City of Chelan Shoreline Master Program: Buffer Science

October 2012

Introduction

The purpose of this document is to:

- Summarize current conditions for the Lake Chelan shoreline
- Discuss the ecological functions to be protected by shoreline regulations such as shoreline buffers, vegetation conservation, and other environmental regulations
- Present excerpts of SMP Guidelines and the SMP Handbook in terms of the issues weighed in setting appropriate buffers

Under separate cover we have also provided an outline of correspondence between the Consultant team and Ecology staff showing the coordination and collaboration that has occurred to date, and a key piece of correspondence that summarized the majority of that collaborative effort.

City of Chelan Shoreline Conditions

The City of Chelan is located in an arid area receiving less than 15 inches of rain annually, much of it likely falling as snow during the winter months. In the City and much of the Urban Growth Area (UGA), lakeshore properties are either developed or in many cases have been altered in preparation for development or associated with adjacent development. A significant number of properties already have an overwater structure, and even more properties have armored shorelines. Existing primary structure setbacks for single-family development range widely, from minimums of 6 and 8 feet from the Ordinary High Water Mark (OHWM) to maximums of 100-200 feet from the OHWM. Approximately one-quarter of the sampled properties (n=57) have primary structure setbacks of less than 25 feet, another quarter have setbacks between 25 and 50 feet. However, these numbers are misleading as the level of alteration is very high between the shoreline and the primary structure. The setback area typically includes primarily lawn and other hardscape, such as pools, large patios and other impervious surfaces, a number of which are parallel and adjacent to the shoreline edge. Non-native trees and shrubs are also found on some properties, although many have nothing but lawn except for shrubs and fences marking property lines.

Primary structure setback numbers from the high lake level are also misleading as lake level management has resulted in seasonal variation of the water's edge (see Exhibit 1 below, from http://www.chelanpud.org/lake-chelan-lake-levels.cfm, and Exhibit 2 showing images from Google Earth during the spring low water period). The information illustrates that in the winter months, when potential stormwater impacts are greatest, the water level drops to a distance of 40 feet in some of the steeper shoreline areas, but more commonly 80 to 150 feet, and in some cases is ~1,000+ feet waterward of the high lake level. Yet it is at the high lake level where armoring and the limit of upland

development are found. Overwater structures are often completely in the dry during 6-9 months of the year, with only the larger public, community or commercial structures extending partially waterward of the low lake elevation.

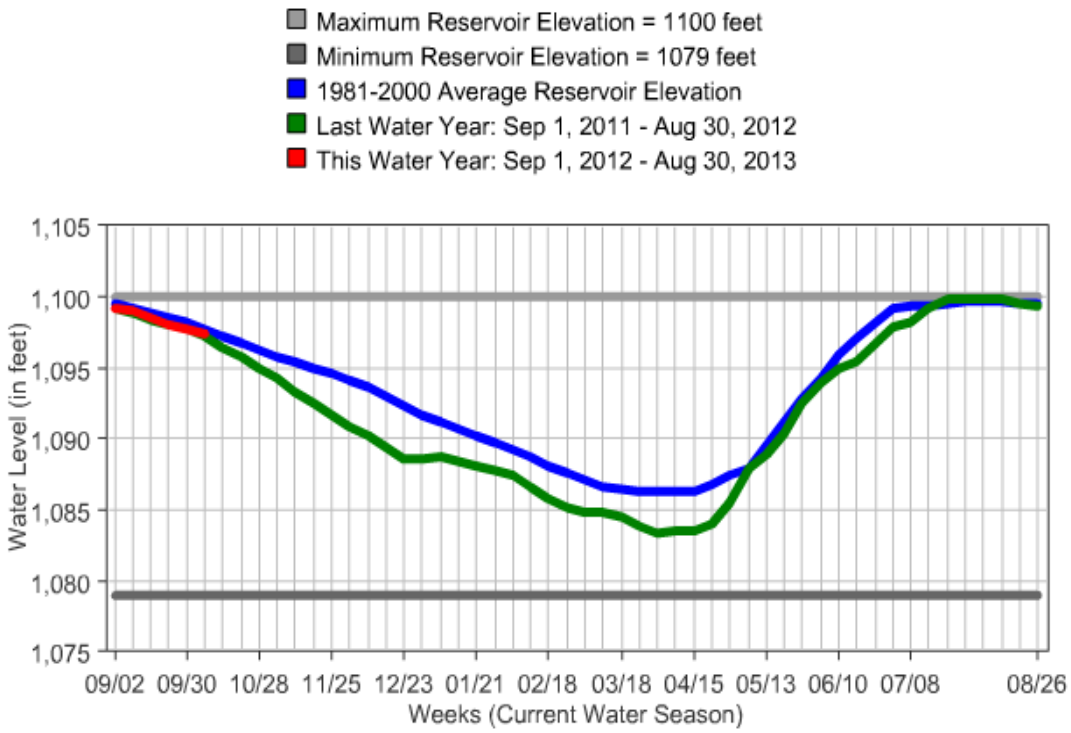

Exhibit 1. Lake Chelan Seasonal Lake Level

Exhibit 2A. Illustration of Lakefront Lots and Distance of Homes and Docks to Low Lake Water– Spaders Bay

