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memorandum

date[1] September 24, 2014

to Doc Hansen

from Adam Merrill and Margaret Clancy

subject Kittitas SMP: Rationale and Explanation for Proposed Shoreline and Aquatic Habitat Buffers

The Kittitas County Revised Final Draft Shoreline Master Program (SMP) (September 2014) proposes buffer widths for Type S waters (shorelines of the state) and other aquatic habitats (Type F, Np, and Ns waters) that occur within SMP jurisdiction. The primary reasons for designating these buffer zones are to: 1) protect ecological functions and processes and 2) protect people and their property from hazards such as landslide, flooding, and channel migration. The recommended buffer widths were developed using a logical process that considered the specific conditions found along Kittitas County waters as well as pertinent scientific literature regarding stream, lake and riparian functions. The purpose of this memorandum is to provide the basis and justification for the recommended buffer widths.

Existing Shoreline and Aquatic Habitat Buffers

Currently, shoreline buffers within Kittitas County are regulated by the County's existing SMP (1975). The 1975 SMP requires shoreline setbacks of 100 feet from ordinary high water for all Shoreline Environment Designations (SEDs), with the exception of the Natural SED which requires a setback of 200 feet (Section 14). SMP Section 19(2) states "buffer strips of permanent vegetation between shoreline developments and associated water bodies are encouraged," but there are no prescriptive standards concerning the condition or quality of the setback, no requirements for the setback to be well-vegetated and no requirements to protect vegetation within the setback zone.

Title 17A of the Kittitas County Code (KCC) also contains aquatic habitat buffer requirements. These apply to streams and waters that are not regulated by the SMP. KCC 17A lists a range of aquatic habitat buffers for each water type, as shown in Table 1.

Table 1. Existing Kittitas County non-shoreline aquatic habitat buffer widths (KCC 17A.07.010[2])[2].

Water Type	Required Buffer (feet)
1[3]	40 to 200

[1] This memorandum replaces the same topic/dated memorandum presented at the September 24, 2014 Board hearing. It has been revised to correct typographical errors.

[2] The County is in the process of updating Title 17A to be consistent with the best available science, so these widths may be revised.

[3] The Title 17A requirement for Type 1 waters, which includes shorelines of the state, differs from the 1975 SMP, but the more restrictive standard would apply.

Water Type	Required Buffer (feet)
2	40 to 100
3	20 to 50
4	10 to 20
5	0

KCC 17A.07.010(3) states that the planning official shall establish the "least restrictive width of buffer necessary" to account for all the following considerations:

1) The overall intensity of the proposed use;

2) The presence of threatened, endangered, or sensitive species or anadromous fish;

3) The aquatic habitat's historical and current susceptibility to severe erosion, channel instability, or aggrading;

4) The presence of multiple channel or islands;

5) Use by the applicant of a buffer enhancement plan;

6) The width of a stream or river and surface area and depth of a lake.

The code does not provide specific guidance for how the presence of any of these conditions would affect the buffer width, so although the planning official could prescribe a 100 foot buffer for a Type 2 water, he or she has little basis for making that decision in light of the "least restrictive" language. In the absence of clear standards for requiring larger than minimum buffers, the narrowest buffer width allowed by KCC 17A.07.010[2] is generally assigned for most development projects (personal communication, Doc Hansen—Kittitas County Planning Official, June 18, 2014). As explained below, the buffer recommendations in the Revised Final Draft SMP for shoreline and non-shoreline waters clearly tie the buffer widths to specific-site conditions. This increases protection of the ecological functions and processes, and gives the planning official and property owners more certainty and provides for greater consistency and transparency when making development decisions.

Proposed SMP Shoreline and Aquatic Habitat Buffers and Justification

The proposed aquatic habitat buffer widths were selected using the following logical step-wise process as recommended by Ecology (Ecology SMP Handbook, Chapter 11, p. 25):

1. **Used information from the inventory and characterization report** (ICR) – The ICR describes the conditions along the County's shorelines and provides a functional assessment for each shoreline reach. The ICR also provides management recommendations geared to the function assessment. We used this information as the basis for the proposed buffers.

2. **Reviewed the scientific literature** – We reviewed the literature concerning stream buffers to distill information on the widths and conditions needed to protect and maintain aquatic habitat functions. Key findings are summarized below.

