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KITTITAS COUNTY CRITICAL AREAS ORDINANCE – FREQUENTLY FLOODED AREAS

Best Available Science Review and Considerations for Code Update

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1.0 INTRODUCTION

Washington State's Growth Management Act (GMA) (RCW 36.70A.060) requires counties and cities to adopt development regulations that protect the functions and values of critical areas, including frequently flooded areas. Kittitas County is undertaking an update of its critical areas ordinance, along with concurrent updates to its shoreline master program. These two efforts overlap and are being closely coordinated. The Washington State Shoreline Management Act (RCW 90.58) requires shoreline master programs to "provide a level of protection to critical areas within the shoreline area that assures no net loss of shoreline ecological functions necessary to sustain shoreline natural resources" (WAC 173-26-221 (2)).

For regulatory purposes, frequently flooded areas are defined, at a minimum, as "lands in the floodplain subject to a one percent or greater chance of flooding in any given year, or within areas subject to flooding due to high groundwater. These areas include, but are not limited to, streams, rivers, lakes, coastal areas, wetlands, and areas where high groundwater forms ponds on the ground surface" (WAC 365-190-030 (8)). This is generally equivalent to the so-called "100-year" floodplain designation mapped by the Federal Emergency Management Agency (FEMA) on Flood Insurance Rate Maps (FIRMs). The FIRMs delineate the 100-year floodplain as consisting of the *floodway* (the area of the floodplain that should be reserved or kept free of obstructions) to allow floodwaters to move downstream and to prevent substantial increases in flood heights) and the *flood fringe* (the 100-year floodplain outside the designated floodway). The floodway is managed for conveyance of floodwaters, while the flood fringe is managed to provide storage, but not to provide significant conveyance. The 100-year flood is also termed the *Base Flood*, and the total area subject to flooding during the 100-year flood is the *Area of Special Flood Hazard*.

As summarized in King County (2004) a floodplain is the generally flat, low-lying area adjacent to a river or stream that is periodically inundated by overbank flows during storm events. Floodwaters rise above the natural containment levels in rivers and streams as a result of excessive rainfall or snowmelt or both. Inundation often causes bank erosion, whereby banks are scoured or undermined by high velocity erosive flows. Bank erosion can expand and exacerbate the flood hazard and/or cause movement or shifting of the channel, gradually over time or episodically through stream avulsion.

Both flooding and channel migration are natural processes that can put life and property at risk.

Development within a floodplain exacerbates these risks. At the same time, overbank flooding provides beneficial ecological functions in terms of sediment and nutrient exchange, sediment storage and groundwater recharge. Flooding and channel migration processes create and maintain healthy aquatic and riparian habitats for fish and wildlife. This includes habitats in the Yakima River basin for the Mid-Columbia River steelhead Distinct Population Segment (DPS) and the Columbia River DPS of bull trout, both listed as threatened under the federal Endangered Species Act.

Kittitas County has significant exposure to several natural flood hazards that have caused millions of dollars in damage in recent years (Tetra Tech 2012). While it is important to protect the functions and values of frequently flooded areas for water quality, quantity, and wildlife habitat, it is also important to protect life and property from the natural hazards associated with these areas.

WAC 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 flood plain 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[1];
5. Greater surface runoff caused by increasing impervious surfaces.

This paper provides an overview of the best available science pertaining to frequently flooded areas and the management of such areas in Kittitas County. The paper reviews the County's existing regulations on frequently flooded areas and (provided as Attachments A and B) and offers considerations for how to incorporate the current scientific understanding of floodplains into their long-term management and protection in Kittitas County. This paper discusses frequently flooded areas chiefly from the perspective of flood effects on human health, safety, and property protection, 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 will be addressed in the papers for wetlands and fish and wildlife habitat conservation areas. One important goal of these reviews will be to ensure that the connection between frequently flooded areas and the other critical areas regulated under Kittitas County Code (KCC) Title 17A is integrated so that ecological impacts associated with development within frequently flooded areas are adequately addressed, consistent with the GMA.

2.0 OVERVIEW OF INVENTORY

FEMA mapping of the 100-year floodplain provides the basis for designation, protection, and regulation of frequently flooded areas (KCC17A.02.140). The 1981 FIRMs for

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

Kittitas County are the official effective maps for Kittitas County, every city and town in the County, and the Yakima Tribe. FEMA distributed the information to the County in digital format and it is available via Kittitas County Community Development Services GIS.

