler
American kestrel	barn swallow	Townsend’s warbler
merlin	northern rough-legged swallow	western tanager
peregrine falcon	gray jay	white-headed woodpecker
prairie falcon	Steller’s jay	three-toed woodpecker
ruffed grouse	Clark’s nutcracker	black-backed
dusky grouse	American crow	woodpecker
spruce grouse	common raven	northern flicker
wild turkey	mountain chickadee	pileated woodpecker
flammulated owl	red-breasted nuthatch	Williamson’s woodpecker
western screech-owl	brown creeper	chipping sparrow
great horned owl	canyon wren	fox sparrow
northern pygmy-owl	golden-crowned kinglet	white-crowned sparrow
northern spotted owl	ruby-crowned kinglet	dark-eyed junco
barred owl	mountain bluebird	brown-headed cowbird
long-eared owl	Townsend’s solitaire	pine grosbeak
northern saw-whet owl	olive-sided flycatcher	Cassin’s finch
great gray owl	gray flycatcher	red crossbill
mourning dove	dusky flycatcher	white-winged crossbill
common nighthawk	red-naped sapsucker	pine siskin
common poorwill	hairy woodpecker	evening grosbeak

Dwarf Shrub-steppe

This habitat appears on sites with little soil development that often has extensive areas of exposed rock, gravel, or compacted soil and is often associated with flats, plateaus, or gentle slopes. This habitat is found across a wide range of elevations from 500 feet to 7,000 feet. Vegetative communities include low sagebrush, shrubby buckwheat species, and Sandberg bluegrass with higher productive sites containing taller bluebunch wheatgrass or Idaho fescue. Low sagebrush cover types are as abundant now as they were prior to 1900. Some species that are known to occur within this vegetation class include:

Mammals		
Preble’s shrew	least chipmunk	northern grasshopper mouse
Merriam’s shrew	yellow-bellied marmot	canyon mouse
California myotis	Washington ground squirrel	montane vole
western small-footed myotis	Belding’s ground squirrel	sagebrush vole
Yuma myotis	golden-mantled ground squirrel	coyote
little brown myotis	Columbia ground squirrel	ermine
long-legged myotis	Townsend’s ground squirrel	long-tailed weasel
long-eared myotis	Merriam’s ground squirrel	American marten
western pipistrelle	Piute ground squirrel	American badger
big brown bat	northern pocket gopher	bobcat
spotted bat	Great Basin pocket mouse	mule deer
Nuttall’s cottontail	deer mouse	white-tailed deer
white-tailed jackrabbit	bushy-tailed woodrat	bighorn sheep
black-tailed jackrabbit	desert woodrat	pronghorn antelope
Amphibians and Reptiles		
long-toed salamander	desert horned lizard	racer
tiger salamandert	long-nosed leopard lizard	night snake
Great Basin spadefoot	short-horned lizard	western whiptail
Woodhouse’s toad	sagebrush lizard	western terrestrial garter snake

western toad	western fence lizard	common garter snake
Pacific tree frog	side-blotched lizard	western rattlesnake
northern leopard frog	rubber boa	gopher snake
Birds		
turkey vulture	greater yellowlegs	northern rough-winged
Canada goose	lesser yellowlegs	cliff swallow
bald eagle	solitary sandpiper	barn swallow
sharp-shinned hawk	willet	rock wren
Cooper's hawk	long-billed curlew	canyon wren
northern harrier	mourning dove	mountain bluebird
red-tailed hawk	barn owl	American robin
Swainson’s hawk	burrowing owl	sage thrasher
ferruginous hawk	great horned owl	European starling
rough-legged hawk	short-eared owl	chipping sparrow
golden eagle	long-eared owl	vesper sparrow
American kestrel	common nighthawk	lark sparrow
merlin	common poorwill	Brewer’s sparrow
peregrine falcon	white-throated swift	black-throated sparrow
prairie falcon	black-chinned hummingbird	sage sparrow
chukar	Say’s phoebe	grasshopper sparrow
flammulated owl	loggerhead shrike	white-crowned sparrow
western screech-owl	northern shrike	savannah sparrow
great horned owl	eastern kingbird	snow bunting
northern pygmy-owl	western kingbird	western meadowlark
gray partridge	black-billed magpie	Brewer’s blackbird
ring-necked pheasant	American crow	American goldfinch
sage grouse	common raven	brown-headed cowbird
sharp-tailed grouse	horned lark	
killdeer	bank swallow	

<u>Desert Playa and Salt Scrub Shrublands</u>

This habitat generally lies at the lowest elevations in hydrologic basins in the driest regions of the Pacific Northwest. Elevations range from 500 to 5,500 feet in Washington. The structural and compositional variation in these habitats is related to changes in salinity and fluctuations in the water table. Areas with little vegetation have highly alkaline and saline soils, are poorly drained or irregularly flooded. Desert playa habitat is less abundant than prior to 1900, due to livestock grazing. Some species that are known to occur within this vegetation class include:

Mammals		
Vagrant shrew	least chipmunk	northern grasshopper mouse
Merriam’s shrew	yellow-bellied marmot	desert woodrat
California myotis	white-tailed antelope squirrel	bushy-tailed woodrat
western small-footed myotis	Townsend’s ground squirrel	montane vole
Yuma myotis	Merriam’s ground squirrel	coyote
little brown myotis	Piute ground squirrel	mink
long-legged myotis	northern pocket gopher	long-tailed weasel
long-eared myotis	Great Basin pocket mouse	mule deer
western pipistrelle	little pocket mouse	bobcat
big brown bat	dark kangaroo mouse	bighorn sheep
spotted bat	Ord’s kangaroo rat	pronghorn antelope
pallid bat	chisel-toothed kangaroo rat	
Nuttall’s cottontail	deer mouse	
black-tailed jackrabbit	canyon mouse	

Amphibians and Reptiles		
Great Basin spadefoot	long-nosed leopard lizard	racer
Woodhouse's toad	short-horned lizard	night snake
western toad	sagebrush lizard	western whiptail
Pacific tree frog	side-blotched lizard	western terrestrial garter snake
bull frog	western ground snake	common garter snake
desert horned lizard	striped whipsnake	western rattlesnake
		gopher snake
Birds		
great egret	American avocet	western kingbird
snowy egret	greater yellowlegs	loggerhead shrike
white-faced ibis	lesser yellowlegs	northern shrike
turkey vulture	solitary sandpiper	northern rough-winged
black duck	willet	cliff swallow
mallard	long-billed curlew	barn swallow
northern pintail	marbled godwit	rock wren
bald eagle	sanderling	horned lark
sharp-shinned hawk	western sandpiper	mountain bluebird
northern harrier	least sandpiper	American robin
red-tailed hawk	Baird's sandpiper	sage thrasher
Swainson's hawk	dunlin	European starling
ferruginous hawk	long-billed dowitcher	American pipit
rough-legged hawk	Wilson's phalarope	Brewer's sparrow
golden eagle	Franklin's gull	black-throated sparrow
American kestrel	mourning dove	sage sparrow
merlin	barn owl	white-crowned sparrow
peregrine falcon	burrowing owl	Brewer's blackbird
prairie falcon	great horned owl	American goldfinch
greater sage grouse	short-eared owl	brown-headed cowbird
sharp-tailed grouse	common nighthawk	black-billed magpie
black-bellied plover	common poorwill	American crow
snowy plover	white-throated swift	common raven
semipalmated plover	black-chinned hummingbird	
killdeer	Say's phoebe	
black-necked stilt	eastern kingbird	

<u>Eastside Grasslands</u>

This habitat develops in hot, dry climates in the Pacific Northwest. The grassland habitat is typically upland vegetation, but it may include riparian bottomlands dominated by non-native grasses. This habitat is typically found at elevations ranging from 500 to 6,000 feet in elevation. Bluebunch wheatgrass and Idaho fescue are the characteristic native bunchgrasses of this habitat and either or both species can be dominant. Grassland habitats have seen drastic declines since the early 1900s with agriculture, grazing, and introduction of exotic species contributing to that decline. Some species that are known to occur within this vegetation class include:

Mammals		
Preble's shrew	Nuttall's cottontail	long-tailed vole
vagrant shrew	white-tailed jackrabbit	western jumping mouse
Merriam's shrew	black-tailed jackrabbit	coyote
coast mole	yellow-bellied marmot	black bear
fringed myotis	Washington ground squirrel	grizzly bear
western small-footed myotis	Belding's ground squirrel	ermine
California myotis	golden-mantled ground squirrel	long-tailed weasel
Yuma myotis	Columbian ground squirrel	American badger

little brown myotis	northern pocket gopher	bobcat
long-legged myotis	Townsend's pocket gopher	mule deer
long-eared myotis	Great Basin's pocket mouse	white-tailed deer
silver-haired bat	Ord's kangaroo rat	bighorn sheep
big brown bat	California kangaroo rat	mink
hoary bat	deer mouse	pronghorn antelope
Townsend's big-eared bat	western harvest mouse	Rocky Mountain elk
western pipistrelle	northern grasshopper mouse	
pallid bat	montane vole	
spotted bat	sagebrush vole	
Amphibians and Reptiles		
long-toed salamander	northern leopard frog	racer
tiger salamander	painted turtle	night snake
Great Basin spadefoot	short-horned lizard	gopher
western toad	sagebrush lizard	western terrestrial garter snake
Pacific tree frog	western fence lizard	common garter snake
Columbia spotted frog	western skink	western rattlesnake
bull frog	side-blotched lizard	rubber boa
Birds		
turkey vulture	black-necked stilt	western bluebird
Canada goose	American avocet	mountain bluebird
mallard	greater yellowlegs	Townsend's solitaire
American black duck	lesser yellowlegs	American robin
American wigeon	spotted sandpiper	sage thrasher
gadwall	solitary sandpiper	American pipit
blue-winged teal	sandhill crane	European starling
cinnamon teal	killdeer	green-tailed towhee
northern pintail	upland sandpiper	chipping sparrow
green-winged teal	long-billed curlew	sage sparrow
northern harrier	rock dove	white-crowned sparrow
sharp-shinned hawk	mourning dove	Brewer's sparrow
Cooper's hawk	barn owl	clay-colored sparrow
Swainson's hawk	great horned owl	lark sparrow
red-tailed hawk	long-eared owl	savannah sparrow
ferruginous hawk	burrowing owl	grasshopper sparrow
rough-legged hawk	snowy owl	vesper sparrow
golden eagle	short-eared owl	Lapland longspur
American kestrel	common nighthawk	snow bunting
merlin	common poorwill	bobolink
gyrfalcon	white-throated swift	western meadowlark
peregrine falcon	Say's phoebe	Brewer's blackbird
prairie falcon	eastern kingbird	brown-headed cowbird
gray partridge	western kingbird	American goldfinch
chukar	loggerhead shrike	black-billed magpie
ring-necked pheasant	northern shrike	American crow
greater sage grouse	northern rough-winged swallow	common raven
sharptail grouse	bank swallow	horned lark
wild turkey	cliff swallow	Lewis's woodpecker
mountain quail	barn swallow	canyon wren
northern bobwhite quail	rock wren	California quail

6.1.4 Fish Habitat Evaluation of Kittitas County

6.1.4.1 Habitats for Anadromous Salmonid Species

All anadromous salmonid species in Kittitas County are considered priority species. Habitats for anadromous salmonid species include freshwater streams and lakes. Habitat use is dependent on the life stage and species, but there is considerable overlap in the range of habitat variables used by different salmonid species. Freshwater streams provide spawning and early-rearing habitat for all anadromous fish species, whereas lakes are where some anadromous fish grow to maturity prior to returning to streams to spawn. Freshwater salmonid life stages require cold-water streams having complex structural habitat and clean gravels free of fine sediment. Upon hatching, juveniles spend varying lengths of time (from days up to 2 years depending on species and stock) in freshwater prior to migrating to sea. After entering the estuary, juvenile salmonids typically spend a period of time inhabiting and foraging among coastal and estuary shoreline habitats.

The streams and rivers of Kittitas County that contain anadromous salmonid species are numerous, and many of the areas designated as FWHCAs support anadromous salmonids. The Yakima River, which flows through Yakima County before discharging to the Columbia River in Benton County, and associated tributaries drain the majority of Kittitas County. Major river reaches and tributaries include the mainstem Yakima River, the Cle Elum River, Teanaway River, Swauk Creek, Taneum Creek and the Little Naches River, all of which contain several anadromous salmonid species and stocks. The Little Naches is on the border between Yakima and Kittitas Counties and entirely on Forest Service land with the exception of several small areas. Other smaller drainages independent of the Yakima watershed also support anadromous salmonid populations.

Keechelus, Kachess, and Cle Elum Reservoirs are all impoundments of historic lakes on the Yakima River or the Cle Elum River and all drain the Yakima watershed. No permanent fish ladders are provided at these facilities to allow for upstream or downstream migration of anadromous salmonids. A temporary fish ladder has been installed on Cle Elum Dam and the Yakama Nation has been trucking and releasing salmonids above the dam and has introduced coho and sockeye salmon into the reservoir. Reclamation proposes to install permanent fish passage facilities at all three dams in the future (Reclamation and Ecology, 2011).

An overview of the status, habitat associations and distribution of priority and listed fish species in Kittitas County, including anadromous salmonid species, is found in Table 6-4.

Table 6-4. Habitat Associations and Distribution of Priority and Listed Fish Species in Kittitas County

Species	Status (Federal/State)	General Location/Distribution
Pacific lamprey	Species of Concern/None	*Habitat*: The larvae of Pacific lamprey are filter feeders that inhabit fine silt and mud substrates in backwaters and quiet eddies of coldwater streams with currents less than 1-foot per second. The larvae may spend four to seven years in freshwater and typically transform into juveniles in October or November and then either migrate to the sea immediately or hold until spring. Adults return to spawn in freshwater between March and October, hold in deep pools and then spawn the following spring (Wydoski and Whitney, 2003).

