CITY OF GIG HARBOR

Shoreline Inventory and Characterization

This report was funded in part through a cooperative agreement with the National Oceanic and Atmospheric Administration. The views expressed herein are those of the author(s) and do not necessarily reflect the views of NOAA or any of its subagencies.

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Last Revised April 2011

TABLE OF CONTENTS

MAP FOLIO

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

1.0 INTRODUCTION

1.1 Background and Purpose

The purpose of this report is to document a baseline inventory of conditions in the shoreline jurisdiction of the City of Gig Harbor (City), Washington. The bulk of this report was prepared in 2003, funded in part through a Washington State Coastal Zone Management Program grant (CZM 306 Grant No. G0200048, as amended). In that same year, the Washington State Legislature passed Substitute Senate Bill (SSB) 6012, which established timelines for all cities and counties to amend their local shoreline master programs (SMPs) consistent with the Shoreline Management Act (SMA), RCW 90.58 and its updated implementing guidelines, Washington Administrative Code (WAC) 173-26. The City of Gig Harbor is required to prepare a comprehensive update to its SMP by the end of 2011. The City's first step towards a comprehensive SMP update is revising the 2003 report to update technical information that has changed or been made available since 2003, and to be consistent with the current state shoreline guidelines. The report provides:

- Analysis and characterization of ecosystem-wide processes that affect the City's shorelines;
- Analysis and characterization of shoreline functions;
- Opportunities for protection, restoration, public access and shoreline use; and
- Shoreline management recommendations and policy options for consideration in subsequent phases of the SMP update.

The inventory and characterization documents current shoreline conditions and provides a basis for updating the City's SMP goals, policies, and regulations. This report will help the City establish a baseline of conditions, evaluate functions and values of resources in its shoreline jurisdiction, and explore opportunities for conservation and restoration of ecological functions.

This characterization also includes a map folio, located at the end of the document. All figures referenced in the document are found in the map folio.

1.2 Shoreline Jurisdiction and Study Area Boundary

Under the SMA, the shoreline jurisdiction generally includes areas that are 200 feet landward of the ordinary high water mark (OHWM) of waters that have been designated as "shorelines of statewide significance" or "shorelines of the state." These designations were established in 1972, and are described in Washington Administrative Code (WAC) 173-18. Generally, "shorelines of statewide significance" include portions of Puget Sound and other marine water bodies, rivers west of the Cascade range that have a mean annual flow of 1000 cubic feet per second (cfs) or greater, rivers east of the Cascade range that have a mean annual flow of 200 cfs or greater, and fresh water lakes with a surface area of 1,000 acres or more. "Shorelines of the state" are generally described as all marine shorelines and shorelines of all other streams or rivers having a mean annual flow of 20 cfs or greater and lakes with a surface area greater than 20 acres.

There are no "shorelines of the state" associated with rivers, streams, or lakes in the City or its Urban Growth Area (UGA) (USGS, 1998; Bahls, et al., 2006). Approximately 8.8 miles of the Puget Sound shoreline within the City limits and in the vicinity of its UGA is defined as a "shoreline of the state" except that the portion of Puget Sound seaward from the line of extreme low tide is considered a "shoreline of statewide significance", per RCW 90.58.030(2)(e). Under the SMA, the shoreline area to be regulated under the City's shoreline master program must include all shorelines of statewide significance, shorelines of the state, and their adjacent shorelands, defined as the upland area within 200 feet of the OHWM, as well as any associated wetlands (RCW 90.58.030) within its municipal jurisdiction. Since the SMP is in part a long-range planning document, this characterization includes those marine shorelines within the city limits as well as the UGA. This includes Gig Harbor Bay (for purposes of this report the marine environment of the Harbor shall be referred to as Gig Harbor Bay), portions of Colvos Passage and the Narrows, and portions of Henderson Bay and Burley Lagoon adjacent to the City's northern city limits and northern UGA boundary (Figure 1). The shoreline jurisdiction also includes areas 200 feet upstream of the mouths of Crescent Creek and Donkey Creek (also known as North Creek), which flow through the City into Gig Harbor Bay. Also included in the study are portions of Purdy Creek, which flows into Burley Lagoon, and Goodnough and McCormick Creeks, which both discharge into Henderson Bay. Unless otherwise stated, generalized references to the city or the city shoreline jurisdiction include shorelines in the UGA.

The City's shoreline jurisdiction also extends to the landward edge of associated wetlands. "Associated wetlands" means those wetlands, that are in proximity to and either influence or are influenced by tidal waters or a lake or stream subject to the SMA (WAC 173-22-030 (1)). These are typically identified as wetlands that physically extend into the shoreline jurisdiction, or wetlands that are functionally related to the shoreline jurisdiction through surface water connection and/or other factors. The specific language from the RCW describes the limits of shoreline jurisdiction as follows:

> *"those lands extending landward for two hundred feet in all directions as measured on a horizontal plane from the ordinary high water mark; floodways and contiguous floodplain areas landward two hundred feet from such floodways; and all associated wetlands and river deltas"* (RCW 90.58.030(2)(f)).