FEMA initiated a nationwide effort in 1997 to modernize the flood mapping program (FEMA 2001). The updated maps will use digital orthophotogrammetry to produce more accurate base maps, from which improved floodplain boundaries will be delineated. In conducting the Map Modernization Program, FEMA will consult with, receive information from, and enter into agreements or other arrangements with State, regional, and local agencies to identify floodplain areas. The intent of using local agencies is to provide more accurate representations of floodplain conditions (FEMA 2003a).

FEMA has commissioned a new Flood Insurance Study and Digital Flood Insurance Rate Map (DFIRM) is currently being conducted within Kittitas County. When completed (adoption of the study results is anticipated in late 2013) a new and more accurate digital version of a FIRM will provide for more powerful mapping and analysis than currently exists with the 1981 paper FIRMs.

3.0 FREQUENTLY FLOODED AREAS IN KITTITAS COUNTY

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 encompasses 2,300 square miles within three major basins or Water Resource Inventory Areas (WRIAs):

Upper Yakima (WRIA 39),

- Alkali – Squilchuck (WRIA 40), and
- Naches (WRIA 38).

Most of the County's area (78 percent) lies within the Upper Yakima basin, which drains into the Yakima River. The Alkali – Squilchuck basin (17 percent) is in the eastern part of the County and drains into the Columbia River. A small portion (5 percent) in the southwestern part of the County is in the Naches basin and drains into the Little Naches River, which becomes the Naches River joining the Yakima River in Yakima County.

Flooding of the stream corridors within Kittitas County generally occurs by three different mechanisms:

- severe but less frequent winter floods resulting from warm Chinook winds or rain-on-snow;
- spring floods resulting from rapid snow melt; and
- short, intense thunderstorms that cause localized flooding and debris flows (Kinnison and Sceva 1963; USACOE 1972).

Flooding typically occurs when runoff reaches the stream channel quickly, usually within a day or so of falling on the ground. Severe stormwater events in eastern Washington are caused by intense precipitation over a short time period. 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, expected in April through June, typically have a larger total volume but are less destructive and last for a longer time period (Tetra Tech/KCM 2003; USACOE 1975).

According to the FEMA FIRM data, there are 7,326 acres of floodway and 48,108 acres of 100-year floodplain within Kittitas County (Figure 1 - provided under separate cover). The majority of this area is within and adjacent to Interstate-90 (I-90), on the mainstem Yakima River. However, Kittitas County has major floodplains along the Yakima, Cle Elum, and Teanaway rivers, as well as along Manastash, Naneum, Taneum, Big, Little, Dry and Reecer Creeks. There are other minor regulated floodplains located throughout the county. The floodplains range from urban type settings around the Cities of Ellensburg and Cle Elum to the rural areas along the Teanaway and smaller streams. Many of the "levees" along these rivers and streams were built more than 80 years ago without regard to future development conditions. None of these levees are federally certified as flood control structures [2](Personal Communication, Kirk Holmes, Kittitas County, June 2012). As such, these aging levees 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 many flood problem areas in Kittitas County. Large-scale developments with urban densities 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 large and unpredictable floodplains and flood capacities. These include, but are not limited to, Cabin, Cole, Big, Little, Silver, Gold, Manastash, Taneum, Wilson and Reecer Creeks (Tetra Tech 2012).

Floods on the Yakima, Teanaway and Cle Elum Rivers occur as the result of snowmelt in spring and early summer and occur after heavy rains in November through March. Ice and debris can have an impact on flood stages when culverts and bridges are obstructed. The spring/summer snowmelt floods are characterized by slow rise and long high flow durations; river stages may be increased by ice and debris jams (Tetra Tech 2012). 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. These 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).

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[2] 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.

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).

Kittitas County experiences episodes of river flooding almost every winter. Large floods that can cause property damage typically occur every three to seven years. Urban portions of the County annually experience nuisance flooding related to drainage issues. The major floods in Kittitas County have resulted from intense weather rainstorms between November and March. 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. Recent floods occurred in November 1990, November 1995 and February 1996 (Tetra Tech 2012). Three recent widespread and severe flooding events occurred in 2009 and 2011, 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. Since 1964, nine presidential-declared flood events in the county have caused in excess of $50 million in property damage.

4.0 FLOODPLAIN FUNCTIONS AND VALUES

Floodplains perform a variety of important water, biological, and societal functions that provide for natural flood and erosion control, water quality maintenance, groundwater recharge, biological productivity, fish and wildlife, harvest of wild and cultivated products, recreational opportunities, and areas for scientific study and outdoor recreation (Federal Interagency Floodplain Management Task Force Report 1994). Floodplains typically contain several major types of habitats including aquatic, riparian, wetland, and upland habitat.

