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DRAFT

SHORELINE ANALYSIS REPORT
Including Shoreline Inventory for City of Bellevue's Shorelines: Lake Washington, Lake Sammamish, Phantom Lake, Kelsey Creek and Mercer Slough

Project: Shoreline Master Program Update

- **Task 2: Analysis and Characterization**

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1.0 INTRODUCTION

1.1 BACKGROUND AND PURPOSE

The City of Bellevue (City) obtained a grant from the Washington Department of Ecology (Ecology) in 2007 to conduct a comprehensive Shoreline Master Program (SMP) update. One of the first steps of the update process is to inventory and characterize the City's shorelines as defined by the state's Shoreline Management Act (SMA) (RCW 90.58). This inventory and characterization was conducted according to direction provided in the Shoreline Master Program Guidelines (Guidelines) and project Scope of Work promulgated by Ecology, and include all areas within current City limits. Under these Guidelines, the City must identify and assemble the most current, accurate and complete scientific and technical information available that is applicable to the issues of concern. To this extent, this shoreline inventory and characterization describes the current regulatory framework surrounding shoreline jurisdiction (Chapter 2), inventories existing conditions (Chapters 3 and 4), assesses ecological functions and ecosystem-wide processes (Chapter 5), and reviews current and potential land uses operating in the City's shoreline jurisdiction (Chapter 6). This analysis will serve as the baseline against which the impacts of future development actions in the shoreline will be measured. The Guidelines require that the City demonstrate that its updated SMP yields "no net loss" in shoreline ecological functions relative to the baseline due to its implementation. Ideally, the SMP in combination with other City and regional efforts will ultimately produce a net improvement in shoreline ecological functions.

A list of potential information sources was compiled and an information request letter was distributed to potential interested parties and agencies that may have relevant information. Collected information was supplemented with other resources such as City documents, scientific literature, personal communications, aerial photographs, Internet data, and a brief physical inventory of the City's shorelines (Appendix A).

1.2 SHORELINE JURISDICTION

As defined by the Shoreline Management Act of 1971, shorelines include certain waters of the state plus their associated "shorelands." At a minimum, the waterbodies designated as shorelines of the state are streams whose mean annual flow is 20 cubic feet per second (cfs) or greater and lakes whose area is greater than 20 acres. Shorelands are defined as:

> "those lands extending landward for 200 feet in all directions as measured on a horizontal plane from the ordinary high water mark; floodways and contiguous floodplain areas landward 200 feet from such floodways; and all wetlands and river deltas associated with the streams, lakes, and tidal waters which are subject to the provisions of this chapter…Any county or city may determine that portion of a one-hundred-year-floodplain to be included in its master program as long as such portion includes, as a minimum, the floodway and the adjacent land extending landward two hundred feet therefrom… Any city or county may also

> include in its master program land necessary for buffers for critical areas (RCW 90.58.030)"

The City's Shoreline Master Program was first adopted in 1974. This SMP consists of the goals and policies in the city's Comprehensive Plan and provisions in the City's Land Use Code. Together these documents represent the City's current SMP. Currently, no environment designations exist for any City of Bellevue shorelines.

The City's existing shoreline management area includes the shorelines along Lake Washington, lower Kelsey Creek, Mercer Slough, Lake Sammamish, Phantom Lake, and their associated wetlands (Appendix D, Figure 1[1]). This shoreline management area has been adjusted (subject to City Council and Ecology approval) concurrent with this SMP update (Appendix D, Figures 2a-2c). Modifications to the jurisdiction boundary, as summarized below, are based on new information regarding associated wetlands (see Technical Appendix Volume I) and waterflow volume. Jurisdictional areas are as follows:

- Lake Washington
- Mercer Slough
- Lower Kelsey Creek
- Lake Sammamish
- Phantom Lake (including Larson Lake and other associated wetland areas)
- Shorelands 200 feet from the OHWM, and including the floodway and 200 feet of adjacent floodplain where present, of each of the listed waterbodies
- Associated wetlands

Washington Department of Ecology's Digital Atlas was consulted to verify the upstream limits of stream and river shoreline jurisdiction based on United Stated Geological Survey's (USGS) recent study of the 20 cubic feet per second (cfs) cut-off. As in the original SMP, Mercer Slough and the lower portion of Kelsey Creek are shoreline jurisdictional. However, per the recent USGS study, the location of 20 cfs has been adjusted slightly upstream in Kelsey Creek, near the confluence with Richards Creek. No other streams within the City have a mean annual flow of 20 cfs or greater. Lake Washington, Lake Sammamish and Phantom Lake all remain shoreline jurisdictional lakes. No other waterbodies within the City boundary exceed 20 acres.

Existing City of Bellevue wetland information (City of Bellevue 2007) and National Wetland Inventory (NWI) data were reviewed to identify known shoreline associated wetlands. Additionally, an inventory to identify, assess, and characterize suspected wetland areas near or within shoreline jurisdiction was also performed as part of this study (Technical Appendix Volume I). Ecology guidance states that an entire wetland is associated if any part of it lies within the area 200 feet from the ordinary high water mark (OHWM) (or floodway in riverine

[1] All figures are included in Appendix D at the end of this report.

environments) of a state shoreline. Further guidance states that wetlands that are hydraulically connected to a Shoreline also would be considered associated, as well as wetlands within the 100-year floodplain. Wetlands that are separated by an obvious topographic break from the shoreline are not associated, provided they are outside the shoreland zone and provided that the break is not an artificial feature such as a berm or road.

Based on field observations and examination of numerous soils samples and background materials, the valley between Phantom and Larsen Lakes is a single wetland, broken on its surface by road overlays with surface connections maintained only by culverts passing stream flow that originates in either Phantom Lake or wetlands associated with Phantom Lake. As shown on the soils map, most of the valley and the mapped wetlands are underlain by Seattle muck. Per the NRCS (http://www2.ftw.nrcs.usda.gov/osd/dat/S/SEATTLE.html), "The Seattle series consists of very deep, very poorly drained organic soils formed in herbaceous and woody deposits in depressions in river valleys and glacial till plains. Slopes are 0 to 1 percent." This description was consistent with our findings.

According to City Parks, an earthen berm was constructed in 2000 by Bellevue Utilities as part of a water quality project between Phantom and Larsen Lakes to divert the surface water away from Phantom Lake and into the drainage channels to the north, toward Larsen Lake (see attached exhibit). Although the stream may not continuously drain surface waters of Phantom Lake, surface water that otherwise would have entered Phantom Lake is supporting stream flow. Groundwater that supplies lake and wetland hydrology is also providing base flow to the stream. Per the City of Bellevue, the outlet weir on Phantom Lake is at elevation 260.18 feet (NAVD88). The topographic contours surrounding Phantom Lake and extending north peak at approximately 262 feet (NAVD88). By this account, Phantom Lake would likely have hydraulic connectivity with Larsen Lake during large flood events. Whether the stream provides the hydraulic continuity necessary to link Phantom Lake, Larsen Lake and the intervening wetlands may still be a matter for some discussion. However, it appears that the active hydric soils present in the valley do provide the necessary hydraulic continuity. Therefore, the associated wetland located along the northwestern portion of Phantom Lake, extends north, entirely surrounding Larsen Lake.

Details regarding the shoreline wetland inventory are provided in Technical Appendix Volume I.

1.3 STUDY AREA

The City of Bellevue is located in north-central King County. The City is surrounded by seven incorporated cities (Kirkland, Redmond, Issaquah, Newcastle, Clyde Hill, Medina, and Beaux Arts), with pockets of unincorporated King County in the southeast. Interstate 405 (I-405) passes through the City from north to south along the western edge of the City. Interstate 90 (I-90) and State Route (SR) 520 pass through the City from west to east respectively. The City encompasses approximately 32 square miles. The study area for this report includes all land currently within the City's proposed shoreline jurisdiction (Appendix D, Figures 2a-2c). The total area subject to the City's updated SMP is approximately 960 acres (1.50 square miles), and encompasses 19.7 miles of stream and lakeshore. Table 1 shows the breakdown of jurisdictional area for each shoreline waterbody.

Table 1. Area of shoreline jurisdiction.

Shoreline	**Total Jurisdictional Area (acres)**	**Total Jurisdictional Area (square miles)**
Lake Washington	219	0.34
Kelsey Creek/Mercer Slough	449	0.70
Lake Sammamish	119	0.19
Phantom Lake	173	0.27
TOTAL	**960**	**1.50**

2.0 CURRENT REGULATORY FRAMEWORK SUMMARY

2.1 CITY OF BELLEVUE

The Shoreline Management Act of 1971 brought about many changes for local jurisdictions, including the City of Bellevue. With the goal "to prevent the inherent harm in an uncoordinated and piecemeal development of the state's shorelines," the City's Shoreline Master Program was developed to help regulate shoreline development in an ecologically sensitive manner with special attention given to public access. Resolution 2345 adopted the City's first Shoreline Master Program on June 17, 1974. The program was updated on September 27, 1982 with the adoption of Ordinance 3145 that created a Shoreline Overlay District (20.25E) within the City's zoning ordinance. Regulations applicable to critical areas which are located within Shoreline jurisdiction were effective August 1, 2006 by Ordinance 5681.

Most of the uses, developments, and activities regulated in Ordinance 5681, are also subject to the City's Comprehensive Plan, the Bellevue Land Use Code, the International Building Code and various other provisions of city, state and federal laws. Any applicant must comply with all applicable laws prior to commencing any use, development, or activity. Bellevue ensures consistency between the SMP and other City codes, plans and programs by reviewing each for consistency during periodic updates of the City's Comprehensive Plan as required by State statute.

The Bellevue Land Use Code (LUC), Critical Areas Ordinance 5680 as amended (20.25H), establishes specific and detailed regulations for most of the uses, development, and activities regulated in the SMP. The LUC and the SMP are intended to operate together to produce coherent and thorough shoreline regulations. In all cases, uses, developments, and activities must comply with both the LUC and the SMP. If there is a conflict between the two, the more protective of critical area functions and values applies.

In 1987, Bellevue adopted regulations to designate and protect sensitive areas. They again updated these provisions in the 1990's pursuant to the Washington State Growth Management Act (GMA) (RCW 36.70A). In response to later GMA amendments, the City adopted in August 2006 a revised Critical Areas Ordinance (CAO) contained in the LUC consistent with best available science and all other requirements of the GMA. All activities which require a substantial development permit, conditional use or variance under the SMP are reviewed under the City's CAO for consistency. As stated above, if there is a conflict between the CAO and SMP, the regulations that offer the greatest environmental protection apply.

In 1995, the City completed an update of the Bellevue Comprehensive Plan pursuant to Growth Management Act requirements. Additional minor amendments have been made to the Comprehensive Plan since 1995, most recently in 2005. The LUC is consistent with and implements the Comprehensive Plan.

Buffers and Structure Setbacks: Shoreline areas within the City of Bellevue, as defined by LUC 20.25E.010, are subject to the shoreline critical area buffer and structure setback requirements of LUC 20.25H.035 (Table 2). These measurements are distances landward of the shoreline's ordinary high water mark.

Table 2. Shoreline Buffers and Setbacks

	Undeveloped Site*	**Developed Site***
Shoreline Critical Area Buffer	50 feet	25 feet
Critical Area Structure Setback	None	25 feet

* An undeveloped site is a site that contains no primary structure, while a developed site is a site that contains a primary structure.

Furthermore, on sites located adjacent to a shoreline with a single-family primary structure established prior to August 1, 2006, encroachments into the shoreline buffer or structure setback shall be modified to exclude the footprint of the existing primary structure (LUC 20.25H.115). Expansion or modification of such primary structures within a shoreline critical area buffer or critical area structure setback is allowed pursuant to LUC 20.25H.055.C.3.n, where expansion outside the shoreline buffer or structure setback is not feasible and where the purpose of the expansion or modification is to serve a function that is an essential component of a single-family residence. This expansion is not allowed to exceed 500 square feet over the life of the structure.

Additionally, modifications to the shoreline buffer or structure setback may be approved if the shoreline buffers on adjacent properties are less than the required buffer for the subject property. However, the adjusted shoreline buffer may not be less than 25 feet (LUC 20.25H.115.B.2.). Modifications may also be approved through a critical areas report pursuant to LUC 20.25H.230. The critical areas report must demonstrate that a requested buffer modification will provide equivalent or better protection of the critical area functions and values that would result from applying the standard buffer.

Pier/Dock Standards: The construction or expansion of one residential dock/pier per residential waterfront lot is allowed pursuant to LUC 20.25E.080.N.1. Each individual dock/pier may not exceed 480 square feet in size, four feet in width, or 150 feet in length and must be fully grated. LUC 20.25E.080.N.1.b provides specifications for pilings associated with moorage facilities and outlines required shoreline plantings necessary to mitigate the impacts of new or expanded moorage facilities. Repair or replacement of existing docks/piers resulting in greater than 50 percent replacement of decking within the first 30 feet waterward of the ordinary high water mark or the replacement of more than 50 percent of the decking of the entire facility shall require the facility to partially comply with the length, width, size, and piling standards mentioned above (LUC 20.25E.080.N.2.a.1).

New or expanded commercial, public access, and marina moorage facilities must comply with the development standards of LUC 20.25E.080.N.3.b. The size and width of such facilities are not specifically regulated, although generally the minimum size necessary to allow for the use is authorized. Grating must be incorporated into the moorage facility to the maximum extent feasible and restrictions are placed on the number, type and location of pilings. Additionally, LUC 20.25E.080.N.3.b.vii details the limits that uncovered commercial, public access, and marina moorage facilities may extend into Meydenbauer Bay. The repair and replacement of existing moorage facilities must also comply to the maximum extent technically feasible with the standards for new or expanded facilities mentioned above.

Moorage facilities located at or waterward of the ordinary high water mark would also likely require permit coordination and compliance with the U.S. Army Corps of Engineers, the Washington State Department of Ecology and the Washington Department of Fish and Wildlife (WDFW).

Shoreline Stabilization Standards: Shoreline stabilizations measures are allowed within the shoreline critical area and shoreline buffer pursuant to 20.25E.080.E. However, shoreline stabilization measures, both hard and soft, are allowed only to protect existing primary structures, public facility or public use structures, and allowed land area (land area located within 25 feet of existing primary structure). Stabilization measures are also only allowed where avoidance measures are not technically feasible and then only after a determination that soft stabilization measures are not technically feasible shall hard stabilization measures be permitted. Hard stabilization measures shall be located at or behind the ordinary high water mark, while soft stabilization measures may be located waterward of the ordinary high water mark.

Shoreline stabilization measures located at or waterward of the ordinary high water mark would also likely require permit coordination and compliance with the U.S. Army Corps of Engineers, the Washington State Department of Ecology and the WDFW.

2.2 STATE AND FEDERAL REGULATIONS

State and federal regulations most pertinent to development in the City's shorelines include the federal Endangered Species Act, the federal Clean Water Act, the state Shoreline Management Act, and the State Hydraulic Code. Other relevant federal laws include the National Environmental Policy Act, Anadromous Fish Conservation Act, Clean Air Act, and the Migratory Bird Treaty Act. State laws which address shoreline issues include the Growth Management Act, State Environmental Policy Act, tribal agreements and case law, Watershed Planning Act, Water Resources Act, Salmon Recovery Act, and the Water Quality Protection Act. A variety of agencies (e.g., U.S. Army Corps of Engineers, National Marine Fisheries Service, U.S. Fish and Wildlife Service, Washington Department of Ecology, Washington Department of Fish and Wildlife) are involved in implementing these regulations, but review by these agencies of shoreline development in most cases would be triggered by in- or over-water work, discharges of fill or pollutants into the water, or substantial land clearing. Depending on the nature of the proposed development, state and federal regulations can play an important role in the design and implementation of a shoreline project, ensuring that impacts to shoreline functions and values are avoided, minimized, and/or mitigated. With the comprehensive SMP update, the City will strive to ensure that Bellevue's SMP regulations are consistent with other

agencies' requirements and explore ways to streamline the shoreline permitting process. A summary of some of the key regulations and agency responsibilities follows.

Section 10: Section 10 of the federal Rivers and Harbors Appropriation Act of 1899 provides the U.S. Army Corps of Engineers (Corps) with authority to regulate activities that may affect navigation of "navigable" waters. Lake Washington and Lake Sammamish are designated navigable waters. Accordingly, proposals to construct new or modify existing in-water structures (including piers, marinas, bulkheads, breakwaters), to excavate or fill, or to "alter or modify the course, location, condition, or capacity of" Lake Washington and Lake Sammamish must be reviewed and approved by the Corps.

Section 404: Section 404 of the federal Clean Water Act provides the Corps, under the oversight of the U.S. Environmental Protection Agency, with authority to regulate "discharge of dredged or fill material into waters of the United States, including wetlands" (http://www.epa.gov/owow/wetlands/pdf/reg_authority_pr.pdf). The extent of the Corps' authority and the definition of fill have been the subject of considerable legal activity. As applicable to the City of Bellevue's shoreline jurisdiction, however, it generally means that the Corps must review and approve most activities in streams, wetlands, and lakes. These activities may include wetland fills, stream and wetland restoration, and culvert installation or replacement, among others. Similar to SEPA requirements, the Corps is interested in avoidance, minimization, restoration, and compensation of impacts.

Federal Endangered Species Act (ESA): Section 9 of the ESA prohibits "take" of listed species. Take has been defined in Section 3 as: "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." The take prohibitions of the ESA apply to everyone, so any action of the City that results in a take of listed fish or wildlife would be a violation of the ESA and exposes the City to risk of lawsuit. Per Section 7 of the ESA, activities with potential to affect federally listed or proposed species and that either require federal approval, receive federal funding, or occur on federal land must be reviewed by the National Marine Fisheries Service (NOAA Fisheries) and/or U.S. Fish and Wildlife Service (USFWS) via a process called "consultation." As previously mentioned, a Corps permit under Section 10 of the Rivers and Harbors Appropriation Act is required for projects in Lake Washington and Lake Sammamish.

Section 401 Water Quality Certification: Section 401 of the federal Clean Water Act allows states to review, condition, and approve or deny certain federal permitted actions that result in discharges to state waters, including wetlands. In Washington, the Department of Ecology is the state agency responsible for conducting that review, with their primary review criteria of ensuring that state water quality standards are met. Actions within streams, lakes or wetlands within the shoreline zone that require a Section 10 or Section 404 permit (see above), will also need to be reviewed by Ecology.

Hydraulic Code: Chapter 77.55 RCW (the Hydraulic Code) gives the Washington Department of Fish and Wildlife (WDFW) the authority to review, condition, and approve or deny "any construction activity that will use, divert, obstruct, or change the bed or flow of state waters." As applicable to the City of Bellevue's shoreline jurisdiction, however, it generally means that WDFW must review and approve most activities in streams and lakes. These activities may

include stream alteration, culvert installation or replacement, pier and bulkhead repair or construction, among others. WDFW can condition projects to avoid, minimize, restore, and compensate adverse impacts.

3.0 ELEMENTS OF THE SHORELINE INVENTORY

Development of a shoreline inventory is intended to record the existing or baseline conditions upon which the development of shoreline master program provisions will be examined to ensure the adopted regulations provide no net loss of shoreline ecological functions. At a minimum, local jurisdictions shall gather, to the extent information is relevant and readily available, the following information:

- Regulations affecting shorelines (see Chapter 2.0)
- Land Use Patterns
- Transportation
- Utilities
- Existing Structures
- Impervious Surfaces and Vegetation
- Shoreline Modifications
- Public Access Areas
- Critical Areas
- Channel Migration Zones and Floodplains
- Archeological and Historical Resources
- Areas of Special Interest
- Restoration Opportunities (degraded sites)
- Data Gaps (see Chapter 7.0)

The following discussion expands upon each of the above required inventory elements, identifying sources of information, and provides a brief City-wide narrative for each element, if appropriate. A list of inventory elements and the various data sources that were utilized for each element are provided in Appendix B. Chapter 4.0 then provides shoreline-specific inventory results and discussions.

3.1 LAND USE PATTERNS

Land use conditions in shoreline areas bear on the preparation of master programs for two reasons.

First, the Shoreline Management Act (SMA), Chapter 90.58 RCW, establishes a policy that gives preference to uses that are unique to or dependent upon a shoreline location. Consequently, WAC 173-26-201(2)(d) calls for master program provisions to give higher priority to the following types of uses, in the order presented below:

1. Areas for protecting and restoring ecological functions.
2. Water-dependent and associated water-related uses.
3. Other water-related and water-enjoyment uses.

4. Single-family residential uses where they are appropriate and can be developed without significant impact to ecological functions and displacement of water-dependent uses.
5. Non-water-oriented uses where the uses descried in 1-4 above are inappropriate or where non-water-oriented uses demonstrably contribute to the objectives of the SMA.

A second important reason for inventorying shoreline and adjacent land uses is that this inventory information is critical for assigning environment designations as called for in WAC 173-26-211. As noted in WAC 173-26-211(3), the SMP and the comprehensive plan must be mutually consistent, and shoreline and adjacent land use is very relevant to the criteria for individual environments in the WAC section.

Land use patterns were derived from GIS mapping from the City's most recent Comprehensive Plan (Appendix D, Figures 3a-3c, City of Bellevue 2005) and from review of aerial photography from 2007. Shorelands surrounding Lake Washington and Lake Sammamish are almost completely built-out with residential uses, while also containing public parks. Phantom Lake is primarily built-out with residential uses, although portions of its shoreline contain undeveloped residential properties and public park open space. Kelsey Creek passes through numerous land uses within the City including, residential, office/professional and public park open space.

As noted in the 2003 Parks and Open Space System Plan, public ownership (existing and potential parks) along Lakes Washington and Sammamish is just over 10 percent of available shoreline, with nearly all occurring along Lake Washington. City standards have been developed which propose 10 to 20 percent of shoreline be available for public access. The Parks and Open Space System Plan emphasizes the need for further acquisition new City shoreline property as well as the development of existing undeveloped City waterfront. Specific emphasis is placed on increasing public access to Lake Sammamish. Currently, the City owns three undeveloped waterfront parcels along Lake Sammamish, totaling approximately 190 feet connected shoreline.

The variety of existing uses and conditions identified on Bellevue's shorelands will be a factor in assigning environment designations to various shoreline areas. The maps and discussion found in Chapter 4.0 provide information that will be useful in that regard.

3.2 TRANSPORTATION

While transportation facilities do not directly impact shorelines in ways similar to direct stormwater input, public and private roadways, whether residential streets or local highways, are correlated with increased impervious surface, decreased water detention, and water quality impacts. As such, the inventory of transportation facilities is an essential facet to determining shoreline function and the spatial relationship of these facilities to various shoreline uses.

In general, information about transportation facilities was derived from the City's *Transportation Improvement Program 2008-2013* (2007), the City's *2007-2013 Capital Investment Program Plan* (2007), the City's *2006-2017 Transportation Facilities Plan* (2006), aerial photographs, and other map resources.

3.3 WASTEWATER AND STORMWATER UTILITIES

There are two primary utilities with the ability to directly and indirectly impact State shorelines: wastewater and stormwater. Wastewater utilities are present within shoreline jurisdiction in the form of sewer main lines within waterbodies such as Lake Washington and Lake Sammamish as well as pump stations and lateral lines. These utilities clearly have potential to affect water quality in the event of line failure. Stormwater utilities also exist within shoreline jurisdiction with numerous direct discharges throughout the City to local waterbodies. Both water quantity and quality are considered areas of concern when discussing stormwater issues.

Information regarding wastewater and stormwater utilities was derived from the City's GIS, King County GIS, the City's *Utilities Strategic Plan Update 2006*, and City staff.

3.3.1 General Background

The Bellevue Utilities department was created in the early-1970s to address the City's rapid urban development and the need for both wastewater and stormwater management within the City. Although the City has grown significantly since its incorporation, the Utilities Department still holds the same values to providing quality services to residents at a reasonable cost while protecting the environment (City of Bellevue website).

The City of Bellevue established the Storm and Surface Water Utility in 1974 aimed at preventing flooding and damage from storms and protect surface water. To this extent, the Utility operates and maintains pipes, catch basins, and flood control sites in conjunction with streams, lakes and wetlands to maintain water quality and to protect salmon and other wildlife. Although much of the Utility's jurisdiction is outside of the shoreline zone, all of the regulated surface waters, both natural and piped, are discharged ultimately into either Lake Washington or Lake Sammamish and thus affect shoreline conditions.

In 2006, the Utilities Department developed the "Bellevue Utilities Strategic Plan Update 2006," which serves as a guidebook for City staff to provide residents a reliable, safe, and well-maintained utilities infrastructure. The Strategic Plan Update 2006 focuses on the services that Utilities provides, identifies strategic investments to achieve long-term goals, and discusses how these goals may be achieved through the implementation of a variety of strategies.

3.3.2 Wastewater Utilities

The City provides sewer services to all areas located within the City of Bellevue. In addition, the City provides services to all of the "Point Cities", including Clyde Hill, Hunt's Point, Medina, and Yarrow Point. King County Natural Resources and Parks Wastewater Treatment Division (formerly known as Metro) treats wastewater from the City at the South Treatment Plant located in Renton. This plant discharges into Puget Sound after providing primary, secondary, and disinfection treatments. Discharges from the plant are regulated by the Washington Department of Ecology under National Pollutant Discharge Elimination System (NPDES) permits, which includes performance standards and monitoring requirements.

Metro was established in 1958 to eliminate wastewater discharges into Lake Washington that were having such a profound adverse effect on water quality and habitat. By 1968, discharges of

untreated sewage, which were once about 20 million gallons per day, had dropped to 0 (except for combined sewer overflows) and water quality in the lake rapidly and dramatically improved (Li *unknown date*; Edmondson 1991). As part of the sewage overhaul, Metro constructed the two treatment plants previously mentioned, and over 100 miles of trunk lines and interceptors. The trunk lines run along the perimeter of Lake Washington, above and below the ordinary high water mark of the lake. The 19 miles of lake lines in Lake Washington and Lake Sammamish were constructed in the 1950s and 1960s. A multi-year condition assessment project was initiated in 2007. So far, only a small portion of the Meydenbauer Bay lake line has been examined. The functional life will greatly depend on the pipe materials, operating conditions and environment the lake lines are exposed to. In general, the lake lines would be expected to remain functional for 50 to 100 years after they were constructed (Heubach, pers. comm., 2008).

According to City staff (Paulsen, pers. comm., 2008), there are no combined sewer overflows (CSOs) located within City of Bellevue jurisdiction. However, CSOs still occur within City of Seattle jurisdiction during high rain events, but the incidence and overall volumes are being reduced. King County recently completed its final and largest Lake Washington CSO project in the Rainier Beach area of Seattle. Prior to implementation of this project in late 2005, CSO volumes into Lake Washington were between 30 and 60 million gallons per year.

A majority of the lake trunk lines within the City of Bellevue are below ordinary high water mark (OHWM) and are buried at a depth of approximately four feet (Paulsen, pers. comm., 2008). However, in a number of areas, specifically along the Lake Washington shoreline, the lake lines are being exposed due to low gravel supply. The City's Capital Improvement Plan (CIP) identifies this as a project to be addressed in the near future. Specific problem areas are identified in Chapter 4. However, due to the nature of the sewer main using a flushing system, examination of the sewer line condition is difficult (Thompson, pers. comm., 2008).

3.3.3 Stormwater Utilities

According to GIS data provided by the Utilities Department, there are well over 200 outfalls (both public and private) which discharge directly into the shoreline area and many more that discharge just outside of shoreline jurisdiction, but subsequently flow into the shoreline area (see Appendix D, Figures 5a-5c). The City operates 11 regional detention facilities, six of which affect the waters draining into Mercer Slough, all of which are fish-passable. The Larsen Lake facility is located within shoreline jurisdiction (Paulsen, pers. comm., 2008).

The City submitted its *2008 Draft Stormwater Management Program* (SWMP) to the Department of Ecology in March 2008. As of March 31st, 2008, the City meets initial National Pollutant Discharge Elimination System (NPDES) Permit requirements (City of Bellevue 2007). The NPDES Phase II permit is required to cover the City's stormwater discharges into regulated lakes and streams. Under the conditions of the permit, the City must protect and improve water quality through public education and outreach, detection and elimination of illicit non-stormwater discharges (e.g., spills, illegal dumping, wastewater), management and regulation of construction site runoff, management and regulation of runoff from new development and redevelopment, and pollution prevention and maintenance for municipal operations.

The NPDES permit will require the City to achieve a number of objectives by March 31 of each year (City of Bellevue 2007). These include:

- Submitting a SWMP document to Ecology describing compliance activities planned in the coming year;
- Post the SWMP on the web; and
- Submit an annual report documenting Permit compliance activities for the previous calendar year.

Bellevue has positioned itself to maintain compliance with future Ecology permit deadlines. Actions recommended for continued compliance include: (excerpted from the *2008 Draft SWMP*).

- Creating an on-going NPDES implementation management group and organizational structure.
- Defining and implementing SWMP implementation cost accounting strategy.
- Defining and implementing an NPDES training program, including a tracking system.
- Defining roles and responsibilities and developing processes and procedures for completing updates to the 2008 SWMP document and the Annual Compliance Report annually for submittal to Ecology on March 31st.

The City has various programs, such as the Private Drainage Inspection Program, to control stormwater pollution through maintenance of public facilities, inspection of private facilities, water quality treatment requirements for new development, source control work with businesses and residents, physical inspections (PIs), vacuum sweeps of sand near aquatic areas, dechlorinization, and pollution spill control and response (Paulsen, pers. comm., March 31, 2008).

The City currently follows Volume 1 of the *1992 Washington State Department of Ecology Stormwater Management Manual for Western Washington*, but will be asking the City Council to approve a switch to Ecology's 2005 *Stormwater Management Manual for Western Washington* as the NPDES Phase II permit requires that the City use minimum requirements that are equivalent to this manual. The City expects to adopt the 2005 manual in 2009. The purpose of stormwater detention is to reduce flooding of roads and structures, and to reduce damage to stream channels (and associated fish habitat) that results from the more frequent and longer duration peak flows that come from developed watersheds. Large lakes such as Lake Washington are not subject to damage from peak flows, and so detention is not required for projects draining directly to them. In addition, the lake level is managed and maintained by the Corps, which further reduces flooding potential. Discharges into streams, such as Kelsey Creek, can have a significant impact on in-stream habitat complexity, peak flow magnitude and duration, bank stability, substrate composition, and a number of other parameters. The water quality impact of stormwater inputs is also significant. Stormwater runoff carries pesticides, herbicides and fertilizers applied to lawns and sports fields; hydrocarbons and metals from vehicles; and sediments from construction sites, among other things. All of these things can harm fish and wildlife, their habitats, and humans.

3.4 IMPERVIOUS SURFACES AND VEGETATION

Impervious surface and conversely, vegetation is relevant to shoreline functions because of the relationship between the two elements and stormwater runoff. In a number of ways, vegetated areas slow the movement and reduce the quantity of runoff that makes its way into streams and other waterbodies. Increases in impervious surface coverage, and the consequent reduction in soil infiltration, have been correlated with increased velocity, volume and frequency of surface water flows. This hydrologic shift alters sediment and pollutant delivery to streams and other receiving bodies (Booth 1998; Arnold and Gibbons 1996). Increased surface water flows associated with impervious surface coverage of suburban areas (20-30%) has been linked to decreased bank stability and increased erosion (May et al. 1997). Rainwater can evaporate off of vegetation without ever reaching the ground, infiltrate into the soils where it is taken up by vegetation and evapotranspirated, infiltrate into the soils to recharge groundwater, or move slowly over the surface or subsurface into a waterbody. Impervious surfaces replace vegetation and speed the movement of runoff into waterbodies while increasing the volume of the runoff, and may pick up pollutants in the process.

The City of Bellevue teamed with American Forests in 1997 to study the changes taking place within the City's forested areas. Through this collaboration, it was discovered that the amount of tree loss within the City was much greater than previously known. Most importantly the tree loss was contributing to an increase in stormwater runoff. The collaboration with American Forests concluded the need for tree retention within the City and the transfer of privately owned Native Growth Protection Tracts into City ownership.

Critical Areas Ordinance, Ordinance 5662, approved in 2006 requires the retention of significant trees to, among other things, reduce the impact of development on the storm drainage system and the City's water resources. Additionally, Ordinance 5683, also approved in 2006 limits the amount of new impervious surfaces associated with new development. Maximum impervious surface limits are set forth for individual land use classifications within the City. The goal of the ordinance is to decrease the overall level of surface runoff, particularly in critical areas.

The City is currently updating its impervious surface and vegetative cover data with preliminary results available for this shoreline inventory. This 2008 data set contains fairly fine detailed information covering various vegetation types (i.e. shrub, coniferous, deciduous), impervious surfaces, and bare ground. Per the City, this data is considered 90 percent complete. However, the remaining 10 percent to be completed relates to clarifying what types of impervious surfaces (i.e. sidewalks, streets, buildings, etc) are shown. Thus, the amount of impervious surface included in this GIS data is considered very accurate and is sufficient for the needs of this shoreline inventory and analysis.

Based on the 2008 data set, the total impervious area within the City's 1.50 square miles of shoreline jurisdiction is 229 acres (0.36 square miles) or approximately 24 percent. Table 3 shows the breakdown of impervious surface by shoreline waterbody. As expected, Lake Washington (41 percent) and Lake Sammamish (39 percent) shorelines contain a much higher percentage of impervious surface than Phantom Lake (7 percent) and Kelsey Creek/Mercer Slough (18 percent) areas which contain primarily areas of open space and/or park land.

Table 3. Known Impervious Surface by Shoreline Waterbody.

Shoreline Waterbody	Total Impervious Area (acres)	% Impervious Surface
Lake Washington	90.3	41
Kelsey Creek/Mercer Slough	79.6	18
Lake Sammamish	46.2	39
Phantom Lake	12.6	7
TOTAL	**229**	**24**

3.5 SHORELINE MODIFICATIONS

Shoreline modifications are anthropogenic alterations to the natural shoreline edge and nearshore environments, and primarily include a variety of armoring types like bulkheads and rock walls (some associated with fill), piers, docks, other in-water structures such as boatlifts, boathouses, and moorage covers, culverts, weirs, and bridges. These sorts of modifications may alter shoreline functions by changing erosion, sediment, and water movement patterns, the distribution of aquatic and terrestrial vegetation, and predator-prey dynamics of fish and wildlife. An inventory of the extent and location of shoreline modifications along shorelines is important to understand baseline conditions and the potential cumulative effect of future goals, policies and regulations. Shoreline armoring can have many justifications, but often the intent of bulkheads is to:

- protect shoreline property by reducing wave impacts and decreasing erosion,
- increase or maintain lawn areas, and/or
- coordinate style of neighboring shoreline properties.

While not all bulkheads are necessary to protect shoreline property from excessive erosion, there are many areas along the City's shoreline, especially on shallow lots with steep banks, which may need some form of shoreline armoring in order to protect existing structures and land uses. The topography along the City's shorelines vary widely from shallow, low-gradient shorelines within portions of Meydenbauer Bay to more steep-gradient shorelines along the northern Lake Sammamish shoreline. Historically, shoreline armoring constituted the use of concrete walls, large boulders, and/or wood timbers. However, many bioengineering techniques have been developed in recent years to provide alternative shoreline protection methods. Chemical treatments of pier components, such as creosote piles, installed prior to today's standards, have also impacted water and sediment quality within Lake Washington, Lake Sammamish and Phantom Lake.

Regarding evaluation of impacts from overwater structures, both measures, total overwater cover and number of structures, are relevant to ecological function assessment. Total overwater cover is an indication of the amount of lake surface that is shaded, which can impact growth of aquatic vegetation and subsequently the food chain as a whole. Overwater cover is also implicated in exacerbating the predator-prey relationship between native fish and non-native fish, particularly between threatened chinook salmon and other salmonids and introduced bass (Fresh et al. 2003; Tabor et al. 2004). The number of structures is relevant as it indicates the number of impedances

to juvenile salmon migration along the shoreline. Studies have indicated that juvenile salmon approaching a sharp change in light and cover may attempt to go around the structure, which increases predation risk (Tabor et al. 2006).

The extent of shoreline modifications were derived from several sources including City GIS, Washington Department of Natural Resources GIS maps on overwater structures, aerial photography, and limited field reconnaissance.

Table 4 shows the breakdown of shoreline modifications by shoreline waterbody. Lake Washington (81 percent) and Lake Sammamish (71 percent) shorelines are more heavily armored than Phantom Lake (2 percent). Mapping of shoreline armoring for the Kelsey Creek/Mercer Slough shoreline has not been completed. However, based on some site inspections throughout the Kelsey Creek/Mercer Slough shoreline, the true extent of shoreline armoring is expected to be extremely low.

Table 4 also shows the extent of overwater cover for each shoreline waterbody. As with shoreline armoring, Lake Washington and Lake Sammamish have much higher results for the number of piers/docks per mile than Phantom Lake. There is some disparity in overwater cover between Lake Washington (34 square feet per lineal foot) and Lake Sammamish (13 square feet per lineal foot). This is primarily due to the presence of large marinas, yacht clubs, and City piers along Lake Washington. Excluding these large piers, the overwater cover for Lake Washington would be approximately 18 square feet per lineal foot. Reach specific details are included in Chapter 4.

Table 4. Extent of Armoring and Overwater Cover by Shoreline Waterbody.

Shoreline Waterbody	% of Armored Shoreline	# of pier/docks per mile	Total overwater cover (sq.ft.) / lineal foot
Lake Washington	81	40	34
Kelsey Creek/Mercer Slough	--[1]	--[1]	--[1]
Lake Sammamish	71	66	13
Phantom Lake	2	12	--[2]
TOTAL	**55**	**36**	**19**

[1] Mapping of shoreline armoring and overwater cover for the Kelsey Creek/Mercer Slough shoreline has not been completed
[2]Area calculations are not available for Phantom Lake

3.6 EXISTING AND POTENTIAL PUBLIC ACCESS SITES

Public access includes the ability of the general public to reach, touch, and enjoy the water's edge, to travel on the waters of the state, and to view the water and the shoreline from adjacent locations. In order to accomplish these goals per WAC guidelines, local governments should develop a set of planning tools that indentifies public access opportunities. This may be

accomplished though a discussion within the City's Comprehensive Plan's Transportation and Parks, Open Space & Recreation elements.

To support this planning, WAC 173-26-201(3)(c) calls for local governments to inventory existing and potential shoreline public access sites, including public rights-of-way and utility corridors. Because shoreline access includes visual access, the team also identified important views of the water from shoreline areas.

Information about public access sites in the City was drawn from City GIS, site visits, aerial photographs, the City's Parks and Community Services Department staff and websites, and the City's land use and parks maps.

3.7 CRITICAL AREAS

The City's critical areas regulations include geologically hazardous areas (landslide, steep slope and coal mine hazards), areas of special flood hazard, wetlands, streams, and habitat associated with species of local importance. The inventory of critical areas was based on a wide range of information sources, including City GIS, King County GIS, critical area inventories, stream type mapping, Washington Department of Fish and Wildlife databases, and other relevant maps and literature obtained from the Washington Department of Natural Resources (DNR), Ecology, National Marine Fisheries Service, and U.S. Fish and Wildlife Service. Soils mapped by the Natural Resource Conservation Service (NRCS) are shown in Appendix D, Figures 9a-9c. Soil types classified as "hydric," or saturated, are indicative of wetland soils.

3.7.1 Geologically Hazardous Areas

The City's geologic hazard areas, as identified by the City's Critical Areas Ordinance (LUC 20.25H.120), include landslide hazard areas, steep slopes and coal mine hazards. Brief designations for each category as defined in the City's Critical Areas Ordinance are as follows:

> *Landslide Hazards*. Areas of slopes of 15 percent or more with more than 10 feet of rise, which also display any of the following characteristics:
>
> - Areas of historic failures, including those areas designated as Quaternary slumps, earthflows, mudflows, or landslides.
> - Areas that have shown movement during the Holocene Epoch (past 13,500 years) or that are underlain by landslide deposits.
> - Slopes that are parallel or subparallel to planes of weakness in subsurface materials.
> - Slopes exhibiting geomorphological features indicative of past failures, such as hummocky ground and back-rotated benches on slopes.
> - Areas with seeps indicating a shallow ground water table on or adjacent to the slope face.
> - Areas of potential instability because of rapid stream incision, stream bank erosion, and undercutting by wave action.
>
> *Steep Slopes*. Slopes of 40 percent or more that have a rise of at least 10 feet and exceed 1,000 square feet in area.

> *Coal Mine Hazards*. Area designated on the Coal Mine Area Maps or in the City's coal mine area regulations, BLUC 20.25H.130, as potentially affected by abandoned coal mines; provided, that compliance with the coal mine area regulations shall constitute compliance with the requirements of this chapter in regard to coal mines.

Additional geologically hazardous areas include areas of liquefaction potential mapped by King County (Appendix D, Figures 12a-12c).

3.7.2 Areas of Special Flood Hazard

For all practical purposes, "frequently flooded areas" are those areas within the 100-year floodplain and any other areas subject to flooding (WAC 365-195-090(4)). Lake Washington does not have a floodplain because it is a controlled water body, but all of Kelsey Creek (including Mercer Slough), Phantom Lake and the Lake Sammamish shoreline are mapped as 100-year floodplain per Federal Emergency Management Agency maps (FEMA 1995) (Appendix D, Figures 10a-10c). These maps show areas with the potential for at least one foot of flooding. This is otherwise known as the "base flood" or the flood having a 1 percent chance of being equaled or exceeded in any given year. The City of Bellevue regulates these areas via its Areas of Special Flood Hazard Regulations (LUC 20.25H.175), which are part of the City's Critical Areas Ordinance.