Wetlands associated with SMA regulated waters in Gig Harbor are limited to estuarine wetlands in the City and UGA (Adolfson, 2005), primarily associated with the lower reaches and mouths of Donkey and Crescent Creeks.

1.3 Shoreline Planning Segments

For the purposes of this study, the City's shoreline jurisdiction was organized into six distinct segments (A through F) based broadly on the physical distinction along the shoreline, the level of ecological functions provided by each segment, as well as existing land uses and zoning. Shoreline Planning Segments are described in Table 1-1 and depicted on Figure 2.

Table 1-1. Shoreline Planning Segments

Segment	Approximate Length (feet)	Approximate Segment Acreage	General Boundaries
A	1,656	4.8	Eastern Urban Growth Area (UGA) along Colvos Passage to the Gig Harbor spit
B	9,614	43.4	North of the Gig Harbor spit in UGA to North Harborview Drive NW/Rust Street Intersection in city limits
C	11,720	48.0	North Harborview Drive NW/Rust Street Intersection to Old Ferry Landing
D	13,092	52.8	Old Ferry Landing to southern UGA along the Narrows
E	4,981	19.3	Along Henderson Bay from McCormick Creek to northern city limits and continuing north in UGA to Goodnough Drive NW/Purdy Drive NW intersection (north of Goodnough Creek)
F	5,611	21.8	Goodnough Drive NW/Purdy Drive NW intersection (north of Goodnough Creek) to northwestern UGA limits along Burley Lagoon

2.0 CURRENT REGULATORY FRAMEWORK SUMMARY*

2.1 City of Gig Harbor

2.1.1 Current Shoreline Management Act Compliance

The SMA is implemented through the development of local SMPs, which establish a system to classify shoreline areas into specific "environment designations." The purpose of the shoreline environment system is to provide a uniform basis for applying policies and use regulations within distinctly different shoreline areas. In a regulatory context, shoreline environment designations provide the governing policy and regulations that apply to land within the SMP jurisdiction. Portions of individual parcels that are outside SMP jurisdiction are governed by zoning and other applicable land use regulations. Generally, environment designations should be based on existing and planned development patterns, biological and physical capabilities and limitations of the shoreline, and a community's vision or objectives for its future development. Under the city's existing SMP (adopted in 1975, last amended in 1994) two shoreline environments are established: Urban and Urban Residential. Refer to the existing SMP for additional information on the existing goals, policies, and environment designations (City of Gig

* The discussion of regulatory requirements included in this report is not intended to be a complete list of all permits or approvals necessary for work within the city's shoreline jurisdiction or other areas within the city or UGA. Other portions of local code and state and federal regulations may apply to development projects within the city. The permits and approvals necessary for construction may vary from parcel to parcel regardless of shoreline jurisdiction and may vary depending on the type and intensity of the work proposed. Prior to any construction within city limits, an applicant should contact the city and the applicable state and federal agencies to determine actual permit requirements. For development of parcels in the UGA outside of the city limits, an applicant should contact Pierce County and the applicable state and federal agencies to determine actual permit requirements.

Harbor, 1994a). Shoreline properties within the City's UGA are regulated under the Pierce County SMP, until such properties are annexed and the City's SMP is amended.

2.1.2 Comprehensive Plan, Zoning and Other City Regulations

- **City of Gig Harbor Comprehensive Plan** – The City of Gig Harbor's *Comprehensive Plan*, adopted in 2004 and last revised in 2008, outlines general growth management goals over the next 20 years. The Plan includes goals and policies for shoreline management, land use, and the environment (City of Gig Harbor, 2007a). The Plan incorporates by reference the Gig Harbor Park, Recreation and Open Space Plan (March 2001) to serve as the City's Park and Recreation Comprehensive Plan Element. Eight "generalized land use categories" are described in the Plan. These categories serve as the basis for more detailed zoning code designations. Land use categories include residential, public/institutional, employment centers, commercial/business, waterfront, planned community development, mixed use, and preservation areas. The *Comprehensive Plan* references policies established in other adopted Gig Harbor planning documents, including the City's Comprehensive Transportation Plan, Stormwater Comprehensive Plan, Comprehensive Water Plan, and Sewer Comprehensive Plan. Land use designations are relevant to this shoreline characterization report as they establish the general land use patterns and vision of growth the City has adopted for areas both inside and outside the shoreline jurisdiction.