Exhibit 2B: Illustration of distance of Shoreline Lots and Associated Docks to Low Water Level

Source: Images from Google Earth, April 2006

The lake is known for its generally clean and clear waters, a result of the ultra-oligotrophic (low nutrient) conditions. Total Maximum Daily Loads (TMDLs) have been developed by the Department of Ecology for DDT/PCBs and for total phosphorus. The lake is also a popular recreation destination because of its climate and waters. The Chelan Public Utility District (PUD) manages the lake level through its FERC license, maintaining a full pool (1,098 – 1,100 feet above mean sea level) from July through early September and for other months between May and October managing lake level so that it does not go below a certain minimum level necessary for lake recreation unless necessary to accomplish higher-priority purposes (such as maintenance of Chelan River flows for fish, flood hazard reduction, etc). How far down the lake is drawn each year is determined by the PUD based on their predicted inflow from rain and snowmelt.

With the exception of a common loon heritage point and a number of fish species (e.g., pygmy whitefish, rainbow trout, kokanee and Chinook salmon, and westslope cutthroat trout), no other Washington Department of Fish and Wildlife-designated Priority habitats or species are mapped in the City's lake shoreline jurisdiction. Wetlands are also not mapped in the City's lake shoreline jurisdiction. On Lake Chelan, mapped geologically hazardous areas in the City's shoreline jurisdiction coincide with those currently undeveloped properties on the northshore that still retain some native shrub-steppe vegetation, lack overwater structures, and appear to lack armoring.

Potential Ecological Functions Served by Shoreline Buffers

In theory, shoreline buffers can provide for a variety of water quality and habitat functions:

- Temperature control and microclimate maintenance
- Large woody debris
- Sediment filtration
- Pollution filtration
- Erosion control

- Wildlife habitat

Many of the potential functions of shoreline vegetation have little to no application in the City of Chelan, including those related to temperature control and provision of large woody debris. Other potential functions have very reduced opportunity to perform because of the management of the lake level by the PUD, which places the water's edge 10s to 100s of feet landward of the summer high water mark for 6-9 months of the year. The existing developed and armored condition of most of the City and the naturally rocky/steep sloped condition of the few remaining undeveloped areas limits the actual and potential value of any vegetation, particularly for wildlife or as a source of organic lake inputs.

Buffer functions related to water quality, however, do have some application regarding Lake Chelan. Lake Chelan listed water quality parameters are DDT/PCBs (managed under one TMDL) and phosphorus (managed under a separate TMDL[1]). The phosphorus listed is caused by septic systems and agriculture (primarily orchards), conditions generally not found in the City of Chelan's shoreline jurisdiction. However, DDT/PCBs are likely widespread in the basin, and disturbance of upland soils can mobilize the DDT (http://www.ecy.wa.gov/programs/wq/tmdl/LkChelanTMDLSummary.html).

WDFW recommends a range of riparian buffer widths shown in Table 1. However, according to WDFW's "Management recommendations for Washington's priority habitats: riparian" (Knutson and Knaef 1997), the recommended widths "only apply to riparian areas associated with streams and rivers" and are based on literature applicable primarily to forested parts of Washington State, primarily Western Washington forest types. Only one of the sources referenced that identified specific buffer widths was based on Eastern Washington forests, and none of the sources addressed recommended buffer widths for arid, non-forested Eastern Washington environments. More discussion of sediment filtration, pollution filtration, and erosion control, the primary buffer functions potentially applicable in the City's Lake Chelan shoreline jurisdiction, is found below the table.