3. **Considered the Critical Area Ordinance as a starting point** – The existing Title 17A buffers do not reflect the latest science. The bottom of range of widths for some stream types was determined to be inadequate to protect most functions (based on the literature review). The widths proposed in the SMP are consistent with the middle and upper end of the range and consistent with the scientific literature.

4. **Analyzed the current development patterns** – The proposed shoreline buffers vary according to the existing and expected land use patterns as indicated by the SEDs. Natural areas are the least developed areas and are ecologically intact. These require the highest level of protection to maintain functions and achieve *no net loss* (of functions) as prescribed by the shoreline guidelines (WAC 173-26) and state law (RCW 36.70A.480). The shorelines designated Urban Conservancy, Rural Conservancy and Residential are generally less ecologically intact and/or more intensively developed compared to Natural shorelines. In these areas, a 100-foot-wide shoreline buffer is adequate to protect functions. This approach is generally consistent with guidance from the Washington Department of Ecology, which states (Ecology SMP Handbook, Chapter 11, p. 19):

> *"The buffers and setbacks for [marine and] freshwater shorelines should be tailored to local conditions including existing shoreline functions and existing and planned land use and public access. Buffers and setbacks likely will vary within a local government's boundaries to reflect different shoreline conditions and functions."*

5. **Included additional measures** – The proposed SMP includes multiple protective measures that work in conjunction with the buffer widths to maintain aquatic habitat functions (for both shoreline and non-shoreline streams). These additional measures are described below.
6. **Consider the public's perspective** – The County has sought and received input on the proposed buffers throughout the SMP update process.

The shoreline buffer widths proposed in Kittitas County's Revised Final Draft SMP are presented in Table 2. The proposed buffer widths for non-shoreline aquatic habitats are shown in Table 3. The SMP requires also a 15-foot-wide building setback from the outer (landward edge of the buffer), which increases the protected zone by 15 feet.

Table 2. Proposed buffers for shorelines (Type S Waters) from the Revised Final Draft Kittitas SMP (September 2014) Table 4.5-1.

Shoreline Environment Designation	Type S Standard Shoreline Buffer Width (feet)
Urban Conservancy	100
Shoreline Residential	100
Rural Conservancy	100
Natural	150

Table 3. Aquatic Habitat Buffers for Type F, Np, and Ns Waters from the Revised Final Draft Kittitas SMP (September 2014) Table 4.2-3.

Aquatic Habitat Conservation Area	Standard Buffer Width

Aquatic Habitat Conservation Area	Standard Buffer Width
Type F Waters	100 feet
Type Np Waters	50 feet
Type Ns Waters	30 feet

Scientific Review

ESA reviewed scientific information, including literature applicable to aquatic habitat buffers in Kittitas County, in support of the County's SMP update. This information indicates that the proposed buffers in the SMP will be effective in maintaining aquatic habitat functions.

Scientific studies show that buffer widths needed to protect functions vary depending upon a variety of factors, including but not limited to the vegetative condition of the buffer, stream size/flows, surrounding topography, and soil type. Studies also indicate that effective buffer widths can vary according to the specific function to be protected, such as large woody debris recruitment, water quality improvement, and instream habitat.

Because of the complexities in the relationships between these factors, buffer recommendations in the scientific literature are often stated as a range of widths required to achieve a certain level of effectiveness for a given buffer function. Effective buffer width ranges for key buffer functions from the reviewed scientific literature are summarized in Table 4, and explained further below.

Table 4. Buffer width recommendations, by ecological function.

Function	Effective Buffer Range (feet)	Minimum Buffer Recommendations and Sources
Fine Sediment Removal	30-213	Broadmeadow and Nisbet (2004) [49 to 213 feet] Desbonnet et al. (1994) [80% at 82 feet] Lynch et al. (1985) [75-80% at 98 feet] Sweeney and Newbold (2014) [65% at 33 feet, 85% at 98 feet] Wenger (1999) [30-100 feet]
Erosion Control/Bank Stabilization	30-200	Burckhardt and Todd (1998) [30-200 feet] Cederholm (1994) [125 feet] Christensen (2000) [100 feet] FEMAT (1993) [98 feet – may be larger in braided channels]
Nitrogen and Phosphorus Removal	30 - 167	Mayer et al. (2005) [75% at 92 feet] (Nitrogen) Vidon and Hill (2007) [66 feet] (Nitrogen)