Kusler (2011) summarized specific floodplains functions and values as follows:

- **Provide flood storage.** Many floodplains temporarily store flood waters and reduce flood heights and velocities for downstream lands.
- **Provide flood conveyance.** Many floodplains act as conveyance areas, reducing flood heights and velocities at upstream, adjacent and downstream lands.
- **Reduce excessive erosion.** Many vegetated floodplain areas help 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.** Many vegetated floodplains, and the wetlands they contain, reduce the sediment flowing into lakes, streams, and estuaries by intercepting and trapping sediment.
- **Provide groundwater recharge.** Some floodplains provide groundwater recharge although most are discharge areas much of the year.

- **Provide groundwater discharge.** Some floodplains help maintain the base flow of streams and help to reduce ground water levels (which would otherwise flood basements) by providing groundwater discharge.
- **Prevent and treat pollution:**
  - Prevent pollution from entering water body **-**Virtually all types of vegetated floodplains and the wetlands they contain may intercept sediments, nutrients, debris, chemicals, etc. from upland sources before they reach down gradient rivers, streams, lakes, estuaries, oceans, and ground waters.
  - Treat (remove) pollution in water body - Wetlands located in lakes, streams, estuaries, depressions, and at other locations may remove pollutants from waters.
- **Provide habitat for fish and shellfish.** Floodplains adjacent to lakes and streams can provide food chain support, spawning areas, rearing areas, and shelter for fish and shellfish.
- **Provide habitat for amphibians, reptiles, mammals, and insect species.** Many floodplains and floodplain wetlands provide habitat for a broad range of mammals, reptiles, amphibians, and birds and corridors for migration or movement.
- **Provide habitat for rare, endangered and threatened species.** Virtually all types of floodplains may provide food chain support, feeding, nesting, and substrates for endangered and threatened animals and plants.
- **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.
- **Provide micro-climate modification.** Floodplains, particularly those near cities, may reduce temperatures and reduce air pollution levels.
- **Provide recreational opportunities and scenic beauty.** Many 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.
- **Provide historical, archaeological, heritage, cultural opportunities.** Some floodplains have historical value; others have archaeological value (e.g., shell middens, burial sites).
- **Provide educational and interpretive opportunities.** Many floodplains and the wetlands they contain provide education and research opportunities for schools and universities and government agencies
- **Provide 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.

4.1 Flood Water Storage

Floodplains store flood waters, which reduces the height, areal extent, and velocity of floodwaters at the point where the floodplain storage exists, as well as upstream and downstream areas. 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, in turn reducing backwater effects and reducing 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.

4.2 Sediment Deposition and Storage

Floodplains also provide for reductions in flow velocity, reduced erosion, and enhanced 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 cross-section. Additionally, vegetation in the floodplain creates roughness. A wider cross-section and increased roughness result in lower flow velocity, which in turn, reduces the erosive power of flowing water. Reduced velocity and physical trapping in vegetation also allow for suspended sediment to settle in the floodplain. This benefits the floodplain and stream, depositing fertile soil and nutrients in the floodplain, and reducing sedimentation in the stream channel. An added benefit of river flow over the floodplain (and the associated reduction in velocities in the main channel) is recruitment and retention of large woody debris (LWD) in the channel; LWD is a critical element of salmonid habitat.

4.3 Groundwater Recharge and Baseflow Maintenance

Floodplains are an interface between groundwater and surface water, providing areas of groundwater discharge or recharge. These areas may vary spatially or seasonally. For example, some areas may always be a discharge or recharge point, based on relatively constant groundwater levels and flow patterns. Other areas may act as a recharge point during dry months when the water table is low and a discharge point 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).

4.4 Floodplain Habitat

Floodplains are also a setting for riparian ecosystems. Riparian ecosystems are found where high water tables, overbank flooding, or channel meandering occur. 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 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 also discussed in the Fish and Wildlife Habitat Conservation Area paper.

4.5 Channel Migration Zones

The channel migration zone (CMZ) boundary delineates the area in which channel processes will occur over a specified period of time (e.g., 100 or 500 years). 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 Creek, Cooper River and Gold Creek (Personal Communication, Patricia Olsen, Ecology, April 2012).

