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memorandum

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to Clallam County SMP Advisory Committee

from Adam Merrill and Margaret Clancy, ESA

subject Explanation of proposed shoreline buffer widths

The November 2012 Clallam County Draft Shoreline Master Program (SMP) contains consultant recommendations for marine and freshwater shoreline buffers. Shoreline buffers are generally recognized as "separation zones" between a water body and the adjacent land uses. Buffers serve two primary purposes: (1) protect shoreline ecological functions and processes; and (2) protect people and property from hazards such as landslides, flooding, and channel migration.

The width of the buffer and the uses that are allowed within it can have wide ranging implications for people and the environment and are subjects of frequent debate. The consultant-recommended buffer standards in the November 2012 Draft SMP, including proposed widths, vegetation requirements, and allowed uses and modifications, were developed in consideration of the pertinent scientific literature regarding nearshore, lake, and riparian processes and functions as well as the specific conditions along Clallam County shorelines. The purpose of this memorandum is to explain the reasoning behind the shoreline buffer recommendations.

Background

The Shoreline Management Act (SMA, RCW 90.58) establishes a broad policy framework for protecting the natural resources and ecology of the shoreline environment. The State's Shoreline Guidelines (Washington Administrative Code [WAC] 173-26) require SMPs to include policies and regulations that will achieve "no net loss" of shoreline ecological functions. Maintaining well-vegetated buffer zones adjacent to shoreline waters is considered a key element of a successful no net loss strategy (WAC 173-26-201(2)(a)).

Many scientific studies have examined marine, stream, and lake buffers and affirmed their importance in performing ecological functions and processes such as nutrient removal, slope stabilization, temperature control, and wildlife migration/movement (NRC, 2002; Naiman and Bilby, 1998; Bolton and Shellberg, 2001; Johnson and Ryba, 1992; Klapproth and Johnson, 2000; Castelle et al., 1994; Wenger, 1999). Most studies acknowledge that buffer effectiveness depends on multiple factors including but not limited to slope, soil type, and vegetative condition. For example, for a buffer to effectively remove nitrogen, the soils in the buffer must have adequate saturation and an abundant supply of carbon, nitrogen, and microbial organisms. The buffer must also have vegetation that can slow runoff so that the water has time to infiltrate into the soil where the nitrogen can be broken down or absorbed by plant roots (Straughan Environmental Services, Inc., 2003).

In part because of the complexities in the relationships between slope, soils, vegetation, and other 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. For a function such as nitrogen removal, for example, the Washington

Department of Fish and Wildlife (2009) reports recommended widths in terms of what is needed to achieve different percentages of removal: 11 feet for 50% nitrogen removal and up to 2,297 feet for 99% nitrogen removal[1]. Depending on the function, the range of recommended widths in the literature can be fairly narrow or quite large—on the order of tens or even hundreds of feet (Figure 1). That said, there are a multitude of studies which suggest that a minimum buffer width of 100 to 150 feet is adequate for most ecological functions (Tables 1 and 2).

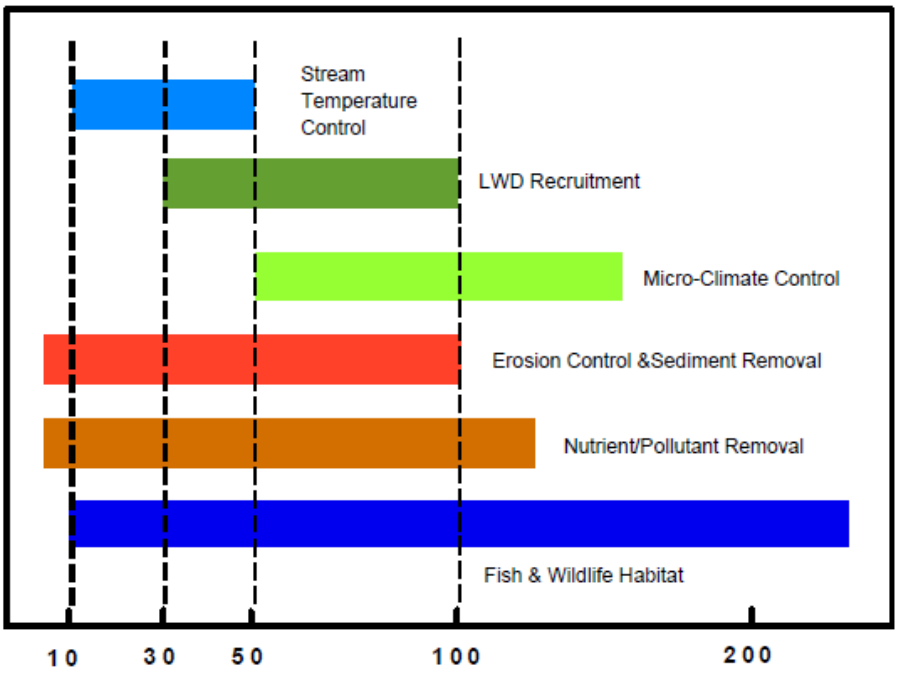

Figure 1. Summary of riparian buffer width ranges (in meters) from current scientific research (May, 2003)[2].