Function	Effective Buffer Range (feet)	Minimum Buffer Recommendations and Sources
		Wenger (1999) [50 to 100 feet] (Nitrogen) Dillaha (1993) [78% at 30 feet] (Phosphorus) Wenger (1999) [45 to 90 feet] (Phosphorus) Kuusemets et al. (2001) [85% nitrogen removal & 84% phosphorus removal @ 167 feet]
Large Woody Debris Recruitment	100-180	Christensen (2000) [100 to 180 feet] May (2003) [100 to 180 feet provide 80-90% LWD] Sweeney and Newbold (2014) [100 feet or 1 SPTH (Site Potential Tree Height)]
Organic Matter Input	50-100	FEMAT (1993) [100 feet] Hawes and Smith (2005) [50-100 feet]
Shade (Water Temperature)	33 - 200	FEMAT (1993) [200 feet for mature forest equivalent] Lynch et al. (1985) [100 feet for mature forest equivalent] Sweeney and Newbold (2014) [<3° C fluctuation at 33ft, <2° C at 66 feet, full protection at 100 feet]
General Wildlife Habitat	66-328	Castelle et al. (1992) [100 feet for beaver] Goates (2006) [240 feet required to protect 90% of hibernation and nesting and 148 feet required to maintain bird communities] Groffman et al. (1991) [197-328 for most wildlife needs] Hawes and Smith (2005) [33 to 164 feet] Knutson and Naef, (1997) [66-230 feet for salmonids] May (2003) [98 to 230 feet for small mammals] Wenger (1999) [49 to 328 feet, depending upon wildlife type]

Fine Sediment Removal

The vegetated buffer strip width required to remove sediments is highly variable and is based on a number of factors, including sediment size (e.g., sand, silt or clay), slope, soil infiltration, and buffer vegetation class (Wenger, 1999). Regardless of these factors, a high percentage of sediment removal typically occurs within the first 15 to 30 feet of the buffer, with larger buffers providing more consistent, long-term control of sediment (Broadmeadow and Nisbit, 2004). In general, progressively wider buffers are also required to trap smaller sediments. According to Norman (1996), the required width ranges from 9.8 feet for removal of sand-sized particles to 49.9 feet for silt-sized, and 400 feet for clay sized particles. In addition, steep slopes and compacted areas may require relatively larger buffers (Wenger, 1999).

Erosion Control/Bank Stabilization

The potential for vegetated buffers to provide erosion control in riparian areas is dependent upon a number of factors, including erodibility of soil type, slope, velocity of runoff, and soil permeability. In forested buffer

systems, the ideal buffer width for stabilizing bank erosion and slowing channel migration is one-half the Site Potential Tree Height (SPTH), or approximately 100 feet in the Pacific Northwest (Christensen, 2000). Reviewed information suggests, however, that forested buffers of 30 feet or greater provide a reduction in channel erosion and migration (Burkhardt and Todd, 1998).

Nitrogen Removal

The reviewed scientific and technical information for nitrogen removal lists effective buffer widths that vary from 50 feet (Wenger, 1999) to 164 feet (Mayer et al., 2007). A primary factor explaining this variability is type of water flow containing the dissolved nitrogen. The majority of transported nitrogen moves into stream corridors through sub-surface flow. Vegetated buffers are generally efficient at removing sub-surface nitrogen, with 75% effectiveness predicted at 92 feet (Mayer et al., 2005). Removal of nitrogen from surface flow is significantly less effective, with 75% effectiveness reported at 389 feet. Nitrogen can also enter a buffer attached to sediments. This particulate nitrogen is removed when sediments are filtered out by buffer vegetation. Overall, Mayer suggests that relatively narrow buffers (less than 49 feet) can be effective at reducing particulate nitrogen concentrations, but larger buffers more consistently removed significant portions of nitrogen (Mayer et al., 2007). The buffer widths needed to achieve 50%, 75% and 90% removal were reported as 10, 92, and 367 feet, respectively (Mayer et al., 2005). In a similar review of available literature, Wenger notes a minimum buffer width of 50 feet for nitrogen removal, but suggests that buffers of 100 feet or more will provide higher levels of nitrogen removal (Wenger, 1999). In addition to flow type and buffer width, other factors influencing buffer efficacy include buffer soil and vegetation conditions. Optimal conditions for nitrogen removal are met in soils with high levels of organic carbon, saturated soil, extended contact with the water table, low oxygen conditions, and high incidence of live plant roots (Correll, 1997, as cited in ELI, 2008). All of these factors will affect the buffer width required to achieve desired nitrogen removal.