  The City initially intended to develop and adopt a View Basin Neighborhood Sub-Area Plan concurrently with the SMP update to address view related issues associated with the area generally bounded by SR-16 on the west, the Gig Harbor Urban Growth Boundary on the east, Vernhardson Street on the north and Grandview Street on the south. The view basin includes the city's primary shoreline area, downtown commercial core, a historic residential area and an upland residential area with significant marine and mountain views. The goal of the Plan is to develop policies and regulations that preserve and enhance the existing character of the View Basin. The View Basin Neighborhood Sub-Area Plan will be developed consistently with the city's Comprehensive Plan and will include the following elements: Land Use; Community Design; Economic Development; Shoreline Management; Parks, Recreation and Open Space, Transportation and Capital Facilities. The plan will also include recommendations for implementing development regulations which would be adopted by the city after the plan's adoption. The plan will address a number of specific topics such as the view basin neighborhood boundary, land use/zoning, design standards, parking, shorelines, future annexation, historic structures and capital facilities. Due to budgetary issues, the development of the Plan has been delayed and will start no sooner than January, 2011. Under the best case scenario, the SMP update process will overlap with this effort; and the two will need to be coordinated on issues related to land use policy, design standards, and shoreline development. If the View Basin planning effort starts after the adoption of the City's updated SMP, it will need to be developed consistently with the SMP, or will identify issues that may require a further update to the document consistent with the provisions of WAC 173-26.

- **Gig Harbor Municipal Code, Title 17: Zoning** – Title 17 of the *Gig Harbor Municipal Code* (GHMC) establishes zoning districts in the city (City of Gig Harbor, 2008a). These districts, which follow land use designations established in the City *Comprehensive Plan*, include three residential zones, four commercial/business zones, two mixed residential/business zones, a public/institutional district, five planned community development zones, an employment district, and three waterfront zones (residential, Millville, and commercial). Zoning is shown on Figure 2.

- **Gig Harbor Municipal Code, Chapters 18.04 (SEPA) and 18.08 (Critical Areas) –** Chapter 18.04 of the GHMC provides guidance to project applicants that require State Environmental Policy Act (SEPA) environmental review.

  Chapter 18.08 of the GHMC establishes development standards, construction techniques, and permitted uses in critical areas and/or their buffers (wetlands, streams, critical fish and wildlife habitat areas, aquifer recharge areas, hillsides, ravine sidewalls, bluffs, landslide and erosion areas, seismic hazard areas, and flood hazard areas) to protect these areas from adverse impacts.

- **Gig Harbor Stormwater Comprehensive Plan –** The *Stormwater Comprehensive Plan* (City of Gig Harbor, 2001a), provides a description of the regulations and physical characteristics of the City's storm drainage system and a summary of capital improvement projects, enhanced maintenance activities, and other recommendations pertaining to the storm drainage system. Some problem areas and capital improvement projects identified in the Plan are located in the City's shoreline jurisdiction.

- **Gig Harbor Municipal Code Chapter 14.20, Stormwater Management** – Chapter 14.20 of the GHMC addresses development and redevelopment activity within the city of Gig Harbor with regard to stormwater drainage. The provisions of the chapter establish the minimum standards and construction procedures that must be met before issuance of a permit for development or redevelopment of property (City of Gig Harbor, 2009).

2.2 State and Federal Regulations

A number of state and federal agencies may have jurisdiction over land or natural elements in the City's shoreline jurisdiction. Local development proposals most commonly trigger requirements for state or federal permits when they impact wetlands or streams; potentially affect fish and wildlife listed under the federal Endangered Species Act (ESA); result in over one acre of clearing and grading; or affect the floodplain or floodway. As with local requirements, state and federal regulations may apply throughout the city, but regulated resources are common within the City's shoreline jurisdiction. The state and federal regulations affecting shoreline-related resources include, but are not limited to:

- Endangered Species Act (ESA): The federal ESA addresses the protection and recovery of federally listed species. The ESA is jointly administered by the National Oceanic and Atmospheric Administration (NOAA) Fisheries (formerly referred to as the National Marine Fisheries Service [NMFS]), and the United States Fish and Wildlife Service (USFWS).

- Clean Water Act (CWA): The federal CWA requires states to set standards for the protection of water quality for various parameters, and it regulates excavation and dredging in waters of the U.S., including wetlands. Certain activities affecting wetlands in the City's shoreline jurisdiction or work in the adjacent rivers may require a permit from the U.S. Army Corps of Engineers and/or Ecology under Section 404 and Section 401 of the CWA, respectively.

- Hydraulic Project Approval (HPA): The Washington Department of Fish and Wildlife (WDFW) regulates activities that use, divert, obstruct, or change the natural flow of the beds or banks of waters of the state and may affect fish habitat. Projects in the shoreline jurisdiction requiring construction below the ordinary high water mark of marine waters in the City or tributary streams could require an HPA from WDFW. Projects creating new impervious surface that could substantially increase stormwater runoff to waters of the state may also require approval.

