DATA ANALYSIS REPORT

Lake Burien, Washington

Prepared for

Lake Burien Shore Club
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Note:
Some pages in this document have been purposefully skipped or blank pages inserted so that this document will copy correctly when duplexed.

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Introduction

The Lake Burien Shore Club has for many decades taken an active role in protecting water quality and ecological functions of Lake Burien. The Draft Shoreline Master Program (Reid Middleton 2009) currently before the Burien Planning Commission includes policy and regulation provisions for establishment of public access to Lake Burien. However, it did not identify existing lake conditions or address potential impacts to those conditions from physical access to the lake by the general public.

The Lake Burien Shore Club (Shore Club) requested that Rob Zisette of Herrera Environmental Consultants (Herrera) summarize existing information on conditions of the lake and identify potential impacts to those conditions as a result of public access to the lake. This report summarizes the existing physical, water quality, aquatic plant, and fish and wildlife conditions in Lake Burien. Based on these conditions, potential impacts to the lake from establishing public access are then addressed.

Information presented in this report is based on review of readily available data and reports. Additional information was obtained by Rob Zisette during a site visit on March 13, 2010. This report was prepared by Rob Zisette, who is a limnologist with 30 years of lake research experience.

Per the detailed discussion below, Lake Burien presents several contraindications for adding public access to the burdens it must carry. One is the increased potential for the introduction and facilitation through public access of non-native, invasive aquatic plants and animals, which could severely impair habitat, water quality, aesthetics, and recreational activities in the lake. Another is the presence of the bluegreen algae *Anabaena* and *Aphanizomenon,* which account for the vast majority of bluegreen blooms in Washington lakes, and can produce the toxins microcystin and anatoxin-a.

Physical Characteristics

According to historical reports by King County (2010), Lake Burien is 44 acres in size with a mean depth of 13 feet (4.0 meters) and a maximum depth of 29 feet (8.8 meters). Features listed for Lake Burien in Lakes of Washington (Wolcott 1973) include an area of 43.7 acres, a maximum depth of 33 feet (10.0 meters), and a lake surface elevation of 320 feet mean sea level. Bathymetric (water depth) contours are shown in Figure 1 (Messick 2010).

The lake watershed is approximately 250 acres in size (King County 2010) as shown in Figure 2 (Messick 2010). The watershed boundary shown as the yellow line in Figure 2 reasonably agrees with the storm drain maps prepared by the City of Burien (Burien 2010). Thus, the watershed area is approximately six times the lake area. The watershed consists entirely of urban land use and no streams currently drain into the lake. The City of Burien (2010) has located 11 stormwater outfalls in the lake (see Figure 7E in Grette 2008).

Lake Burien drains to an outlet channel located at the northeast corner of the lake (see blue line in Figure 2). Lake water flows from this short channel over a weir that was installed in the 1960s to reduce the lake level drawdown during the dry summer months (Warren 2010). Flow from the weir enters a culvert that drains southeast to Miller Creek. Recent observations indicate that there has been no surface outflow from the lake from approximately late April to early November (Warren 2010).

The lake level typically decreases approximately 2 feet during the summer. During the wet winter months, the lake level is generally maintained within 0.2 feet of the weir elevation, which is approximately equivalent to the ordinary high water mark. No flooding of shoreline properties has been observed (Warren 2010). Based on 1 year of lake level data from October 1994 through September 1995 (King County 2010), the lake level increased from to a minimum elevation of 69 centimeters (2.3 feet) below the weir in October 1994 to a maximum elevation of 5 centimeters (0.2 feet) above weir in January 1995, and then decreased to a minimum elevation of 58 centimeters (1.9 feet) below the weir by the end of September 1995.

Lake Burien is located in an aquifer recharge area (Burien 2009). The lake may not receive much groundwater inflow because of the shallow surrounding topography. It is likely that stormwater drainage is the primary hydrologic input to Lake Burien, with additional input from direct precipitation.

Water Quality

Eutrophication and Phosphorus Cycling

The principal water quality concern for lakes is eutrophication. Eutrophication is a process of nutrient enrichment and increased productivity that can occur naturally, and is commonly accelerated in urban lakes. Phosphorus is the primary nutrient controlling eutrophication of lakes because it is typically the nutrient that limits algae growth, since large pools of carbon and nitrogen are available in the atmosphere. Stormwater runoff is the primary source of phosphorus in most urban lakes, including Lake Burien. Other external sources of phosphorus in Lake Burien include direct precipitation and shallow ground water, which enters the lake via storm drain outfalls and may also enter the lake via seeps in the nearshore zone of the lake. An additional external source of phosphorus is waterfowl feces, which can be a significant source for small shallow lakes.

Internal loading is also a common source of phosphorus to urban lakes. Internal loading refers to processes inside the lake that contribute phosphorus to the water and includes various components in the lake phosphorus cycle. Typically, the primary source of internal loading is the release of iron-bound phosphorus from anoxic (i.e., low or no oxygen) sediments. Anoxic sediment release of phosphorus typically occurs in deep portions of the lake where oxygen is consumed by decomposing microorganisms, but can also occur in shallow sediments that are highly enriched with organic matter or located under aquatic plant canopies. Other sources of internal phosphorus loading include shallow (oxygenated) sediment release during algae blooms

that create high pH conditions (greater than 9), vertical migration of bluegreen algae (cyanobacteria) from the sediments up into the water column, and decay of algae and aquatic plants in the water column.

In the Puget Sound lowlands, most of the external phosphorus loading to lakes occurs during the wet winter months. Most of that external load settles to the lake bottom and then recycles back into the water column as internal loading during the dry summer months when lakes are thermally stratified. Lakes of sufficient depth, such as Lake Burien, become thermally stratified in the late spring when the surface waters warm and become less dense than the cooler deep waters. As water temperature and density differences increase in the water column during the summer, a thermocline becomes established that separates the epilimnion (surface layer) and hypolimnion (bottom layer). A strong thermocline (high thermal gradient) dramatically reduces the transport of phosphorus from deep sediments in the hypolimnion to algae growing in the epilimnion. A weak thermocline can temporarily degrade during cool, windy periods of the summer, causing the movement of the phosphorus-rich hypolimnion waters into the epilimnion. Ultimately, the thermocline breaks down in the fall when the lake temperature cools, and the lake becomes completely mixed in November. Many lakes experience rapid growth (blooms) of algae in the fall in response to both internal (mixing) and external (stormwater) phosphorus sources.

Insufficient amounts of temperature profile data are available from King County (2010) to evaluate the location or strength of the thermocline in Lake Burien. Temperature was measured in the surface (1 meter depth) and the bottom (8 meter depth) water samples on two occasions per year during the summer of 2000 through 2004. Surface water temperatures ranged from 16 to 23°C and bottom water temperatures ranged from 10 to 18°C, and there was typically a 5°C difference between the surface and bottom water sample. Based on these data, it is unknown whether the 5°C change is abrupt or gradual and represents a strong or weak thermocline, respectively.

Trophic State

Lakes are classified into the following three categories of trophic state that represent increasing amounts of eutrophication:

- Oligotrophic (not enriched)
- Mesotrophic (moderately enriched)
- Eutrophic (highly enriched)

Trophic state is determined using summer (June through September) mean values of three parameters:

- Total phosphorus concentration in the epilimnion (surface layer)
- Chlorophyll *a* concentration in the epilimnion (phytoplankton pigment in the surface layer)

- Secchi depth (water transparency measured by lowering an 8-inch Secchi disk in the water until it disappears from view)

A trophic state index (TSI) is calculated for each of these parameters where values less than 40 represent an oligotrophic lake, values between 40 and 50 represent a mesotrophic lake, and values greater than 50 represent a eutrophic lake.

Trophic state parameters were measured in Lake Burien during the summers of 1998, 2000, 2001, 2002, 2003, and 2004 as part of the King County Lake Stewardship Program. Water samples were collected by lake stewards (residents) and analyzed by the King County Environmental Laboratory. Data quality is reviewed and posted on the stewardship program website (King County 2010). The Lake Burien data are presented for surface (1 meter) total phosphorus concentration in Figure 3, surface (1 meter) chlorophyll *a* concentration in Figure 4, Secchi depth in Figure 5, and trophic state index (TSI) in Figure 6.

Total Phosphorus

Surface (1-meter depth) phosphorus concentrations in Lake Burien typically ranged from 10 to 15 micrograms per liter (ug/L) in April through July, and typically increased to a range of 15 to 20 ug/L in September and October (see Figure 3). A minimum concentration of 7 ug/L was observed in May 2002 and a maximum concentration of 29 ug/L observed in October 2001.

Bottom (8-meter depth) water samples were also analyzed for total phosphorus on two occasions each year and exhibited a much higher mean concentration (33 ug/L) than the surface water samples (14 ug/L) collected concurrently. Higher concentrations of phosphorus are typically observed in bottom water samples due to the decay of settled organic matter. Much higher total phosphorus concentrations likely would have been observed in bottom water samples if the hypolimnion had become anoxic during the summer. In addition, mean total phosphorus concentrations were the same (33 ug/L) for bottom water samples collected in May and June compared to those collected in August and September. These results suggest that internal loading from anoxic sediment release may not have been a significant source of phosphorus in Lake Burien.

Cholorophyll a

Chlorophyll *a* is the primary photosynthetic pigment present in all species of algae. Concentrations of chlorophyll *a* are used as a measure of phytoplankton (free-floating algae) biomass. Surface (1-meter depth) chlorophyll *a* concentrations in Lake Burien typically ranged from 2 to 4 micrograms per liter (ug/L) in May through August, and typically increased to a range of 4 to 8 ug/L in September and October (see Figure 4). Surface chlorophyll *a* concentrations exceeded 8 ug/L on one occasion in October 2000 (12.8 ug/L) and October 2003 (12.2 ug/L).

Bottom (8-meter depth) water samples were also analyzed for chlorophyll *a* on two occasions in each of 3 years (2002-2004). The mean summer (August/September) chlorophyll *a*

concentrations were much higher in the bottom water samples (18.5 ug/L) than in the surface water samples (3.4 ug/L) collected concurrently. Higher concentrations of chlorophyll *a* may be observed in bottom water samples due to settling of phytoplankton, but this large of a difference suggests that phytoplankton may have been growing at the low light levels and high phosphorus concentrations near the bottom of the lake.

Phytoplankton

Water samples were also analyzed for phytoplankton composition by King County. Phytoplankton analysis results are presented in reports but not in the online database (King County 2010). A list of observed phytoplankton species has been compiled by lake resident Christine Edgar (Edgar 2010). Phytoplankton identified in Lake Burien include common genera in the following groups:

- Diatoms: *Fragilaria*, *Asterionella*, *Cyclotella*
- Chlorophytes (greens): *Botryococcus*, *Crucigenia*
- Cryptophytes: *Cryptomonas*
- Dinoflagellates: *Peridineum*, *Ceratium*
- Chrysophytes: *Dinobryon*
- Bluegreens (cyanobacteria): *Anabaena*, *Aphanizomenon*, *Aphanothece*, *Anacystis*

Phytoplankton succession in Lake Burien appears to generally follow the following pattern of dominance common to mesotrophic lakes: diatoms in the spring, dinoflagellates and greens in the summer, and bluegreens in the fall. There have been no reports of bluegreen algae blooms in Lake Burien.

Observations of the bluegreens *Anabaena* and *Aphanizomenon* in Lake Burien are of particular interest. These two genera (along with *Microcystis*, which has not been reported in Lake Burien) account for the vast majority of bluegreen blooms in Washington lakes, and both genera can produce the toxins microcystin and anatoxin-a (Ecology 2010b). Toxic algae blooms have been documented at an increasing rate in Washington lakes over the past 25 years and are an emerging public health issue. Although most blooms are not toxic, pets and wildlife have died after exposure to toxic bluegreens in Washington lakes, and people have become ill after swimming in lakes with blooms of toxic bluegreens (Ecology 2010b).

Secchi Depth

Secchi depth is a measure of water transparency or clarity that is primarily affected by phytoplankton concentrations, but it can also be affected by water color (tannins), bacteria, inorganic colloidal matter, and suspended fines (silt and clay). Typically, Secchi depth decreases as chlorophyll *a* increases when water transparency is primarily affected by phytoplankton, but the effects of phytoplankton biomass on Secchi depth can vary widely depending on the size the dominant phytoplankton cells or colonies.

Secchi depths in Lake Burien are shown on an inverse scale in Figure 5 for comparison with temporal patterns in total phosphorus and chlorophyll *a*. Secchi depths showed a general pattern of decreasing from 4 to 6 meters in May to 2 to 3 meters in October. However, the temporal pattern in Secchi depth is not as consistent as it is for total phosphorus and chlorophyll *a*. Unusual observations include a particularly low Secchi depth of 2.0 meters in May 2000 and a particularly high Secchi depth of 6.0 meters in October 2004.

Trophic State Index

Trophic state indices (TSIs) are presented for total phosphorus, chlorophyll *a*, Secchi depth, and the mean value for these three TSIs in Figure 6. Trophic state indices ranged from 39 to 43, which is in the lower range of mesotrophic status (40 to 50). Overall, the mean summer TSI did not exhibit a substantial increasing or decreasing trend between 1998 and 2004. The lower mesotrophic status of Lake Burien is rather unusual considering it is located in a totally developed basin within King County.

King County (2001) evaluated the trophic status and water quality trends in 49 small lakes that participated in volunteer lake monitoring activities. Ratings included 14 oligotrophic lakes, 20 mesotrophic lakes (including Lake Burien), 13 eutrophic lakes, and 2 hypereutrophic lakes (TSI greater than 60). Trend analysis of data for 1996 through 2000 identified a statistically significant increase in the mean TSI for four lakes and a significant decrease for one lake. Although more than 5 years of data may be needed to detect a change in the TSI, mesotrophic lakes such as Lake Burien are much more susceptible to changes in trophic state than are eutrophic lakes.

Aquatic Plants

Aquatic plants are an important component of lakes because they provide habitat for invertebrates and fish, supply food for waterfowl, and can affect the phosphorus cycle and algae growth in lakes. Excessive growth of aquatic plants can severely impair habitat, water quality, aesthetics, and recreational activities. For example, many lakes in King County and throughout Washington have been infested with the non-native, invasive plant Eurasian watermilfoil (*Myriophyllum spicatum*), which typically grows in large monotypic (single species) stands that form a dense canopy. In addition, another non-native plant Brazilian elodea (*Egeria densa*) has more recently invaded local lakes where jurisdictions have undertaken a substantial effort at eradication. Information on invasive plant species identification, occurrence, impacts, and control methods are provided on websites maintained by King County (2010) and the Washington Department of Ecology (2010a).

King County (1999) conducted an aquatic plant survey of Lake Burien on August 12, 1999. The aquatic plant map is presented in Figure 7. Eighteen plant species were identified including 5 submergent types, 2 floating-leaved types, and 10 emergent types. The submergent types included a dwarf spike rush (*Eleocharis*), one pondweed species (*Potamogeton pusillus*), common waterweed (*Elodea canadensis*), and two genera of macroalgae (*Nitella* and *Chara*).