Species	Status (Federal/State)	General Location/Distribution
		Distribution: Coastal streams from southern California to the Gulf of Alaska. In Washington, the species is found in most large and coastal and Puget Sound rivers and occurs long distances inland into the Columbia, Snake, and Yakima River systems. In the Yakima Basin, the species is considered extremely rare and none have been documented in Kittitas County above Roza Dam.
River lamprey	Species of Concern/Candidate	*Habitat*: River lamprey are an anadromous species and require clean gravel substrate in streams for spawning and egg incubation. After hatching, lampreys burrow in silt and mud, often in off-channel areas, where they typically remain for a period of years. During this stage, lampreys require relatively stable habitats (Close et al., 1995). *Distribution:* Found in coastal and inland streams from northern California to southeastern Alaska, but little information is available regarding the population status of river lamprey in Washington.
White sturgeon	Priority species	*Habitat*: White sturgeon primarily occupy bottom habitats in large river systems. Young of the year sturgeon prefer hard clay, mud, silt, gravel, and sand substrates at depths ranging from 40 to 90 feet. Juveniles prefer boulder bedrock substrates in the 50 to 70 foot depth range. Adults occupy bottom habitats of varying degrees; however, they tend to choose large, deep pools and eddies in main river channels. Juveniles and sub-adults occupy off-channel sloughs during the summer months, but move to deeper waters during the winter. *Distribution*: White sturgeon are found in marine waters and freshwaters from Monterey Bay California to Cook Inlet in northwestern Alaska. In Kittitas County, white sturgeon are primarily limited to the Columbia River, as the Yakima River provides insufficient depths to support the species.
Leopard dace	None/Candidate	*Habitat*: Leopard dace usually occur in stream habitats with fairly low current velocity. Juveniles typically prefer shallow backwater pools while adults typically occupy habitats up to three feet in depth over rocky substrates covered in silt (Wydoski and Whitney, 2003). *Distribution*: Spotty distribution in the Columbia and Fraser River systems. In Kittitas County, the leopard dace is likely to occur in the mainstem Columbia River and Yakima River. Leopard dace are considered extremely rare in the Yakima River as evidenced by only three specimens being collected between Roza Dam and Prosser Dam (RM 47-128) between 1997 and 1999 electrofishing and seining studies (Wydoski and Whitney, 2003).
Umatilla dace	None/Candidate	*Habitat*: Umatilla dace are a benthic species found in relatively productive low-elevation streams and require clean substrates of rock, cobble, and boulder with velocities strong enough to minimize sedimentation of substrate. Generally found in shallow (less than 3 feet in depth) water adjacent to streambanks. Adult dace seek out deeper habitats with larger

Species	Status (Federal/State)	General Location/Distribution
		substrates that allow for refuge at varying flow conditions (Wydoski and Whitney, 2003). *Distribution*: Umatilla dace, similar to leopard dace, have a spotty distribution in the Columbia River Basin east of the Cascade Mountains. In Washington, this species has only been identified in the Columbia, Yakima, Okanogan, Similkameen, Kettle, Colville and Snake Rivers. 53 Umatilla dace were collected below Prosser Dam on the Yakima River during electrofishing and seining studies from 1997 to 1999. None were collected from the Yakima River below Roza and Sunnyside Dams during that same time period (Wydoski and Whitney, 2003).
Mountain sucker	None/Candidate	*Habitat*: The mountain whitefish is widely distributed in streams and lakes throughout Washington. In streams, they are found primarily in riffle habitats during the summer, but move to large pools or slow-moving runs during the winter. Mountain whitefish move into large pools prior to spawning to ripen and then move into swifter riffle habitats or runs to spawn (typically in the fall) (Wydoski and Whitney, 2003). *Distribution*: Mountain whitefish are likely the most abundant fish in the Yakima River and their distribution is throughout the basin.
Bull trout	Threatened/Candidate	*Distribution:* Because bull trout require very cold water temperatures for certain life-history stages, the distribution of bull trout is generally restricted to upper reaches of sub-basins. Bull trout are distributed throughout the mainstem Columbia and Yakima Rivers. Yakima River tributaries that are known or presumed to support bull trout include: Kachess River (Kachess Reservoir) and Box Canyon and Mineral Creeks; Cabin Creek; Gold Creek (Keechelus Reservoir); Cle Elum River (Cle Elum Reservoir) and tributaries including the Cooper River (Cooper Lake), Fortune Creek, and the Waptus River; Teanaway River including the West Fork, Middle Fork, and North Forks and tributaries including DeRoux Creek, Jack, Indian, Middle, Standup, Stafford, and Beverly Creeks; Swauk Creek and Williams Creek; Taneum Creek; Manastash Creek (potential); Little Naches River and Milk and Pileup Creeks (WDFW, 2012).

Species	Status (Federal/State)	General Location/Distribution
Chinook salmon	Upper Columbia Spring-run is endangered Yakima Spring-run Chinook are not federally listed Lower Columbia, Upper Columbia Spring-run are state candidate species	*Habitat*: Juveniles and adults require cold, well-oxygenated water. Spawning generally occurs in riffle areas with clean gravel and cobble substrates. Juveniles use pool habitat and instream cover such as LWD, spaces among cobbles, and undercut banks as resting areas and/or for refuge from predators. Cobble substrate and off-channel habitats such as secondary channels, backwaters, or ponds provide important refuge from flows for overwintering juveniles. After river entry, adults on spawning migration use resting pools, which provide refuge from river currents and high water temperatures that are often encountered in the summer and early autumn. *Distribution*: Not much is known about the distribution of fall-run Chinook in the Yakima Basin. Species distribution is the mainstem Columbia River and the Yakima River, including a small portion in Kittitas County. Spring-run Chinook can be found in the mainstem Columbia and Yakima Rivers and in Yakima River tributaries including: the Little Naches River and its tributary Quartz Creek; Taneum Creek, Swauk Creek, Manastash Creek; Cle Elum River, Kachess River, Big Creek, Tucker Creek (rearing), Cabin Creek (rearing), and the Teanaway River (North, Middle, and West Forks and several tributaries), Umtanum (rearing); and Squaw, Cooke, Badger, and Naneum Creeks (rearing) (WDFW, 2012). Significant rearing occurs in the Reecer and Wilson Creek drainages.
Coho	Priority species	Distribution: Primarily extirpated throughout much of its historical range in the Yakima Basin. Efforts are currently underway to reintroduce coho salmon to the Yakima Basin. Coho have been introduced into a number of tributaries including Big, Wilson, Naneum, Taneum, Reecer, Swauk, Lost, Jack, Pileup, Little Naches, and Quartz. Coho are generally tributary spawners, and could potentially spawn anywhere suitable habitat exists The purpose of the program is to establish a naturally producing coho population, without any supplementation. Any tributary with access and adequate habitat in Kittitas County is coho habitat.
Kokanee	Priority species	Distribution: Found in Keechelus, Kachess, and Cle Elum Reservoirs. Spawn in upstream tributaries.
Pygmy whitefish	Species of Concern/Sensitive	*Habitat:* Pygmy whitefish most often occupy deep, unproductive (oligotrophic lakes) with temperatures below 50°F. Migration is limited to spawning in moderate to high velocity tributary streams. While in lakes, they typically occupy depths greater than 20 feet (Wydoski and Whitney, 2003). *Distribution:* Pygmy whitefish are found in Kachess, Keechelus, and Cle Elum Reservoirs in Kittitas County (Wydoski and Whitney, 2003).

Species	Status (Federal/State)	General Location/Distribution
Rainbow trout/steelhead/inland redband	Threatened/Candidate for steelhead Priority species for rainbow trout and redbands	*Habitat*: Similar general instream habitat requirements as other salmonids. Steelhead have an extended freshwater juvenile rearing period as with Chinook and coho salmon, but also require habitat for feeding and resting during an extended adult freshwater phase. *Distribution*: Summer-run steelhead are found in both the Columbia and Yakima River mainstems and use many of their tributaries for spawning and rearing. The mainstem Yakima River provides spawning, rearing and migration habitat, while the mainstem Columbia River is primarily a migration corridor for upstream spawning migrations and outmigration of smolts and kelts. Yakima tributaries known to support spawning and rearing of steelhead include: Big Creek; Teanaway River (North, Middle and West Forks and tributaries including Indian, Dickey, Jack and Stafford Creeks); Cle Elum River, Kachess River (presumed); Peterson Creek, Tillman Creek, Taneum Creek, Manastash Creek, Umptanum Creek, Swauk Creek (Iron Creek and Williams Creek tributaries); and the Little Naches River (Quartz Creek and Matthews Creek tributaries). Columbia River tributaries include Cherry Creek, Johnson Creek, Whiskey Dick Creek, Quilomene Creek, Brushy Creek, and Tarpiscan Creek (WDFW, 2012). In addition, resident rainbow trout are found throughout the Yakima River drainage and sometimes interbreed with steelhead.
Sockeye salmon	None/Candidate	*Habitat*: Similar general instream habitat requirements for migration and spawning as other salmonid species. Sockeye salmon are unique in that juveniles rear in freshwater lakes for up to a year prior to migrating to the ocean. *Distribution*: Sockeye salmon were once widely distributed in the Yakima Basin; however, construction of dams at the outlet of once natural lakes (Kachess, Keechelus, and Cle Elum) eliminated the necessary lake rearing period for juveniles and the species disappeared from the watershed. The Yakama nation began reintroducing sockeye to Cle Elum Reservoir in 2009 after temporary fish passage facilities were installed on Cle Elum Dam. The released sockeye are of the Wenatchee and Lake Osoyoos stocks and were captured at Priest Rapids Dam on the Columbia River (Reclamation and Ecology, 2011). Sockeye of the Lake Wenatchee stock currently migrate through the Columbia River adjacent to Kittitas County on their upstream spawning migrations to the Wenatchee River and Lake Wenatchee. Sockeye reintroduced into Cle Elum Reservoir are now distributed in the Cle Elum Reservoirs, the Cooper and Cle Elum Rivers, and the Yakima River downstream of the Cle Elum Reservoir.

Species	Status (Federal/State)	General Location/Distribution
Westslope cutthroat trout	Priority species	*Habitat*: Westslope cutthroat trout have similar general requirements as all salmonids. The westslope cutthroat trout, unlike the coastal cutthroat trout, has only three life history forms, the resident (resides in natal stream year-round), adfluvial (rears in small streams and then moves to lakes to mature), and fluvial (rears in small streams and moves to larger streams/rivers to mature). *Distribution*: Ten populations of westslope cutthroat trout were identified in the Upper Yakima River Basin (Wydoski and Whitney, 2003). Five of the populations were determined to be genetically pure stocks, including the Cabin Creek and Naneum Creek stocks in Kittitas County. The other five populations including the North Fork Taneaum Creek, Wilson Creek populations within Kittitas County contained 5 to 20 percent hybrids with rainbow trout (Trotter et al., 1999). It is likely that the various life history forms of westslope cutthroat trout occur in many of the Yakima River tributary streams and lakes.

6.2 Overview of FWHCA Functions and Values

6.2.1 Wildlife Habitat

Habitat refers to the physical and biotic features of the environment that sustain and support fish or wildlife and may be assessed at a variety of scales from the ecoregional to a specific site (e.g., a high elevation talus slope). The predominant vegetation (e.g., conifer forest) and/or the presence of particular structural elements (e.g., snags, cliff faces) are typically used to classify wildlife habitat (McComb, 2001). Habitat preference varies between wildlife species and may change over the course of the year for a given species of fish or wildlife. Generally, as habitat type changes, the assemblage of fish and wildlife species will also change; as habitat diversity increases the number and diversity of fish and wildlife species increases; ecotones (habitat type edges) have a high diversity of fish and wildlife species; and larger habitat blocks support a greater number of species than smaller habitat units (Castelle et al., 1992; O'Connell et al., 2000; O'Neil et al., 2001; Sheldon et al., 2003).

Habitat provides the resources necessary for individuals of a species to survive and reproduce. Habitat functions are often described as the ability to provide food (foraging habitat), protection from the weather and predators (cover), and allowing for successful reproduction (breeding habitat) (O'Neil et al., 2001). An additional function of habitat is to allow the movement of animals over the landscape through dispersal, allowing genetic mixing between populations; and migration; which allows a species to maximize available resources (Lemkuhl et al., 2001; McComb, 2001). Wildlife species vary in their habitat requirements and use of a particular habitat type will vary by season and over the life of the individual. Habitat generalists, such as deer or red-tailed hawks, thrive in a variety of habitat types, while habitat specialists, such as the harlequin duck require very specific habitat types and features. For most species, the habitat type selected for foraging will differ from habitat selected for thermal or security cover. Most species require specialized habitat features for reproduction (e.g., cavities for cavity-nesting birds) and for many species the availability of these breeding habitat features is used to determine the suitability of habitat (Anderson and Gutzwiller, 1994; McComb, 2001; Sheldon et al., 2003).

The suitability of habitat for a given wildlife species is determined by the habitat occurring within the species' range, the size of the habitat patch, whether the habitat is accessible (connectivity), the presence of requisite structural elements, and the amount of habitat alteration and disturbance (Morrison et al., 1998; McComb, 2001). Some habitats may only be used for a short period of time but are critical in sustaining a species.

Providing travel corridors for wildlife that maintain connectivity between habitat blocks is an important role of habitat. This connectivity reduces the likelihood of populations becoming isolated and prone to extinction due to random events or inbreeding (Morrison et al., 1998; Lemkuhl et al., 2001; King County, 2003). If wide enough and suitable vegetation/structure is present, corridors may serve as habitat in their own right (O'Connell et al., 2000; Kauffman et al., 2001; King County, 2003). The potential value of corridors to wildlife is not entirely positive as corridors may contribute to the spread of fire, invasive species, and disease and may dampen speciation by contributing to genetic mixing (King County, 2003). In a review of the value of habitat corridors to wildlife, King County (2003) determined that overall the benefit of maintaining connectivity between habitat patches and wildlife populations outweighs the risks to wildlife populations, particularly in landscapes with a high degree of human development.

Migration and dispersal habitat within Kittitas County includes riparian corridors and the foothills of the east Cascades. The County provides important wintering and stopover habitat for migratory waterfowl and raptors; valuable wintering, summer range, and calving areas for several large mammals including Elk, bighorn sheep, and deer; and territories for large predators such as grey wolves and grizzly bear.

As travel or dispersal habitat, buffers are preferred habitat for a number of wildlife, including: amphibians, birds, small mammals, and large mammals. Because small mammals and amphibians often have relatively small home ranges and are limited in their ability to move long distances, buffers provide the necessary cover and microclimate for these species to access water bodies and wetlands (Knutson and Naef, 1997; Kauffman et al., 2001; Sheldon et al., 2003). Overhead canopy is essential for adequate security cover for a number of species (lynx, fishers, northern spotted owls, pileated woodpeckers) that tend to avoid crossing open areas. Due to their linear nature, riparian corridors are especially valuable for connecting blocks of suitable habitat (Kauffman et al., 2001; Sheldon et al., 2003).