Phosphorus Removal

Most phosphorus is delivered to riparian buffers attached to sediment. Therefore, buffer widths sufficient to remove sediments should also remove phosphorus (Wenger, 1999). Dilaha (1993) reported 61% removal in a 15-foot-wide buffer and 79% removal in a 30-foot-wide buffer. Desbonnet (1994) reported similar results: 30 feet removed 60% of the phosphorus, but 279 feet was required to remove 80% of this nutrient. This discrepancy may be caused by a higher percentage of dissolved phosphorus (vs. adsorbed to sediment) in the studies reported by Desbonnet. In a synthesis of prior literature, Wenger (1999) recommends buffers from 49.5 to 99 feet, provided that the buffer width is increased with increasing slope or higher likelihood of phosphorus inputs from animal waste, fertilization, and other high-nutrient activities.

Large Woody Debris Recruitment and organic matter inputs

A substantial portion of the large woody debris in riverine systems originates from the surrounding riparian buffer. In general, the minimum buffer distance for long-term, natural LWD recruitment is 100 feet, while 30 foot buffers provide approximately 50% of natural levels (May, 2003). The recruitment area may be much larger in systems with a history of channel migration. The recommended buffer widths for these systems are typically on the high end, often 180 feet or more.

Smaller organic matter inputs follow a similar pattern to LWD. Most fine organic litter originates within 100 feet of the stream channel (FEMAT, 1993). In general, the riparian buffer vegetation of an area determines the quantity and characteristics of both large woody debris and fine organic matter in a stream channel (Naiman et al., 2000).

Stream shading and water temperature

Cool water temperatures are critical for survival of multiple aquatic species, including salmonids. Shade provided by riparian vegetation is important for moderating the temperature of streams and rivers. FEMAT (1993) reports that a 100-foot buffer, as measured from the edge of a forest stand, results in 70% shading effectiveness. In other reviewed literature, minimum effective buffer widths for shade vary widely, from 30 to 230 feet. In general, increased shading (and corresponding cooler water temperatures) occurs with wider buffer widths and taller vegetation species.

General Wildlife Habitat

Vegetated riparian areas provide crucial habitat for a variety of wildlife species. Wildlife use riparian areas more than any other type of habitat (Thomas et al., 1979). In the reviewed literature, habitat requirements and recommended buffers vary widely, depending upon species and specific life history requirements.

Summary

The proposed aquatic habitats buffers in the SMP (which range from 30 to 150 feet) are within the range of effective buffer widths, as documented in the relevant scientific literature (Table 4). In addition the SMP contains a number of other important provisions that work in conjunction with the standard buffers to protect aquatic habitats as described below.

SMP Buffer Provisions

In addition to specifying minimum buffer widths that protect most aquatic habitat functions, the SMP contains several other provisions to protect streams, including:

- Where a use is being intensified adjacent to a degraded buffer area that is not well vegetated, the Administrator may require the degraded area to be revegetated to maintain aquatic habitat conservation area functions and values (SMP 4.2.K.1)
- A 15-foot-wide building setback. The setback is measured from the outer edge of the buffer. This effectively adds 15 feet of additional width to the buffer and ensures that adjacent land uses will not encroach into the protected area.
- Strict vegetation conservation standards. New uses and developments to be located landward of required shoreline buffers. The SMP also requires shoreline buffers to be maintained in a well-vegetated condition that supports native plant species at densities that would occur in similar undisturbed settings. The focus of these provisions is to ensure the buffers are fully functioning and limit development and activities in the buffers. This is an important difference from the exiting (1975) SMP, which does not contain prescriptive vegetation conservation standards. The setback can be unvegetated or disturbed and therefore not protective of buffer functions.
- A requirement to locate new homes and structures outside of channel migration zones. This effectively extends the stream protections well beyond (landward of) the buffer zones for stream that have known migration potential.
- A requirement to mitigate buffer impacts using the mitigation sequence. This ensures that impacts to buffer vegetation will be avoided, minimized, or compensated for impacts through replacement.
- A requirement for subdivisions to have lots that contain at least one site that is suitable for use or development that adheres to the standard shoreline buffer.
- The Administrator can increase buffer zone widths for aquatic habitats on a case-by-case basis when the standard buffer is inadequate to prevent habitat degradation and protect the structure and functions of the habitat area (SMP 4.2.K.5)