Table 1. Washington State Department of Fish and Wildlife Buffer Ranges and Relevance in Lake Chelan Shoreline

Riparian habitat function	Range of reported widths in meters (feet)	Average of reported widths in meters (feet)	Relevant in the City of Chelan Lake Chelan shoreline jurisdiction?
Temperature control	11-46 (35-151)	27 (90)	No- not consistent with existing conditions
Large woody debris	30-61 (100-200)	45 (147)	No- not consistent with existing conditions
Sediment filtration	8-91 (26-300)	42 (138)	Yes – see below
Pollution filtration	4-183 (13-600)	24 (78)	Yes – see below
Erosion control	30-38 (100-125)	34 (112)	Yes – see below
Microclimate maintenance	61-160 (200-525)	126 (412)	No- not consistent with existing conditions
Wildlife habitat	8-300 (25-984)	88 (287)	No- not consistent with existing conditions

Source: First three columns from http://wdfw.wa.gov/publications/00029/wdfw00029.pdf

[1] A Total Maximum Daily Load, or TMDL, is a calculation of the maximum amount of a pollutant that a waterbody can receive and still safely meet water quality standards.

Summary of Existing and Proposed Buffers and other Environmental Protection Features

Residential setbacks required under the City of Chelan's existing SMP "shall be identical to the rear yard setback required by the applicable zoning ordinance (as measured from the ordinary high water line); except where the average slope of the 50' portion of the lot abutting the water exceeds 100% and bedrock is exposed at the surface, the minimum setback may be reduced to zero." According to City of Chelan Code 17.20.040, the required rear yard setback is 20 feet in the R-1 Single Family Residential zone. In the Multi-Family Residential zone, the rear yard setback is 20 feet plus 1 foot for each 2 feet by which the building exceeds 30 feet in height. A common line setback is not incorporated in the existing City of Chelan SMP.

The proposed buffers are shown in Table 2 below. Except for park uses in the Shoreline Park/Public environment, each designation has been assigned a numeric standard buffer and a potential reduced buffer that can be achieved administratively through use of a number of mitigation options (e.g. improve ecological functions of the site through supplemental vegetation plantings between the development and the OHWM, improvement of any existing shoreline stabilization, etc.). The proposed buffer reduction options are intended to promote the addition of native vegetation and shoreline softening that leads to water quality and erosion protection while allowing for redevelopment in an urban environment. In the absence of the reduced buffer options, shoreline enhancement may be more difficult to attain.

Table 2. Shoreline Buffers by Environment Designation for the City of Chelan.

Environment Designation[1]	Standard Buffer	Reduced Buffer
Shoreline Park/Public		
Existing and proposed parks	Not applicable. See regulations in Section 4.5.2.D.5	
Other public lands	100'	50'
Shoreline Residential – Single Family – Lake Chelan[2]	Tier 1: 100' Tier 2: 50' Tier 3: 25'	Tier 1: 50' Tier 2: 25' Tier 3: 20'
Shoreline Residential – Multi-Family – Lake Chelan	35'	25'
Shoreline Residential – Single Family and Multi-Family – Chelan River	100'	50'
High Intensity	20'	10'

1 When environment designations are parallel, the buffer of the waterward environment extends only to the upland edge of that environment. The buffer for the landward environment would apply to uses and modifications in that upland environment. See 1-3 below for criteria guiding buffer reductions.

2 A buffer tier has been assigned to all waterfront parcels located in the Shoreline Residential – SF environment designation as shown on the map in Appendix F based on their existing conditions. Subdivisions of Tier 3 parcels take the Tier of the parent parcel. Subdivisions of Tier 1 parcels may be either Tier 1, Tier 2 or Tier 3 as outlined in Section 4.5.2.D.10.

Source: Integrated Draft, Shoreline Master Program, for the City of Chelan

The High Intensity buffer of 20 feet reflects the existing condition, which shows that half of sampled properties are set back 20 feet or less from the OHWM. Many of the uses in this environment are water-dependent or water-related, and will be required to provide public access and/or restoration through other provisions of the SMP. The Shoreline Residential-Multi-Family buffer of 35 feet is likewise based on the existing built condition. The Chelan River environments results in a proposed buffer of 100 feet.

The Shoreline Residential –Single Family-Lake Chelan environment includes a proposal for tiered buffers to reflect the distinct characters of developed (generally Tier 3) and undeveloped (generally Tier 1) lands in the City and its UGA that contain or are planned for residential development.

It should be noted that shoreline buffers are not the only environmental protection measures that can address shoreline functions of concern. The proposed SMP contains a suite of regulations that protect existing vegetation, particularly native vegetation and trees, in Vegetation Conservation and Shoreline Buffers (Section 4.5). The proposed SMP addresses soil erosion through the general Water Quality section (Section 4.6), and also in provisions of Vegetation Conservation and Shoreline Buffers (Section 4.5) which require retention of stormwater runoff onsite. The SMP also discourages use of chemical treatment of landscaping, and requires that any application of chemicals must be in strict conformance to the manufacturer's instructions.