- National Pollution Discharge and Elimination System (NPDES): Ecology regulates activities that result in wastewater discharges to surface water from industrial facilities or municipal wastewater treatment plants. NPDES permits are also required for stormwater discharges from industrial facilities, construction sites of one or more acres, and municipal stormwater systems that serve populations of 100,000 or more.

3.0 LAND AND SHORELINE USE PATTERNS

The city encompasses an area of approximately seven square miles. An additional three square miles of unincorporated land lies within the City's UGA. As of June, 2009, the City's population was approximately 7,500. Growth in population is expected in Gig Harbor. The population growth target for the year 2022 (the Comprehensive Plan horizon year) is 10,800 (City of Gig Harbor, 2007a). Current land use, zoning maps, and aerial photographs indicate that most properties in the City's shoreline jurisdiction are at least partially developed, including buildings, parking lots, roads, and waterfront oriented development, such as marinas and private docks and piers.

3.1 Existing Land Use

Current land use in Gig Harbor is a mix of residential, commercial/business, vacant, open space and recreation, resource lands, and waterfront areas. Residential land use is currently the dominant land use extending throughout the City and its UGA. Along Gig Harbor Bay, approximately 50 percent of the land use adjacent to the shoreline is residential, concentrated in the East Gig Harbor UGA and near the mouth of Crescent Creek. Approximately 83 percent of the land use south of the Gig Harbor Bay inlet is residential. The City's remaining shoreline jurisdiction along Gig Harbor Bay is currently in waterfront land uses including commercial/retail buildings; an historic area known as "Millville," which housed the original sawmills used during the City's early lumber industry days; parks; marinas; and commercial fishing and private docks. Land uses adjacent to the shoreline of Henderson Bay and Burley Lagoon include residential, commercial, and business (City of Gig Harbor, 2007b; Pierce County, 2008).

The City conducted a survey of existing uses to determine the number of water-oriented and non-water-oriented uses present along the shoreline in Gig Harbor (see Appendix E). The survey focused on areas with an existing concentration of commercial uses. These included downtown Gig Harbor (generally along Harborview Drive), North Gig Harbor (generally along North Harborview Drive) and Henderson Bay and Burley Lagoon in the Purdy commercial area. Parcels were categorized as either water-dependent, water-related, water-enjoyment, or non-water-oriented (referred to in the survey as "non-conforming"). The table below is a summary of the survey findings:

Table 3-1. Summary of Water-oriented and Non-water-oriented Uses Surveyed

Use Type	Downtown Gig Harbor (number of parcels)	North Gig Harbor (number of parcels)	Henderson Bay and Burley Lagoon (number of parcels)	Total for Each Use
Water-dependent	20	0	1	21
Water-related	6	4	2	12
Water-enjoyment	16	5	5	26
Total water-oriented	**42**	**9**	**8**	**59**
Non-water-oriented	12	7	6	25
Total non-water-oriented	**12**	**7**	**6**	**25**
Total Number of Parcels Surveyed	**54**	**16**	**14**	**84**

The findings of the City survey revealed a mix of water-oriented and non-water-oriented uses in the commercial areas of Gig Harbor and its UGA. Overall, 70 percent of the properties surveyed contain water-oriented uses and 30 percent contain non-water-oriented uses. Water-dependent uses are prevalent in downtown Gig Harbor, while uses in North Gig Harbor and Henderson Bay and Burley Lagoon are a balanced mix between water-oriented and non-water-oriented.

The mix of commercial uses in downtown Gig Harbor is not a new trend. Since the early 1900s, downtown Gig Harbor has been characterized by a mix of water-dependent uses such as netsheds and logging mills and business services such as a post office, general store, and livery stable. As downtown Gig Harbor expanded, additional uses such an auto repair shop, sheet metal shop, ferry terminal, shipyards, fuel depots, and marinas were established (Andrews History Group, 2009).

3.2 Comprehensive Plan

According to the Gig Harbor *Comprehensive Plan* (City of Gig Harbor, 2007a), the City contains a variety of designated land uses. In the City's shoreline jurisdiction, the predominant comprehensive land use designation is waterfront uses followed by residential low density. Waterfront land use designations occupy approximately 55 percent of the City's shoreline jurisdiction; residential designations occupy approximately 28 percent; and commercial/business designations occupy 17 percent. Remaining land use designations along the shoreline in the City's UGA include Public/Institutional and Employment Centers. The Waterfront designation provides for a variety of mixed uses along the waterfront which are allowed under the City's SMP, and more particularly defined in the zoning code. Waterfront uses in this designation provide for marinas, commercial and retail uses, and residential uses (City of Gig Harbor, 2007a, 2007b).