The presence and configuration of a CMZ generally depend on whether the amount of sediment is in balance with or greater than the stream's ability to transport sediment. When the amount of sediment exceeds the stream's ability to transport it, the stream channel will aggrade and raise its bed elevation. Aggraded channels tend to move horizontally to form multiple or braided channels in order to deposit sediment. If the sediment supply is reduced or removed, or if stream flow increases, channels will incise and become entrenched and channelized (see discussion of effects of channelization below). Channels respond with horizontal movement (lateral migration, avulsion, channel widening, channel narrowing) and vertical movement (incision and aggradation) depending on site-specific circumstances and watershed conditions (Ecology 2003).

Channel migration zone typically encompass floodplains and some portions of terraces. Although CMZs may simply correspond to the channel itself, as is the case with bedrock canyons, CMZs can also extend from hillslope to hillslope across the entire valley bottom, as is the case with some alluvial rivers. Increased entrenchment can cause the channel to abandon former floodplains, which become terraces that are seldom flooded or entirely isolated from the stream, although abandoned floodplains are still at risk from channel migration. Channel migration creates a diverse collection of vegetation types and ages, which promotes a healthy aquatic, riparian, and terrestrial system (Naiman and D'ecamps 1997).

The area necessary to maintain the functions and values of frequently flooded areas may include the extent of the 100-year floodplain, and should be wide enough to permit natural channel migration (Knutson and Naef 1997; Snyder and Stanford 2001; Stanford et.al. 2002; Ward and Stanford 1995). The *Fish and Wildlife Habitat Conservation Area* BAS paper discusses regulation of channel migration zones.

5.0 HUMAN ACTIVTY 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 improvements (roads)—and channelization. The combination of these activities often results in a disconnection of 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) and water withdrawals (e.g., irrigation). Each of these impact mechanisms is described below. Climate change will also affect alter the flow regime, potentially exacerbating other types of human disturbance within floodplains.

5.1 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). Much of the 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.

Without compensatory volume replacement, filling would reduce floodplain storage, and result in increased flood elevations. Fill directly affects salmon and other aquatic species by converting aquatic habitat areas to uplands. NMFS (2008) indicates that although some would argue floodplains are not lost with filling, because floodwaters are merely displaced to different locations along the river system. However, this paradigm fails to recognize that rather than inundating high quality riparian areas, wetlands, oxbows, and other off-channel habitats, floodwaters are increasingly displaced to areas that include infrastructure that represents poor habitat, such as roads, homes, and businesses.

Filling, paving, soil compaction, and construction of impervious surfaces also increase runoff (increasing peak flows and durations of elevated flows) and reduce infiltration (reducing groundwater recharge and base flows). Surface erosion can also increase from filled sites and from agricultural fields if proper best management practices (BMPs) are not in place (e.g., buffers, relay crops, etc.).

Filling also reduce 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 infratstructure 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.

5.2 Floodplain Clearing

Another type of floodplain impact, related to human development and often associated floodplain filling is the loss of natural riparian and upland vegetation **(**Haring 2001). Presettlement riparian vegetation in floodplain areas 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 LWD 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 in channels, 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.

5.3 Channelization

Stream or river channelization can be described as 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).

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), increased 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).

A primary cause of channelization are hydromodifications, defined as hardened features that act as barriers that restrict the movement of water, sediment, animals (e.g., fish), or other material such as LWD, either downstream or laterally within the floodplain, including the channel migration zone. 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 also 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).

5.4 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. These types of disconnection has: 1) reduced or eliminated off-channel habitats such as sloughs and side channels; 2) increased flow velocity during flood events due to the constriction of the channel; 3) reduced subsurface flows and groundwater contribution to the stream; and 4) simplified channels since LWD is lost and channels are often straightened when levees are constructed (Haring 2001). Channels can also become disconnected from their floodplains as a result of down-cutting and incision of the channel from losses of LWD, decreased sediment supplies, and increased high flow events.

Reduced connectivity between off-channel and mainstream habitats impacts the ability of the ecosystem to support salmonid populations, including steelhead and bull trout. Elimination of off-channel habitats results in the loss of important habitats for juvenile salmonids. Sloughs and backwaters that are 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 LWD 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).

5.5 Flow Regulation

Flow regulation (dams and reservoirs) have known affects on several fundamental ecological principles essential to the proper functioning of riverine systems such as reduced habitat diversity and decreased native biodiversity with increasing non-native species (Stanford et al. 1996, Eitemiller et al. 2002). In addition to these affects, floodplain function is also impacted. Flow regulation can reduce nutrient exchange between the floodplain and the river channel, due to less frequent overbank flows, as well as reducing occurrence of the frequent small-discharge flood events that are central components to maintaining habitat connectivity, resulting in altered habitat formation processes (Eitemiller et al. 2002).