The National Marine Fisheries Service recently (September 22, 2008) released a biological opinion on the effects of FEMA's National Flood Insurance Program (NFIP) throughout Puget Sound (National Marine Fisheries Service 2008). This document identifies the NFIP as having the ability to change the implementation of the insurance program throughout Puget Sound communities to reduce impacts on critical habitat for certain salmon species. FEMA expects to work with local jurisdictions in the near future to ensure that critical habitat is being protected within their implementation areas. It is not clear at this time whether the City of Bellevue will need to further address this issue.

Flooding is commonly the result of excess surface water runoff and is exacerbated when eroded soil from cleared land or unstable slopes reduces the waterway's natural capacity to carry runoff water. This may eventually result in property damage, public safety hazards, and destroying aquatic and riparian habitat. Numerous small floodplains exist in areas of Bellevue, such as along Coal Creek west of I-405; Kelsey Creek through the Lake Hills Greenbelt, Glendale Golf Course, and Kelsey Creek Park; Valley Creek near Highland Park; Richards Valley; and the shoreline of Lake Sammamish.

Some floodplain development is allowed such as streets, parking lots, buildings on pilings, some filling of the floodplain, and channelization of streams so long as the development does not affect the base flood elevation. Many practices have resulted in public hazards due to flooded streets, parking lots, and buildings located in the floodplain; increases in stream velocities causing erosion, scouring and sedimentation; property damage and the destruction of aquatic and riparian habitat.

3.7.3 Wetlands

Section 20.25H.095 of the City's Critical Area Ordinance provides the following GMA required definition of a wetland:

> Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. Wetlands do not include those artificial wetlands intentionally created from non-wetland sites, including, but not limited to, irrigation and drainage ditches, grass-lined swales, canals, detention facilities, wastewater treatment facilities, farm ponds, and landscape amenities, or those wetlands created after July 1, 1990, that were unintentionally created as a result of the construction of a road, street, or highway. Wetlands may include those artificial wetlands intentionally created from non-wetland areas to mitigate the conversion of wetlands.

The City initially mapped wetlands as part of the 1987 Sensitive Areas Notebook and provided a partially updated map as part of the 2003 *Bellevue Critical Areas Update Wetland Inventory*. Wetland mapping used a combination of soils mapping, aerial photographs, National Wetland Inventory maps, submitted reports, and some field inventory (Appendix D, Figures 11a-11c). Soils mapped by the NRCS are shown on Appendix D, Figures 9a-9c. Soil types classified as "hydric" are indicative of wetland soils; four hydric soil types were mapped in portions of shoreline jurisdiction in the City limits.

As mentioned in Chapter 1.0, the City of Bellevue completed in Spring 2008 a shoreline wetland inventory to identify, assess, and characterize known and suspected wetlands in and adjacent to shoreline jurisdiction.

Table 5 shows the breakdown of wetland area by shoreline waterbody. As expected, the shoreline areas of Kelsey Creek/Mercer Slough and Phantom Lake are almost entirely wetland, comprising 92 and 87 percent of their total jurisdictional areas, respectively. Conversely, wetlands along the Lake Washington shoreline comprise approximately 10 percent of the jurisdictional area and this is likely exaggerated due to the inclusion of the mouth of Mercer Slough as part of the Lake Washington shoreline. No wetlands have been inventoried along Lake Sammamish. However, there are likely many small, minor, lake-fringe wetlands marking the edge of the lake in some locations. Reach specific details are included in Chapter 4.

Table 5. Extent of Inventoried Wetlands by Shoreline Waterbody.

Shoreline Waterbody	Total Wetland Area (acres)	% Wetland Area
Lake Washington	22.3	10
Kelsey Creek/Mercer Slough	412.8	92
Lake Sammamish	NA	NA
Phantom Lake	150.6	87
TOTAL	**586**	**61**

3.7.4 Streams

Information regarding streams tributary to or originating in the shoreline waterbodies was gathered from WDFW's Priority Habitats and Species (PHS) maps and reports (WDFW 2007), WRIA 8 map products (King County DNR 2001), City of Bellevue GIS data (City of Bellevue 2007), The City of Bellevue Stream Typing Inventory (The Watershed Company 2001), and other agency resources.

Many streams pass through the City of Bellevue, discharging into Lake Washington and Lake Sammamish (Appendix D, Figures 11a-11c and 13a-13c). Several of these streams are known to support fish use, including chinook, coho, sockeye, and kokanee salmon, steelhead and cutthroat trout. Two of the more prominent fish-bearing streams include Kelsey Creek, Coal Creek, and their tributaries. However, salmonid and other fish species are known to inhabit other smaller Lake Washington and Lake Sammamish tributaries such as Vasa Creek, Meydenbauer Creek, Lewis Creek, and Yarrow Creek. Many of the smaller tributaries to Lake Washington and Lake Sammamish originate as hillside seeps or springs and flow seasonally or during periods of heavy rains.

3.7.5 Habitat Associated with Species of Local Importance

WDFW mapping of Priority Habitat and Species also indicates the presence of other Fish and Wildlife Habitat Conservation Areas within and adjacent to the shoreline zone (Appendix D, Figures 13a-13c). These include pileated woodpecker breeding areas, historic and current bald eagle nest locations, great blue heron nest colony, wetlands, urban natural open space, and riparian zones.

Fish and Wildlife Habitat

In addition to the shoreline waterbodies themselves, significant fish and wildlife habitats in the City's shorelines include non-jurisdictional waterbodies (i.e. small lakes and streams) and wetlands. Otherwise, most of the shoreline areas are altered by residential, agricultural, commercial or industrial development. These land uses do provide differing levels of habitat for different species, but those habitat types are not limiting in the watershed and the species served are highly adaptable to urban environments and may be introduced.

The City of Bellevue recently conducted a shoreline habitat inventory intended to specifically identify, assess, and characterize areas of special habitat within shoreline jurisdiction. This includes an evaluation of shoreline jurisdiction by habitat value, to identify areas of low, moderate, and high values with additional notation for areas of on-going agriculture. Areas which currently contain significant wetlands and serve many functions (i.e. Mercer Slough) were given a "reserve" value. Additionally, areas of specific interest, including significant forest patches, perch trees, snag rich areas, and overhanging vegetation were also assessed. Detailed discussion of findings are included in Technical Appendix Volume II and results are summarized in the analysis of shoreline functions provided in Chapter 5.

Special Status Species

Special status species are species that are listed or proposed for listing under the State or Federal Endangered Species Act or that are identified by WDFW as state Priority Species. All game and

food fishes, including salmon, trout, and char, are considered to be Priority Species by the WDFW. In addition, Coastal-Puget Sound bull trout and Puget Sound steelhead trout are listed as threatened by the USFWS and Puget Sound chinook salmon are listed as threatened by NOAA Fisheries.

The USFWS has recently accepted a petition to review whether the Lake Sammamish kokanee population should be protected under the Endangered Species Act (Proposed, U.S. Federal Register, 6 May 2008). Through this 12-month review process, the USFWS will determine whether this population as a whole would qualify as a "distinct population segment" (DPS). In order to be considered a DPS, three criteria need to be examined: (1) discreteness of the population segment in relation to the remainder of the taxon to which it belongs; (2) significance of the population segment in relation to the remainder of the taxon; and (3) conservation status of the population segment in relation to the Endangered Species Act standards for listing. Criteria for all three elements must be satisfied to list a DPS. Recent studies on kokanee salmon in Lake Sammamish have discovered three genetically distinct populations (early-, middle-, and late-run) and have focused on developing a better understanding of species needs and habitat limiting factors (Berge and Higgins 2003). The early-run was declared extinct in 2003.

Specific information on fish occurrence and habitat use within the City was provided by the PHS data (WDFW 2007), *Washington State Salmon and Steelhead Stock Inventory* (SASSI) (WDFW 2002); the *SASSI Bull Trout/Dolly Varden Appendix* (WDFW 1998); the *Catalog of Washington Streams and Salmon Utilization, Volume 1, Puget Sound Region* (Williams et al. 1975); the *Habitat Limiting Factors and Reconnaissance Assessment Report* (Kerwin and Nelson 2000), *The Green/Duwamish and Central Puget Sound Watershed Salmon Habitat Plan* (Green/Duwamish 2005), the *Lake Washington/Cedar/Sammamish Watershed (WRIA 8) Chinook Salmon Conservation Plan* (King County 2005), *Lake Washington/Cedar/Sammamish Watershed (WRIA 8) Near-Term Action Agenda for Salmon Habitat Conservation* (King County 2002), historical sockeye salmon spawning location maps per WDFW, and additional sources as cited in the text.

Although other sensitive species are likely to occur in the City's shoreline areas, according to WDFW, the following special status species are known to occur in one or more of the City of Bellevue's shorelines:

- Bald Eagles (*Haliaeetus leucocephalus*) (nesting and/or foraging in Lake Washington and Lake Sammamish)
- Pileated Woodpecker (*Dryocopus pileatus*) (Lake Washington, Lake Sammamish, and Kelsey Creek/Mercer Slough)
- Bull Trout (*Salvelinus confluentus*) (Lake Washington and Lake Sammamish)
- Chinook Salmon (*Oncorhynchus tshawytscha*) (Lake Washington, Lake Sammamish, and Kelsey Creek/Mercer Slough)
- Chum Salmon (*O. keta*) (Lake Washington, Lake Sammamish, and Kelsey Creek/Mercer Slough)
- Coho Salmon (*O. kisutch*) (Lake Washington, Lake Sammamish, and Kelsey Creek/Mercer Slough)
- Pink Salmon (*O. gorbuscha*) (Lake Washington, Lake Sammamish, and Kelsey Creek/Mercer Slough)

- Sockeye Salmon (*O. nerka*) (Lake Washington, Lake Sammamish, and Kelsey Creek/Mercer Slough)
- Kokanee Salmon (*O. nerka* landlocked form) (Lake Washington and Lake Sammamish)
- Steelhead (*O. mykiss*) (Lake Washington, Lake Sammamish, and Kelsey Creek/Mercer Slough)
- Cutthroat Trout (*O. clarki*) (Lake Washington, Lake Sammamish, and Kelsey Creek/Mercer Slough)

Species of Local Importance

The City has designated 23 different species of local importance per Section 20.25H.150, many of which reside within areas of shoreline jurisdiction. This list includes the following:

- Bald Eagle
- Peregrine falcon (Falco peregrines)
- Common loon (Gavia immer)
- Pileated woodpecker
- Vaux's swift (Chaetura vauxi)
- Merlin (Falco columbarius)
- Purple martin (Progne subis)
- Western grebe (Aechmophorus occidentalis)
- Great blue heron (Ardea herodias)
- Osprey (Pandion haliaetus)
- Green heron (Butorides striatus)
- Red-tailed hawk (Buteo jamaicensis)
- Western big-eared bat (Plecotus townsendii)
- Keen's myotis (Myotis keenii)
- Long-legged myotis (Myotis volans)
- Long-eared myotis (Myotis evotis)
- Oregon spotted frog (Rana pretiosa)
- Western toad (Bufo boreas)
- Western pond turtle (Clemmys marmorata)
- Chinook salmon
- Bull trout
- Coho salmon
- River lamprey (Lampetra eyresi)

The habitat associated with these species is designated as a critical area. Any proposal which impacts one or more of these habitats must implement a WDFW wildlife management plan per Section 20.25H.160.

Relevant species are described in greater detail for each shoreline in Chapter 4.0. Special status species locations, except for fish distribution, are not mapped in order to protect nesting sites and other sensitive use areas.

Aquatic Conditions

General lakewide information related to aquatic conditions are provided in the City's inventory of shoreline habitat (Technical Appendix Volume II). This information includes a summary of limnological and ecological processes occurring within the Lake Washington watershed. Discussions of limnological processes includes water quality, substrate characteristics, and hydrologic inputs, while ecological processes include aquatic food web dynamics, fisheries, and aquatic vegetation distribution and management. Specific information related to each shoreline waterbody is presented in Chapter 4, where appropriate, and included in the analysis of shoreline functions in Chapter 5.

The introduction of any non-native species has an effect on native species and habitats, although it is often difficult to predict those effects. However, there is a growing number of non-native aquatic plant and animal species whose current or potential impacts on native species, and habitats are known to be significant. Potential threats may be evidenced by the degree of negative impact these species have upon the environment, human health, industry and the economy (WDFW 2001). Potential negative impacts relevant to the City's shoreline environment include:

- loss of biodiversity;
- threaten ESA-listed species such as salmon;
- alterations in nutrient cycling pathways;
- decreased habitat value of infested waters;
- decreased water quality;
- decreased recreational opportunities;
- increased safety concerns for swimmers; and
- decrease in property values.

Eurasian watermilfoil and water lily are a public and, in some areas, an ecological nuisance along the majority of Bellevue's shorelines, particularly in some of the marinas and other shallow-water nearshore areas. Where milfoil is dense and close to the surface, it can entangle swimmer's legs and clog boat props. Propeller action can also chop the milfoil into small bits, which disperse in the lake and start new infestations. Nuisance-motivated control of invasive vegetation using herbicides has been approved by Ecology for treatment within high use public access areas. Other methods of treatment may include, but is not limited to, the use of aquatic weed harvesters, blankets, raking, and hand pulling. However, regarding milfoil in particular, the weeding or harvesting of plant growth may in turn further spread the growth of the invasive vegetation as many aquatic weeds can regenerate from separated plant particles. In any case of aquatic weed management, permits are required from Ecology. Detailed descriptions of aquatic weed management, acceptable herbicides, and permit requirements, can be found in Technical Appendix Volume II.

3.8 FLOODPLAIN AND CHANNEL MIGRATION ZONE

3.8.1 Floodplain

Floodplain boundaries were developed from the FEMA FIRM and the City's GIS mapping (Appendix D, Figures 10a-10c). As noted above, Lake Washington does not have a floodplain

due to its lake elevation control by the Corps. However, floodplains are designated for Lake Sammamish, Phantom Lake and Kelsey Creek/Mercer Slough.

3.8.2 Channel Migration Zone

According to definitions in Ecology's Shoreline Master Program Guidelines (WAC 173-26-020), "'Channel migration zone (CMZ)' means the area along a river within which the channel(s) can be reasonably predicted to migrate over time as a result of natural and normally occurring hydrological and related processes when considered with the characteristics of the river and its surroundings." In other words, river and stream channels can move, or migrate, laterally across their floodplains. Channel migration can occur gradually, as a river erodes one bank and deposits sediment along a point bar on the other, or can occur as an abrupt shift of the channel to a new location. Such abrupt shifts are called avulsions, which may happen during a single flood event. The highest rates of channel migration typically occur in zones of rapid sediment deposition, such as where steep rivers flow out of foothills onto flatter floodplains to form an alluvial fan.

Channel migration poses a potential and sometimes underestimated risk to public health and safety. It represents a different type of flood hazard than getting inundated by overbank flow, and can endanger properties and structures located outside of the regulatory floodplain and thus thought to be safe. It may be the least recognized and yet most destructive type of damage that results from flooding. Erosion caused by channel migration can undermine houses, roads, and infrastructure, wash away property, and even threaten lives (http://dnr.metrokc.gov/wlr/flood/migration.html).

In Bellevue, discussions of channel migration are relevant only for Kelsey Creek. However, the lower portion of Kelsey Creek within shoreline jurisdiction is fairly well contained with limited ability to move laterally within the floodplain. As such, the City does not have a defined CMZ. Channel migration zones do not typically apply to lakes.

3.9 HISTORICAL OR ARCHAEOLOGICAL SITES

The Washington State Office of Archaeology and Historic Preservation (OAHP) WISAARD website was searched to identify known historical or archaeological features (http://www.oahp.wa.gov/gis/INDEX.CFM). Additional information used to identify historic or culturally significant sites within shoreline jurisdiction was obtained from the City of Bellevue's *Historic and Cultural Resources Survey* (Tobin and Pendergrass 1997), the Eastside Heritage Center (http://www.scn.org/arts/bellehist/), King County Landmarks and Heritage Program, (http://www.4culture.org/heritage/resources/H01overview.doc), and the Online Encyclopedia of Washington State History (http://www.historylink.org/essays/output.cfm?file_id=313).

3.10 OTHER AREAS OF SPECIAL INTEREST

Areas of special interest not included in the other elements of the inventory, such as rapidly developing waterfronts, eroding shorelines, or other degraded sites with potential for ecological restoration were identified based on the references described above and during the field

reconnaissance of the study area. Special-interest topics are shoreline-specific, and are included in Chapter 4.0.

3.10.1 Water-Oriented Uses

According to Ecology's SMP Guidelines (173-26-020 WAC), "water-oriented use means a use that is water-dependent, water-related, or water-enjoyment, or a combination of such uses." The following descriptions and examples are provided:

- Water-dependant uses consist of uses which require direct access to the water to perform their primary function. Typical examples include ports, marinas, aquaculture facilities, and ferry terminals. For the City of Bellevue, water-dependent uses include several local marinas.

- Water-related uses refer to uses that do not require direct water access, yet provide goods or services associated with water-dependant uses. Typical examples include boat/canoe rentals and marine supply stores.

- Water-enjoyment uses refer to uses that do not require direct water access but are enhanced by a waterfront location. Typical examples include restaurants and aquariums.

3.10.2 Toxic or Hazardous Waste Sites

Four sites are identified in Bellevue on the Washington Department of Ecology's *Hazardous Sites List* (dated August 23, 2007). However, none of the sites on the list are within shoreline jurisdiction.

According to the U.S. Environmental Protection Agency's (EPA) Envirofacts Data Warehouse website (http://www.epa.gov/enviro/), dozens of sites within Bellevue are listed as being regulated by EPA. However, only three of the sites are within shoreline jurisdiction. Each of the sites are classified as being regulated as hazardous waste sites by the EPA. The sites are the Meydenbauer Marina (2 99th Ave NE), Sisters of Saint Joseph of Peace (1663 Killarney Drive), and the Newport Shores Yacht Basin. The sites are not authorized to discharge into waters.

3.11 OPPORTUNITIES FOR PROTECTION AND RESTORATION

Restoration of shoreline areas, in relation to shoreline processes and functions, commonly refers to methods such as re-vegetation, removal of invasive species or toxic materials and removal of bulkhead structures, piers, and docks. Consistent with Ecology's definition, use of the word "restore," or any variations, in this document is not intended to encompass actions that re-establish historic conditions. Instead, it encompasses a suite of strategies that can be approximately delineated into four categories: creation (of a new resource), restoration (of a converted or substantially degraded resource), enhancement (of an existing degraded resource), and protection (of an existing high-quality resource).

There is a critical distinction between restoration and mitigation. Mitigation will require applicants whose shoreline proposals will have adverse impacts to complete actions to mitigate those impacts or provide compensation in other ways for losses of ecological function. The City cannot require applicants to go beyond returning the impacted area (or compensating in other ways for lost functions) to the condition it was in at the time of this inventory or as further detailed at the time of application. However, the City can encourage applicants to implement restoration actions that will improve ecological functions relative to the applicant's pre-project condition.

The Opportunity Areas discussions in this section and in Chapter 4 present options for "restoration" that would improve ecological functions (Appendix D, Figures 15a-15c). For example, enhancement of riparian vegetation, reductions or modifications to shoreline hardening, minimization of in- and over-water structures, and improvements to fish passage would each increase one or more ecological parameters of the City's shoreline. These options could be implemented voluntarily by the City or City residents or, depending on specific project details, could be required measures to mitigate adverse impacts of new shoreline projects.

Opportunity areas were initially identified during the compilation of the critical areas materials described above, review of 2007 aerial photographs, and a field reconnaissance in Spring 2008. More detailed descriptions of each reach can be found in Chapter 4.0 below. Generally, restoration opportunities which have been identified are focused on publicly-owned open spaces and natural areas. Many other restoration opportunities exist throughout the City on private property. These opportunities would include many of the same issues as listed above, but would likely occur only through voluntary means or through re-development proposals.

A second category of restoration opportunities that will be discussed in greater detail in a separate Shoreline Restoration Plan document are those planned for implementation as part of the City's *2007-2013 Capital Investment Program Plan* report. Of particular relevance to the objective of improving shoreline function are the Park Redevelopment and Storm Drainage elements. These elements include numerous projects that provide fish passage improvement, bioengineered streambank stabilization, restoration of armored streambanks, flood abatement, water quality improvement, and riparian vegetation enhancement among others. Many of these projects are planned "upstream" of shoreline jurisdiction, but will still have positive effects on the shoreline environment.

The Restoration Plan document will be prepared in 2009, as a later phase of the Shoreline Master Program update process, consistent with WAC 173-26-201(2)(f). The Restoration Plan will "include goals, policies and actions for restoration of impaired shoreline ecological functions. These master program provisions should be designed to achieve overall improvements in shoreline ecological functions over time, when compared to the status upon adoption of the master program." The Restoration Plan will mesh the specific potential projects identified in this report, with regional or City-wide efforts and programs of the City, watershed groups, and environmental organizations that contribute or could potentially contribute to improved ecological functions of the shoreline. Prioritization of specific projects and project types will be based on a quantitative assessment where feasible, and implementation strategies and schedule will be outlined.

4.0 SHORELINE-SPECIFIC CONDITIONS

To categorize distinct areas of the City's shorelines for planning purposes, the shoreline jurisdiction was classified into four inventory waterbodies (1. Lake Washington, 2. Kelsey Creek/Mercer Slough, 3. Lake Sammamish, and 4. Phantom Lake) based broadly on the level of separation between shoreline waterbodies, as well as existing land uses and zoning (Table 6). This chapter discusses each shoreline waterbody separately, identifying reaches and summarizing the inventory details for later use in the analysis of shoreline functions (Chapter 5).

In order to break down the four shoreline waterbodies into manageable units and to help evaluate differences between discrete shoreline areas, each shoreline waterbody has been sequentially divided into reaches based on (1) Land Use (i.e. residential, water-dependent, park, office) and (2) shoreline specific condition (i.e. topography, morphology, land cover, etc.). The result is a total of 42 reaches as identified below (see Appendix D, Figures 16a – 16c):

Lake Washington (28 reaches): Reaches 1 – 28

Kelsey Creek/Mercer Slough (4 reaches): Reaches 29 – 32

Lake Sammamish (5 reaches): Reaches 33 – 37

Phantom Lake (5 reaches): Reaches 38-42

For Lake Washington, given the length of shoreline, varying land use types, and large number of reaches, the 28 reaches were further categorized into three areas, Residential, Water-Dependent Uses, and Parks (described below). This level of categorization allows for easier and more meaningful comparison between shoreline waterbodies, such as comparing residential areas along Lake Washington to those along Lake Sammamish.

Each shoreline waterbody and corresponding reaches have been inventoried per the elements listed in Chapter 3. Results of this inventory are detailed within each waterbody discussion and displayed in the Map Folio, Appendix D.

Table 6. Proposed Length and Area of Shoreline Jurisdiction per Shoreline Waterbody.

Shoreline Waterbody	Approximate Length (feet / miles)	Approximate Area (acres / sq. miles)
Lake Washington	48,161 feet / 9.12 miles	213 acres / 0.33 sq. miles
Kelsey Creek/Mercer Slough	19,741 feet / 3.74 miles	455 acres / 0.71 sq. miles
Lake Sammamish	26,193 feet / 4.96 miles	119 acres / 0.19 sq. miles
Phantom Lake	9,933 feet / 1.88 miles	173 acres / 0.27 sq. miles
TOTAL	**104,027 feet / 19.7 miles**	**960 acres / 1.50 sq. miles**

4.1 LAKE WASHINGTON

The City of Bellevue is bordered on its western boundary by approximately 9.12 miles of Lake Washington shoreline. As described above, the shoreline was broken into 28 reaches based on both land use and environmental factors and these reaches were categorized into three areas, Residential, Water-Dependent Use, and Parks. Examples of the breakdowns by reach type are shown in Exhibit 1. These reaches are later evaluated for their ecological functions of their respective shoreline areas (Chapter 5).

Exhibit 1. Examples of Lake Washington Reach Types

Residential: contains land areas in shoreline jurisdiction generally dominated by residential (single- and multi-family) land uses. There are 18 reaches within the residential land use area.

Reach Numbers: 1, 3, 5, 7, 8, 9, 11, 13, 15, 16, 18, 21, 22, 23, 25, 26, 27, and 28

Water-Dependent Use: contains land areas in shoreline jurisdiction dominated by water-dependent uses (i.e. marinas, boat launching facilities). There are two reaches, the first contains the marinas and yacht clubs within Meydenbauer Bay and the second contains the marinas, yacht club, and boat launch just south of Mercer Slough.

Reach Numbers: 6 and 20

Parks: contains land areas in shoreline jurisdiction generally dominated by Parks and Open Space. There are 8 reaches within this land use area.

Reach Numbers: 2, 4, 10, 12, 14, 17, 19, and 24

The following discussions summarize the inventory results for each of the three land use areas with particular attention given to areas where variability between reaches can be noted.

4.1.1 Land Use Patterns

Residential Reaches

Reaches within the Residential category are made up almost exclusively of single-family land uses along the City's Lake Washington shoreline with the exception of one multi-family use area within Meydenbauer Bay. However, a mix of different single-family Zoning and Comprehensive Plan designations do exist (see Table 7 and Appendix D, Figure 3a). The Residential reaches begin at the northern City limits and runs nearly continuously to the southern City limits. Only small pockets of the other two land use areas break-up the nearly continuous single-family dominated shoreline. Additionally, the Sisters of St. Joseph of Peace ministry and retreat occupies an approximately 10-acre parcel located just south of Chism Beach Park. This parcel, with approximately 500 feet of shoreline, contains a Single-Family Low Density (SF-L) Comprehensive Plan designation and is the only occurrence of a non single-family use within the Residential reaches. Based on available GIS and land-use data, there appear to be approximately 23 vacant, undeveloped lots within the Lake Washington shoreline jurisdiction, all of which are located within residential areas. This includes lots both adjacent to and upland of the shoreline.

Table 7. Residential Reaches: Land Use and Comprehensive Plan Designation

Existing Land Use	Comprehensive Plan Designation	
Reaches: 1, 3, 5, 7, 8, 9, 11, 13, 15, 16, 18, 21, 22, 23, 25, 26, 27, and 28 • Single-Family Residential • Multi-Family Residential • Church/religious activity	Single-Family Low Density (SF-L)	35.8 acres / 21%
	Single-Family Medium Density (SF-M)	93.6 acres / 56%
	Single-Family High Density (SF-H)	33.1 acres / 20%
	Multi-Family Low Density (MF-L)	0.1 acres / <1%
	Multi-Family Medium Density (MF-M)	2.1 acres / 1%
	Multi-Family High Density (MF-H)	3.0 acres / 2%

Water-Dependent Use Reaches

The northernmost reach (Reach 6) in the Water Dependent Use category is located in Meydenbauer Bay. This reach contains The Bellevue Marina at Meydenbauer Bay and the Meydenbauer Yacht Club. The Bellevue Marina at Meydenbauer Bay, operated by the City of Bellevue Parks and Community Services Department, offers three docks with a total of approximately 43 covered and 60 uncovered slips. This marina is not a public-use facility as it only provides access to individuals leasing boat slips. The Meydenbauer Yacht Club, a private

facility offers three docks and a total of 105 (mostly covered) slips. Although a portion of this reach contains an Office (O) land use designation, there are no existing office uses in this reach.

The southernmost reach (Reach 20) is located along the Lake Washington shoreline in an area bounded by the Mercer Slough Nature Park to the north and the Newport Shores single-family residential neighborhood to the south. This reach is essentially made up of two waterfront parcels. The northern parcel contains the Newport Yacht Basin, a marina for use by a condominium association. This marina has a total of 416 slips, of which approximately half are covered. A development company leases 120 of the slips, while the remaining slips are owned by individual owners. The Newport Yacht Basin facility also contains a parts and repair shop, boat sales, and gas pumps. The second and southern parcel contains the Newport Yacht Club. This marina contains 119 slips, all of which are leased to the public or held under license agreements with residents of the adjacent Newport Shores neighborhood. Both parcels have single-family zoning and comprehensive plan designations (Table 8). Between these two parcels is the SE 40th Street street-end and public boat launch operated by the City of Bellevue. This public facility is included within Reach 20 due to it strictly being considered a water-dependent use.

In addition to the waterfront parcels, a third, upland parcel is owned by Seattle Boat which operates a dry-dock boat storage and launching facility with a launching easement associated with the Newport Yacht Basin. This parcel is potentially expanding their water-dependant use by increasing boat storage capacity.

Table 8. Water-Dependent Use Reaches: Land Use and Comprehensive Plan Designation

Existing Land Use	Comprehensive Plan Designation	
Reaches 6 and 20 • Marina • Yacht Club	Single-Family Medium Density (SF-M)	7.8 acres / 60%
	Multi-Family High Density (MF-H)	5.0 acres / 38%
	Office (O)	0.2 acres / 2%

Park Reaches

Reaches within the Park category are made up exclusively of public park sites along the Lake Washington shoreline. There are a total of eight park sites scattered along the shoreline and mixed in with predominantly single-family land uses (Appendix D, Figure 8b). These uses include two Comprehensive Plan Designations (Table 9). The eight parks, which include (from north to south along the shoreline): Clyde Beach Park, Meydenbauer Beach Park, Chism Beach Park, Burrows Landing, Chesterfield Beach Park, Enatai Beach Park, Mercer Slough Nature Park, and Newcastle Beach Park, are listed in Table 10 along with the approximate total acreage as well as the length of shoreline contained within the respective park. For the purposes of evaluating Lake Washington shoreline conditions separate from Mercer Slough and Kelsey Creek, this inventory assesses the mouth of Mercer Slough as a reach within the Lake Washington shoreline. The remaining area within Mercer Slough Nature Park is then considered a reach within Mercer Slough/Kelsey Creek shoreline jurisdiction.

Table 9. Park Reaches: Land Use and Comprehensive Plan Designation

Existing Land Use	Comprehensive Plan Designation[1]	
Reaches 2, 4, 10, 12, 14, 17, 19, and 24 • Parks	Parks/Single-Family Low Density (P/SF-L)	2.1 acres / 7%
	Parks/Single-Family Medium Density (P/SF-M)	26.4 acres / 83%

[1]Approximately 10% of Park area lies outside of Comprehensive Plan Designation.

Table 10. Existing Park Sites

Existing Park Site	Acreage Within Shoreline Jurisdiction	Shoreline Frontage (approx.)
Clyde Beach Park (Reach 2)	1.1	185 ft
Meydenbauer Beach Park (Reach 4)	1.4	279 ft
Chism Beach Park (Reach 10)	5.0	989 ft
Burrows Landing (Reach 12)	0.2	32 ft
Chesterfield Beach Park (Reach 14)	0.3	71 ft
Enatai Beach Park (Reach 17)	2.5	742 ft
Mercer Slough Nature Park (Reach 19)	11.7	2,679 ft
Newcastle Beach Park (Reach 24)	9.8	1,647 ft

4.1.2 Transportation

There are very few major arterial road sections in shoreline jurisdiction (Appendix D, Figure 2b). The majority of public roadways within 200 feet of the Lake Washington shoreline are primarily residential streets used by residents to access shoreline properties. There are also several unimproved street ends (Killarney Drive, SE 60th St., and SE 62nd St.) that terminate at the shoreline of Lake Washington. These are further discussed under Public Access areas. The nearest arterials are 101st Avenue SE, as it passes along Meydenbauer Bay, and portions of Lake Washington Boulevard as it passes along Mercer Slough and near the southern City limits. All remaining public roadways within shoreline jurisdiction, with the exception of Interstate 90, are used for local access. Interstate 90 passes through shoreline jurisdiction as it leaves Bellevue and crosses Lake Washington on its way to Mercer Island. Additionally, Interstate 405, which parallels the shoreline through most of south Bellevue, comes near, but not quite within, 200 feet of Lake Washington at the southernmost City limits.

See Table 11 below for a description of public roadways along Lake Washington that are located within shoreline jurisdiction. Roadways, which do not include private roads or driveways, were measured in GIS and are approximate.

Table 11. Roadways within shoreline jurisdiction: Lake Washington

Roadway	Roadway classification	Roadway within Jurisdiction (ft.)
Hazlewood Ln. NE	Local access	645
Pleasure Pt. Ln. NE	Local access	375
Lakehurst Ln. NE	Local access	2,750
Cascade Key	Local access	3,000
Crescent Key	Local access	1,620
Columbia Key	Local access	1,072
Skagit Key	Local access	1,250
SE 40th St.	Local access	975
SE Lake Rd.	Local access	150
Killarney Way	Local access	75
SE 15th St.	Local access	160
Shoreland Dr. SE	Local access	515
SE Shoreland Pl.	Local access	410
SE Bellevue Pl.	Local access	260
Meydenbauer Wy SE	Local access	185
99th Ave NE	Local access	140
92nd Ave NE	Local access	170

The City's *2006-2017 Transportation Facilities Plan* does not propose any improvement projects within the shoreline jurisdiction.

4.1.3 Wastewater and Stormwater Utilities

Wastewater Utilities

All Lake Washington shoreline areas within the City are provided with sewer service by the City (Appendix D, Figure 4b). There are a number of lakelines located along this shoreline, a majority of which are 8-inch lines which feed the numerous homes along the shoreline. As previously mentioned, staff (Paulsen, pers. comm., 2008) stated that a number of these lakelines which are buried 4-feet below OHWM are being exposed due to low gravel supply. The City's Capital Improvement Plan (CIP) identifies this as a project to be addressed in the near future. In addition to sewer lines, there are also eight pump stations and two flush stations located within shoreline jurisdiction along Lake Washington.

In Meydenbauer Bay, six areas of exposed sewer main line have been identified (Thompson, pers. comm., 2008). Three areas are located along the western shore, adjacent to the Town of Medina, two are along the northern shoreline (one just west of Meydenbauer Beach Park), and one along the southern shoreline. The City has identified significant deterioration of the pipe at a

location adjacent to the Bellevue Marina at Meydenbauer Bay. Although the pipe's structural integrity has been affected at this location, this deterioration has not resulted in pipe leakage. The City is currently investigating corrective measures to fix this situation. A spot check of the same line near the north end of Meydenbauer Bay found the pipe to be in good working condition. The overall conditions of the remaining line sections are unknown, but are being assessed.

A King County Metro main briefly crosses into shoreline jurisdiction at the mouth of Mercer Slough. This line serves the City of Bellevue as well as the City of Mercer Island. Wastewater from the Metro lines is conveyed to the South Treatment Plant in Renton. According to the City's *2007- 2013 Capital Investment Program*, there are no specific sewer projects identified within the Lake Washington shoreline jurisdiction. The CIP does mention the sewer system pipeline rehabilitation project which will monitor and replace, if necessary, any sewer pipes which have been found to be deteriorated or defective. However, the CIP does not specifically identify the locations since problem areas will be located upon inspection.

Stormwater Utilities

Approximately 67 stormwater outfalls are located within the Lake Washington shoreline area, as noted on the City's GIS data (Appendix D, Figure 5b). According to staff, no regional stormwater facilities are located within the shoreline area (Paulsen, pers. comm., 2008).

Both private and public facilities contribute to stormwater outfall into shoreline waterbodies. A majority of water discharge is from single-family residential development, of which many of the older developments empty directly into the lakes and streams. There is very limited water quality treatment for outfalls. If so, these are limited to newer large-scale developments, particularly in the downtown area. Meydenbauer Bay developments have limited, if any, water treatment facilities. The City conducts occasional sediment removal in the bay, most recently at the Meydenbauer Bay Yacht Club outfall in August 2008 (Varner, pers. comm., 2008).

According to the City's *2007-13 Capital Investment Program*, there is one project located within the Lake Washington shoreline jurisdiction area. The Meydenbauer Creek Erosion Control project will "construct a retaining wall and/or channel improvements between two 60-inch culverts under 101st Avenue SE and approximately 120 feet upstream. Riparian vegetation will then be reestablished" (City of Bellevue 2007).

The City also has several on-going City-wide projects located in various locations in the stormwater system as issues arise, some of which may occur within shoreline jurisdiction. The following projects are excerpts from the CIP:

> Minor Storm and & Surface Water Capital Improvement Projects: Ongoing program to fund minor capital improvements to the City's storm drainage system which are needed to resolve minor deficiencies, solve maintenance problems in conjunction with other City projects such as street overlays, or improvements, or to address neighborhood issues. They are generally small projects that wouldn't justify separate CIP projects, and oftentimes can't be anticipated.

Storm Water System Conveyance Infrastructure Rehabilitation: This ongoing program rehabilitates or replaces defective storm drainage pipelines and ditches identified in the Utility's condition assessment program or other means. Projects are prioritized based on the severity of deterioration, the risk and consequence of failure, and coordination with planned street improvement projects.

Neighborhood Enhancement Program: This project sets aside funding to respond to resident needs in specific geographic areas in concert with other City objectives and priorities as identified through the Neighborhood Enhancement Program or other neighborhood initiatives. Eligible projects might include landscaping a detention pond or enhancing a neighborhood stream, often in partnership with the Parks Department.

4.1.4 Impervious Surfaces and Vegetation

Based on the 2008 data set, the total impervious area within the Lake Washington shoreline jurisdiction is 90.3 acres (0.14 square miles) or approximately 41 percent of this shorelines total area (Appendix D, Figure 6b). Total vegetative cover within the Lake Washington shoreline is 127 acres (0.20 square miles) or approximately 58 percent of this shorelines total area (Appendix D, Figure 14b).

Table 12 shows the breakdown of impervious surface and vegetative cover by each Lake Washington land use area. The Water-Dependent Use reaches had the highest overall percent impervious coverage (72%), followed by Single-Family (44%), and Parks (20%).

Table 12. Lake Washington Impervious Surface and Vegetative Cover by Reach Type.

Land Use Reaches	Total Impervious Area (acres)	% Impervious Surface	Total Vegetative Area (acres)	% Vegetative Cover
Residential	74.5	44	93.7	56
Water-Dependent Use	9.4	72	3.8	29
Parks[1]	6.4	20	23.8	75
TOTAL	**90.3**	**43**	**121.4**	**57**

[1] Where percent impervious and vegetative cover does not equal 100 percent, these areas likely include significant areas of open water, such as the mouth of Mercer Slough, or bare earth.

4.1.5 Shoreline Modifications

A combination of recent aerial photographs, existing GIS information, and brief field visits conducted in Spring 2008 were used to collect information about shoreline modifications along the Lake Washington shoreline (Appendix D, Figures 7a through 7e, Tables 13 and 14).

As expected, a majority of the shoreline has been altered with either vertical or boulder bulkheads. Reaches within Water-Dependent Uses (Reaches 6 and 20) are the most heavily armored, with nearly 100 percent armoring, followed by Residential (87 percent), and Parks (33 percent).

Similarly, the highest amount of overwater cover per lineal foot of shoreline is found in Reaches 6 and 20 (194 square feet per lineal foot). This is attributed to the presence of marinas and large moorage facilities, all of which were constructed decades ago. Park reaches had overwater cover of approximately 56 square feet/lineal foot, while Residential reaches had 18 square feet/lineal foot.

There are approximately 317 individual pier/dock structures along the Residential reaches, which equates to approximately 43 structures per mile.

Table 13. Lake Washington Lake Edge Condition by Reach Type.

Land Use Reaches	**Lake Edge Condition (feet / % of shoreline within land use area)**			
	Vertical[1]	**Boulder[2]**	**% Total Armoring**	**% Natural / Semi-Natural[3]**
Residential	17,969 47%	15,641 41%	87%	13%
Water-Dependent Use	2,984 99%	38 1%	100%	0%
Parks	898 14%	1,258 19%	33%	67%
TOTAL (percent of total length)	**21,851 45%**	**16,938 35%**	**81%**	**19%**

[1] "Vertical" shorelines encompass concrete, wood and mortared boulder armoring types. The key characteristic, besides a generally vertical orientation, is the lack of interstitial spaces in the face of the bulkhead that could provide some habitat.
[2] "Boulder" shorelines are typically angular or rounded granite or basalt. They may be vertical or sloped, but they all contain interstitial spaces, which provide some habitat and may absorb or attenuate some wave energy.
[3] "Natural/Semi-Natural" shorelines captures those areas that are not solidly armored at the ordinary high water line; they may include some scattered boulders or woody debris at or near the ordinary high water line. "Natural/semi-natural" designation is not intended to describe the environmental condition upland of ordinary high water.

Table 14. Lake Washington Overwater Cover by Reach Type .[1]

Land Use Reaches	**Overwater Structures (piers/docks/marinas)**		**Cover/ Lineal Foot**	**# of Overwater Structures/ Mile**
	#	**Area (SF)**		
Residential	317	676,429	17.6	43
Water-Dependent Use	28	581,565	193.7	49
Parks	22	374,239	56.5	18
TOTAL	**367**	**1,632,233**	**33.9**	**40**

[1] Overwater cover calculations include piers and docks, but also includes areas of covered moorage and boathouses.

4.1.6 Existing and Potential Public Access Sites

Lake Washington has eight public park sites and two street-ends that provide physical access to the water for water enjoyment activities, such as swimming and fishing (Appendix D, Figure 8b). For boating activities, the City of Bellevue offers one motorized and one non-motorized boat launch along Lake Washington. Additionally, there are three private marinas/yacht clubs and one semi-private marina, as discussed below in section 4.1.10, that provide shoreline access opportunities for residents.

According to the 2003 Parks and Open Space System Plan, a majority of the Lake Washington shoreline is privately owned. City standards propose that 10 to 20% of the City's shoreline should be available for public access. In order to achieve this goal, this City is actively pursuing the acquisition of additional waterfront properties to expand public access.

Developing public shoreline access to the shoreline area is a priority of the City, as evidenced by the goals and policies included in the Shoreline Management Program Element of the City's Comprehensive Plan. Except for single-family residential lots, the Comprehensive Plan encourages public access to and along the water's edge for all development. Future public access may be available through unopened street-ends which occur near Killarney Drive, SE 60th Street, and SE 62nd Street.