Buffers provide habitat for a significant proportion of the Pacific Northwest's wildlife species, from invertebrates to large mammals (Castelle et al., 1992; Knutson and Naef, 1997; Kauffman et al., 2001). Because amphibians require moist conditions protected from temperature extremes, they are more closely associated with wetland and riparian buffers than other wildlife taxa. Many amphibian species breed and rear young in open/standing water yet spend the majority of their life cycle in the adjacent upland habitats. Of the 33 amphibian species documented in the Pacific Northwest, all require free water or moist terrestrial sites for breeding (Leonard et al., 1993). Vegetated buffers can provide essential cover, foraging, and dispersal habitat within the environmental conditions needed by amphibians (Castelle et al., 1992; Knutson and Naef, 1997; Sheldon et al., 2003).

How wide a buffer needs to be to provide effective habitat is dependent on the wildlife species of interest (Table 6-5). For many forest birds and deer and elk, riparian buffers should be at least 200 feet in width (Knutson and Naef, 1997). To maintain the species number of neotropical migrant birds, Keller et al. (1993) and Hodges and Krementz (1996) recommended buffers of at least 328 feet (as cited in Knutson and Naef, 1997). Beavers require buffers between 200 and 330 feet (Roderick and Milner, 1991, Pollack and Kennard, 1998).

Table 6-5. Recommended Buffer Widths to Provide Effective Wildlife Habitat

Wildlife Taxa	Buffer Width in Feet
Invertebrates	100 (Rudolf and Dickson)
Reptiles and amphibians	100 to 312
Forest dwelling birds	200 (Darveau et al., 1995)
Neotropical migratory birds	328 (Keller et al., 1993; Hodges and Krement, 1996)
Bald eagle	164 to 656
Great blue heron	328 to 984
Small mammals	39 to 330 (Roderick and Milner, 1991)
Large mammals	200 to 328

6.2.2 Fish Habitat

Productive salmonid habitat is necessarily complex owing to the myriad requirements of various lifestages. Salmonids require cold clean waters, silt-free substrates, natural flow conditions, and structurally complex habitat suitable for spawning, rearing, and migration. The aquatic habitat features important for supporting salmonid populations include riparian condition, large woody debris (LWD) recruitment, fish passage, floodplain connectivity, channel migration, bank stability, pools, off-channel habitat, substrate/fines, water quality, and hydrology.

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. In addition, riparian vegetation interacts with natural erosional and depositional processes of streams as channels migrate across valley bottoms to form instream habitat. As channels move back and forth through this channel migration zone (CMZ), instream pools and riffles are formed. Channel migration also promotes floodplain connectivity and recruitment of LWD, which can be a primary factor influencing channel form by the creation pools, riffles and off-channel habitats that are essential to support all life stages of anadromous salmonids (May, 2000).

Historically, natural riparian corridors in the Pacific Northwest were nearly continuous and the importance of riparian continuity is widely recognized (May et al., 1997; Naiman and Bilby, 1998; Wenger, 1999). 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, nutrients, and prey production in downstream waters.

Along lake shorelines, riparian vegetation is also a key element of ecological function and has a significant influence on the habitat value of the riparian zone, and in adjacent aquatic and terrestrial areas (Zelo and Shipman, 2000). Though not as well defined as for riverine systems, freshwater shoreline riparian zones serve many of the same functions (e.g., LWD, shading, organic matter production, sediment filtration, microclimate), as well as some additional functions unique to shorelines (Gregory et al., 1991; Naiman et al., 1992).

The following discussion is a review of major riparian functions and the level of functionality afforded by riparian buffers of varying widths as reported in the literature. Tables 6-6 through 6-9 summarize the conclusions and recommendations for riparian buffer widths in frequently cited literature reviews of riparian buffer functions. These tables illustrate the range of effective buffer widths reported in the literature needed to provide a reasonable level of habitat functionality under most conditions. Buffer recommendations and functionality are frequently expressed in terms of site-potential tree height (SPTH), which is the height of mature trees that a given site can be expected to support.

Following the tables, further discussion of riparian functionality and considerations for determining buffer effectiveness is provided. In addition, riparian functions for lake shorelines are included in the discussion where appropriate.

Table 6-6. Stream Riparian Functions and Appropriate Widths Identified by May (2000).

Function	Range of Effective Buffer Widths in the Scientific Literature (feet)	Minimum Recommended Width Specified in May (2000) (feet)	Notes on Function
Large Woody Debris	33 to 328	262	1 SPTH based on longterm natural levels
Water Temperature	36 to 141	98	Based on adequate shade
Sediment removal and erosion control	26 to 600	98	For 80% sediment removal
Pollutant Removal	13 to 860	98	For 80% nutrient removal
Microclimate	148 to 656	328	Optimum long-term support

Table 6-7. Stream Riparian Functions and Appropriate Widths Identified by Knutson and Naef (1997).

Function	Range of Effective Buffer Widths (feet)
Large Woody Debris	100 to 200
Water Temperature	35 to 151
Erosion Control	100 to 125
Sediment Filtration	26 to 300
Pollutant Removal	13 to 600
Microclimate	200 to 525

The Forest Ecosystem Management Assessment Team's (FEMAT) identifies the boundaries for Riparian Reserves (buffers) surrounding fish-bearing streams are defined by five potential criteria: 91 m (300 ft) slope distance on each side of the channel, two site-potential trees, the outer edges of the 100 year floodplain, the distance from the active channel to the top of the inner gorge, or to the outer edges of riparian vegetation, whichever is greatest. (FEMAT, 1993)

Spence et al. (1996) refer to the FEMAT (1993) SPTH standard for riparian buffers in forested environments. A SPTH can be defined as the potential height of a mature tree at a particular location. A SPTH of 110 feet for forests east of the Cascade Mountains was established, and estimates are that a buffer width of approximately 0.75 SPTH (82.5 feet) is needed to provide minimum protection of stream shading, litter inputs, LWD, and nutrient regulation. FEMAT constructed curves that correlate the percent effectiveness of a function in relation to SPTH (Figure 6-1), and found that buffers designed to protect 100 percent of LWD recruitment will likely provide close to 100 percent of small organic litter as well.

Table 6-8. Stream Riparian Functions and Appropriate Widths Identified by FEMAT (1993).

Function	Number of SPTH	Equivalent (feet)
Large Woody Debris	.75*	82.5
Shade	.75	82.5
Sediment Control	.75	82.5
Bank Stabilization	.5	55
Organic Litter	0.5	55
Microclimate	to be determined	to be determined

*Exceptions occur in alluvial valleys, where stream channels may shift in response to sediment deposition and high flow events (Spence et al., 1996).

Although data quantifying the effective zone of influence relative to root strength is scarce, FEMAT (1993) concluded that most of the stabilizing influence of riparian root structure is probably provided by trees within 0.5 SPTH of the stream channel (55 feet). As a result, buffer widths for protecting other riparian functions are likely adequate to maintain bank stability, except on steep slopes. Buffers designed to protect other stream functions will generally control sediments to the degree that they can be controlled by riparian vegetation. Buffer widths designed to protect LWD recruitment and shading may be adequate to prevent excessive nutrient or pollution concentrations. Nevertheless, where land use activity is intense, buffers for protecting nutrient and pollutant inputs may need to be wider than those designed to protect other riparian functions, particularly when land use activities may exacerbate existing water quality problems. Little information exists and additional research is needed before buffer widths likely to protect riparian microclimate can be determined (Spence et al., 1996).

As specified in WDNR Forest and Fish Report (1999), SPTH has been determined for different stream site classes in western and eastern Washington (Table 6-9). Site classes are based on soil conditions and range from the most productive to the least productive sites (Goldin, 1992). It has been determined that the most productive sites (Site Class I) in Eastern Washington would have a SPTH of 130 feet and the least productive sites (Site Class V) would have a SPTH of 60 feet. Based on these site potentials and stream size, riparian buffer prescriptions have been developed that are most applicable to forested lands. Differences in stream size for a given site class are used to further modify prescribed buffer dimensions within the overall riparian management zone

(RMZ); which is equivalent in width to the SPTH so that different portions of the buffer (core, inner, and outer areas) have different dimensions to provide appropriate levels of protection (Table 6-9).

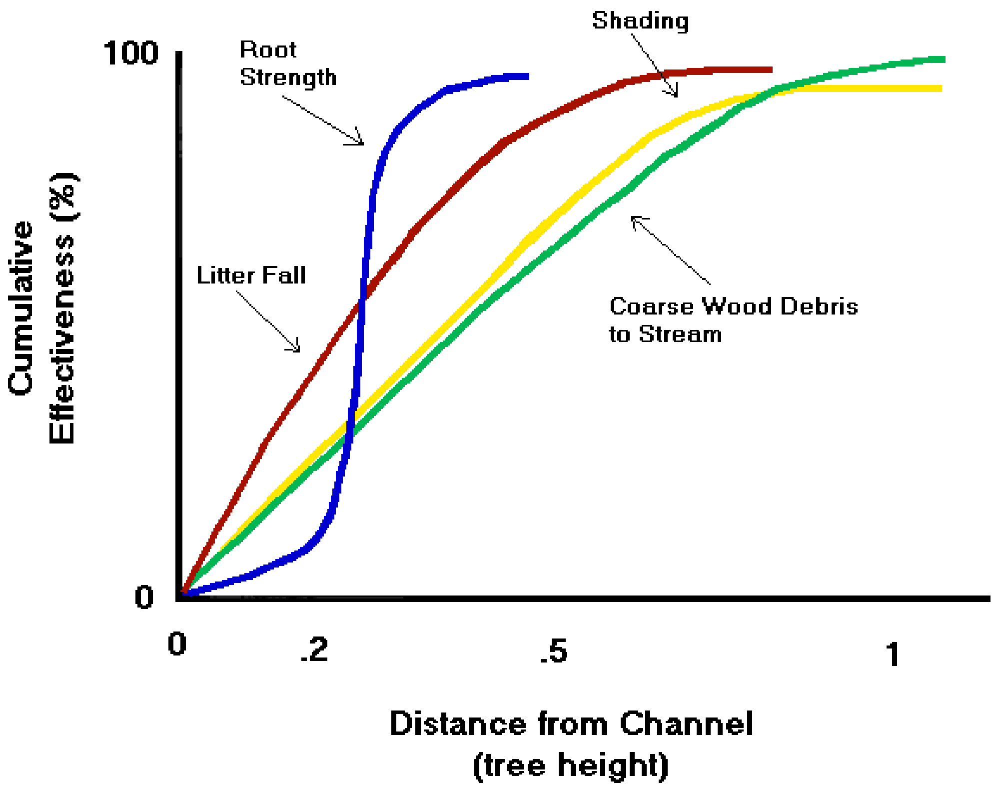

Figure 6-1. Curves correlating to the percent effectiveness of a function in relation to SPTH (FEMAT 1993).

Table 6-9. Example of Riparian Buffer Width Prescriptions from WDNR (1999).

Site Class	RMZ/SPTH Width (ft)	Core Zone Width (ft)	Inner zone width (measured from outer edge of core zone) (feet)		Outer zone width (measured from outer edge of inner zone) (feet)	
			Stream width ≤ 15ft	Stream	Bankfull width ≤ 15ft	Bankfull width > 15 ft
I	130	30	45	70	55	30
II	110	30	45	70	35	10
III	90	30	45	70	15	0
IV	70	30	45	70	0	0
V	60	30	45	70	0	0

The WDFW's (1997) Final Environmental Impact Statement for the Wild Salmonid Policy developed a buffer system dependent on a stream-typing system. It recommends a maximum buffer of 100 to 150 feet on each side of a stream larger than 5 feet wide, with a minimum of at least 50 feet on all other streams. The buffers may need to be expanded to accommodate anticipated channel migration, as an additional buffer against windthrow, or to address upslope instability. Intermittent and ephemeral streams with low stream gradient and relatively flat slope may not need the full buffer width, and the buffer width may be reduced to that necessary to protect the stream from upslope sedimentation and significant changes in stream temperature.

Pollack and Kennard (1998) and Frisell (2013) recommend buffers that take into account the age of a tree when using SPTH to establish management buffers. The WDNR buffer recommendations (see Table 6-9) are primarily based on trees that are 100 years of age, which according to Pollack and Kennard (1998) and Frissell (2013), is not sufficient to be considered mature in the Pacific Northwest. They contend that the 100-year old age used by WDNR is meant more as a silvicultural standard and is not ecologically based. Pollack and Kennard (1998) recommend a buffer of 250 feet for all perennial streams and variable buffers of 50 to 250 feet on all seasonal streams. One caveat that Pollack and Kennard identified was that the 250-foot buffer for perennial streams should be considered an interim buffer as buffers on small perennial streams may be reduced once the stream has recovered from a degraded state. In response to the SPTH standard for riparian buffers in forested environments identified by FEMAT (1993), Frisell (2013) recommends that an adequate buffer to protect stream function should be equivalent to approximately three SPTHs (up to 400 feet) with the LWD functions being maintained between 250 and 350 feet, nutrients functions maintained between 150 and 250 feet, and temperature/thermal regimes being maintained between 150 and 200 feet. The reason Frisell identifies such a large buffer related to LWD is that windthrow from outside the standard 1 SPTH is responsible for supplying a large amount of the LWD that enters a stream.

The following sections provide additional description of riparian functions including:

- Channel migration zones,
- LWD recruitment,
- Stream shading and temperature,
- Bank stabilization and habitat formation,
- Filtering of sediment, nutrients and chemicals,
- Organic input and nutrient source, and
- Microclimate.

Though the following discussion is primarily focused on stream habitats, additional discussion of how riparian vegetation influences lake shorelines is included where appropriate.

6.2.2.1 Channel Migration Zones (CMZs)

The importance of protecting the CMZ is well-documented (Knutson and Naef, 1997; May, 2000; WDNR, 1999, 2003; Smith, 2002). Knutson and Naef (1997) state "the channels of some streams, particularly larger streams and rivers in broad, alluvial valleys, may migrate across the valley as a result of natural erosional and depositional processes; the area over which the channel is expected to migrate is called the channel migration zone." As stream channels migrate across valley bottoms, riparian vegetation interacts with natural erosional and depositional processes, which promotes floodplain connectivity, LWD recruitment potential and the formation of instream habitat (May, 2000).