These native submergent plants were present to a maximum depth of 6 meters and covered a total of 30.8 acres, representing 70 percent of the lake area. Although the number of submergent plant species was relatively low, the high coverage of submergent plants and absence of a non-native species are indicative of high habitat quality.

The floating leaved types included a native water lily (*Nuphar lutea*) and the non-native white water lily (*Nymphaea odorata*) covering a total of only 0.3 acres. The low coverage of white water lily indicates that this non-native species does not impair habitat or recreational activities in the lake.

Three non-native plants designated as noxious weeds were observed among the emergent types. Purple loosestrife (*Lythrum salicaria*) and garden loosestrife (*Lysimachia vulgaris*) were observed along much of the north and south shores (see Figure 7). Reed canarygrass (*Phalaris arundinacea*) was also observed at one location on the north shore and one location on the east shore. Lake Burien residents have recently been working with Katie Messick of King County to map and control these noxious weeds. A map of the most recent survey conducted in July and September 2009 by King County is presented in Figure 8 (Messick 2010). The number of observed plants was similar, but many plant locations have changed since the 1999 survey.

Overall, the aquatic plant community in Lake Burien provides excellent habitat for fish and wildlife, and does not appear to impair aesthetic or recreational benefits of the lake. The excellent condition of this community is not common for other lakes located within developed basins within King County. The principal reason for its excellent condition is that an invasive submergent plant such as milfoil has not become established in the lake. To prevent and address potential introductions of invasive plants, the Shore Club should continue to educate residents and survey the lake for the presence of invasive species.

Fish and Wildlife

Lake Burien provides habitat for numerous fish and wildlife. An inventory of fish and wildlife observed in the immediate vicinity of Lake Burien has been recently compiled by lake resident Christine Edgar (Edgar 2010). This information is briefly summarized here and is currently being evaluated by Dr. Sarah Cooke, a senior wetland biologist with Cooke Scientific Services located in Seattle, Washington.

Fish species observed in Lake Burien by lake residents include the following types of warm water fish: largemouth bass, perch, crappie, pumpkinseed sunfish, and catfish (Edgar 2010). A bass inventory conducted approximately 12 years ago by R.L. Steater identified only healthy largemouth bass weighing 3 to 8 pounds each. In addition, small numbers of lake trout have been planted on occasion by lake residents (Warren 2010).

Numerous aquatic animals have been observed in the lake, including turtles, frogs, crayfish, otter, waterfowl, and water-dependent birds. Two species of note include the western painted

turtle, which is an endangered species in Washington, and the bull frog, which is a non-native species that impacts native amphibian populations.

Public Access Impacts

Lake Burien is surrounded by private property and currently there is no public property for physical access to the lake by the general public. As noted in the Introduction, the Draft Shoreline Master Program (Reid Middleton 2009) currently before the Burien Planning Commission includes policy and regulation provisions for establishment of public access to Lake Burien. Although public access could increase recreational benefits of the lake, it would threaten the existing habitat for aquatic organisms in the lake.

The primary threat of public access to aquatic habitat would be the increased opportunity for introductions of non-native, nuisance species to the lake. Of primary concern would be the introduction of Eurasian watermilfoil (milfoil). Milfoil is very abundant in nearby lakes and small fragments of this invasive plant are commonly present on watercraft and readily transported to other lakes where viable fragments are released to establish a new population. Introductions of milfoil or other aquatic nuisance species do not occur solely through motorized watercraft or large crowds; it is now recognized that less intensive uses can result in the introduction of harmful species, with harmful results to the water body. As noted above, information about milfoil and other invasive plant species is provided on websites maintained by King County (2010) and the Washington Department of Ecology (2010a).

If milfoil or other invasive plant species became established in the lake it would likely have significant, direct impacts on aquatic habitat and indirect impacts on water quality in Lake Burien. Milfoil can grow to a depth of at least 6 meters and would likely occupy most of the lake area within a relatively short period of time (e.g., less than 10 years). The aquatic plant biomass would likely increase in the lake to an excessive amount that could dramatically increase internal phosphorus loading, and ultimately fuel nuisance growths of filamentous algae and blooms of toxic bluegreen algae.

Public access would also increase the potential for introductions of aquatic invertebrates that can have devastating effects on aquatic habitat and water quality. Washington lakes are currently threatened by introductions of the quagga mussel, zebra mussel, New Zealand mudsnail, rusty crayfish, spiny water flea, and others (WDFW 2010). There is no reason to assume that Lake Burien would be immune from effects of these organisms and, due to its relatively small size, it may have less capacity to accommodate them.

A study of aquatic invasive species transport by small-craft boats and trailers was recently conducted in northern Wisconsin and the Upper Peninsula of Michigan (Rothlisberger et al. 2010). This research confirmed the widespread understanding that boats are an important vector in the spread of aquatic invasive species. A total of 13 aquatic plant species and 51 taxa of small-bodied organisms were observed on the tested boats.

In summary, any public access scenario for Lake Burien would entail significant risk of degradation to the lake's ecological functions as described above. And once set in motion the processes resulting in such degradation are not easily reversed.

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Figures

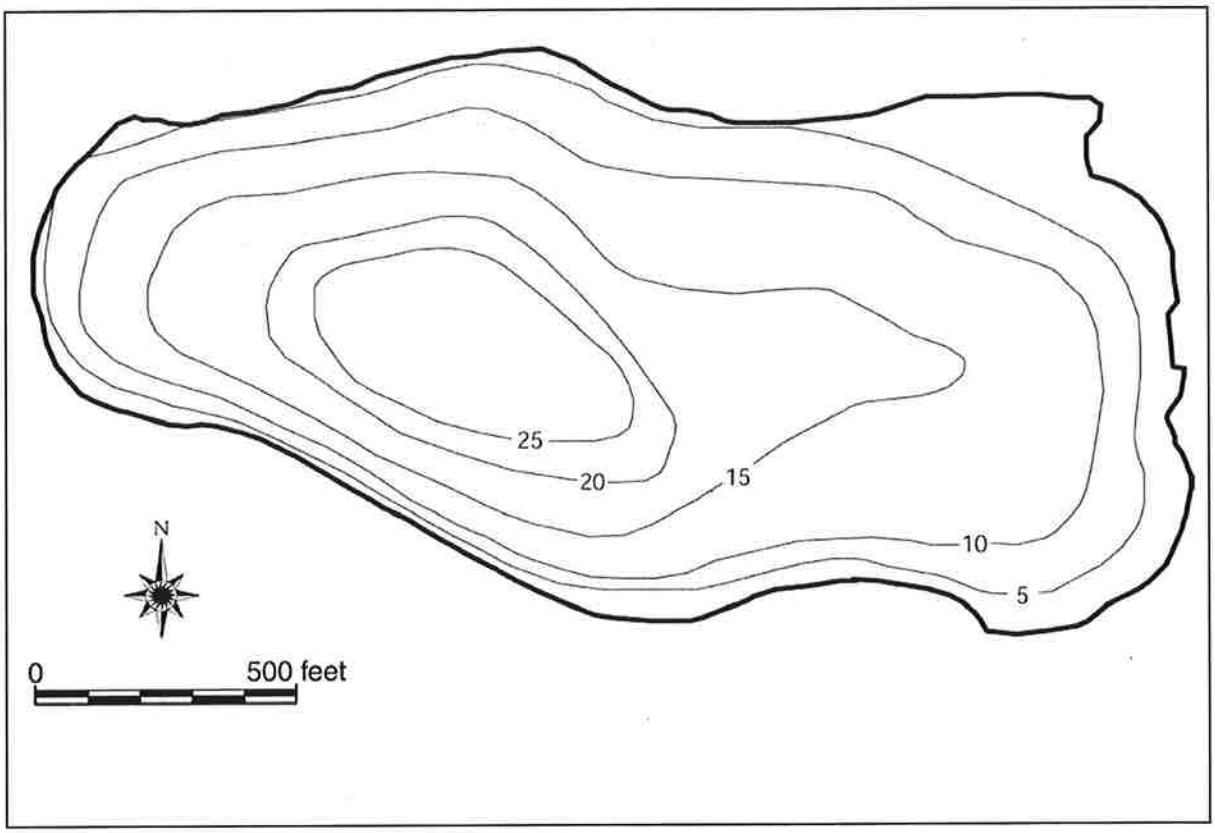

Figure 1. Lake Burien bathymetry showing depth contours in feet (source: Messick 2010).

Figure 2. Lake Burien watershed (source: Messick 2010).

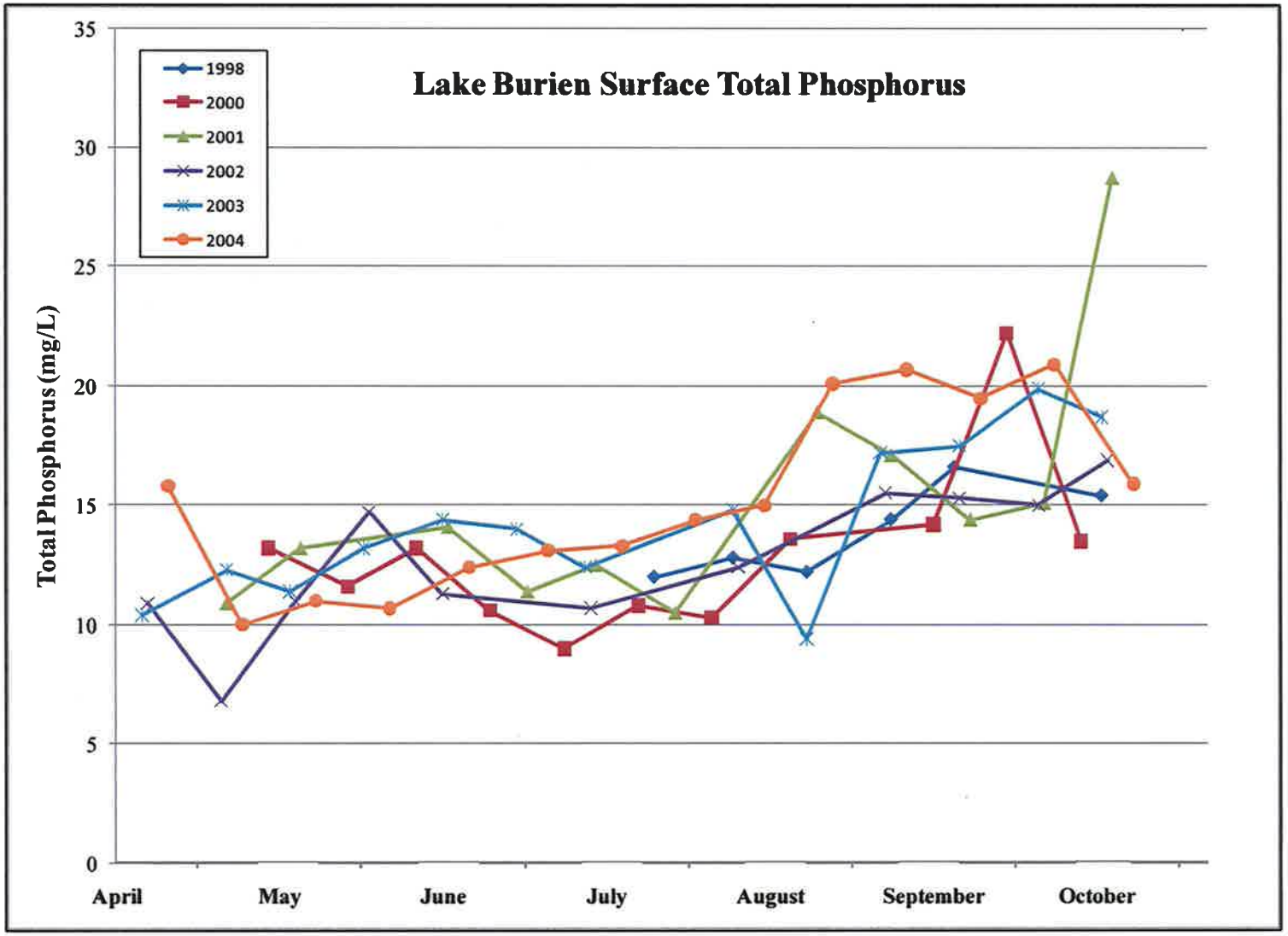

Figure 3. Lake Burien total phosphorus concentrations at 1 meter depth (source: King County 2010).

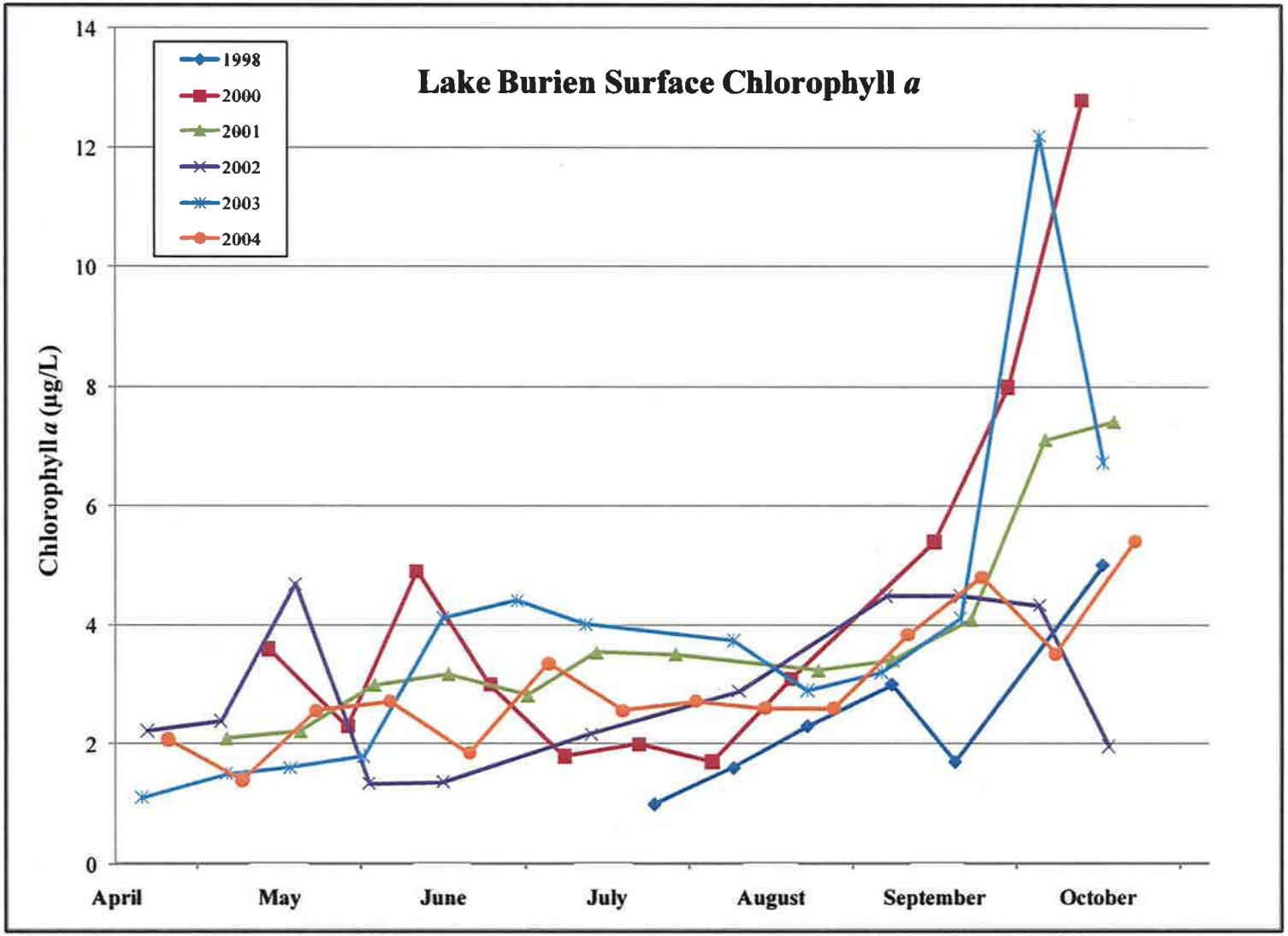

Figure 4. Lake Burien chlorophyll *a* concentrations at 1 meter depth (source: King County 2010).