Goals established in the *Comprehensive Plan* focus on the preservation of the unique waterfront associated with the City. According to the *Comprehensive Plan*, waterfront design should preserve existing visual points of interest and architecture and should be established in a manner that encourages outdoor activities along the commercial waterfront zones. In addition, the Environment Element of the *Comprehensive Plan* mentions general goals to ensure the protection of harbor resources and related waterfront lands by encouraging mixed-use developments, buffer zone setbacks, common shoreline or dock improvements, and other innovative concepts that conserve or increase commercial fishing and recreational boating activities. Finally, the Shoreline Management Element discusses general goals to protect the natural quality of the City shorelines, including preserving the natural shoreline and harbor setting through regulating dredging; excavations; landfill; and construction of bulkheads, piers, docks, marinas or other improvements that will restrict natural functions or the visual character of the harbor or shoreline.

3.3 Zoning Designations

The City's zoning designations generally follow land use designations discussed above. Single-family residential zoning (R-1) occupies the largest portion of the total shoreline area (approximately 75 percent), including urban growth areas. Remaining zoning designations in the Gig Harbor Bay shoreline area are divided between Waterfront Commercial, Waterfront Residential, Waterfront Millville, Commercial District, and Medium-Density Residential District. The area south of Gig Harbor Bay, along the Puget Sound Narrows shoreline, includes zoning designations of Single-Family and Medium-Density Residential. The Henderson Bay shoreline environment within city limits (near McCormick Creek) is currently zoned Single-Family Residential. The Henderson Bay and Burley Lagoon shoreline environments, within the City's UGA boundary, are currently zoned by Pierce County as Single-Family Residential, Waterfront Commercial, General Business District, Employment District, and Public-Institutional District (Figure 2) (City of Gig Harbor, 2007b).

Table 3-2 identifies the relative percentage of existing land uses in each planning segment based on 2008 Pierce County Assessor generalized land use records (Pierce County, 2008). Table 3-2 also includes the Comprehensive Plan land use and zoning designations for each segment, as

well as the approximate amount of impervious area within each shoreline planning segment. Impervious area in the City's shoreline jurisdiction was estimated based on zoning. Zoning classes allow varying degrees of development densities and associated impervious surface cover (City of Gig Harbor, 2008a). Finally, Table 3-2 identifies the shoreline environment designations for areas that were within the City limits as established by the 1994 *Shoreline Master Program*.

Table 3-2. Land Use and Zoning

Shoreline Segment	Existing Land Use (Includes approximate percentage within the segment)		*Comprehensive Plan* Land Use Designations	Existing Zoning (Includes Approximate percentage of each zoned area within the segment)		Approximate Impervious Area	Shoreline Environments (if applicable)
A	Residential Transportation/Utilities Vacant Resource Land	53% 21% 14% 13%	Residential Low	Single-Family Residential (R-1)	100%	40%	Natural/ Rural Residential (Pierce County SMP)
B	Residential Transportation Recreation/Open Space Vacant	78% 11% 6% 6%	Residential Low Public/Institutional	Single-Family Residential (R-1) Waterfront Residential (WR)	99% 1%	40%	Rural Residential (Pierce County SMP) Urban (near Crescent Creek)
C	Transportation/Utilities Commercial Residential Unclassified Vacant Resource Land Recreation/Open Space	29% 27% 23% 7% 7% 3% 2%	Waterfront Residential Low Commercial/Business	Waterfront Commercial (WC) Waterfront Residential (WR) Waterfront Millville (WM) Single-Family Residential (R-1) Commercial District (C-1) General Business District (B-2) Downtown Business District (DB) Residential and Business District (RB-1)	31% 22% 19% 13% 8% 4% 3% 1%	63%	Urban
D	Residential Vacant Recreation/Open Space Unclassified Uses	83% 8% 5% 4%	Residential Low	Single-Family Residential (R-1) Medium-Density Residential (R-2)	94% 6%	41%	Urban Residential
E	Residential Recreation/Open Space Transportation/Utilities Unclassified Uses Vacant	63% 14% 14% 4% 4%	Residential Low	Single-Family Residential (R-1)	100%	40%	Rural Residential (Pierce County SMP)
F	Transportation/Utilities Commercial Residential Vacant Resource Land	50% 18% 16% 12% 3%	Commercial/Business Employment Centers Public/Institutional	Single-Family Residential (R-1) Waterfront Commercial (WC) General Business District (B-2) Employment District (ED) Public-Institutional District (PI)	51% 40% 6% 2% 1%	55%	Urban (Pierce County SMP)

Sources: City of Gig Harbor, 2007; Pierce County, 2008.

3.4 Roads and Transportation Facilities

State Route (SR) 16 provides primary transportation access into the City and its UGA from surrounding areas in Kitsap and Pierce Counties. State Route 302 provides access to the northeastern portion of the City's UGA as it crosses Henderson Bay near the Purdy Sand Spit in Segment F. Randall Drive NW and Goodman Drive NW provide roadway access to residential properties along the easterly shoreline of Gig Harbor Bay (Segments A and B). North Harborview Drive and Harborview Drive provide roadway access to commercial and retail waterfront areas along the north and westerly shoreline areas of Gig Harbor Bay, respectively (Segment C). Roadway access is restricted to private roads and driveways within Segment D, south of Gig Harbor Bay. Purdy Drive NW parallels the Burley Lagoon and Henderson Bay shoreline areas in Segments E and F. State Route 302 (Key Peninsula Highway) crosses Henderson Bay on the Purdy Sand Spit in Segment F, separating Henderson Bay from Burley Lagoon.