[1] *Protecting Nearshore Habitat and Functions in Puget Sound* (2009) (http://wdfw.wa.gov/publications/00693/wdfw00693.pdf)

[2] *Stream-Riparian Ecosystems in Puget Sound Lowland Eco-Region: A Review of Best Available Science. Watershed Ecology LLC.*

Table 1. Stream and lake buffer width recommendations, by ecological function

Function	Effective Buffer Range – feet (from Reviewed Literature)	Minimum Buffer Recommendations and Sources
Fine Sediment Removal	49 to 213	Broadmeadow and Nisbet (2004) [49 to 213 ft] Davies and Nelson (2004) [98 ft] May (2003) [98 ft] Pentec (2001) [70% effectiveness @ 98 ft]
Erosion Control/ Bank Stabilization[1]	98 to 125	Cederholm (1994) [125 ft] Christensen (2000) [100 ft] FEMAT (1993) [98 ft – may be larger in braided channels] Knutson and Naef (1997) [100 to 125 ft]
Nitrogen and Phosphorus Removal	49 to 167	Christensen (2000) [100 ft] Kuusemets et al. (2001) [85% nitrogen removal & 84% phosphorus removal @ 167 ft] Wenger (1999) [49 to 98 ft]
Large Woody Debris Recruitment	100 to 164	Christensen (2000) [150 ft] FEMAT (1993) [70% effectiveness @ 100 ft] Knutson and Naef (1997) [147 ft] May (2003) [164 ft]
Organic Matter Input	10 to 200	FEMAT (1993) [70% effectiveness @ 66 ft] Hawes and Smith (2005) [10 to 33 ft] Knutson and Naef (1995) [100 to 200 ft] Wenger (1999) [98 ft]
Shade (Water Temperature)	30 to 230	FEMAT (1993) [70% effectiveness @ 100 ft] Hawes and Smith (2005) [30 to 230 ft] May (2003) [164 ft] Wenger (1999) [33 ft]
General Wildlife Habitat	33 to 328	Goates (2006) [240 ft required to protect 90% of hibernation and nesting and 148 ft required to maintain bird communities] Hawes and Smith (2005) [33 to 164 ft] May (2003) [98 to 230 ft for small mammals] Wenger (1999) [49 to 328 feet, depending upon wildlife type]

Table 2. Marine buffer width recommendations, by ecological function

Function	Effective Buffer Range –feet (from Reviewed Literature)	Minimum Buffer Recommendations and Sources
Fine Sediment Removal	23 to 213	Broadmeadow and Nisbet (2004) [49 to 213 ft] Desbonnet et al. (1995) [80% effectiveness @ 23 ft] May (2003) [98 ft] Pentec (2001) [70% effectiveness @ 98 ft]
Nitrogen Removal	75 to 167	Christensen (2000) [100 ft] Desbonnet et al. (1995) [70% effectiveness @ 75 feet] Kuusemets et al. (2001) [85% removal @ 167 ft]
Phosphorus Removal	100 to 167	Christensen (2000) [100 ft] Desbonnet et al. (1995) [70% effectiveness @ 115 ft] Kuusemets et al. (2001) [84% removal @ 167 ft]
Large Woody Debris Recruitment	100 to 164	Christensen (2000) [150 ft] FEMAT (1993) [70% effectiveness @ 100 ft] Knutson and Naef (1997) [147 ft] May (2003) [164 ft]
Shade (Water Temperature)	30 to 100	FEMAT (1993) [70% effectiveness @ 100 ft] Hawes and Smith (2005) [30 ft] Wenger (1999) [33 ft]
General Wildlife Habitat	33 to 328	Goates (2006) [240 ft required to protect 90% of hibernation and nesting and 148 ft required to maintain bird communities] Hawes and Smith (2005) [33 to 164 ft] May (2003) [98 to 230 ft for small mammals] Wenger (1999) [49 to 328 feet, depending upon wildlife type]

Approach for Developing Buffer Recommendations

With so many factors to consider when identifying appropriate buffer standards, it can be tempting to opt for a parcel-by-parcel buffer strategy since a single width or set of widths seems unjustified. However, such approaches are typically unworkable in a regulatory context because they provide no predictability for property owners and are costly and time consuming to administer. As a result, most jurisdictions have opted for fixed-width strategies that allow for some variability based on the existing shoreline conditions and the intensity of the adjacent land use. This is the approach recommended in the November 2012 draft SMP, where the proposed buffer widths vary by shoreline environment designation, lot depth, and development type (major versus minor new development) (Table 3).