Stormwater runoff from impervious surfaces can also increase the volume of water and the timing and size of the peak flood (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).

5.6 Climate Change

A recent review of the effects of climate change on salmon (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) and 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.

Warmer temperatures will result in more winter precipitation falling as rain rather than snow throughout much of the Pacific Northwest, particularly in mid-elevation basins where average winter temperatures are near freezing. The decline of the region's snowpack is predicted to be greatest at low and middle elevations due to increases in air temperature and less precipitation falling as snow. The average decline in snowpack in the Cascade Mountains, for example, was about 25% over the last 40 to 70 years, with most of the decline due to the 2.5 degrees F increase in cool season air temperatures over that period. As a result, seasonal stream flow timing will likely shift significantly in sensitive watersheds (Littell, et al., 2009).

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. In addition to affecting general river hydrology, changes in climate can result in changes in the timing, magnitude, and frequency of flood flows and alter sediment dynamics in streams, thereby affecting the processes that form and maintain floodplains.

6.0 FUNCTIONS AND STATUS OF FREQUENTLY FLOODED AREAS 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 significantly degraded aquatic habitat. 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 via urbanization and irrigation activities.

Yakima River floodplains were likely historically important in providing fish habitat

(Snyder and Stanford, 2001), but these areas are now degraded (Stanford 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 also 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 streamflow 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 are directly affected by the truncation of flood flows that results 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 in the Yakima River Basin. Of particular importance has been the loss of habitat complexity, including connectivity between off-channel and mainstream habitats, 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 wetted areas that occurred historically. This deprivation of lateral connectivity has resulted in loss of habitat, reduced vertical connectivity, loss of or changes in nutrient flux, and reduction in the tempering affect of groundwater on stream temperature. The result has been a significant loss, compared to pristine conditions, of horizontal and vertical connectivity; diminished habitat heterogeneity through the loss of off-channel habitat; and a general loss of ecosystem function.

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. 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 removing 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, forestry, or rural residential areas. Some mapped floodplains are within areas designated for master planned resort or urban uses. 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 also 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.

7.0 FLOODPLAIN MANAGEMENT AND PROTECTION TOOLS

In addition to existing Kittitas County code concerning frequently flooded areas (KCC 17A.05) and flood hazards (KCC 14.08), several floodplain management tools are directly relevant to floodplain management within Kittitas County. These include the recently developed Hazard Mitigation Plan (Tetra Tech 2012), the proposed county-wide Flood Control Zone District (FCZD), the Washington Model Flood Damage Prevention Ordinance, and recent guidance by FEMA and the National Marine Fisheries Service (NMFS) on ensuring the NFIP is consistent with the Endangered Species Act (ESA).These mechanisms for managing frequently flooded areas, mitigating flood hazards, and protecting humans and natural habitats are described below.

7.1 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 a FCZD. In January 2012 the Citizens Advisory 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 Flood Control Zone District in accordance with RCW 86.15 (see Attachment C for resolution). On July 17th, 2012, the BOCC is scheduled to make a final decision regarding formation of the FCZD. The initial efforts of the FCZD, whose boundaries include all of Kittitas County including incorporated areas, 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.

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 FCZS will update the 1996 Comprehensive Flood Hazard Management Plan (CFHMP).

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.

7.2 Washington Model Flood Damage Prevention Ordinance

As a condition of participation in the National Flood Insurance Program (NFIP), communities are required to adopt and enforce a flood hazard reduction ordinance that meets the minimum requirements of the NFIP (44 CFR 60.3); however, 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. Additionally, development in the floodway (where water is likely to be deepest and fastest) will potentially create constrictions that increase flood heights. 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 floodplain ordinance is generally consistent with the 2004 Model Code, and with State and Federal Requirements for flood control and protection. Kittitas County’s ordinance, as based on the 2004 Model Ordinance, identifies flood hazard areas, provides procedures for development permits, review, and enforcement, and provides standards for floodproofing and flood control activities.

7.3 NMFS Biological Opinion on FEMA NFIP

In western Washington, changes to floodplain management have been driven by the 2008 National Marine Fisheries Service (NMFS) Biological Opinion on the National Flood Insurance Program (commonly referred to as the NFIP BiOp). The BiOp determined that implementation of the NFIP in the Puget Sound region was jeopardizing Endangered Species Act-listed salmon species through damage to associated habitat within floodplain areas.