- The fish and wildlife habitat conservation areas regulations require a habitat management plan if there are special status species or habitats located within 200 feet of a proposed use or development (SMP Section 4.2.N). A habitat management plan must include measures to avoid, minimize, and/or compensate for adverse impacts to special status species and habitats, such as habitat enhancement, establishment of habitat buffers, and seasonal restrictions on construction activities.
    - Buffer averaging and buffer reductions for single-family development are tightly controlled. The allowed buffer averaging and buffer reduction would result in buffers that are still within the range of effective buffer widths as reviewed in the scientific literature and are limited to certain situations. The conditions for averaging include:
        - The development is not a residential subdivision of more than 4 lots;
        - The buffer has not been previously averaged or reduced;
        - No feasible site design could be accomplished without buffer averaging;
        - The averaging will not adversely impact functions and values;
        - The minimum width of the buffer at any given point is at least 75% of the standard buffer width or 25 feet, whichever is greater;
        - The area that is added to the buffer to offset the reduction is well-vegetated. Vegetation enhancement may be required to ensure this criterion is met; and
        - An approved critical areas report demonstrates that the averaging will not adversely impact functions and values.
    - The conditions for reduction include:
        - The existing buffer is predominantly un-vegetated, composed of nuisance species or is in a highly disturbed condition;
        - The minimum width of the reduced buffer is at least 75% of the standard width (thus, a 100-foot wide buffer could be reduced to 75 feet);
        - The reduced portion of the buffer cannot exceed 40% of the buffer length on the development property;
        - The reduced buffer area is planted and enhanced with native species;
        - A mitigation plan is developed and implemented; and
        - An approved critical areas report demonstrates that the reduction will not adversely impact functions and values.

These protective buffer regulations will ensure that aquatic habitats within County shoreline jurisdiction are protected over time.

Conclusion

A review of the applicable scientific and technical information indicates that the proposed Kittitas County SMP shoreline and aquatic habitat buffer system is adequate to protect aquatic habitat functions. The proposed buffer requirements are clearer and more rigorous than the existing County SMP and Title 17A setback and buffer requirements, which have no vegetation conservation requirements, are difficult to administer, and require the planning official to establish the “least restrictive width of buffer necessary.” The buffer system in the proposed SMP will allow for more predictable, transparent and protective regulation of streams and shoreline as compared to the current system and will achieve no net loss of shoreline ecological functions.

References

Broadmeadow, S. and T.R. Nisbet. 2004. The Effects of Riparian Forest Management on the Freshwater Environment: A Literature Review of Best Management Practice. Hydrology and Earth Systems Sciences, 8(3): 286-205.

Burckhardt, J.C. and B.L. Todd, 1998. Riparian Forest Effect on Lateral Stream Channel Migration in the Glacial Till Plains. Journal of the American Water Resources Association 34:179-184

Castelle, A.J., C. Conolly, M. Emers, E.D. Metz, S. Meyer, M. Witter, S. Mauermann, T. Erickson, and S.S. Cooke. 1992. Wetland Buffers: Use and Effectiveness. Washington Department of Ecology, Publication No. 92-10. Olympia, WA.

Cedarholm C.J. 1994. A Suggested Landscape Approach for Salmon and Wildlife Habitat Protection in Western Washington Riparian Ecosystem. Pages 78-90 in A.B. Caey and C. Elliott. 1994. Washington Forest Landscape Management Project – Progress Report No. 1., Washington Department of Natural Resources, Olympia.

Correll, D.L. 1997. Buffer Zones and Water Quality Protection: General Principles. *In*: Buffer Zones: Their Processes and Potential in Water Protection. The Proceedings of the International Conference on Buffer Zones September 1996. Haycock, N.E., T.P. Burt, K.W.T. Goulding, and G. Pinay (Eds). Quest Environmental. UK.