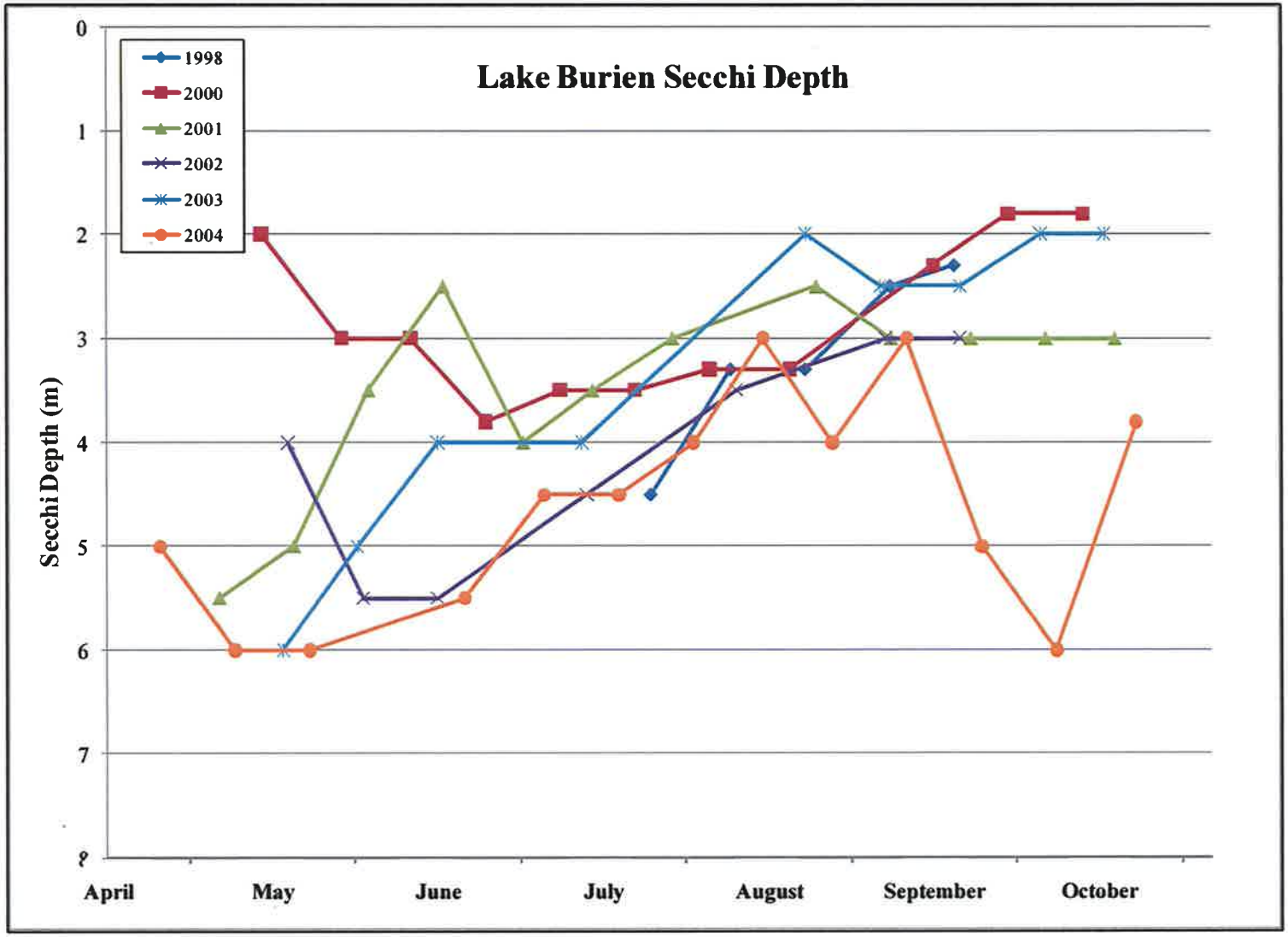

Figure 5. Lake Burien Secchi depths (source: King County 2010).

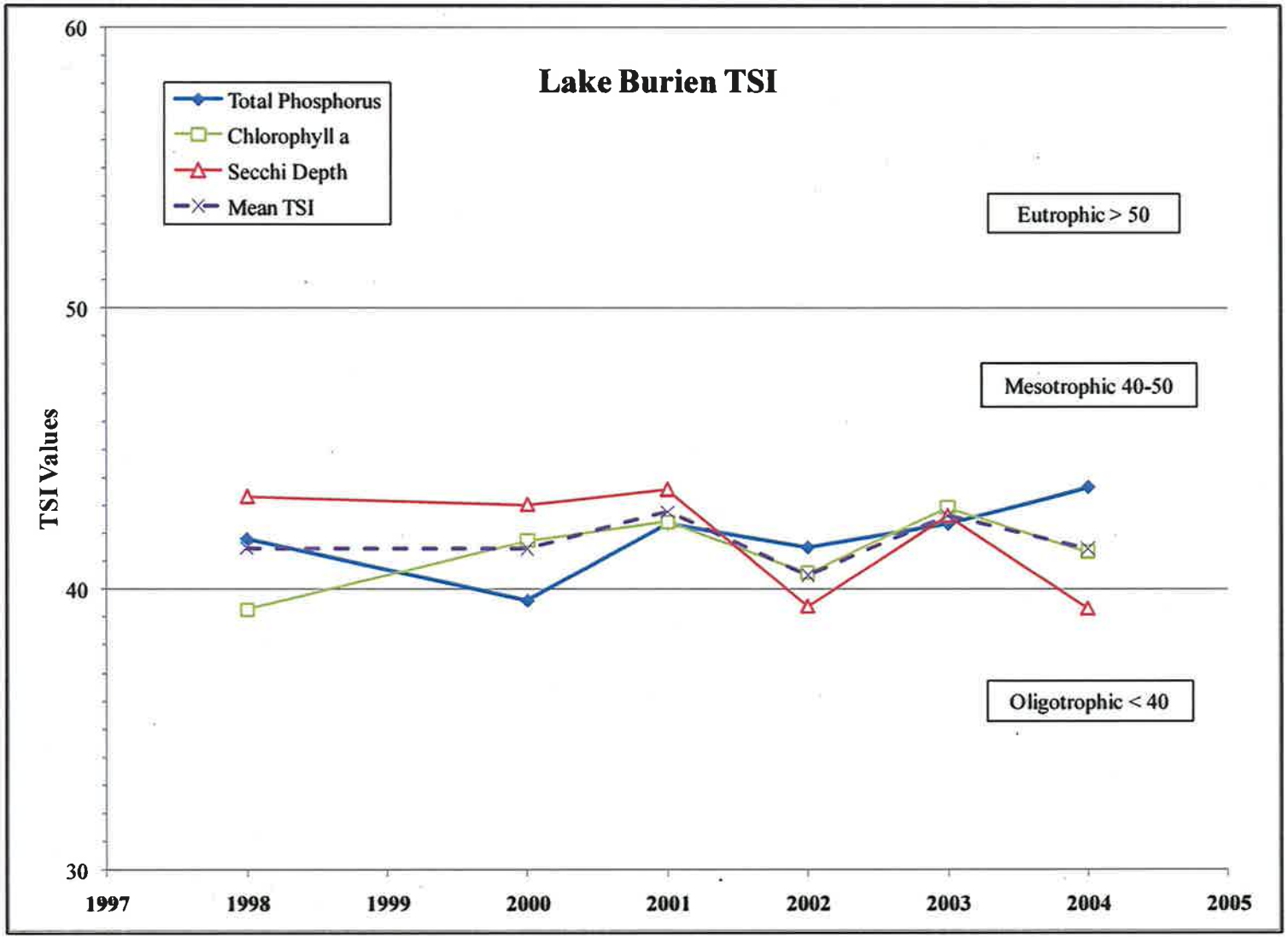

Figure 6. Lake Burien trophic state indices.

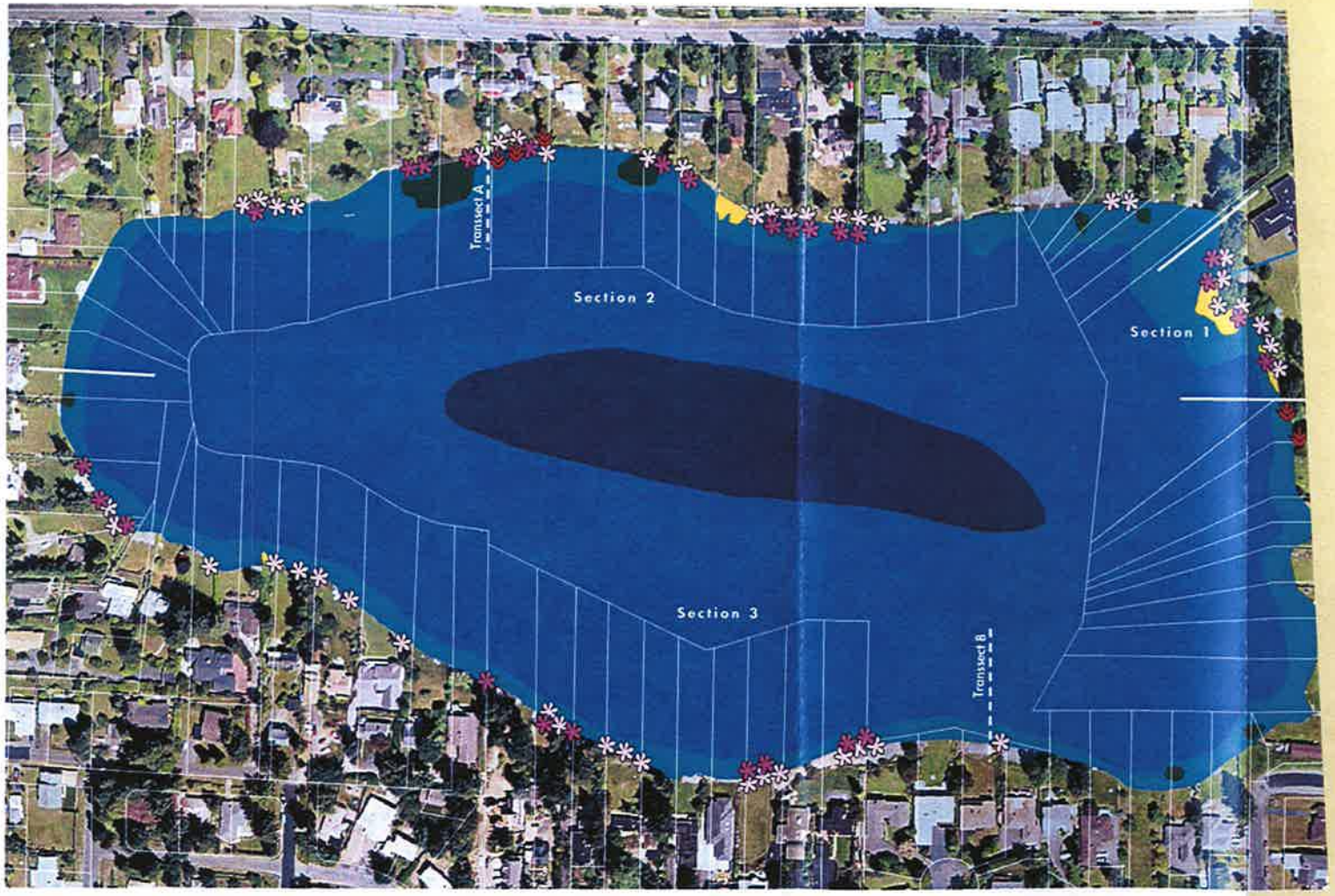

Figure XX

Lake Burien
Weed Location Map

LEGEND

- *Lythrum salicaria* (Purple Loosestrife)
- *Lysimachia vulgaris* (Garden Loosestrife)
- *Phalaris arundinacea* (Reed Canary Grass)

- Stream
- Section boundary
- Transsect line
- Floating
- Emergent
- Submergent
- No plants or sparse
- No plants—deep
- Parcel boundary

N

0 100 200 300 Feet

October 1999

Produced by:
GIS/Visual Communications Unit, WLR
King County Department of Natural Resources

File Name: 9910 Burien AquaPlantMap.eps

Figure 7. Lake Burien 1999 aquatic plant map (source: King County 1999).

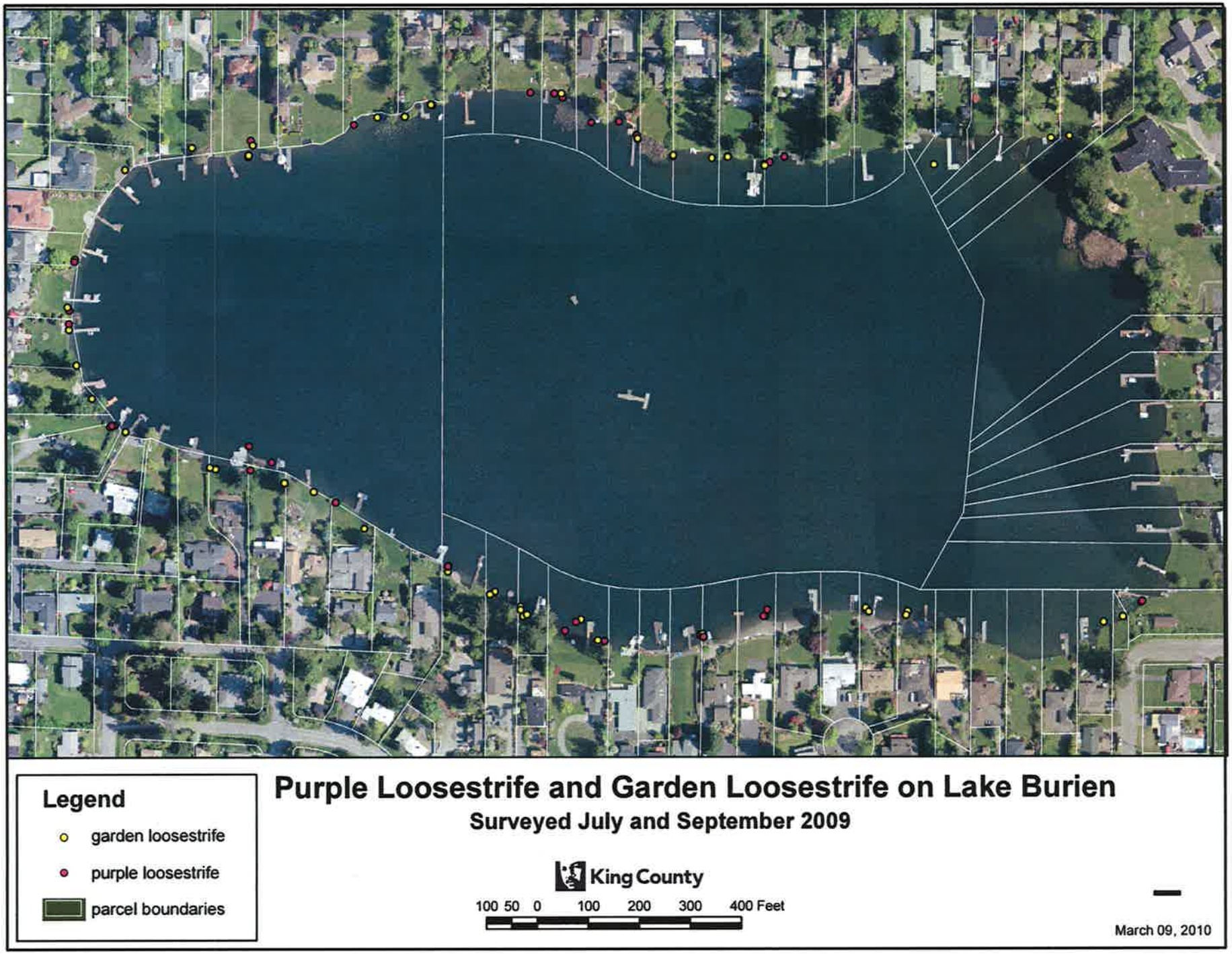

Figure 8. Lake Burien 2009 purple loosestrife and garden loosestrife locations (source: Messick 2010).