3.5 Utilities

The existing Gig Harbor wastewater treatment plant, located on nine acres of property west of Harborview Drive at its intersection with North Harborview Drive, has a permitted maximum monthly treatment capacity of 1.6 million gallons per day (mgd) (City of Gig Harbor, 2002). Treated wastewater is discharged from the plant through an outfall pipe varying in size into the northwest portion of Gig Harbor Bay. The plant utilizes an activated sludge biological process to reduce the amount of organic matter in the wastewater to meet effluent standards. Treated wastewater is discharged through the outfall, located approximately 1,900 feet offshore (Chris Munter, personal communication, 2001) and at a depth of 21 feet below mean lower low water (MLLW) (City of Gig Harbor, 1993). Wastewater discharge receives secondary treatment, with an average annual rate of 0.85 million mgd (Jones and Stokes, 2000).

In addition, several community septic systems are permitted under the current development standards where connection to the City collection system is not feasible (City of Gig Harbor, 2002). Septic systems are located in residential areas within planning segments A and B, within the City's UGA. These systems are permitted by Pierce County. The City's Wastewater Comprehensive Plan (City of Gig Harbor, 2002) has identified wastewater collection system expansion basins within its UGA, including all shoreline areas in segments A, B, D, E, and F.

As the wastewater treatment plant neared the total treatment capacity, including the treatment capacity reserved through the City sewer capacity reservation process, the City implemented a two-phased expansion of the wastewater treatment plant. The scheduled completion for phase one of the wastewater treatment plant expansion project is 2010, with phase two completed beyond 2010. At the completion of both phases the expanded treatment plant would have a capacity of 2.4 mgd. The City has also planned to replace the existing wastewater outfall with a 24-inch outfall and diffuser pipe in Colvos Passage. Construction of the outfall has been split into two phases. The first phase, now completed, involved the onshore work and replaced the previous 10-inch pipe with a 24-inch pipe. Construction of the second phase, scheduled for 2010 and 2011, would involve offshore work and would replace the current 10-inch pipe with a 24-inch pipe. The completed marine portion of the outfall pipe would extend approximately 9,200

feet offshore to a depth of approximately 190 feet below mean lower low water (MLLW). Connection to the existing outfall would be made landward of the OHWM within a public right-of-way along the northwestern shoreline of Gig Harbor. (City of Gig Harbor, 2007a; Cosmopolitan Engineering Group and Golder Associates, Inc., 2002).

Gig Harbor's storm drainage collection and conveyance system consists of typical components such as inlets, catch basins, piping, open ditches, natural streams, wetlands, ponds, and stormwater detention and water quality ponds. Stormwater is eventually conveyed to Gig Harbor Bay, Henderson Bay, Wollochet Bay, and Puget Sound (City of Gig Harbor, 2001a). Many of the existing storm drainage systems were constructed in the City between the 1930's and 1950's, when there was minimal development. The City's 1987 *Stormwater Comprehensive Plan*, adopted prior to the current 2001 *Stormwater Comprehensive Plan*, indicates that approximately 20 stormwater outfalls, ranging in diameter from 8 to 48 inches, are in service and mostly located on private property. Therefore, the City is not able to access all stormwater outfalls for maintenance and inspection without the property owners' consent. Reduced levels of maintenance have resulted in degradation of the outfalls. The type and extent of degradation, however, is unknown (URS Corporation and Triangle Associates, 1987). Stormwater facilities in the City's UGA along Henderson Bay and Burley Lagoon include drainage facilities connected to Goodnough Creek and Purdy Creek.

Areas cleared of vegetation are susceptible to erosion, which can significantly increase sediment loading to nearby drainage courses and water bodies. Without detention or retention, the volume of stormwater runoff can also generally increase during and following construction as vegetative cover is removed and replaced with impervious surfaces such as roads and rooftops. Increased stormwater runoff could lead to erosion of stream banks and accelerated channel scouring from increased flow rates, which eventually can adversely impact the quality of stormwater eventually draining into marine waters adjacent to Gig Harbor and the City UGA (City of Gig Harbor, 2001a). The City adopted in August 2009 new stormwater regulations and a new stormwater manual in accordance with the City's NPDES Phase 2 Municipal Stormwater Permit. The new regulations and stormwater manual include best management practices for stormwater runoff, requirements for detecting and eliminating illicit discharges, and guidelines for new development. These new regulations and the new stormwater manual are equivalent to Department of Ecology requirements for stormwater management and prevention of stormwater pollution.