The amount of park and open space area within shoreline jurisdiction is one measure of the existing public access opportunities, and is summarized in Table 15. Parks/open space provide approximately 1.3 miles of public waterfront access of the 9.12 miles along Lake Washington. This includes approximately 0.5 miles of waterfront along Mercer Slough, which is only accessible via water.

Table 15. Lake Washington Park/Open Space Area by Reach Type.

Land Use Reaches	**Area of Park/Open Space**	**% of Shoreline**	**Other Access Notes**
Residential	0 acres	0 %	Public access is limited. Several street-ends, which appear to be unopened, occur near Killarney Drive, SE 60th Street, and SE 62nd Street.
Water-Dependent Use	2.4 acres	19%	Reach 20 currently contains a public boat launch area at the SE 40th street-end. Both reaches include marinas and yacht clubs.
Parks	25.7 acres	81%	Numerous small and medium sized parks scattered along the shoreline.
TOTAL	**28.2 acres**	**13%**	

4.1.7 Critical Areas

Residential Reaches

Geologically Hazardous Areas

Shoreline jurisdiction within these reaches contains areas of steep slope, primarily the shoreline immediately south of Meydenbauer Bay and near the southern City limits south of Newcastle Beach Park, and areas of moderate to high liquefaction potential (Appendix D, Figure 12b). Liquefaction areas, mapped by King County, include the immediate shoreline along most of Lake Washington and areas extending upstream within both the Meydenbauer Creek and Coal Creek basins. Liquefaction areas within the Coal Creek basin include the entire lower delta containing the Newport Shores community. There are no coal mine hazards within the Residential Reaches.

Flood Hazard Areas

Only the area surrounding the mouth of Coal Creek is classified as a flood hazard area within the Residential reaches (Appendix D, Figure 10b). Portions of lower Meydenbauer creek are also within a designated flood hazard area, but outside of the 200-foot shoreline jurisdiction.

Wetlands

Recent wetland inventory work along the Lake Washington shoreline found two areas containing associated wetlands within the Residential reaches (see Technical Appendix Volume I). None of these wetlands extend beyond 200 feet from the ordinary high water mark of Lake Washington and thus would not extend shoreline jurisdiction beyond the current proposed boundary.

One wetland, approximately 5.5-acre in size, is located at the shallow southeast end of Meydenbauer Bay, near the mouth of Meydenbauer Creek. This is a Category IV wetland that provides very low water quality and shoreline erosion protection functions, and only marginal habitat function, according to Ecology's rating form.

Several other small lake fringe wetlands are located near the mouth of Coal Creek within the Newport Shores community. These low-functioning wetlands receive some flow from Coal Creek during flooding events, but are largely influenced by the fluctuating water level of Lake Washington. The largest of these wetlands is just over one-half acre and lies immediately north of Coal Creek on the edge of Lake Washington. This Category III wetland has little opportunity to reduce flood flow at the bottom of the Coal Creek basin, though it does provide minimal water quality function. Two degraded Category IV wetlands, smaller than 1,000 square feet, are located just south of Coal Creek on the edge of Lake Washington. No significant functions are performed by these wetlands.

Streams

Within the Residential reaches, there are eight recognized streams that empty into Lake Washington (Appendix D, Figure 11b). From north to south, the first is Meydenbauer Creek. Perhaps the most urbanized of all the City's streams, Meydenbauer Creek flows less than one-half mile through commercial and residential lots before flowing into Lake Washington's Meydenbauer Bay. The stream is known to support cutthroat trout and therefore, the stream has been classified as Type F.

The second, and most significant stream within the Residential reaches, is Coal Creek. Coal Creek flows from its headwaters in Cougar Mountain Park through protected parkland before passing through residential lots on the downstream end. Coal Creek, classified as a Type F stream, is known to support chinook, sockeye, and coho salmon, as well as cutthroat trout.

South of Coal Creek, six other small streams (per Bellevue GIS stream map) flow into the lake. Lakehurst Creek, the largest of these streams, along with the other unnamed tributaries, flow through steep culverts beneath I-405 before entering Lake Washington. None of these streams contain suitable fish habitat and all have been classified as either Type N or O streams.

Other Fish and Wildlife Habitat Conservation Areas

Priority Habitats: WDFW mapping of Priority Habitat and Species identifies three bald eagle nests in or adjacent to shoreline jurisdiction within Residential reaches. Nesting and foraging buffers for these bald eagles extends along much of the residential shoreline between Meydenbauer Bay and Mercer Slough (Appendix D, Figure 13b).

The Residential reaches contains primarily Moderate upland habitat throughout with Low habitat in and around the southeast end of Meydenbauer Bay and the Newport Shores community. The one exception is the area in and adjacent to the Sisters of St. Joseph of Peace ministry and retreat, which can be considered relatively High habitat given its forested (although fragmented) condition containing numerous perch trees along the shoreline. Only a few sporadic areas of significant overhanging vegetation (i.e. areas with more than 50 lineal feet of overhanging vegetation) exist within the Residential reaches (see Technical Appendix Volume II).

Special Status Species: Priority species noted by WDFW (2007) in the Residential reaches include anadromous and resident fish species within Lake Washington and Coal Creek. The species in both waterways include, chinook, coho, sockeye, and kokanee salmon, winter steelhead, and resident cutthroat. Dolly Varden/bull trout are found only within Lake Washington and not the associated tributary streams in Bellevue.

Aquatic Conditions: Aquatic conditions throughout the Residential reaches are described in the Technical Appendix Volume II. Relevant discussions include aquatic vegetation, sockeye salmon spawning areas, shoreline bathymetry, wave fetch, and substrate conditions. Areas of sedimentation have been noted in Meydenbauer Bay and Newport Shores communities, with historical dredging occurring in both locations.

Water-Dependent Use Reaches

Geologically Hazardous Areas

Shoreline jurisdiction within the two Water-Dependent Use reaches is void of any landslide hazard areas, steep slopes or coal mine hazard areas (Appendix D, Figure 12b). Liquefaction areas, mapped by King County, extend throughout the shoreline jurisdiction surrounding the Newport Yacht Basin and the mouth of Coal Creek.

Flood Hazard Areas

There are no flood hazard areas within Water-Dependent Use reaches (Appendix D, Figure 10b).

Wetlands

There are no associated wetlands known to be present within the Water-Dependent Use reaches. However, the Mercer Slough wetland contained in Reaches 19 and 29 borders Reach 20 and is part of a parcel belonging to Seattle Boat Company (Appendix D, Figure 11b).

Streams

There are no streams within the Water-Dependent Use reaches that flow into Lake Washington (Appendix D, Figure 11b).

Other Fish and Wildlife Habitat Conservation Areas

Priority Habitats: WDFW mapping of Priority Habitat and Species (WDFW 2007) does not identify any priority habitat within the Water-Dependent Use reaches (Appendix D, Figure 13b).

These two reaches are absent of any significant habitat areas and thus contains only Low upland habitat value (Technical Appendix Volume II, Figure 2). No areas of significant overhanging vegetation exist within these reaches.

Special Status Species: Priority species noted by WDFW (2007) in the Water-Dependent Use reaches include anadromous and resident fish species within Lake Washington. The species include, chinook, coho, kokanee, and sockeye salmon, winter steelhead, resident cutthroat, and Dolly Varden/bull trout.

Aquatic Conditions: Aquatic conditions throughout the Water-Dependent Use reaches are described in the Technical Appendix Volume II. Within these two reaches, aquatic invasive species, particularly Eurasian Watermilfoil (*Myriophyllum spicatum*) are known to be very problematic. The City of Bellevue has a permit for treatment at high use public access areas, including the SE 40th Boat Launch.

Park Reaches

Geologically Hazardous Areas

Shoreline jurisdiction within Park reaches contains some areas of steep slope, primarily those parks located between the south end of Meydenbauer Bay and Beaux Arts, but also includes Meydenbauer Beach Park (Appendix D, Figure 12b). Liquefaction areas, mapped by King County, include the immediate shoreline along most of Lake Washington. Liquefaction areas within the Coal Creek basin include Mercer Slough and the entire lower delta containing the entire Newcastle Beach Park. There are no coal mine hazards within Park reaches.

Flood Hazard Areas

Only the area containing Mercer Slough is considered a flood hazard within the Park reaches (Appendix D, Figure 10b).

Wetlands

Recent wetland inventory work along the Lake Washington shoreline found three wetlands within Meydenbauer Beach Park and two wetlands within Newcastle Beach Park (see Technical Appendix Volume I). The wetlands in Meydenbauer Beach Park (all within 200 feet of the

ordinary high water mark) are each small Category IV wetlands (each less than 1,000 square feet). Though they are separated by uplands, each wetland is likely fed by the same groundwater seep. A ditch and culvert run through the wetland areas. The wetlands do not provide significant water quality improvement functions, erosion prevention functions, or habitat value to the shoreline as they are separated from the lake by a rock bulkhead.

Of the two wetlands found in Newcastle Beach Park, only the 6.2-acre wetland immediately bordering Lake Washington has been determined to be a shoreline associated wetland. Overbank flooding from the small on-site stream, groundwater seeps, and the fluctuating water level of the lake provide most of the hydrology to this wetland. This is a Category II wetland which provides important filtration functions during stream flood events. Abundant downed logs and standing snags on the shoreline provide unique habitat for wildlife along the southern boundary of the park adjacent to Lake Washington. The wetland does not provide any significant flood flow reduction, though its dense vegetation protects the Lake Washington shoreline from wind- and boat-driven waves.

All of the Lake Washington shoreline across Mercer Slough is considered wetland.

Streams

There are two streams that flow into Lake Washington within the Park reaches, Kelsey Creek (Mercer Slough) and an unnamed stream which flows entirely within Newcastle Beach Park (Appendix D, Figure 11b). Mercer Slough is considered a Type S stream and is therefore considered a "shoreline of statewide significance". It supports chinook, coho, and sockeye salmon, winter steelhead, and resident cutthroat. Mercer Slough is summarized in greater detail in Chapter 4.4.

The stream in Newcastle Beach Park meanders through low gradient wetlands prior to outflow into Lake Washington via a fairly undefined channel. This stream does not support fish and has been classified a Type N stream.

Other Fish and Wildlife Habitat Conservation Areas

Priority Habitats: WDFW mapping of Priority Habitat and Species (WDFW 2007) identifies an osprey nest near Meydenbauer Beach Park (Appendix D, Figure 13b). The nest was once located in an artificial nest box on a pole at Meydenbauer Marina near the end of 99th Avenue NE back in 1998. Under permit, the nest box was moved to a live fir tree in Meydenbauer Beach Park, where the osprey resided through 2004. Since Spring 2005 the osprey pair has nested at Hidden Valley Sports Park, about 1-¼ miles from the original nest location. Currently, there is no known osprey activity in the vicinity of Meydenbauer Bay (Cole, R. pers. comm. 2008). Meydenbauer Beach Park contains some areas of fragmented forest, but setback from the shoreline.

WDFW mapping of Priority Habitat and Species also identifies only bald eagle nesting sites and associated nesting and foraging buffers within the Park reaches (WDFW 2007).

The Park reaches contain primarily moderate upland habitat throughout with the exception of Chism Beach Park and a portion of Newcastle Beach Park that have high habitat and Mercer Slough which is entirely reserve habitat. Mercer Slough is an area mapped as containing

significant wetlands. High quality overhanging vegetation exists throughout the Park reaches (see Technical Appendix Volume II).

Each of these parks contain areas of significant forest patches or fragmented forest that provides improved urban habitat value.

Special Status Species: Priority species noted by WDFW (2007) in the Park reaches include anadromous and resident fish species within Lake Washington. The species include chinook, coho, kokanee, and sockeye salmon, winter steelhead, resident cutthroat, and Dolly Varden/bull trout.

Aquatic Conditions: Aquatic conditions throughout the Park reaches are described in the Technical Appendix Volume II. The City of Bellevue has a permit for treatment at high use public access areas, including Newcastle Beach Park.

4.1.8 Floodplain and Channel Migration Zone

Floodplain

As mentioned in section 3.8.1, Lake Washington does not have a floodplain due to its lake elevation control by the Corps.

Channel Migration Zone

As mentioned in section 3.8.2, channel migration zones do not typically apply to lakes.

4.1.9 Historical or Archaeological Sites

According to the Office of Archeology and Historic Preservation's (OAHP) WISAARD (Washington Information System for Architectural and Archaeological Records Data) website, there are not any sites of historical interest located in the City of Bellevue's Lake Washington shoreline area. However, the City's Historic and Cultural Resources Survey (Tobin and Pendergrass 1997) has documented five (5) sites within shoreline jurisdiction considered historic or culturally significant. Sites are summarized in Table 16. Sites with local designations presume the future existence of a local designation program in Bellevue. State Register sites are lower priority and would likely warrant some symbolic or honorary recognition.

The Lake Washington shoreline in the area that is now Bellevue was likely inhabited by a number of Native American tribes up to thousands of years before the first European settlers arrived. These tribes developed tools appropriate for their habitats and utilized the resources of the lake. Up to the eighteenth century, the Salish Indians had at least seven winter villages located along the eastern shore of Lake Washington. Despite the abundance of Native American villages along the shoreline, none of the sites survive today (Tobin and Pendergrass 1997).

Table 16. Historical or Culturally Significant Sites.

Site (Reach)	Address	Year Built	Historical Designation
American Pacific Whaling Fleet Buildings (now Meydenbauer Bay Marina) (Reach 6)	9905 Lake Washington Blvd NE	1930-1931	Local Designation (High priority)
Meydenbauer Bay Yacht Club (Reach 6)	9927 Meydenbauer Way SE	1906-1912	Local Designation (High priority)
Sandell House (Reach 1)	9011 Lake Washington Blvd NE	1928	Local Designation (Medium priority)
Calvert House (Reach 9)	415 Shoreland Dr SE	1909-1910	State Register
St. Mary's Convent (Reach 13)	1655-1663 Killarney Way	1932	State Register

4.1.10 Other Areas of Special Interest

Water-Oriented Uses

Water-dependent uses: Three private marinas and one semi-private marina are located on Lake Washington within Bellevue. Private marinas include the Newport Yacht Club, the Newport Yacht Basin, and the Meydenbauer Yacht Club. The Bellevue Marina at Meydenbauer Bay, operated by the City of Bellevue Parks and Community Services Department, offers three docks with a total of approximately 43 covered and 60 uncovered slips. This marina is not a public-use facility as it only provides access to individuals leasing boat slips. One smaller private community dock, servicing shoreline condominiums, is located within the southeast corner of Meydenbauer Bay. Water-dependent uses also include single- and multi-family piers and docks.

Water-related uses: The dry-dock boat storage facility provided by Seattle Boat Company adjacent to the Newport Yacht Basin is considered the only a water-related use along Lake Washington.

Water-enjoyment uses: Several types of water-enjoyment uses exist along the Lake Washington shoreline. These include the City's shoreline parks, which offer recreational shoreline access, and single- and multi-family dwellings adjacent to the water.

4.1.11 Opportunity Areas

WRIA 8 Watershed-Wide Programs

The *Salmon and Steelhead Habitat Limiting Factors Report for the Cedar-Sammamish Basin (Water Resource Inventory Area 8)* (Kerwin 2001) identifies the following five "limiting habitat factors and impacts on Lake Washington:"

- The riparian shoreline of Lake Washington is highly altered from its historic state. Current and future land use practices all but eliminate the possibility of the shoreline to function as a natural shoreline to benefit salmonids;

- Introduced plant and animal species have altered trophic interactions between native animal species;
- The known historic practices and discharges into Lake Washington have contributed to the contamination of bottom sediments at specific locations;
- The presence of extensive numbers of docks, piers and bulkheads have highly altered the shoreline; and
- Riparian habitats are generally non-functional

The 2005 *Final Lake Washington/Cedar/Sammamish Watershed (WRIA 8) Chinook Salmon Conservation Plan* does not identify any specific projects along the Bellevue shoreline or in nearby areas up- and down-lake, but does include the following general recommendations to reduce predation on outmigrating juvenile chinook salmon in its "Action Start-List for Migratory Areas":

- Encourage salmon friendly shoreline design during new construction or redevelopment by offering incentives and regulatory flexibility to improve bulkhead and dock design and revegetate shorelines. Increase enforcement and address nonconforming structures over long run by requiring that major redevelopment projects meet current standards.
- Discourage construction of new bulkheads; offer incentives (e.g., provide expertise, expedite permitting) for voluntary removal of bulkheads, beach improvement, riparian revegetation.
- Support joint effort by NOAA Fisheries and other agencies to develop dock/pier specifications to streamline federal/state/local permitting; encourage similar effort for bulkhead specifications.
- Promote value of light-permeable docks, smaller piling sizes, and community docks to both salmon and landowners through direct mailings to lakeshore landowners or registered boat owners sent with property tax notice or boat registration tab renewal. Offer financial incentives for community docks in terms of reduced permit fees, loan fees/percentage rates, taxes, and permitting time, in addition to construction cost savings.
- Develop workshop series specifically for lakeshore property owners on lakeside living: natural yard care, alternatives to vertical wall bulkheads, fish friendly dock design, best management practices for aquatic weed control, porous paving, and environmentally friendly methods of maintaining boats, docks, and decks. Related efforts include creation of a website to convey workshop material, an awareness campaign, "Build a Beach," to illuminate impact of bulkheads on development of sandy beaches.
- Restore shoreline in Lake Washington Section 1: work with private property owners to restore shoreline in Section 1. Use interpretive signage where possible to explain restoration efforts.

Additional recommendations from WRIA 8 to further water quality restoration of the lake and its tributaries, reduce the population of cutthroat trout,[2] and enhance juvenile chinook rearing areas are as follows:

- Address water quality and high flow impacts from creeks and shoreline development through NPDES Phase 1 and Phase 2 permit updates, consistent with Washington

[2] Cutthroat trout are currently considered the dominant predator in Lake Washington.

Department of Ecology's 2001 *Stormwater Management Manual*, including low impact development techniques, on-site stormwater detention for new and redeveloped projects, and control of point sources that discharge directly into the lakes. Stormwater impacts from major transportation projects (for new and expanded roadways proposed during the next ten years) should be addressed. Encourage low impact development through regulations, incentives, education/training, and demonstration projects throughout subarea.

- Protect and restore water quality and other ecological functions in tributaries to reduce effects of urbanization and reduce conditions which encourage cutthroat. Protect and restore forest cover, riparian buffers, wetlands, and creek mouths by revising and enforcing critical areas ordinances and Shoreline Master Programs, incentives, and flexible development tools.
- Promote through design competitions and media coverage the use of "rain gardens" and other low impact development practices that mimic natural hydrology. Combine a home/garden tour or "Street of Dreams" type event featuring these landscape/ engineering treatments.

Residential Reaches

Many residential shoreline properties throughout these reaches have the potential for improvement of ecological functions through: 1) reduction or modification of shoreline armoring, 2) reduction of overwater cover and in-water structures (grated pier decking, pier size reduction, pile size and quantity reduction, moorage cover removal), 3) improvements to nearshore native vegetative cover, and/or 4) reductions in impervious surface coverage. Similar opportunities would also apply to undeveloped lots which may be used as community lots for upland properties or local street-ends and utility corridors. Other opportunities may exist to improve either fish habitat or fish passage for those properties which have streams discharging to Lake Washington.

Water-Dependent Use Reaches

These two reaches consist of two private marinas and a small public boat launch facility. Opportunities exist to improve habitat conditions along the shoreline by reducing overwater cover through the installation of deck grating on the existing piers and overall size reduction, removing or minimizing the impacts of shoreline armoring, and improving nearshore native vegetation.

Park Reaches

The eight City parks contained within the Park reaches vary in size from small landings (i.e. Burrows Landing) to large parks (i.e. Newcastle Beach Park). Each of these parks contains some form of overwater cover, shoreline access, and shoreline armoring. Opportunities to restore shoreline ecological functions exist at each location but vary in size and magnitude. Typical opportunities to improve habitat conditions include reducing overwater cover through the installation of deck grating on the existing piers and overall size reduction, removing or minimizing the impacts of shoreline armoring, and improving nearshore native vegetation. Detailed review and analysis of restoration opportunities at these and other City-owned properties in shoreline jurisdiction would occur during preparation of the Restoration Plan component.

4.2 KELSEY CREEK/MERCER SLOUGH

Kelsey Creek flows through the heart of Bellevue and is the primary component of the most productive and diverse stream network in the City. From its headwaters near Phantom Lake to its outflow into Mercer Slough and subsequently Lake Washington, Kelsey Creek and its tributaries pass through numerous parks, open spaces, school campuses, residential areas, commercial hubs, and a golf course. The majority of Kelsey Creek is not considered a shoreline of the state (i.e. its mean annual flow is less than 20 cubic feet per second [cfs]). However, per USGS calculations, a mean annual flow of 20 cfs is sustained at a point approximately 700 feet upstream of the confluence with Richards Creek. From this point until it empties into Lake Washington, Kelsey Creek, Mercer Slough, and their associated wetlands are considered shorelines of the state.

For the purposes of this inventory and analysis of ecological functions, the Kesley Creek/Mercer Slough shoreline waterbody has been divided into four distinct reaches, each containing associated wetlands.

Reach Number	Description
29	Mercer Slough Nature Park: the area downstream of I-405, not including the Bellefield Office Complex or the Sturtevant Creek wetland, north of SE 8th Street.
30	Bellefield Office Complex
31	Lower Kelsey Creek: area upstream of I-405 to the USGS 20cfs cutoff
32	Sturtevent Creek Wetland: associated wetland north of SE 8th Street and west of I-405.

4.2.1 Land Use Patterns

Although only approximately 3.3 miles of Kelsey Creek/Mercer Slough shoreline lies within shoreline jurisdiction, the stream still manages to pass through an assortment of various land uses. These include single-family, multi-family, light industrial, and office land use designations (Table 17). The most predominant of these uses is parks, as the downstream section of Kelsey Creek flows within the Mercer Slough Nature Park (Appendix D, Figure 3b).

Table 17. Kelsey Creek/Mercer Slough Land Use and Comprehensive Plan Designation

Reach	Comprehensive Plan Designation	
Reach 29 (Mercer Slough Nature Park)	Light Industrial (LI)	2.9 acres / 1%
	Multi-family Medium Density (MF-M)	100.6 acres / 31%
	Office (O)	13.1 acres / 4%
	Office Limited Business (OLB)	3.6 acres / 1%
	Single-Family Low Density (SF-L)	160.9 acres / 50%
	Single-Family Medium Density (SF-M)	45.4 acres / 14%
Reach 30 (Bellefield Office Complex)	Office (O)	74.2 acres / 99%
	Single-Family Low Density (SF-L)	0.1 acres / <1%
	Single-Family Medium Density (SF-M)	0.5 acres / 1%
Reach 31 (Lower Kelsey Creek)	Light Industrial (LI)	3.0 acres / 7%
	Multi-family Low Density (MF-L)	4.5 acres /11%
	Office Limited Business (OLB)	5.2 acres / 13%
	Single-Family High Density (SF-H)	5.2 acres / 13%
	Single-Family Medium Density (SF-M)	23.0 acres / 56%
Reach 32 (Sturtevant Creek Wetland)	Office Limited Business (OLB)	12.2 acres / 100%

Based on available GIS and land-use data, there appear to be approximately 8 vacant, undeveloped lots within the Kelsey Creek/Mercer Slough shoreline jurisdiction. This includes lots which may already be encumbered by associated wetland areas.

4.2.2 Transportation

Within shoreline jurisdiction, Kelsey Creek and Mercer Slough passes under Lake Hills Connector, 121st Ave SE, I-405, 118th Ave SE, and I-90 (Appendix D, Figure 2b). In addition, the following roadways come within 200 feet of the shoreline waterbodies or pass over the associated wetlands: SE 7th Place, SE 8th Street, SE 9th Place, 114th Avenue SE, and SE 15th Street.

See Table 18 below for a description of public roadways within the Kelsey Creek/Mercer Slough corridor that are located within shoreline jurisdiction. Roadways, which do not include private roads or driveways, were measured in GIS and are approximate.

Table 18. Roadways within shoreline jurisdiction: Kelsey Creek/Mercer Slough

Roadway	Roadway classification	Roadway within Jurisdiction (ft.)
SE 7th Pl.	Local access	520
SE 8th St.	Major arterial	1,395
121st Ave. SE	Local access	390
Lake Hills Connector	Major arterial	690
114th Ave. SE	Local access	520
SE 15th St.	Local access	410
112th Ave. SE	Major arterial	1,355

The City's *2006-2017 Transportation Facilities Plan* lists one improvement project near, but not within, Kelsey Creek's shoreline jurisdiction. The project involves the installation of sidewalks along 123rd Avenue SE and 128th Avenue SE. Although it has not yet been determined, this proposed project may also include improvements along 121st Avenue SE, which would fall within shoreline jurisdiction.

4.2.3 Wastewater and Stormwater Utilities

Wastewater Utilities

All Kelsey Creek and Mercer Slough shoreline areas within the City are provided with sewer service by the City (Appendix D, Figure 4b). However, there are very few sewer lines in this shoreline area due to the majority of the area being within preserved public open space. The few lines within this shoreline waterbody consist of 8-inch lines which feed office and industrial parks located along Mercer Slough in Reach 30. In addition to the sewer lines, there is one pump station (Wilburton) operated by King County that is located within shoreline jurisdiction along Kelsey Creek (Reach 31) on the corner of SE 9th Place and 121st Avenue SE.

Two King County Metro mains cross into shoreline jurisdiction through the Kelsey Creek corridor, parallel to the Wilburton trestle just east of I-405, and another through the Mercer Slough area near the mouth just north of I-90. These lines are part of a network, which serves the City of Bellevue and other Eastside cities. Wastewater from the Metro lines is conveyed to the South Treatment Plant in Renton.

According to the City's *2007- 2013 Capital Investment Program*, there is one specific sewer project identified within the Kelsey Creek/Mercer Slough shoreline jurisdiction. The following is an excerpt from the City's CIP:

> East CBD Sewer Trunkline Improvements: This project would provide funding to replace approximately 1,600 feet of 12-inch and 20-inch diameter pipe with 24-inch and 27-inch sewer pipelines (estimated), which will convey sewage from the eastern side of the central business district (CBD). The project is needed to provide sufficient sewer capacity to allow planned development in the eastern part of the CBD. Sufficient

capacity will reduce the likelihood and occurrence of sewer outflows, which pollute surface waters and create potential health and safety hazards.

Other ongoing, City-wide projects mentioned in the CIP include the sewer system pipeline rehabilitation project which will monitor and replace, if necessary, any sewer pipes which have been found to be deteriorated or defective; and the sewage pump station improvements, which will rehabilitate and repair sewage pump station and flush stations throughout the wastewater system.

Stormwater Utilities

Per available GIS information, there appear to be approximately 76 stormwater outfalls located within Kelsey Creek and Mercer Slough shoreline jurisdiction. However, according to GIS data, most of these outfalls do not directly discharge into Kelsey Creek, but rather into the wetlands and open space located along the corridor (Appendix D, Figure 5b). According to staff, no regional stormwater facilities are located within the shoreline area (Paulsen, pers. comm., 2008).

According to the City's *2007-13 Capital Investment Program*, there are no stormwater projects located within the Kelsey Creek shoreline area. However, there are a number of on-going City-wide projects located in various locations in the stormwater system as issues arise, some of which may occur within shoreline jurisdiction (City of Bellevue 2007). The following projects are identified in the CIP:

Minor Storm and & Surface Water Capital Improvement Projects: Ongoing program to fund minor capital improvements to the City's storm drainage system which are needed to resolve minor deficiencies, solve maintenance problems in conjunction with other City projects such as street overlays, or improvements, or to address neighborhood issues. They are generally small projects that wouldn't justify separate CIP projects, and oftentimes can't be anticipated.

Storm Water System Conveyance Infrastructure Rehabilitation: This ongoing program rehabilitates or replaces defective storm drainage pipelines and ditches identified in the Utility's condition assessment program or other means. Projects are prioritized based on the severity of deterioration, the risk and consequence of failure, and coordination with planned street improvement projects.

Neighborhood Enhancement Program: This project sets aside funding to respond to resident needs in specific geographic areas in concert with other City objectives and priorities as identified through the Neighborhood Enhancement Program or other neighborhood initiatives. Eligible projects might include landscaping a detention pond or enhancing a neighborhood stream, often in partnership with the Parks Department.

4.2.4 Impervious Surfaces

Based on the 2008 data set, the total impervious area within the Kelsey Creek/Mercer Slough shoreline jurisdiction is 79.6 acres or approximately 18 percent of this shoreline's total area (Appendix D, Figure 6b). Total vegetative cover within the Kelsey Creek/Mercer Slough

shoreline is 378 acres or approximately 83 percent of this shoreline's total area (Appendix D, Figure 14b).

Table 19 shows the breakdown of impervious surface and vegetative cover by each reach. The Office Complex reach clearly had the highest overall percentage of impervious surface (48 percent).

Table 19. Kelsey Creek/Mercer Slough Impervious Surface and Vegetative Cover by Shoreline Reach.

Reach	Total Impervious Area (acres)	% Impervious Surface	Total Vegetative Area (acres)	% Vegetative Cover
Reach 29 (Mercer Slough Nature Park)	34.0	10	294.4	90
Reach 30 (Bellefield Office Complex)	36.1	48	39.9	53
Reach 31 (Lower Kelsey Creek)	8.7	21	32.5	79
Reach 32 (Sturtevant Creek Wetland)	0.7	6	11.5	94
TOTAL	**79.6**	**17**	**378.2**	**83**

4.2.5 Shoreline Modifications

Kelsey Creek and Mercer Slough are relatively free of any shoreline modifications. The notable exception is that Kelsey Creek is routed through two parallel culverts, approximately 600-ft in length, as it passes underneath I-405. Additionally, some shoreline armoring is present through the portion of Mercer Slough adjacent to the light industrial and office land uses, although no field inventory of this area has been conducted.

Three small piers/docks were observed within the Mercer Slough shoreline jurisdiction, while no structures were noted within Kelsey Creek. Within the Mercer Slough Nature Park, one small floating dock structure is located just south of the northern pedestrian bridge. This structure appears to be used for public access and viewing. Two additional small overwater structures exist adjacent to the Sweylocken Boat Launch (non-motorized boat launch), just north of I-90. Additional in-water structures include support columns and bridge abutments associated with I-90, the SE 15th Street and 114th Avenue SE bridges accessing the Bellefield Office Complex, two pedestrian bridges, and utility poles.

The remainder of the stream channel is natural and offers extensive habitat features; which is primarily a result of the protection offered by the surrounding public park system through which it flows.

4.2.6 Existing and Potential Public Access Sites

Kelsey Creek and Mercer Slough offer extensive public access opportunities (Appendix D, Figure 8b). A portion of Kelsey Creek lies within Kelsey Creek Park, a City owned open space area offering picnic and play areas and trails. In addition, almost the entirety of Mercer Slough flows within the Mercer Slough Nature Park. This City Park includes over 320 acres of wildlife habitat adjacent to the Mercer Slough. Here, the public has access to over 7 miles of trails, picnic areas, waterfront access, canoeing, blueberry farms and educational centers. There is one non-motorized boat launch (Sweylocken Boat Launch) within Mercer Slough Nature Park.

4.2.7 Critical Areas

Geologically Hazardous Areas

Erosion Hazard areas exist in several small places along the periphery of Mercer Slough and Kelsey Creek (Appendix D, Figure 12b). The most notable location is just north of Kelsey Creek within the Wilburton Hill Park. Other areas exist near the intersection of Bellevue Way SE and 112th Ave SE and along the western side of 118th Ave SE. There are no mapped areas of Seismic or Landslide Hazard areas within Kelsey Creek shoreline jurisdiction.

Flood Hazard Areas

Flood Hazard Areas are mapped along the entire length of Kelsey Creek and Mercer Slough (Appendix D, Figure 10b). Both waterways and some areas of associated wetlands are considered to be within a 100-year floodplain.

Wetlands

The Mercer Slough area contains a unique and large shoreline wetland system that currently extends from just north of Coal Creek at its southern edge, northward to SE 6th Street near downtown Bellevue (Appendix D, Figure 11b). Both Kelsey and Sturtevant Creeks flow into Mercer Slough. Alterations to the watershed have fragmented the Mercer Slough wetland, though much of the wetland adjacent to the slough remains contiguous. The complex is characterized by organic, peat-based soils, which support a unique assemblage of plants, though some of the fragments described below contain only mineral soils. Despite historic alterations, the Mercer Slough complex's size, location, and composition provide important functions to the City's shoreline. Four distinct wetland areas within the complex are discussed in this section.

The Bellefield Office Complex is surrounded by the Mercer Slough Wetland. Standing water was observed throughout the complex during the site visit in Spring 2008. Since wetland parameters are met throughout, and there is a hydrologic connection via groundwater to other portions of the wetland, the Bellefield Office Complex (with the exclusion of impervious surface) is included as part of the Mercer Slough Wetland. Other land use types in the Mercer Slough Wetland include roadways and agricultural land. A portion of Interstate 90 passes through the wetland on pilings. Additionally, several trails, radio towers, and an active blueberry farm are contained within the large wetland.

This high-functioning, Category I wetland is ideally situated to help sequester non-point source pollution flowing from the contributing basins of Kelsey Creek and Sturtevant Creek. The thick vegetation along the Lake Washington shoreline protects against erosion. The complex, sinuous

edges between the various habitat types, abundant snags and downed woody debris throughout the wetland provide high quality wildlife habitat. Also, abundant overhanging vegetation along the slough and interior stream channels is beneficial for salmonids using Kelsey Creek.

Upstream of Mercer Slough, six high functioning wetlands are located in and adjacent to shoreline jurisdiction of Lower Kelsey Creek (Reach 31). These wetlands have been divided by a series of roadways, including SE 8th Street, the north- and south-bound lanes of Lake Hills Connector, and SE 7th Place. Despite the historic alteration to the landscape, these wetland units provide critical water quality, flood flow retention, and habitat functions.

Additionally, the Sturtevant Creek Wetland (Reach 32), an approximately 12-acre riverine wetland, is located just upstream of SE 8th Street. Once contiguous with Mercer Slough wetland, the two areas are now connected by an approximately 15-foot-wide metal culvert beneath SE 8th Street. The wetland sits at the base of the highly urbanized 773-acre Sturtevant Creek basin. Regular overbank flooding from Sturtevant Creek and groundwater provide much of the hydrology to the wetland. This Category III wetland likely biofilters non-point source pollution from the urbanized Sturtevant Creek watershed during flood events. A few small snags and large woody debris near Sturtevant Creek and SE 8th Street provide a moderate level of habitat function. However, the wetland has no connectivity to other habitat types as office buildings and roads surround it. The wetland has potential to store and diffuse flood flow, but there are no resources threatened by flooding downstream of the wetland, as Mercer Slough water levels are controlled by Lake Washington. Though SE 8th Street has constricted the surface connection between the Sturtevant Creek Wetland and the Mercer Slough wetland, there is likely a broad hydrologic groundwater connection which establishes this wetland as associated with shoreline jurisdiction.

Streams

Because of their importance as natural resources, both Kelsey Creek and Mercer Slough have been designated as “shoreline of statewide importance” and are both classified as Type S streams. These are the only streams in Bellevue to carry this distinction. Low gradient, sluggish flows, and a large volume of water characterize the habitats of these streams. Associated wetlands surround Mercer Slough on all sides and provide additional habitat features for fish and other wildlife. Mercer Slough is connected to Lake Washington and as such, fish use can be expected from all species present in the lake. Of special importance are chinook, coho, and sockeye salmon, which pass through the Mercer Slough en route to spawning grounds in the Kelsey Creek system.

In addition to Kelsey Creek and Mercer Slough, at least five other streams flow into areas of shoreline jurisdiction (Appendix D, Figure 11b). Richards Creek flows into Kelsey Creek just downstream of the 20 cfs point. This short section of Richards Creek is classified as a Type F stream. Further downstream, an unnamed tributary flows in Kelsey Creek from the Wilburton Hill Park. This stream is also classified a Type F stream. The final stream that flows into Kelsey Creek is Sturtevant Creek, a Type F stream, which enters Kelsey Creek just before it becomes Mercer Slough. There are two separate tributaries that flow into Mercer Slough. Both flow from the east of Mercer Slough and are associated with large wetland areas. The northern most of these tributaries is classified as a Type N stream while the other is classified as a Type F stream.

Other Fish and Wildlife Habitat Conservation Areas

Priority Habitats: WDFW mapping of Priority Habitat and Species classifies four separate areas as Priority Habitat within the Kelsey Creek shoreline corridor (Appendix D, Figure 13b). These areas are categorized as either urban natural open space or wetlands (WDFW 2007).

According to WDFW, the urban natural open space area is described as "Relatively densely forested tracts. Some steep hillsides". This area is located within Mercer Slough at the approximate site of the Bellefield Office Complex. Areas of wetlands are described as "Large mixed wetland in association with large lake. Open water, persistent emergent, scrub shrub, emergent and forested". These areas make up a majority of the remainder of the Mercer Slough wetlands area and also upstream areas, east of I-405 along Kelsey Creek.

Kelsey Creek, Mercer Slough, and their associated wetlands contains primarily Reserve habitat due to the extensive wetland complex surrounding these waterbodies (Technical Appendix Volume II). The only exceptions are the agricultural areas within Mercer Slough Nature Park maintained by the City (Agriculture habitat) and Bellefield Office Complex (Moderate habitat). The associated wetlands just east of I-405 along the north side of Kelsey Creek contain several snag rich areas. The lower portion of Mercer Slough contains areas of fragmented forest and significant perch trees. Nearly the entire length of Kelsey Creek/Mercer Slough that is within shoreline jurisdiction contains overhanging vegetation.

Special Status Species: Priority species noted by WDFW (2007) include a great blue heron colony located alongside Mercer Slough. In addition, WDFW lists the following anadromous and resident fish species as being present in Mercer Slough, Kelsey Creek and Richards Creek: fall chinook, coho salmon, sockeye salmon, resident coastal cutthroat and rainbow trout.

The nearest bald eagle nest is mapped approximately one-half mile west of the area within Beaux Arts Village.

4.2.8 Floodplain and Channel Migration Zone

Floodplain

As mentioned in section 4.2.7, nearly the entire Kelsey Creek/Mercer Slough shoreline area lies within the limits of a 100-year floodplain.

Channel Migration Zone

There are no known reports detailing the channel migration zone of the lower Kelsey Creek/Mercer Slough system. However, it appears from existing mapping of the system that the potential for channel migration is limited. In the approximately 1,200 feet between the upstream limit of the jurisdictional area and the culvert under the westbound lane of the Lake Hills Connector, the channel is in a broad topographic swale. The 100-year floodplain in this area is rather wide, and there is likely some potential for migration within approximately 100 feet of either side of the existing channel. The 2005 aerial photograph has some indications of potential alternate channels in this area, as well as potential ponded areas.

From that culvert, the stream flows in an open channel for approximately 450 feet before crossing under the eastbound lanes of the Lake Hills Connector. The culverts serve as a limit to channel migration potential, since the stream must remain locked into the position defined by the culvert. In addition, the road embankment prevents significant lateral movement of the channel.

Once under the east-bound lane of the Lake Hills Connector, the stream flows approximately 1,000 feet to a culvert under 121st Ave SE. This area also has a relatively broad floodplain, but no evidence of channel migration can be seen. The gradient of this stream section is quite low, and may not be sufficient to generate the scour necessary for the channel to migrate.

Below the 121st Ave SE culvert, the stream flows approximately 600 feet under the Wilburton railroad trestle and into culverts located under the Interstate 405 embankment. Such short stream sections with culverts at both ends dictating the stream path have little potential for migration.

Downstream of Interstate 405 the channel enters Mercer Slough. The gradient for the lower 9,000 to 10,000 feet of channel (depending on which path is followed) is virtually zero, with the water surface controlled by the level of the lake. The 100-year flood elevations at the upstream end of the slough are only 1 foot higher than high lake level elevations (FEMA FIRM #'s 53033C0656 F, 53033C0658 F, May 1995). Given the exceptionally low gradient, flood flows are unlikely to generate significant erosive force on the banks to encourage channel migration.

4.2.9 Historical or Archaeological Sites

According to the Office of Archeology and Historic Preservation's (OAHP) WISAARD (Washington Information System for Architectural and Archaeological Records Data) website, there is one site of historical interest located within the City of Bellevue's Kelsey Creek/Mercer Slough shoreline jurisdiction area. The site is the Wilburton Trestle. The trestle, originally constructed in 1904, spans nearly 1,000-ft over Kelsey Creek and SE 8th Street. The Washington State Register of Historic Places recognizes the trestle as historically significant. Although just outside of shoreline jurisdiction, the Frederick W. Winters House, located along the east side of Bellevue Way SE near SE 22nd Street but outside of the shoreline associated wetland, is Bellevue's only building on the National Historic Register. The Winters House is owned and maintained by the Parks & Community Services Department and includes program space for City staff and the non-profit Eastside Heritage Center.

The City of Bellevue's *Historic and Cultural Resources Survey* also identifies a site within shoreline jurisdiction as historically significant. The Overlake Farm, originally built in 1948, is located just west of Mercer Slough and occupies approximately 25 acres and 18,000 blueberry bushes. The site is owned by the City of Bellevue and is recognized by the City of Bellevue for its historical significance, but is not honored with a designation.

4.2.10 Other Areas of Special Interest

Water-Oriented Uses

Water-dependent uses: Water-dependent uses within the Kelsey Creek/Mercer Slough shoreline waterbody are limited to the Sweyolocken boat launch, a small public boat launching facility for non-motorized boats located approximately 0.25 miles from the mouth of Mercer Slough.