From a regulatory standpoint, the definition of CMZs varies. The Washington Forest Practices Board (WDNR, 1999) defined CMZs as "...the area that streams have recently occupied (in the last few years or less often decades), and would reasonably be expected to occupy again in the near future." However, the Forests and Fish Report (WDNR, 1999) provided the following guidance for defining CMZs:

> "Operationally, the CMZ should be equivalent to the area that a stream is expected to occupy in the time period it takes to grow a tree of sufficient size to provide geomorphic/ecological functions in the channel. On smaller streams, it may be appropriate to be concerned where the stream could move within 100 years or less. However, larger wood is needed to function in larger, high-energy channels. To be functional, recruitment trees must be very large, with root wads attached. As a consequence, on a larger stream, it may be necessary to include areas in the CMZ that the stream could occupy in the next 200 years or more."

Regardless of the time frame used to define a CMZ, what ultimately determines the presence of a CMZ is physical evidence of channel migration such as inactive channels, old meander bends, sloughs, oxbows, or floodplain terraces. By definition, such features only occur within CMZs and any classification system of channel migration potential can only be derived from such evidence of channel migration. In general though, channel migration can be expected to occur in lower gradient streams and rivers having broad valleys (that were often formed by such channel migration processes over long periods of time), which are typical of those reaches designated as "Shorelines of the State" (i.e., having a mean annual flow equal to or greater than 20 cubic feet per second (cfs)) in Kittitas County. In Kittitas County many streams or portions of streams have the potential to migrate including the Yakima River, Coleman Creek, Wilson Creek, Manastash Creek, Taneum Creek, Teanaway River, Cooper River and Gold Creek (ESA, 2013).

6.2.2.2 Large Woody Debris (LWD) Recruitment

Woody debris consists of root wads, trees, and limbs that fall into the stream as a result of bank undercutting, mass slope movement, normal tree mortality, windthrow, or debris flow. The majority of woody debris is supplied by the riparian area, and to a lesser extent, by the zone of influence. Woody debris is often transferred from tributaries during debris flows. Woody debris affects channel shape by forming obstructions (in single pieces or in large jams) that alter stream flow and velocity, which in turn promotes erosion and deposition in the channel bed and create a variety of habitat niches.

Woody debris traps organic and inorganic matter. Trapped organic matter, such as leaves, insects, or fish carcasses, provide the basic food supply within the stream environment. Trapped salmon carcasses, for instance, import nutrients from the ocean and function as fertilizer for downstream habitats. Trapped inorganic matter such as sand and gravel creates habitat and provides spawning grounds for fish. Woody debris in and around the stream channel creates upland habitat for a variety of organisms. Decaying woody debris functions as habitat for riparian seedlings, influencing plant succession. Woody debris amends the physical and chemical properties of the underlying soil. By trapping water, woody debris increases the amount of biologically and chemically active surface area, activating consumption of organic matter by invertebrates (Bolton and Monohan, 2001; Chesney, 2000; Knutson and Naef, 1997; Montgomery and Buffington, 1993, Mikkelsen and Vesho, 2000; Naiman and D'ecamps, 1997).

Many studies suggest buffers approaching one SPTH are needed to maintain natural levels of recruitment of LWD (Spence et al., 1996; Murphy and Koski, 1989; Robison and Beschta, 1990; Van Sickle and Gregory, 1990, and FEMAT 1993). However, more recent studies are finding that windthrow from outside the one SPTH zone is responsible for much of the LWD delivery to the stream and that protection must be provided outside the one SPTH zone (buffering the buffer) to ensure that trees are always available to contribute to LWD recruitment from inside the one SPTH, including areas out to three SPTH (Frisell, 2013).

6.2.2.3 Shading and Temperature

Stream temperature in any given location is primarily dependent on the temperature of water directly upstream, or the input water temperature (GEI, 2002). Riparian vegetation serves to reduce solar heating and maintain water temperatures. Under undisturbed conditions, stream temperatures are maintained because the surface and groundwaters that comprise stream flow are thermally protected by upland and riparian vegetation and soils. As forested area in a watershed is removed, thermal protection is lost, the ratio of warmer surface to cooler groundwater in a stream increases, and stream temperatures increase. Therefore, actions in upper watersheds can lead to increased water temperatures in lowland areas, but adequate shading is required in lowland areas to prevent further solar heating.

The value of riparian buffers in moderating stream temperatures is well-established, but the effectiveness of different buffer widths varies depending on site conditions. Several authors (Beschta et al., 1987) have concluded that buffer strip widths of 100 feet or more generally provide the same level of shading as that of an old growth forest in the Pacific Northwest while several authors have recommended a minimum buffer width of 30 feet (Davies and Nelson, 1994). In forested areas, harvest treatments that leave overstory vegetation buffers adjacent to streams have been shown to have no significant impact on stream temperature (Lee and Samuel, 1976; Rishel et al., 1982; Lynch et al., 1984; Sugimoto et al., 1997).

In coastal British Columbia, Gomi et al. (2003) conducted a 6-year field experiment to evaluate the effects of riparian buffer widths on stream and riparian ecosystems, including stream temperature response. Treatments included no timber harvesting, harvesting with 33-foot and 100-foot wide riparian buffers, and clear-cut harvesting with no buffer. The results indicated that water temperature in the streams with 33 -foot and 100-foot wooded buffers did not exhibit statistically significant warming. Todd (2000) examined various buffer functions and found that smaller riparian buffers (as narrow as 40 feet) are required to protect water temperature and food web functions, and Johnson and Ryba (1992) recommend a similar buffer width of from 30 to 100 feet to effectively protect stream temperature. However, Brown and Kryier (1971) noted that on very small streams, adequate shade may be provided by brush species.

There is little published information regarding buffer widths needed to provide natural levels of shade for streams in forest, rangeland, and agricultural systems east of the Cascade Mountains. Eastside forests, particularly old-growth ponderosa pine forests, have lower stem densities and crown-closure than westside Douglas-fir-dominated systems and frequently lack the dense understory vegetation typical of many westside riparian areas. Consequently, the width of buffers needed to maintain full shading may differ. For hardwood dominated riparian forests that were once common along streams east of the Cascades, appropriate buffer widths for shade are even less certain, in part because examples of intact riparian ecosystems are extremely rare. Buffer widths designed to protect other riparian functions (e.g., LWD recruitment) are likely to be adequate to protect stream shading (Spence et al., 1996).

6.2.2.4 Bank Stabilization and Habitat Formation

Streams tend to erode the outer banks of meander bends while depositing sediment as bars on the inside of the meander bends. Through this continual process of erosion and deposition, the location and quality of habitats and the meander pattern and position within the valley changes over time. This process acts in response to natural and unnatural disturbances within a watershed and serves to create and recreate salmonid habitat. For any given disturbance, the rate, magnitude, and nature of channel response in part depends on the condition of riparian vegetation.

Vegetation helps protect streambanks and shorelines from erosion. Diverse native vegetation can be expected to moderately resist shoreline erosion allowing channels to physically respond to disturbances, thereby forming and reforming salmonid habitat features over time (Reeves et al., 1995). As reviewed in Spence et al. (1996), roots bind streambank soils and slow water currents, thereby stabilizing stream banks. Stream currents carve the material underneath the root zone creating shelter and structural habitat for salmonids and terrestrial and aquatic macroinvertebrates. Other benefits of the natural channel formation and migration process include erosion of gravels from streambanks, which replenishes spawning substrate, and the undercutting of streamside trees, which become a primary source of LWD.

In many areas of the populated and developed lowland areas of Kittitas County, natural channel formation processes have been interrupted by armoring streambanks with artificial structures such as rock-riprap. This interruption of channel-forming processes may be necessary to protect lives and property, but it must be acknowledged in such cases that complete resistance to shoreline erosion comes at the expense of natural habitat forming processes, and other methods of providing habitat are then be required to sustain populations of aquatics species.

As concluded in FEMAT (1993), an appropriate width for providing bank stabilization is 0.5 SPTH (Table 6-8). Based on this criterion, this distance will vary depending on site conditions, but would be expected to range from about 50 to 100 feet. While relatively narrow buffers of immature vegetation may provide adequate bank stabilization in some rare instances, particularly in low-gradient reaches of smaller streams, other studies recommend a width of 100 feet as generally sufficient to control streambank erosion, even in areas of high mass wasting (Knutson and Naef, 1997; May, 2000; Cederholm, 1994).

6.2.2.5 Filtering of Sediment, Nutrients, and Chemicals

Uptake of dissolved chemicals and filtration of sediments from overland runoff and flood water is an important riparian function (Cummins et al., 1994). The chemicals that constitute plant nutrients may be largely incorporated in the riparian zone's biomass. This combined with the trapping of sediment within the riparian landscape contributes to the building of "new land" involved in channel or shoreline migration. Any action, such as clearing, that degrades the integrity of the riparian zone will hamper to some degree these chemical filtering, uptake and land-building functions.

Literature review by FEMAT (1993) indicates that healthy riparian zones greater than 200 feet from the edge of a floodplain remove most sediment from overland flow; however, FEMAT (1993) cited many studies to support a buffer width of one SPTH (i.e., 110 feet) to filter sediments from runoff (Johnson and Ryba, 1992; Belt et al., 1992, Broderson, 1973; Corbett and Lynch, 1985, Lynch et al., 1985). Sufficiency of buffer widths is dependent on slope steepness, with wider buffers required for steeper slopes (Vanderholm and Dickey, 1978). Given this, widths of 100 to 300 feet are generally sufficient for filtering substantial proportions of sediment (50 to 90 percent) originating from hill slopes (Karr and Schlosser, 1977; Johnson and Ryba, 1992; Belt et al., 1992; Lowrance et al., 1986, 1988). While these recommendations are based mainly on short-term studies, some long-term studies have been conducted that also support a recommended buffer width of 100 to 300 feet for filtering sediment (Lowrance et al., 1986, 1988).

Buffer widths reported for removal of pollutants, nutrients and chemicals can vary widely based on vegetation type, soil type, and slope. Knutson and Naef (1997) report that buffer widths ranging from 13 feet to more than 850 feet are adequate for nutrient reduction or removal depending on site conditions. Terrell and Perfetti (1989) report riparian widths of 200 and 600 feet as necessary for removing pesticides, animal waste, and nutrients from croplands. Though there is a wide range of effective buffer widths reported in the literature, widths of 100 feet are generally sufficient for removing nutrient or bacterial pollution (Lynch et al., 1985; Terrell and Perfetti, 1989).

If buffers are the primary means of protection against input of sediments, nutrients, pesticides and pathogens, then relatively wide buffers may be required. However, by employing appropriate BMPs such as sediment controls and managing the application of fertilizer and pesticides, the risk of transport into streams can be markedly reduced, thereby reducing the riparian buffer width required to effectively protect streams from these impacts. Numerous studies illustrate that significant sediment filtering and water quality benefits can be achieved in agricultural areas (generally low-gradient systems with little side-slope) by buffers or vegetation filter strips ranging from 25 to 50 feet, particularly in combination with suitable BMPs (GEI, 2002). Application of variable buffer widths in agricultural areas may be appropriate where BMPs are used to minimize sediment, nutrient and chemical delivery to streams. In some cases, a buffer may need to be increased to minimize the potential for sediment delivery to a stream, as in the case of areas where steep slopes are present..

6.2.2.6 Organic Input

Riparian trees and other vegetation furnish fresh waters with a "litter fall" of plant particles (leaves, pollen grains, etc.) and terrestrial insects. These organic materials compose a major energy source for food webs that sustain production of salmonids, particularly in low- and mid-order streams (Gregory et al., 1991; Naiman et al., 1992; Cummins et al., 1994). Along small stream channels, outside sources of nutrients such as litter fall from healthy stands of riparian vegetation is a greater contributor to the aquatic food web than in-channel algae production, which tends to predominate as the basis in wider, less shaded streams (Vannote et al., 1980) and in standing waters. Clearing riparian vegetation may reduce or destroy the nutrient-providing function depending on the extent of the action and the relative importance of litter fall in sustaining nutrient input into the system.

Little research has been done relating litter contributions to streams as a function of distance from the stream channel; however, it is assumed that most fine organic litter originates within 30 feet, or approximately 0.5 tree heights from the channel (FEMAT 1993). In deciduous woodlands, windborne leaf litter may travel farther from source trees than needles or twigs from coniferous vegetation; consequently, riparian buffers may need to be wider than suggested above to protect natural levels of organic inputs. In Kittitas County this would be true along many of the larger streams such as the mainstem Yakima and Cle Elum Rivers where wide floodplains are dominated by willow and cottonwood species.

6.2.2.7 Microclimate

Microclimate, defined as the local climate (humidity, wind speed, and air temperature) within the stream and riparian ecosystem, is primarily affected by the quality and extent of riparian vegetation (Pollack and Kennard, 1998). Watershed scale microclimate also influences stream temperatures, contributing to lower temperatures in forested watersheds than in urbanized or otherwise cleared watersheds. Brosofske et al. (1997) documented that riparian microclimate is important to consider in management because it affects plant growth, therefore influencing ecosystem processes such as decomposition, nutrient cycling, plant succession, and plant productivity. Thus microclimate alterations can affect structure of the riparian forest, the waters within it, and the well-being of many animals, including fish. Riparian buffer widths necessary for microclimate control are generally much wider than those necessary for other functions, with the exception of habitat for some species of wildlife. A riparian buffer width of 200 feet may provide minimum or partial microclimate function in some circumstances; however, widths greater than 300 feet are generally required to provide full microclimate protection (Spence et al., 1996; Chen et al., 1990; Brosofke et al., 1997; Franklin and Forman, 1987).

6.3 Human Activity and FWHCA Functions

There are a variety of ways in which humans can affect FWHCAs, the habitat and species alterations that are relevant to Kittitas County are described below.

6.3.1 Wildlife Habitat

For wildlife, disturbance may include a behavioral and an ecological component. The behavioral aspect of disturbance may be defined as any action, such as human presence or noise from machinery, which alters the behavior of an animal (Dahlgren and Korschgen, 1992; Martin, 2001). The ecological component of disturbance includes an alteration of the structure and/or floristics of wildlife habitat. Disturbance may include spatial and temporal components and direct and indirect effects. Factors such as the size of the affected area, the timing of disturbance, and the duration of the disturbance influence the degree of disturbance. Wildlife species vary in their tolerance of disturbance and habitat alteration and this tolerance may vary over the course of the year (Martin, 2001; McComb, 2001). The sensitivity of wildlife species to disturbance may depend on the distance of the activity from the subject species, screening vegetation or terrain, and in some cases, the previous exposure (habituation) of the individual to the activity.