Table 3. Recommended shoreline buffers in the November 2012 Clallam County Draft SMP (section references refer to the draft SMP document)

	Marine Waterfront	Shoreline Residential - Intensive	Shoreline Residential - Conservancy	Resource Conservancy	Natural
Shoreline Habitat Buffer[1,4] (for both Marine and Freshwater Shorelines)					
Minor New Development, Existing lots ≤ 200 ft depth from OHWM to rear lot line	50	50	100	150	175
Minor New Development, Existing lots > 200 ft depth from OHWM to rear lot line	75	75	125	150	175
Major New Development	100	100	150	150	175
Land Divisions	100	100	150	150	175
Shoreline Safety Buffer[2,3,4]					
Freshwater Shorelines		150		150 (Outside of the channel migration zone if buildable area exists – see Section 3.8.3)	
Marine Shorelines	100 (150 for exceptional feeder bluff)				
Shoreline-specific Buffers[4]					
Dungeness River – New development shall be located landward of the mapped channel migration zone or at least 150 feet from Ordinary High Water Mark (OHWM), whichever is greater, regardless of the Shoreline Designation or lot size.					
Lake Sutherland – New development shall be at least 35 feet landward of the OHWM regardless of lot size or Shoreline Designation					

[1]**Habitat buffers** shall be measured from the OHWM and shall apply to all new uses and developments in shoreline jurisdiction.

[2]**Safety buffer on marine shorelines** shall be measured from the top of the bluff and shall apply only to uses and developments on parcels located in areas mapped in the March 2012 Shoreline Inventory and Characterization Report or more recent information as landslide hazard area, feeder bluff or exceptional feeder bluff.

[3]**Safety buffer on river shorelines** shall apply only to uses / developments on parcels located in areas mapped in the March 2012 Shoreline Inventory and Characterization Report or more recent information as channel migration zones. This includes but is not limited to portions of Morse Creek, Elwha River, Indian Creek, Salt Creek, Pysht River, Lyre River, East Twin River, West Twin River, Deep Creek, Clallam River, Hoko River, Little Hoko River, Herman Creek, Sekiu River, North Fork Sekiu River. The safety buffer shall be measured from the OHWM.

[4]**Additional buffers:** Uses/ development may also be subject to additional buffers due to presence of wetlands, Type F, Np and Ns streams, habitats for federally listed threatened or endangered species, or landslide hazard areas as prescribed in Section 4.2.3 and 4.3. Refer to Table 2-1 and 2-2 for which shoreline uses/development/ modifications are allowed, prohibited or conditional. Refer to Chapters 3 and 4 for additional regulations pertaining to specific uses/development/modifications.

The SMP requires the buffers to be kept in a predominantly well vegetated and undisturbed condition, defined as an average density of at least 150 woody stems per acre or fifty five percent (55%) areal cover of vegetation. The vegetated areas must comprise at least eighty percent (80%) of the buffer area. The remaining twenty percent (20%), or at least fifteen (15) linear feet of the water frontage, whichever is greater, may be retained as lawn for active use.

In developing these buffer recommendations, we relied heavily on the information in the March 2012 Shoreline Inventory and Characterization Report (ICR) (ESA, 2012). The following is a brief recap of findings from the ICR that influenced the buffer recommendations:

- Clallam County streams, lakes, and associated riparian habitats provide critical habitat for many fish and wildlife species, including several Endangered Species Act-listed salmonids and many State-identified "priority species."
- The upper stream reaches in the County flow through a densely forested landscape, through Olympic National Park, National Forest, State Forest, and private commercial timber lands. Along the downstream segments, land use and ecological conditions are more variable, but forest and shrub cover along these streams plays an essential role in stabilizing banks, moderating flows, and slowing runoff, as well as shading water (to keep water temperature low), providing large woody structure and nutrients, and adding habitat structure to the aquatic environment. In the eastern portion of the County, agriculture and residential development (including pockets of high-density residential development) are common in the river valleys, such as along the Dungeness River and Morse Creek. In the western half of the County, the lower stream reaches generally flow through managed commercial timber lands, such as along the Pysht and Sol Duc Rivers.
- Most of the streams within the County drop from high-elevation snowfields to sea level in 30 miles or less, which creates dynamic rivers that can flood within hours of a heavy rain event, scouring the banks and sometimes even carving new river channels as they move through narrow valleys. Areas of potential channel migration have been identified for many but not all of Clallam County streams. The Jamestown S'Klallam Tribe (2008) conducted an in-depth study of the Dungeness River, which mapped the outer extent of known historic channels, plus potential future migration over the next 100 years. Ecology et al. (2011) mapped several other County rivers in a separate study. These studies identify river reaches where new development should be avoided or located sufficiently distant from the stream channel to prevent interference with natural stream processes.
- The County's SMP-regulated lakes (Lake Sutherland and Lake Pleasant) are in relatively good ecological condition. Lake Sutherland, located in the eastern portion of the County, is bordered by dense residential development. Lake Pleasant, located to the west, is primarily surrounded by commercial timberlands with residential development and an industrial site located along the south shore.
- Clallam County's marine shorelines provide habitat for numerous economically and culturally important wildlife species including many species of shellfish, sand lance, surf smelt, Pacific herring, coho salmon, chum salmon (fall and summer), pink salmon sockeye salmon, Chinook salmon (fall and spring), steelhead (summer and winter), cutthroat trout, rainbow trout, Dolly Varden/bull trout, harbor seal, and gray whale. The abundant kelp and eelgrass beds in the intertidal zone are productive foraging grounds for these and other species.
- Geologic hazards are prevalent along the Strait of Juan de Fuca. Coastal Geologic Services (2011) characterized the condition of the bluffs in terms of erosion potential. Although they did not analyze erosion rates, because actual bluff retreat rates at different locations can vary widely depending upon shore orientation, stratigraphy, exposure, and land use, they identified areas of rapidly receding bluffs based on historical analysis and physical evidence. Subsequent analyses provided by the Jamestown

S'Klallam Tribe shows that marine buff recession rates of over 2 feet per year occur in some locations (e.g., between Green Point and MacDonald Creek).