Water-related uses: There are no water-related uses in the Kelsey Creek/Mercer Slough shoreline jurisdiction.

Water-enjoyment uses: The Mercer Slough Nature Park provides over seven miles of public trails, a visitor's center, environmental education center, picnic areas, and a non-motorized launch.

Non water-oriented uses: The Bellefield Office Complex includes office and industrial businesses that are not water oriented.

4.2.11 Opportunity Areas

Opportunities for restoration along the Kelsey Creek/Mercer Slough shoreline are dramatically different from the other shoreline areas within the City. While in general, this area is relatively void of needed improvements, given the expansive wetland complex and significant habitat already provided, several opportunity areas are identified. The surrounding associated wetlands could benefit from the removal of invasive vegetation and replanting with native vegetation. Fish passage issues are likely the biggest concern within this area of shoreline jurisdiction. While no structural fish passage barriers have been identified through these reaches, high water temperatures and low flow during late summer and early fall salmon migration may hinder passage.

4.3 LAKE SAMMAMISH

The City of Bellevue is bordered on its eastern boundary by approximately 4.96 miles of Lake Sammamish shoreline. The shoreline is made up almost exclusively of single-family residences, with the exception of small pockets of multi-family residential, several small retail establishments, and private park facilities. The shoreline is nearly completely developed with a few scattered undeveloped properties in some areas. Shoreline armoring and extensive amounts of docks and piers also dominate the shoreline.

For analysis of shoreline ecological functions (see Chapter 5), the Lake Sammamish shoreline has been divided into five reaches (Reaches 33-37).

Reach Number	Description
33, 34, and 35	Residential reaches between north City limits and Vasa Park.
36	Vasa Park
37	Residential reach south of Vasa Park

4.3.1 Land Use Patterns

According to the City of Bellevue's Comprehensive Plan, the Lake Sammamish shoreline contains the following land uses as described below and highlighted in Table 20 (Appendix D, Figure 3c):

Single-Family Medium Density (SF-M): Extends from the northern City limits southward for approximately 3.15 miles. This area contains residential lots, almost all of which are developed with single-family structures.

Single-Family High Density (SF-H): Continues from the SF-M boundary south to the Issaquah City limits. This area also contains single-family home lots that are largely developed. However, lots that are slightly smaller than those within the SF-M district can be found in some areas. The SF-H area also contains Vasa Park and Sammamish Bible Camp (SAMBICA), two semi-private resort/day camps that offers campsites, lodging, and approximately 530 and 250 feet of shoreline access, respectively. Also within the SF-H area are three commonly owned properties that are used for private recreational purposes. These are located at 17806 SE 40th Place, 3818 West Lake Sammamish Parkway SE, and 3206 West Lake Sammamish Parkway SE.

Multi-Family Medium Density (MF-M): Two small areas of existing multi-family uses are found along the Lake Sammamish shoreline. Both are located along the southern portion of the shoreline tucked within the SF-M land use district. The first is the 29-unit Sammamish Shores Condominiums and the second is the 52-unit Larkspur Landing Condominiums. No other existing multi-family uses exist along the shoreline. However, additional multi-family uses are expected, such as the proposed Widgeon Condominiums along the southern lakeshore.

Neighborhood Business (NB): Two small retail stores exist just upland of Lake Sammamish along the southern portion of the shoreline. In both circumstances, while the area designated as NB intersects with the 200 foot shoreline jurisdiction, the business uses lies outside of shoreline jurisdiction. The northern NB designation located at 2810 West Lake Sammamish Parkway SE includes a narrow, 4-foot-wide strip of land which extends down to Lake Sammamish. This lot appears to include both a residence and a store, which is allowed in the NB zoning. Both business uses located in the NB designations blend in with and provide for the surrounding community.

Table 20. Lake Sammamish Land Use and Comprehensive Plan Designation

Existing Land Use	Comprehensive Plan Designation	
Reach 33 (Residential)	Single-Family Medium Density (SF-M)	31.0 acres / 100%
Reach 34 (Residential)	Single-Family Medium Density (SF-M)	16.1 acres / 100%
Reach 35 (Residential)	Multi-family Medium Density (MF-M)	1.6 acres / 3%
	Neighborhood Business (NB)	0.1 acres / <1%
	Single-Family High Density (SF-H)	11.7 acres / 25%
	Single-Family Medium Density (SF-M)	32.7 acres / 71%
Reach 36 (Vasa Park)	Single-Family High Density (SF-H)	2.9 acres / 100%
Reach 37 (Residential)	Multi-family Medium Density (MF-M)	0.4 acres / 2%
	Neighborhood Business (NB)	<0.1 acres / <1%
	Single-Family High Density (SF-H)	17.2 acres / 97%

Based on available GIS and land-use data, there appear to be approximately 21 vacant, undeveloped lots within the Lake Sammamish shoreline jurisdiction, all of which are located within residential areas. This includes lots both adjacent to and upland of the shoreline.

4.3.2 Transportation

The majority of Lake Sammamish shoreline jurisdiction is void of public streets, as the majority of shoreline road access is held in private ownership and access easements (Appendix D, Figure 2c). Roadways in public ownership are limited to a small section of West Lake Sammamish Parkway, the main north-south arterial along the lake, and two residential side streets that provide access to shoreline properties (Table 21). Otherwise, the majority of lakefront properties take access from private driveways off West Lake Sammamish Parkway.

Table 21. Roadways within shoreline jurisdiction: Lake Sammamish

Roadway	Roadway classification	Roadway within Jurisdiction (ft.)
SE 40th Pl.	Local access	700
W. Lake Sammamish Pkwy SE	Minor arterial	975
SE 29th Ct.	Local access	86

The City's *2006-2017 Transportation Facilities Plan* lists one improvement project proposed within Lake Sammamish shoreline jurisdiction. The project involves the improvement of West Lake Sammamish Parkway from the northern City limits south to I-90. Improvements include the addition of a 4-foot-wide shoulder on the east side of the roadway, repaving of existing lanes, a 10-foot-wide multi-purpose trail on the west side of the roadway, landscaping, installation of additional traffic signals and pedestrian crossings, storm drainage repairs, and water quality and fish passage improvements. Only portions of the proposed transportation improvements will take place within shoreline jurisdiction.

The West Lake Sammamish Parkway improvements are being constructed in phases over the next several years. Water quality will be examined as part of the initial drainage report expected to be completed in March 2009. It is likely that filter vaults would be used in portions of the project to help improve water quality. Exact numbers and locations will be determined during the final design phase.

Additionally, the City is also rehabilitating eight existing unreinforced concrete stormwater culverts. The culverts range in size from 18" to 24" and were originally installed in the 1920's. The City is looking at repairing the culverts through trenchless methods that would not require full replacement or upsizing since no change in runoff volumes or flow paths are proposed.

4.3.3 Wastewater and Stormwater Utilities

Wastewater Utilities

All Lake Sammamish shoreline areas within the City are provided with sewer service by the City (Appendix D, Figure 4c). There are a number of lakelines located along the shoreline, a majority of which are 8-inch lines which feed the numerous homes along the lakeshore. In addition to sewer lines, there are also seven pump stations and one flush station located within shoreline jurisdiction along Lake Sammamish.

A King County Metro main briefly crosses into shoreline jurisdiction at approximately the SE 38th Street alignment and West Lake Sammamish Parkway SE. This line, which serves the City of Bellevue as well as the City of Issaquah and unincorporated King County, begins in the City of Issaquah and passes along the Lake Sammamish shoreline before traversing uphill through the City of Bellevue and eventually connecting with the Eastside Interceptor. Wastewater from the Metro line is conveyed to the South Treatment Plant in Renton. A Metro main pump station (Sunset), operated by King County, is located along West Lake Sammamish Parkway in the Lake Sammamish shoreline jurisdiction.

According to the City's *2007- 2013 Capital Investment Program*, there are no specific sewer projects identified within the Lake Sammamish shoreline jurisdiction. The CIP does mention the sewer system pipeline rehabilitation project which will monitor and replace, if necessary, any sewer pipes which have been found to be deteriorated or defective. However, the CIP does not specifically identify the locations since problem areas will be located upon inspection.

Stormwater Utilities

Approximately 124 stormwater outfalls, both public and private, discharge into Lake Sammamish (Appendix D, Figure 5c), many of which lead into the shoreline area and eventually discharge waters into the lake. A majority of water discharge is from single-family residential development, of which many of the older developments empty directly into the lakes and streams. There is very limited water quality treatment for outfalls. According to City staff, no regional stormwater facilities are located within the shoreline area (Varner P., pers. comm., 2008).

According to the City's *2007-13 Capital Investment Program*, there are no specific stormwater projects located within the Lake Sammamish shoreline area. However, there are a number of on-going City-wide projects located in various locations in the stormwater system as issues arise, some of which may occur within shoreline jurisdiction (City of Bellevue 2007). The following projects are excerpts from the CIP:

> Minor Storm and & Surface Water Capital Improvement Projects: Ongoing program to fund minor capital improvements to the City's storm drainage system which are needed to resolve minor deficiencies, solve maintenance problems in conjunction with other City projects such as street overlays, or improvements, or to address neighborhood issues. They are generally small projects that wouldn't justify separate CIP projects, and oftentimes can't be anticipated.
>
> Storm Water System Conveyance Infrastructure Rehabilitation: This ongoing program rehabilitates or replaces defective storm drainage pipelines and ditches identified in the Utility's condition assessment program or other means. Projects are prioritized based on the severity of deterioration, the risk and consequence of failure, and coordination with planned street improvement projects.
>
> Neighborhood Enhancement Program: This project sets aside funding to respond to resident needs in specific geographic areas in concert with other City objectives and priorities as identified through the Neighborhood Enhancement Program or other neighborhood initiatives. Eligible projects might include landscaping a detention pond or enhancing a neighborhood stream, often in partnership with the Parks Department.

4.3.4 Impervious Surfaces and Vegetation

Based on the 2008 data set, the combined total impervious area within the Lake Sammamish shoreline jurisdiction is 46.2 acres or approximately 39 percent of this shorelines total area (Appendix D, Figure 6c). Total vegetative cover within the Lake Sammamish shoreline is 66.0 acres or approximately 55 percent of this shorelines total area (Appendix D, Figure 14c). These values represent all shoreline areas. In contrast, Vasa Park (Reach 36) contains only approximately 18 percent impervious surface and 65 percent vegetative cover. However, this reach represents only 2 percent of the total shoreline area.

Table 22 shows the breakdown of impervious surface and vegetative cover by each reach. The impervious surface coverage within residential reaches along Lake Sammamish, with an average

cover of approximately 39 percent, are approximately 5 percent lower than residential areas along Lake Washington (~44%).

Table 22. Lake Sammamish Impervious Surface and Vegetative Cover by Shoreline Reach.

Shoreline	Total Impervious Area (acres)	% Impervious Surface	Total Vegetative Area (acres)	% Vegetative Cover
Residential (Reach 33)	14.1	43	19.4	59
Residential (Reach 34)	5.7	32	9.4	54
Residential (Reach 35)	18.1	38	25.5	54
Vasa Park (Reach 36)	0.5	18	1.9	65
Residential (Reach 37)	7.8	42	9.8	53
TOTAL	**46.2**	**39**	**66.0**	**55**

4.3.5 Shoreline Modifications

A combination of recent aerial photographs and brief field visits conducted in Spring 2008 were used to collect information about shoreline modifications along the Lake Sammamish shoreline (Appendix D, Figures 7a through 7e, Tables 23 and 24).

As expected, a majority of the shoreline has been altered with either vertical or boulder bulkheads. The extensive amount of residential development has resulted in 71 percent armoring along the shoreline. Also, as expected, the shoreline contains a large number of overwater structures (326) resulting in a high number per mile (approximately 65 structures per mile). This can be attributed to the presence of individual piers/docks on a majority of the residential properties. There are approximately 364 parcels with some lakeshore frontage along Lake Sammamish. Thus, there are approximately 38 lots without a pier or dock structure. However, this number does not account for shared recreational lots or lots with joint- or multi-family use structures.

Table 23. Lake Edge Condition along Lake Sammamish.

Lake Edge Condition (feet / % of shoreline)			
Vertical[1]	**Boulder[2]**	**% Total Armoring**	**% Natural / Semi-Natural[3]**
13,884 53%	4,711 18%	71	29%

[1] "Vertical" shorelines encompass concrete, wood and mortared boulder armoring types. The key characteristic, besides a generally vertical orientation, is the lack of interstitial spaces in the face of the bulkhead that could provide some habitat.
[2] "Boulder" shorelines are typically angular or rounded granite or basalt. They may be vertical or sloped, but they all contain interstitial spaces, which provide some habitat and may absorb or attenuate some wave energy.

[3] "Natural/Semi-Natural" shorelines captures those areas that are not solidly armored at the ordinary high water line; they may include some scattered boulders or woody debris at or near the ordinary high water line. "Natural/semi-natural" designation is not intended to describe the environmental condition upland of ordinary high water.

Table 24. Overwater Cover within Lake Sammamish.[1]

Piers/Docks		Cover (sq.ft.)/ Lineal Foot	# of Overwater Structures/ Mile
#	Area (SF)		
326	331,940	13	66

[1] Overwater cover calculations include piers and docks, but also includes areas of covered moorage and boathouses.

4.3.6 Existing and Potential Public Access Sites

The amount of area zoned or designated as park/open space within shoreline jurisdiction is one measure of the existing public access opportunity. Unfortunately, because the Lake Sammamish shoreline is predominantly occupied by single-family residential uses, there are very few opportunities for public access (Appendix D, Figure 8c).

According to the 2003 Parks and Open Space System Plan, a majority of the Lake Sammamish shoreline is privately owned. City standards propose that 10 to 20% of the City's shoreline should be available for public access. In order to achieve this goal, this City is actively pursuing the acquisition of additional waterfront properties to expand public access.

Lake Sammamish offers no developed parks or public access sites within the City of Bellevue. The City, however, owns three properties totaling 190 feet of shoreline which may be developed at a future time. The City acquired two adjacent parcels in 1994. They are located to the east of the existing Weowna Park. In December 2007, the City acquired a third property immediately adjacent to the north. Together the three properties contain approximately 190 linear feet of shoreline. It also appears that the two northernmost parcels each contain a dock.

Two non-residential uses exist along the shoreline and both are privately owned (Table 25). The first is Vasa Park, a park owned and operated by the Vasa Homeowners Association. The park, with approximately 530 feet of shoreline frontage, does, however, offer public access from May 15 to October 15 each year. Due to its large size and significant length of shoreline ownership, the Vasa Park property has been identified as a separate reach (Reach 36) for evaluating shoreline ecological functions. The other non-residential shoreline use is the Sammamish Bible Camp (SAMBICA), a non-profit Christian camp and conference center. The SAMBICA property offers approximately 250 feet of Lake Sammamish shoreline for private use.

Table 25. Existing Access opportunities within Lake Sammamish Shoreline Jurisdiction.

Use	Shoreline Frontage	Ownership	Other Access Notes
Vasa Park	530 ft	Private	Park/resort, which is privately owned by neighborhood homeowners association. However, the park does offer public access opportunities from May 15 to Oct. 15 of each year.
Sammamish Bible Camp	250 ft	Private	Private, non-private Christian camp and conference center. Shoreline access available only for guests/members.
TOTAL	**750 ft**		

4.3.7 Critical Areas

Geologically Hazardous Areas

Seismic Hazard areas exist along the Lake Sammamish shoreline from the northern boundary of Weowna Park to the southern City limit (Appendix D, Figure 12c). Steep slope hazard areas are mainly present along the northern lakeshore, but are also present east of Weowna Park. Areas of moderate to high liquefaction potential exist along the entire Lake Sammamish shoreline within the City limits. No coal mine hazards are located along Lake Sammamish.

Flood Hazard Areas

The entire Lake Sammamish shoreline is considered to be within a 100-year floodplain. Additionally, the areas surrounding the mouth of Vasa Creek and areas upland approximately 0.5 miles have also been identified as within a floodplain area (Appendix D, Figure 10c).

Wetlands

No major wetland areas have been identified along the Lake Sammamish shoreline within the City of Bellevue. However, there are likely many small, minor, lake-fringe wetlands marking the edge of the lake in some locations.

Streams

At least ten recognized streams flow into Lake Sammamish within the City of Bellevue (Appendix D, Figure 11c). Five of the streams, located within the northern portion of shoreline jurisdiction begin in deep ravines where steep slopes have constrained development. All four streams flow through culverts beneath West Lake Sammamish Parkway before entering Lake Sammamish. In terms of habitat, these four streams are nearly identical. All are perennial streams through steep, forested ravines, but lack enough flow to create well-formed pools or provide fish habitat. Due to the small size of these streams along with numerous significant fish barriers, fish have not been observed in these four streams. These streams have been classified as Type N.

Further south, Phantom Creek flows from Phantom Lake into Lake Sammamish. This basin, located in east Bellevue, contains Weowna Park and predominately single-family housing. Historically, Phantom Lake drained into Kelsey Creek. However, near the turn of the century, a

man-made outfall from Phantom Lake diverted flow into Lake Sammamish, creating Phantom Creek. Previously existing data for the downstream section of Phantom Creek indicates the presence of coho salmon and possibly sockeye salmon as well (Williams et al 1975). Phantom Creek at the outlet to Lake Sammamish has been classified as a Type F stream.

Further south, Vasa Creek flows through southeast Bellevue, passing through steep bedrock reaches and well-defined gravel channels, before crossing beneath I-90 and transitioning to a low gradient stream through a riparian corridor into Lake Sammamish. The downstream portion of Vasa Creek contains cutthroat trout and late-run kokanee, as well as coho and sockeye salmon. Vasa Creek is classified as a Type F stream.

South of Vasa Creek, three unnamed streams flow through southeast Bellevue, under I-90, and into Lake Sammamish. It is believed that cutthroat trout are supported in these streams. However, no specific locations or population estimates have been documented. These streams have been classified as Type F streams.

Other Fish and Wildlife Habitat Conservation Areas

Priority Habitats: WDFW mapping of Priority Habitat and Species does not classify any areas of Priority Habitat within Lake Sammamish shoreline jurisdiction (Appendix D, Figure 13c). Several urban natural open space areas are mapped just outside of the jurisdiction area, including a large area encompassing the Weowna Park and the steep undeveloped ravines north of the park. WDFW classifies this area as “Steep, wooded hillside overlooking Lake Sammamish just north of Weowna Park”, and “City and/or County parks located in Bellevue. Only the portions with desirable wildlife habitat are mapped” (WDFW 2007).

The Lake Sammamish shoreline contains primarily Low to Moderate upland habitat throughout with the exception of a few small areas with High habitat value (Technical Appendix Volume II). The shoreline is generally void of significant forest areas and is limited to only small fragmented forest areas that provide moderate habitat value. Due to the highly developed nature of the Lake Sammamish shoreline, very little overhanging vegetation exists.

Special Status Species: Priority species noted by WDFW (2007) in Lake Sammamish are chinook, coho, sockeye, and kokanee salmon, dolly varden/bull trout, winter steelhead, and resident cutthroat trout. Priority species in Vasa Creek include coho and kokanee salmon and resident cutthroat trout.

The nearest bald eagle nest is mapped over one mile easterly of the shoreline along the eastern shore of Lake Sammamish.

Aquatic Conditions: While there are no known applications to control aquatic invasive vegetation, Eurasian watermilfoil is known to be a significant problem species with widespread infestations around the lake. WDFW does not track the removal of aquatic nuisance species by residential homeowners acting under the pamphlet HPA. Discussion of other aquatic conditions including sockeye salmon spawning areas, shoreline bathymetry, wave fetch, and substrate conditions are described in the Technical Appendix Volume II.

4.3.8 Floodplain and Channel Migration Zone

Floodplain

The entirety of Lake Sammamish is considered to have a floodplain. Therefore, all shoreline jurisdiction along Lake Sammamish within the City of Bellevue contains areas of floodplain up to the 36.6' (NAVD 88) elevation.

Channel Migration Zone

Channel migration zones do not typically apply to lakes.

4.3.9 Historical or Archaeological Sites

According to the Office of Archeology and Historic Preservation's (OAHP) WISAARD (Washington Information System for Architectural and Archaeological Records Data) website, there are not any sites of historical interest located in the City of Bellevue's Lake Sammamish shoreline area. Additionally, the City of Bellevue's *Historic and Cultural Resources Survey* doesn't identify any sites of interest along the Lake Sammamish shoreline.

4.3.10 Other Areas of Special Interest

Water-Oriented Uses

Water-dependent uses: Water-dependent uses are limited to single- and multi-family piers and docks. No other water-dependent uses, such as public or private marinas, are located along the Lake Sammamish shoreline.

Water-related uses: There are no water-related uses along the Lake Sammamish shoreline.

Water-enjoyment uses: Several types of water-enjoyment uses exist along the Lake Sammamish shoreline. These include both Vasa Park and SAMBICA which offer recreational shoreline access for portions of the year, and single- and multi-family dwellings adjacent to the water.

Non water-oriented uses: Two small areas located along West Lake Sammamish Parkway SE are designated as Neighborhood Business per the Comprehensive Plan and are not water oriented. However, neither of these areas front Lake Sammamish and only a very small portion of the areas are actually within shoreline jurisdiction.

4.3.11 Opportunity Areas

WRIA 8 Watershed-Wide Programs

The *Salmon and Steelhead Habitat Limiting Factors Report for the Cedar-Sammamish Basin (Water Resource Inventory Area 8)* (Kerwin 2001) identifies the following five "limiting habitat factors and impacts on Lake Sammamish:"

- Alteration of the type and abundance of salmonid predators in Lake Sammamish have been identified as a probable factor of decline;
- Select areas of Lake Sammamish contain elevated concentrations of sediment-associated contaminants;

- Eurasian water milfoil locally degrades water quality by reducing dissolved oxygen levels below minimum requirements for salmonids. The invasive nature of Eurasian water milfoil has likely decreased the overall diversity of macrophytes throughout Lake Sammamish; and
- The riparian buffers often are inadequate and fragmented.

The 2005 *Final Lake Washington/Cedar/Sammamish Watershed (WRIA 8) Chinook Salmon Conservation Plan* does not identify any specific projects along the City's Lake Sammamish shoreline, but does include the following general recommendations to reduce predation on outmigrating juvenile chinook salmon in its "Action Start-List for Migratory Areas":

- Encourage salmon friendly shoreline design during new construction or redevelopment by offering incentives and regulatory flexibility to improve bulkhead and dock design and revegetate shorelines. Increase enforcement and address nonconforming structures over long run by requiring that major redevelopment projects meet current standards.
- Discourage construction of new bulkheads; offer incentives (e.g., provide expertise, expedite permitting) for voluntary removal of bulkheads, beach improvement, riparian revegetation.
- Support joint effort by NOAA Fisheries and other agencies to develop dock/pier specifications to streamline federal/state/local permitting; encourage similar effort for bulkhead specifications.
- Promote value of light-permeable docks, smaller piling sizes, and community docks to both salmon and landowners through direct mailings to lakeshore landowners or registered boat owners sent with property tax notice or boat registration tab renewal. Offer financial incentives for community docks in terms of reduced permit fees, loan fees/percentage rates, taxes, and permitting time, in addition to construction cost savings.
- Develop workshop series specifically for lakeshore property owners on lakeside living: natural yard care, alternatives to vertical wall bulkheads, fish friendly dock design, best management practices for aquatic weed control, porous paving, and environmentally friendly methods of maintaining boats, docks, and decks. Related efforts include creation of a website to convey workshop material, an awareness campaign, "Build a Beach," to illuminate impact of bulkheads on development of sandy beaches.

Additional recommendations by WRIA 8 to further water quality restoration of the lake and its tributaries, reduce the population of cutthroat trout,[3] and enhance juvenile chinook rearing areas are as follows:

- Address water quality and high flow impacts from creeks and shoreline development through NPDES Phase 1 and Phase 2 permit updates, consistent with Washington Department of Ecology's 2001 *Stormwater Management Manual*, including low impact development techniques, on-site stormwater detention for new and redeveloped projects, and control of point sources that discharge directly into the lakes. Stormwater impacts from major transportation projects (for new and expanded roadways proposed during the next ten years) should be addressed. Encourage low impact development through

[3] Cutthroat trout are currently considered the dominant predator in Lake Washington. See section 5.2.3 for more information on predator-prey interactions in Lake Washington.

regulations, incentives, education/training, and demonstration projects throughout subarea.

- Protect and restore water quality and other ecological functions in tributaries to reduce effects of urbanization and reduce conditions which encourage cutthroat. Protect and restore forest cover, riparian buffers, wetlands, and creek mouths by revising and enforcing critical areas ordinances and Shoreline Master Programs, incentives, and flexible development tools.
- Promote through design competitions and media coverage the use of "rain gardens" and other low impact development practices that mimic natural hydrology. Combine a home/garden tour or "Street of Dreams" type event featuring these landscape/ engineering treatments.

Many residential shoreline properties along Lake Sammamish have the potential for improvement of ecological functions through: 1) reduction or modification of shoreline armoring, 2) reduction of overwater cover and in-water structures (grated pier decking, pier size reduction, pile size and quantity reduction, moorage cover removal), 3) improvements to nearshore native vegetative cover, and/or 4) reductions in impervious surface coverage. Similar opportunities would also apply to any undeveloped lots and opportunities may exist to improve either fish habitat or fish passage for those properties which have streams discharging to Lake Sammamish.

4.4 PHANTOM LAKE

Phantom Lake is located in eastern Bellevue and is surrounded by public open space and single-family housing. The lake itself is approximately 65 acres, and drains near the northeast corner to Phantom Creek, which flows into Lake Sammamish. Historically, Phantom Lake drained into Kelsey Creek. However, near the turn of the century, a man-made outfall from Phantom Lake diverted flow into Lake Sammamish, creating Phantom Creek. The previous outlet to Kelsey Creek has since become an area of wetlands that stretches approximately one mile in a northwesterly direction to Larsen Lake. This area includes all of Phantom Lake, Larsen Lake and all their associated wetlands (See Appendix C). Together this area is known as the Lake Hills Greenbelt, which encompasses over 150 acres of public open space and includes trails, shoreline access, fishing, produce stands, and wildlife viewing.

For the purposes of this inventory and subsequent analysis of shoreline ecological function, the shoreline jurisdiction surrounding Phantom Lake, including the Lake Hills Greenbelt, has been divided into five distinct reaches. Four reaches surround Phantom Lake directly. Two of which are single-family residential areas, one contains the Robinsglen Nature Park, and the last consists of the Lake Hills Greenbelt open space adjacent to Phantom Lake. The fifth reach consists of the Lake Hills Greenbelt north of SE 16th Street.

Reach Number	Description
38 and 40	Residential reaches surrounding Phantom Lake.

39 Lake Hills Greenbelt at Phantom Lake

41 Robinsglen Nature Park

42 Lake Hills Greenbelt north of SE 16th Street.

4.4.1 Land Use Patterns

Single-family residences and public open space surround Phantom Lake (Appendix D, Figure 3c). Larsen Lake and the remaining Lake Hills Greenbelt is surrounded entirely by public open space. Single-family residential properties surrounding Phantom Lake carry an SF-L designation (Single-family low density), while the remaining publicly owned parcels within the open space corridor carry a P/SF-L designation (Parks/Single-family low density) (Table 26). There are approximately 41 residential properties surrounding Phantom Lake, four of which are undeveloped. Based on available GIS and land-use data, there appear to be approximately 15 total vacant, undeveloped lots within the Phantom Lake shoreline jurisdiction, including the areas around Larson Lake and the associated wetlands. This includes lots both adjacent to and upland of the shoreline.

Table 26. Phantom Lake Land Use and Comprehensive Plan Designation

Existing Land Use	Comprehensive Plan Designation	
Reach 38 (Residential)	Single-Family Low Density (SF-L) Single-Family Medium Density (SF-M)	17.4 acres / 88% 2.3 acres / 12%
Reach 39 (Lake Hills Greenbelt at Phantom Lake)	Single-Family Low Density (SF-L)	21.4 acres / 100%
Reach 40 (Residential)	Single-Family Low Density (SF-L) Single-Family Medium Density (SF-M)	9.5 acres / 93% 0.7 acres / 7%
Reach 41 (Robinsglen Nature Park)	Single-Family Low Density (SF-L)	1.1 acres / 100%
Reach 42 (Lake Hills Greenbelt north of SE 16th St., including agricultural use)	Community Business (CB) Multi-family Medium Density (MF-M) Single-Family High Density (SF-H) Single-Family Low Density (SF-L)	2.3 acres / 2% 0.1 acres / <1%% 5.4 acres / 4% 112.9 acres / 94%

4.4.2 Transportation

Several residential street ends surrounding Phantom Lake fall within shoreline jurisdiction. These roadways include, 163rd Place SE, SE 16th Street and SE 17th Street. Otherwise, only residential driveways are located within 200-ft of Phantom Lake. Additionally, several major roadways bisect associated wetlands located northwest of Phantom Lake (Appendix D, Figure 2c). These include SE 16th Street, 156th Avenue SE, Lake Hills Boulevard and 148th Avenue SE. While these roadways lie within the corridor of associated wetlands, they are not considered to be within shoreline jurisdiction. The City's *Transportation Facilities Plan 2006-2017* does not identify any transportation projects within the Phantom Lake shoreline area.

4.4.3 Wastewater and Stormwater Utilities

Wastewater Utilities

All Phantom Lake shoreline areas within the City are provided with sewer service by the City. There are very few sewer lines in this shoreline area due to the majority of the area being within the Lake Hills Greenbelt (Appendix D, Figure 4c). The few lines within this shoreline area consist of 8-inch lines which feed the numerous homes along the lake's shoreline.

A King County Metro main briefly crosses into shoreline jurisdiction through the Lake Hills Greenbelt at approximately 154th Avenue SE alignment between SE 10th Street and SE 16th Street. This line is part of a network which serves the City of Bellevue as well as the City of Issaquah and unincorporated King County. It begins in the City of Issaquah and passes along the Lake Sammamish shoreline before it traverses uphill through the City of Bellevue and eventually connects with the Eastside Interceptor. Wastewater from the Metro lines is conveyed to the South Treatment Plant in Renton.

According to the City's *2007- 2013 Capital Investment Program* (CIP), there are no specific sewer projects identified within the Phantom Lake shoreline jurisdiction. The CIP does mention the sewer system pipeline rehabilitation project which will monitor and replace, if necessary, any sewer pipes which have been found to be deteriorated or defective. However, the CIP does not specifically identify the locations since problem areas will be located upon inspection.

Stormwater Utilities

There are three stormwater outfalls which directly discharge into Phantom Lake, and approximately 28 others which lead into the shoreline jurisdiction area near the lake and along the Lake Hills Greenbelt, as noted on the City's GIS data (Appendix D, Figure 5c). According to staff, there is one regional stormwater facility located within the shoreline area near Larsen Lake (Paulsen, pers. comm., 2008).

According to the City's *2007-13 Capital Investment Program*, there are several flood control stormwater projects located near Larsen Lake within the Phantom Lake shoreline jurisdiction. The following is an excerpt from the City's CIP:

> Flood Control Program: Flooding exceeds the targeted level of protection as a result of insufficient public drainage system capacity. Presently the flooding at various sites includes residential and/or commercial structural flooding or flooding which limits access to businesses. This program will construct improvements to drainage systems to alleviate flooding where the Utility's goal for level of service for protection from flooding is not met. Project improvements could involve increasing conveyance capacity; re-routing drainage; or adding detention, infiltration, or other runoff control mechanisms.
>
> Locations in the Larsen Lake area include:
>
> - 156th Ave SE & SE 4th Storm Drainage Improvements
> - SE 9th Street Storm Drainage Improvements

- Phantom/Larsen Channel re-grading

There are also a number of on-going City-wide projects located in various locations in the stormwater system as issues arise, some of which may occur within shoreline jurisdiction (City of Bellevue 2007). The following projects are identified within the CIP:

Minor Storm and & Surface Water Capital Improvement Projects: Ongoing program to fund minor capital improvements to the City's storm drainage system which are needed to resolve minor deficiencies, solve maintenance problems in conjunction with other City projects such as street overlays, or improvements, or to address neighborhood issues. They are generally small projects that wouldn't justify separate CIP projects, and oftentimes can't be anticipated.

Storm Water System Conveyance Infrastructure Rehabilitation: This ongoing program rehabilitates or replaces defective storm drainage pipelines and ditches identified in the Utility's condition assessment program or other means. Projects are prioritized based on the severity of deterioration, the risk and consequence of failure, and coordination with planned street improvement projects.

Neighborhood Enhancement Program: This project sets aside funding to respond to resident needs in specific geographic areas in concert with other City objectives and priorities as identified through the Neighborhood Enhancement Program or other neighborhood initiatives. Eligible projects might include landscaping a detention pond or enhancing a neighborhood stream, often in partnership with the Parks Department.

4.4.4 Impervious Surfaces and Vegetation

Based on the 2008 data set, the total impervious area within the Phantom Lake shoreline jurisdiction is 12.6 acres or approximately 7.3 percent of this shoreline's total area (Appendix D, Figure 6c). Total vegetative cover within the Phantom Lake shoreline is 162.4 acres or approximately 93.9 percent of this shoreline's total area (Appendix D, Figure 14c).

Table 27 shows the breakdown of impervious surface and vegetative cover by each reach, with the two residential reaches combined. The residential reaches had the highest overall percentage of impervious surface (15.4 percent). However, this is much lower than residential areas of Lake Washington or Lake Sammamish.

Table 27. Phantom Lake Impervious Surface and Vegetative Cover by Shoreline Reach.

Shoreline	Total Impervious Area (acres)	% Impervious Surface	Total Vegetative Area (acres)	% Vegetative Cover
Residential (Reaches 38 and 40)	4.6	15.4	25.2	84.0
Robinsglen Nature Park (Reach 41)	0.1	0.5	21.2	98.7
Lake Hills Greenbelt at Phantom Lake (Reach 39)	0.1	7.7	1.1	96.6
Lake Hills Greenbelt north of Phantom Lake (Reach 42)	7.8	6.5	115.0	95.3
TOTAL	**12.6**	**7.3**	**162.4**	**93.9**

4.4.5 Shoreline Modifications

The most common shoreline modifications on Phantom Lake are anthropogenic alterations to the natural lake edge and nearshore environments, and primarily include a variety of armoring types (some associated with fill) and piers. These sorts of modifications alter the function of the lake edge, change erosion and sediment movement patterns, affect the distribution of aquatic vegetation, and are often accompanied by upland vegetation loss.

Shoreline Armoring

Wind-driven waves during storms are the main source of shoreline erosion. However, due to the relatively small size of Phantom Lake, typical wind-driven waves would be small and lack enough power to do substantial damage.

Aerial photos and limited field observation indicate several shoreline condition types: vegetated, grass to water's edge, sand, gravel, and bulkheads (boulder, wood or concrete). Although a detailed field inventory of shoreline armoring has not been conducted, the amount of shoreline armoring based on aerial photography is estimated at only 2.4 percent. Three areas of shoreline armoring have been noted, two within the residential reaches and a small section along Robinsglen Nature Park.

No shoreline armoring is believed to exist along the shoreline of Larson Lake.

Piers

Based on aerial photos there are approximately 22 piers on Phantom Lake, one of which is associated with the Lake Hills Greenbelt. Larsen Lake contains just one pier also offering shoreline access as part of the Lake Hills Greenbelt. The remaining piers on Phantom Lake can be attributed to single-family residences surrounding the lake. Although specific information on pier material could not be located, it is probable that many of the piers were constructed using

components treated with chemicals that are no longer approved for in-water use because of their potential to have adverse affects on water and sediment quality.

4.4.6 Existing and Potential Public Access Sites

Although primarily surrounded by residential uses, Phantom Lake has two park sites along its shoreline and other expansive public open spaces throughout its associated wetland areas. Robinsglen Nature Park and a portion of the Lake Hills Greenbelt are located on the lake. Both parks provide public shoreline access opportunities (Appendix D, Figure 8c). The Lake Hills Greenbelt offers approximately 935 feet of shoreline frontage on Phantom Lake. However, a large majority of the frontage is inaccessible due to the associated wetlands on the property. Nevertheless, the park does contain a short trail and pier that allows for lake viewing opportunities. Robinsglen Nature Park offers approximately 225 feet of shoreline frontage. However, the shoreline contains a substantial amount of native vegetation and therefore offers limited shoreline access.

The remainder of shoreline jurisdiction within the Phantom Lake shoreline waterbody is made up entirely of public open space contained within the Lake Hills Greenbelt north of SE 16th Street. The Lake Hills Greenbelt measures over one mile in length as it runs from Phantom Lake in a northwesterly direction to Larsen Lake. The entire park corridor is over 150 acres and offers over three miles of trails, picnic areas, non-motorized water access, fishing, blueberry farms and seasonal produce stands. Along with Phantom Lake and Larsen Lake, diverse habitat includes forests, wetlands and streams.

Within the Phantom Lake shoreline waterbody, there is potential for enhancement or restoration of the existing habitat found within the park.

4.4.7 Critical Areas

Geologically Hazardous Areas

The entire area of shoreline jurisdiction surrounding Phantom Lake is void of any geologically hazardous areas (Appendix D, Figure 12c). The nearest seismic and landslide hazard areas are located over one-third of a mile to the east, along the shores of Lake Sammamish. The nearest erosion hazard areas are located two-thirds of a mile to the west along Kelsey Creek. No coal mine hazards are located within the Phantom Lake shoreline area.

Flood Hazard Areas

Almost the entire area within shoreline jurisdiction surrounding Phantom Lake has been mapped as a flood hazard area.

Wetlands

The shoreline jurisdiction surrounding Phantom Lake includes an approximately 170-acre wetland complex adjacent to both Phantom and Larsen Lakes (Appendix D, Figure 11c). The complex extends north approximately 1.8 miles from the south edge of Phantom Lake, to Sammamish High School, adjacent to Main Street, northwest of Larsen Lake. Historically, the area was one contiguous wetland, but human alteration to the landscape, including road building, ditching and farming, has fragmented the system into four distinct wetland units. Based on field

observations and examination of numerous soils samples and background materials, the valley between Phantom and Larsen Lakes is a single wetland complex, broken on its surface by road overlays with surface connections maintained only by culverts passing stream flow that originates in either Phantom Lake or wetlands associated with Phantom Lake. As shown on the soils map (Appendix D, Figure 9c), most of the valley and the mapped wetlands are underlain by Seattle muck. Most of the perimeter around Phantom Lake contains fringe wetlands. However, the wetland areas shown on Figure 9c may actually be larger than depicted due to apparent understating of wetland area derived from aerial photography. Due to the high fluctuating lake level, many shoreline areas containing grass lawn may also be considered wetland if verified by actual field review.

According to City Parks, an earthen berm was constructed in 2000 by Bellevue Utilities as part of a water quality project between Phantom and Larsen Lakes to divert the surface water away from Phantom Lake and into the drainage channels to the north, toward Larsen Lake. Although the stream may not continuously drain surface waters of Phantom Lake, surface water that otherwise would have entered Phantom Lake is supporting stream flow. Groundwater that supplies lake and wetland hydrology is also providing base flow to the stream. Per the City of Bellevue, the outlet weir on Phantom Lake is at elevation 260.18 feet (NAVD88). The topographic contours surrounding Phantom Lake and extending north peak at approximately 262 feet (NAVD88). By this account, Phantom Lake would likely have hydraulic connectivity with Larsen Lake during large flood events. It appears that the active hydric soils present in the valley do provide the necessary hydraulic continuity. Regardless of their fragmentation, these wetlands have been determined to be connected via subsurface hydrologic connectivity. Therefore, all of these wetlands are considered to be associated with Phantom Lake and thus part of shoreline jurisdiction.

Streams

Two streams and their associated tributaries flow within Phantom Lake's shoreline jurisdiction. The first, Phantom Creek, begins as a small tributary flowing into the southwest corner of Phantom Lake. Phantom Creek continues downstream, beginning at the eastern edge of Phantom Lake and flowing downstream though a wooded ravine and into Lake Sammamish. Both upstream and downstream portions of Phantom Creek are classified as Type F streams.

Just northwest of Phantom Lake are the headwaters of Kelsey Creek. Kelsey Creek goes on to be the most productive and diverse stream network in the City. As Kelsey Creek flows toward Larsen Lake it passes through low gradient, sediment-filled channels with very little or no flow. Habitat in this area is of poor quality due to the channelized nature of the stream. Kelsey Creek flows both into and around Larsen Lake. There is also at least one other unnamed tributary that flows into Larsen Lake. Kelsey Creek and its tributaries in this area are classified as Type F streams.

Other Fish and Wildlife Habitat Conservation Areas

Priority Habitats: WDFW mapping of Priority Habitat and Species classifies eleven separate areas as Priority Habitat within the Phantom Lake corridor. These areas are categorized as riparian zones, urban natural open space, or wetlands (WDFW 2007).

According to WDFW, riparian zones within the corridor are described as "wooden riparian areas, several small wetlands." Urban natural open space is described as "City and/or County parks located in Bellevue. On the portions with desirable wildlife habitat are mapped. Lake Hills Park contains wetlands." Finally, wetlands are described as "emergent marsh, wet meadow, open water (man-made), and scrub shrub."

Phantom Lake and its associated wetlands contains primarily Reserve habitat due to the extensive wetland complex between Phantom and Larson Lakes. The only exceptions are the blueberry patch maintained by the City (Agriculture habitat) and the residential area surrounding Phantom Lake (Moderate habitat). Phantom Lake does contain several areas of significant perch trees as well as fragmented forest. The associated wetland to the north, between Phantom and Larson Lakes, contains two areas of forest patch. Several areas surrounding Larson Lake are rich in snags. Larson Lake contains a significant amount of overhanging vegetation along its eastern shoreline although the amount has not been quantified.