6.3.1.1 Ecological Disturbance

Habitat alterations may be temporary (e.g., clear cutting a forest stand) or permanent (e.g., converting grassland to a residential development). These alterations often refer to changes in vegetation structure (e.g., converting mature forest to a seedling stand) or floristics (e.g., deciduous forest to shrub field) and may include introducing exotic species and disrupting nutrient cycling processes. Table 6-10 contains a list of common development activities that can alter habitat and negatively impact species associated with those habitats in Kittitas County.

Habitat fragmentation, the isolation of habitat patches, is a source of disturbance that may affect habitat suitability well beyond the site of the altered habitat. For wildlife species such as the wolverine, the presence of a road may serve as a dispersal barrier, fragmenting the habitat and rendering otherwise suitable habitat on the far side of the road inaccessible (Claar et al., 1999; Lemkuhl et al., 2001). Habitat alteration may change the vegetative community and structural elements of a site, affecting the density or species assemblages of wildlife using the site (McComb, 2001). Generally, as the size of the habitat area increases, the number of species and individuals the area can sustain also increase. The maximum number of individual animals of a given species that a particular area can support is referred to as carrying capacity (Robinson and Bolen, 1984). Habitat alterations may decrease or increase a site's carrying capacity. For most wildlife species, as the size of a habitat patch is reduced or as the habitat is converted to more urbanized uses, carrying capacity is reduced. The remaining habitat patches have greater edge habitat, are more exposed to domestic animals that prey on native wildlife, and have less connectivity to other habitat areas.

Table 6-10. Effects of Disturbance and Habitat Alteration on Wildlife

Activity	Habitat Effect	Sensitive Species Effects*	Areas at Risk in Kittitas County
Clearing	Changes in habitat composition, complexity, and structure; loss of snags and large-diameter trees; loss of cover, foraging, and nesting habitat; habitat fragmentation; alteration of local hydrology; and potential introduction of nonnative species.	Snag dependent species (pileated woodpeckers, cavity nesting ducks), forest interior or old-growth associated species (fisher, northern goshawk). Large trees in riparian/shoreline areas important for bald eagle and great blue heron nest and perch sites.	Much of old-growth in analysis area has been harvested. Potential for habitat loss throughout the County, especially near urban areas. Riparian and shoreline areas are especially important as habitat.

Activity	Habitat Effect	Sensitive Species Effects*	Areas at Risk in Kittitas County
Grading	Loss of soil organic layer; potential soil compaction; loss of cover and foraging habitat; loss of nest/den sites; alteration of local hydrology; increased sedimentation of local waters; potential for landslides; mass wasting on steep slopes.	Burrowing animals such as ground squirrels, burrowing owls, shrews, pocket gophers, badgers, and foxes.	Identified geologically hazardous areas, areas with erodible soils, shoreline areas with steep slopes. Undeveloped grasslands and shrub-steppe habitat.
Urbanization	Loss of open space, breeding, feeding, cover, and dispersal habitat; loss of unique habitats and species diversity, habitat fragmentation, increased prevalence of introduced species, increased wildlife injury/mortality from vehicle collisions, domestic cats and dogs, increased behavioral disturbance from human presence.	Species intolerant of human activities or with large home ranges (gray wolf, wolverine, grizzly bear, bighorn sheep), ground-nesting birds (California quail, dark-eyed junco), species associated with unique habitats (rare plants, butterflies), species at risk of injury or death from motor vehicle collisions such as deer, raccoon, skunk, and snakes, and species intolerant of pressures from non-native species for resources and nest sites including neotropical migrant birds	Open space and natural lands adjoining urban centers – Ellensburg, Cle Elum , Kittitas and Thorp areas, and much of unincorporated county that is being developed for commercial, residential, and rural residential use.
Shoreline development	Loss/alteration of shoreline vegetation, habitat fragmentation, alteration of shoreline morphology (shoreline armoring), degraded water quality (runoff, faulty septic systems), and degraded instream habitat.	Species intolerant of human activities (bald eagles, great blue heron) or dependent on clean water and intact shoreline ecosystem (salmonids).	All freshwater lakes and streams in Kittitas County.
Water management	The construction and operation of reservoirs results in altered hydrologic regimes, altered riparian conditions and in some instances can result in the conversion from upland into aquatic habitats.	All species associated with riparian habitats, agricultural areas.	All streams, lakes, reservoirs, or lands identified in Kittitas County for expansion of water storage and delivery systems

Activity	Habitat Effect	Sensitive Species Effects*	Areas at Risk in Kittitas County
Agricultural practices	In Kittitas County, agriculture has affected hydrology on a large-scale, which in turn has resulted in altered wetland and riparian habitats. In addition, agricultural activity can result in degraded water quality and altered sediment profiles in aquatic systems resulting from agricultural runoff. Many wildlife species benefit from agriculture and are dependent on crops as a source of food. Crop damage is potential source of conflict for wildlife. Agriculture also requires extensive clearing and grading activities and increases the level noise and human disturbance.	Species associated with habitat edges (red-tailed hawk) sensitive to loss of natural areas. Waterfowl, including geese may depend on crops as food during migration. Elk and deer populations may be controlled to reduce crop damage. Species that occupy valley bottoms, riparian, and sage scrub habitats where these areas are being converted to agricultural use, or occur in close proximity to or downstream from these areas of agricultural activity including species such as sage grouse, salmon, trout, and neotropical migrant birds.	Eastern portion of County and areas surrounding the Yakima Valley, including the Teanaway area.
Introduction of non-native species	Potential loss of breeding, feeding, and cover habitat; displacement and extirpation of native species; ecosystem simplification. In riparian habitat as an example, alteration of native riparian habitat functions, including associated wildlife refuge, insect litter, and replacement of coniferous shade producing trees.	Insects dependent on rare native plants, aquatic or wetland associated species (beaver), and neotropical migrant birds.	County wide, especially riparian/wetland habitats and grasslands.
Increased noise/light	Flushing from breeding or foraging areas, interruption or interference with courtship, potential increased susceptibility to predation.	Species intolerant of human activities (marbled murrelets, northern spotted owl, and northern goshawks).	Undeveloped areas of the County with relatively low levels of ambient noise and light including agricultural and rural areas

Activity	Habitat Effect	Sensitive Species Effects*	Areas at Risk in Kittitas County
Human presence/recreational activities	Flushing from breeding or foraging areas, interruption or interference with courtship, potential increased susceptibility to predation.	Species intolerant of human activities (marbled murrelets, northern spotted owl, and northern goshawks, great blue heron).	Undeveloped areas of the County with relatively low levels of human use.

Source: Ferguson et al. (2001); Lemkuhl et al. (2001); Sheldon et al. (2003).

*Species identified are only a fraction of those affected by the identified activity.

While the majority of Kittitas County's land base is undeveloped, much of the land has been altered by mining, agriculture, or forestry and the habitat value of these lands has been reduced from historic conditions. Significant portions of the wetlands and floodplains in Kittitas County have been converted to agricultural lands, particularly in areas adjacent to the Yakima and Teanaway Rivers. The human population of the County continues to grow, converting open space areas to housing developments. The County is served by an extensive road and highway system, but these roads may represent barriers to wildlife dispersal and contribute to wildlife mortality. Interstate 90, U.S Route 97, State Route 10, and State Route 970 are major arterials that may limit the dispersal of wildlife. Residential development along the freshwater shorelines, particularly the Yakima and Teanaway Rivers, has reduced the habitat value for fish and wildlife in these areas. Forestry related activities continue to fragment habitats, reduce migration corridors, and contribute to habitat degradation in habitats such as riparian areas through increased sediment delivery from logging roads and reduced buffer functions.

While not associated with any one specific development activity, beaver dam removal can have detrimental effects on a variety of habitats. Beaver are very important for changing ecosystem processes and providing significant habitat for many other species at the pond site itself, and upstream and downstream of the pond area. Loss of beavers has had a major impact on fish and wildlife habitat in Kittitas County. Beavers create and maintain high quality habitat by altering hydrology, restoring aquatic and riparian function, providing salmonid and amphibian habitat, increasing surface area of aquatic systems, improving water quality and, increasing bird species diversity especially in shrub steppe habitats (Pollack et al., 2004; Pollack et al., 2003; Cooke and Zack, 2008).

6.3.1.2 Behavioral Disturbance

Direct effects of behavioral disturbance on wildlife can include an interruption of activity, flushing, and abandonment of a site or young. Indirect effects may include weight loss due to reduced food intake, or population decline as a result of lower breeding success for disturbed pairs (Castelle et al., 1992). Human presence may be sufficient to disturb some wildlife species, while other species may be relatively tolerant of humans. The time of year or wildlife activity may influence the sensitivity of wildlife to disturbance. Some species may be tolerant of human presence or activities while foraging but are highly sensitive to human presence while breeding or rearing young (McComb, 2001; Stinson et al., 2001; Quinn and Milner, 2004). Common loons are highly sensitive to human development and activities at nesting lakes and have abandoned nests as a result of human disturbance (Richardson et al., 2000). Activities such as the use of heavy equipment, blasting, and pile driving may disturb species for up to 0.25 mile beyond the source of the noise (Ruediger et al., 2000; Watson and Rodrick, 2002; Kennedy, 2003).

Recreation can be a major source of disturbance in breeding and wintering habitat (Claar et al., 1999; Stinson et al., 2001). Conflicts with farmers as a result of crop damage may contribute to the decline of the elk herds. Wildlife viewing also may be a source of disturbance. Recreational fisherman and bird watchers have interrupted feeding bald eagles (Watson and Pierce, 1998; Stinson et al., 2001).

6.3.2 Fish Habitat

Streams and rivers originating in the headwater areas of Kittitas County once flowed through dense forested areas and broad vegetated floodplains. These streams had natural flow regimes, excellent water quality, and complex instream cover. Today, healthy riparian areas are scarce or inadequate and streams and rivers are frequently confined, controlled, or realigned to accommodate agricultural or development activities. Human activities have had similar effects on lake habitats.

The following are the most critical aquatic habitat concerns in Kittitas County (Haring, 2001):

- Fish passage barriers (lack of instream flow, lack of fish passage), and lack of screening associated with irrigation diversions, which impairs fish passage into suitable habitat in the upper portions of tributaries.
- Impaired floodplain function on the Yakima River and many tributaries.
- Altered hydrology, resulting in unnaturally high flows through the irrigation season in some streams and low flows in a number of tributary streams, and substantially reduced spring runoff in most years.
- Impaired riparian function on many tributaries.
- Lack of habitat complexity (e.g., little LWD, channel simplification, lack of pools).
- A high delivery of fine sediment and associated toxics, primarily from irrigation return flows.
- Lack of anadromous fish passage at Cle Elum, Keechelus, and Kachess Dams.

6.3.2.1 Freshwater Riverine Limiting Factors

Salmonid habitat conditions and productivity have been impacted by a variety of land use and water development actions in the watershed. These uses contributed to the development of the important agricultural, forestry, and mining industries in the Yakima Basin, but historical watershed modifications were implemented with limited consideration of effects on salmonid resources. According to Haring (2001), the dramatic decline in salmon and steelhead production in the Yakima Basin is most likely associated with the combination of habitat-related impacts in the late 1800s and early 1900s:

- Irrigation development—Irrigation diversions were constructed on the mainstem Yakima and many of its tributaries. Most were constructed without upstream fish passage facilities or downstream juvenile fish screening, and many dewatered reaches downstream from the diversion.
- Construction of irrigation storage reservoirs—Dams at the outlets of naturally occurring Keechelus Lake, Kachess Lake, and Cle Elum Lake were built without upstream fish passage, precluding access and anadromous salmonid production from approximately 70

miles of highly productive fish habitat upstream of the dams. Construction of the original crib dams and the storage dams resulted in the extirpation of sockeye salmon from the Yakima River Basin.

- Splash damming (log drives)—From 1879 through approximately 1915, splash dams were constructed on tributaries in the upper Yakima, and the channels were cleared in order to drive large log rafts downriver to lumber mills, resulting in a significant decline in suitable salmonid habitat in those basins.
- Mining—Discovery of gold in Swauk Creek in the 1870s led to extensive placer mining, which created extensive alteration of the channel, substrate, and banks, and caused extensive turbidity. This affected salmonid production in Swauk Creek and likely downstream in the Yakima River.
- Removal of beaver—Beaver dams were historically common throughout the watershed. Beaver trapping in the mid-1800s resulted in a loss of beaver dams that helped maintain hydrology during dry periods, resulting in an associated loss of valuable juvenile salmonid rearing habitat and possibly creating additional impairments to upstream fish passage.
- Grazing—Extensive grazing occurred in the late 1800s, particularly in higher elevation subwatersheds.

Snyder and Stanford (2001) acknowledge five factors limiting salmonid production in the Yakima Basin:

- Negative interactions between fish species—wild versus exotic and wild versus hatchery,
- Alteration of the flow regime,
- Impairment of water quality,
- Alteration of the natural temperature regime, and
- Reduction in habitat heterogeneity and floodplain connectivity.

6.3.2.2 Altered Flow Regimes

Dam construction and reservoir operation within the Yakima River Basin drastically altered the natural flow regime of the Yakima River. The current flow regime:

- Produces flows that are unnaturally low during fall and winter;
- Reduces available fall and winter salmonid rearing habitat;
- Reduces flood flows and frequencies that formerly helped flush smolts through the system ;
- Creates unnatural fluctuations that strand and kill fish or displaces them to suboptimal habitat;
- Has unnaturally high flows all summer, which results in channel erosion and loss of habitat structure such as large woody debris (Reclamation, 2002).

Flow fluctuations within the Yakima River that occur as part of the Bureau of Reclamation's Yakima Project operations may exacerbate erosion of riverbanks, harming native riparian vegetation. Pollution from agricultural return waters may impair the riparian vegetation along the river. Pesticides, sediment, and unnatural nutrient balances may deter native plant growth, possibly promoting the growth of nonnative species (Reclamation, 2002).

One byproduct of the Yakima Project that has become a key element in Yakima Basin water management is flood control. Flood control reduces both flood frequency and the extent of flooding, allowing counties to permit the development of the floodplain for other uses (e.g., agriculture or home building), which often results in diminishing riparian vegetation. Grazing livestock can damage riparian vegetation, as can the development of home sites along the river or tributaries, when new residents clear areas adjacent to the waterbody. However, not all development is necessarily detrimental to local riparian vegetation. For instance, upslope irrigation may actually raise a surface water table and increase the water available to some natural riparian areas, thereby increasing the growth of riparian vegetation (Reclamation, 2002).