- Approximately 27 percent of the marine shore is considered to be "feeder bluff." Feeder bluffs are recognized as a critically important resource in Puget Sound. The Puget Sound Partnership has targeted protection of feeder bluffs as a key component of the Puget Sound Action Agenda. Other shore types along the Strait of Juan de Fuca include barrier beaches, spits, rocky platforms, stream deltas, inlets, and embayments. These features, which are formed as a result of the County's unique geographic and oceanographic setting, are continually evolving and changing in response to dynamic physical processes such as sediment erosion and deposition, landslides, and bluff retreat. While these are natural processes that maintain beaches and spits, these changing shorelines and in particular landslides and bluff retreat can be hazardous to structures (and their occupants) that are built too close to the bluff edge.

To supplement the ICR reach-scale analysis, we also conducted a detailed analysis of shoreline vegetation using current aerial photographs to assess the implications of different buffer widths on marine, lake, and river properties (to be documented in the Cumulative Impact Assessment and No Net Loss Summary Report, in process). This analysis suggested that to maintain existing functions and achieve no net loss, buffers in some areas of the County would need to increase beyond what is currently required in Clallam County (typically 50 feet for Rural shorelines, 75 feet for Conservancy shorelines, and 150 feet for Natural shorelines, notwithstanding presence of other critical areas). We believe there are additional reasons to increase buffer widths in some cases. These reasons include the following:

- Effects of climate change, including increased flooding, storm surges, and sea level rise, will pose greater threats to Clallam County shorelines in the foreseeable future compared to today. Wider buffers will help to mitigate climate impacts on people and property.
- Recent federal court rulings on the National Flood Insurance Program have indicated that floodplain development is jeopardizing federally listed salmon species. Local governments are required to increase the level of floodplain protection (impose greater restrictions on floodplain development) or risk losing NFIP eligibility.
- According to the Puget Sound Nearshore Ecosystem Restoration Project's comprehensive assessment of Puget Sound shorelines, the Juan de Fuca subbasin has the highest proportion of sites recommended for protection in all of the Puget Sound basin (Cereghino et al., 2012). The County's ability to prevent degradation and maintain the quality and health of the nearshore environment is central to the region's overall Puget Sound recovery efforts.
- Recent studies of bluff conditions (by Coastal Geologic Services and Randy Johnson, Jamestown S'Klallam Tribe) have refined our understanding of the existing bluff conditions and of the dynamic and changing nature of the County's marine shorelines. Bluff retreat rates in some areas of the County have been shown to be 2 feet per year or more. Focusing future development further away from rapidly eroding and inherently unstable shorelines allows more space for natural processes to occur and reduces that chances that people or property will be threatened when changes happen. There is wide consensus in the scientific literature that well-vegetated buffer zones help maintain slope stability (and in turn structures and human safety). Most researchers suggest that steeper slopes and/or faster eroding shorelines require wider buffers than stable shorelines (Washington Sea Grant, 2009). In addition to requiring shoreline buffers of 75 to 150 feet (from ordinary high water) on most of the marine shoreline, the County building code requires a maximum setback of 100 feet from the top of the bluff in unstable areas. The maximum buffer may not be adequate in the highly erosive areas (e.g., exceptional feeder bluffs) or in areas with known landslide hazards. The proposed strategy opts for a minimum buffer based on the latest bluff mapping and provides allowances for buffer reduction when wider buffers are demonstrated to be unnecessary based on site-specific investigation.

- Ecology identified and mapped channel migration zones on many Clallam County rivers using the latest techniques and data. The results indicate that the areas subject to potential migration are in most cases much wider than previously thought. Focusing future development further away from the existing channel margins is one way to keep people and property out of harm's way and ensure that new development does not interfere with natural processes. This means increasing buffer widths for several major river systems in the County.
- A recent assessment of the effectiveness of regional salmon recovery efforts suggests that the region is falling well short of its commitments to restore salmon populations to healthy levels. The study calls for greater effort across the Puget Sound region in preventing further habitat decline because our current approaches are not achieving the desired outcomes (Judge, 2011).