Special Status Species: Priority species noted by WDFW (2007) in the area are chinook, coho, and sockeye salmon within Kelsey Creek downstream of Lake Hills Boulevard. Additionally, resident cutthroat is noted by WDFW within Kelsey Creek downstream of Larsen Lake.

The nearest bald eagle nest is mapped almost two miles easterly of the corridor along the eastern shoreline of Lake Sammamish.

Aquatic Conditions: A study of Phantom Lake in 1985 found the lake to be eutrophic and suffering from deteriorating water quality conditions that would continue if restoration measures were not implemented. The lake was found to have very high nutrient concentrations, low water clarity, a severe dissolved oxygen deficiency, and was dominated by nuisance concentrations of blue-green algae. The primary water quality issue was the excessive inputs of phosphorus from within the watershed and internal cycling of phosphorus from bottom sediments.

Four major elements of restoration for Phantom Lake were proposed and implemented.

1. A hypolimnetic aerator was installed in Phantom Lake to increase the lake's dissolved oxygen level without mixing and destratifying the lake. The aerator was anchored in the deepest portion of the lake and was supplied compressed air by two electric compressors housed in a concrete vault onshore west of the lake. The aeration improvements were installed in 1991.
2. Phantom Lake was also treated with aluminum to help improve water quality. A total of 67 tons of aluminum in liquid form was added to Phantom Lake in September 1990. The aluminum treatment was intended to reduce the concentration of soluble phosphorus by precipitating the phosphorus and decreasing the amount of phosphorus released to the water column from bottom sediments.
3. A small, adjustable outlet structure was built on the lake's outlet creek to slow the rate at which the lake level drops in late spring and summer. The goal was to maintain a water level that would create a hydraulic barrier that diverted shallow groundwater flows away from the lake.

4. In an attempt to interrupt surface flows intended for Phantom Lake, a dike and cutoff channel were constructed northwest of the lake. Surface flows were identified as being the major external source of nutrients to the lake. The dike and cutoff channel redirected flow toward Larsen Lake through a biofiltration channel.

4.4.8 Floodplain and Channel Migration Zone

Floodplain

As mentioned in section 4.4.7, nearly the entire Phantom Lake area of shoreline jurisdiction is located within the 100-year floodplain (Appendix D, Figure 10c).

Channel Migration Zone

As mentioned in section 3.8.2, channel migration zones do not typically apply to lakes. In addition, King County maps do not identify any of the streams within the area of shoreline jurisdiction as having channel migration zones.

4.4.9 Historical or Archaeological Sites

According to the Office of Archeology and Historic Preservation's (OAHP) WISAARD (Washington Information System for Architectural and Archaeological Records Data) website, there are not any sites of historical interest located in the City of Bellevue's Phantom Lake shoreline jurisdiction area. However, the City of Bellevue's *Historic and Cultural Resources Survey* does identify two sites of interest in this area (Tobin and Pendergrass 1997). The first is the Masunaga House, a residence originally built near Phantom Lake in 1890 and later moved to Larsen Lake. The house is recognized by the State Register. The second site is the Larsen Lake Blueberry Farm. The farm covers approximately 16 acres on the corner of 148th Avenue NE and SE 8th Street. This site is recognized by the City for its historical significance, but is not honored with a designation.

4.4.10 Other Areas of Special Interest

Water-Oriented Uses

Water-dependent uses: Water-dependent uses are limited to single-family piers and docks. There are no other water-dependent uses located within Phantom Lake's shoreline jurisdiction.

Water-related uses: The agricultural uses associated with the Larson Lake Blueberry Farm can be considered a water-related use. The location of the agricultural activity is enhanced due to its proximity to the available water.

Water-enjoyment uses: Both Phantom and Larsen Lakes offer water-enjoyment uses through visual and physical access. Both lakes include public pier access via the Lake Hills Greenbelt. Numerous residential properties also surround Phantom Lake, providing private access opportunities.

4.4.11 Opportunity Areas

Similar opportunities for ecological improvements exist for the residential properties on Phantom Lake that exist for properties on Lakes Washington and Sammamish. However, given the size of the waterbody and surrounding basin, the Phantom Lake properties have much greater potential per parcel to provide ecological benefit. Mechanisms such as reduction or modification of shoreline armoring, minimizing overwater cover, providing native shoreline vegetation, reducing or eliminating applications of chemicals, pesticides, and herbicides, and reducing impervious surfaces, are all applicable measures to achieve improvements in shoreline ecological function for Phantom Lake. Similar opportunities would also apply to any undeveloped lots and City owned parcels. The associated wetlands surrounding both Phantom and Larson Lakes could benefit from the removal of invasive vegetation and replanting with native vegetation.

5.0 ANALYSIS of ECOLOGICAL FUNCTIONS and ECOSYSTEM WIDE PROCESSES

5.1 LAKE WASHINGTON WATERSHED (WRIA 8)

5.1.1 Geographic Context

The City of Bellevue is located within the Cedar/Sammamish watershed (Water Resource Inventory Area 08 [WRIA 08]) which encompasses 692 square miles. Lake Washington comprises the largest receiving waterbody, collecting water from two major rivers (Cedar and Sammamish Rivers) before flowing through Lake Union and ultimately into Puget Sound via the Lake Washington Ship Canal and Hiram Chittenden locks (Exhibit 2).

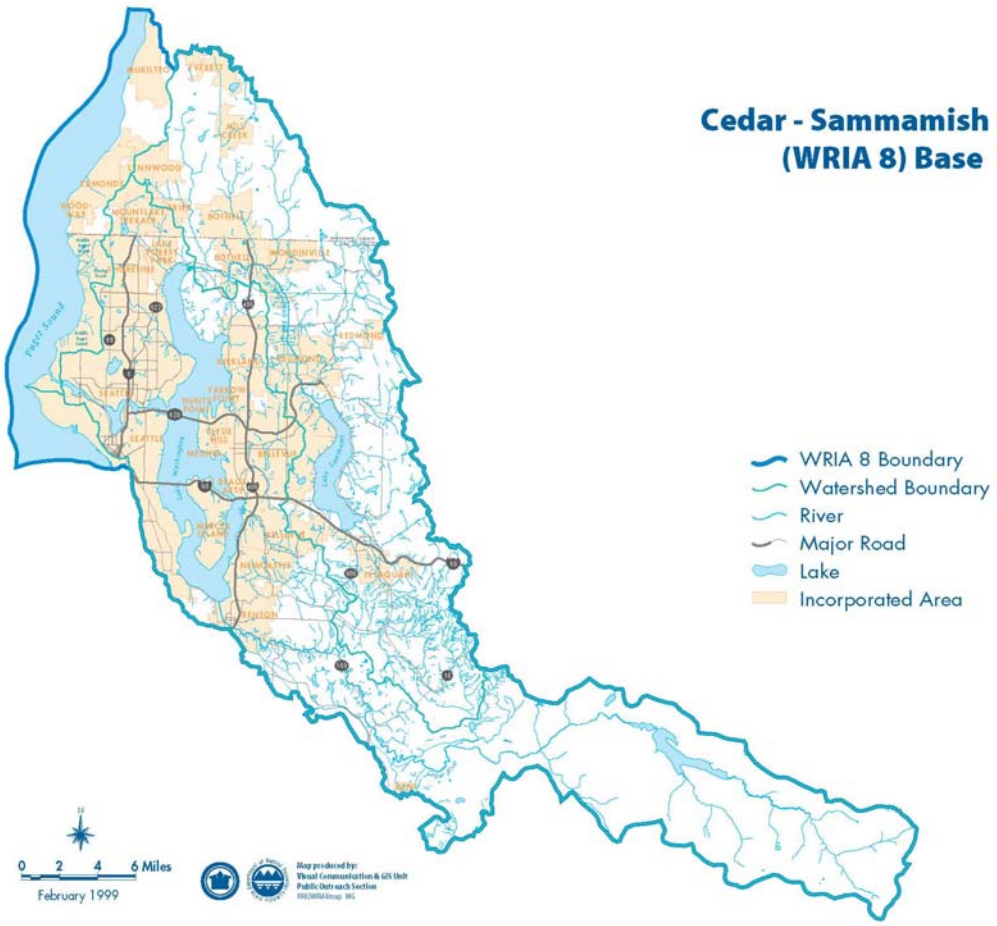

Exhibit 2. Overview of the Cedar/Sammamish watershed and its subwatershed boundaries. **(http://dnr.metrokc.gov/Wrias/8/wria8planimetric.pdf)**

5.1.2 Historic Geology, Topography, and Drainage Patterns

The lowering of Lake Washington that resulted from the construction of the Lake Washington Ship Canal and Hiram Chittenden locks (completed in 1916) and the concurrent elimination of the Black River and the diversion of the Cedar River into Lake Washington were the most monumental modifications. Lake Union was connected to Lake Washington via the Montlake Cut, and the former outlet to Lake Union was enlarged to form the Fremont Cut. Locating the locks near the western terminus of Salmon Bay converted the formerly saltwater inlet into a freshwater channel, eliminating over 7 km (4 mi.) of estuarine habitat. Lowering Lake Washington and diverting the Cedar River affected both the fish populations and the condition of the habitat. Cedar River fish stocks were locally adapted to a riverine migration and an extensive estuary, instead of the current lengthy lacustrine migration and an abrupt transition between warm, fresh water and significantly colder, more saline conditions below the locks. Lake Washington fish stocks, while accustomed to the lengthy lacustrine migration, were also adapted to an extensive estuary. The approximately 9-foot reduction in lake level eliminated much of the available shallow-water and freshwater marsh habitat, and decreased the length of the shoreline. Chrzastowski (1983) reports a loss of 15.3 km (9.5 miles) of shoreline, and an estimated loss of 410 hectares (1,013 acres) of wetland resulting from the lowering of the lake.

The construction of the Hiram Chittenden locks and subsequent water level regulation in Lake Washington by the Corps eliminated the annual flood-driven seasonal inundation of the shoreline that historically shaped the structure of the vegetation community. The hardstem bulrush- and willow-dominated community that existed prior to 1916 has been replaced by developed shorelines with landscaped yards. The management of the lake level by the Corps to maintain a high water volume throughout the summer and subsequently lowering the lake during the late fall and winter essentially reverses the natural lake hydrograph. This reversal impacts the growth of many species of native terrestrial and emergent vegetation. Conversely, this hydrograph reversal indirectly acts to buffer shorelines from potential wind-driven wave impacts during winter storms. The loss of natural shoreline has reduced complex shoreline features such as overhanging and emergent vegetation, woody debris (especially fallen trees with branches and/or rootwads intact), and gravel/cobble beaches. Evermann and Meek (1897) noted in 1896 that “the shore of Lake Washington is not well adapted to collecting with a seine” due to the abundant submerged woody debris, and dense underbrush, small trees, and tule (hardstem bulrush) that fringed the shoreline. The loss of native shoreline vegetation and wetlands has also reduced naturally occurring nutrients and food resources.

Lake Sammamish, the second largest lake in King County, was formed as the continental glaciers of the Pleistocene retreated, leaving behind a relatively long, narrow trough with water impounded by glacial debris. The lake extends nearly 8 miles north-south, is generally less than one mile wide, and has a maximum depth of just over 100 feet. The watershed contributing to the lake includes Issaquah Creek, Tibbetts Creek, Laughing Jacobs Creek, Lewis Creek, Vasa Creek, Phantom Lake Creek, Idyllwood Creek, and Pine Lake Creek, and a number of small or unnamed creeks. Water leaves the lake via the Sammamish River, which flows to Lake Washington and then to Puget Sound. In the early 1960s, the Sammamish River was dredged by the U.S. Army Corps of Engineers (Corps) to control flooding in the valley and the lake. This dredging reduced the elevation of high water events on the lake by several feet.

The woody debris, once abundant along the shoreline of Lake Washington and Lake Sammamish in the historical condition has been replaced with structurally simple piers. A survey of 1991 aerial photos along Lake Washington estimated that 4 percent of the shallow-water habitat within 30.5 m of the shore was covered by residential piers (ignoring coverage by commercial structures and vessels) (Malcom, pers. comm., 22 November 1999). A study conducted in 2000 reported that there were 2,737 docks in Lake Washington, and that approximately 71 percent of the shoreline was armored (Toft 2001). Although a similar lake-wide study has not been completed for Lake Sammamish, similar results are expected. The loss of complex habitat features (i.e., woody debris, overhanging vegetation, emergent vegetation), and shallow-water habitat in Lakes Washington and Sammamish has reduced the availability of prey refuge habitat and forage for juvenile salmonids. As NOAA Fisheries- and USFWS-mandated standard conservation measures are implemented with individual shoreline projects, and bioengineering methods and other "fish-friendly" designs for shore protection are adapted to lakeshore use, the condition of the Lake Washington and Lake Sammamish shorelines, in terms of fish and wildlife habitat may improve over time. However, the present availability of quality shoreline habitat for salmonids and their prey species remains substantially below its historical level. Recent and ongoing efforts to address the concern of growth management within the watershed and facilitate recovery efforts for salmon and salmon habitat, specifically for chinook salmon, include working with local jurisdictions to implement shared strategies for salmon recovery (WRIA 8 Steering Committee 2005; WRIA 8 Steering Committee 2002).

While water quality in Lake Washington is often considered moderate to good, the present state is a tremendous improvement from its condition just 50 years ago. Prior to the formation of Metro (now part of King County's Department of Natural Resources and Parks) in 1958, local sewage treatment plants around Lake Washington discharged effluent directly into the lake, resulting in large cyanobacteria (*Oscillatoria rubescens*) blooms that made the lake unsafe for recreation. After the construction of regional wastewater treatment facilities in Renton and at West Point in Seattle, effluent discharges dropped from approximately 20 million gallons per day to zero (Edmondson 1991). The subsequent reduction in phosphorus loading from the effluent discharges resulted in relatively immediate improvements to the lake's water quality. While water clarity was measured to be only 30 inches in 1964, clarity improved to 10 feet by 1968, reaching 25 feet by 1993.

5.1.3 Major Land Use Changes and Current Shoreline Condition

A key feature of urban areas is impervious surface coverage. Increases in impervious surface coverage, and the consequent reduction in soil infiltration, have been correlated with increased velocity, volume and frequency of surface water flows. This hydrologic shift alters sediment and pollutant delivery to streams and ultimately to downstream receiving water bodies (Booth 1998; Arnold and Gibbons 1996). Increased surface water flows associated with impervious surface coverage of suburban areas (20-30%) has been linked to decreased bank stability and increased erosion (May et al. 1997a). Knutson and Naef (1997), in their literature review, concluded that as little as 10 percent impervious surface coverage is sufficient to alter streambank stability and erosion. Changes in hydrology and stream morphology brought on by impervious surfaces have also been linked to shifts in macroinvertebrate community composition, which could have profound and far-reaching impacts on the productivity of a watershed (Pederson and Perkins 1986, as cited in Leavitt 1998). Changes in fish assemblages have been correlated with changes

in stream temperature and base flow as a result of increased impervious surface coverage (Wang et al. 2003). Increases in flood frequency and volume have been correlated to declining salmon populations in some Puget Sound lowland streams (Moscrip and Montgomery 1997). Riparian areas can protect against these factors by moderating surface water and sediment inputs. However, while riparian quality has been shown to be inversely proportional to the level of urbanization (May et al. 1997b), impervious surface area alone is not the only component to predicting stream biological conditions (Booth et al. 2004).

Many concerns have arisen in recent years over the impacts from the urbanization of predominantly forested areas, especially areas which contain erosion-susceptible geologic substrate and relatively high gradients (Booth and Henshaw 2001). Booth et al. (2002) conclude that under typical rural land uses, impacts to watershed ecology from reduced forest-cover area can be as great or greater than similar increases in impervious area. Threshold levels of 10 percent impervious coverage and 35 percent deforested area have been found to mark a distinct transition towards severely degraded stream conditions (Booth 2000).

In general, development is known to have detrimental effects on salmonids, particularly with spawning abundance and success. Pess et al. (2002) found that wetland occurrence, local geology, stream gradient, and land use were significantly correlated with adult coho salmon abundance. While positive correlations were found between spawner abundance and forested areas, negative correlations were found between spawner abundance and areas converted to agriculture or urban development. Fish species diversity has been found to decline with increasing levels of urban development, while cutthroat trout tend to become the dominant salmonid species (Lucchetti and Fuerstenberg 1993; Ludwa et al. 1997). The WRIA 8 Steering Committee has recently recognized the need to restore coho salmon spawning habitat in order to reduce the population of cutthroat trout, a known predator of juvenile chinook salmon (WRIA 8 Steering Committee 2005).

The following information and the inventory data described in Chapters 3 and 4 are presented to give historical context to the analysis of existing ecological functions and processes (i.e. baseline conditions). The urbanization of the Lake Washington watershed has increased impervious area, reduced forest cover, and increased nutrient and chemical loading to environmentally sensitive areas. These factors eventually contribute to increased storm flows, channel incision, sedimentation, and reduction in water quality, to name a few, ultimately impacting downstream receiving water bodies such as Lake Washington. The *Salmon and Steelhead Habitat Limiting Factors Report for the Cedar-Sammamish Basin (Water Resource Inventory Area 8)* (Kerwin 2001) identifies the following five "limiting habitat factors and impacts on Lake Washington and Lake Sammamish:"

- The riparian shoreline is highly altered from its historic state. Current and future land use practices all but eliminate the possibility of the shoreline to function as a natural shoreline to benefit salmonids;
- Introduced plant and animal species have altered trophic interactions between native animal species;
- The known historic practices and discharges into these waterbodies has contributed to the contamination of bottom sediments at specific locations;

- The presence of extensive numbers of docks, piers and bulkheads have highly altered the shoreline; and
- Riparian habitats are generally non-functional.

5.1.4 ESA Listings

Lake Washington, Lake Sammamish, and the associated watershed lies within the geographic range of two federally listed species of salmonids: 1) chinook salmon of the Puget Sound Evolutionary Significant Unit (ESU) (Threatened, U.S. Federal Register, 28 June 2005), and 2) bull trout of the Coastal-Puget Sound Distinct Population Segment (DPS) (Threatened, U.S. Federal Register, 1 November 1999). In addition to chinook salmon and bull trout, steelhead of the Puget Sound DPS are present in the watershed and are currently Proposed as Threatened (U.S. Federal Register, 29 March 2006). Coho salmon of the Puget Sound-Strait of Georgia ESU are also present in the watershed and are currently considered a Species of Concern (U.S. Federal Register, 15 April 2004), indicating that they are under less active consideration for formal listing. An ESU of Pacific salmon is considered to be a distinct population segment (DPS) and thus a "species" under the Endangered Species Act.

Lake Washington is also located within critical habitat that has been formally designated for Puget Sound chinook salmon and Coastal-Puget Sound bull trout. Critical habitat for chinook salmon includes the Lake Washington Subbasin (Watershed Code 17110012-03) of the Puget Sound ESU (U.S. Federal Register, 2 September 2005), and critical habitat for bull trout of the Coastal-Puget Sound DPS includes Lake Washington, which is in Critical Habitat Unit 28 – Puget Sound (U.S. Federal Register, 26 September 2005).

5.2 ANALYSIS OF ECOLOGICAL FUNCTIONS

King County and several other local jurisdictions around Lake Washington and Lake Sammamish (i.e. cities of Kirkland, Lake Forest Park, and Sammamish) have already completed an analysis and characterization of shoreline areas surrounding these waterbodies. Other local jurisdictions, including the Cities of Seattle, Bellevue, Renton, Issaquah, and Kenmore, are also conducting Shoreline Master Program updates and are currently conducting inventory and analysis of shoreline conditions. Coordination with these jurisdictions and review of their findings has been ongoing and will continue to be concurrent with the Shoreline Master Program update process for the City of Bellevue.

Ecological processes and functions of the City of Bellevue's shoreline areas are summarized in Tables 28 through 31 and illustrated on Figure 16. These tables are organized around the Department of Ecology's list of processes and functions for streams and lakes. For both streams and lakes, the list includes the evaluation of four major processes: 1) hydrologic; 2) vegetation; 3) hyporheic; and 4) habitat. These are further broken down into the following functions (18 for streams and 15 for lakes) which are in turn used to evaluate reach performance:

Stream Functions	Lake Functions
1. Hydrologic Functions • Storing water and sediment • Transport of water and sediment • Attenuating flow energy • Developing pools, riffles, and gravel bars • Removing excess nutrients and toxic compounds • Recruitment of large woody debris (LWD) and other organic material	**1. Hydrologic Functions** • Storing water and sediment • Attenuating wave energy • Removing excess nutrients and toxic compounds • Recruitment of large woody debris (LWD) and other organic material
2. Vegetative Functions • Temperature regulation • Water quality improvement • Slowing riverbank erosion; bank stabilization • Attenuating of flow energy • Sediment removal • Provision of LWD and organic matter	**2. Vegetative Functions** • Temperature regulation • Water quality improvement • Attenuating wave energy • Sediment removal and bank stabilization • LWD and organic matter recruitment
3. Hyporheic Functions • Removing excess nutrients and toxic compounds • Water storage and maintenance of base flows • Support of vegetation • Sediment storage	**3. Hyporheic Functions** • Removing excess nutrients and toxic compounds • Water storage • Support of vegetation • Sediment storage and maintenance of base flows
4. Habitat Functions • Physical space and conditions for life history • Food production and delivery	**4. Habitat Functions** • Physical space and conditions for life history • Food production and delivery

Assessment of each function is based upon both quantitative data results derived from the GIS inventory information described in Chapter 4 and a qualitative assessment based on aerial photography and field inventory, where possible. As described in Chapter 4, each shoreline waterbody has been divided into reaches based on various morphological, ecological, and land-use conditions.

Lake Washington:	Reaches 1-28 (Table 28)
Kelsey Creek/Mercer Slough:	Reaches 29-32 (Table 29)

Lake Sammamish:	Reaches 33-37 (Table 30)
Phantom Lake:	Reaches 38-42 (Table 31)

In the ensuing Tables 28 - 31, each reach has been given a "score" for each ecological function based on the available and relevant GIS information. Scoring was completed on a 1 to 5 scale, with 1 representing "low" function and 5 representing "high" function. The level categories are:

1 = Low
2 = Low/Moderate
3 = Moderate
4 = Moderate/High
5 = High

The scores for each function are then averaged within each of the four major processes such that each reach has a hydrologic, vegetative, hyporheic, and habitat score. Finally, these four values are averaged, so as not to weight one process more than another, resulting in a final reach score that is identified at the bottom of each table and illustrated on Figure 16. Tables 28 – 31 also include a qualitative "performance" summary to provide more detailed reach specific information.

5.2.1 Lake Washington Results

As described in Chapter 4, the Lake Washington reaches (1-28) have been organized by their basic land use descriptions (i.e. residential, park, and water-dependent uses).

Residential Reaches: 1, 3, 5, 7, 8, 9, 11, 13, 15, 16, 18, 21, 22, 23, 25, 26, 27, and 28

Park Reaches: 2, 4, 10, 12, 14, 17, 19, and 24

Water Dependent Reaches: 6 and 20

In order to condense this information as much as possible and limit the repetitiveness of the ecological function summary and corresponding tables, reaches which have similar functional characteristics have been grouped together. For example, residential reaches 1, 3, 5, and 8 were grouped together since they occupy the land area within Meydenbauer Bay and thus exhibit similar functional characteristics (Exhibit 3). Conversely, reach 22 (Newport Keys) consists of unique environmental and land-use characteristics, such that it was evaluated singly. The various groupings are listed below:

<u>Residential Groups</u>
R1 (reaches 1, 3, 5, and 8)
R2 (reaches 11, 13, and 15)
R3 (reaches 16, 18)
R4 (reaches 23, 25, and 27)
R5 (reaches 9, 26, and 28)
R6 (reach 7)
R7 (reach 21)

<u>Park Groups</u>
P1 (reaches 2, 4, 10, 12, 14, 17)
P2 (reach 19)
P3 (reach 24)

<u>Water Dependent Groups</u>
WD1 (reach 6)
WD2 (reach 20)

R8 (reach 22)

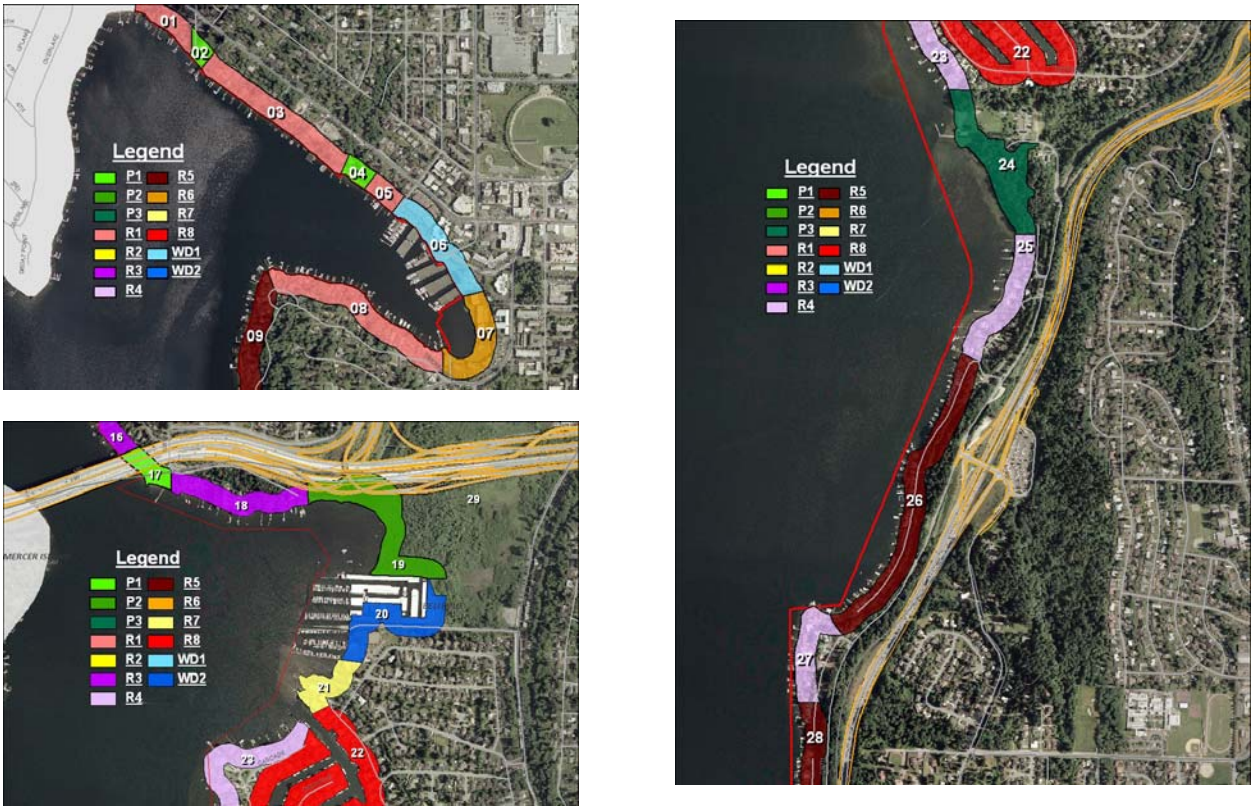

Exhibit 3. Examples of Lake Washington Reach Groups

Function scores and performance results for Lake Washington are detailed in Table 28. In summary, the reach groups are listed below with their corresponding value for ecological function.

<u>Residential Groups</u>

R1 (reaches 1, 3, 5, and 8)	Low/Moderate
R2 (reaches 11, 13, and 15)	Low/Moderate
R3 (reaches 16, 18)	Low/Moderate
R4 (reaches 23, 25, and 27)	Low/Moderate
R5 (reaches 9, 26, and 28)	Low/Moderate
R6 (reach 7)	Moderate
R7 (reach 21)	Moderate
R8 (reach 22)	Low

<u>Park Groups</u>

P1 (reaches 2, 4, 10, 12, 14, 17)	Low/Moderate
P2 (reach 19)	Moderate/High

P3 (reach 24)	Moderate/High
<u>Water Dependent Groups</u>	
WD1 (reach 6)	Low
WD2 (reach 20)	Low

Based on this information, most of the City's Lake Washington shoreline can be characterized as having low/moderate ecological function. Three reaches are characterized as having low ecological function. These are Reach 6, which includes the Meydenbauer Bay marinas and yacht clubs, Reach 20, which also contains a marina and yacht club, and Reach 22, which contains Newport Keys within the Newport Shores community.

Conversely, two park reaches are characterized as having moderate/high ecological function. These are Reach 19 (mouth of Mercer Slough) and Reach 24 (Newcastle Beach Park).

5.2.2 Kelsey Creek/Mercer Slough Results

The Kelsey Creek/Mercer Slough shoreline includes only four reaches (29-32), each with its own unique characteristics and functions. Thus, each of these four reaches has been assessed individually in Table 29. In summary, the reaches are listed below with their corresponding value for ecological function.

Reach 29 (Mercer Slough Nature Park)	High
Reach 30 (Bellefield Office Complex)	Moderate/High
Reach 31 (Lower Kelsey Creek)	Moderate/High
Reach 32 (Sturtevant Wetland)	Moderate/High

Not surprisingly, the Kelsey Creek/Mercer Slough shoreline can be characterized as having moderate/high to high ecological function. Much of this is based upon the extensive wetland complex which is associated with this system along with the large amount of public open space and protected natural areas. Of note, Reach 30, which contains the Bellefield Office Complex, rated higher than expected (Moderate/High, score = 3.5). While this reach contains an extensive amount of impervious surface and commercial land uses, it is surrounded by higher value habitat within the Mercer Slough Nature Park and the slough itself which completely encircles the office complex.

5.2.3 Lake Sammamish Results

The Lake Sammamish shoreline includes five reaches (33-37), each of which has been evaluated separately and described in Table 30. As described in Chapter 4, these reaches are almost entirely residential, with small pockets of multi-family and shared recreational uses. Unlike some of the Lake Washington reaches, the Lake Sammamish reaches have not been grouped together, as they initially appeared to have very distinct landscape characteristics. However, as the results indicate below, most of these reaches can be characterized as having low/moderate ecological function.

Reach 33 (northern reach)	Low/Moderate
Reach 34	Low/Moderate
Reach 35	Low/Moderate
Reach 36 (Vasa Park)	Moderate
Reach 37 (southern reach)	Low/Moderate

5.2.4 Phantom Lake Results

The Phantom Lake shoreline includes five reaches (38-42), two of which are predominantly residential (38 and 40) and three which are considered as park or open space (39, 41, and 42). As with the Lake Washington reach summary, the two residential reaches surrounding Phantom Lake have been combined into one analysis due to their functional similarity. However, the park and open space reaches are each evaluated separately due the differences between both their land uses and landscape characteristics. While the function scores and performance results for Phantom Lake are detailed in Table 31, the final summarized results are listed below.

Reaches 38 and 40 (residential)	Moderate/High
Reach 39 (Lake Hills Greenbelt at Phantom Lake)	High
Reach 41 (Robinsglen Nature Park)	Moderate/High
Reach 42 (Lake Hills Greenbelt north of Phantom Lake)	High

Although the Phantom Lake shoreline is very different from the Kelsey Creek/Mercer Slough system, the results of the ecological function analysis are rather similar. Both systems exhibit moderate/high to high shoreline ecological functions. Again, this is primarily due to the extensive shoreline associated wetland surrounding Phantom Lake and the vast amount of public open space and protected natural shoreline. Surprisingly, the residential areas surrounding Phantom Lake also had a moderate/high result. This is partly due to several factors, including a general lack of shoreline armoring and presence of lake-fringe wetlands.

Table 28. Function Summary of Bellevue's Lake Washington Shoreline

LAKE WASHINGTON		
Function	**Performance**	**Score[1]**
Hydrologic Storing water and sediment	**Residential Reaches** The lake of course provides excellent water and sediment storage functions. However, the residential uplands surrounding the lake within shoreline jurisdiction have relatively low water and sediment storage functions. Impervious surfaces and compact managed lawns interfere with infiltration of precipitation and rapidly send water "downstream." Wetlands and other natural water and sediment storage features are generally lacking. Slight differences in function between residential groups are evident given the adjacent land slope (percent steep slope) and some areas of higher vegetative cover. But these areas are usually correlated since steep slopes are typically less developed.	**Group R1: 2.0** **Group R2: 2.3** **Group R3: 2.7** **Group R4: 3.0** **Group R5: 1.3** **Group R6: 2.7** **Group R7: 3.3** **Group R8: 2.0**
	Park Reaches Park areas within shoreline jurisdiction along the Lake Washington shoreline generally provide similar water and sediment storage functions as the residential areas, having moderate impervious surfaces and compact managed lawns. Differences between park groups are noted below, but they typically related to presence of wetland, vegetative cover, and impervious surfaces. **Group P1 (Reaches 2,4,10, 12, 14, 17):** These parks are highly developed with very little water and sediment storage. A few small wetlands are present in Reach 4, but they provide very limited storage capacity. **Group P2 (Reach 19):** The mouth of Mercer Slough is part of an extensive wetland with high vegetative cover and low impervious surface. However, the presence of I-90 through this area and some adjacent steep slopes to the west slightly reduce the overall storage functions. **Group P3 (Reach 24):** The large wetland areas both along Lake Washington and in the upland area of the park, contribute to significant water and sediment storage functions through this reach.	**Group P1: 2.3** **Group P2: 4.3** **Group P3: 5.0**

LAKE WASHINGTON		
Function	**Performance**	**Score[1]**
	Water Dependent Reaches High percentages of impervious surface, correlated with low vegetative cover, generally result in low/moderate water and sediment storage functions within these reaches.	**Group WD1: 2.0** **Group WD2: 2.1**
Hydrologic Attenuating wave energy	**Residential Reaches** The changes to the lake elevation per the 1916 modifications made the nearshore environment generally steeper, with less opportunity for gradual nearshore slopes to attenuate wave energy. Bulkheading and other shoreline modifications have further steepened the nearshore. Also, the removal of woody debris and prevention of its accumulation along the shore has minimized this important component of shoreline roughness and energy attenuation. However, the reversal of the natural lake hydrograph (manipulated to result in a lower lake level during the winter *wet* season) has ameliorated the effects of low wave energy attenuation somewhat. Differences between reach groups are noted below, but typically variations in percent armoring and adjacent steep slope (indicator for shoreline bathymetry) are the driving factors. **Groups 1-5:** Vary between low to moderate function. **Group R6 (Reach 7):** This area lacks significant shoreline armoring and given its location in a protected bay with shallow water, this reach has high potential to attenuate wave energy. **Group R7 (Reach 21):** Similar to Reach 7, this reach at the mouth of Coal Creek provides shallow water, minimal shoreline armoring, and areas of shoreline wetland vegetation, all increasing wave attenuation function. **Group R8 (Reach 22):** The location of this reach within the Newport Keys alleviates wave action driven from wave fetch. However, the extent of shoreline armoring along the keys reduces the ability of this area to dissipate boat wakes.	**Group R1: 1.5** **Group R2: 1.5** **Group R3: 2.0** **Group R4: 3.0** **Group R5: 1.0** **Group R6: 5.0** **Group R7: 4.3** **Group R8: 3.0**

LAKE WASHINGTON		
Function	**Performance**	**Score[1]**
	Park Reaches Similar to residential reaches (Groups R1-R5), parks along the City's Lake Washington shoreline are typically heavily armored with little nearshore tree and shrub cover. Differences between groups are noted below. **Group P1 (Reaches 2,4,10, 12, 14, 17):** As noted above, these parks are heavily armored, lack shoreline vegetation that may contribute to in-water debris, and are fairly exposed to high wave fetch given their location along the shoreline and accompanying bathymetry. **Group P2 (Reach 19):** The extensive wetland at the mouth of Mercer Slough acts to alleviate wave energy in this and adjacent reaches. The presence of a long wave fetch through the east channel, terminates at this reach, accentuating the wave attenuation function of Mercer Slough. **Group P3 (Reach 24):** Although Newcastle Beach Park contains some shoreline armoring and a high-use recreational area along the northern park shoreline, the associated wetland and natural shoreline to the south provides excellent wave attenuation for this and adjacent properties.	**Group P1: 2.3** **Group P2: 3.5** **Group P3: 4.5**
	Water Dependent Reaches **Group WD1 (Reach 6):** The location of this reach within the eastern end of Meydenbauer Bay minimizes wind-driven wave action encountered in this reach. However, the presence of marinas increases large boat traffic and subsequently creates boat wakes where normal wave action would be minimal. This use increases the need for shoreline armoring which correlates with reduced wave attenuation functions. **Group WD2 (Reach 20):** Although this reach is nearly 100 percent armored, areas of shallow water which surround the mouths of Coal Creek and Mercer Slough, improves the ability of this reach to attenuate wave energy.	**Group WD1: 2.5** **Group WD2: 2.1**

LAKE WASHINGTON		
Function	**Performance**	**Score[1]**
Hydrologic Removing excess nutrients and toxic compounds	**Residential Reaches** Across groups, the Residential reaches contain intensively landscaped lakefront homes. The upland shoreline areas are more often a source of nutrients and toxic compounds, via lawn treatment runoff (pesticides, fertilizers, herbicides) and road runoff (hydrocarbons, metals). Key factors affecting variability of reaches to remove excess nutrients and toxic compounds include percent impervious surface, housing density, vegetative cover, and soil infiltration potential. Regardless, all reach groups, with the exception of Group R7 (Reach 21), rated low/moderate for removal functions. Reach 21, located at the mouth of Coal Creek likely performs a slightly higher removal function (moderate) than the other groups.	**Group R1: 1.7** **Group R2: 2.2** **Group R3: 2.4** **Group R4: 1.9** **Group R5: 2.1** **Group R6: 2.0** **Group R7: 2.6** **Group R8: 2.0**
	Park Reaches As in the residential settings described above, the majority of park area within the City's Lake Washington shoreline jurisdiction is a source of nutrients and toxic compounds via lawn treatment and impervious surface runoff. **Group P1 (Reaches 2,4,10, 12, 14, 17):** For the reasons listed above, these reaches rate low/moderate for this function. **Group P2 (Reach 19):** The nearshore vegetation and extensive wetland along the shoreline of Mercer Slough likely take up nutrients and other pollutants. With the exception of I-90, comparatively less impervious surface area feeds into the lake from this reach. **Group P3 (Reach 24):** Although the heavily used park area may contribute to nutrient and toxic compound inputs to the lake, the extensive shoreline and upland wetland areas likely offset these inputs and provide for excellent nutrient and toxic compound removal functions.	**Group P1: 2.3** **Group P2: 3.5** **Group P3: 4.5**
	Water Dependent Reaches The majority of the areas within the two WD reaches are sources of nutrient and toxic compounds due to extensive impervious surfaces and high vehicular traffic within these areas (high sources of hydrocarbon inputs).	**Group WD1: 1.3** **Group WD2: 1.3**

LAKE WASHINGTON		
Function	**Performance**	**Score[1]**
Hydrologic Recruitment of LWD and other organic material	**Residential Reaches** Recruitment of LWD and organic material is a function of shoreline vegetation, extent of development, and potential to transport material through adjacent streams and other sources. Dense residential shoreline zone development in these reaches, including shoreline armoring modifications, restrict the ability of the lake to recruit LWD and organic material. Essentially all of the primordial lakeshore forest vegetation has been removed, and so is not available for recruitment, and re-growth has been limited and patchy as a result of development. Most of the residential reaches rate low/moderate for this function. Variations from this rating are noted below. **Group R4 (Reaches 23, 25, 27):** This reach is characterized by relatively shallow lots and adjacent steep slopes. Subsequently, shoreline development is closer to the water, with less vegetative cover than other reaches resulting in a rating of low function. **Group R7 (Reach 21):** This reach includes both the mouth of Coal Creek, which likely transports organic material from the upper basin, and a shoreline associated wetland. The wetland includes shrub and emergent vegetation which likely provides some recruitment of LWD and organic material and thus rates moderate for this function. **Group R8 (Reach 22):** Given the highly urban residential setting, dense housing, and extent and type of shoreline armoring, the area of Newport Keys (Reach 22) provides very little recruitment potential of LWD and organic material and subsequently rates low for this function.	**Group R1: 1.7** **Group R2: 2.0** **Group R3: 1.7** **Group R4: 1.3** **Group R5: 2.0** **Group R6: 1.7** **Group R7: 2.7** **Group R8: 1.0**

LAKE WASHINGTON		
Function	**Performance**	**Score[1]**
	Park Reaches Again, similar to residential areas, most of the City parks along Lake Washington lack the ability to input large amounts of LWD and other organics to the lake since most of these areas are absent extensive vegetative cover along the shoreline. **Group P1 (Reaches 2,4,10, 12, 14, 17):** For the reasons listed above, this group rates low/moderate for this function. **Group P2 (Reach 19):** The area of Mercer Slough provides an extensive amount of shoreline vegetation, but in the form of small shrub and emergent cover. LWD input is generally lacking as upstream areas within Kelsey Creek have been cut off by I-405. Regardless, this reach rates moderate/high for this recruitment function. **Group P3 (Reach 24):** The southern shoreline of Newcastle Beach Park is extremely well vegetated with both deciduous and coniferous trees. This, in conjunction with input from the associated wetland, likely provides moderate/high recruitment functions.	**Group P1: 2.0** **Group P2: 3.7** **Group P3: 4.0**
	Water Dependent Reaches Neither reach provides potential for LWD recruitment. Very limited input of other organics are available in Reach 6 from adjacent vegetated areas.	**Group WD1: 1.7** **Group WD2: 1.8**
Vegetation Temperature regulation	**Residential Reaches** Lack of dense shoreline vegetation throughout most of these reaches eliminates potential for some shading of the shallow-water nearshore area. Vegetation is less effective at shading south- and west-facing shoreline areas due to midday sun from the south and afternoon sun from the west. Some sporadic shoreline vegetation does exist along the residential shoreline, but it lacks continuity. The Residential reaches vary between low/moderate to moderate function with variation coming from such factors as impervious surface and vegetative cover percentages. Only Reach 8, located along a northeast facing shoreline in Meydenbauer Bay, has a slightly higher potential to improve nearshore shading. However, even this reach lacks significant vegetation along the shoreline.	**Group R1: 2.0** **Group R2: 2.5** **Group R3: 2.5** **Group R4: 3.0** **Group R5: 1.8** **Group R6: 2.8** **Group R7: 3.3** **Group R8: 2.5**