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March 23, 2010

Attn: Don Warren, President & Lake Steward
Lake Burien Shore Club
Burien, WA

RE: Review of the City of Burien's Draft Shoreline Master Plan (SMP) as it applies to Public Access for Lake Burien

Dear Mr. Warren:

The Lake Burien Shore Club is concerned that the Draft Shoreline Master Program (SMP) adopts a policy of public access for Lake Burien without an investigation into the impacts it might have on the Lake ecosystem and water quality. The Shore Club asked me, in my capacity as a professional wetlands scientist, to review the portions of the Draft SMP amendments pertaining to Lake Burien, and to determine what data, if any, exists to support the City's proposed public access policies. As detailed below, my review and analysis of the existing data and my own field investigation lead me to the conclusion that there is insufficient information to support adoption of these policies and that such adoption would likely be inconsistent with the level of protection required to maintain the sensitive lake, it's adjacent wetlands, streams, and associated wildlife, in sound ecological health.

Findings Summary

It is apparent that the Burien Shoreline Master Program Update relies on the following reports generated by City's Consultants:

- Shoreline Inventory (Grette Associates 2008)
- Shoreline Analysis and Characterization (Grette Associates 2008)
- Cumulative impacts Analysis (Grette Associates 2009)
- Shoreline Restoration Plan (Grette Associates 2009)

These documents do not reflect analysis of existing data and conditions with respect to Lake Burien as is required under the Shoreline Management Act (SMA) and outlined in the Shoreline Management Plan Guidelines adopted by the Department of Ecology (WAC 173-26-201, Comprehensive Process to Prepare or Amend Shoreline Master Programs, Section 3C and D).

The City is proposing public physical access to the Lake without studying the impacts to the Lake functions that could result, and therefore, without addressing measures necessary to mitigate such impacts. The Draft SMP is therefore, not in

compliance with the Shoreline Management Act (SMA) (RCW 890.58), and SMP Guidelines (WAC 173-26, Part III). The SMA and SMP Guidelines require current scientific-based or a "Best Available Science" (BAS) -based characterization of shoreline ecological functions, adoption of a no-net-loss policy with respect to these ecological functions, recognition of potential consequences from proposed management actions, and adoption of appropriate mitigation measures.

Focusing primarily on the Lake's wetland functions. I have reviewed all the documents and web-based resources listed in the reference section at the end of this document in addition to undertaking the personal communications listed there. I also conducted reconnaissance field research at the Lake and its wetlands on March 3, 2010. Most of the wetlands information I have reviewed (and gathered) is notably not referenced in the City's or its consultant's characterization and resultant analysis. The Lake's aquatic resources, and potential impacts to them from the proposed public access, were finally addressed in a report by limnologist Rob Zisette of Herrera Environmental Consultants, which was submitted to the Planning Commission by the Shore Club on March 17, 2010. This report concluded that providing public access to Lake Burien could have adverse and unintended impacts on its ecological well-being in terms of the introduction of invasive, non-native plant and animal species, and the potential for water quality degradation.

Analysis

1. **Proposed SMP Policies are not based on current and best available science.** In reading the four reports listed above which formed the basis for the Draft SMP Update, it is apparent that very little attempt was made to find the available data for the Lake, let alone do additional studies required by the SMA and SMP guidelines. Rather, the City's consultant team stated that they only needed to comply with the characterization of the Lake found in the City's Municipal Code and Comprehensive Plan. In my own discussions with Department of Ecology scientists, (Pers. Comm. With Eric Stockdale, March 2010), it has been made clear that an SMP developed without analysis of current lake conditions and functions (e.g., water quality, hydrology, and wildlife habitat) would be unlikely to survive Ecology's mandatory SMP review process.

   There is little evidence that Grette staff reviewed existing Lake data or coordinated their recommendations with any other scientists with expertise of the Lake. The SMP guidelines specifically identify this collaboration as being essential to the characterization and impact assessment for developing the SMP. King County has an on-line a report that covers ten years of study data and analysis of the Lake. There is only one apparent reference to other studies in the Grette reports and this is regarding phosphorus concentrations in the Lake. This data likely comes from the King County Lake Report, although it is not listed in the bibliography. The Coastal Atlas (Wa. DOE Web resource 2010) similarly is not referenced and it shows the quality of Lake Burien to be excellent, in stark

contrast to all other lakes in the urban corridor. The Lake shore is completely surrounded by private property and no residents report seeing Grette staff on their properties to collect data.

As part of the impact analysis, it is important to know what wildlife currently exists on the lake. No wildlife censuses were done as part of the lake characterization and there was no attempt to collect existing data from King County and/or local residents regarding the Lake's resident birds, migratory birds, mammals, fish, amphibians, reptiles or insects. The residents and a local fish expert, Richard Streater, have identified trout, bass, sunfish and perch, yet the City in their Municipal Code, Comprehensive Plan, and Draft SMP state there are no fish in the Lake. As discussed below, shore residents regularly observe eagles, hawks, and heron preying on fish in the Lake. The Lake Steward has not been contacted by anyone from the City's consultant team, despite the fact that he has a significant amount of data after years of monitoring the Lake.

2. **Lake Reconnaissance and other data discoveries.** In addition to reviewing and analyzing existing data respecting Lake Burien, I visited the Lake on March 3, 2010; met with shore residents and circumnavigated the shoreline in a boat. I took photographs, recorded vegetation types, shoreline characteristics, water visibility, the presence of invasive plant species: aquatic, wetland, and upland plant and animal taxa. I ran the wetland data through the Wetland Rating form for Western Washington (Hruby 2004) and I took notes on birds and fish and reptiles. A neighbor showed me photos of the painted turtles that lay eggs on her beach, and there are reports that red slider turtles may also be present. There are bullfrogs and Cascade frogs, and crayfish in the Lake. None of this information is included in Grett's Shoreline Inventory or Shoreline Analysis and Characterization. One wonders how Grette developed the Impact Analysis without being aware of the wildlife and water quality of the Lake.

   For more than 60 years, shore residents have tracked wildlife use of the lake and environs and recently have been taking bird census data, some using Audubon Guidelines. Priority species, including bald eagles, osprey, and blue heron use this lake for perching and feeding. These species are observed regularly. Although not documented in the City's record, the residents give first hand reports of this. I saw both blue heron and bald eagles the day I visited. Lake residents have identified over 80 different species of birds. Long-term residents report bird sightings have increased since the development of the third runway and filling of many of the wetlands at SeaTac. An animal inventory was compiled by the residents and included bats, mice, rats, voles, shrews, raccoons, weasels, opossums, squirrels (grey), and a historic sighting of otter in the 90's.

   There are existing patches of undisturbed wetlands scattered around the Lake, especially in the northeast corner in front of the Ruth Dykeman Center. This area has a large aquatic plant community dominated by hardstem bulrush (a native plant), with an associated riparian corridor that leads to the outlet and Burien Creek which has both upland and wetland components. The other lakeshore vegetation patches are both herb and shrub dominated, ranging from 1/5 to ½ of

the lakeshore frontage of a particular lot. The herbaceous patches are dominated by softrush and yellow-flag iris, but native rushes, grasses and sedges can also be found. There are scattered sandy beaches around the Lake and resident reports indicate that turtles nest on most.

The Lake water quality is remarkably good, according to the Department of Ecology Coastal Atlas and King County Lake Monitoring Data, as well as the analysis recently prepared by Rob Zisette at Herrera Environmental Consultants. The only motors allowed in the Lake are electric. The lake residents do not move their boats from Lake Burien to outside lakes and back. This means that there are few to no opportunities for invasive weeds to be introduced into the Lake. Mr. Zisette's limnology report addresses the ecosystem effects of introduction of invasive species, plant and animal.

The Lake residences are on sewer so there is no septic effluent leaching into the Lake, a common occurrence in other lakes throughout the County. There were no algal blooms, and I could see the bottom in areas where the depth is reported to be at least 10 feet (King County Web site bathymetry). There appear to be only a few patches of pond lily (as seen on aerial photographs from the summer). I saw no algae, milfoil or elodea (common noxious aquatic weeds in urban lakes)

The Lake is currently entirely developed with residences, with the exception of the Ruth Dykeman parcel in the northeast corner. The dominant activity on the Lake is by personal boats, most using electric motors. Electric motors make very little wake as they tend to move very slowly through the water. Additionally, the local residents and Lake Steward monitor the Lake for any irregular activity. Residents for the most part, keep their dogs from the Lake, so there is no dog fecal matter entering the lake and according to residents there is relatively little disturbance of the birds by dogs or cats.

3. **SMP Public Access provisions should not be adopted in absence of required scientific support and analysis**

Based on my research and observations, I find Lake Burien to be in surprisingly good condition for an urban lake and the water quality, habitat, and the number of species of wildlife present are not matched in the urban setting. In a case such as this, public access would result in (potentially irreparable) impacts to the ecosystem. It would be unwise to introduce public access which could upset the current balance, especially without investigating what the potential impacts might be.

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Personal communications

Erik Stockdale, Washington State Department of Ecology, Bellevue staff. Staff assigned to review the Burien SMP. March 3 and 11.

Richard Streater, fishing lures author and fish expert. March 2010

Sarah Spear Cooke
Certified Wetland Professional and Fellow
Society of Wetland Scientists

City Council
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BMHA
BURIEN MARINE HOMEOWNERS ASSOCIATION

Re: Memorandum Describing Existing Conditions of Burien Marine Shoreline

Honorable City Councilmembers,

I am a member of the Burien Marine Homeowners Association. Over the course of the last several months we have developed a detailed assessment of the Burien shoreline in which we have gathered factual information that is relevant to the City's update of its SMP. The attached memorandum is the result of hundreds of hours of work gathering data and synthesizing it for your consideration. Mayor McGilton welcomed this type of citizen-compiled scientific data at a recent Council meeting on June 14, 2010.

The information summarized in the attached memorandum is designed to supplement and correct the shoreline inventory prepared by the City's consultant, Grette and Associates (the "Grette Inventory"). The Grette Inventory is largely narrative in structure and fails to provide as much quantified detail as is required to understand existing conditions. A clear understanding of existing conditions is crucial to the City's update of its SMP because it is the standard from which no net loss is measured. Without a clear picture of the existing conditions of our shoreline that are provided in the attached memorandum, the City cannot determine what is required to ensure no net loss of shoreline ecology. It is our hope that the attached information will help the Council better understand the baseline from which no net loss should be measured.

In summary, and as is explained in detail in the attached memorandum the Burien nearshore is more fully developed than is suggested in the inventory prepared by Grette and Associates. Outside of Seahurst Park, the shoreline of Burien is almost as fully developed as the terrain will allow. Additionally, the attached memorandum demonstrates the following points:

- Almost 85% of the privately owned land within 65' of the OHWM (the area that would be within the proposed no-touch area) is already modified (i.e., it contains a primary structure, accessory structures, concrete patios, or landscaping. For the purpose of this memorandum we use the term landscaping to refer to lawns, flower beds, and small to medium sized ornamental shrubs and trees.
- Nearly 75% of the homes on waterfront lots would be non-conforming structures, due solely to their proximity to OHWM, if the 65' no-touch area were introduced. The nature of the existing parcels and surrounding terrain is such that few, if any, of these homes could be brought in to conformance even after total destruction of the home.
- Less than 7% of the land area in the SMP jurisdiction is privately owned and undeveloped. Most of this remaining area is judged to be unsuitable for new development due to naturally occurring constraints such as steep or unstable slopes.
- Privately owned waterfront properties are almost fully armored and the majority of these bulkheads experience significant wave energy for several hours every day.
- Natural conditions are found primarily on unbuildable land.

CFTR: 08/02/10

July 19, 2010

This information will help the City evaluate whether the proposed regulations are necessary to satisfy the no net loss standard. The introduction of large no-touch buffers is a common strategy to protect areas where there is existing habitat and natural function from impacts due to new substantial developments. The attached memorandum demonstrates that the Burien Marine shoreline is already highly altered and that this approach will not serve the goal of achieving No Net Loss. On the flip side, the proposed buffers will create a burden on owners of existing waterfront homes, rendering a vast majority of them nonconforming. In light of the burden this type of regulation will create on shoreline homeowners, the City must reject the buffer approach included in the regulations.

Additionally, the attached memorandum demonstrates that the proposed vegetation conservation buffer and associated regulations are overly restrictive and will require individual property owners to shoulder the burden of the City's restoration goals. The attached memorandum shows that significant portions of the shoreline in the M1, M3 and M4 reaches are very highly modified and have no native vegetation at all. The land is dedicated to structures and other hardscape or else to landscaping. The draft regulations, for example the regulation requiring revegetation of 75% of the portion of a lot in the vegetation conservation buffer, would functionally preclude any broadly defined "alterations" on the site. In light of the existing conditions described in the attached memorandum, these overly restrictive measures do not ensure no net loss and will create a significant burden on homeowners. We encourage the City to adopt more reasonable regulations governing shoreline vegetation conservation, such as those proposed in the BMHA's redline.