The shoreline buffer widths recommended in the November 2012 SMP are consistent with Ecology guidance3, which states as follows:

- Undeveloped shorelines with largely intact ecological functions should be protected with buffers of 150 feet to 200 feet. Shorelines with extensive critical areas, or within channel migration zones or floodplains, also will need buffers to protect life and property during flooding.
- Rural residential development, where houses and appurtenances such as garages and sheds cover 25 to 35 percent of the ground, some area is landscaped, and the rest is in native vegetation, would likely need buffers of 150 feet to protect existing functions.
- Small-lot residential development in highly developed areas provides some ecological functions. Buffers or setbacks with vegetation conservation requirements of roughly 30 to 60 feet may be appropriate. If these areas include critical areas, larger buffers likely will be needed.
- Heavily developed waterfront areas with port facilities, water-dependent industry, overwater structures such as docks for containerized shipping, or other intensely developed areas may have limited ecological functions. In these areas, buffers or setbacks may not be appropriate. Regulations should address retention of any existing vegetation and encourage restoration where it is appropriate.

The buffer widths (50 to 175 feet for habitat buffers and 150 for safety buffers) are also within the range recommended by the scientific literature for most functions. In fact, the vast majority of the shorelines in Clallam County would have a minimum buffer width of at least 150 feet (measured from ordinary high water) because most (73 percent) of the shoreline area is designated Resource Conservancy or Natural (Table 4). Approximately 23 percent of the shoreline would have a minimum buffer of 100 feet under the Shoreline Residential - Conservancy designation. Approximately 2.6 percent of the shoreline area would have a minimum 50-foot buffer (Table 4). Minimum buffers will be wider for developments on lots more than 200 feet deep and when the proposed development is considered major new development (e.g., commercial development, subdivisions, and large scale single-family developments). The minimum buffer widths for minor new developments (reported in Table 4) would only apply to single-family residential developments on small lots that meet the following criteria intended to reduce adverse impacts:

- Total clearing/land disturbance within shoreline jurisdiction cannot exceed fifteen percent (15%) of parcel area or twenty thousand (20,000) square feet, provided that a minimum of two thousand five hundred (2,500) square feet is allowed; and

[3] Washington Department of Ecology's Shoreline Handbook, (http://www.ecy.wa.gov/programs/sea/shorelines/smp/handbook/Chapter11.pdf)

- Impervious area (including structures) within shoreline jurisdiction can be up to the lesser of five percent (5%) of the total parcel area or six thousand five hundred (6,500) square feet, provided that a minimum of two thousand (2,000) square feet is allowed; and
- Cumulative footprint (area) of all structures on the parcel must be less than four thousand (<4,000) square feet.

Table 4. Percent of Clallam County shoreline area protected by various minimum buffer widths

Shoreline Environment Designation	Minimum buffer (feet) for residential development (see Table 1)	Percent of total shoreline area (acres) with this designation (excludes aquatic areas)
Marine Waterfront	50	0.2%
Shoreline Residential – Intensive	50	2.4%
Shoreline Residential - Conservancy	100	22.8%
Resource Conservancy	150	66.1%
Natural	175	6.8%
Other (Federal, Tribal)	NA	1.6%

The practice of differentiating buffer widths depending on the type of development (major versus minor) has been used in Clallam County's critical area regulations for several years. This practice was challenged before the Growth Management Hearings Board in 2003, but the County prevailed in Superior Court (Clallam County vs. Western Washington Growth Management Hearings Board, et al., 2003). In their opinion memorandum, the Court stated that "local circumstances" should be a consideration when applying best available science and that it is unreasonable to require larger buffers when a smaller buffer would result in no measurable impact on the environment.

Rationale for Specific Buffers

In part to inform the establishment of appropriate buffer widths, ESA examined existing shoreline setbacks and riparian vegetation conditions focusing on both developed areas and areas that had high potential for future development. We decided on a two-pronged approach that defines minimum widths needed to protect habitat functions and applies a separate "additive" buffer when safety concerns related to marine feeder bluffs and channel migration are present. We used our best professional judgment to recommend habitat and safety buffer widths for each shoreline environment designation that take into account all of the following:

- The ecological, cultural, and economic value of the resource being protected (presence of salmonids, shellfish, priority wildlife species, etc.);
- The level of degradation or shoreline modification as indicated by water quality listings, the presence of structures such as armoring, levees, dikes, roads, etc.;
- The vegetative characteristics (vegetation type, diversity, and maturity) of the uplands along lakes, rivers, and marine waters;

- The presence of potential hazards (such as eroding bluffs, landslides, and channel migration zones) to people and property;
- The existing lot pattern, including lot size and configuration;
- The type and intensity of the existing land use; and
- The planned land use and the risks that the development might pose to shoreline functions.

Habitat Buffers

Habitat buffers are somewhat misnamed because they are designed to ensure that buffers perform a full suite of hydrologic, water quality, and habitat-related functions including but not limited to the following:

- Providing shade necessary to maintain the cool temperatures required by salmonids, spawning forage fish, and other aquatic biota;
- Providing organic inputs critical for aquatic life;
- Providing food in the form of various insects and other benthic macroinvertebrates;
- Stabilizing banks, minimizing erosion, and reducing the occurrence of landslides. The roots of trees and other riparian vegetation provide the bulk of this function;
- Reducing fine sediment input into the aquatic environment through stormwater retention and vegetative filtering;
- Filtering and vegetative uptake of nutrients and pollutants from groundwater and surface runoff;
- Providing a source of large woody debris into the aquatic system. Large woody debris is the primary structure that functions as a hydraulic roughness element to moderate flows. Large woody debris also serves a pool-forming function, providing critical salmonid rearing and refuge habitat. Abundant large woody debris increases aquatic diversity and stabilization;
- Regulating microclimate in the stream-riparian and intertidal corridors; and
- Providing critical wildlife habitat, including migration corridors and feeding, watering, rearing, and refuge areas.