LAKE WASHINGTON		
Function	**Performance**	**Score[1]**
	Park Reaches As discussed above, similar to residential areas, most of the City parks along Lake Washington lack significant shoreline vegetation that would act to provide temperature regulation along the lakeshore. Even so, given the overall size of the lake, the degree to which its shorefront lacks vegetation, and the low percentage of its overall surface area subject to potential shading from the shore, any vegetation likely does not have a measurable effect on lake water temperature. **Group P1 (Reaches 2,4,10, 12, 14, 17):** For the reasons listed above, these reaches rate moderate for temperature regulation functions. **Group P2 (Reach 19):** The Mercer Slough reach rates moderate/high for temperature regulation functions due to the high degree of vegetative cover and the importance of the Kelsey Creek input to the lake. Mercer Slough is on the 303d list for temperature. **Group P3 (Reach 24):** The shoreline associated wetland as well as the upland wetland in Newcastle Beach Park both provide extensive shading to the small stream which flows into Lake Washington. The south portion of this park is well vegetated to provide nearshore vegetation. For these reasons, this reach rates high for temperature regulation function.	**Group P1: 2.5** **Group P2: 3.8** **Group P3: 4.5**
	Water Dependent Reaches High percentages of impervious surface and limited nearshore vegetation provides little temperature regulation functions for Lake Washington. Per the factors used to evaluate temperature regulation (i.e. impervious surface, vegetative cover, exposure to sun, etc), both of the WD reaches rated low/moderate for this function. However, qualitative analysis of this area would indicate that a low rating is more appropriate.	**Group WD1: 1.7** **Group WD2: 1.8**

LAKE WASHINGTON		
Function	**Performance**	**Score[1]**
Vegetation Water quality improvement	**Residential Reaches** Residential areas are dominated by lawn and landscaping, but typically lack dense buffers of lakeside vegetation. As such, they are typically sources of water quality contaminants such as fertilizers, herbicides and pesticides. In Runoff from the urban impervious surfaces is typically not filtered through vegetation. In addition to the residential pollutants (fertilizers, herbicides, and pesticides), urban runoff carries hydrocarbons, metals, sediments and other pollutants from roads and parking lots. Most residential reaches rate low/moderate for water quality improvement functions as evaluated by factors of housing density, percent wetland, and percent vegetative cover. Minor variations are noted below. **Group R3 (Reaches 16, 18):** These two reaches are located along the shoreline just south of Beaux Arts and northwest of Mercer Slough. These areas rated moderate for water quality improvement due to slightly higher vegetative cover through the shoreline jurisdiction area. **Group R7 (Reach 21):** This reach contains a shoreline associated wetland along Coal Creek that has the potential to improve water quality of water flowing into Lake Washington and is thus rated moderate for this function.	**Group R1: 2.0** **Group R2: 2.0** **Group R3: 2.7** **Group R4: 2.0** **Group R5: 2.0** **Group R6: 1.7** **Group R7: 3.0** **Group R8: 2.0**

LAKE WASHINGTON		
Function	**Performance**	**Score[1]**
	Park Reaches Similar to the better residential reaches, most parks within the City's Lake Washington shoreline perform moderate water quality improvement functions. In general, these parks lack significant shoreline vegetation and have the potential to act as a source instead of a sink for fertilizers, herbicides, and pesticides. Conversely, other park areas containing grass lawn are potential sources for excess nutrients and chemicals which are considered a detriment to water quality. Variations within Reaches 19 and 24 are listed below. **Group P1 (Reaches 2,4,10, 12, 14, 17):** Rated as moderate for the reasons listed above. **Group P2 (Reach 19):** The wetland along Mercer Slough has the potential to provide exceptional water quality improvement functions. This area of the lake is generally lined by a mixture of shrubs and emergent vegetation. Dense vegetation increases travel time to the lake itself, allowing the vegetation to filter pollutants. This reach rates high for water quality improvement functions. **Group P3 (Reach 24):** Similar to Reach 19, the wetland within Newcastle Beach Park likely provides significant water quality improvement to lake inflow.	**Group P1: 2.7** **Group P2: 5.0** **Group P3: 4.7**
	Water Dependent Reaches Lack of shoreline vegetation, high degree of impervious surface, and high density of surrounding land use leads to low water quality improvement functions for these reaches.	**Group WD1: 1.0** **Group WD2: 1.3**

LAKE WASHINGTON		
Function	**Performance**	**Score[1]**
Vegetation Attenuating wave energy	**Residential Reaches** Prior to construction of the Locks and subsequent lowering of the lake elevation, the lake was ringed with emergent wetlands and mature mixed-forest communities. Those communities are now almost entirely absent in these reaches, so vegetation does not provide any significant wave attenuation function for most shoreline areas. As mentioned above, bulkheading and other shoreline modifications have replaced native vegetation and natural woody debris as the features in place to attenuate wave energy. The majority of reaches rate as low/moderate for wave attenuation. Exceptions are noted below. **Group R6 (Reach 7):** This reach along the east end of Meydenbauer Bay, contains a shoreline associated wetland along the immediate shoreline. Although this area does not typically receive heavy wave action, extensive amounts of aquatic vegetation likely attenuates wind or boat derived waves. This reach rates moderate/high for wave attenuation. **Group R7 (Reach 21):** Although this reach is more exposed to wind and boat derived waves than Reach 7, the shoreline vegetation (including shrub and emergent vegetation) acts in conjunction with shallow water to attenuate wave energy. For this reason, this reach also rates moderate/high for this function. **Group R8 (Reach 22):** Lake of any significant vegetation along this reach results in a low rating for this function.	**Group R1: 1.5** **Group R2: 1.8** **Group R3: 1.8** **Group R4: 2.5** **Group R5: 1.5** **Group R6: 3.5** **Group R7: 4.0** **Group R8: 1.0**

LAKE WASHINGTON		
Function	**Performance**	**Score[1]**
	Park Reaches **Group P1 (Reaches 2,4,10, 12, 14, 17):** The majority of parks within this group contain extensive shoreline armoring and have been cleared of significant shoreline vegetation and subsequently perform low/moderate wave attenuation function. The City is currently developing plans to modify several waterfront parks, including removing bulkheads where possible and restoring shoreline vegetative function. **Group P2 (Reach 19):** Vegetation along the mouth of Mercer Slough is extensive. Conversely, the mouth of Mercer Slough is located at the end of a long wave fetch which extends up the east channel. For these reasons, Mercer Slough performs a moderate/high wave attenuation function. **Group P3 (Reach 24):** Although Newcastle Beach Park contains a large swimming beach with concrete bulkhead and fixed-pile pier, the exposure of the natural vegetated shoreline faces south, where the existing vegetation acts to attenuate wave energy. This reach rates moderate/high for this function.	**Group P1: 2.0** **Group P2: 3.5** **Group P3: 4.3**
	Water Dependent Reaches Neither of these reaches contains shoreline vegetation that would act to attenuate wave energy and thus rate as low for this function.	**Group WD1: 1.0** **Group WD2: 1.0**
Vegetation Sediment removal and bank stabilization	**Residential Reaches** Under natural conditions, there would be an ongoing, underlying rate of shoreline erosion, which would contribute to maintaining substrate conditions. Instead, the lake shore around most of the lake now has little shoreline vegetation and a significant proportion of it is armored. While this "stabilizes" the banks, it also limits natural recruitment of lakebed materials. Most reaches rate between low and moderate for this function. The only two exceptions are Reach 7 and 21 which each rate high due to lack of shoreline armoring, presence of associated wetlands, and percent vegetated area.	**Group R1: 1.5** **Group R2: 1.6** **Group R3: 1.9** **Group R4: 2.8** **Group R5: 1.2** **Group R6: 4.5** **Group R7: 4.7** **Group R8: 1.0**

LAKE WASHINGTON		
Function	**Performance**	**Score[1]**
	Park Reaches **Group P1 (Reaches 2,4,10, 12, 14, 17):** Similar to most residential reaches, park areas within Group P1 are heavily armored and typically lack natural shoreline vegetation which, under undeveloped conditions, would act to buffer the shoreline by removing sediments and contaminants as well as stabilize the banks. **Group P2 (Reach 19):** The mouth of Mercer Slough is likely the most natural Lake Washington shoreline in the City. This area contains natural shoreline vegetation that provides both stability and potential removal of sediment and contaminants. **Group P3 (Reach 24):** As noted in sections above, the vegetation along the south shoreline of Newcastle Beach Park, including the associated wetland, provides a moderate/high level of stability and sediment removal function for this and adjacent shorelines.	**Group P1: 2.0** **Group P2: 3.8** **Group P3: 4.1**
	Water Dependent Reaches These reaches do not contain shoreline vegetation that would act to remove sediment and provide bank stabilization. These areas have extensive shoreline armoring associated with the marinas and yacht club uses. They subsequently rate low for this function.	**Group WD1: 1.0** **Group WD2: 1.0**
Vegetation LWD and organic matter recruitment	**Residential Reaches** Again, the loss of natural, forested shoreline vegetation and its replacement primarily with lawn and other types of landscaping has nearly eliminated large woody debris and organic matter recruitment potential along the lake shore. Any trees or large woody debris that do enter the lake are likely to be quickly removed out of concern for safety or to reduce the risk of property damage. Most reaches rate low to low/moderate with the exception of Reaches 7 and 21, which rate moderate and moderate high, respectively.	**Group R1: 1.5** **Group R2: 2.0** **Group R3: 2.0** **Group R4: 1.5** **Group R5: 1.5** **Group R6: 3.0** **Group R7: 3.5** **Group R8: 1.0**

LAKE WASHINGTON		
Function	**Performance**	**Score[1]**
	Park Reaches **Group P1 (Reaches 2,4,10, 12, 14, 17):** In general, shoreline parks within Group P1 contain only a minor amount of shoreline vegetation and thus have only a slight opportunity to supply LWD and organic matter to the lake. As with the residential reaches, any trees or woody debris that does enter the lake on park property would likely be removed from the immediate shoreline area. **Group P2 (Reach 19):** Extensive amount of LWD and organic matter is available throughout the mouth of Mercer Slough. This is the last remaining natural shoreline within the City's Lake Washington jurisdiction. The lack of large trees is the only limiting factor and thus this reach rates moderate/high for this function. **Group P3 (Reach 24):** The south shoreline of this reach contains mature trees which have the ability to contribute LWD to Lake Washington. Several fallen trees are often located along the shoreline and can be mobile during periods of high water. This reach is rated as moderate/high for this function.	**Group P1: 2.5** **Group P2: 3.5** **Group P3: 4.0**
	Water Dependent Reaches Neither of these reaches contains shoreline vegetation that would provide LWD or significant organic matter and thus rate as low/moderate for this function.	**Group WD1: 1.5** **Group WD2: 1.5**
Hyporheic Removing excess nutrients and toxic compounds	**Residential Reaches** The hyporheic zone along most of the City's Lake Washington shoreline is more restricted by fairly extensive shoreline armoring, but likely does provide some nutrient and toxic compound removal for water which infiltrates into the hyporheic zone instead of running off to enter the lake directly as surface flow. Slight variations between the residential reaches exist due to differences between the amount of impervious surface, percent steep slopes and vegetative cover. All of which relate to the ability of surface water to infiltrate into the soil, allowing the removal of excess nutrients and toxic compounds. Most reaches rated low/moderate to moderate for this function.	**Group R1: 1.7** **Group R2: 2.0** **Group R3: 2.3** **Group R4: 2.7** **Group R5: 1.7** **Group R6: 2.7** **Group R7: 3.3** **Group R8: 1.5**

LAKE WASHINGTON		
Function	**Performance**	**Score[1]**
	Park Reaches **Group P1 (Reaches 2,4,10, 12, 14, 17):** In general, most parks rate slightly higher than the City's residential areas for this function due to the greater amount of open space and vegetative cover, which allows surface water to infiltrate into the soil and to the hyporheic zone. **Group P2 (Reach 19):** Throughout the more natural sections of lakeshore present in Reaches 19 and 24, this function is accentuated. In Mercer Slough, water transport is slowed due to low stream gradient, allowing water to infiltrate into the hyporheic zone throughout the associated wetland. **Group P3 (Reach 24):** Similar to Group P1, this reach has a large open space in which surface water is allowed to infiltrate to the hyporheic zone. The sand and silt soils in this area are conducive to allowing water to infiltrate rapidly. This area rates high for this function.	**Group P1: 2.7** **Group P2: 4.3** **Group P3: 4.7**
	Water Dependent Reaches Given the extent of impervious surface and lack of available soil to allow for infiltration, both of these reaches rate low for removal of excess nutrients and toxic compounds. Both locations are more likely a source of toxic compounds rather than a sink.	**Group WD1: 1.0** **Group WD2: 1.0**
Hyporheic Water storage	**Residential Reaches** The hyporheic zone is restricted by shoreline armoring, although the water storage function is not of particularly high importance in a lake with a high average retention time (low flow-through) and relatively low fluctuations in water surface elevation that is controlled by the U.S. Army Corps of Engineers. Slight variations within the Residential reaches can be found between levels of shoreline armoring, vegetative cover, and soil infiltration potential. Regardless, most reaches rated low/moderate to moderate for this function.	**Group R1: 1.6** **Group R2: 2.4** **Group R3: 2.4** **Group R4: 2.6** **Group R5: 1.8** **Group R6: 2.8** **Group R7: 3.4** **Group R8: 1.0**

LAKE WASHINGTON		
Function	**Performance**	**Score[1]**
	Park Reaches As mentioned above, the water storage function is not of particularly high importance in a lake with a high average retention time and regulated water surface elevation. However, the hyporheic water storage capacity for the park areas, specifically those with less shoreline armoring, large vegetated open spaces and permeable soils should be higher.	**Group P1: 2.2** **Group P2: 4.6** **Group P3: 4.8**
	Water Dependent Reaches **Group WD1 (Reach 6):** With a large percentage of this reach as impervious surface and shoreline armoring at the water's edge, this area rates low for this water storage function. **Group WD2 (Reach 20):** Although this reach has a high degree of impervious surface and shoreline armoring similar to Reach 6, the connectivity to the associated wetland located east of Newport Yacht Club has the potential to contribute to some water storage within this reach.	**Group WD1: 1.0** **Group WD2: 1.5**
Hyporheic Support of vegetation	**Residential Reaches** The hyporheic zone likely supports hydrology that in turn supports near-shore wetland and riparian vegetation. The functioning of the hyporheic zone in terms of supplying water to vegetation is increased substantially due to the lake level being held artificially high by the Army Corps of Engineers at the Ballard locks during the summer growing season. Areas with gentle lakeshore sloping increases the extent of areas where the roots of vegetation would be within range of the hyporheic zone. Along most of the residential reaches, much of the shoreline zone within range of the hyporheic zone is vegetated with lawn and other landscaping, which is not generally supported by hyporheic water storage, but instead, by irrigation or precipitation. For these reasons the residential reaches rate low to low/moderate for this function.	**Group R1: 1.5** **Group R2: 2.5** **Group R3: 2.0** **Group R4: 1.5** **Group R5: 1.5** **Group R6: 1.0** **Group R7: 2.0** **Group R8: 1.0**

LAKE WASHINGTON		
Function	**Performance**	**Score[1]**
	Park Reaches As noted above, lake hydrology that could support vegetation through the hyporheic zone is broken by shoreline armoring. **Group P1 (Reaches 2,4,10, 12, 14, 17):** Most of the parks within Group P1 are heavily armored and lack significant shoreline vegetation that could potentially be supported by hyporheic hydrology. **Group P2 (Reach 19) and Group P3 (Reach 24):** Both of these reaches have minimal to no shoreline armoring and excellent shoreline vegetation that is connected to the lake's hyporheic zone.	**Group P1: 2.5** **Group P2: 4.5** **Group P3: 4.5**
	Water Dependent Reaches **Group WD1 (Reach 6):** This reach is nearly completely disconnected to the lake's hyporheic zone by heavy shoreline armoring and impervious surfaces. **Group WD2 (Reach 20):** Similar to Reach 6, Reach 20 also has extensive shoreline armoring and impervious surfaces which restrict available hydrology to shoreline vegetation.	**Group WD1: 1.0** **Group WD2: 1.0**
Hyporheic Sediment storage and maintenance of base flows	**Residential Reaches** While no data is available about the characteristics of the Lake Washington hyporheic zone, it is believed that sediment storage is likely occurring along areas which both lack shoreline armoring and have the soil characteristics to allow sediment storage (i.e. interstitial spaces). Sediment storage and maintenance of base flows (lake level) are somewhat in conflict, since the more the interstitial spaces in the soils are filled with sediment, the less space is available for the storage of water. However, neither sediment composition/storage nor base flows are particularly important in Lake Washington. In nearly all reaches, with the exception of Reaches 7 (Group 6) and 21 (Group 7), the hyporheic zone is restricted by extensive shoreline armoring and rates low for sediment storage and maintaining base flow functions.	**Group R1: 1.0** **Group R2: 1.0** **Group R3: 1.0** **Group R4: 1.0** **Group R5: 1.0** **Group R6: 3.0** **Group R7: 4.5** **Group R8: 1.0**

LAKE WASHINGTON		
Function	**Performance**	**Score[1]**
	Park Reaches **Group P1 (Reaches 2,4,10, 12, 14, 17):** As with the residential reaches, the hyporheic zone is restricted by extensive shoreline armoring, which limits movement of fines from the lake into the hyporheic zone. **Group P2 (Reach 19):** While this reach contains only a very limited amount of shoreline armoring, the soil capacity of muck soils does not allow for significant sediment storage within the hyporheic zone of this reach. **Group P3 (Reach 24):** Lake of significant shoreline armoring in conjunction with soil capacity results in a moderate/high rating for this reach.	**Group P1: 2.0** **Group P2: 2.5** **Group P3: 4.0**
	Water Dependent Reaches Both of these reaches rate low for sediment storage due to the extensive shoreline armoring which is present.	**Group WD1: 1.0** **Group WD2: 1.0**

LAKE WASHINGTON		
Function	**Performance**	**Score[1]**
Habitat Physical space and conditions for life history	**Residential Reaches** Under natural conditions, the lake bottom would gradually rise in a shallow wedge such that incoming waves would roll up the bottom, losing energy. This reduced energy environment would be more hospitable to emergent vegetation, which further attenuates wave energy, providing a refuge for small fish and amphibians. Shallow nearshore areas in Lake Washington provide critical rearing, foraging and migration habitat for fish, particularly salmonids. Shoreline armoring, however, generally eliminates the low-energy shallow-water environment, creating a deeper, turbulent nearshore that is inhospitable to small fish and amphibians, as well as to emergent vegetation. Shoreline armoring can also reduce upwelling/downwelling areas, which are optimal for sockeye salmon spawning. The deeper water also allows larger fish predators to prey on the small fish. Aquatic mammals, like muskrats, seem to have adapted to the armored shoreline, and still find den sites in the looser boulder bulkheads. The absence of dense shoreline vegetation is a limiting factor in terrestrial species (birds, mammals, amphibians) use of the shoreline, since cover, food, nesting sites, travel corridors, etc. are absent. Most of the residential reaches rate low/moderate with the exceptions noted below: **Group R7 (Reach 21):** This reach rated slightly higher than the others (moderate) due to its location at the mouth of Coal Creek with a fairly well vegetated upland and shallow nearshore environment. **Group R8 (Reach 22):** This reach rated as low functioning for providing conditions that could potentially contribute to fish and wildlife habitat. Shoreline armoring, deep channels, lack of vegetation, etc. are all factors which limit this reaches ability to provide quality habitat.	**Group R1:1.6** **Group R2: 2.0** **Group R3: 2.0** **Group R4: 1.5** **Group R5: 1.7** **Group R6: 2.4** **Group R7: 2.9** **Group R8: 1.2**

LAKE WASHINGTON		
Function	**Performance**	**Score[1]**
	Park Reaches **Group P1 (Reaches 2,4,10, 12, 14, 17):** Park areas within this reach provide a moderate level of physical space for terrestrial wildlife, having large open spaces, forest fragments, and reduced impervious surfaces compared to the residential reaches. However, given the extent of shoreline armoring, lack of nearshore vegetation and limited wetlands, the nearshore aquatic environment does not function as it did historically. **Group P2 (Reach 19):** The shore along Mercer Slough is typically lined with native wetland and upland vegetation. This dense shoreline vegetation is beneficial for terrestrial species' (birds, mammals, amphibians) and increases their use of the shoreline since cover, food, nesting sites, travel corridors, etc. are more available. Shallow nearshore areas include both emergent and some submerged vegetation, which attenuates wave energy and provides a refuge for small fish and amphibians. These shallow nearshore areas provide rearing, foraging and migration habitat for fish. Maturing shoreline vegetation provides large organic debris recruitment to the lake to a moderate degree, which should increase over time as the tree/shrub cover continues to mature. Much of this reach also includes excellent shallow-water habitat, including sandy areas preferred by juvenile chinook, and complex areas with a lot of vegetative and woody structure for other fish and aquatic life. **Group P3 (Reach 24):** The shoreline associated wetland and natural shoreline conditions along the south shoreline of Newcastle Beach Park creates a moderate/high habitat function for terrestrial and aquatic organisms.	**Group P1: 2.6** **Group P2: 4.2** **Group P3: 4.2**
	Water Dependent Reaches **Group WD1 (Reach 6):** Similar to previous discussions, this reach in Meydenbauer Bay is heavily armored with high degree of impervious surface. This reach rates low for physical habitat space. **Group WD2 (Reach 20):** While this reach also is heavily armored, it rates slightly better than Reach 6 due to the proximity to associated wetlands located east of Newport Yacht Basin.	**Group WD1: 1.1** **Group WD2: 1.4**

LAKE WASHINGTON		
Function	**Performance**	**Score[1]**
Habitat Food production and delivery	**Residential Reaches** Food production from the uplands is limited by the lack of native seed- and fruit-bearing vegetation. This may be made up for, in part, by fruit trees and other non-native vegetation in yards which supplies some food for wildlife. The historical emergent wetland areas that are now reduced or absent, in part due to the lowering of the lake level as well as from development, also provided productive foraging areas for small mammals, wading birds and waterfowl. With the exception of Reach 21 (R7), which rated as moderate, the residential reaches generally rated as low/moderate for food delivery and production.	**Group R1: 1.5** **Group R2: 1.8** **Group R3: 1.9** **Group R4: 1.5** **Group R5: 1.6** **Group R6: 1.9** **Group R7: 2.8** **Group R8: 1.3**
	Park Reaches **Group P1 (Reaches 2,4,10, 12, 14, 17):** Generally, the parks within this group have a low/moderate ability to supply food sources for terrestrial and aquatic wildlife. Lack of large forested areas and/or aquatic emergent/overhanging vegetation has reduced the ability for these park areas to provide these resources at a higher level. **Group P2 (Reach 19):** The mouth of Mercer Slough provides a moderate/high level of food production and transport. Mercer Slough brings nutrients down from Kelsey Creek and its associated tributaries and outfalls into Lake Washington in one of the more natural settings on the lake. **Group P3 (Reach 24):** Although fish use along this shoreline area and within the associated stream has not been extensively documented, recent Lake Washington studies have shown the importance of small tributary streams to rearing of chinook salmon. The small stream flowing through Newcastle Beach Park may be a quality food source for salmonids during their outmigration to Puget Sound. This reach rates high for food production and delivery functions.	**Group P1: 2.4** **Group P2: 4.3** **Group P3: 4.5**

LAKE WASHINGTON

Function	Performance	Score[1]
	Water Dependent Reaches **Group WD1 (Reach 6):** This reach contains very limited vegetative cover and thus lacks the ability to provide significant food sources. As well, the reach is also limited in its ability to deliver food resources from other areas such as streams and wetlands due to its location within an urban environment. **Group WD2 (Reach 20):** Although similar conditions (i.e extensive nearshore armoring and impervious surfaces) exist within Reach 20 as is found within Reach 6, this reach is adjacent to a large associated wetland that has some potential to provide a moderate level of food production. However, delivery of any food resources is minimized due to the disconnect of developed upland areas between the wetland and the lake.	**Group WD1: 1.4** **Group WD2: 1.6**

Reach Group	Average Hydrologic Score	Average Vegetation Score	Average Hyporheic Score	Average Habitat Score	Average TOTAL Score
Group R1	**1.7**	**1.7**	**1.4**	**1.6**	**1.6 = Low/Moderate**
Group R2	**2.0**	**2.0**	**2.0**	**1.9**	**2.0 = Low/Moderate**
Group R3	**2.2**	**2.2**	**1.9**	**2.0**	**2.1 = Low/Moderate**
Group R4	**2.3**	**2.4**	**1.9**	**1.5**	**2.0 = Low/Moderate**
Group R5	**1.6**	**1.6**	**1.5**	**1.6**	**1.6 = Low/Moderate**
Group R6	**2.5**	**3.1**	**2.2**	**2.2**	**2.5 = Moderate**
Group R7	**3.2**	**3.7**	**3.3**	**2.8**	**3.3 = Moderate**
Group R8	**1.9**	**1.5**	**1.1**	**1.2**	**1.4 = Low**
Group P1	**2.4**	**2.3**	**2.3**	**2.5**	**2.4 = Low/Moderate**
Group P2	**3.9**	**3.9**	**3.8**	**4.3**	**4.0 = Moderate/High**
Group P3	**4.5**	**4.3**	**4.5**	**4.4**	**4.4 = Moderate/High**
Group WD1	**2.1**	**1.2**	**1.0**	**1.3**	**1.4 = Low**
Group WD2	**1.8**	**1.3**	**1.1**	**1.5**	**1.4 = Low**

[1] Low = 1, Low/Moderate = 2, Moderate = 3, Moderate/High = 4, High = 5

Table 29. Function Summary of Bellevue's Kelsey Creek and Mercer Slough Shoreline

KELSEY CREEK / MERCER SLOUGH		
Function	**Performance**	**Score[1]**
Hydrologic Storing water and sediment	**Reach 29 (Mercer Slough Nature Park):** HIGH. The majority of this reach is high-quality wetland with low impervious surface, excellent water storage capability and vegetation communities that provide sediment-trapping functions. Floodplain connectivity of the creek and the generally flat topography also enables storage and attenuation of flood flows and trapping and storage of fine sediments in the wetland floodplain. These fine sediments are incorporated into the floodplain topsoil to nourish vegetative growth, in turn supporting wildlife habitat. Wetland and floodplain regulations have helped to keep the reach undeveloped, and thus able to better carry out this function. The sediment storage function of this reach is particularly important as it prevents creation of a delta at the mouth of the creek that might interfere with fish passage into the stream at low lake. **Reach 30 (Bellefield Office Complex):** MODERATE. This reach has a high impervious surface percentage offset by numerous wetlands. However, the wetlands are disjointed and are likely separated from the stream even during flood events. **Reach 31 (Lower Kelsey Creek):** MODERATE. Sediment and water storage potentials are reduced compared to downstream Reach 29 by increased steep slopes and higher impervious area. The wetland complexes, while somewhat disconnected from the stream by roadways, still provide valuable water and sediment storage functions. **Reach 32 (Sturtevant Wetland):** HIGH. Although this reach ranked high, its actual potential to store water and sediment is limited by the volume of water that can pass from Mercer Slough into the wetland via a low-gradient culvert.	**Reach 29: 4.7** **Reach 30: 3.0** **Reach 31: 3.3** **Reach 32: 5.0**

KELSEY CREEK / MERCER SLOUGH		
Function	**Performance**	**Score[1]**
Hydrologic Transport of water and sediment	The Mercer Slough/Kelsey Creek shoreline is naturally a low-velocity, depositional area due to the landscape position of the waterbody in the watershed. Although function scores for each reach are low, these scores are expected and appropriate for this system. **Reach 29 (Mercer Slough Nature Park):** LOW. As explained above, sediment and water transport functions are low. **Reach 30 (Bellefield Office Complex):** LOW. This reach likely has slightly lower transport capabilities than the other reaches because of the probable reduced velocities in the side-channel and the sharp bend at the downstream end of the reach – more sediment will be deposited at lower velocities. **Reach 31 (Lower Kelsey Creek):** LOW. The slightly higher stream gradients in this reach increase the flow velocities and the sediment carrying capacity. **Reach 32 (Sturtevant Wetland):** NA.	**Reach 29: 1.1** **Reach 30: 1.2** **Reach 31: 1.2** **Reach 32: (NA)**
Hydrologic Attenuating flow energy	**Reach 29 (Mercer Slough Nature Park):** HIGH. As mentioned above, some sections of broad wetlands and floodplain remain. These are effective at attenuating stream flow energy during flood events. Streamside and wetland willows, dense reed canarygrass, scattered woody debris, and low gradient also dissipate flow energy. **Reach 30 (Bellefield Office Complex):** MODERATE/HIGH. The shallow waters, numerous stream bends, and aquatic vegetation likely reduce flow energy substantially through this branch of the creek. **Reach 31 (Lower Kelsey Creek):** MODERATE/HIGH. The slightly higher stream gradients in this reach increase the flow velocities, but this may be offset by higher presence of large woody debris, larger trees along the stream bank, and riffles and other channel-roughening features that may absorb stream energy. **Reach 32 (Sturtevant Wetland):** HIGH. During high flow events, diversion of stream flow into this wetland through a culvert likely contributes to some reduced flow velocity in the main channel. However, the scoring model likely overestimates its importance.	**Reach 29: 4.8** **Reach 30: 4.3** **Reach 31: 4.2** **Reach 32: 5.0 (NA)**
Hydrologic Developing pools, riffles, and gravel bars	This naturally depositional, low-gradient area has limited riffle and gravel bar development. The primary habitat is long runs that provide rearing and migration habitat, rather than spawning habitat. **Reach 29 (Mercer Slough Nature Park):** HIGH. Riffles and gravel bars are virtually non-existent, but pool/run habitat is abundant. Large and small woody debris enhance pool function and value. **Reach 30 (Bellefield Office Complex):** MODERATE. Again, pool/run habitat is dominant, with fewer pieces of wood.	**Reach 29: 4.5** **Reach 30: 3.2** **Reach 31: 3.5** **Reach 32: 5.0 (NA)**

KELSEY CREEK / MERCER SLOUGH		
Function	**Performance**	**Score[1]**
	Reach 31 (Lower Kelsey Creek): MODERATE/HIGH. This reach, because of its slightly higher stream gradient and stream flow, includes patches of riffles and gravel bars, suitable for salmon spawning. **Reach 32 (Sturtevant Wetland):** NA	
Hydrologic Removing excess nutrients and toxic compounds	**Reach 29 (Mercer Slough Nature Park):** MODERATE/HIGH. The broad wetland/floodplain areas provide a competent biofiltration function. Only a few stormwater outfalls draining developed areas enter this reach without some initial treatment. **Reach 30 (Bellefield Office Complex):** MODERATE. Stormwater outfalls and the office complex, including a lot of parking area, may be significant sources of pollutants (hydrocarbons, metals) to this reach. The interspersed wetlands likely provide some biofiltration of pollutants. **Reach 31 (Lower Kelsey Creek):** MODERATE/HIGH. Substantial wetland areas located in Reach 31 provide some biofiltration of pollutants entering the system from numerous stormwater outfalls or through high stream flows. **Reach 32 (Sturtevant Wetland):** MODERATE/HIGH. Although this reach ranked high, its actual potential to remove excess nutrients and toxic compounds is limited by the volume of water that can pass from Mercer Slough into the wetland via a low-gradient culvert.	**Reach 29: 4.4** **Reach 30: 2.5** **Reach 31: 3.8** **Reach 32: 3.9**

KELSEY CREEK / MERCER SLOUGH		
Function	**Performance**	**Score[1]**
Hydrologic Recruitment and transport of LWD and other organic material	Streambank forest vegetation, particularly large coniferous trees, is moderate in much of the reach, due to natural constraints such as wetland hydrology. However, virtually the entire reach is vegetated and the stream is lined in most areas by dense deciduous thickets. Flood flows likely recruit and transport abundant small woody debris and organic material. As explained above, the landscape position of the stream and the flat topography generates a lower-energy system that limits the ability of even high flows to recruit large trees. **Reach 29 (Mercer Slough Nature Park):** HIGH. This reach has high recruitment and transport potential as a result of its low level of development, lack of confinement, and greater floodplain connectivity relative to the other reaches. **Reach 30 (Bellefield Office Complex):** MODERATE: Channel migration potential is highly curtailed in this reach by the office developments and adjacent roadway. **Reach 31 (Lower Kelsey Creek):** MODERATE/HIGH. This reach, although rating lower than Reach 29, is actually slightly higher in energy and may have higher recruitment ability. This is limited by the higher percentage of developed area, including the I-405 overpass complex and other roadways. **Reach 32 (Sturtevant Wetland):** LOW/MODERATE. Although LWD is unlikely to pass from the wetland to Mercer Slough, small organic material may be carried with draining floodwaters from the wetland into the stream.	**Reach 29: 4.5** **Reach 30: 3.3** **Reach 31: 3.8** **Reach 32: 2.0**
Vegetation Temperature regulation	**Reach 29 (Mercer Slough Nature Park):** MODERATE/HIGH. The relatively broach channel is only sparsely shaded by adjacent vegetation. This reach is on Ecology's 303(d) list for water temperature impairment. **Reach 30 (Bellefield Office Complex):** MODERATE. Similar to Reach 29, shading by vegetation does very little to reduce water temperatures. **Reach 31 (Lower Kelsey Creek):** MODERATE. This reach contains a narrower channel that is better shaded by the larger riparian vegetation. **Reach 32 (Sturtevant Wetland):** NA	**Reach 29: 4.3** **Reach 30: 2.8** **Reach 31: 3.3** **Reach 32: (NA)**
Vegetation Water quality improvement	**Reach 29 (Mercer Slough Nature Park):** HIGH. The broad wetland/floodplain areas provide a competent biofiltration function. **Reach 30 (Bellefield Office Complex):** MODERATE. Although this reach rated only moderate for water quality improvement, the wetlands and riparian area have greater opportunity to perform this function because of their connectivity to the developed areas which are sources of pollutants. **Reach 31 (Lower Kelsey Creek):** HIGH. Substantial wetland areas located in Reach 31 provide some biofiltration of pollutants entering the system from numerous	**Reach 29: 5.0** **Reach 30: 3.0** **Reach 31: 4.6** **Reach 32: 4.4**

KELSEY CREEK / MERCER SLOUGH		
Function	**Performance**	**Score[1]**
	stormwater outfalls or through high stream flows. **Reach 32 (Sturtevant Wetland):** MODERATE/HIGH. The vegetation in this reach has high potential for removing excess nutrients and toxic compounds. However, this is limited by the volume of water that can pass from Mercer Slough into the wetland via a low-gradient culvert.	
Vegetation Slowing riverbank erosion; bank stabilization	**Reach 29 (Mercer Slough Nature Park):** HIGH. The dense grasses and shrubby vegetation such as willows that line much of the banks are fairly effective at stabilizing soils and slowing the rate of erosion. **Reach 30 (Bellefield Office Complex):** MODERATE. The banks are stable in this reach, although this is likely due more to low stream energy and channel form than dense streamside vegetation. **Reach 31 (Lower Kelsey Creek):** MODERATE/HIGH. This reach has the highest percentage of large trees along the stream bank, which provide valuable bank stabilization. **Reach 32 (Sturtevant Wetland):** NA	**Reach 29: 4.7** **Reach 30: 3.0** **Reach 31: 3.7** **Reach 32: NA**
Vegetation Attenuation of flow energy	**Reach 29 (Mercer Slough Nature Park):** HIGH. As mentioned above, some sections of broad wetlands and floodplain remain. These are effective at attenuating stream flow energy during flood events. Streamside and wetland willows, dense reed canarygrass, scattered woody debris, and low gradient also dissipate flow energy. **Reach 30 (Bellefield Office Complex):** MODERATE/HIGH. The shallow waters, numerous stream bends, and aquatic vegetation likely reduce flow energy substantially through this branch of the creek. **Reach 31 (Lower Kelsey Creek):** MODERATE. The slightly higher stream gradients in this reach increase the flow velocities, but this may be offset by higher presence of large woody debris, larger trees along the stream bank, and riffles and other channel-roughening features that may absorb stream energy. **Reach 32 (Sturtevant Wetland):** HIGH. This reach indirectly absorbs some of the flow energy when flood flows enter the wetland system via the culvert and are stored there at least temporarily.	**Reach 29: 5.0** **Reach 30: 4.3** **Reach 31: 4.3** **Reach 32: 5.0**
Vegetation Sediment removal	**Reach 29 (Mercer Slough Nature Park):** HIGH. The majority of this reach is high-quality wetland with low impervious surface, excellent water storage capability and vegetation communities that provide sediment-trapping functions. Floodplain connectivity of the creek and the generally flat topography also enables storage and attenuation of flood flows and trapping and storage of fine sediments in the wetland floodplain. The sediment removal function of this reach is particularly important as it	**Reach 29: 5.0** **Reach 30: 4.3** **Reach 31: 4.3**

KELSEY CREEK / MERCER SLOUGH		
Function	**Performance**	**Score[1]**
	prevents creation of a delta at the mouth of the creek that might interfere with fish passage into the stream at low lake. **Reach 30 (Bellefield Office Complex):** MODERATE/HIGH. Significant sediment removal is likely limited to the right bank of the side-channel by the dense. Wetlands in the office park are disconnected from stream flow even during flood events, and thus have little opportunity to capture sediment. **Reach 31 (Lower Kelsey Creek):** MODERATE/HIGH. Sediment removal potential is reduced compared to downstream Reach 29 by increased steep slopes and narrower floodplain. The wetland complexes, while somewhat disconnected from the stream by roadways, still provide valuable sediment removal functions for any sediments that would otherwise reach the stream through uplands. **Reach 32 (Sturtevant Wetland):** HIGH. Although this reach ranked high, its actual potential to remove sediment is limited by the volume of water that can pass from Mercer Slough into the wetland during flood flows via a low-gradient culvert.	**Reach 32: 5.0**
Vegetation Provision of LWD and organic matter	Streambank forest vegetation, particularly large coniferous trees, is moderate in much of the reach, due to natural constraints such as wetland hydrology. However, virtually the entire reach is vegetated and the stream is lined in most areas by dense deciduous thickets. Flood flows likely recruit and transport abundant small woody debris and organic material. As explained above, the landscape position of the stream and the flat topography generates a lower-energy system that limits the ability of even high flows to recruit large trees. **Reach 29 (Mercer Slough Nature Park):** HIGH. The organic matter contribution of this reach is very high because of its low level of development, lack of confinement, and dense vegetated wetlands. However, the percentage of conifers, which provide the highest value LWD, is very low. **Reach 30 (Bellefield Office Complex):** MODERATE/HIGH. Most of the large trees are located within the developed office complex, which limits their potential to provide LWD and organic matter to the streams. The narrow riparian fringe does provide smaller woody debris and abundant organic matter, as well as the in-stream aquatic vegetation. **Reach 31 (Lower Kelsey Creek):** MODERATE/HIGH. This reach has the greatest actual potential to provide LWD to the stream system because of its higher percentage of large conifers close to the stream. **Reach 32 (Sturtevant Wetland):** MODERATE/HIGH. Although LWD is unlikely to pass from the wetland to Mercer Slough via the culvert, smaller organic material may	**Reach 29: 4.7** **Reach 30: 3.7** **Reach 31: 4.0** **Reach 32: 3.7**

KELSEY CREEK / MERCER SLOUGH		
Function	**Performance**	**Score[1]**
	be carried with draining floodwaters from the wetland into the stream.	
Hyporheic Removing excess nutrients and toxic compounds	**Reach 29 (Mercer Slough Nature Park):** HIGH. Sub-surface soils and biological agents in the extensive associated wetland areas and below the streambed are high-functioning for removal of excess nutrients and toxic compounds that may otherwise enter the system from the highly developed basin. **Reach 30 (Bellefield Office Complex):** MODERATE. The functioning of the adjacent hyporheic zone in this reach is compromised by the inputs of pollutants into it from potentially contaminated impervious surface runoff. **Reach 31 (Lower Kelsey Creek):** MODERATE/HIGH. **Reach 32 (Sturtevant Wetland):** MODERATE/HIGH. This wetland is actually part of and interacting with the Sturtevant Creek hyporheic zone. Sub-surface soils and biological agents in the wetland are high-functioning for removal of excess nutrients and toxic compounds that may otherwise enter the system from the highly developed basin.	**Reach 29: 4.9** **Reach 30: 3.3** **Reach 31: 4.0** **Reach 32: 4.3**
Hyporheic Water storage and maintenance of base flows	The entire Mercer Slough/Kelsey Creek wetland complex is likely critical to maintenance of summer base flows, in particular because of the lower temperatures of this source which may help moderate the high summer water temperatures. It is difficult to delineate without special study, however, where the hyporheic zone ends and the groundwater table begins. **Reach 29 (Mercer Slough Nature Park):** HIGH. The hyporheic zone is likely quite wide and potentially fairly deep in this reach, with high water storage capacity. **Reach 30 (Bellefield Office Complex) and Reach 31 (Lower Kelsey Creek):** MODERATE/HIGH. Modifications in the system that may have reduced the capacity of the system to store water include deep fills associated with I-405, other major roadways, and the office park. **Reach 32 (Sturtevant Wetland):** HIGH. This reach likely supports summer base flows at the downstream end of Sturtevant Creek and less directly Mercer Slough/Kelsey Creek.	**Reach 29: 4.8** **Reach 30: 3.8** **Reach 31: 4.0** **Reach 32: 4.8**
Hyporheic Support of vegetation	There is more than adequate water present in the hyporheic/groundwater zone to support wetland and riparian vegetation in all reaches. The hyporheic/groundwater zone has largely determined the type of vegetation communities present in all reaches.	**Reach 29: 4.6** **Reach 30: 3.9** **Reach 31: 3.7**