Development of irrigated agricultural areas has reduced riparian areas by encouraging development of farmland in riparian and adjacent arid zones. Additionally, some natural stream channels are used to deliver irrigation water. Many of the natural streambeds in the upper Yakima Basin are used as delivery canals. Water is put into these waterbodies upstream, to provide water to downstream irrigators. The flow fluctuations that occur as a result of these practices may erode streambanks and destroy natural riparian vegetation (Reclamation, 2002). In general, the effects of altered flow regimes in tributary streams are often highly variable and outside that which would occur under natural conditions. For example, some tributary streams experience water withdrawals during the irrigation season reducing flows even farther than that observed during normal summer low-flow conditions (e.g. lower Manastash Creek and Taneum Creeks. In other times and places flows are much higher than those that would be observed under natural conditions as a result of irrigation diversions from one place to another.

6.3.2.3 Habitat Concerns

The salmonid production potential in the Yakima Basin is not nearly as bleak as the information above might indicate. The watershed has both existing production potential and significant habitat restoration potential. There are still areas with highly productive habitat conditions, and other areas where high quality habitat exists upstream of existing fish passage barriers. Salmonid recovery will require a combination of efforts (Haring, 2001):

- Habitat restoration and resource protection by landowners.
- Revision, implementation, and enforcement of land use ordinances that provide protection for natural ecological processes within the instream and riparian corridors.
- Protection of currently functioning instream and riparian habitat, particularly in key habitat areas.
- Restoration of natural instream and riparian ecological processes, where they have been impaired.

6.3.2.4 Climate and Oceanic Conditions

There is mounting evidence that Pacific salmon, both of hatchery and natural origins, experience large year-to-year and decade-to-decade changes in productivity as a result of ocean conditions (Mantau and Francis, 2003). In the Pacific Northwest, temperature and precipitation data go back about 100 years. During that time there have been four relatively distinct climatic periods:

- 1896-1914—Generally wet and cool.
- 1915-1946—Generally dry and warm.
- 1947-1975—Generally wet and cool.
- 1976-1994—Generally dry and warm.

Scientists have found that salmon returns in the Northwest show long-term behavior that closely follows climatic cycles (ISG, 1999; NRC, 1996). Anderson (1995, quoted in Taylor and Southards, 1997) analyzed climatic data and Columbia River spring Chinook salmon returns back to 1940, determining that cool, wet periods correlated with increased returns and warm, dry periods were associated with decreased returns. . While there are undoubtedly human-induced effects on the fish, the natural variability may be a significant influence as well (Taylor and Southards, 1997).

There are indications that global ocean and atmosphere conditions are the cause of the long-term climate variations. There also are data that indicate a switch in climate regimes occurred in 1994, and that the Pacific Northwest has returned to a wet, cool winter cycle. Some returning salmon numbers have increased dramatically over the last several years, following the 1997-1998 El Niño event (Taylor and Southards, 1997).

While it might be tempting to attribute all changes in salmon abundance to ocean conditions and to conclude therefore that stream corridor management is unnecessary, all human effects on the stream corridor reduce the capacity of the environment to produce and sustain salmon populations, which makes stream corridor management even more important when ocean conditions reduce natural production (NRC, 1996).

In 2009, the University of Washington Climate Impacts Group (CIG) published a study on the impacts of climate change on the Yakima River Basin, particularly on agriculture. The study predicted that the percentage of water shortage years will increase from the historical 14 percent to 32 percent in the 2020s, 36 percent in the 2040s, and 77 percent in the 2080s. Water shortages in the Yakima Basin threaten instream flows for fish. Historically, snowmelt has been an important source of surface water in the Yakima Basin, meeting most of the water supply demands in the spring and early summer. Under projected climate change scenarios, increased temperatures would lead to reduced snowpack as more precipitation falls as rain. Additionally, snowpack would melt earlier in the season. The CIG found that, with a 1^{o}C rise in temperature, snowmelt volume will be reduced by 12 percent. A 2^{o}C rise in temperature will cause a 27 percent decrease in snowmelt volume (Vano et al., 2009). This suggests that instream flows in the Yakima Basin are particularly susceptible to climate change.

6.3.2.5 Harvest and Habitat Factors

A number of factors outside the Yakima River Basin have led to depletion of salmonids stocks in the basin. These include harvesting, both commercial and recreational on the Columbia River and in the ocean; mortality at downstream hydroelectric dams; habitat degradation from headwater logging and mining operations; floodplain and habitat degradation from roads and other development; and stranding of fish in unscreened irrigation diversions (ISG, 1999).

Harvests impact salmon productivities directly—by reducing the numbers in the spawning populations—and indirectly—by reducing the diversity in the population, which impacts factors important to basic productivity. Overfishing occurs when fishing removes enough spawners from a population to cause it to decline. Overfishing reduces the production of salmon by reducing or eliminating the populations that have adapted to the habitat types and environmental conditions of the basin (ISG 1999).

Prior to 1941, excessive harvest exploitation and widespread habitat degradation acted together to reduce the abundance of Columbia River Basin salmon stocks. Overfishing of the salmon runs by the commercial fishery in the lower Columbia River was documented as early as the 1870s. Seventeen years later, biologists were looking to the lower river fisheries to explain sharp declines in salmon returns to the Yakima River (particularly spring Chinook and sockeye) (McDonald 1894, quoted in ISG 1999).

Craig and Hacker (1940, quoted in ISG 1999) discuss in detail human population growth, logging, mining, hydroelectric power, and flood control and navigation as causes for the decline in salmon resources during the nineteenth century and early twentieth century. Regarding factors contributing to the first major Columbia River Chinook salmon harvest declines, from 1884 to 1889, Craig and Hacker cite the reduction of late spring and early summer Chinook by fishing and reductions in fishing effort as a result of falling demand for the relatively high-priced Columbia River salmon.

While all of these factors may have influenced the depletion of salmonid stocks in the greater Columbia River Basin, poor fish passage conditions at Roza Dam between 1939 and 1988 is viewed as the primary driver for the decline in anadromous stocks from the Upper Yakima Basin.

6.4 FWHCA Management and Protection Tools

Protection and management of FWHCAs requires protection of individual species and populations as well as the habitat areas that meet all of their life stage needs. Appropriate identification and mapping of species and habitats, use of buffers, restrictions on the timing of certain land use activities, and habitat restoration/mitigation are effective tools for accomplishing these goals.

Federal and state agencies and local jurisdictions may mitigate human disturbance of wildlife by prohibiting the intentional disturbance of wildlife species/individuals and designating areas as off limits to public entry. Management recommendations for a number of species (e.g., lynx, bald eagles, great blue herons) include restricting human activities around nesting or breeding sites (Ruediger et al., 2000; Watson and Rodrick, 2002; Quinn and Milner, 2004).

6.4.1 Identification and Mapping of Species and Habitat

The USFWS designates critical habitat for federally listed species. Land use in designated critical habitat is usually restricted and requires consultation with the USFWS prior to actions by other federal agencies. The WDFW PHS Program identifies lands used by priority species and management recommendations may limit the timing or extent of land use actions. Public agencies may designate their lands for the management of fish and wildlife habitat or condition land use practices through rules and permitting requirements.

The Critical Areas Assistance Handbook (Ousley et al., 2003) recommends that local jurisdictions use PHS data in designating FWHCAs and that when possible, large, round or square blocks of habitat should be emphasized for FWHCAs rather than small or linear tracts.

6.4.2 Stream Classification

Classifying streams is an important management tool, as a classification system can help target the appropriate level of protection for particular stream types. In general, streams that provide fish habitat are considered a higher priority for protection than streams that do not.

The stream classification system in WAC 222-16-030 classifies streams as follows:

- **Type S Water** - all waters, within their bankfull width, as inventoried as "shorelines of the state" under chapter 90.58 RCW and the rules promulgated pursuant to chapter 90.58 RCW including periodically inundated areas of their associated wetlands.
- **Type F Water** - segments of natural waters other than Type S Waters, which are within the bankfull widths of defined channels and periodically inundated areas of their associated wetlands, or within lakes, ponds, or impoundments having a surface area of 0.5 acre or greater at seasonal low water and which in any case contain fish habitat.
- **Type Np Water** - means all segments of natural waters within the bankfull width of defined channels that are perennial nonfish habitat streams. Perennial streams are waters that do not go dry any time of a year of normal rainfall. However, for the purpose of water typing, Type Np Waters include the intermittent dry portions of the perennial channel below the uppermost point of perennial flow.
- **Type Ns Water** - means all segments of natural waters within the bankfull width of the defined channels that are not Type S, F, or Np Waters. These are seasonal, nonfish habitat streams in which surface flow is not present for at least some portion of a year of normal rainfall and are not located downstream from any stream reach that is a Type Np Water. Ns Waters must be physically connected by an above-ground channel system to Type S, F, or Np Waters.

6.4.3 Buffers

Buffers are vegetated lands separating critical areas from more intensive land uses and are intended to reduce potential impacts to the critical areas from activities beyond the buffer (O'Connell et al., 2000; Sheldon et al., 2003). Land use regulations have required buffers around wetlands and streams for a number of years and buffers have been the subject of numerous scientific studies and reviews (see previous discussion on wildlife buffers).

6.4.3.1 Wildlife Habitat

For wildlife, the principal functions of buffers are to provide habitat (feeding, cover, and breeding) and travel corridors; microclimate modification; organic input; and to ameliorate the impacts of human disturbance (Castelle et al., 1992; Kauffman et al., 2001; Sheldon et al., 2003). The suitability of habitat buffers for wildlife is related to the width and floristic composition of the buffer (Castelle et al., 1992; Knutson and Naef, 1997; Sheldon et al., 2003). Generally, wider buffers with more complex plant communities have higher habitat value. Forested buffers provide more habitat niches and functional value to wildlife than scrub-shrub buffers, which in turn are more effective as habitat than buffers dominated by herbaceous vegetation (Castelle et al., 1992; Knutson and Naef, 1997; Sheldon et al., 2003).

6.4.3.2 Fish Habitat

For protection of instream salmonid habitat, a wide range of recommended riparian buffer widths is presented in existing studies (see previous discussion of riparian buffer functions). Design of riparian buffers must consider the ecological, cultural, and economic values of the resource, land use characteristics, and existing riparian quality throughout watersheds in order to address the cumulative impacts on stream functions and the resources being protected (Johnson and Ryba, 1992; Castelle et al., 1994; Wenger, 1999).

Appropriate buffer sizes will depend on the area necessary to maintain the desired riparian or stream functions for the given suite of land use activities. A wider buffer may be desired to protect streams from impacts resulting from activities such as trail construction, recreation, pets, garbage, and tree removal. These concerns are often greater in areas of high-intensity land use and thus wider buffers, or restrictions (such as building setbacks) that keep a potential hazard from occurring, may be needed, while narrower buffers may suffice in areas of low-intensity land use (May, 2000). It should be noted that opportunities for protection or improvement of buffer conditions in areas of high-intensity land use are often effectively foreclosed by existing development, or the existing habitat conditions are already highly altered. Under such conditions, establishing buffers wide enough to provide an effective full-range of riparian functions may be unattainable and other actions may be required to improve habitat conditions beyond what riparian buffers are able to provide. In addition, buffer vegetation type, diversity, condition, and maturity are equally as important as buffer width, and the best approach to providing high-quality buffers is to strive for establishing and maintaining mature native vegetation communities (May, 2000).

In general, most studies found that buffer recommendations that are protective of LWD are largely protective of other riparian functions such as shade, organic litter input, and bank stability. Riparian function related to sediment, nutrient and chemical removal as well as microclimate function may require buffers in excess of that deemed necessary to protect LWD functions, especially in areas where the stream is adjacent to areas of erodible soils and steep slopes.

6.4.4 Timing Restrictions

Some species of wildlife may be particularly sensitive to disturbance during their breeding seasons and restrictions on mechanized activities within a given distance of nest/den sites are a means of habitat protection. For example, WDFW management recommendations for bald eagles includes restricting activities within 880 feet of an active bald eagle nest, January 1 through August 15 (Watson and Rodrick, 2002) and within 0.5 mile of northern goshawk nests, March 1 through September 30 (Desimone and Hays, 2003).

Timing restrictions for conducting in-water work are necessary to protect habitat and life-stage requirements that differ by species and time of year. No timing restrictions for in-water work are specified in the current KCC, but windows for conducting work within the OHWM of freshwater and lake systems have been established by state and federal resources agencies. The general and approved fish work windows for most Kittitas County streams is from July 1 to September 30 (Table 6-11). However, there are numerous streams with slightly shorter work windows or ones that require a separate determination, as identified in WDFW's Hydraulic Project Approval (HPA) to be issued for each individual site.