These buffers are measured from the ordinary high water mark and apply to all shorelines. A summary of how the habitat buffers relate to each shoreline designation is provided below.

Marine Waterfront Shorelines

Certain areas of the marine waterfront are relatively intensively developed for a mixture of commercial, residential, and recreational uses. This occurs in the western half of Clallam Bay and at several private recreational shoreline areas, including Snow Creek, Silver King, and Whiskey Creek resorts. These areas generally have hardened shorelines, multiple overwater structures, boat ramps, water-oriented development and use immediately adjacent to shorelines, high levels of impervious surface, and sparse or patchy riparian vegetation.

For any minor new development including single-family residential development occurring in these areas, a relatively narrow buffer of 50 to 75 feet is generally adequate to maintain the existing riparian vegetation functions (shade, organic inputs). For larger scale or more intensive developments (e.g., commercial development, major recreational development) a minimum 100-foot buffer is required. These higher intensity developments

generally result in more ground disturbance and impervious surface, generate more runoff, and cause greater noise and light impacts compared to less intensive development such as an average-sized residence on an existing lot. In addition, lots in these densely developed areas tend to be relatively small and shallow (for example, the average lot depth along Diamond Point is approximately 100 feet), so it is not possible to accommodate a wide buffer and still retain some development potential.

The rational for the recommended buffers is as follows:

- Existing vegetated buffers within these shorelines are generally narrow and patchy, so a wider habitat buffer would not necessarily result in better ecological functioning.
- While all major new development will require a 100-foot-wide habitat buffer, components and uses that are water-dependent and water-related will be allowed within the shoreline buffer when compensatory mitigation is provided. This will allow for future development consistent with existing (and desired) patterns, while requiring improvement of existing degraded conditions as mitigation for new uses with higher potential for riparian impact.
- While the minimum recommended 50-foot habitat buffer (only for minor new development on shallow lots) is below several of the buffer ranges in the scientific literature (Tables 1 and 2), these studies were based upon unaltered riparian areas. The proposed buffers will adequately protect the remaining vegetated buffer areas.

Shoreline Residential - Intensive Shorelines

On the more densely developed shorelines of the County (such as Diamond Point, lower Morse Creek, and other areas designated Shoreline Residential - Intensive), structural shoreline armoring is ubiquitous. Natural riparian vegetation in these areas is highly fragmented and/or consists of a relatively narrow strip of forest or shrub habitat along the shoreline (providing shade and organic inputs). Where present, vegetated buffers on small lots are relatively narrow (25 to 50 feet in width), but many of these areas have lawn or landscaping with sparse natural buffer vegetation. This pattern was observed on both developed and undeveloped lots.

A relatively narrow buffer of 50 to 75 feet is generally adequate to maintain the existing riparian vegetation functions (shade, organic inputs) in these areas when the proposed development is single-family residential. For larger scale or more intensive developments (e.g., commercial development, subdivisions) a minimum 100-foot buffer is required. These higher intensity developments generally result in more ground disturbance and impervious surface, generate more runoff, and cause greater noise and light impacts compared to less intensive development such as an average-sized residence on an existing lot. In addition, lots in these densely developed areas tend to be relatively small and shallow (for example, the average lot depth along Diamond Point is approximately 100 feet), so it is not possible to accommodate a wide buffer and still retain some development potential.

The rational for the recommended buffers is as follows:

- Existing vegetated buffers are generally narrow or non-existent, so a wider buffer would not necessarily result in better ecological functioning.
- While a 50-foot buffer is below the minimum recommended buffer width for some functions in the scientific literature (Tables 1 and 2), many of these studies were based upon unaltered riparian areas. The proposed buffers will adequately protect the remaining vegetated areas.

Shoreline Residential - Conservancy Shorelines

In areas of the County with larger parcels and more rural zoning densities (areas designated Shoreline Residential - Conservancy), riparian vegetation generally consists of a relatively wide, mostly contiguous band of mature forest, often extending 200 feet or more landward of the shoreline (Miller Peninsula, Freshwater Bay, McDonald Creek shorelines, for example). In areas of this designation that are more developed, the existing contiguous band of mature forest is still generally at least 100 feet wide (Sequim Bay, Dungeness Bay and Harbor, Green Point vicinity shorelines, for example). These shorelines are generally unarmored without overwater or in-water structures.