KELSEY CREEK / MERCER SLOUGH		
Function	**Performance**	**Score[1]**
		Reach 32: 3.6
Hyporheic Sediment storage	The soil types in the shorelands adjacent to the stream system are too fine to provide much sediment storage, although flood flows likely deposit stream sediments on the surface. However, in-channel sediment storage is very high in these slow-moving, depositional reaches.	**Reach 29: 5.0** **Reach 30: 5.0** **Reach 31: 4.7** **Reach 32: 4.7**
Habitat Physical space and conditions for life history	All reaches provide important in-stream migration and rearing habitat for fish, particularly in Reaches 29 and 31 which have abundant overhanging vegetation and moderate large woody debris. Reach 31 also has some alternating pool-riffle sequences, but these are not considered significant for salmonids. **Reach 29 (Mercer Slough Nature Park):** HIGH. This reach, with its mix of wetland types and the stream itself, provides important high-functioning local habitat for breeding, migrating, and foraging birds, amphibians, and mammals. Although the reach is flanked by major roads to the east and west, and an office park to the north, the area is large enough and disturbance levels low enough that many species have ample space and conditions to carry out one or more necessary life cycle stages. **Reach 30 (Bellefield Office Complex):** MODERATE/HIGH. This reach is highly fragmented by the office park development, limiting its potential to provide suitable habitat for many species. **Reach 31 (Lower Kelsey Creek):** HIGH. Although Reach 31 has a high percentage of forested wetland habitat, it is affected more than Reach 29 by the I-405 corridor and is fragmented by other major roadways. **Reach 32 (Sturtevant Wetland):** HIGH. The Sturtevant Creek wetland, although surrounded by development, still provides important breeding and foraging habitat for birds and amphibians.	**Reach 29: 5.0** **Reach 30: 4.0** **Reach 31: 4.7** **Reach 32: 4.7**
Habitat Food production and delivery	The native (and some non-native) vegetation components of the associated wetlands in each reach provide sources of seeds, berries, and other edible plant parts eaten by birds and small mammals. Insect production in the wetlands is likely quite high, providing additional food for insect-eating birds and amphibians. In-stream invertebrates are also an abundant food source for fish and birds. **Reach 29 (Mercer Slough Nature Park):** HIGH. Food production in this reach is very high, and includes non-native berries such as blueberries.	**Reach 29: 4.8** **Reach 30: 3.6** **Reach 31: 4.2**

KELSEY CREEK / MERCER SLOUGH

Function	Performance	Score[1]
	Reach 30 (Bellefield Office Complex): MODERATE/HIGH. Food production and delivery are likely stymied by the fragmentation of these wetlands and location within a dense office development. Fringe wetlands and uplands along the creek contain a high percentage of invasive species such as reed canarygrass and Himalayan blackberry which have little value as monocultures. **Reach 31 (Lower Kelsey Creek):** MODERATE/HIGH. Similar to Reach 29, food production in this reach is good, although broken up by roadways. **Reach 32 (Sturtevant Wetland):** MODERATE/HIGH. Food produced in this reach that benefits the creek system is delivered during flood events through a culvert.	**Reach 32: 3.9**

Reaches	Average Hydrologic Score	Average Vegetation Score	Average Hyporheic Score	Average Habitat Score	Average TOTAL Score
Reach 29	**4.0**	**4.8**	**4.8**	**5.0**	**4.6 = High**
Reach 30	**2.9**	**3.6**	**4.0**	**3.8**	**3.5 = Moderate/High**
Reach 31	**3.3**	**4.0**	**4.1**	**4.4**	**4.0 = Moderate/High**
Reach 32	**3.6**	**4.6**	**4.3**	**4.3**	**4.2 = Moderate/High**

[1] Low = 1, Low/Moderate = 2, Moderate = 3, Moderate/High = 4, High = 5

Table 30. Function Summary of Bellevue's Lake Sammamish Shoreline

LAKE SAMMAMISH		
Function	**Performance**	**Score[1]**
Hydrologic Storing water and sediment	**Reach 33:** LOW/MODERATE: Impediments to water and sediment storage functions are more severe along this relatively steep sloped shoreline. A high amount of impervious surfaces and relatively impermeable alderwood soil types combined with steep sloped uplands and intensely landscaped areas decrease water infiltration and promote rapid overland flow of water and sediment toward the lake in this reach. Wetlands and other natural water and sediment storage features are also generally lacking. **Reach 34:** MODERATE: Water and sediment storage in this reach is primarily impeded by the relatively high amount of impervious surfaces associated with this residential lake shore. However, this shoreline reach benefits from the presence of gradual slopes and permeable gravelly and sandy loam soils that increase infiltration and water / sediment storage. **Reach 35:** LOW/MODERATE: Impediments to water and sediment storage functions are not as severe as those present in reach 33, but the moderate-steep sloped shoreline and relatively high amount of impervious surfaces found in this reach promote overland flow of water and sediment toward the lake. The gravelly sandy loam soils are permeable and the heavily vegetated uplands are features that help the water and sediment storage function of this reach. **Reach 36:** MODERATE/HIGH: The lake of course provides excellent water and sediment storage functions. Similarly, the relatively gradual slopes associated with the uplands around Vasa Park reduce the speed of overland flow and enables more precipitation to penetrate into the aquifer, increasing water and sediment storage. However, the large impervious parking lot, close proximity of high density housing, and compact managed lawns can interfere with infiltration of precipitation and increase the rate of water flowing towards the lake. Regardless, the gradual slopes and permeable soils promote water retention and provide a significant water storage function for this reach. **Reach 37:** LOW/MODERATE: The water and sediment storage function of this section is primarily impeded by high amounts of impervious surfaces and reduced vegetative cover along this shoreline. However, the water and soil storage function benefits from the low to moderate slopes and permeable silt and sand soil types found in this reach.	**Reach 33: 1.7** **Reach 34: 2.7** **Reach 35: 2.0** **Reach 36: 3.7** **Reach 37: 2.3**

LAKE SAMMAMISH		
Function	**Performance**	**Score[1]**
Hydrologic Attenuating wave energy	**Reach 33:** LOW: The wave attenuating function of this shoreline reach is greatly impeded by the high levels of shoreline armoring, steep gradients, and substantial fetch, oriented to take full advantage of the prevailing wind patterns from the southeast. **Reach 34:** LOW/MODERATE: The wave attenuation function of this shoreline reach is generally impeded by moderate amounts of shoreline armoring, and the substantial fetch associated with the prevailing wind patterns. However, wave energy is attenuated somewhat by the presence of a more gradual shoreline gradient and the presence of some natural shoreline. **Reach 35:** LOW/MODERATE: The wave attenuation function of this shoreline reach is reduced by the relatively steep slopes and moderate number of bulk heads. However, the wave energy is somewhat reduced by the decrease in fetch compared to reaches 33 and 34. Similarly, a moderate amount of natural shoreline exists in this reach reducing near shore water depths and wave energy. **Reach 36:** MODERATE/HIGH: The majority of this reach contains a gentle gradient and semi natural shoreline that helps attenuate most of the wave energy. However, the prevailing winds from the southeast and significant fetch can produce episodically strong waves. **Reach 37:** LOW/MODERATE: The gradual gradients and northeast exposure of this shoreline reach promote wave attenuation. However, the majority of this shoreline is armored which results in deeper water at the land water interface intensifying wave energy potential at the shoreline.	**Reach 33: 1.0** **Reach 34: 2.0** **Reach 35: 2.0** **Reach 36: 3.7** **Reach 37: 2.3**
Hydrologic Removing excess nutrients and toxic compounds	**Reach 33:** LOW/MODERATE: The upland shoreline areas are more often a source of nutrients and toxic compounds, via lawn treatment runoff (pesticides, fertilizers, herbicides) and road runoff (hydrocarbons, metals). Poor soil infiltration, steep slopes, and high amounts of impervious surfaces reduce the time it takes for runoff to make it to the lake reducing the nutrient and toxic compound removal function of this reach. However, moderate amounts of vegetative cover are present to remove some of the nutrient and toxic compounds prior to lake entry. **Reach 34:** LOW/MODERATE: The highly developed medium density housing found in the upland areas of this shoreline are a source of nutrients and toxic compounds, via lawn treatment runoff (pesticides, fertilizers, herbicides) and road runoff (hydrocarbons, metals). However, the gradual slopes, relatively permeable soils, and moderate amounts of vegetative cover likely remove some of the nutrient and toxic compound load prior to lake entry.	**Reach 33: 1.9** **Reach 34: 2.2** **Reach 35: 2.3** **Reach 36: 2.6** **Reach 37: 2.0**

LAKE SAMMAMISH		
Function	**Performance**	**Score[1]**
	Reach 35: LOW/MODERATE: The heavily vegetated areas of Weowna Park containing swaths of open space likely increase the removal of nutrients and toxic compounds in the uplands despite their accompanying steep slopes and moderately impermeable soil types. Closer to the lake the soils become more permeable and slopes decrease, but the potential for nutrient and toxic compounds entering the lake increase with development via lawn treatments and road runoff. **Reach 36:** MODERATE: The tree and shrub community found within the park likely takes up nutrients and other pollutants that would otherwise flow into the lake. Comparatively less impervious surface area, including road and roof areas, feed into the lake from this reach reducing a common source of toxic compounds. Similarly, the relatively good water infiltration, storage, and permeable soils promote nutrient uptake and filtration. However, surrounding areas are relatively developed increasing the potential that runoff will carry more hydrocarbons, metals, nutrients, sediments, and other pollutants to the lake than would be the case from less intensely developed areas. **Reach 37:** LOW/MODERATE: The high amount of impervious surfaces and moderate to high house density found in this reach of shoreline likely is a source of nutrients and toxic compounds. The moderate vegetative cover, permeable soils, and gradual slopes should remove some of the nutrient and toxic compounds prior to entry into the lake.	
Hydrologic Recruitment of LWD and other organic material	**Reach 33:** LOW/MODERATE: The general lack of stream input, heavily armored shorelines, and lack of trees in close proximity to the shoreline greatly reduce the potential for hydrologic recruitment of organic material in this shoreline reach. Dense residential shoreline zone development, including shorefront armoring modifications, restrict the ability of the lake to recruit LWD and organic material. Essentially all of the primordial lakeshore forest vegetation has been removed, and so is not available for recruitment, and re-growth has been limited and patchy as a result of development. **Reach 34:** LOW/MODERATE: Reduced shoreline armoring in this reach and the presence of a few small streams increases the potential for hydrologic recruitment of organic material to the lake. However, the dense residential shoreline zone development restrict the ability of the lake to recruit LWD and organic material due to the removal of vegetation in close proximity to the water. **Reach 35:** LOW/MODERATE: Hydrologic recruitment of organics in this reach is facilitated by the presence of some small streams associated with Weowna Park. Similarly, the moderate levels of armoring along the shoreline should facilitate hydrologic recruitment of organic material. However, The dense residential shoreline	**Reach 33: 2.0** **Reach 34: 2.3** **Reach 35: 2.0** **Reach 36: 2.5** **Reach 37: 2.0**

LAKE SAMMAMISH		
Function	**Performance**	**Score[1]**
	zone developments, including some shorefront armoring modifications, restrict the ability of the lake to recruit LWD and organic material, and re-growth of vegetation has been limited and patchy as a result of development. **Reach 36:** LOW/MODERATE: The lake likely receives a moderate amount of organic materials from this reach via windfall from the deciduous trees found in the area. However wind is not a hydrologic factor. LWD recruitment is limited by the lack of trees in close proximity to the shoreline and the low rate of shore erosion. Similarly, the presence of a public swimming beach likely result in the physical removal of any LWD or significant amounts of other types of organic material. Some organic material likely recruits from the northern sections of the park where trees and vegetation are closer to the shoreline. However, this section of shoreline is armored reducing erosion and the likelihood of hydrologic recruitment of organics. **Reach 37:** LOW/MODERATE: Large amounts of shoreline armoring, dense residential shoreline development and the lack of vegetation in close proximity to the shoreline greatly limit recruitment of organic material in this reach. The presence of a few small streams potentially provides some limited organic material recruitment to the lake.	
Vegetation Temperature regulation	**Reach 33:** LOW: The southeast exposure of this reach combined with the lack of dense shoreline vegetation throughout most of this reach eliminates the potential for some shading of the nearshore area. A moderate amount of vegetation in the uplands likely provides some shading for the limited amount of water that is stored or delayed in this area. **Reach 34:** LOW/MODERATE: Fewer impervious surfaces compared to reach 33 and vegetative cover associated with stream inputs in this area likely provides some temperature regulation function. However, the southeastern expose and lack of dense shoreline vegetation throughout most of this reach eliminates potential for some shading of the shallow-water nearshore area. **Reach 35:** LOW/MODERATE: Modest amounts of impervious surfaces and vegetative cover in this reach, combined with an eastern exposure, provide limited temperature regulation function. The general lack of dense shoreline vegetation throughout most of this reach eliminates potential for some shading of the nearshore area. **Reach 36:** MODERATE/HIGH: Relatively high vegetative cover, good water infiltration, and the substantial vegetated upland increase shading and facilitate some temperature regulation function for this shoreline reach. Even so, given the overall size of the lake, the degree to which its shorefront lacks vegetation, and the low percentage of its	**Reach 33: 1.8** **Reach 34: 2.5** **Reach 35: 2.3** **Reach 36: 3.5** **Reach 37: 2.8**

LAKE SAMMAMISH		
Function	**Performance**	**Score[1]**
	overall surface area subject to potential shading from the shore, this vegetation likely does not have a measurable effect on lake water temperature. **Reach 37:** MODERATE: The north to northeast exposure of this reach likely provides some temperature regulation function. However, the large amount of impervious surfaces and lack of shoreline vegetation eliminates most of this reaches potential temperature regulation function.	

LAKE SAMMAMISH		
Function	**Performance**	**Score[1]**
Vegetation Water quality improvement	**Reach 33:** MODERATE: The modest number of storm water outfalls, medium density housing along the shore and adjacent areas, and relatively high amount of vegetative cover provide the opportunity for water quality improvements in this reach. However, residential areas are dominated by lawn and landscaping and typically lack dense buffers of lakeside vegetation. As such, they are sources of water quality contaminants such as fertilizers, herbicides and pesticides. Runoff from the urban impervious surfaces is typically not filtered through vegetation. In addition to the residential pollutants (fertilizers, herbicides, and pesticides), urban runoff carries hydrocarbons, metals, sediments and other pollutants from roads and parking lots. Similarly, the impervious soils, steep slopes, and poor water storage likely reduces the water quality improvement potential of this reach of shoreline. **Reach 34:** MODERATE: Limited storm water outfalls, moderate amounts of vegetative cover, and medium density housing provide the potential for water quality improvement function in this shoreline reach. However, similar to all of the Bellevue reaches of shoreline on Lake Sammamish, potential water quality concerns arise from residential areas dominated by lawn and landscaping with limited lakeside vegetation buffer. **Reach 35:** MODERATE: Similar to reach 34, this shoreline has limited storm water outfalls, moderate amounts of vegetative cover, and medium density housing providing the potential for water quality improvement function. Additionally, the adjacent Weowna Park likely provides improved water quality to waters entering this shoreline reach from the uplands. However, like all of the Bellevue reaches of shoreline on Lake Sammamish, potential water quality concerns arise from residential areas dominated by lawn and landscaping with limited lakeside vegetation buffer. **Reach 36:** MODERATE: Opportunities for water quality improvement in this reach are promoted by the moderate amounts of vegetative cover, a low number of storm water outfalls, and limited residential development. The moderate level of water storage promoted by porous soils and gradual slopes also slows water passage allowing the vegetation more opportunities to filter pollutants and improve water quality. However, the adjacent areas are developed and serve as a potential source of water quality contamination. **Reach 37:** MODERATE: Relative dense housing and reduced shoreline vegetation in this reach reduces the potential water quality improvement function of this shoreline despite the presence of adjacent open spaces and good water storage potential. Similar to the other reaches of Lake Sammamish shoreline, water quality concerns arise from residential areas dominated by lawn and landscaping with limited lakeside vegetation buffer.	**Reach 33: 2.6** **Reach 34: 2.7** **Reach 35: 2.6** **Reach 36: 3.0** **Reach 37: 2.5**

LAKE SAMMAMISH		
Function	**Performance**	**Score[1]**
Vegetation Attenuating wave energy	**Reach 33:** LOW: The steep shoreline gradients, heavy armoring, and southeastern exposure of this shoreline reach provides little wave energy attenuation function. Vegetation does not provide any significant wave attenuation function for most shoreline areas. As mentioned above, bulkheading and other shoreline modifications have replaced native vegetation and natural woody debris as the features in place to attenuate wave energy. **Reach 34:** LOW/MODERATE: The wave attenuation function of this shoreline reach is generally impeded by moderate amounts of shoreline armoring, and the substantial fetch associated with the prevailing wind patterns. However, wave energy is attenuated somewhat by the presence of a more gradual shoreline gradient and the presence of some natural shoreline and aquatic vegetation. **Reach 35:** LOW/MODERATE: The wave attenuation function of this shoreline reach is reduced by the relatively steep slopes and moderate number of bulk heads. However, the wave energy is somewhat reduced by the decrease in fetch compared to reaches 33 and 34. Similarly, a moderate amount of natural shoreline exists in this reach reducing nearshore water depths promoting a limited amount of vegetative growth and wave energy attenuation. **Reach 36:** MODERATE: The majority of this reach contains a gentle gradient and semi natural shoreline that helps attenuate most of the wave energy. However, the absence of dense emergent and submerged vegetation reduces the wave attenuation ability of this shoreline. Prevailing winds from the southeast and significant fetch can produce episodically strong waves along the vegetative and LWD-poor swimming beach. **Reach 37:** LOW/MODERATE: The gradual gradients and northeast exposure of this shoreline reach promote wave attenuation. However, the majority of this shoreline is armored which results in deeper water at the land water interface intensifying wave energy potential at the shoreline. Similarly, the absence of LWD and significant amounts of aquatic vegetation further reduces the wave attenuation function of this shoreline.	**Reach 33: 1.0** **Reach 34: 1.8** **Reach 35: 1.8** **Reach 36: 3.0** **Reach 37: 2.0**
Vegetation Sediment removal and bank stabilization	**Reach 33:** LOW/MODERATE: Under natural conditions, there would be an ongoing, underlying rate of shoreline erosion, which would contribute to maintaining substrate conditions. Instead, the lake shore in this reach now has little vegetation and a significant proportion of it is armored. While this “stabilizes” the banks, it also limits natural recruitment of lakebed materials. **Reach 34:** LOW/MODERATE: This reach of shoreline is only moderately armored and contains relatively gradual slopes which would naturally promote stable sediments and	**Reach 33: 1.5** **Reach 34: 2.4** **Reach 35: 2.2** **Reach 36: 3.8** **Reach 37: 2.3**

LAKE SAMMAMISH		
Function	**Performance**	**Score[1]**
	banks. However, similar to all of Bellevue's Lake Sammamish urban shoreline, the absence of LWD and dense vegetation results in a reduction of natural bank stabilization and sediment removal function. **Reach 35:** LOW/MODERATE: Moderate amounts of shoreline armor combined with relatively steep slopes and poor wave attenuation reduce the natural bank stabilization and sediment functions of this reach. The absence of aquatic vegetation and dense shoreline vegetation further reduce the natural bank stabilization and sediment removal process and limits the natural recruitment of lakebed materials. **Reach 36:** MODERATE/HIGH: Much of the lakeshore in this reach is unarmored and possesses a gradual gradient suggesting that the rate of shoreline erosion is near an underlying, natural, ongoing rate. This moderated rate of erosion contributes towards maintaining natural lake substrate conditions. However, the presence of a heavily used public swimming beach likely has some adverse impacts on the retention of sediment and bank stabilization. Similarly, the swimming beach presumably negatively impacts the establishment of aquatic vegetation that would further facilitate stable sediments and bank function for this shoreline. **Reach 37:** LOW/MODERATE: The lakeshore in this reach possesses a gradual gradient, but the large amount of shoreline armor and absence of aquatic vegetation negatively influences the natural bank and sediment functions. Under natural conditions, there would be an ongoing, underlying rate of shoreline erosion, which would contribute to maintaining substrate conditions. Instead, the lake shore in this reach is depauperate of shoreline vegetation and a significant proportion of it is armored. While this "stabilizes" the banks, it also limits natural recruitment of lakebed materials.	
Vegetation LWD and organic matter recruitment	**Reach 33:** LOW/MODERATE: The absence of dense vegetation and trees in close proximity to the shoreline greatly reduces the potential for organic matter recruitment in this reach of shoreline. Similarly, the prevailing winds likely would push leaf litter and other organic material away from the lake shore rather then assisting in recruitment. The removal of natural, forested shoreline vegetation and its replacement primarily with lawn and other types of landscaping has nearly eliminated large woody debris and organic matter recruitment potential along the lake shore. Any trees or large woody debris that do enter the lake are likely to be quickly removed out of concern for safety or to reduce the risk of property damage. **Reach 34:** LOW/MODERATE: Again, the loss of natural, forested shoreline vegetation and its replacement primarily with lawn and other types of landscaping has nearly eliminated large woody debris and organic matter recruitment potential along the lake	**Reach 33: 2.0** **Reach 34: 2.3** **Reach 35: 2.5** **Reach 36: 3.0** **Reach 37: 2.5**

LAKE SAMMAMISH		
Function	**Performance**	**Score[1]**
	shore. Any trees or large woody debris that do enter the lake are likely to be quickly removed out of concern for safety or to reduce the risk of property damage. **Reach 35:** LOW/MODERATE: The heavily forested upland associated with Weowna Park potentially contributes organic material to this shoreline reach via wind delivery. However, similar to the rest of the lake shore the absence of vegetation in close proximity to the water likely limits organic material recruitment. LWD is virtually nonexistent along the shoreline. **Reach 36:** MODERATE: The lake likely receives a moderate amount of organic materials from this reach via windfall from the deciduous trees and other terrestrial vegetation located in the area. However, LWD recruitment is limited by the lack of trees in close proximity to the shoreline and the likely removal of any potentially hazardous LWD located in proximity to the public swimming beach and park area. **Reach 37:** LOW/MODERATE: Prevailing winds and the presence of some open space adjacent to this shoreline reach potentially contributes to the recruitment of organic material. But the absence of vegetation associated with the land / water interface likely limits recruitment of organic matter and LWD.	
Hyporheic Removing excess nutrients and toxic compounds	**Reach 33:** LOW/MODERATE: Steep slopes, impervious surfaces and soil types, combined with large amounts of shoreline armoring likely increase overland flow of runoff and restricts the ability of the hyporheic zone to remove nutrients and toxic compounds in this reach. However, the relatively abundant vegetative cover adjacent to this shoreline likely does offer some nutrient uptake and removal of toxic compounds. **Reach 34:** MODERATE: Relatively gradual slopes and permeable sand and silt soil types should reduce overland flow and promote water infiltration and moderate levels of nutrient uptake and filtering of toxic compounds in this reach. **Reach 35:** MODERATE: Despite the relatively steep slopes associated with northern sections of this reach of shoreline the abundant vegetation of the adjacent Weowna Park and presence of permeable soil types likely provides significant water infiltration and hyporheic filtering of nutrients and toxic compounds. Southern portions of this shoreline reach are more developed and likely provide less nutrient and toxic compound removal function. **Reach 36:** MODERATE/HIGH: The hyporheic zone in this section of lake shore likely provides a moderate to high amount of nutrient and toxic compound removal function. Gentle gradients and soils composed of small permeable particles likely interact with the relatively abundant vegetation to slow water movement, increase infiltration and	**Reach 33: 2.0** **Reach 34: 2.8** **Reach 35: 2.7** **Reach 36: 3.6** **Reach 37: 2.8**

LAKE SAMMAMISH		
Function	**Performance**	**Score[1]**
	facilitate the removal of nutrients and toxic compounds. Water quality is likely protected in part due to upland runoff moving through the hyporheic zone or moving towards the lake as shallow groundwater flow. **Reach 37:** MODERATE: Gradual gradients, adjacent open spaces, and highly permeable sand and silt soils should promote excellent water infiltration and the opportunity for the filtration of nutrients and toxics in the hyporheic zone along this shoreline. However, the relative high level of development, impervious surfaces, and armoring in this reach increases overland flow and reduce the natural effectiveness of the hyporheic zone at filtering nutrients and toxic compounds.	
Hyporheic Water storage	**Reach 33:** LOW: Water storage in the hyporheic zone in this reach should be limited due to the steep slopes, impermeable soil types, and high amounts of impervious surfaces present. **Reach 34:** LOW-MODERATE: Sub-surface water storage in this reach would be facilitated by gradual slopes and permeable soils. However, moderate amounts of impervious surfaces and developed shorelines would reduce water infiltration and promote overland flow to the lake, negatively impacted water storage in the hyporheic zone. **Reach 35:** LOW-MODERATE: Similar to reach 33, steep slopes and shoreline development would speed water overland toward the lake. However, some water storage likely occurs due to the abundant open space provided by adjacent parks and the permeable soil types of the shoreline. **Reach 36:** MODERATE: Although the water storage function is not of particularly high importance in a lake with a high average retention time (low flow-through) and highly regulated water surface elevation, the hyporheic water storage capacity for this reach would likely be high. Water infiltration would be facilitated by the gradual slopes, permeable soils, and abundant vegetation found in this shoreline reach. **Reach 37:** LOW-MODERATE: Water storage would be promoted in this shoreline reach by adjacent open space, gradual slopes, and permeable soils. However, relatively high levels of development contributing to impervious surfaces and shoreline armoring would reduce water infiltration and reduce the water storage function of this shoreline reach.	**Reach 33: 1.4** **Reach 34: 2.4** **Reach 35: 2.0** **Reach 36: 3.0** **Reach 37: 2.4**
Hyporheic Support of vegetation	**Reach 33:** LOW/MODERATE: The limited vegetation along this relatively steep shoreline within range of the hyporheic zone is primarily lawn and other landscaping plants with less developed root structures, which are not generally supported by hyporheic water storage, but instead, by irrigation or precipitation. It is unclear how	**Reach 33: 1.5** **Reach 34: 2.5** **Reach 35: 2.0**

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Function	**Performance**	**Score[1]**
	many of the relatively abundant trees that are slightly removed from the immediate shoreline have access to hyporheic derived water. **Reach 34:** MODERATE: Vegetation associated with this shoreline reaches hyporheic zone likely receives moderate support from underground water sources. The more gradual slopes and permeable soils enable the hyporheic zone to extend farther into the shoreline and provide trees farther from the lake shore access to hyporheic water supplies. **Reach 35:** LOW/MODERATE: Similar to reach 33, much of the shoreline zone within range of the hyporheic zone is vegetated with lawn and other landscaping, which is not generally supported by hyporheic water storage, but instead, by irrigation or precipitation. Relatively steep slopes likely limit access to hyporheic derived water for many of the trees positioned farther from the immediate shoreline. **Reach 36:** MODERATE: The hyporheic zone likely supplies moderate amounts of water to the vegetation in this shoreline reach due to the presence of gradual shoreline sloping and highly permeable soil types. However, much of the park is vegetated with lawn and other shallow rooted landscaping vegetation limited in their root development and reducing access to underground water supplies. **Reach 37:** MODERATE: Gradual slopes and permeable soil types likely promote moderate amounts of access to hyporheic water by vegetation in this shoreline reach. The presence of heavily armored shorelines, moderate to high density housing, and the relative absence of deep rooted vegetation likely limits the extent this water supply is used by shoreline vegetation.	**Reach 36: 3.3** **Reach 37: 2.5**
Hyporheic Sediment storage and maintenance of base flows	**Reach 33:** LOW: The hyporheic zone in this reach is restricted by extensive shoreline armoring and steep slopes, which limits movement of fines from the lake into the hyporheic zone. Similarly, water movement through the hyporheic zone in this reach is restricted by shoreline armor, steep slopes, and a high amount of impervious surfaces and soil types. **Reach 34:** MODERATE: The hyporheic zone is partially restricted by shoreline armoring, which limits movement of fines from the lake into the hyporheic zone. However, permeable soil types and relatively gental slopes likely provide storage space for moderate amounts of sediment and water. **Reach 35:** LOW/MODERATE: Moderate shoreline armoring combined with steep slopes likely restrict the sediment storage capability of the hyporheic zone in this reach. The relative large amount of open space in the uplands should be contributing to the maintenance of base flows in the smaller streams located in this reach.	**Reach 33: 1.0** **Reach 34: 2.7** **Reach 35: 2.3** **Reach 36: 4.0** **Reach 37: 2.7**

LAKE SAMMAMISH		
Function	**Performance**	**Score[1]**
	Reach 36: MODERATE/HIGH: While no data is available about the characteristics of the Lake Sammamish hyporheic zone, it is believed that sediment storage is likely occurring along Reach 36. There are few anthropogenic obstacles in this reach. The permeable soil types likely provide Interstitial spaces in the soils to store sediment and water. However, neither sediment storage or hyporheic maintenance of base flow appears to be currently important in Lake Sammamish. **Reach 37:** MODERATE: The hyporheic zone in this reach is restricted by extensive shoreline armoring, limiting movement of fines from the lake into the hyporheic zone. The silt and sand soil types and relatively gradual slopes should provide moderate water and sediment storage space, assuming some movement occurs around the extensive shoreline armoring.	
Habitat Physical space and conditions for life history	**Reach 33:** LOW/MODERATE: This reach of lake shore contains a high percentage of shoreline armoring and steep slopes. Under natural conditions, the lake bottom would gradually rise in a shallow wedge such that incoming waves would roll up the bottom, losing energy. This reduced energy environment would be more hospitable to emergent vegetation, which further attenuates wave energy, providing a refuge for small fish and amphibians. Shallow nearshore areas in Lake Sammamish provide critical rearing, foraging and migration habitat for fish, particularly salmonids. Shoreline armoring, however, generally eliminates the low-energy shallow-water environment, creating a deeper, turbulent nearshore that is less hospitable to small fish and amphibians, as well as to emergent vegetation. Shoreline armoring can also reduce upwelling/downwelling areas, which are optimal for kokanee spawning. The deeper water also facilitates larger fish predators to prey on the small fish. Aquatic mammals, like muskrats, seem to have adapted to the armored shoreline, and still find den sites in the looser boulder bulkheads. The absence of dense shoreline vegetation is a limiting factor in terrestrial species (birds, mammals, amphibians) use of the shoreline, since cover, food, nesting sites, travel corridors, etc. are absent. **Reach 34:** LOW/MODERATE: The gradual gradients and reduced shoreline armoring in this shoreline reach provide better habitat for animals than what is found in reach 33, but the lack of shoreline vegetations still limits the functional space available to animals. The absence of dense shoreline vegetation is a limiting factor in terrestrial species (birds, mammals, amphibians) use of the shoreline, since cover, food, nesting sites, travel corridors, etc. are absent. **Reach 35:** LOW/MODERATE: The steep slopes, moderately armored shoreline, and lack of dense shoreline vegetation likely limit the amount of habitat availability in this shoreline reach. However, the presence of adjacent open space in the uplands	**Reach 33: 1.8** **Reach 34: 2.2** **Reach 35: 2.3** **Reach 36: 3.3** **Reach 37: 2.0**

LAKE SAMMAMISH		
Function	**Performance**	**Score[1]**
	provides some habitat for terrestrial species that would episodically utilize the Lake Sammamish shoreline. Additionally, the wooded uplands would be a potential source of LWD and other organic material that could provides future structure to the shoreline of the lake. **Reach 36:** MODERATE: The shore along Reach 36 primarily contains a public swimming beach with a limited amount of shoreline vegetation in the northern portion of the park. However, the park provides a moderate amount of vegetative cover which is beneficial for terrestrial species' (birds, mammals, amphibians). Shallow nearshore areas attenuate wave energy and provide some refuge for small fish. These shallow nearshore areas provide rearing, foraging and migration habitat for fish. Maturing shoreline vegetation provides large organic debris recruitment to the lake to a moderate degree. This reach also includes sandy areas preferred by juvenile Chinook. **Reach 37:** LOW/MODERATE: The heavily armored shoreline and relatively high levels of development likely inhibit the life history of many animals in this shoreline reach. Similar to the other shoreline reaches, dense shoreline vegetation limits terrestrial species (birds, mammals, amphibians) use of the shoreline, since cover, food, nesting sites, travel corridors, etc. are absent.	
Habitat Food production and delivery	**Reach 33:** LOW/MODERATE: Food production from the uplands is moderately available and provided in various forms, including native seed- and fruit-bearing vegetation. Some food production is made up for, in part, by fruit trees and other non-native vegetation in yards which supplies some food for wildlife. **Reach 34:** LOW/MODERATE: Food production from the uplands is moderately available in the form of native seed- and fruit-bearing vegetation. Some food production is made up for, in part, by fruit trees and other non-native vegetation in yards which supplies some food for wildlife. Similarly, the presence of a stream corridor likely provides additional food production in the form of insects and organic material for both the terrestrial and aquatic habitats. **Reach 35:** LOW/MODERATE: Food production from the uplands in this shoreline reach is similarly provided by native seed- and fruit-bearing vegetation. Additionally, the many small stream corridors located in this reach likely provide additional food production in the form of insects and organic material. However, food production in this shoreline is still limited due to the lack of shoreline vegetation, absence of wetlands, and limited presence of LWD and organic material. **Reach 36:** MODERATE/HIGH: Food production from the uplands along Reach 36 is available in various forms, including native seed- and fruit-bearing vegetation. Not only does native upland vegetation provide food directly for terrestrial wildlife, but it is a	**Reach 33: 2.0** **Reach 34: 2.1** **Reach 35: 2.3** **Reach 36: 2.7** **Reach 37: 2.1**

LAKE SAMMAMISH

Function	Performance	Score[1]
	source of insects and other organic matter that make their way into the water to provide food for fish and other aquatic life. **Reach 37:** LOW/MODERATE: Food production is moderately available in this reach in the adjacent upland open spaces. However, food production is still limited in the shoreline by the absence of native vegetation, organic material, and wetlands. The relatively high development in this area likely provides food for some wildlife in the form of fruit trees and other non-native vegetation in yards.	

Reaches	Average Hydrologic Score	Average Vegetation Score	Average Hyporheic Score	Average Habitat Score	Average TOTAL Score
Reach 33	**1.6**	**1.8**	**1.5**	**1.9**	**1.7 = Low/Moderate**
Reach 34	**2.3**	**2.3**	**2.6**	**2.2**	**2.3 = Low/Moderate**
Reach 35	**2.1**	**2.3**	**2.2**	**2.3**	**2.2 = Low/Moderate**
Reach 36	**3.1**	**3.3**	**3.5**	**3.0**	**3.2 = Moderate**
Reach 37	**2.2**	**2.4**	**2.6**	**2.0**	**2.3 = Low/Moderate**

[1] Low = 1, Low/Moderate = 2, Moderate = 3, Moderate/High = 4, High = 5

Table 31. Function Summary of Bellevue's Phantom Lake Shoreline

PHANTOM LAKE		
Function	**Performance**	**Score[1]**
Hydrologic Storing water and sediment	The lake itself, of course, provides excellent water and sediment storage functions. By definition, a lake consists of stored water, and sediments tend to settle out and become deposited in such low-energy, quiet-water areas. However, the uplands surrounding the lake within Shoreline jurisdiction can have very different water and sediment storage capacities and functions depending on soils conditions and level of development. **Reaches 38 and 40 (Residential):** MODERATE/HIGH: Some impervious surfaces are present in the residential areas, and compact managed lawns can interfere with infiltration of precipitation and rapidly send water towards the lake. Regardless, the two residential reaches provide greater water storage than other shoreline uplands throughout the City's jurisdiction. **Reach 39 (Lake Hills Greenbelt at Phantom Lake):** HIGH: Much of the upland within Lake Hills Greenbelt along Phantom Lake is well-vegetated wetland and less intensely developed, resulting in relatively good water and sediment storage functions. There is little impervious surface or landscaped area to interfere with infiltration of precipitation. **Reach 41 (Robinsglen Nature Park):** HIGH Similar to the upland along the shoreline of Reach 39, the upland within Robinsglen Nature Park is well-vegetated with little park development, resulting in relatively good water and sediment storage functions. There is little impervious surface or landscaped area to interfere with infiltration of precipitation. **Reach 42 (Lake Hills Greenbelt north of Phantom Lake):** HIGH: While the Lake Hills Greenbelt north of Phantom Lake does not directly border the shoreline waterbody of Phantom Lake, the extensive wetland complex and Larson Lake provide excellent water and sediment storage functions. There is little impervious surface to interfere with infiltration of precipitation.	Reaches 38 and 40: 4.2 Reach 39: 5.0 Reach 41: 5.0 Reach 42: 5.0

PHANTOM LAKE		
Function	**Performance**	**Score[1]**
Hydrologic Attenuating wave energy	The lake is not large enough to generate very large waves. Boat wakes are not believed to be a major factor, especially since gas-powered engines are prohibited. **Reaches 38 and 40 (Residential):** HIGH: The majority of residential properties do not have bulkheads for shoreline protection since shoreline erosion is not known to be a serious problem. These areas naturally perform well at attenuating wave energy due to gentle slopes and aquatic vegetation along the shoreline edge. **Reach 39 (Lake Hills Greenbelt at Phantom Lake):** HIGH: The banks along Reach 39 are heavily vegetated with accumulated overhanging and fallen vegetation which protect the lake somewhat from wind energy. Furthermore, prevailing winds would blow generally offshore and so would have little fetch over which to generate waves. **Reach 41 (Robinsglen Nature Park):** HIGH: Similar to the immediate shoreline along Reach 39, the shoreline along Robinsglen Nature Park is well-vegetated protecting the shoreline from wave action, although the location of this reach with respect to the prevailing winds would likely result in higher wave impacts. **Reach 42 (Lake Hills Greenbelt north of Phantom Lake):** N/A: This area of associated wetland does not provide wave attenuation on Phantom Lake	Reaches 38 and 40: 5.0 Reach 39: 5.0 Reach 41: 4.5 Reach 42: N/A
Hydrologic Removing excess nutrients and toxic compounds	**Reaches 38 and 40 (Residential):** MODERATE: The residential reaches include intensively landscaped lakefront homes. These upland shoreline areas are more often a source of nutrients and toxic compounds than forested areas, via lawn treatment runoff (pesticides, fertilizers, herbicides) and road runoff (hydrocarbons, metals). **Reach 39 (Lake Hills Greenbelt at Phantom Lake):** MODERATE/HIGH: Relatively little impervious surface area feeds into the lake from Reach 39, so runoff carries less in the way of hydrocarbons, metals, sediments, and other pollutants to the lake than would be the case from roads, parking lots, and other developed areas. The reach is characterized by wetland, low slope, a high degree of tree and shrub cover along the shoreline. **Reach 41 (Robinsglen Nature Park):** MODERATE/HIGH: Although the immediate reach area is similar to the upland along Reach 39, the reach area of Robinsglen Nature Park is not as large and thus does not provide as much benefit to pollutant removal. **Reach 42 (Lake Hills Greenbelt north of Phantom Lake):** MODERATE/HIGH: This reach, with the extensive wetland complex, likely does an excellent job at removing nutrients and toxic compounds.	Reaches 38 and 40: 2.9 Reach 39: 4.4 Reach 41: 3.9 Reach 42: 4.4
Hydrologic Recruitment of LWD and	**Reaches 38 and 40 (Residential):** MODERATE: Residential development and other upland modifications restrict the ability of the lake to recruit LWD and organic material	Reaches 38 and 40: 2.8

PHANTOM LAKE		
Function	**Performance**	**Score[1]**
other organic material	from these reaches since much of the lakeshore forest vegetation has been removed and so is not available for recruitment. However, both reaches do contain large areas of wetland fringe and patches of forest habitat that may contribute to organic material. **Reach 39 (Lake Hills Greenbelt at Phantom Lake):** MODERATE/HIGH: A more actively eroding lakeshore could recruit the large woody debris and other organic materials present along this reach. However, lakeshore erosion along this reach is quite slow and does not appear to be a primary factor in the recruitment of wood or other organic materials to the lake. Some wood, however, does fall into the lake as trees die or due to wind, but these are not hydrologic factors. **Reach 41 (Robinsglen Nature Park):** MODERATE: Similar to the shoreline along Reach 39, the Robinsglen Nature Park is well-vegetated containing some tree cover. However, the vegetated area is much smaller and would does not have as much potential for recruitment. **Reach 42 (Lake Hills Greenbelt north of Phantom Lake):** MODERATE/HIGH: This reach is not located directly along the shoreline of Phantom Lake and thus does not contribute directly to recruitment of LWD and organic material, although recruitment of these materials is likely significant within the wetland complex itself.	Reach 39: 4.0 Reach 41: 2.5 Reach 42: 3.8
Vegetation Temperature regulation	**Reaches 38 and 40 (Residential):** MODERATE/HIGH: Although this residential area contains less vegetation than the remaining Phantom Lake shoreline jurisdiction, nearshore wetlands and forest fragments have the potential to provide some shading of the shallow-water nearshore area. Vegetation is less effective at shading south- and west-facing shoreline areas due to midday sun from the south and afternoon sun from the west. **Reach 39 (Lake Hills Greenbelt at Phantom Lake):** HIGH: The well-vegetated shore provides good shading to the lake surface, particularly during the warmer, afternoon hours. As tree cover matures, shade may increase somewhat. **Reach 41 (Robinsglen Nature Park):** MODERATE/HIGH: Although this area also has a well-vegetated shoreline, its southwest exposure minimizes shading potential and temperature regulation during warm summer months. **Reach 42 (Lake Hills Greenbelt north of Phantom Lake):** HIGH: This very well-vegetated wetland complex provides very good temperature regulation to the stream and Larson Lake.	Reaches 38 and 40: 3.9 Reach 39: 4.5 Reach 41: 4.3 Reach 42: 4.8