Sediment Filtration

Riparian zones stabilize banks, slow and filter overland flow, and store sediment that is released into waterbodies gradually, mimicking natural rates of movement across the landscapes. Fine sediment is generally transported through stormwater runoff events in winter months, which corresponds with the time when levels in Lake Chelan are managed to be the lowest and the effective setback widths are the greatest (60-1,000+ feet). The effectiveness of sediment filtration by a riparian zone depends on riparian zone density and composition, overland flow volume, hillslope, width of the protected zone, and sediment particle size (Osborne and Kovacic 1993). Long-term studies indicate that a 98-foot-wide riparian zone may be needed to maintain sediment retention capacity over multiple years and a riparian zone closer to 300 feet would ensure effective retention of fine sediments.

The proposed shoreline buffers fall within the lower range of buffers in Table 1 for sediment filtration, but buffer widths are not the only protective measure for sediment filtration functions. Significant erosion can be minimized by limiting exposed soils, and this is required under the proposed SMP for the entire shoreline lot, not just the buffer area. The proposed standard requiring infiltration and detention of stormwater for entire shoreline developments will also capture sediment, thus improving sediment filtration functions. The proposed buffer, sediment control measures for entire lots, and the lower lake level during the most critical months would work together to address sediment filtration.

Pollution Filtration

Nitrogen and phosphorus are nutrients commonly found in fertilizers, and enter waterways through channelized runoff, groundwater flow, or overland flow. Similar to sediment transport, nutrients and other pollutants are transported to waterbodies through stormwater runoff events in winter months, which corresponds with the time when levels in Lake Chelan are managed to be the lowest and the effective setback widths are the greatest (60-1,000 feet). The addition of these nutrients to aquatic ecosystems can lead to poor water quality conditions, including reduced dissolved oxygen rates, increased pH, and eutrophication (Mayer *et al*. 2005). The rate of nitrogen removal from surface and groundwater flow is extremely variable depending on local conditions including soil composition, surface versus subsurface flow, riparian zone width, and riparian composition (Mayer *et al.* 2005). In 2005, the USEPA conducted an extensive review to investigate the qualities of a riparian zone that

effectively limit nutrient pollution (Mayer *et al*. 2005). A meta-analysis of all of the studies revealed that riparian zones removed nutrients through subsurface flow more effectively than surface flow (Mayer *et al*. 2005). In fact, riparian zones ranging from 3-675 feet removed around 89% of *subsurface* nitrates *regardless* of riparian zone width (Mayer *et al.* 2005). On the other hand, nitrogen removal in *surface* flow was positively correlated with buffer width, with effective filtration beginning at a minimum of approximately 110 feet.

The proposed shoreline buffer fall within the lower range of effective buffers for pollution filtration (Table 1). Because the proposed SMP requires treatment and either onsite infiltration or detention of stormwater for the entire development, and these methods will result in subsurface treatment of stormwater, the proposed SMP is expected to provide nutrient filtration that is better than the existing conditions, which rely only on setback widths for treatment of stormwater runoff. The proposed buffer, water quality treatment measures for entire lots, and the lower lake level during the most critical months would work together to address pollutant filtration.

Erosion Control

Trees, shrubs, and herbaceous plants commonly found in riparian zones provide bank stability and help control bank erosion. Beeson and Doyle (1995) found that major bank erosion is 30 times more likely on stream bends with bare banks compared to vegetated banks, and that densely vegetated banks are the most effective at resisting erosion. Another study found that vegetated stream banks are up to 20,000 times more resistant to erosion than bare stream banks (Smith 1976). Similar conclusions are expected for lakeshore settings. Few studies have examined the width of a riparian zone needed for bank stability, and those studies that have are generally focused on maintaining a sufficient width to allow for channel migration on streams, which is not a factor on Lake Chelan.

In the residential areas of Lake Chelan, much of the shoreline is armored with hard armoring that obviates the function of vegetation in bank stabilization. On unarmored lake shorelines, the type and density of vegetation at the ordinary high water mark is going to be of the greatest importance, rather than the width of the riparian zone. Proposed SMP standards that require replanting of any vegetation that contributed to shoreline ecological function and was adversely impacted during redevelopment are expected to be sufficient to maintain bank stability and control for excessive erosion. The vegetation conservation mechanisms apply to the full shoreline jurisdiction, and not just to the buffer area.