These shorelines support some of the highest quality habitat for salmon, shorebirds, shellfish, and other species and perform critical roles in terms of providing recruitment areas for large woody debris and protecting water quality. These areas also tend to be ecologically sensitive and in some cases are unsuitable for intensive development because they contain critical saltwater or freshwater habitats such as wetlands, feeder bluffs, floodplains, etc. For example, Sequim Bay, which is an important forage fish and juvenile salmonid rearing habitat, is very sensitive to nutrient and contaminant inputs compared to the Strait of Juan de Fuca. Other examples include the large and mostly undeveloped, yet subdividable, parcels along Freshwater Bay and the northwest portion of Miller Peninsula, and the unique shoreline spits and river mouths (e.g., Gibson Spit and the Salt Creek estuary), where ecologic functions are generally intact, and the shoreline and associated uplands provide important habitat for a variety of wildlife species.

In order to protect these high-quality habitats and intact riparian functions, wider riparian buffers are necessary for all types of development within these shorelines, including minor new development. By far, the most common type of development will be single-family residential, which will require a minimum buffer of 100 to 125 feet. This width will provide adequate protection of existing mature riparian forest, while allowing for development consistent with existing patterns.

The rational for the recommended buffers is as follows:

- These areas are among the most ecologically productive marine and freshwater shorelines in the County.
- Shoreline development in these areas potentially poses a greater risk to ecological functions. Therefore, a wider buffer of 100 to 150 feet is needed to protect the full range of functions and achieve no net loss. As with the Shoreline Residential – Intensive buffers, the specific width of the buffer is scaled to the parcel depth since our analysis shows that areas with larger parcel sizes generally have more intact and high-functioning buffers to begin with.
- While commonly occurring primary development (including single-family residential structures) would have to occur landward of the habitat buffer, the Final Draft SMP provides reasonable allowances for private use of habitat buffer areas. Allowances without compensatory mitigation requirements include view corridors, hazard tree removal, pathways and pedestrian beach access structures, and boating facilities (where otherwise allowed). Additional allowances are provided for buffer averaging and, in certain instances, common line buffers.
- Habitat buffers of 100 to 125 feet required for single-family residential development will not constrain existing, undeveloped lots. We reviewed existing lot patterns in areas where this designation is proposed, and virtually all existing lots have adequate depth to allow for development outside of the habitat buffer. (See discussion of hazard buffers, below, for implications of proposed habitat buffers.)

Resource Conservancy Shorelines

Resource Conservancy-designated shorelines are the most common type of shorelines in the County, encompassing significant reaches of marine shoreline to the west of Freshwater Bay, the large majority of Morse Creek, the East and West Twin Rivers, Deep Creek, the Pysht, Clallam, Hoko, and Sekiu Rivers, as well as significant upstream reaches McDonald and Morse Creeks, and the Elwha River. Resource Conservancy-designated shorelines are generally unaltered and bordered by dense riparian tree cover, which provides high-quality habitat for a variety of fish and wildlife species. These shorelines are located on lands zoned for commercial forestry, although some are specifically designated as "no-cut" zones and managed for conservation purposes instead of timber production. The purpose of this designation is to maintain resource lands in a predominantly forested condition for sustained timber production, habitat conservation, wilderness and/or outdoor recreational use, and to ensure that where scattered and/or relatively isolated residential or recreational developments do occur, such use is located well away (150 feet or more) from adjacent shorelines in order to maintain intact riparian conditions and ensure no net loss.

The rational for the recommended 150-foot habitat buffer is as follows:

- Resource Conservancy shorelines are mostly unaltered and dominated by dense, forested riparian vegetation, but some cleared or otherwise altered areas are present in limited and distinct locations.
- The recommended 150-foot buffer widths are within the range of appropriate buffer widths for functions in the reviewed scientific literature (Tables 1 and 2).
- Existing lots and parcels within Resource Conservancy-designated shorelines are generally of sufficient size (5 acres or greater) to accommodate a 150-foot buffer for all new development.
- Small and/or shallow lots are extremely rare in this designation, with a minimal number of lots rendered as non-conforming under the updated SMP even with application of the ample protective buffer. The habitat buffer averaging provisions of the updated SMP provide additional flexibility.

Natural Shorelines

The marine and stream shores designated as Natural are among the least altered and most ecologically intact shorelines in the County, providing important habitat for a variety of fish and wildlife species. These lands are generally undevelopable because of their ecological characteristics and/or their hazardous conditions, and include densely forested (closed-canopy) riparian habitat extending throughout the shoreline environment. Alterations requiring shoreline modification generally do not occur within Natural-designated shorelines, outside of crossings required for existing public transportation or utility uses.

For Natural-designated shorelines (e.g., state park owned marine shorelines along the Miller Peninsula, numerous estuarine shorelines, unaltered spits, the marine shoreline west of Clallam Bay, the lower Dungeness and Elwha Rivers, and middle reaches of Morse and Indian Creeks), we recommend a habitat buffer width of 175 feet for all new development.

The rational for the recommended buffer is as follows:

- Natural shorelines are generally unaltered and dominated by dense, forested riparian vegetation extending throughout shoreline jurisdiction.
- The recommended 175-foot buffer width is within the upper range of appropriate buffer widths for functions in the reviewed scientific literature (Tables 1 and 2). Wider buffers along Natural shorelines are needed to protect these high-functioning and unaltered riparian areas.