Finally, it is worth noting that the information we are providing reinforces the idea discussed in the recent public forums of using Seahurst Park as the best opportunity to realize gains to shoreline ecology. The work that Burien is doing in Seahurst Park is an exemplary effort that should be applauded. Even with the work that has already been completed, all of the scientific panelists that attended the City's forum on June 14 agreed that there was more to be done and that Seahurst Park presents the best restoration opportunities and should be the focus of any restoration plan. Additionally, if the City wants to generate gains to shoreline ecology that offset potential future losses in other areas of the Burien shoreline, Seahurst Park presents the best city-wide opportunity to ensure no net loss of shoreline ecology throughout the city.

We hope that this information is helpful as you craft regulations designed to ensure "no net loss" of shoreline ecology. We would be happy to meet with members of council, staff or the Department of Ecology at any time to clarify what we have done and to share any of the data we have collected and synthesized.

Sincerely,

Michael D. Noakes

Michael D. Noakes
Burien Marine Homeowners Association

Existing Conditions of Burien Marine Shoreline
Prepared on Behalf of the Burien Marine Homeowners Association

1. Introduction and Methodology

This memorandum describes the existing conditions of the Burien Marine Shoreline. It synthesizes information gathered through field investigations and analysis of maps and aerial photographs.

Field investigations included walking the entire length of the shoreline multiple times observing and noting existing shoreline conditions. Measurements of the existing current setbacks from OWHM, in accordance with RCW 90.58.030 where feasible or using the existing bulkhead where necessary, were taken using a laser range finder.

In addition to our field notes and surveys, we recorded our field data through hundreds of photographs of shoreline properties. Finally our field investigation includes interviews with shoreline property owners many of whom have lived here for decades and have significant knowledge of the history of shoreline development.

This evaluation also relies on high quality aerial images such as those available in Google Earth. Figure 1.1, which shows four waterfront homes and two undeveloped upland parcels on a steep slope along 30th Ave SW, provides an example of the level of detail that is readily available.

Figure 1.1: An aerial image of 6 properties along 30th Ave SW

Tools within Google Earth were used to map the boundaries of properties, homes, accessory structures, roads, lawns and ornamental shrubs, and regions of relatively natural tree growth and other vegetation. The physical surveys and extensive photographs were used to guide and validate this portion of the activity.

Computer programs were developed to evaluate and summarize the data that had been collected. Principal among these is a program that evaluates the regions that were mapped in Google Earth to estimate the area coverage along the shoreline. This program simulates the process of walking the line of OHWM one foot at a time. At each step a 200' sight line perpendicular to the shore is defined and the condition of the land is evaluated at every 1 foot step along this line. This process was repeated for the nearly 26,500 feet of the Burien Marine Shoreline to develop an estimate of the nature of the development for all 121 acres to a resolution of 1 square foot.

The condition of the land has been classified into three categories.

- Hardscape is impervious materials such as primary structures, accessory structures, patios, decks, roads and so on.
- Landscaping is lawns, hedges, flower beds, small to medium sized ornamental trees and shrubs, and so on.
- Natural conditions refer to clusters of natural growth trees, shrubs, and natural ground cover. There was no attempt to distinguish between native and non-native species.

King County Tax Assessor databases were accessed to determine the state of each tax parcel. This provided the ability to determine which parcels are privately owned, to determine when a number of small adjacent parcels have been collected by a single owner and are being treated as a single property, and most importantly to determine which parcels are judged to be unbuildable by the assessors office due to conditions including terrain, access, and slide history.

Properties are classified as waterfront or upland. Waterfront properties are those that include any land that reaches OHWM. In most cases these are properties with meaningful frontage on the shoreline but there are a few situations in which this is a narrow strip that is used to provide beach access to a home that it is substantially further back. Upland properties are those that do not have physical waterfront access. There are examples of both waterfront properties and upland properties that are partially within the SMP jurisdiction and partially beyond it.

2 Overall Characteristics and Observations

The City's Shoreline Inventory (the "Grette Inventory") and Draft SMP divide the Burien shoreline into four broad reaches: M1, M2, M3 and M4. During the field surveys it became apparent that the shoreline is more complex than the four large reaches suggest. For purposes of review and characterization, it is helpful to divide each reach into more discrete divisions or "segments" that are based on the terrain, conditions, and the patterns of development along the shoreline.

Table 2.1 summarizes this partitioning and the remainder of this section describes the distinct terrain in each segment and the resulting development patterns that were observed. The table indicates the length of each segment and its position along the shoreline relative to the boundary between North Burien and Seattle. All calculations are performed in feet; there may be small apparent discrepancies that result from rounding issues when converting these values to miles for display in this table.

Reach	Segment	Length (ft)	Start Point (mi)	Length (mi)	Area (acres)
M1	Seola/30th	1769	0.00	0.34	8.12
	Shorewood Drive	1806	0.34	0.34	8.29
	Standring Lane	2009	0.68	0.38	9.22
M2	Seahurst Park	4368	1.06	0.83	20.06
	25th Ave	1652	1.88	0.31	7.58
M3	149/150/151st	2371	2.20	0.45	10.89
	Start of Maplewid Ave	1654	2.65	0.31	7.59
	Sunset Trail	3815	2.96	0.72	17.52
	Three Tree Point Lane	836	3.68	0.16	3.84
M4	171st	1269	3.84	0.24	5.83
	172nd	1858	4.08	0.35	8.53
	Seacoma Blvd	446	4.43	0.08	2.05
	South Burien	2564	4.52	0.49	11.77
Total		26417	5.00	5.00	121.29

Table 2.1 A summary of the 13 Reach Segments along the Marine Shoreline

2.1 Reach M1

The M1 reach is divided into three segments described in further detail below.

Seola Lane and 30th Ave SW

This segment consists of 34 properties including waterfront properties along Seola Lane and 30th Ave and upland properties along Marine View Drive. Seola Lane and 30th Ave SW run roughly parallel to the shoreline and immediately behind the waterfront homes. Marine View Drive also runs roughly parallel to the shoreline but is further inland and on a bluff above 30th Ave.

Most of the developed properties are in a narrow strip of land along Seola Lane and 30th Ave SW between the OHWM and the toe of an increasingly steep bluff. A small number of upland homes sit at the top of this bluff along Marine View Drive with land that extends down the hill and into SMP jurisdiction along 30th Ave SW.

At the southwest end of this segment are two tract waterfront parcels that appear to be owned by a collective in the Shorewood neighborhood for their common interests. The grade of this land would impose a challenge to new development.

There are 6 privately owned parcels in this segment that have not been developed. All of these are on the steep slope upland of 30th Ave SW and appear to be unbuildable due to the terrain. The King County has assessed each of these parcels at between $1000 and $4500 which confirms this judgement.

The location of waterfront homes between the OWHM and upland bluff is a principal geographic feature in this segment that appears with some frequency throughout the Burien shoreline. Figure 2.1 is provided to help visualize an example of these features. This figure includes a depiction of the SMP jurisdiction in green and the proposed no-touch area in red.

Figure 2.1: A portion of 30th Ave SW

Shorewood Drive
This segment includes a stretch of Shorewood Drive that runs roughly parallel to the shoreline. The segment is dominated by a relatively steep hill that stretches from Shorewood Drive down to OHWM. At the north end of this segment the homes tend to be at the top of the bluff along Shorewood Drive. As one moves southwest along Shorewood the grade becomes less steep near OHWM and one begins to note homes within 50' of OWHM.

Standring Lane
This is a gated community of 24 homes along the waterfront on Standring Lane. Standring Lane is a private road. The land is relatively level at the north of this segment but a hill begins shortly thereafter upland of Standring Lane.

The single parcel that is upland of this stretch of Standring Lane is on a steep slope. The King County Tax Assessor reports the grade as close to 50% and has marked this property as unbuildable and assigned a tax value of less than $18,000.

This segment is 100% armored to protect the homes that tend to sit within 20 - 30' of the bulkhead. The water facing side of these bulkheads is beyond the current natural OHWM and they experience significant levels of wave energy for several hours at a time twice per day.

2.2 Reach M2
M2 has been divided in to two segments.

Seahurst Park
Over three quarters of a mile of beautiful public park that is being steadily restored.

25th Ave
A segment of 15 waterfront homes most of which are located at the top of an extremely steep bluff. The land along this steep slope is in natural condition. Eagle Landing Park is at the south end of this segment.

2.3 Reach M3
M3 is divided in to four segments

149th/150th/151st
This segment consists of 36 homes at the bottom of a steep hill. Most of the homes are between the base of the bluff and the OHWM with street access at the top of the bluff. Accordingly, several of these homes include private trams to provide access to the streets from the homes below.

Start of Maplewild Ave SW
A segment of 23 homes along the first 1/3 of a mile of Maplewild Ave SW. These parcels frequently stretch from the OHWM to Maplewild Ave SW. The terrain is generally quite steep and a good fraction of the homes sit at the top of the bluff rather than along the immediate waterfront. It is believed that the position of these homes is a consequence of the conditions of the terrain rather than owner preference. Waterfront homes become more prevalent towards the southwest end of this segment where the grade becomes less severe.

Sunset Trail
This is the longest developed segment defined in this memorandum. It includes 94 properties between Maplewild Avenue and the water. A small footpath, the Sunset Trail, runs parallel to Maplewild Ave and roughly bisects the length of this segment with homes on either side of the trail. The trail is relatively close to the water at the north end of the segment which has created relatively short parcels with homes constrained by the 20' setback line and the Sunset Trail. The terrain becomes steeper as one moves southward and the trail moves away from the water. At this point some homes are located along the trail at the top of a short bluff but a few homes have been constructed close to OHWM. As one continues along the trail the terrain becomes less severe and homes become more common adjacent to OHWM.

Three Tree Point Lane
The terrain becomes almost flat between the end of the Sunset Trail and the point at Three Tree Point. The 14 homes in this neighborhood tend to sit comparatively far back, the average setback is slightly over 65', and have fully landscaped backyards.

2.4 Reach M4
M4 is divided in to four segments.

171st
This segment contains 16 homes set between SW 171st St and the OHWM. These properties are fully developed with structures and fully altered landscaping.

172nd
This segment consists of a set of 51 parcels including a public street end. There are 41 homes located along the landward side of SW 172nd street. There is a steep hill immediately behind all of these homes. The waterward side of the street is fully hardscaped and this segment is almost completed armored.

Seacoma Blvd
This segment contains 12 private homes. Nine of these are located in a small development along Seacoma Blvd which is between SW 172nd St and OHWM. The remaining three homes are landward of SW 172nd St. These properties are generally short and narrow. This segment is fully armored and extensively hardscaped or landscaped.

South Burien
SW 172nd Ave moves sharply away from the water at the south end of the Seacoma Blvd segment due to a steep bluff. The parcels in the South Burien Segment are long and narrow and nearly all of them stretch from 172nd down to the water. Many of the homes are at the top of the bluff.

2.5 Development Metrics by Reach

Table 2.2 shows the number of properties within each Reach. Public or common land includes parks, street ends, and tract parcels that cannot be developed. The privately owned land is either waterfront, there is some frontage on Puget Sound, or upland. Private properties may be developed, exclusively with a Single Family Residence, or undeveloped. Review of the King County Tax Assessors database suggests that nearly every undeveloped parcel is judged to be unbuildable due to conditions such as steep slopes and frequent slides.

		M1	M2	M3	M4	Marine
Public/Common		2	3	4	2	10
Waterfront	Developed	66	12	112	101	291
	Undeveloped	1	2	8	2	14
Upland	Developed	17	0	44	14	75
	Undeveloped	9	0	0	2	11
Total		95	17	168	121	401

Table 2.2 The number of properties within each reach

Table 2.3 shows the percentage of the linear length of the shoreline that is protected by shoreline armoring and the type of armoring in use.

	M1	M2	M3	M4	Total
Rip Rap	58%	24%	42%	23%	37%
Concrete	35%	0%	35%	68%	35%
Wood	1%	2%	12%	3%	5%
Total	94%	26%	90%	94%	77%

Table 2.3 Level and Type of Armoring by Reach

Table 2.4 summarizes the percentage of land area within 200' of OHWM in each overall condition by reach. As will become clearer in the next section, on private property the Natural condition is strongly correlated with the presence of steep slopes where development is precluded.

	M1	M2	M3	M4	Total
Hardscape	22%	1%	24%	51%	25%
Landscape	24%	0%	30%	37%	24%
Natural	54%	99%	46%	12%	51%

Table 2.4 Area Occupied by Land Coverage

The nature of the terrain has a large impact on the location of the homes. Homes tend to be located relatively close to the water with a hill immediately upland, or else they are at the top of a bluff and are set back from the water. Table 2.5 indicates the number of waterfront homes that are located within 65' of OHWM. This is the depth of the no-touch area in the Burien SMP draft. If this regulation were adopted almost 75% of the waterfront homes would be lawfully non-conforming based solely on their proximity to OHWM. Furthermore the prevalence of steep slopes, as well as roads and foot trails, behind those homes means that few, if any, of the affected homes could be made conforming even if the home were completely destroyed.

	M1	M2	M3	M4	Total
Home < 65'	83%	8%	74%	76%	74%

Table 2.5 Percentage of homes that are within 65' by Reach

2.6 Summary

As described above the Marine Shoreline is almost as fully developed as conditions have allowed with the obvious exception of Seahurst Park. The marine shoreline is dominated by the presence of steep slopes which have strongly shaped the patterns of development.

In some areas the slope remains steep all the way to the OHWM and the homes are found at the top of the bluff. The steep slope tends to preclude development and the land between the home and OHWM is in a relatively natural state.

More commonly the slope is set back sufficiently to allow homes to be placed at the bottom of the hill with the slope immediately behind. In some cases the land is so narrow that residents rely on steep stairs or private trams to reach their homes. Otherwise there may be room for a walking trail or a limited access roadway before the bluff is encountered. These conditions tend to push these homes close to the current 20' setback requirement. In this case the slope behind the home tends to be in relatively natural conditions.

The majority of privately owned undeveloped parcels are found on these slopes and the parcels are usually flagged as unbuildable in the King County Tax Assessors database. Almost all of the remaining parcels are heavily discounted due to slide histories. It is estimated that perhaps 10% to 20% of the privately owned undeveloped land is likely to be developed in a 20 year planning horizon.

3. Development Conditions along the Marine Shoreline

The discussion of the conditions of the shoreline in terms of Reaches and Segments with those reaches helps to enhance one's intuition about the nature of the Burien Marine Shoreline but it may lead to erroneous assumptions about the true prevalence about certain features.

This section will present a more quantified review of conditions using a uniform measure of distance in feet along the shoreline and to a depth of 200' from OHWM. Recall that this area has been mapped in Google Earth and the conditions have been sampled at a resolution of 1 sq. ft. Results are then presented in terms of length, areas, and relative percentages of these. This eliminates misunderstandings that may occur when parcels of significantly different sizes are being implicitly compared.

3.1 Public and Private Land

Figure 3.1 shows the percentage of land area within the SMP jurisdiction that is in public vs. private ownership. For privately owned land this chart indicates whether the land is on a developed parcel or an undeveloped parcel.