Summary of Proposed Buffers and Science

Although the buffer requirements for development in the Shoreline Residential environment are lower than one might expect when considering WDFW recommendations that were developed for forested conditions, because of lake level fluctuation caused by dam operations, the actual distance between the lakeshore and development is much greater than the minimum buffer width for the majority of the year when the water level is low. On the other hand, certain effects of development, such as the vegetation clearing and water quality impacts are likely to occur year-round. The City's SMP provisions account for these functions by requiring water quality treatment and onsite infiltration or detention for new development. Together, the provisions for vegetation replacement, water quality treatment, and onsite

infiltration for all new or redeveloped properties are expected to compensate for any potential effects of smaller buffer widths on the shorelines of Lake Chelan.

SMP Guidelines and Handbook Excerpts

The preceding discussion has focused on the science underlying the buffer and other environmental protection proposals. However, the SMP Guidelines (WAC 173-26) and Ecology's SMP Handbook (http://www.ecy.wa.gov/programs/sea/shorelines/smp/handbook/Chapter11.pdf) are based on multiple policy objectives consistent with the Shoreline Management Act: ecological protection, preferred water-oriented uses, and public access. The establishment of shoreline buffers is only one potential technique that can address ecological functions. In addition, guidance indicates that local governments can and should consider existing shoreline conditions, existing and future land uses, and the ability to achieve no-net-loss of ecological function.

From Shoreline Vegetation Conservation section of the SMP Guidelines:

- Establish vegetation conservation standards that implement the principles in WAC 173-26-221(5)(b). Methods to do this may include setback or buffer requirements, clearing and grading standards, regulatory incentives, environment designation standards, or other master program provisions. Selective pruning of trees for safety and view protection may be allowed and the removal of noxious weeds should be authorized. [The "principles" referenced here include extensive discussion about riparian corridor functions, use of available scientific and technical information, and specific mention of WDFW's management recommendations.]
- The intent of vegetation conservation is to protect and restore the ecological functions and ecosystem-wide processes performed by vegetation along shorelines. Vegetation conservation should also be undertaken to protect human safety and property, to increase the stability of river banks and coastal bluffs, to reduce the need for structural shoreline stabilization measures, to improve the visual and aesthetic qualities of the shoreline, to protect plant and animal species and their habitats, and to enhance shoreline uses.
- Master programs shall include; planning provisions that address vegetation conservation and restoration, and regulatory provisions that address conservation of vegetation; as necessary to assure no net loss of shoreline ecological functions and ecosystem-wide processes, to avoid adverse impacts to soil hydrology, and to reduce the hazard of slope failures or accelerated erosion.
- Local governments should identify which ecological processes and functions are important to the local aquatic and terrestrial ecology and conserve sufficient vegetation to maintain them. Such vegetation conservation areas are not necessarily intended to be closed to use and development, but should provide for management of vegetation in a manner adequate to assure no net loss of shoreline ecological functions.

Ecology's Handbook for vegetation/buffers says several things that help support establishment of buffers/setbacks that are not based solely on science:

- "Vegetation conservation standards, including buffers and setbacks, should be based on local shoreline conditions."
- "Some local governments with intensely developed shorelines have established only setbacks from the OHWM. Vegetation conservation is required, and planting new vegetation, replacing noxious weeds and invasive plants with native plants, and other habitat improvements are required for new or expanded development. These measures meet the requirements of the SMP Guidelines to protect ecological functions, as buffers do."

- "Shoreline buffers must be based on shoreline ecological functions, development patterns and anticipated preferred uses discussed in the SMP and supporting documents."
- "Therefore, when determining shoreline buffer width, you should consider the potential risk to the ecological functions. If ecological functions would be negatively affected, consider what measures would offset the impact to ecological functions. If mitigation measures and restrictions on land use would not offset the impacts from a smaller buffer, larger buffers are necessary to achieve no net loss of shoreline ecological functions."
- "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."
- "People ask why their local shorelines have buffers or setbacks that are different than those in nearby areas. The answer is that the buffers reflect the local conditions including shoreline ecological functions and existing development -- these are not the same everywhere, so different buffers or setbacks are required. In all cases, however, buffers and setbacks should be designed, in combination with SMP regulations, to assure no net loss of shoreline ecological functions."
- "Following are general recommendations for buffers, based on Ecology's approval of several dozen SMPs…. 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…"

Conclusion

The proposed shoreline buffers account for the primary ecological function of concern on Lake Chelan – water quality – and are designed to work in concert with other environmental protection measures that address entire developments such as water quality treatment, infiltration, and other measures. The shoreline buffers also account for Lake Chelan-specific conditions including natural and built environment conditions. They would allow the City to achieve no-net-loss of ecological function. In addition, they would include incentives to result in improved conditions – shoreline enhancement where no vegetation currently exists.

References

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