- Existing lots within Natural-designated shorelines are generally of sufficient size (5 acres or greater) to accommodate a 175-foot or wider buffer.

Safety Buffers

Given the well-documented erosion and landslide hazards that are present along most of the County's marine shorelines, we recommended that an additional buffer should be established from the top of the bluff to ensure that those lands can be safely developed without the need for future structural shoreline armoring/stabilization. The safety buffer only applies in areas that, according to Washington Coastal Atlas and/or the WDNR, are designated as a landslide hazard area, unstable slope, unstable slope–recent slide, or unstable slope–old slide. The safety buffer is also applied to areas mapped in the March 2012 Inventory and Characterization report as feeder bluff or exceptional feeder bluff since the underlying geology and physical characteristics of these areas indicate they are highly erosive relative to other areas of the marine shoreline[4].

On the marine shoreline the minimum safety buffer is 100 feet, unless the area is designated as an exceptional feeder bluff, in which case the minimum safety buffer is 150 feet since these areas are documented to be "the most rapidly receding bluff areas with the highest volumes of sediment input to the marine system per lineal foot" of shoreline (ESA, 2012). Bluff retreat rates at different sites can vary significantly, depending upon shore orientation, stratigraphy, exposure, and land use.

Given that significant landslide and bluff rates have been observed along some shoreline areas (such as a retreat rate of 2 feet per year at some sites), having a minimum buffer standard instead of the current maximum 100-foot setback is prudent. At a site with an average retreat rate of 2 feet per year, a 150-foot buffer would protect a new structure for 75 years. The requirement to maintain the buffer in a well-vegetated condition (as opposed to simply imposing a building setback) is needed because tree and shrub roots are much more effective at stabilizing slopes as compared to lawn, pasture, or otherwise unvegetated areas.

We reviewed implications of the safety buffer requirements of the updated SMP on existing marine residential lots (primarily designated Shoreline Residential – Conservancy). Existing undeveloped lots generally have adequate depth to allow for development and still meet required buffers of 100 feet for landslide hazard areas and 150 feet for exceptional feeder bluffs. We identified 11 existing lots or less (less than 2 percent of total lots with marine hazard buffer requirements) that would not have adequate room to build outside of the safety buffer; some of these lots would not be so constrained if the allowances for buffer averaging are considered.

On river shorelines that have mapped channel migration zones (portions of Morse Creek, Elwha River, Indian Creek, Salt Creek, Pysht River, Lyre River, East Twin River, West Twin River, Deep Creek, Clallam River, Hoko River, Little Hoko River, Herman Creek, Sekiu River, and the North Fork Sekiu River), a safety buffer of 150 feet (measured from the ordinary high water mark) is intended to direct development away from the active channel corridor where there is a proximate risk of erosion and deposition associated with lateral channel migration. The Ecology-delineated channel migration zones include the active channel corridor (essentially the stream meander belt) plus an additional erosion hazard zone typically equal to 50 to 100 percent of the active channel width, as well as avulsion hazard zones that may extend outside the erosion hazard zone. We used professional judgment to determine that a buffer of 150 feet on either side of the existing channel would be a reasonably conservative approximation of the active channel width in most cases.

We designated this zone as the riverine safety buffer so that if these areas develop, they do so in a way that minimizes interference with normal river processes and minimizes risk to people and properties. Keeping

[4] The safety buffer does not apply to areas mapped as talus feeder bluff unless these areas are also mapped as landslide hazards, which is often the case in Clallam County.

developments well landward of the channel reduces, but does not eliminate, the likelihood that these properties will require structural shoreline stabilization in the future. The safety buffer does not totally neutralize risks associated with channel erosion or avulsion though, which is why the SMP recommends that development be located landward of the migration zone if there is sufficient area to do so.

Other Buffer Recommendations

The November 2012 draft SMP contains separate recommendations for buffers on the Dungeness River and Lake Sutherland. For Lake Sutherland, we recommended maintaining the existing shoreline buffer of 35 feet since the lake is relatively densely developed with residences and based upon current County zoning regulations, the lake shore is almost entirely built out. Existing home setbacks are narrow (ranging from approximately 0 to 40 feet), and most of the lots lack natural riparian buffer vegetation. We recommend a **35-foot** buffer for all development types for the following reasons:

- Existing vegetated buffers are generally highly-altered and narrow or non-existent, so a wider buffer would not necessarily result in better ecological functioning.
- A 35-foot buffer is somewhat wider than the existing setbacks on many of the developed lots, especially along the eastern shores of the lake.
- The lakeshore is almost entirely built out; a 35-foot buffer for new development and redevelopment will not result in a significant decrease in the shoreline vegetation.

On the Dungeness River, we based the buffer recommendations on the information provided in the Dungeness River Comprehensive Flood Management Plan, which recommends locating new developments outside of the mapped channel migration zone (Clallam County, 2009). The channel migration zone conditions along the Dungeness River have been extensively studied and the migration zone has been carefully delineated and vetted. As such the recommendations in the Plan constitute the best available information upon which to base buffer requirements.

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