The Northwest Region NMPS BiOp issued a Reasonable and Prudent Alternative (RPA) to the existing NFIP in Puget Sound. An RPA is an action(s) that a federal agency can take to avoid the likelihood of jeopardy. The RPA included various elements, which can be summarized as follows:

1. Notify affected communities of determination
2. Change mapping procedures to reduce impacts
3. Require communities to consider impacts on fish habitat when issuing floodplain development permits
4. Changes to community rating system (CRS) program
5. Addressing levee vegetation maintenance effects
6. Mitigation to adversely affected habitat
7. Report to NMFS on progress towards meeting requirements

Element 3 of the RPA requires communities to consider impacts on fish habitat when issuing floodplain development permits. In response element 3 of the BiOp, the FEMA now requires all future public and private development in Puget Sound to demonstrate that it will not adversely affect Endangered Species Act listed salmon and associated habitat. Cities and counties throughout the Puget Sound region are responsible for approving compliance before issuing floodplain development permits, creating new technical, administrative, and legal challenges. FEMA (2010) developed a *Model Ordinance for Floodplain Management under the National Flood Insurance Program and the Endangered Species Act* as one pathway to meet the requirements of the BiOp.

Although many of provisions of the model ordinance (FEMA 2010) are focused on aquatic habitat, the ordinance was written to be inclusive of all ESA-listed species in the affected area. The model ordinance combines structural-based floodplain requirements with species-based habitat requirements and also includes higher regulatory standards than required to meet the requirements of the RPA.

FEMA has developed a total of three key approaches to complying with the NFIP BiOp. Commonly described as the ‘three door’ approach, compliance can occur through 1) adoption of FEMA’s model ordinance, 2) demonstration of programmatic protections that are consistent, and 3) requiring permit-by-permit consistency.

The legal rationale behind the BiOp is currently in the process of being applied to other regions of the western United States where Endangered Species Act-listed salmonids are distributed, and could eventually apply to Kittitas County, where several Endangered Species Act-listed salmonid species occur. For example in March 2012, the U.S. District Court for the Eastern District of California entered judgment in a case based on a settlement agreement in which FEMA agreed to request consultation with the (NMFS and the U.S. Fish and Wildlife Service (FWS) under section 7 of the Endangered Species Act regarding the impacts of its implementation of the NFIP on threatened and endangered species in the Sacramento-San Joaquin River Delta.

8.0 REVIEW OF KITTITAS COUNTY FREQUENTLY FLOODED AREAS REGULATIONS

Kittitas County regulates critical areas, including wetlands, through Title 17A of the KCC, which was last updated in 1995 (Attachment A). Frequently flooded areas are specifically addressed in KCC 17A.05.010 through 17A.05.020.

In adopting revisions to the critical areas code in 1995, the Kittitas County Board of Commissioners raised several important points, including the following:

- Kittitas County has a low per capita income, and the County has an obligation to ensure low-cost economic development and housing.
- Unmaintained wetland and stream buffers can encourage the growth and spread of noxious weeds.
- Voluntary farm conservation programs have already provided substantial benefits to water quality.

The amount of scientific information and agency guidance on floodplain management has grown substantially since the County's frequently flooded 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.

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:

- Incorporation of floodplain functions and values
- Land use regulations within frequently flooded areas
- Reporting requirements for floodplain development
- Mitigation Sequencing
- Requirements for compensatory floodplain storage

8.1 Incorporation of Floodplain Functions and Values

8.1.1 Existing Kittitas County Code

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

8.1.2 Considerations for Code Updates

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:

- KCC 17A.05 (Frequently Flooded Areas) does not refer to KCC 14.08 (Flood Damage Prevention – see Attachment B), and vice-versa. A reference should be adopted within KCC 17A.05, stating that all development shall conform to the provisions of KCC Title 14, Flood Damage Prevention and within Title 14, stating that flood damage protection activities shall conform to Chapter 17A.05.
- KCC does not explicitly recognize that natural floodplains, stream channels, and natural protective barriers help accommodate and convey floodwaters. Consider revision of KCC 17A.05 to indicate that "Natural floodplains, stream channels, and natural protective barriers help accommodate and convey floodwaters".
- KCC does not explicitly recognize the value of frequently flooded areas for maintaining and providing fish and wildlife habitat. Consider revision of 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." Also state the intention that that compliance with KCC 17A shall be consistent with the other provisions of Title 17A that protect ecological functions and values of critical areas and minimize risks of geologic hazards.