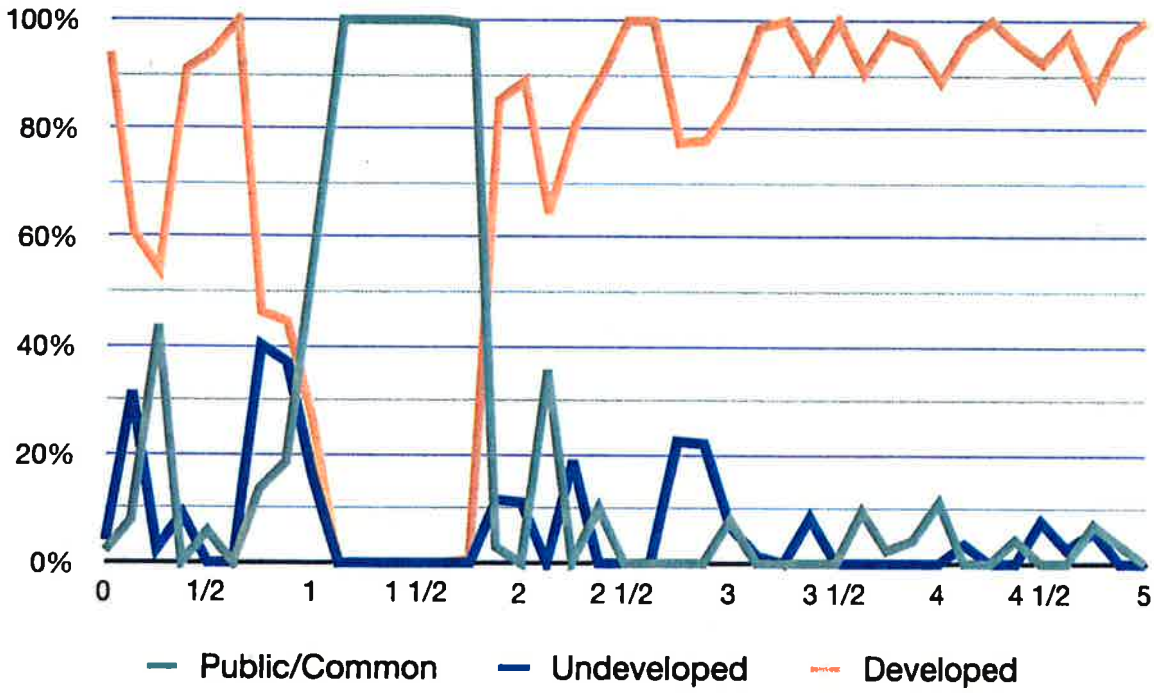

Figure 3.1 Public/Common vs Private land along the Shoreline

The x-axis represents distance, in miles, from the border between Seattle and Burien. The left end of the axis is Seattle and the right end is Normandy Park. The y-axis is the percentage of land area of each type as a fraction of the total area of the SMP jurisdiction. Seahurst Park begins at a little more than 1 mile from Seattle, and the remainder of the developed shoreline stretches from about 2.25 miles to Normandy Park.

The public/common land includes parks, street ends, and tract parcels. The first spike near Seattle is the two tract parcels at the southeast end of the Seola Lane / 30th Ave segment, the second major spike is Seahurst Park, the third spike is Eagle Landing Park, and the remaining spikes are street ends and minor tract parcels. Slightly over 20% of the total area is in the public trust. Almost all of this land is in a natural condition and it is unlikely that this land will become more fully developed in a minimum 20 year planning period. In fact this land provides the best opportunity for restoration activities.

Slightly less than 7% of the total SMP area is on properties that are privately owned but undeveloped. As has been discussed, the majority of this land is noted as unbuildable in the King County Tax Assessors database and much of the rest is heavily discounted due to access or slide history. For example the first two spikes near Seattle represent parcels on the steep slope behind 30th Ave SW and the third major spike around 3/4 of a mile from Seattle is a large unbuildable parcel behind Standring Lane. Queries of the tax database for each undeveloped property suggests that perhaps 1 or 2% of the total SMP area is both undeveloped and buildable. Nearly all of this land is in a natural condition.

3.2 Conditions on Privately Owned, Developed Property

Approximately 70% of the area is assigned to properties that have been developed exclusively with single family residences and their appurtenant structures; a priority use in the SMA. Figure 3.2 shows the patterns of use for the developed properties. A gap is shown for Seahurst Park.

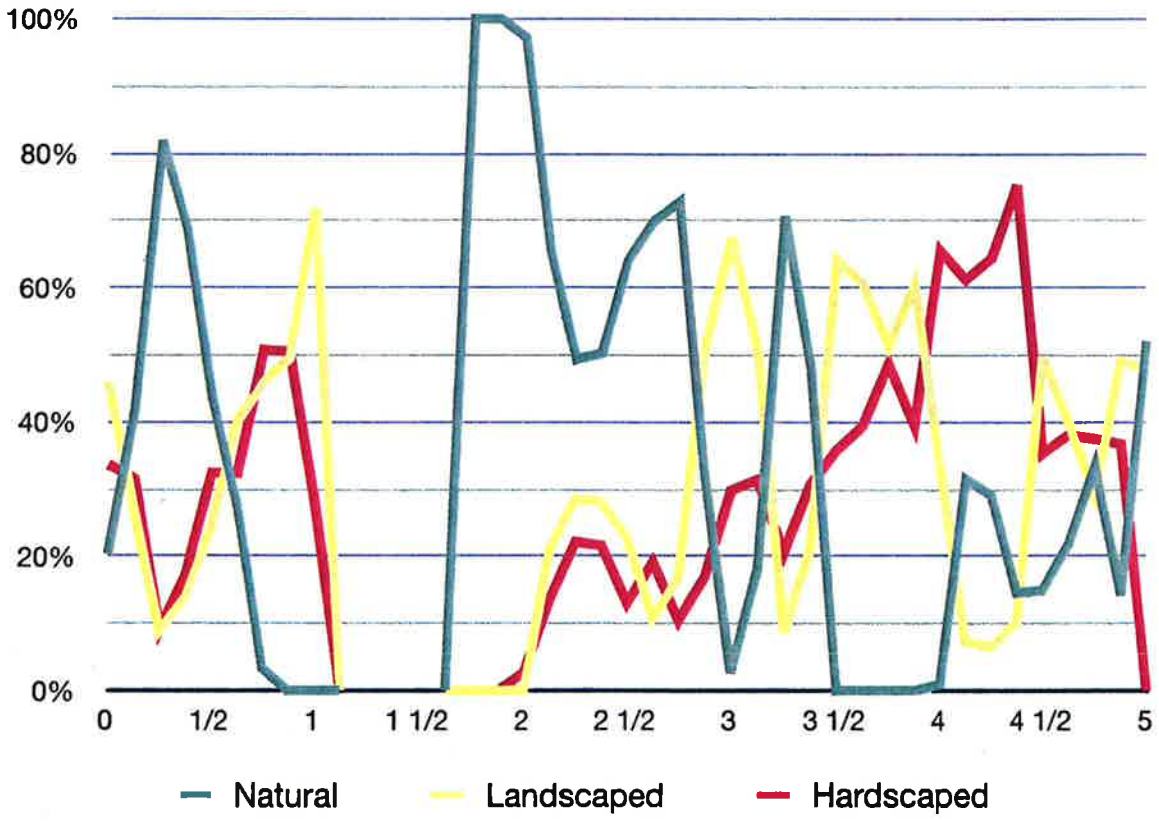

Figure 3.2 Conditions on privately owned developed properties

The total percentage of land coverage sums to 100% for most of this chart. The primary exception is the roughly 3/4 of a mile of Seahurst Park where there is no private property at all which is depicted as 0% for all coverage types.

For the Marine shoreline as a whole, the acreage of developed land within 200' of OHWM is approximately 1/3 natural, 1/3 landscaped, and 1/3 hardscaped. Although natural conditions exist on developed land throughout the shoreline it is particularly prevalent on steeper slopes.

The large spike of natural land in the first 1/4 mile corresponds to area in the vicinity of the tract parcels along 30th Ave SW. Most of the land in this area is in common ownership. The relatively small amount of privately owned land is located at the bottom of the steep bluff between Marine View Drive and 30 Ave SW which is then in a Natural state.

The second spike roughly 2 miles from Seattle corresponds to the steep slope to the southwest of Seahurst Park which is in a fully natural condition all the way to OWHM.

The remaining natural conditions are strongly correlated to bluffs along much of M3 and the south end of M4.

Figure 3.3 clarifies this point by focussing on the altered conditions within privately developed properties for the first 65' from OHWM. This is the area that is proposed as a no-touch area in the Burien draft SMP. Almost 85% of the private developed land within 65' of OHWM is already in an altered condition. There are significant sections of the shoreline where 100% of this area is altered. The first trough around 1/4 miles from Seattle is the steep slope along Shorewood Drive that has tended to force homes to the top of the bluff. The large trough at 1.5 miles is, of course, Seahurst Park which is publicly owned. The remaining peaks and troughs correspond almost perfectly to the position of the hill. The land is fully developed near OHWM when the slope allows and relatively natural when the home has been forced to the top of the bluff. This is the area that is currently proposed as a no-touch area in Burien draft SMP update.

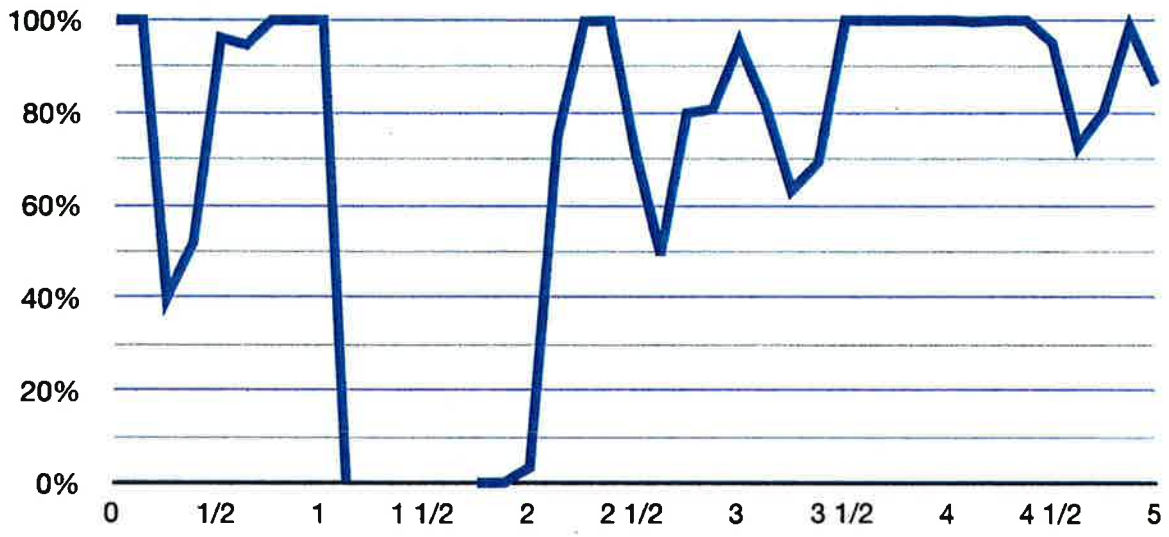

Figure 3.3 Altered conditions within the first 65' from OHWM

Figure 3.4 provides an indication of how altered the conditions are based on distance from OHWM. The red line (1%) indicates the distance where altered conditions are first encountered. The green line (100%) indicates the furthest point of altered land in SMP jurisdiction. Finally the yellow line (50%) indicates the distance travelled to cover half of the total altered land.

For much of the marine shoreline, altered conditions begin immediately at OWHM. Exceptions occur primarily where steep bluffs extend all the way to OHWM in which case the altered conditions are pushed up the bluff.

For much of the first 2.5 miles of shoreline, and ignoring Seahurst Park, the furthest point of altered land is around 100' to 125' from OHWM. The remaining distance is observed to be steep slopes that are in a largely natural condition.

One is more likely to find altered conditions within the full 200' as one continues south along the shore. The region near the tip of Three Tree Point, approximately 3.8 miles from Seattle, is highly altered for the entire 200' from OHWM. This is reflected in the figure with the 1% point at about 2', the 50% point at 100', and the far point at 200'.

The average distance to the start of the altered condition on privately owned land is 5', the average distance to the 50% level is approximately 75', and the 100% level averages approximately 145'. Note carefully that these averages disregard all public/ common land. This quantifies the intuition that the steep bluffs have tend to push the primary residence towards OHWM or else to the top of the bluff and outside of SMP jurisdiction. Outside M2, there is not an existing functioning riparian buffer for most of the shoreline. Defining a generic no-touch area of 65' will not change this and will not contribute to the No Net Loss standard in the SMP guidelines.

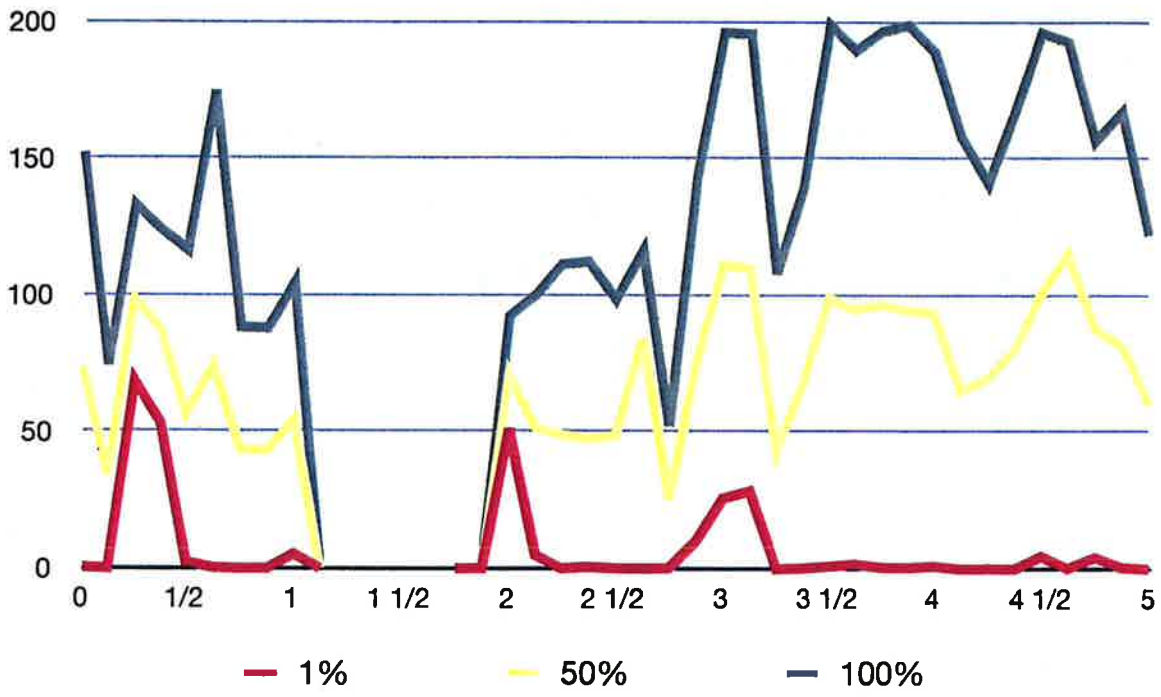

Figure 3.4 Distance Ranges of Altered Condition on Private Property

3.2 Shoreline Armoring

The plan has expressed a concern that new development near the shoreline will create a need for additional shoreline armoring. Figure 3.5 shows that the vast majority of the shoreline is almost completely armored; 95% or more by length. The significant exception is the 20% of the shoreline that includes Seahurst Park and the step bluffs immediately to the south.