PHANTOM LAKE		
Function	**Performance**	**Score[1]**
Vegetation Water quality improvement	**Reaches 38 and 40 (Residential):** MODERATE/HIGH: The residential areas predominantly include lawn and landscaping areas rather than dense buffers of native lakeside vegetation. These residential areas are likely to be sources of water quality contaminants such as fertilizers, herbicides and pesticides. However, the lake-fringe wetland that surrounds much of Phantom Lake, even within the residential reaches, provides some water quality improvement. **Reach 39 (Lake Hills Greenbelt at Phantom Lake):** HIGH: The wetland area within the Lake Hills Greenbelt likely provides excellent water quality improvement to Phantom Lake. **Reach 41 (Robinsglen Nature Park):** MODERATE/HIGH: This reach provides moderate/high water quality improvement functions for this specific area due to its vegetated condition and low gradient. **Reach 42 (Lake Hills Greenbelt north of Phantom Lake):** HIGH: Similar to Reach 39, this reach likely provides excellent water quality improvements due to the extensive wetland complex.	Reaches 38 and 40: 3.8 Reach 39: 4.8 Reach 41: 4.2 Reach 42: 4.8
Vegetation Attenuating wave energy	**Reaches 38 and 40 (Residential):** HIGH: Lake-fringe wetland and lack of shoreline armoring allow shoreline vegetation to contribute to wave attenuation along these residential reaches. **Reach 39 (Lake Hills Greenbelt at Phantom Lake):** HIGH: The high quality and extensiveness of shoreline wetland vegetation along with a predominantly east facing unarmored shoreline that is away from prevailing winds provides excellent wave attenuation. **Reach 41 (Robinsglen Nature Park):** MODERATE/HIGH: Although the large tree cover along the shoreline provides very good wave attenuation, this area rates slightly less than Reach 39 due to a partially armored shoreline and a west facing condition. **Reach 42 (Lake Hills Greenbelt north of Phantom Lake):** N/A: This area is not connected directly to Phantom Lake and thus the vegetation does not contribute to wave attenuation.	Reaches 38 and 40: 4.5 Reach 39: 5.0 Reach 41: 4.0 Reach 42: N/A
Vegetation Sediment removal and bank stabilization	**Reaches 38 and 40 (Residential):** HIGH: Although these two reaches are primarily composed of single-family residential uses, the majority of the lakeshore is unarmored, has a high percentage of vegetative cover with relatively low impervious surface and a fairly continuous lake-fringe wetland—all of which contribute to stable banks and sediment retention. **Reach 39 (Lake Hills Greenbelt at Phantom Lake):** HIGH: The very well-vegetated wetland fringe provides excellent functions for sediment removal and bank	Reaches 38 and 40: 4.8 Reach 39: 5.0 Reach 41: 4.5

PHANTOM LAKE		
Function	**Performance**	**Score[1]**
	stabilization. **Reach 41 (Robinsglen Nature Park):** HIGH: Similar to the reaches described above, Reach 41 has a well vegetated shoreline and little impervious surface. **Reach 42 (Lake Hills Greenbelt north of Phantom Lake):** HIGH: Although this reach does not provide direct bank stabilization to Phantom Lake, this extensive wetland complex provides excellent sediment removal functions.	Reach 42: 5.0
Vegetation LWD and organic matter recruitment	**Reaches 38 and 40 (Residential):** MODERATE/HIGH: The loss of natural, forested shoreline vegetation and its replacement primarily with lawn and other types of landscaping has reduced large woody debris recruitment potential along these two reaches. However, these two reaches still maintain a moderate lake-fringe wetland and some three/shrub vegetation that likely contributes to organic matter recruitment. Any trees or large woody debris that falls along private property would likely be quickly removed out of concern for safety or to reduce the risk of property damage. **Reach 39 (Lake Hills Greenbelt at Phantom Lake):** MODERATE/HIGH: This reach has the potential to supply a large amount of LWD and organic matter input to the lake. **Reach 41 (Robinsglen Nature Park):** MODERATE/HIGH: Although the shoreline within Reach 41 is vegetated with trees and shrubs, the small shoreline area within this reach would not contribute as much LWD and organic matter as Reach 39. **Reach 42 (Lake Hills Greenbelt north of Phantom Lake):** MODERATE/HIGH: Given the proximity of Reach 42 to Phantom Lake, it is not likely that this reach would contribute LWD directly to the lake. However, this reach would likely provide a high input of organic matter within the associated wetland and Larson Lake area.	Reaches 38 and 40: 3.9 Reach 39: 4.0 Reach 41: 3.5 Reach 42: 4.3
Hyporheic Removing excess nutrients and toxic compounds	**Reaches 38 and 40 (Residential):** MODERATE/HIGH: The hyporheic zone along these predominantly residential reaches likely provides high nutrient and toxic compound removal function, treating water from the uplands as it infiltrates into the hyporheic zone rather than running off to enter the lake directly as surface flow. The lack of significant shoreline armoring and the presence of lake-fringe wetlands also accentuates the removal of nutrients and toxic compounds. **Reach 39 (Lake Hills Greenbelt at Phantom Lake):** HIGH: The large amount of open space, wetland fringe, and vegetative cover contributes to high rates of infiltration, allowing the hyporheic zone to perform high nutrient and toxic compound removal functions. **Reach 41 (Robinsglen Nature Park):** HIGH: Similar to the upland along the shoreline of Reach 39, this well-vegetated park results in high rates of infiltration allowing the hyporheic zone to perform high nutrient and toxic compound removal functions.	Reaches 38 and 40: 3.6 Reach 39: 4.9 Reach 41: 4.7 Reach 42: 4.9

PHANTOM LAKE		
Function	**Performance**	**Score[1]**
	Reach 42 (Lake Hills Greenbelt north of Phantom Lake): HIGH: This flat, vegetated wetland significantly slows upland runoff, allowing the hyporheic zone to perform high rates of nutrient and toxic compound removal.	
Hyporheic Water storage	Although the water storage function is not of particularly high importance in a lake with a high average retention time (low flow-through) and relatively low fluctuations in water surface elevation, the hyporheic water storage capacity surrounding Phantom Lake with its natural vegetation, low slopes, and large wetland areas is considered relatively high. **Reaches 38 and 40 (Residential):** MODERATE/HIGH: Although hyporheic water storage functions are likely higher than other shoreline waterbodies around the City, the cleared landscape and modified shorelines likely lead to lower functions than the other reaches around the lake. **Reach 39 (Lake Hills Greenbelt at Phantom Lake):** HIGH: **Reach 41 (Robinsglen Nature Park):** HIGH **Reach 42 (Lake Hills Greenbelt north of Phantom Lake):** HIGH:	Reaches 38 and 40:3.8 Reach 39: 5.0 Reach 41: 4.6 Reach 42: 5.0
Hyporheic Support of vegetation	**Reaches 38 and 40 (Residential):** MODERATE/HIGH: much of the shoreline within range of the hyporheic zone is vegetated with lawn and other landscaping, which is not generally supported by hyporheic water storage, but instead, by irrigation or precipitation. **Reach 39 (Lake Hills Greenbelt at Phantom Lake):** MODERATE/HIGH: Predominantly muck soils within the associated wetland and extensive native vegetation likely accentuates available water in the hyporheic zone to support vegetation. **Reach 41 (Robinsglen Nature Park):** MODERATE/HIGH: Although vegetation is not as extensive as in Reach 39, shoreline vegetation, both wetland and upland trees and shrubs, are still likely supported by wicking of water. Only a minor amount of shoreline armoring exists in this reach which has the potential to inhibit hydrology across the hyporheic zone. **Reach 42 (Lake Hills Greenbelt north of Phantom Lake):** MODERATE/HIGH: The hyporheic zone across the Lake Hills Greenbelt likely supports the extensive wetland throughout this reach.	Reaches 38 and 40: 3.9 Reach 39: 4.3 Reach 41: 3.9 Reach 42: 4.3
Hyporheic Sediment storage and	Lake levels or base flows are not known to be supported significantly by the hyporheic zone. However, the surrounding low slopes surrounding Phantom Lake likely enhances the amount of water stored in the hyporheic zone which would be available	Reaches 38 and 40: 4.3

PHANTOM LAKE		
Function	**Performance**	**Score[1]**
maintenance of base flows	to support lake levels. **Reaches 38 and 40 (Residential):** MODERATE/HIGH: The residential reaches have a slightly higher rate of soil infiltration and likely have slightly less contribution to base flows and maintenance of lake level. **Reach 39 (Lake Hills Greenbelt at Phantom Lake):** HIGH: **Reach 41 (Robinsglen Nature Park):** HIGH: **Reach 42 (Lake Hills Greenbelt north of Phantom Lake):** HIGH:	Reach 39: 5.0 Reach 41: 4.7 Reach 42: 5.0
Habitat Physical space and conditions for life history	The lake is largely surrounded by native wetland vegetation, even along the residential areas. This dense shoreline vegetation is beneficial for terrestrial species' (birds, mammals, amphibians) and increases their use of the shoreline since cover, food, nesting sites, travel corridors, etc. are more available. Shallow nearshore areas include both emergent and submerged vegetation, which attenuates wave energy and provides a refuge for small fish and amphibians. These shallow nearshore areas provide rearing and foraging habitat for fish. Maturing shoreline vegetation provides large organic debris recruitment to the lake to a moderate degree. **Reaches 38 and 40 (Residential):** MODERATE/HIGH: The residential areas within these reaches contain less upland vegetation (trees/shrubs) than the other reaches around the lake. **Reach 39 (Lake Hills Greenbelt at Phantom Lake):** HIGH: Reaches 39, 41, and 42 provide extensive space for high quality terrestrial and nearshore habitat. **Reach 41 (Robinsglen Nature Park):** HIGH: **Reach 42 (Lake Hills Greenbelt north of Phantom Lake):** HIGH:	Reaches 38 and 40: 4.1 Reach 39: 5.0 Reach 41: 4.5 Reach 42: 4.9
Habitat Food production and delivery	Food production from the uplands is available in various forms throughout these reaches, including native seed- and fruit-bearing vegetation. Fruit trees and other non-native vegetation in yards may also supply some food for wildlife. Not only does native upland vegetation provide food directly for terrestrial wildlife, but it is a source of insects and other organic matter that drop into the water to provide food for fish and other aquatic life. The emergent wetland areas present along sections of the lakeshore, particularly in the parks, provide productive foraging areas for small mammals, wading birds and waterfowl. **Reaches 38 and 40 (Residential):** MODERATE: Food production from the uplands is limited by the reduced availability (compared to other Phantom Lake reaches) of native seed- and fruit-bearing vegetation. This may be made up for, in part, by fruit trees and other non-native vegetation in yards which supplies some food for wildlife. **Reach 39 (Lake Hills Greenbelt at Phantom Lake):** HIGH: Excellent food production	Reaches 38 and 40: 3.3 Reach 39: 4.6 Reach 41: 3.6 Reach 42: 4.6

PHANTOM LAKE

Function	Performance	Score[1]
	and delivery to the lake. **Reach 41 (Robinsglen Nature Park):** MODERATE/HIGH: Although lake fringe vegetation provides very good food production and deliver, this reach contains some cleared areas within the Nature Park which reduces this overall function. **Reach 42 (Lake Hills Greenbelt north of Phantom Lake):** HIGH: While the Lake Hills Greenbelt north of Phantom Lake is not directly connected to the shoreline waterbody, the extensive wetland complex and Larson Lake provide excellent food production and delivery.	

Reaches	Average Hydrologic Score	Average Vegetation Score	Average Hyporheic Score	Average Habitat Score	Average TOTAL Score
Reaches 38 and 40	**3.7**	**4.2**	**3.9**	**3.7**	**3.9 = Moderate/High**
Reach 39	**4.6**	**4.7**	**4.8**	**4.8**	**4.7 = High**
Reach 41	**4.0**	**4.0**	**4.5**	**4.1**	**4.2 = Moderate/High**
Reach 42	**4.4**	**4.8**	**4.8**	**4.8**	**4.7 = High**

[1] Low = 1, Low/Moderate = 2, Moderate = 3, Moderate/High = 4, High = 5

6.0 LAND USE ANALYSIS AND IMPLICATIONS

As noted in Section 3.1, land use patterns are an important consideration in SMP analysis because such analysis can identify opportunities for "preferred uses", especially water-dependent, water-related and water-enjoyment uses. Land uses adjacent to the water are also a determinant in assigning environment designations to specific sections of the shoreline. Additionally, an analysis of land use conditions is necessary to determine potential land use changes and their effect on shorelines with respect to SMA objectives. Finally, the existing land uses and proposed environment designation boundaries and provisions must be mutually consistent with Bellevue's comprehensive plan.

As part of SMP development, the shoreline is to be classified into specific shoreline environment designations based upon existing land use patterns, baseline inventory results, goals stipulated in the City's Comprehensive Plan, and Ecology criteria. Ecology Guidelines include six recommendations for shoreline environment designations (listed below). However, each jurisdiction may use alternate or parallel environment designations, as appropriate, as long as they provide equal or better protection than the standard.

The five of the six recommended shoreline environment designations are summarized as follows, including their intended purpose and potential criteria. "Rural Conservancy" has been omitted from this discussion as it is not applicable to the City of Bellevue.

<u>"Natural" Environment:</u>

The purpose of the "Natural" environment is to protect those shoreline areas that are relatively free of human influence or that include intact or minimally degraded shoreline functions intolerant of human use. These systems require that only very low intensity uses be allowed in order to maintain the ecological functions and ecosystem-wide processes. Consistent with the policies of the designation, local government should include planning for restoration of degraded shorelines within this environment.

<u>"Aquatic" Environment:</u>

The purpose of the "Aquatic" environment is to protect, restore, and manage the unique characteristics and resources of the areas waterward of the ordinary high-water mark.

<u>"High-intensity" Environment:</u>

The purpose of the "High-Intensity" environment is to provide for high-intensity water-oriented commercial, transportation, and industrial uses while protecting existing ecological functions and restoring ecological functions in areas that have been previously degraded.

<u>"Urban Conservancy" Environment:</u>

The purpose of the "Urban Conservancy" environment is to protect and restore ecological functions of open space, flood plain and other sensitive lands where they exist in urban and developed settings, while allowing a variety of compatible uses.

Common alternate titles include "Urban Conservancy – Open Space," or "Urban Conservancy – Low Intensity" which reflects the general nature of these designated areas as public open space areas and their likely development pressure.

"Shoreline Residential" Environment:

The purpose of the "Shoreline Residential" environment is to accommodate residential development and appurtenant structures that are consistent with this chapter. An additional purpose is to provide appropriate public access and recreational uses.

Common alternate titles or variations include "Low-Density Residential," "High-Density Residential," "Urban Residential," and "Urban Mixed" to differentiate the varying types of development densities which may be occurring or should be planned for along shorelines.

This section examines the data gathered in the inventory and describes (1) likely land uses and comprehensive plan designations and (2) implications for shoreline management for each of the four shoreline waterbodies. Likely or appropriate environment designations are listed for each reach. However, further evaluation of proposed environment designations, including designation criteria and management policies, will be developed during later phases of the SMP update process and will not be covered further in this report.

6.1 LAKE WASHINGTON

As noted in Chapter 4, the Lake Washington shoreline waterbody has been separated into 28 different reaches and categorized based on three land-uses. A summary of likely land use changes and the implications for shoreline management, including potential environment designations, for each land-use category is included in Tables 32-34. Within these tables, variations between reaches are discussed.

- Residential reaches: contains land areas in shoreline jurisdiction generally dominated by Single-Family Low Density (SF-L), Single-Family Medium Density (SF-M), Single-Family High Density (SF-H), Multi-Family Medium Density (MF-M), and Multi-Family High Density (MF-H) land use designations.

- Water Dependent Use Reaches: contains land areas in shoreline jurisdiction generally dominated by Single-Family Medium Density (SF-M) and Multi-Family High Density (MF-H) land use designations.

- Park Reaches: contains land areas in shoreline jurisdiction generally dominated by a Parks/Single-Family Medium Density (P/SF-M) land use designation.

6.1.1 Residential Reaches

Table 32. Likely changes in land use and implications for shoreline management for Lake Washington Residential Reaches.

Reaches	Likely Changes in Land Use	Implications for Shoreline Management
Reaches 1, 3, 5, 8, 9, 11, 13, 15, 16, 18, 21, 22, 23, 25, 26, 27, and 28 Single-family development along the Lake Washington shoreline.	With the exception of Reach 5, there is little likelihood of a change in land use because these residential reaches are almost entirely built out and are consistent with the Comprehensive Plan land use designations. Reach 5 is currently part of the Meydenbauer redevelopment plan which could change this reach to a park use. Reach 13 contains the Sisters of St. Joseph of Peace property, which is not expected to experience a change in land use, but does represent a potential opportunity for the City to explore ways to protect its nearshore habitat value.	Shoreline Residential appears to be the most appropriate environment designation for these reaches, with the exception of the Sisters of St. Joseph of Peace property, which may benefit from a parallel designation of Urban Conservancy along the shoreline.
Reach 7 Multi-family development along the Lake Washington shoreline .	There is little likelihood of change in land use within this reach. Existing multi-family properties may be redeveloped as similar uses or revitalized as mixed-use properties.	Urban Mixed or Urban Residential would be appropriate environment designations for this reach.

6.1.2 Water Dependent Use Reaches

Table 33. Likely changes in land use and implications for shoreline management for Lake Washington Water Dependent Use Reaches.

Reaches	Likely Changes in Land Use	Implications for Shoreline Management
Reach 6 Water dependent uses within Meydenbauer Bay (Meydenbauer Yacht Club and Bellevue Marina).	It is unlikely that the Yacht Club facility will change in the foreseeable future. However, land use changes to the City-owned marina property are possible in conjunction with the Meydenbauer redevelopment plan.	High Intensity may be a suitable environment designation for this reach.
Reach 20 Water dependent uses within the Newport Shore areas (Newport Yacht Basin and Newport Yacht Club).	With the exception of the current proposed expansion of the Seattle Boat Company property, it is unlikely that these facilities will change in the foreseeable future, although the existing residential land use designations are likely not appropriate.	High Intensity may be a suitable environment designation for this reach.

6.1.3 Park Reaches

Table 34. Likely changes in land use and implications for shoreline management for Lake Washington Park Reaches.

Reaches	Likely Changes in Land Use	Implications for Shoreline Management
Reach 4 Meydenbauer Beach Park.	The park is expected to remain a park, but will likely develop with more active uses, although perhaps not all within shoreline jurisdiction. There are opportunities to increase public access and increase opportunities for water-dependent recreational uses when this park is improved. Environmental restoration should also be considered.	Urban Conservancy – Open Space appears to be the most appropriate environment designation for this reach.
Reach 19 Mouth of Mercer Slough	There are no likely changes in land use for Mercer Slough Park.	Natural appears to the appropriate environment designation for this reach.
Remainder of public parks along the Lake Washington shoreline – Reaches 2, 10, 12, 14, 17, and 24.	There are no likely changes in land use for these public parks along Lake Washington. Minor park improvements and environmental restoration may occur in the future. The existing land use designations are appropriate.	Urban Conservancy – Open Space appears to be the most appropriate environment designation for these reaches.

6.2 KELSEY CREEK/MERCER SLOUGH

As noted in Chapters 4 and 5, the shoreline of Kelsey Creek/Mercer Slough has been divided into four reaches. A summary of likely land use changes and the implications for shoreline management, including potential environment designations, is included in Table 35.

- Reach 29 – Mercer Slough Nature Park: contains land areas in shoreline jurisdiction generally dominated by Single-Family Low Density (SF-L), Parks/Single-Family Low Density (P/SF-L), Multi-Family Medium Density (MF-M), and Parks/Multi-Family Medium Density (P/MF-M) land use designations.

- Reach 30 – Office: contains land areas in shoreline jurisdiction generally dominated by an Office (O) land use designation.

- Reach 31 – Lower Kelsey Creek Open Space: contains land areas in shoreline jurisdiction generally dominated by Single-Family Medium Density (SF-M) and Parks/Single-Family Medium Density (P/SF-M) land use designations.

- Reach 32 –Sturtevent Wetland: contains land areas in shoreline jurisdiction generally dominated by a Office, Limited Business (OLB) land use designation.

Table 35. Likely changes in land use and implications for shoreline management for Kelsey Creek/Mercer Slough.

Reaches	Likely Changes in Land Use	Implications for Shoreline Management
Reach 29 Mercer Slough Nature Park.	This area is unlikely to change as it is in public ownership and carries a Parks land use designation.	Urban Conservancy – Open Space appears to be the most appropriate environment designation for this reach.
Reach 30 The existing Bellefield Office Complex	With the Office (O) land use designation and predominance of office uses, it is unlikely that property in this area will change use.	High Intensity appears to be the most appropriate environment designation. It is important to add SMP provisions that ensure that shoreline conditions in this area are upgraded if it redevelops.
Reach 31 Open space adjacent to Kelsey Creek east of Interstate 405	This area is unlikely to change as it is in public ownership and carries a Parks land use designation.	Urban Conservancy – Open Space appears to be the most appropriate environment designation for this reach.
Reach 32 Sturtevant wetlands	There are no likely changes in land use, except for potentially some environmental restoration. The City should consider changing the land use designation to Parks because it currently has an Office, Limited Business designation.	Urban Conservancy – Open Space appears to be the most appropriate environment designation for this reach, although the existing land use designation is Office, Limited Business.

6.3 LAKE SAMMAMISH

As noted in Chapters 4 and 5, the shoreline of Lake Sammamish has been divided into five reaches. A summary of likely land use changes and the implications for shoreline management, including potential environment designations, is included in Table 36.

- Reaches 33-35, 37 – Residential: contains land areas in shoreline jurisdiction generally dominated by Single-Family Medium Density (SF-M), Single-Family High Density (SF-H), Multi-Family Medium Density (MF-M), and Neighborhood Business (NB) land use designations.

- Reach 36 – Vasa Park: contains land areas within Vasa Park, designated by a Single-Family High Density (SF-H) land use designation.

Table 36. Likely changes in land use and implications for shoreline management for Lake Sammamish.

Reaches	Likely Changes in Land Use	Implications for Shoreline Management
Reaches 33 and 34 Single-family residential development	There is little likelihood of a change in land use because the residential Reaches are almost entirely built out and are consistent with the Comprehensive Plan land use designations.	Shoreline Residential appears to be the most appropriate environment designation for these reaches.
Reach 35 Single- and Multi-family residential development	Although this reach contains a mix of single- and multi-family uses, there is little likelihood of any major changes in land use because the residential properties are nearly built out and are consistent with the Comprehensive Plan land use designations. However, the City has acquired three single-family shoreline parcels with the intention of developing a future park site. Therefore, land use changes in this reach is likely.	Shoreline Residential appears to be the most appropriate environment designation for this reach. In anticipation of City future park development of the current City-owned parcels, a separate Urban Conservancy designation could be given to these parcels.
Reach 36 Vasa Park	This private park area is unlikely to change land uses. However, because the property is not in public ownership, conversion to another use is possible. The only anticipated changes might include some park improvements.	Urban Conservancy – Open Space appears to be the most appropriate environment designation for this reach, although the existing land use designation is Single-Family Medium (SF-M) Density.
Reach 37 Single- and Multi-family residential development	Although this reach contains a mix of single- and multi-family uses, there is little likelihood of any major changes in land use because the residential properties are nearly built out and are consistent with the Comprehensive Plan land use designations.	Shoreline Residential appears to be the most appropriate environment designation for this reach However, the SAMBICA property would benefit from an alternate designation to account for its primary recreational use. Urban Conservancy appears to be a reasonable environment designation. .

6.4 PHANTOM LAKE

As noted in Chapter 4, the shoreline of Phantom Lake has been divided into five reaches. For the purposes of the analysis of land use changes and implications for shoreline management, the Residential reaches are discussed together. A summary of likely land use changes and the

implications for shoreline management, including potential environment designations, is included in Table 37.

- Reaches 38 and 40 – Residential: contains land areas in shoreline jurisdiction generally dominated by Single-Family Low Density (SF-L) and Single-Family Medium Density (SF-M) land use designations.

- Reaches 39 and 41 – Phantom Lake Parks: contains land areas in shoreline jurisdiction generally dominated by a Parks/Single-Family Low Density (P/SF-L) land use designation.

- Reach 42 – Larsen Lake/Lake Hills Greenbelt north of Phantom Lake: contains land areas in shoreline jurisdiction generally dominated by Single-Family Low Density (SF-L), Parks/Single-Family Low Density (P/SF-L), and Single-Family High Density (SF-H) land use designations.

Table 37. Likely changes in land use and implications for shoreline management for Phantom Lake.

Reaches	Likely Changes in Land Use	Implications for Shoreline Management
Reaches 38 and 40 Single-family residential development	There is little likelihood of a change in land use because the residential areas are almost entirely built out and are consistent with the Comprehensive Plan land use designations.	Shoreline Residential appears to be the most appropriate environment designation for this area.
Reach 39 Lake Hills Greenbelt at Phantom Lake	There are no likely changes in land use for this public park along Phantom Lake. Minor park improvements and environmental restoration may occur in the future. The existing land use designations are appropriate.	Urban Conservancy – Open Space appears to be the most appropriate environment designation for this reach.
Reach 41 Robinsglen Nature Park	There are no likely changes in land use for this public park along Phantom Lake. Minor park improvements and environmental restoration may occur in the future. The existing land use designations are appropriate.	Urban Conservancy – Open Space appears to be the most appropriate environment designation for this reach.
Reach 42 Lake Hills Greenbelt north of Phantom Lake	There are no likely changes in land use, except for minor park improvements and potentially some environmental restoration.	Urban Conservancy – Open Space appears to be the most appropriate environment designation for this reach.

7.0 SHORELINE MANAGEMENT RECOMMENDATIONS

The following are recommended actions for translating inventory and characterization findings into proposed SMP policies, regulations, environment designation boundaries and restoration strategies for areas within the shoreline jurisdiction.

7.1 SHORELINE MASTER PROGRAM

7.1.1 Shoreline Environment Designation Provisions

Recommendations for specific shoreline segments are discussed in Chapter 6.0. These include: Shoreline Residential, Urban Mixed or Urban Residential, High Intensity, Urban Conservancy – Open Space, and Natural.

Consider adding a new Aquatic environment designation for jurisdictional shoreline waterward of the ordinary high-water mark. This new designation would be consistent with the recommended designations in Department of Ecology's Shoreline Master Program Guidelines (WAC 173-26-201(3)(f)).

7.1.2 General Policies and Regulations

The City of Bellevue's current Shoreline Master Program and associated policies and regulations may be adequate to address many of the current Washington State Department of Ecology SMP update requirements. The following general shoreline policies and regulations are proposed to be considered in meeting the requirements listed under WAC 173-26. As part of assuring no net loss of shoreline ecological functions, the SMP should include provisions to require the analysis of environmental impacts and mitigation for unavoidable environmental impacts.

Archaeological and Historic Resources

There are several known historic resources located along Bellevue's shoreline, as discussed in Chapter 4.0. Although there are no known archaeological resources located along Bellevue's shoreline, policies should address clear direction regarding historical and cultural resources and circumstances when a special study may be necessary and what action to undertake in the event of an unexpected archaeological discovery. The following standards shall be incorporated into the City's SMP, per Ecology's SMP guidelines:

- Require that developers and property owners immediately stop work and notify the local government, the Office of Archaeology and Historic Preservation, and affected Indian tribes if archaeological resources are uncovered during excavation

- Require that permits issued in areas documented to contain archaeological resources require a site inspection or evaluation by a professional archaeologist in coordination with affected Indian tribes.

Critical Areas Regulations

Provide for critical area regulations within the Shoreline Management Area that provide at least an equal level of protection to the current City-wide critical area regulations.

Further, if the City elects to incorporate either by reference or appendix its existing critical areas regulations into the SMP, those regulations may need to be amended further to comply with additional WAC criteria in WAC 173-26-221(2)(c). This may include limitations on critical area exceptions and exemptions.

Address the fact that there are a number of wetlands which are hydraulically connected to the shoreline waterbodies and thus may extend shoreline jurisdiction beyond the standard 200-foot jurisdictional area.

Flood Hazard Management Regulations

Ensure that the SMP reflects items regarding flood hazard prevention as discussed in the City's current Emergency Operations Plan.

Parking Regulations (Accessory)

Prepare provisions that accommodate accessory parking for Bellevue's parks, trails and open space users. In many places, parking may be advantageously located outside jurisdiction, but in some locations, it may be necessary to develop parking within shoreline jurisdiction. Some parks may have adequate levels of parking, while many of the locations have limited parking. Continue to seek ways to provide parking opportunities to allow park users adequate access to facilities.

Public Access

Work with the Parks department to identify improvements to increase the quality of public access. The City of Bellevue's shorelines provide excellent public access opportunities. Besides the Lake Washington shoreline, Mercer Slough, Kelsey Creek and the Lake Hills Greenbelt all provide a variety of opportunities such as passive enjoyment, nature study, fishing, boating and active sports. Provide provisions that promote the expansion of public access along the Lake Sammamish shoreline. Provisions for water-enjoyment uses and recreation uses should allow appropriate park and recreation improvements and encourage water-enjoyment uses along appropriate sections of the shoreline.

Policies and regulations that address the development of new or redevelopment of existing access and recreation facilities should ensure that the development of such facilities result in no net loss of ecological function. Regulations should address upland uses and developments within shoreline jurisdiction, such as the location and design of parking facilities and active play areas, as well as the development of in-water and nearshore structures, such as piers/docks and swimming areas.

Ensure policies and regulations that are developed for the SMP are consistent with those identified in the City's Parks & Open Space System Plan, the Shoreline Management

Element and Parks, Open Space and Recreation Element of the Comprehensive Plan. In general, physical access for swimming, boating, passive recreation (such as interpretive trails) and habitat enhancement should continue to be priority policy objectives for the management of shoreline public access sites.

Include regulations which limit height, provide minimum setbacks and maintain view corridors along shoreline areas which are sensitive to view impacts while preserving natural vegetation and tree cover along shoreline waterbodies.

Shorelines of Statewide Significance

Refer to or incorporate Shorelines of Statewide Significance priorities of RCW 90.58.020 in the SMP policies. Lake Washington, Lake Sammamish, and Mercer Slough are Shorelines of Statewide Significance; provisions for shorelands of these waterbodies must address the priorities in section 90.58.020 RCW. Additionally, public access areas of the lake shorelines and trails and waterways of Mercer Slough provide a significant amount of recreational opportunities within shoreline jurisdiction and therefore should be considered of relevance to state interest. Finally, corridors for migrating listed salmon species, habitat restoration and water quality improvements are in the broader statewide interest. By giving priority to these shoreline functions, the Master Program can comply with shorelines of statewide interest policy.

In managing the shoreline area, City of Bellevue shall develop regulations that:

- Preserve the natural character of the shoreline to the extent possible;
- Seek long term over short term benefits to the shoreline area;
- Protect resources and ecology of the shoreline area; and,
- Increase public access and recreational opportunities along the shoreline.

Water Quality

Identify measures that can be taken to improve water quality, particularly along Lake Washington, Lake Sammamish and Phantom Lake.

Incorporate or reference appropriate goals and policies from the City's water and stormwater management plans.

Incorporate as appropriate any goals, policies or regulations that result from the City's efforts to comply with its NPDES Phase II stormwater permit requirements. Integrate City's NPDES stormwater activities with shoreline planning, either as part of the SMP or the Restoration Plan.

Address the sustainability of the City's water quality, public health, and stormwater discharge as it relates to the protection of the ecological functions of the shoreline.

Vegetation Conservation

Include provisions to retain and enhance shoreline vegetation around Lake Washington, Lake Sammamish, Larsen Lake and Phantom Lake.

Identify measures to enhance vegetation along the Mercer Slough and Kelsey Creek.

Include provisions for the control of invasive aquatic weeds, especially on Lake Washington and Lake Sammamish. If necessary, include in the SMP policies calling for public actions to address invasive aquatic weeds.

Low Impact Development and "Green Building" Practices

Coordinate with City staff to make sure that SMP provisions support the City's goals and WRIA 8 recommendations for encouraging environmentally responsible development.

Explore opportunities to provide incentives for low impact development on the shoreline. For example, limit impermeable surface coverage unless mitigated through LID techniques.

7.1.3 Shoreline Modification Provisions

Shoreline Stabilization

Explore a range of incentives to reduce the amount of bulkheads and shoreline armoring over time around the Lake Washington and Lake Sammamish shorelines. Water depth and erosion concerns vary greatly around the lakes. Waves from water ski and wakeboard boats, along with waves derived from wind action, appear to be the most likely to cause shoreline erosion. As discussed in the critical areas ordinance, alternative methods to typical shoreline armoring using native vegetation and other natural shoreline features should be considered.

Include regulations which permit shoreline stabilization structures only if there is a demonstrated need to protect existing structures from erosion.

Ensure "replacement" and "repair" definitions and standards are consistent with WAC 173-26-231(3)(a). Replacement structures should be designed, located, sized and constructed to assure no net loss of ecological function.

City CIP plans should be designed to assure no net loss of ecological function and values.

Shoreline Restoration

Include provisions encouraging applicable shoreline restoration activities.

Piers, Docks and Floats

Continue to provide clear dimensional standards for new piers and replacement/modified piers, as well as standards that address materials used for dock and pier replacements/modifications that may be proposed in the future along Lake Washington.

Continue to include regulations which encourage joint-use docks whenever feasible rather than individual docks for each residence.

Continue to ensure pier regulations are consistent with state and federal design standards.

Fill

As directed by the Shoreline Master Program Guidelines, provide appropriate limitations on placement of fill in shoreline areas, including areas waterward of the ordinary high water mark. Restoration fills should be encouraged, including improvements to shoreline habitats, material to anchor large woody debris placements, and as needed to implement shoreline restoration.

Breakwaters, Jetties, Groins and Weirs

Consistent with WAC 173-26-231(3)(d), the SMP should prohibit these structures unless necessary to "necessary to support water-dependent uses, public access, shoreline stabilization, or other specific public purpose."

Dredging and Dredge Material Disposal

As directed by the Shoreline Master Program Guidelines, provide appropriate limitations on dredging (excavation) in shoreline areas. Dredging activities in the City's shorelines are not expected to occur on a frequent basis, but may be conducted as part of certain maintenance activities, or to implement restoration projects or culvert/bridge replacements.

Shoreline Habitat and Natural Systems Enhancement Projects

The SMP should include incentives to encourage restoration projects, particularly in areas identified as having low function. Emphasize that certain fills can be an important component of some restoration projects.

7.1.4 Shoreline Uses

Agriculture

Include provisions for selected applicable agricultural activities. There are a few sections of shoreline that feature small agricultural activities, specifically within Mercer Slough Nature Park and Lake Hills Greenbelt. The Comprehensive Plan includes land use designations that allow for agricultural support activities. The SMP should address these uses within the limited context envisioned in Bellevue's Comprehensive Plan.

Boating Facilities

Include provisions for boat ramps, launches, floats, and marinas located along the City's shorelines.

Address the issue of boating impacts, such as erosion from boat wakes or water quality degradation, on Lake Washington and Lake Sammamish.

Incorporate regulations which assure future development activities of boating facilities do not impact shoreline ecological functions and will result in no net loss.

Ensure regulations mitigate aesthetic impacts of boating facilities to avoid adverse impacts to adjoining uses.

In-stream structural uses

In-stream structural uses within the shoreline management area may include such features as culverts, landscape ponds, or minor enhancements. Per WAC 173-26-241(3)(g), develop policies and regulations that considers "protection and preservation of ecosystem-wide processes, ecological functions, and cultural resources," during location and planning of in-stream structures.

Recreation

Work with the Parks Department to identify issues related to park development. City parks provide many opportunities for shoreline restoration and can serve as demonstration projects to the greater public. Policies and regulations related to parks management should provide clear preferences for shoreline restoration consistent with public access needs and uses. Existing natural parks should be protected and enhanced. Focus on expansion of park system along the Lake Sammamish shoreline.

Develop policies which continue to encourage the enhancement of ecological functions along the undeveloped portions of the shoreline and retain future options for passive and active shoreline recreation and public access.

Residential Development

Maintain appropriate residential setbacks from the OHWM based on no-net loss of shoreline ecological functions.

Consider providing incentives to achieve shoreline rehabilitation and enhancement.

Educate waterfront homeowners regarding fish and wildlife habitat enhancement along their shoreline. Encourage the removal of shoreline armoring, where feasible, through the use of code incentives.

Include a policy to continue education of waterfront homeowners about the use of fertilizers and chemicals and encourage natural lawn care and landscaping methods to reduce chemical output into surrounding waterbodies.

Continue to encourage low impact development techniques that reduce impervious surface areas and increase use of eco-friendly stormwater detention/transmission.

Transportation

Address impacts from transportation projects (e.g.: SR 520 expansion)

Utilities

Whenever feasible, all shoreline utility projects should be coordinated so as to minimize ecological impacts to the shoreline. Address issue of utility lines along the shoreline.

Include provisions for utilities repair and maintenance in shoreline jurisdiction, particularly for in-water utilities work.

Water Oriented Commercial Uses

Address opportunities for including more uses that increase opportunities for public enjoyment of the shoreline. For example, restaurants and cafes and other retail activities that orient toward the water should be addressed. Identify opportunity sites and include SMP provisions specifically allowing such uses. Discuss with Parks Department the possibility of concessions for small eating and drinking establishments as part of park development.

Include provisions for public transportation and utilities development in the shoreline jurisdiction. However, transportation or parking facilities as a primary use should be discouraged.

7.2 RESTORATION PLAN

The Restoration Plan should be prepared consistent with WAC 173-26-201(2)(f)(i-vi) by addressing the following six subjects:

(i) Identify degraded areas, impaired ecological functions, and sites with potential for ecological restoration;

The discussions of degraded areas, impaired functions, and opportunity areas included in this report should be carried forward to the Restoration Plan.

(ii) Establish overall goals and priorities for restoration of degraded areas and impaired ecological functions;

A recommended starting point for development of restoration goals and priorities is the WRIA 8 products. Although the WRIA 8 work is largely salmon-focused, many of the salmon-related goals, policies, and other actions benefit other fish and wildlife as well. The WRIA 8 goals and policies should be examined and supplemented as needed to ensure that these goals are appropriate and comprehensive for application to Lake Washington and Lake Sammamish.

(iii) Identify existing and ongoing projects and programs that are currently being implemented, or are reasonably assured of being implemented (based on an evaluation of funding likely in the foreseeable future), which are designed to contribute to local restoration goals;

Identify City programs and outside organizations that are actively engaged in planning and implementing projects that could directly or indirectly contribute to achievement of restoration goals. A special effort should be made to ensure that all City departments are contacted to identify additional projects or programs. Further, other organizations should be contacted to determine what projects or programs may be implemented in the future that would have a positive effect on shoreline ecological functions.

(iv) Identify additional projects and programs needed to achieve local restoration goals, and implementation strategies including identifying prospective funding sources for those projects and programs;

The degraded areas, impaired ecological functions, and sites with potential for ecological restoration identified under (i) above, and not addressed by any of the programs and projects identified in (iii) above, could be translated into additional projects and programs that the City should evaluate for implementation potential. Often, implementation of projects and programs is dependent on annual budgets, grant funding, partnerships with other entities, and unexpected "windfalls." The City should clearly identify and then pursue potential partners for implementation of certain projects or programs.

(v) Identify timelines and benchmarks for implementing restoration projects and programs and achieving local restoration goals; and

(vi) Provide for mechanisms or strategies to ensure that restoration projects and programs will be implemented according to plans and to appropriately review the effectiveness of the projects and programs in meeting the overall restoration goals.

To the best of its ability, the City should identify timelines and benchmarks for each project and program. For some planned actions, such as implementation of CIP projects, this may be easy. For other projects and programs that are the responsibility of outside organizations or that do not have a clear City authority, timelines and benchmarks may of necessity be vague and speculative. City staff and elected officials must share a commitment to planning for restoration and monitoring project and program effectiveness in order for the City to meet its long-term restoration goals.

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9.0 LIST OF ACRONYMS and ABBREVIATIONS

CAO .....City of Bellevue Critical Areas Ordinance

Corps .....U.S. Army Corps of Engineers

Ecology .....Washington Department of Ecology

GMA .....Growth Management Act

HPA.....Hydraulic Project Approval

LUC.....Bellevue Land Use Code

LWD .....Large Woody Debris

NOAA Fisheries.....National Marine Fisheries Service

NRCS .....Natural Resources Conservation Service

PAHs .....polycyclic aromatic hydrocarbons

PCBs .....polychlorinated biphenyls

PHS .....Priority Habitats and Species

SMA .....Shoreline Management Act

SMP.....Shoreline Master Program

USFWS .....U.S. Fish and Wildlife Service

USGS .....U.S. Geological Service

WDFW.....Washington Department of Fish and Wildlife

APPENDIX A

INFORMATION REQUEST LETTER AND DISTRIBUTION LIST

APPENDIX B

LIST OF DATA SOURCES

APPENDIX C

ASSESSMENT OF SHORELINE JURISDICTION

APPENDIX D

MAP FOLIO