8.1.3 Reporting Requirements for Floodplain Development

Existing Kittitas County Code

The KCC currently only 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 the Kittitas County Planning Department, 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).

Considerations for Code Updates

Where development within a frequently flooded area will occur, 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 KCC14.08.110). The information provided can be utilized by Kittitas County to 1) ensure compliance with the frequently flooded provisions of the CAO, and 2) to ensure compliance with the floodplain development permit. Several options that provide various levels discussed below exist for incorporation of additional requirements.

<u>Option 1</u>

Where development will occur within a frequently flooded area, consider requiring the applicant to provide the following specific information within KCC 17A.05 as part of a Critical Areas Study: The example language below summarizes the standard information that should be provided by the applicant:

1. The Critical Areas Study/ floodplain application will provide one or more site plans, drawn to scale, showing:
    - A. The nature, location, dimensions, and elevations of the property in question;
    - B. Names and location of all lakes, water bodies, water-ways and drainage facilities within 300 feet of the site;
    - C. The elevations of the 10-, 50-, 100-, and 500-year floods, where the data are available (see KCC 14.08.040);
    - D. The proposed drainage system including, but not limited to storm sewers, overland flow paths, detention facilities and roads;
    - E. Existing and proposed structures, fill, pavement and other impervious surfaces, and sites for storage of materials;
    - F. All wetlands;
    - G. 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
    - H. Existing native vegetation and proposed revegetation.
2. If the proposed project involves grading, excavation, or filling, the site plan shall include proposed post-development terrain at one foot contour intervals.
3. If the proposed project includes a new structure, substantial improvement, or repairs to a substantially damaged structure that will be elevated, the Critical Areas Study / floodplain application shall include a completed Elevation Certificate, FEMA Form 81-31, (currently required under KCC 14.08) for the building site and the proposed structure.
4. If the proposed project includes a new structure, substantial improvement, or repairs to a substantially damaged nonresidential structure that will be dry floodproofed, the Critical Areas Study / application shall include the Elevation Certificate for the building site and the elevation in relation to the datum of the effective FIRM to which the structure will be dry floodproofed and a certification by a registered professional engineer or licensed

architect that the dry floodproofing methods meet the floodproofing criteria in KCC 14.08 (currently required under KCC 14.08).

5. The Critical Areas Study/ application shall include a description of the extent to which a stream, lake, or other water body, including its shoreline, will be altered or relocated as a result of the proposed development (currently required under KCC 14.08).
6. The Critical Areas Study/ application shall include documentation that the applicant will apply for all necessary permits required by Federal, State, or local law. The application shall include written acknowledgment that the applicant understands that the final certification of use or certificate of occupancy will be issued only if the applicant provides copies of the required Federal, State, and local permits or letters stating that a permit is not required. The floodplain permit is not valid if those other permits and approvals are not obtained prior to any ground disturbing work or structural improvements.
7. Mitigation is required and whether the mitigation and monitoring plans and bonding measures proposed by the applicant.
8. Whenever mitigation is required to compensate for adverse impacts to critical areas, the development application will include:
   A. An analysis of potential impact as detailed above.
   B. A mitigation plan that meets the specific mitigation requirements for frequently flooded areas and that is sufficient to protect the general public health, safety and welfare, consistent with the goals, purposes, objectives and requirements of Title 17A; and
   C. A monitoring plan that includes explicit performance standards and a monitoring protocol adequate to determine compliance with the stated standards.

<u>Option 2</u>

A second option, which would require greater applicant and review effort but would meet the requirements of the NMFS 2008 Bi-Op as well as the 2010 FEMA model ordinance, would include as a requirement submittal of a habitat impact assessment (in addition to the information in Option 1 above) for all activities not currently exempted from a floodplain permit requirement (KCC Title 14) or the following activities.

1. Repairs or remodeling of an existing structure, provided that the repairs or remodeling are not a substantial improvement or a repair of substantial damage.
2. Expansion of an existing structure that is no greater than ten percent beyond its existing footprint, provided that the repairs or remodeling are not a substantial improvement or a repair of substantial damage. This measurement is counted cumulatively from the effective date of this ordinance. If the structure is in the floodway, there shall be no change in the dimensions perpendicular to flow.
3. Activities with the sole purpose of creating, restoring or enhancing natural functions associated with floodplains, streams, lakes, estuaries, marine areas, habitat, and riparian areas that meet Federal and State standards, provided the activities do not include structures, grading, fill, or impervious surfaces.