Table 6-11. Allowable In-Water Work Windows for Kittitas County Streams

Washington Counties and State Waters including tributaries[1] - Water Resource Inventory Area (WRIA) is given in parentheses	Work is Allowed only Between These Dates
Kittitas County	July 1 - September 30
Brushy Creek (40.0612)	July 1 - February 28
Colockum Creek (40.0760)	July 1 - October 31
Quilomene Creek (40.0613)	July 1 - October 31
Stemilt Creek (40.0808) - Upstream of falls	July 1 - February 28
Tarpiscan Creek (40.0723)	July 1 - February 28
Tekiason Creek (40.0686)	July 1 - February 28
Whisky Dick Creek (40.0591)	July 1 - February 28
Yakima River (39.0002) - Roza Dam to Teanaway River	August 1 - August 31
Naches River (38.0003) - Tieton River to Bumping River	July 1 - August 15
Little Naches River (38.0852) - Mouth to Matthew Creek	July 16 - August 15
Little Naches River (38.0852) - Upstream of Matthew Creek	July 16 - August 15
Pileup Creek (38.0932)	July 16 - August 31
Gold Creek (38.MISC)	July 16 - February 28
Swauk Creek (39.1157)	July 16 - September 30
Baker Creek (39.1157)	July 16 - September 30
First Creek (39.1157)	July 16 - September 30
Iron Creek (39.1157)	July 16 - September 30
Williams Creek (39.1157)	July 16 - September 30
Boulder Creek (39.1157)	July 16 - February 28
Cougar Gulch (39.1157)	July 16 - February 28
Lion Gulch (39.1157)	July 16 - February 28
Yakima River (39.0002) - Teanaway River to Easton Dam	August 1 - August 31
Yakima River (39.0002) - Upstream of Easton Dam	August 1 - August 31
Cle Elum River (39.1434) - Mouth to Dam	July 16 - August 31
Cle Elum River (39.1434) - Upstream of Cle Elum Dam	Submit Application
Big Boulder Creek (39.1434MISC)	August 1 - February 28
Camp Creek (39.1434MISC)	August 1 - February 28
Fortune Creek (39.1434MISC)	August 1 - August 15
South Fork Fortune Creek (39.1434MISC)	August 1 - February 28

Washington Counties and State Waters including tributaries[1] - Water Resource Inventory Area (WRIA) is given in parentheses	Work is Allowed only Between These Dates
Howson Creek (39.1434)	July 16 - February 28
Little Salmon Le Sac Creek (39.1482)	August 1 - August 15
Paris Creek (39.1434MISC)	August 1 - February 28
Salmon Le Sac Creek (39.1520)	August 1 - February 28
Kachess River (39.1739) - Upstream of Lake Kachess	Submit Application
Kachess River (39.1739) - Below Dam	July 16 - August 15
Box Canyon Creek (39.1765)	Submit Application
Mineral Creek (39.1792)	August 1 - August 15
Lake Keechelus (39.1842) tributaries	July 16 - August 15
Gold Creek (Lake Keechelus) (39.1842)	Submit Application
Manastash Creek (39.0988)	July 16 - September 30
Naneum Creek (39.0821)	July 16 - September 30
Taneum Creek (39.1081) - Mouth to I-90	July 16 - August 31
Taneum Creek (39.1157) - Upstream of I-90	July 16 - September 30
Teanaway River (39.1236)	July 16 - August 31
NF Teanaway River (39.1260)	Submit Application
Umtanum Creek (39.0553)	July 16 - September 30
Wenas Creek, Below Dam (39.0032)	July 16 - October15
Wenas Creek, Upstream of Wenas Lake (39.0032)	July 16 - February 28
Other Yakima River tributaries not listed	July 16 - August 31

[1]The work time for Kittitas County applies to all waters within the county, unless a work time is given for a listed water in that county. The work time for a listed water applies to all its tributaries, unless a tributary of that water is also listed.

6.4.5 Habitat Mitigation

Mitigation refers to the avoidance or minimization of project related impacts to critical areas. Mitigation may also include the restoration or enhancement of existing fish and wildlife habitat or the creation of new habitat, when impacts are unavoidable. Where required, mitigation often includes the approval of a mitigation plan, monitoring of the mitigation site for a specified period (5 to 10 years), and posting of a mitigation bond.

6.4.6 Anadromous Species Management and Recovery

Management strategies that promote and allow natural stream corridor processes to evolve over time tend to succeed because they work with the natural tendencies of a stream corridor, rather than working against them (Ebersole et al., 1997, quoted in Bolton and Shellberg, 2001). Existing habitat conditions, habitat limiting factors, and proposed protection measures for anadromous salmonids in Kittitas County have been presented in several completed or ongoing management documents (Knight, 2009; Haring, 2001; USFWS, 2002; NMFS, 2009; YBFWRB; 2009; YBFWRB, 2012).

6.4.6.1 Bull Trout

Protection and management of bull trout is tiered to different populations based on their current status in Kittitas County:

> **Tier I: "Action" populations:** These are populations where recovery actions would provide an immediate benefit to habitat conditions and population levels, and thus are the highest priority across all populations (Gold Creek and Box Canyon Creek).
>
> **Tier II: "Protection" populations:** These are populations to protect and to continue monitoring, but where actions are expected to solicit a limited population level response (Kachess River). These populations are the next priority tier for implementing recommended actions.
>
> **Tier III: "Monitor" populations:** These are populations where the priority action is to determine if bull trout are currently present, because the number of individuals in these populations is low or unknown. Implementation of recovery actions is a low priority. If an extant, a self-sustaining population of bull trout is discovered, or when supplementation/reintroduction efforts are initiated, these would be re-evaluated (Cle Elum River, Teanaway River, and Upper Yakima River).

As the method described above was applied, a comprehensive list of actions prioritized among and within populations was created. The recommended actions may be Broad Scale Actions, Population-Scale Actions or Monitoring Actions. The scale of these actions varies temporally and spatially. The following is a list of prioritized actions that will lead to the recovery of the species:

Broad Scale Actions are recognized as crucial to the recovery of bull trout populations but will require large scale coordination efforts from entities across the basin. These actions are described separately to draw attention to this distinction. The implementation of these actions will benefit bull trout on a long-term timescale and include the following (YBFWRB, 2012):

- **Restore Healthy Salmonid Populations:** Although there is no specific historic data on bull trout utilization of salmon resources in the Yakima Basin, one can assume that bull trout thrived as a result of the abundance of numerous species of anadromous salmonids that historically returned to the Yakima Basin to spawn and for which bull trout depended on as a source of prey (YBFWRB, 2012). There are many programs that are making progress towards this goal. The Yakima-Klickitat Fisheries Project (www.ykfp.org) is dedicated to enhancing stocks of salmon currently present in the basin (spring and fall Chinook) and reintroducing extirpated stocks (coho and summer Chinook). The Yakama Nation has also initiated a program to reintroduce sockeye salmon into Lake Cle Elum. Steelhead recovery is being implemented with habitat improvement projects throughout the basin, in addition to a Yakama Nation steelhead kelt reconditioning program.
- **Passage at Major Storage Facilities (Kachess, Kelchelus, Cle Elum):** These storage dams constructed between 1910 and 1933 do not have any fish passage facilities and act as barriers that exclude anadromous fish from the watersheds above these dams and prevent resident fishes that spawn above the dams, including bull trout, from regularly

using downstream habitats. Bull trout that are lost downstream of these dams cannot return to spawn in their natal streams. This disruption of natural migration routes has had significant negative effects on Yakima Basin bull trout populations including: isolation of populations resulting in an increased risk of inbreeding and loss of genetic diversity; reducing or eliminating the chance that stray fish could recolonize areas after an isolated catastrophic event either isolated or eliminated a local population; and limiting adult and juvenile productivity by limiting foraging areas and preventing the distribution of ocean derived nutrients into upper watersheds provided by spawning Pacific salmon and steelhead.

Establishing volitional, two way fish passage at each of the storage dams in the Yakima Basin is identified as a priority by multiple agencies, for multiple fish species. In 2002, the Bureau of Reclamation began an assessment process to evaluate passage possibilities at each of the dams. Based on this process, Cle Elum and Bumping reservoirs were selected to move forward to feasibility studies, and a Final Cle Elum Fish Passage Environmental Impact Statement (EIS) was released in 2011 (see: http://www.usbr.gov/pn/programs/ucao_misc/fishpassage/index.html). Funding to construct the fish passage facilities is included in the Yakima River Basin Integrated Water Management Program (Reclamation and Ecology, 2011). Meanwhile, interim downstream fish passage was constructed at Cle Elum dam in 2005 and the Yakama Nation has been re-establishing a sockeye salmon run into this watershed by transporting adult sockeye from the Columbia River to Cle Elum Reservoir

Population Scale Actions are mostly specific to individual populations, or a group of populations. The focus is on-the-ground actions, many of them ready to be implemented if funding becomes available.

Monitoring Actions encompasses a wide variety of on-the-ground activities. Monitoring is an important way to track progress towards goals, document trends, and test hypotheses. It is often difficult to find funding for monitoring projects, thus making it critical to prioritize and clearly define the questions being asked. Monitoring Actions may include:

- **Population Monitoring:** Snorkel or redd surveys to detect presence of bull trout and to monitor trends in abundance, juvenile densities, etc.
- **Baseline Habitat Monitoring:** Gathering data on trends in habitat over time, such as temperature, flow, sediment, etc.
- **Implementation Monitoring of Completed and Recommended Actions:** Effectiveness monitoring to determine longevity of actions (e.g., cattle or camping exclusions) or intended habitat response (e.g., "Did the riparian restoration result in increased stream shade?").
- **Threats Research and Monitoring**: These actions address uncertainties regarding the threats severity ratings and effects on populations. For example, through the Threats Analysis, angling was identified as a threat that may be significant for most bull trout populations. Data collected during creel surveys could substantiate this and direct attention to problem areas.

6.4.6.2 Steelhead

Recovery of Yakima Basin steelhead will include a suite of activities that, if implemented, will contribute to improved habitat conditions for all anadromous salmonids in the basin (NMFS, 2009; YBFWRB, 2009). The following focuses on recovery efforts pertinent to waters in Kittitas County:

- Continue efforts to protect existing functional habitat;
- Significantly improve passage flows and instream and riparian conditions in the Little Naches and Upper Yakima watersheds;
- Addressing the effects of reservoir operations and irrigation withdrawals on steelhead;
- Improving migration conditions in the Yakima River;
- Improving juvenile and kelt outmigration conditions at Rosa Dam;
- Improving unimpeded passage for steelhead in key tributaries (Manastash Creek, Taneum Creek, and if feasible Naneum Creek and Cle Elum River);
- Hydropower management, predator control, and minimizing shoreline development along the Columbia River; and
- Management of grazing and recreation activities for Columbia River tributary streams in the northeast part of the County.

6.4.6.3 Other Anadromous Fishery Recovery Actions

The Yakima-Klickitat Fish Project, a joint effort between the Yakima Nation and WDFW with funding from the Bonneville Power Administration (BPA), is developing hatchery programs to supplement spring- and fall-run Chinook salmon and reintroduce coho salmon into the Yakima Basin.

The Yakama Nation has begun reintroducing sockeye salmon above Cle Elum Dam and entities throughout the basin are proposing to provide upstream and downstream fish passage for all anadromous salmonids. This will restore a historical lake-dependent run of sockeye salmon to the Yakima Basin and provide an ocean-derived nutrient supply to the watershed. This will also serve to open up additional habitat to other anadromous salmonids and discontinue isolation of certain populations (bull trout for example).

An important component to the Columbia Basin ecosystem, Pacific lamprey are significant prey for a number of other species, provide marine nutrients to tributary ecosystems and are often viewed as the “canary in the coal mine” for ecological challenges facing other species like salmon. To address the decline of these species, the Columbia River treaty tribes (Umatilla, Nez Perce, Yakama, and Warm Springs) created a comprehensive restoration plan for Pacific lamprey. The Tribal Pacific Lamprey Restoration Plan is the first restoration plan for Pacific lamprey that will address lamprey restoration through a wide range of mainstem and tributary actions. The plan looks to halt the decline of lamprey by 2012 and reestablish lamprey populations throughout the mainstem Columbia River and its tributaries. The plan seeks to improve mainstem and tributary passage for juvenile and adult lamprey, restore and protect mainstem and tributary habitat, reduce toxic contaminants, and consider supplementation programs to aid re-colonization throughout the basin (CRITFC, 2011). Additional efforts to reverse the decline of Pacific lamprey are now underway, and are guided by the USFWS lamprey recovery planning and the Pacific

Lamprey Recovery Plan for the Yakima Basin, which is being developed by the Yakama Nation Fisheries Program.

6.5 Existing County FWHCA Code Provisions and BAS Recommendations

The County's overall framework for habitat protection is contained in KCC 17A.03 and 17A.07. These sections identify and designate the species and habitats that are subject to the code requirements. In general, these regulations are minimal in nature. The amount of scientific information and agency guidance on FWHCA management has grown substantially since the County's regulations were last updated. The following sections describe general code update considerations, along with summaries of existing regulations, best available science, and specific code update considerations for the FWHCAs present in Kittitas County, as defined within the GMA.

6.5.1 Designating Regulated FWHCAs

6.5.1.1 Existing Kittitas County Code

The existing code provides a definition for FWHCAs in KCC 17A.02.090 and indicates that FWHCAs are:

- Those lands in Kittitas County owned or leased by the Washington State Department of Fish and Wildlife;
- Those lands donated to or purchased by Kittitas County for corridors pursuant to RCW 36.70A.160;
- Wetlands;
- Big game winter range;
- Riparian habitat;
- Habitats for species of local importance.

6.5.1.2 Considerations for Code Update

The designation of FWHCAs should be revised and updated to include all elements of the GMA definition:

- Areas with which state or federally listed species (endangered, threatened, candidate, or sensitive) have a primary association.
- State priority habitats and areas associated with state priority species.
- Habitats and species of local importance.
- Naturally occurring ponds under twenty (20) acres.
- Waters of the state.
- Lakes, ponds, streams, and rivers planted with game fish by a government or tribal entity.
- State natural area preserves and natural resource conservation areas.

- Land essential for preserving connections between habitat blocks and open space.

6.5.2 Stream Typing System

6.5.2.1 Existing Kittitas County Code

The KCC currently classifies streams into five categories:

- **Type 1**: shorelines of the state
- **Type 2**: not Type 1, but have a 'high fish, wildlife or human use'
- **Type 3**: not Type 1 or 2, but have a 'moderate to slight fish, wildlife, or human use'
- **Types 4 and 5**: 'not truly waters, but are waterways which are intermittent in nature and may be dry beds at any time of the year'

This typing system is based upon WAC 222-16-031, with the exception of Types 4 and 5. New water types have been established in WAC 222-16-030, but this system will not go into effect until fish habitat water type maps have been adopted by the State. Until such time, the interim water typing system established in WAC 222-16-031 will continue to be used by the State. New water types are presented in Table 6-12 for informational purposes along with a conversion table for the interim and new water types.

Table 6-12. Water Type Conversions from WAC 222-16-031.

Permanent Water Typing	Interim Water Typing
Type S	Type 1
Type F	Types 1 and 2
Type Np	Type 4
Type Ns	Type 5

6.5.2.2 Best Available Science Summary

A state-wide water typing system has been established in WAC 222-16-030. The water types are based primary upon fish use and stream flow regime (perennial or seasonal). This system represents best available science, because it is based on an understanding of stream functions and what is needed to protect fish habitat. As excerpted from WAC 222-16-030, the water types are as follows:

- **Type S Water**: all waters, within their bankfull width, as inventoried as "shorelines of the state" under chapter 90.58 RCW and the rules promulgated pursuant to chapter 90.58 RCW including periodically inundated areas of their associated wetlands.
- **Type F Water**: segments of natural waters other than Type S Waters, which are within the bankfull widths of defined channels and periodically inundated areas of their associated wetlands, or within lakes, ponds, or impoundments having a surface area of 0.5 acre or greater at seasonal low water and which in any case contain fish habitat.
- **Type Np Water**: means all segments of natural waters within the bankfull width of defined channels that are perennial nonfish habitat streams. Perennial streams are waters

that do not go dry any time of a year of normal rainfall. However, for the purpose of water typing, Type Np Waters include the intermittent dry portions of the perennial channel below the uppermost point of perennial flow.