Other utilities in the City's shoreline jurisdiction include water supply mains, communication lines, and electrical lines that service docks and boat moorages. No other major service lines lie within the shoreline jurisdiction in the city limits (Chris Munter, personal communication, 2002). Tacoma Power maintains a transmission line that serves the Key Peninsula. The powerline corridor crosses Henderson Bay and Burley Lagoon in Segment F. Existing towers are located on Purdy Spit and just outside shoreline jurisdiction, approximately 150 feet landward of Purdy Drive NW near the intersection with Goodnough Drive NW.

3.6 Existing and Potential Public Access Sites

Existing and potential public access sites were identified from information provided in the *Gig Harbor Parks, Recreation, and Open Space Plan, Gig Harbor Parks, Recreation and Open Space Master Plan* (City of Gig Harbor, 2001b, 2010), and the *Gig Harbor Comprehensive Plan* (City of Gig Harbor, 2007a). Public access sites were also identified from 1998 aerial photographs and field reconnaissance of the study area in August 2003 and May 2008. Existing open space in the City's shoreline jurisdiction includes both public and private utilities and facilities, along with wetlands. Major parks and facilities in the City's shoreline jurisdiction providing public access to the shoreline are shown in Figure 3. Several are also identified in the planning segment maps, Figures 11 through 13 (Map Folio). Some public access locations have been established directly through the city's shoreline permit process as a condition of approval of the permits. Public access locations and opportunities include the following (see Figure 3 for general location):

- **Gig Harbor Spit Lighthouse** (Segment A) – The United States Coast Guard Spit Lighthouse is located along the spit and allows limited public access at a beach area near the Gig Harbor Bay inlet. Local residents use the area as a beach and hand-powered watercraft landing area.

- **Wheeler Street Road-End** (Segment B) – This 0.4-acre road right-of-way (ROW) provides beach access. Vehicles traveling along Vernhardson Street have an opportunity for a clear view of the Crescent Creek estuary. The ownership of this ROW is contested and the site is considered undeveloped.

- **Randall Street Boat Launch** (Segment B) – This 0.2-acre two-lane boat launch is located on the northeast side of Gig Harbor Bay at the end of Randall Street. The street right-of-way has been improved by the Pierce County Department of Public Works with the development of a boat launch and temporary moorage facility.

- **City Park at Crescent Creek** (Segment B) – This 9.8-acre site is located at the head of the bay along the north side of Vernhardson Street and the east side of Crescent Creek. It is the City's oldest public park and is commonly known as "City Park" by residents. It includes a WPA constructed covered picnic/cooking facility, restrooms, viewing platform, play area and big toy, baseball field, open space, basketball and tennis court, benches, BMX facility, sand volleyball courts and picnic tables.

- **Finholm View Climb** (Segment C) **–** This 0.32-acre road right-of-way extends between Franklin Avenue below Harbor Ridge Middle School and the Finholm Business District. The public access area includes a wooden stairway system with overlook platforms, viewing areas, benches, and a public restroom.

- **Ruth M. Bogue Viewing Platform** (Segment C) – This 0.10-acre harbor overlook consists of a plaza located on top of a sanitary sewer pump station and is developed with benches and landscaping. The park is located on the waterfront side of North Harborview Drive.

- **Donkey Creek Park** (Segment C) – This 1.3-acre property, recently acquired by the City, formerly housed a lumberyard and associated buildings. Although the property is not located directly adjacent to the shoreline, the site falls within Segment C. Future plans include the restoration of Donkey Creek, including the "day lighting" of the creek and buffer as well as preservation of the property's natural area and scenic location.

- **Austin Estuary Park** (Segment C) – This natural habitat site located at the mouth of Donkey Creek contains a total of 8.44 acres including uplands and tidelands. It offers panoramic views of the bay, a soft-landing for hand-powered watercraft, and passive recreation with trails and seating.

- **Murphy's Landing Condominiums/Marina** (Segment C) – Public access at this location in the form of an overwater, pedestrian access, boardwalk with views was established as part of a shoreline permit approval.

- **Eddon Boat Park** (Segment C) – This 2.89-acre site located midway between the Downtown and Finholm Business Districts includes the historic Eddon Boat Building, dock and marine ways, and brick house. It also includes 0.74-acre of open space and 0.014-acre of tidelands with panoramic views of the bay.

- **Jerisich Park** (Segment C) – The park, together with Skansie Brothers Park abutting on the south, occupies 3.15 acres including tidelands, and is located within the extended Rosedale Street NW ROW. A 1,500-square foot pier with restrooms, picnic tables, and benches overlooks the harbor and adjacent marinas. An extra 352 linear foot floating pier provides day-use boat moorage and fishing access.

- **Skansie Brothers Park** (Segment C) – This property, acquired by the City in November 2002, abuts Jerisich Park on the south. The Skansie home and net shed, built in the early 1920s, are also located on the property.