4. Development of open space and recreational facilities, such as parks, trails, and hunting grounds, that do not include structures, fill, impervious surfaces or removal of more than 5% of the native vegetation on that portion of the property in the Regulatory Floodplain.
5. Repair to onsite Septic Systems provided the ground disturbance is the minimal necessary.

If not specifically excluded by these exceptions, a permit application to develop in the a frequently flooded area that potentially supports Endangered Species Act-listed fish species, shall include an assessment of the impact of the project on federal, state or locally protected species and habitat, water quality and aquatic and riparian habitat. The assessment would determine if the project would adversely affect:

A. Species that are Federal, state or local listed as threatened or endangered.
B. The primary constituent elements for critical habitat, when designated,
C. Essential Fish Habitat designated by the National Marine Fisheries Service,
D. Fish and wildlife habitat conservation areas,
E. Other protected areas and elements necessary for species conservation.

8.2 Land use Regulations within Frequently Flooded Areas

Existing Kittitas County Code

Currently, neither KCC Title 17A specifically reference subdivisions. 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 specify 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.

Considerations for Code Updates

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 shall 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. The County could 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 lot 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 land; and 3) Require a minimum setback of 15 feet from a frequently flooded areas 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 should 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).
- Another option to consider would require greater applicant and review effort but would meet the requirements of the NMFS 2008 Bi-Op as well as the 2010 FEMA model ordinance, would require that new development shall be designed and located to minimize the impact on flood flows, flood storage, water quality, and habitat. Specific requirements could include:

1. Requiring stormwater and drainage features shall incorporate low impact development techniques, if technically feasible, that mimic pre-development hydrologic conditions, such as stormwater infiltration, rain gardens, grass swales, filter strips, disconnected impervious areas, permeable pavement, and vegetative roof systems.
2. If the proposed project will create new impervious surfaces so that more than 10 percent of the portion of the lot in the frequently flooded is covered by impervious surface, the applicant shall demonstrate that there will be no net increase in the rate and volume of the stormwater surface runoff that leaves the site or that the adverse impact is mitigated.

8.3 Mitigation Sequencing

Existing Kittitas County Code

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.

Considerations for Code Updates

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.

Neither Kittitas County frequently flooded area regulations, nor the flood damage prevention code (KCC Chapter 14.08) includes a mitigation sequencing requirement. In other words, applicants are not required to document that proposed impacts to frequently flooded areas 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. Recent evaluations of the success of mitigation efforts statewide and throughout the nation have strongly recommended more emphasis on mitigation sequencing to reduce the need for compensatory mitigation (Ecology 2008, ELI and TNC 2009).

8.4 Requirements for Compensatory Floodplain Storage

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 (see Attachment A). 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."

Applicability of No Net Flood Storage Loss Provision

Although the existing regulations for frequently flooded areas addresses a 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. Loss of floodplain storage and associated hydrologic, geomorphic, and biological functions occurs in smaller streams as well (those with mean annual flow of less than twenty cubic feet per second). In addition, significant flood hazards exist along some of these smaller streams. 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.

Floodplain Compensatory Storage Function

Not all floodplain/ flood storage features provide identical functions. For example, dynamic flood storage can occur where flood flows 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.

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 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.

Considerations for Code Updates

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 designated as shorelines of the state. For example, this requirement could be expanded to include 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. Alternatively, the County could include those non-shorelines of the state where frequent or intense flooding is known to occur.
- 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 in flood hazard, consider incorporating code language that recommends or requires the preferred prioritization of compensatory floodplain mitigation. An example 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.

8.5 Summary of Considerations for Code Updates

There are a number of ways that the Kittitas County frequently flooded regulations (KCC Title 17A) can be strengthened and clarified to provide more specific protection for floodplains and for people and property in the vicinity of floodplains based upon best available science. The considerations in this document are based upon the scientific record to date and focus on the frequently flooded areas. We recognize that the County needs to balance all GMA goals and can look to this and other land management, natural resource use, stormwater, and roads/maintenance programs in total to assess progress toward protecting human life, property, and floodplain function.

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ATTACHMENT A. KITTITAS COUNTY CODE TITLE 17A

ATTACHMENT B. KITTITAS COUNTY CODE 14.08

ATTACHMENT C. KITTITAS COUNTY RESOLUTION 2012-001