- **Type Ns Water:** means all segments of natural waters within the bankfull width of the defined channels that are not Type S, F, or Np Waters. These are seasonal, nonfish habitat streams in which surface flow is not present for at least some portion of a year of normal rainfall and are not located downstream from any stream reach that is a Type Np Water. Ns Waters must be physically connected by an above-ground channel system to Type S, F, or Np Waters.

6.5.2.3 Considerations for Code Update

Implementing the water typing system of WAC 222-16-030 has advantages in terms of stream protection and management. Additionally, adopting the State system would be beneficial to applicants with proposed projects that would require both County and State permit approvals.

6.5.3 Documenting FWHCAs

6.5.3.1 Existing Kittitas County Code

The KCC currently requires the preparation of a critical area checklist by applicants, which includes:

1. A legal description of the land;
2. The location of critical areas on the identified land;
3. Any voluntary methods or activities as it pertains to critical areas, including incentives offered by local or state government;
4. Plans to scale showing location of proposed work, dimensions of proposed structures, estimates of fill/excavation, drainage facilities, and significant natural features (Survey not normally required);
5. Provisions for waiver of critical area delineation; and
6. Provisions for field verification of critical area checklist.

The checklist is then processed by Kittitas County Community Development Services, which then makes a determination as to whether or not critical area are located on the property and makes a final decision consistent with the underlying permit concerning the critical area designation and related mitigation (KCC 17A03.040).

6.5.3.2 Best Available Science Summary

To avoid and minimize potential project-related impacts to FWHCAs, the areas should be thoroughly assessed and documented. The boundaries of wildlife habitat areas can be difficult to accurately determine; this work should be performed by a qualified professional biologist with Kittitas County-specific knowledge and experience.

6.5.3.3 Considerations for Code Update

When habitat mapping (such as the State PHS maps) indicates that a development would occur within or adjacent to a FWHCA, the applicant should provide the adequate information to the County on existing site conditions, impacts, and mitigation (in addition to the information currently required in KCC 17A03.040). This information should be provided in the form of a Critical Areas Study (CAS) or Habitat Management Plan (HMP), which should be prepared by a qualified specialist in the disciplines of fish and/or wildlife biology. The information provided on FWHCAs in the report can be utilized by Kittitas County to ensure compliance with the FWHCA provisions of the CAO. Listed below is the standard information that should be provided by the applicant and should be incorporated into the code update for critical areas, at a minimum:

- Map showing location of OHWM and/or locations of wildlife habitat conservation area(s);
- Identification of any endangered, threatened, sensitive, or candidate species that have a primary association with the habitat(s) in the project area;
- Vegetative, faunal, topographic, and hydrologic characteristics of the habitat; and
- Detailed discussion of potential direct and indirect impacts resulting from the project, and the management practices to be utilized that will protect the habitat after the project site has been developed.

6.5.4 Wildlife Habitat Buffers

6.5.4.1 Existing Kittitas County Code

KCC 17A.07 does not contain provisions for wildlife habitat buffers.

6.5.4.2 Best Available Science

For wildlife, the principal functions of buffers are to provide habitat (feeding, cover, and breeding) and travel corridors; microclimate modification; organic input; and to ameliorate the impacts of human disturbance (light, noise, human intrusion) (Castelle et al., 1992; Kauffman et al., 2001; Sheldon et al., 2003). Effective buffer widths vary, depending primarily on the wildlife species of interest (see previous discussion of wildlife buffer widths and functions).

6.5.4.3 Considerations for Code Update

Given that the range of effective buffer widths presented in the science varies greatly depending upon the specific species of interest, it may not be useful to incorporate specific standard wildlife habitat buffer widths in the KCC. The County should consider requiring protective buffers for designated wildlife habitat protection areas, and having the appropriate site- and species-specific buffer determined by a qualified professional biologist.

6.5.5 Stream Buffers

6.5.5.1 Existing Kittitas County Code

Buffer Widths

In the existing KCC 17A.07.010(2), required riparian buffers range from 0 to 200 feet, depending upon the stream type and other factors, such as the intensity of the proposed use and the presence of anadromous fish. The specified buffer widths from OHWM are:

- **Type 1 waters**: 40-200 feet
- **Type 2 waters**: 40-100 feet
- **Type 3 waters**: 20-50 feet
- **Type 4 waters**: 10-20 feet
- **Type 5 waters**: no buffer required

The existing County code does not specify how the specific buffer widths are to be determined within the range of buffers listed for each stream type. For example, the code does not indicate how much or what type of enhancement is required to qualify for the smallest buffer width, or what is considered a high-intensity vs. a low-intensity land use.

Uses in Riparian Buffers

Riparian buffer areas are to be retained in their natural condition or may be improved to enhance buffer functions and values. Where buffer disturbance has occurred during construction, revegetation with native vegetation may be required. The Kittitas County noxious weed ordinance must be followed (KCC 17A.04.035).

Although reference is made to keeping buffers in a natural condition, the County's existing regulations do not explicitly state that buffers must be well vegetated. The code says that revegetation "may be" required if buffers are disturbed during construction. The code does not specifically prohibit activities that reduce buffer functions such as impervious surfaces, soil compaction, or vegetation clearing in buffers.

Buffer Width Averaging

Riparian buffer width averaging is allowed in Kittitas County under certain conditions. The applicant has to demonstrate that: 1) averaging is necessary to avoid an extraordinary hardship caused by circumstances peculiar to the property; 2) the buffer contains variations in sensitivity due to physical characteristics; 3) low-impact land uses would be located adjacent to areas where the buffer is reduced; and 4) buffer width averaging will not adversely impact riparian function and values (KCC 17A.07.010[5]).

6.5.5.2 Best Available Science

Buffer Widths

Riparian buffer areas provide a variety of important functions, such as providing habitat for many species of wildlife, water shading, bank stabilization, sediment/nutrient filtering, and organic nutrient input. For protection of instream salmonid habitat conditions, a wide range of recommended riparian buffer widths is presented in existing studies (see previous discussion of riparian buffer functions). Ideally, designation of riparian buffer widths should consider the ecological, cultural, and economic values of the resource, land use characteristics, and existing riparian quality throughout watersheds in order to address the cumulative impacts on stream functions and the resources being protected. According to BAS, a buffer width of about 100 feet would reasonably provide for most stream riparian habitat functions important to fish populations. For streams without fish populations, buffers between 30 and 100 feet would be adequate to protect most non-habitat riparian functions, such as sediment filtration and pollutant removal.

Uses in Riparian Buffers

Human disturbances to buffers can reduce the effectiveness of riparian buffers over time. The goal of regulating the types of uses allowed within riparian buffers is to ensure that the buffers serve their purpose of providing habitat and protecting stream functions over time. Uses that create impervious areas, clear vegetation, or compact soils may compromise the buffer's ability to protect riparian functions. Examples of low-impact uses that are often allowed in buffers include stormwater treatment facilities (e.g., swales or level spreaders) and pervious walking trails.

Buffer Width Averaging

The Kittitas County provisions for buffer width averaging are generally consistent with best available science and agency guidance. However, County code does not specify a minimum allowable buffer width (either in feet or percent of standard width). This could allow buffers to be reduced well below the widths that have been found in the scientific literature to provide certain functions.

6.5.5.3 Considerations for Code Update

The following revisions would help ensure that County buffer requirements protect riparian functions and are more consistent with the scientific information about buffer functions. These changes can also provide more certainty for applicants about what buffer widths will be applied for their projects.

- Define buffer standards for all stream types that are consistent with the best available science. It is recommended that the following minimum buffer widths be specified in the KCC:
  - Type S waters: (determined under the County's Shoreline Management Program)
  - Type F waters: 100 feet
  - Type Np waters: 50 feet
  - Type Ns waters: 30 feet
- Activities that reduce buffer functions (e.g., vegetation clearing, impervious surfaces, soil compaction) should be subject to mitigation sequencing requirements. Appropriate mitigation should be required for buffer impacts. This could be specified in an earlier section of the code that applies to all critical areas.

- To ensure protection of riparian functions when buffer averaging is utilized, specify that:
  - The minimum width of the buffer at any point is at least 75% of the standard width or 25 feet , whichever is greater; and
  - The area that is added to the buffer to offset the reduction is well-vegetated. The County could require vegetation enhancement if needed.

6.5.6 Timing Restrictions

6.5.6.1 Existing Kittitas County Code

Timing restrictions for instream work are not specified in KCC and there are no provisions stating that timing restrictions established by other agencies be adhered to. The existing KCC does not include provisions to restrict certain activities or regulate development during key wildlife life stages such as breeding periods.

6.5.6.2 Best Available Science Summary

It is widely understood that placing limitations on when certain activities can be conducted can minimize impacts to species. For example, restricting soil disturbing activities adjacent to streams or rivers to periods of low precipitation (typically summer and early fall) can minimize the potential for erosion of upland soils and delivery of fine sediments to streams, which can degrade spawning habitat for salmonids and also result in direct injury to fish via increased turbidity. Also, land use activities or construction activities can be timed to occur when sensitive fish and wildlife species are least likely to be present based on each species specific life histories.

6.5.6.3 Considerations for Code Update

KCC should specify that all in-water work timing will be consistent with approved fish work windows determined by WDFW and referenced in the WAC. In addition, limitations should be placed on development activities during breeding and nesting periods for important species. Appropriate timing restrictions for wildlife species should be based upon best available science and agency recommendations, and specified in the project Habitat Management Plan.

6.5.7 Habitat Mitigation

6.5.7.1 Existing Kittitas County Code

With the exception of riparian buffers, KCC 17A.07 does not contain provisions for mitigating direct, unavoidable impacts to aquatic or wildlife habitat. In addition, the existing regulations do not include a mitigation sequencing requirement. In other words, applicants are not required to document that proposed impacts to FWHCAs and their buffers have been avoided and minimized before unavoidable impacts are allowed. This reduces the incentive for applicants to find ways to avoid impacts, and therefore it is more likely that mitigation will be required. Because many mitigation projects are unsuccessful there is no guarantee that lost functions will be replaced, especially in the short term.

6.5.7.2 Best Available Science Summary

Recent evaluations of the success of mitigation efforts statewide and throughout the nation have strongly recommended more emphasis on impact avoidance and minimization (the first two preferred steps in mitigation sequencing) to reduce the need for compensatory mitigation (Ecology 2008, ELI and TNC 2009).

When impacts are unavoidable, restoration or enhancement of existing fish and wildlife habitat or creation of new habitat is necessary to maintain habitat functions. Mitigation should be planned by a professional biologist, with experience in habitat restoration. To ensure that the mitigation is successful, the site should be monitored and maintained for a specified period (5 or more years).

6.5.7.3 Considerations for Code Update

To improve the success of compensatory mitigation projects and reduce the risk of a net loss of habitat functions, the following updates to County FWHCA regulations could be considered:

- Require mitigation sequencing in the County's FWHCA regulations to increase the incentive for applicants to avoid impacts and the need for mitigation. This would reduce the potential for net loss of habitat functions.
- Require mitigation projects to have a mitigation plan prepared by a qualified professional, including written goals, objectives, performance standards, a monitoring and maintenance plan, and a contingency plan. The project applicant is responsible for site monitoring and maintenance throughout a specified number of years.

6.5.8 Channel Migration Zones

Pursuant to WAC 365-190-120(6), channel migration zones are considered to be geologically hazardous areas. See Section 2.5 for code considerations for regulating channel migration zones.

6.6 Summary of Findings and Code Recommendations

Table 6-13 summarizes considerations for updates to Kittitas County FWHCA regulations based on a review of the best available science.

Table 6-13. Summary of Considerations for Updates to Kittitas County Wetland Regulations

Topic	Existing Kittitas County Code Sections (if applicable)	Potential Code Changes
Designating FWHCAs	KCC 17A.02.090	Use the standard GMA definitions for FWHCAs.
Stream Typing System	KCC 17A.07.010	Implement the water typing system specified in WAC 222-16-030.
Documenting FWHCAs		Specify the conditions under which a special habitat study will be required. For example, a study, performed by a qualified biologist, could be required if a development is proposed within 200 feet of a mapped priority wildlife habitat area. At a minimum, a special habitat study should include the following information: • Map showing location of OHWM and/or locations of wildlife habitat conservation area(s) • Identification of any endangered, threatened, sensitive, or candidate species that have a primary association with the habitat(s) in the project area • Vegetative, faunal, topographic, and hydrologic characteristics of the habitat • Detailed discussion of potential direct and indirect impacts resulting from the project, and the management practices to be utilized that will protect the habitat after the project site has been developed
Wildlife Habitat Buffers		Require protective buffers for designated wildlife habitat protection areas. The appropriate site- and species-specific buffer should be determined by a qualified professional biologist, based upon the best available science.
Stream Buffers	KCC 17A.07.010	Define buffer standards for all stream types that are consistent with the best available science. It is recommended that the following minimum buffer widths be specified in the KCC: • Type S waters: 150 feet • Type F waters: 100 feet • Type Np waters: 50 feet • Type Ns waters: 30 feet Specify that activities that reduce buffer functions should be subject to mitigation sequencing requirements. For unavoidable impacts, appropriate mitigation should be required for buffer impacts. Specify a minimum buffer width (or percentage) that is allowed for buffer width averaging.

Topic	Existing Kittitas County Code Sections (if applicable)	Potential Code Changes
Timing restrictions		Specify that all in-water work timing will be consistent with approved fish work windows, as determined by WDFW and referenced in the WAC. In addition, limitations should be placed on development activities during breeding and nesting periods for important species. The regulations should state that appropriate timing restrictions for wildlife species should be based upon best available science and agency recommendations, and specified in the project Habitat Management Plan.
Habitat mitigation		To improve the success of compensatory mitigation projects, the following mitigation regulations should be considered: • Add a mitigation sequencing requirement to the FWHCA regulations, to reduce the potential for a new loss of habitat functions. This could be specified in an earlier section of the code that applies to all critical areas. • Specify that mitigation projects must have a mitigation plan prepared by a qualified professional that includes written goals, objectives, performance standards, a monitoring and maintenance plan, and a contingency plan. Specify that mitigation projects must be monitored and maintained for at least 5 years.
Channel migration zones		See Section 2.5

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APPENDIX A
CRITICAL AREA INVENTORY MAPS