The second dip depicted in the chart is in the Three Tree Point Lane segment of M3. As described in section 2.3, this is one of the few developed segments where the edge of the properties averages approximately 5' landward of the current OHWM. In sum, the buildable undeveloped lots that we are aware of are either at the top of a bluff or are already armored.

The majority of these bulkheads are now waterward of OHWM and the bulkheads are subject to significant wave energy, both natural and as a result of large container ships that travel to and from Tacoma, for several hours twice per day and protect homes that are commonly within 65' of the bulkhead.

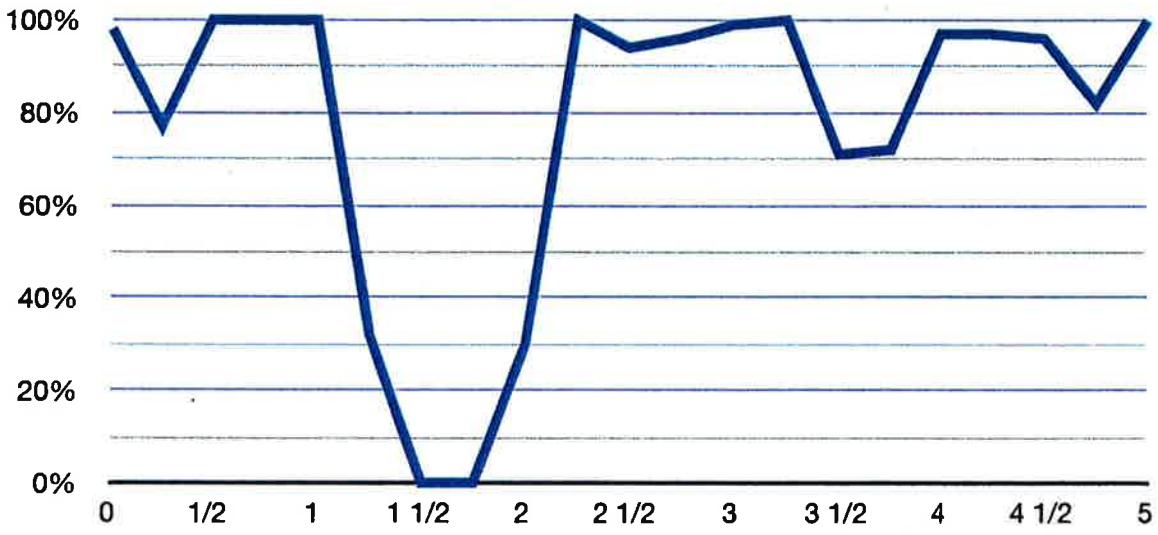

Figure 3.5 Presence of armoring along the Shoreline (mi)

3.5 Summary

This memorandum has demonstrated that the privately owned land within 200' of OHWM is highly developed.

Less than 7% of the total area is assigned to privately owned properties that are entirely undeveloped and most of this property is assessed by the King County Tax Assessors office as unbuildable. It is estimated that only 1% of 2% of the land is available for brand new development.

Slightly more than 20% of the total area is publicly owned and is not considered a candidate for new development in a 20 year planning period. Although this land is in a broadly natural condition this is the land where restoration efforts are most readily pursued.

A little over 70% of the total area is privately owned and contained by properties where a single family residence exists. Approximately 1/3 of this area is in a broadly natural condition and the remaining 2/3 is altered. Most of the homes are in generally good condition but there are a few homes that are candidates for significant reconstruction in the near term, and there is a reasonable expectation that others will require major rennovation in a 20 year planning period.

Development within the shoreline has been driven by terrain. There are steep bluffs along the majority of the shoreline. Homes are pushed close to OHWM wherever conditions allow but then return to the top of the bluffs where the hill is too close to the shore. The nature of the terrain and the desirability of living along OHWM means there is effectively no functioning riparian vegetation area adjacent to OHWM for the majority of M1, M3, and M4.

CEDAROCK CONSULTANTS, INC.

MEMORANDUM

Date: June 4, 2010

From: Carl Hadley

Subject: **The Use of Science to Develop Marine Buffer Recommendations in Burien**

This memorandum was prepared on behalf of the Burien Marine Homeowners Association (BMHA) in response to the Burien City Council's solicitation for science-based input on Burien's draft Shoreline Master Program ("draft SMP"). Specifically, this memorandum addresses the science used to develop marine shoreline buffer recommendations in Burien. First, the memorandum addresses the large volumes of reports and data that have been provided to the City Council, covering many aspects of buffers and buffer widths recommended to protect ecological functions. This science explores predominantly freshwater streams and rivers in forested, undeveloped environments such that it has limited applicability to Burien's urban developed marine shoreline. Second, this memorandum explores potential buffer benefit given existing developed conditions found along Burien's marine shoreline. As explained in further detail below, buffers have limited ability to protect or enhance shoreline ecology in developed urban environments, like that of Burien. Third, this memorandum explains the *"no net loss"* standard in the Shoreline Management Act ("SMA") and what it means in light of existing developed, urban conditions along the Burien shoreline.

What science is Ecology and the City of Burien currently using to define marine shoreline buffer widths and is that science applicable to the Burien marine shoreline?

Nearly all of the scientific literature and literature reviews referenced to support recommended marine buffers in the draft SMP address buffer functions and widths necessary to provide fully functioning natural pathways on freshwater streams in forested areas. Much of this literature investigates the results of tree harvesting in forests, or the effects of various agricultural practices. Notably, the studies evaluate functions provided by natural, forested conditions. Moreover, the literature discusses buffer function on habitat in freshwater streams, not marine (saltwater) shorelines. For example, all three references (May 2003, Knutson and Naef 1997, and FEMAT 1993) cited in the *Recommended Widths for Protected Areas and Buffers* chapter of the document *Protecting Nearshore Habitat and Functions in Puget Sound* discuss work done almost exclusively on streams and rivers in native forests.

These distinctions are important. The literature must be approached with caution when evaluating marine buffer functions and promulgating buffer recommendations. Some of the ecological functions provided by marine buffers are similar to those studied near streams, while other functions are irrelevant. For example, the 35-foot to 151-foot wide buffers

recommended to protect water temperature in streams won't have any influence on water temperature in Puget Sound due to the huge volume of water (relative to a stream), dominating influence of winds and currents, and miniscule potential shading ability compared to the overall surface area of Puget Sound.

By contrast to the natural forested environments that are the subject of the literature upon which the draft SMP relies, Burien's marine shoreline in the three reaches designated residential (M1, M3, and M4) has been altered significantly and is developed for urban residential use. Ninety-two percent of the water front lots on the reaches designated Urban Residential are already developed for single family use. Sixty-three percent of the 243 lots measured to date contain primary residences located within 50-feet of the ordinary high water mark. The full suite of buffer functions that support marine habitat adjacent to natural forests is reduced in areas of highly modified landscape. The presence of native vegetation in the buffer area is key to providing the functions described in references cited by Ecology and these references presume natural forested conditions. They do not consider urban constraints that prohibit or restrict a return to those natural conditions. Examples of these constraints include:

- Populated areas with large numbers of private properties along the shoreline;
- Existing buffer widths and conditions constrained by structure and infrastructure;
- Extensive existing bulkheads;
- Public safety (for example hazard trees or flooding);
- Engineered water quality protection rather than via buffer function.

While there is little available research with which to guide marine buffer recommendations in urban settings, we do not think this will be a particular issue for the City of Burien given existing conditions as discussed below.

Do buffers work in developed areas?

Buffers are typically designed to conserve existing or potential shoreline ecology and can be justified if there is reasonable confidence that the buffers will preserve natural functions. Functions of fully vegetated buffers can include pollutant removal, erosion control, large woody debris recruitment, water temperature moderation, wildlife habitat, bank protection, and nutrient input (among others). While these are all important factors in aquatic habitats within forested areas, the functions may not exist, or may be much less important in urban developed areas.

For example, one of the functions of shoreline ecology is woody debris recruitment. Woody debris is the accumulation of fallen trees and limbs that ultimately contribute to habitat quality. Buffer widths between 150-feet to 200-feet are typically required to provide 100 percent of the woody debris function observed in an intact native forest. However, there are few if any mature to old growth trees currently found along the marine shoreline in Burien and the potential of trees being allowed to grow for 100 to 300 years and then naturally fall is remote. Many if not most old and potentially unstable trees near existing homes and in parks and other

public places are legally removed as hazard trees. Only within non-developed areas, such as portions of Seahurst Park, is it likely that older trees will develop to maturity and be allowed to fall. Any significant trees that are located on private property near the shoreline can be protected using a significant tree ordinance. A buffer is not required to protect this function.

Similarly, as discussed above, buffers have little effect on water temperature in Puget Sound. Buffers also have little ability to preserve natural conditions that prevent erosion and protect bank stability where the banks are already stabilized with a dense mix of houses, landscaping, and hardscape, including significant bulkheads. With the exception of Seahurst Park, there are almost no trees hanging over the bulkheads that provide nutrients. Nor (with the exception of Seahurst Park) are there large patches of native vegetation suitable for use by wildlife habitat. Implementing buffer requirements under these situations would do little if anything to further reduce erosion, or protect nutrient inputs and wildlife habitat.

Vegetated buffers can separate pollution generating surfaces from Puget Sound and help remove pollutants via filtering and sediment deposition. However, the buffer must be vegetated, preferably with native shrubs and herbs. There is very little existing native vegetation on Burien's marine shoreline, thus requiring a buffer to conserve this function would have little effect. Rather than implementing buffers, water quality can better be protected by encouraging or requiring the use of native plants along the shoreline, prohibiting fertilizer and pesticide use, limiting other pollution generating activities such as painting and car washing, and collecting and treating road surface runoff before discharge to the Puget Sound.

What is No Net Loss?

The Shoreline Management Act requires regulations that ensure "no net loss" of ecological function. No net loss is not currently defined as part of the Shoreline Management Act. However, the term as used elsewhere (e.g. wetlands or recreational facilities) has been interpreted to mean that any adverse change to a condition found immediately prior to a proposed action, and caused by the action, will be balanced by an equivalent (or greater) gain somewhere else (i.e., loss balanced by gain).

Net loss is not compared to theoretical (perfect), or pre-development (undisturbed) conditions. This is one reason that science based on intact forests is not relevant along the Burien shoreline. Net loss is compared to existing conditions as found today. Along the marine shoreline in Burien, existing conditions include areas of dense development, extensive bulkheads, and very little native vegetation (Reaches M1, M3, and M4). Further development in these areas will have little adverse effect on existing ecological functions.

Because existing conditions are so important to the implementation of the Shoreline Management Act, the BMHA is currently working to further quantify existing conditions along the marine shoreline. Measurements of bulkhead coverage, building setbacks, and vegetative condition along the shoreline are currently being gathered and will be provided to the City and Ecology for use in developing reasonable and effective protection standards for the area.

We are recommending that the City of Burien define no net loss as follows: **No Net Loss** means that, following an action, shoreline ecological functions necessary to sustain shoreline natural resources are equivalent to ecological functions immediately prior to the action. "Net" change is based on inventory and analysis of existing conditions. When applied to shoreline habitat functions, the net result of any action should be no diminishment in shoreline ecological functions as they currently exist. No net loss does not compare to theoretical, perfect, or undisturbed conditions.

Are there alternatives to buffers on individual properties to protect existing ecological functions?

The Shoreline Management Act requires that local governments evaluate existing nearshore conditions and establish policies and regulations to ensure no net loss of those functions. The most realistic strategy for the Burien marine shoreline is to recognize and protect natural buffer features that have a direct functional role on water and habitat quality within the constraints of the urban environment.

As noted in the document *Protecting Nearshore Habitat and Functions in Puget Sound* (pg. III-37) buffers work best when applied to undeveloped or partially developed areas. Establishing buffers is less effective as the sole mechanism to protect the nearshore in more developed areas. This is primarily because buffers don't work well when they are established around existing residences. The structures immediately become non-conforming and a homeowner loses control of property which may have been utilized as yard or outdoor living space. Buffers in these settings often results in degraded vegetation, poor habitat quality, and potentially lower property values. While a buffer was theoretically applied, in effect there was no improvement in ecological function.

Instead, the City could achieve no net loss through regulations such as those proposed in the BMHA's redline. Additionally, the City of Burien could consider achieving ecological balance by improving habitat on a more regional, city-wide basis, rather than looking to balance ecological loss with gain on each individual property via implementation of large buffer requirements. Along the shoreline this could include further ecological enhancements to Seahurst Park and potential purchase and enhancement of undeveloped lots, perhaps using a mitigation banking plan. This approach is used elsewhere as an available alternative to on-site mitigation.

futurewise
Building communities
Protecting the land

Recommendations on
Making Small Shoreline Buffers Work with Buffer Science

Working Draft - Nov. 2009

Introduction

In the course of reviewing Shoreline Master Programs (SMPs), Futurewise has seen several proposals for small buffers in areas of existing development. Some of these proposals seem to be based on the belief that, if a small buffer is established based on existing development patterns, unlimited continued development outside that small buffer will have no additional impacts to ecological functions, and thus no mitigation is necessary. This paper shows that there is no logical basis for such a strategy, and provides a recommended strategy for the acceptable use of small buffers in existing developed areas – especially cities - which we believe allows for reasonable development while also having a reasonable chance of protecting the existing shoreline functions as the Shoreline Management Act and the Shoreline Master Program Guidelines require.

Purpose of Regulatory Buffers – Avoiding & Minimizing Impacts

The Shoreline Management Act (SMA) policy statement in RCW 90.58.020 lists the primary policy objective of the act: "This policy contemplates protecting against adverse effects to the public health, ***the land and its vegetation and wildlife, and the waters of the state and their aquatic life***, while protecting generally public rights of navigation and corollary rights incidental thereto." In addition, the SMA policy provides that "[p]ermitted uses in the shorelines of the state shall be designed and conducted in a manner to ***minimize***, insofar as practical, any resultant damage to the ecology and environment of the shoreline area and any interference with the public's use of the water."

To implement these policies to protect the ecology and to minimize damage, as well as other policies of the SMA, the SMP Guidelines require **No-Net-Loss of Ecological Functions**, stating specifically: "Local master programs shall include policies and regulations designed to achieve no net loss of those ecological functions."[1]

This is accomplished through **Mitigation Sequencing**,[2] whereby the first task of mitigation is avoidance of impacts, the second task is minimization of impacts, and the third is compensation for remaining impacts. Stated another way, allowing development to impact the shoreline is supposed to be the last option, not the first option. Impacts should only be allowed to the extent that it is not practical to avoid damage to the environment and the public's use of the water, and then the development should minimize and compensate for those impacts.

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[1] WAC 173-26-186(8)(b) under Governing Principles of the Guidelines relating to ecological functions; and implemented in WAC 173-26-201(2)(c) under Basic Concepts. Despite being called 'Guidelines,' the SMA, in RCW 90.58.080(1), requires that shoreline master programs shall be consistent with the SMP Guidelines.