Desbonnet, A., P. Pogue, V. Lee, and N. Wolff. 1994. Vegetated Buffers in the Coastal Zone: A Summary Review and Bibliography. Coastal Resources Center Technical Report No. 2064. University of Rhode Island 72pp.

Dillaha, T. 1993. Development of a Buffer Zone Evaluation Model/Procedure. Report to the Virginia Council on the Environment. Coastal Resources Management Program, Virginia Polytechnic Institute and University, Blacksburg, Virginia.

Environmental Law Institute. 2008. Planner's Guide to Wetland Buffers for Local Governments. 25pp. ISBN 978-58576-137-1.

ESA. 2013a. Kittitas County Regional Shoreline Master Program Update—Shoreline Inventory and Characterization Report (Final). Seattle, WA.

ESA. 2014a. Kittitas County Shoreline Master Program Update—Cumulative Impacts Analysis. Revised July 2014. Seattle, WA.

ESA. 2014b. Kittitas County Critical Areas Ordinance—Best Available Science Review and Considerations for Code Update (Final Report). Seattle, WA.

FEMAT (Forest Ecosystem Management Assessment Team). 1993. Forest Ecosystem Management: An Ecological, Economic, and Social Assessment, US Departments of Agriculture, Commerce, and Interior. Portland, OR.

Groffman, P.M., A.J. Gold, T.P. Husband, R.C. Simmons, and W.R. Eddleman. 1991. An Investigation into Multiple Uses of Vegetated Buffer Strips. Narrangansett Bay Project No. NBP-91-63. Providence, RI.

Hawes, E., and M. Smith. 2001. Riparian Buffer Zones: Functions and Recommended Widths. Prepared for the Eightmile River Wild and Scenic Study Committee. Yale School of Forestry and Environmental Studies: New Haven, Connecticut.

Kittitas County Shoreline Master Program. March 5, 1975.

Kittitas County Final Draft Shoreline Master Program. Kittitas County Regional Shoreline Master Program Update. January 2014. Seattle, WA.

Kittitas County Revised Final Draft Shoreline Master Program. Kittitas County Regional Shoreline Master Program Update. July 2014. Seattle, WA.

Knutson, K. L., and V. L. Naef. 1997. Management recommendations for Washington's priority habitats: riparian. Wash. Dept. Fish and Wildl., Olympia. 181pp.

Kuusemets, V., U. Mander, K. Lohmus, and M. Ivask. 2001. Nitrogen and Phosphorus Variation in Shallow Groundwater and Assimilation in Plants in Complex Riparian Buffers Zones. Water Science and Technology: 44(11-12): 615-622.

Lynch, J. A., E. S. Corbett, and K. Mussallem. 1985. Best Management Practices for Controlling Non-Point Source Pollution on Forested Watersheds. Journal of Soil and Water Conservation 40**:**164-7.

Mayer, P.M., S.K. Reynolds Jr., and T.J. Canfield. 2005. Riparian Buffer Width, Vegetative Cover, and Nitrogen Removal Effectiveness: A Review of Current Science and Regulations. EPA/600/R-05/118. Cincinnati, OH, U.S. Environmental Protection Agency

Mayer, P.M., S.K. Reynolds Jr., M.D. McCutchen, and T.J. Canfield. 2007. Meta-analysis of Nitrogen Removal in Riparian Buffers. Journal of Environmental Quality 36:1172-1180.

Sweeney, B.W., and J.D. Newbold. 2014. Streamside Forest Buffer Width Needed to Protect Stream Water Quality, Habitat, and Organisms: A Literature Review. Journal of American Water Resources Assocation (JAWRA) 50(3): 560-584. DOI: 10.1111/jawr.12203

Vidon, P. G. and Hill, A. R. 2006. A Landscape-Based Approach to Estimate Riparian Hydrological and Nitrate Removal Functions. JAWRA Journal of the American Water Resources Association, 42: 1099–1112. doi: 10.1111/j.1752-1688.2006.tb04516.x

Wenger, Seth. 1999. A Review of the Scientific Literature on Riparian Buffer Width, Extent, and Vegetation. Office of Public Service & Outreach, Institute of Ecology, University of Georgia. Athens, Georgia.