[2] WAC 173-26-201(2)(c) under Basic Concepts and Protection of Ecological Functions; and implemented in WAC 173-26-201(2)(e) under Basic Concepts, Environmental Impact Mitigation.

One of the primary ways to accomplishing mitigation sequencing for shoreline waters (streams, lakes, wetlands, marine waters, etc.) and adjacent shorelands is to protect the functions and values provided by intact vegetation using a **regulatory** buffer or setback and vegetation retention area of a width supported by science. Such a buffer can provide many important functions and help protect the water quality and water resources.

An adequate regulatory buffer can serve three purposes:

(1) It helps accomplishes the first task of mitigation sequencing – avoidance. ***But this is only the case if the buffer is intact.***

(2) An intact buffer also minimizes the adverse impacts of development and redevelopment - such as water quality, glare, and noise impacts.

(3) For both degraded and intact areas, the buffer also identifies the area within which new development will cause impacts that need mitigation. Degraded buffers perform functions at a dampened level, depending on the amount of degradation. Even heavily degraded shorelines can perform functions at some level. This is specifically stated in the SMP Guidelines.[3] When development (including redevelopment, expansion, and more intensified uses) occurs within degraded buffer area, the impacts can be reduced and compensated for by enhancing the degraded functions.

If the regulatory buffer is not of adequate size to avoid and mitigate impacts, as is the case when using small buffers, new development outside the small buffer will still cause new impacts.

Vegetative Buffer Areas Perform Many Functions

The peer-reviewed scientific evidence shows that intact buffers of a width based on science are needed to adequately mitigate the impacts of adjacent development on lakes, rivers, streams, marine waters, and wetlands.[4] The scientific studies document that (1) small buffers, even with intact vegetation, are incapable of fully mitigating development impacts; and (2) degraded buffers are unable to fully perform their buffering function. The science of intact buffer areas of adequate width shows that they perform many functions – some are provided below and grouped by similarity. Of particular importance is that even degraded conditions retain some functions, in spite of claims to the contrary.

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[3] WAC 173-26-201(2)(c) under Basic Concepts and Protection of Ecological Functions.

[4] Karen Cappiella and Tom Schueler, Crafting a Lake Protection Ordinance Urban Lake Management, Watershed Protection Techniques 3(4) p. 756 (2001) accessed on November 5, 2009 at: http://www.cwp.org/Resource_Library/Center_Docs/special/lakes/_ulm_lakeprotectionord.pdf; K. L. Knutson & V. L. Naef, ***Management Recommendations for Washington's Priority Habitats: Riparian*** p. XI, pp. 164 – 67 (Wash. Dept. Fish and Wildlife, Olympia WA: 1997) accessed on November 5, 2009 at: http://wdfw.wa.gov/hab/ripfinal.pdf; Sheldon, D., T. Hruby, P. Johnson, K. Harper, A. McMillan, T. Granger, S. Stanley, and E. Stockdale, ***Wetlands in Washington State - Volume 1: A Synthesis of the Science*** p. 5-55 (Washington State Department of Ecology Publication #05-06-006. Olympia, WA: March 2005) accessed on November 5, 2009 at: http://www.ecy.wa.gov/pubs/0506006.pdf; and EnviroVision, Herrera Environmental, and Aquatic Habitat Guidelines Working Group ***Protecting Nearshore Habitat and Functions in Puget Sound: An Interim Guide*** pp. II-38 to II-46 & pp. III-34 – III-42 (October 2007) accessed on November 5, 2009 at: http://wdfw.wa.gov/hab/nearshore_guidelines/.

Water Quality and Infiltration

- Inhibiting surface erosion from surface runoff and flood flows.
- Filtering sediment from surface runoff and flood flows.
- Removing and transforming nutrients and harmful substances from surface runoff and flood flows.
- Infiltrating and storing surface runoff and flood flows into groundwater for later release to water bodies.
- Removing and transforming nutrients and harmful substances from groundwater passing through root zones.

Stabilization

- Providing stabilization to streambanks and lake shores against erosive water forces through root mats and root-strength.
- Contributing in-water woody debris which reduces and slows erosive water forces against streambanks and lake shores through barriers and increased roughness.

In-Water Habitat

- Providing fish with over-water hanging cover from predators.
- Providing shade to help cool the water, especially for shallow margins.
- Contributing in-water woody debris needed for creation of fish habitat.
- Contributing in-water organic matter to support fish food species (insects and invertebrates), and other aquatic life.
- Screening or dampening noise, glare, and human activity from the water.

Land Habitat

- Providing refuge for fish from fast flood flows, as well as access to large quantities of food.
- Providing natural processes and food web functions to support wildlife.
- Providing wildlife habitat areas (for feeding, reproducing, resting, etc.) for riparian species, and for upland species that use riparian areas.
- Providing a wildlife migratory corridor along the water to other areas.
- Altering the microclimate near the water to be more suitable for aquatic and riparian species by sheltering from wind, holding humidity, etc.
- Screening or dampening noise, glare, and human activity.
- Providing separation from human activity for sensitive aquatic and upland wildlife species.

While full-sized, intact buffers perform almost the full level of the functions above, degraded buffers can perform low levels of functions, and additional development continues to impact these. It is not the case that degraded buffers have no functions, and thus no mitigation is needed for new development outside and arbitrary small buffer area.

Small Degraded Buffers Cannot Protect Shoreline Functions

The currently available science shows that using the science-based buffer for avoidance and mitigation in mitigation sequencing has several logical outcomes that bear on the use of small buffers for existing development:

1. If the science-based buffers are intact, they can protect the resource from many impacts from nearby development.
2. If the buffers are not intact, they cannot protect the resource from adjacent development - even if it meets the buffer width - and there will be impacts.
3. If development takes place within the buffer area, there will be impacts.
4. In the case of existing development within the science-based buffer width, the vegetation is both degraded and there is not enough width. The presence of existing development does not mean that new development will not have impacts or even that existing development does not have ongoing impacts. Just as in #3 above, continued development in the normal science-based buffer area will increase the impacts. Simply making the buffer width number smaller to match the existing development does not change the presence of impacts.
5. Using small regulatory buffer widths to accommodate existing development establishes built-in impacts in the SMP review system.
6. Since the normal path of development in urban areas over time is expansion and intensification, there will be a continual increase in impacts and degradation across shoreline jurisdiction in these areas. This creates issues for both the Cumulative Impacts Analysis and the Restoration Plan.

This information shows that just because the science-based buffer area is degraded, it is not the case that unlimited additional development has no additional impacts as long as it meets a small regulatory buffer or setback.

This evidence also shows that small buffers cannot be applied to areas that may still have intact functions if those functions are to be protected from loss.

Some small buffer systems proposed in some SMPs seem to assume that the smaller degraded buffer works the same as an intact science-based buffer, i.e. adequately providing functions and buffering against impacts as long as development is outside the buffer line. But peer-reviewed scientific literature shows that a smaller degraded buffer is incapable of performing functions adequately and incapable of protecting the resource it is intended to protect.

New Development and Existing Development Impact Shoreline Functions

Expansion of existing development, redevelopment, and new development on vacant land all adversely affect shoreline resources and functions. In fact, even existing development continues to cause impacts to ecological functions. As described above, this is the case even for development outside a small regulatory setback. Consider the following adverse impacts of development on the shoreline resources.

- New structures and impervious surfaces increase runoff volumes, remove vegetation, remove native soils that absorb water, and reduce the area available to infiltrate those volumes. Note that these impacts are partially mitigated through stormwater ordinances. However, stormwater regulations generally only address increased peak

runoff volumes, not the other impacts.[5] In addition, small developments are only required to comply with some of the storm water requirements reducing their ability to address these impacts.[6]

a. The increased runoff is focused into smaller receiving areas, thus increasing the erosive power of the surface runoff in those areas.
b. Where infiltration can still occur, the focused runoff drives infiltrated water to the groundwater table more rapidly with less opportunity for treatment.
c. Less vegetation area is available to filter sediment and nutrients from flood waters and the larger volumes of surface runoff passing over the site.
d. Less vegetation root structure is available to treat groundwater.
e. The trend of decreased infiltration in a drainage basin changes the hydrology of the basin by increasing winter flows and deceasing summer and fall flows adversely affecting water quality and aquatic habitats.

- Adding additions or new structures and impervious surfaces, and removing or simplifying vegetation (cutting trees, replacing shrubs with lawn, paving, etc.) also adversely affect habitat:
  a. Higher value habitat areas and migration pathways are eliminated or replaced with lower value areas, until the most simplified areas (open impervious surfaces) have only limited value for migration pathways and separation areas. More complex areas for nesting and refuge are most susceptible to loss.
  b. Substituting non-native species for native vegetation results in a loss of food sources for the entire food web. Many native insect species cannot effectively use non-native vegetation for food. The reductions in insect populations then affect the fish that feed on them.
  c. Natural processes and food web functions are reduced or eliminated with the progressive removal of complex vegetation elements.
  d. Species (large and small) capable of using degraded areas are greatly reduced with greater degradation.
  e. Microclimate is altered for species currently using site.
  f. Reduces the organic matter input to the water from drifting and blowing wind that supports the aquatic food web and life.
  g. Reduces the large woody debris input from trees and branches falling into the water that is needed to form and diversify fish and aquatic life habitat.

- In addition removing or simplifying the vegetation near water also:
  a. Reduces the root strength and root mats that provide bank stabilization.
  b. Increases sun exposure on shallow water areas and heats them.

- Residential uses have additional impacts, not directly related to construction, that increase with enlargement or expansion of the use. Aside from lighting, very little

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[5] Washington State Department of Ecology, ***Stormwater Management Manual for Western Washington Volume 1 – Minimum Technical Requirements*** pp. 1-20 – 1-26 (February 2005). Accessed on November 5, 2009 at: http://www.ecy.wa.gov/biblio/0510029.html

[6] ***Id.*** at 2-9.

can be done to mitigate these impacts – they are a function of the existence of the development. Non-residential uses can have impacts similar to residential uses that vary depending on the activities and the level of use.

a. Human presence and activity that impacts or drives off fish and wildlife. Bigger residences mean more people on the property, whether family members or guests.
b. Pets that prey on or drive off fish and wildlife. More family members increase the likelihood of having more pets.
c. Machinery and vehicular noise that impacts or drives off fish and wildlife. More people on the property increase the likelihood of having more machines and vehicles – including automobiles, watercraft, and mechanical toys.
d. Use of chemicals and fertilizers for house and yard. Larger structures and grounds increase the use of chemicals.
e. Use of night lighting that impacts or drives off fish and wildlife. Larger structures and grounds increase the use of night lighting.

- Existing uses can also have impacts that increase over time. While shoreline master programs do not apply to most existing uses, these impacts show that allowing an expanded, redeveloped, or new use that continues to rely on existing, degraded buffers or non-existent buffers will result in an increased loss of shoreline functions, contrary to the requirements of the SMA. Further, shoreline master programs do apply to ongoing activities that require five year permit renewals. The SMP should require measures to protect shoreline functions when those permits are renewed.
  a. Buffers degrade over time, so existing uses increase their pollution loads as the buffers degrade.
  b. Even if the pollution being discharged to the water body remains the same, the receiving waters can become more contaminated as pollutants build up in aquatic sediments and the water body year after year. Some pollutants are removed or transformed by flushing and biological processes, but others build up over time.

Recommendations Using Small Buffers or Setbacks with Planting Alternatives

Based on the discussion above, regulatory systems that use small buffers alone are ineffective and fail to comply with the SMA. While a science-based regulatory buffer can provide a means of avoidance, and to a lesser degree minimization, small degraded regulatory buffers and setbacks do not, and result in a system with built-in adverse impacts to ecological functions.

Since a system that uses small buffers or setbacks alone cannot accomplish avoidance, or otherwise mitigate the impacts of a development, the only other acceptable strategy for their use if the built-in impacts are offset by built-in mitigation measures, including mitigation for habitat impacts. This is best accomplished by an improvement of the existing degraded buffer or habitat conditions. Even with this approach to using small buffers or setbacks, the SMP must also address the range of different shoreline conditions in a logical and systematic manner. Below is our recommended strategy for jurisdictions to use small buffers or setbacks for existing developed areas.

1. The shoreline area should be carefully mapped, and the existing level of development should be characterized. This should be part of the inventory and characterization regardless of the use of small buffers. When broad variations exist in setback and vegetation, the areas should be categorized based on the character so the protection measures can consider such variations.
2. Science-based regulatory buffer widths need to be adopted for intact or large setback areas. These areas need to be protected from further degradation.
3. Small regulatory buffers widths or setbacks with native vegetation planting (as described in item 4) can be used for areas of existing development, and should be based on the vegetation and setback categories identified during mapping. However, these areas need to be wide enough to function and function over time. For example, the narrowest high quality buffer than can filter nutrients is 13 feet; the minimal width for filtering pollutants is 33 to 52 feet.[7] And buffers degrade over time as they filter out nutrients and pollutant. Wider buffers are needed to protect other important shoreline functions.
4. Built-in mitigation requirements need to be included when an intact science-based buffer cannot be used to mitigate impacts of new development. This should include various means of enhancing the degraded shoreline areas where doing so is possible – such as planting native shoreline vegetation, removal or reduction of unnecessary shore armoring or other near-water structures, etc. Where native vegetation is planted it needs to include native groundcover, shrub, and tree planting; and needs to extend across the shoreline with allowances for water access.
5. Only very limited uses should be allowed in the setback and no uses can be allowed within the planted areas if they are to function. Encroachments into a buffer or setback vegetation should be limited to those that are water-dependent and water-related. Water-enjoyment and non-water-oriented uses and facilities can function without being in the buffer area.
6. Where native vegetation is not present in the buffer or setback, it must be planted and maintained. This must include native understory, shrub, and tree planting and extend across the shoreline with allowances to access the shoreline. At a minimum, this planted area needs to be large enough to maintain fully grown native trees.
7. Low impact development (LID) techniques should be required to minimize storm water runoff and help maintain a more natural hydrologic system. This is needed to help reduce the polluted storm water that would otherwise overwhelm the narrow planting strip.
8. Major redevelopments and changes in use, must established scientific based buffers, or at least wider buffers, to ensure no net loss of shoreline functions.
9. When permits for activities are renewed every five years, buffers or setbacks and vegetation plantings should be required.

While small buffers can be made acceptable for highly developed urban areas and rural areas, there needs to be policy support for not basing the buffer width on the available scientific information. Of course science-based buffers should be used for intact areas. Such

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[7] K. L. Knutson & V. L. Naef, Management Recommendations for Washington's Priority Habitats: Riparian p. XI, pp. 164 (Wash. Dept. Fish and Wildlife, Olympia WA: 1997).

justification can be provided in the jurisdiction's policy that supports the use of shoreline buffers. We recommend a policy similar to the following:

> *BUFFER POLICY:* While buffers widths based on science are necessary to protect ecological functions, using them is not possible in existing heavily developed areas, such as along some parts of [FILL IN THE BLANK]. In such areas, an alternative strategy is established using smaller buffers [or setbacks and native vegetation plantings] that are based on the existing development pattern, in combination with mitigation requirements for new development that provide enhancement of the smaller buffer and other degraded features to address impacts of the new development outside the small buffer areas.