- **Arabella's Landing Marina** (Segment C) – Located at Dorotich Street and Harborview Drive, public access at this location was established as part of a shoreline permit approval. Pedestrian access onto an overwater pier at the foot of Dorotich Street provides views.

- **Russell Foundation Building** (Segment C) – Located along Harborview Drive between Pioneer Way and Soundview Drive, public access at this location was established as part of a shoreline permit approval. A plaza with viewing platform located at the street level of the building is open to the public during hours of operation and on weekends.

- **Soundview Drive Street-End** (Segment C) – Public access in the street ROW is located in this 0.4-acre street-end situated on the west side of the Gig Harbor Bay.

- **Harborview Drive Street End/Old Ferry Landing** (Segment D) – This 1.0-acre site at the east end of Harborview Drive overlooks The Puget Sound Narrows and Dalco Passage at the entrance to Gig Harbor Bay. The street-end provides parking and a viewing platform with interpretive signage. A trail in the street ROW extends from the viewing platform to the beach. Most owners of the beach cabins to the south use this location as their primary access

to the cabins. Opportunities exist to formalize this trail and beach access. As part of the ongoing update to the City's comprehensive parks plan, the Parks Commission has identified this location as a priority for formalizing access to the beach. The City owns the street ROW and an adjacent parcel to the south (0.31 acres) which is mostly vegetated bluff but includes beach area. Pierce County owns a parcel adjacent to the northern edge of the ROW which is entirely beach and tidelands.

- **Purdy Sand Spit** (Segment F) – 7.5 acres of undeveloped salt-water beachfront provides public access near the SR 302 Bridge along Henderson Bay. A park and boat launch owned by Pierce County is located on the spit.

Most of these parks and open space areas are characterized by the City as Resource Activity Parks and are owned and managed by the City. Other locations are public access view points on private property, established through the City's shoreline permit process as a condition of permit approval. The Randall Street Boat Launch is a Pierce County Department of Parks, Recreation, and Community Services Park (City of Gig Harbor, 2001b).

Although no shoreline trails currently exist within the City or its UGA, one trail is proposed along the Gig Harbor shoreline outside of Gig Harbor Bay. The North Beach Trail would extend approximately 1.25 miles along the Colvos Passage shoreline, north of the USGS lighthouse located on the spit in Segment A to Sunrise Beach, a Pierce County waterfront park. (City of Gig Harbor, 2001b). The 2001 Park, Recreation, and Open Space Plan notes that the trail would be designated on an informal basis (i.e., no structural improvements other than signage) along the beach at the base of the bluff. This section of beach includes both public and privately owned tidelands and would require the permission of private landowners. However, the informal trail would be isolated and buffered from the residential development located on top of the steep bluff. The Pierce County 2008 Park, Recreation & Open Space Plan (Pierce County, 2008) does not identify this location as part of a proposed regional trail system.

The City is currently updating its Park, Recreation, and Open Space Plan. The update is expected to be complete during the SMP update process. Opportunities for enhancing or developing shoreline access should be coordinated between these two comprehensive planning efforts. Development of an "in-lieu fee" program to facilitate shoreline access improvements may provide flexibility and predictability in administering the City's SMP. In cases where on-site public access is not feasible or safe, based on the use and operations of the primary waterfront use or the physical site constraints, an in-lieu fee program could assist in achieving goals for increased or enhanced shoreline access and recreation.

3.7 Historical/Cultural Resources

3.7.1 Listed Properties and Previous Studies

Historic and cultural resources are documented through a variety of sources. Official registers include the National Register of Historic Places and the Washington State Heritage Register. In 2005, the City of Gig Harbor adopted Chapter 17.97 of the GHMC (Historic Preservation) to provide for the identification, evaluation, designation and protection of designated historic

resources within the boundaries of the city. This action created the Gig Harbor Register of Historic Places. The City provides nomination forms for citizens wishing to designate property or buildings as historic. Currently, three properties are formally listed on the City's register:

- Ancich Net Shed – 3618 Harborview Drive; built 1928-29. This structure is one of 17 historic net sheds in the city. This dock and net shed is listed for its historical significance, architecture, and cultural heritage importance.

- Eddon Boat Building Site – 3805 Harborview Drive; built in 1945 and the former site of Anderson & Sons Boat Yard, built in 1920 and burned down in 1959. This historic boatyard site is listed for its historical significance, architecture, and cultural heritage importance.

- Fishing Vessel Shenandoah – 4121 Harborview Drive; built in 1925; owned and operated by Antone Janovich and donated to the Harbor History Museum. This historic fishing vessel is listed for its historical significance, fishing vessel construction, and cultural heritage.

The City's zoning code establishes the Gig Harbor Historic District and provides design guidelines (GHMC 17.99.500 through 17.99.580) for development and redevelopment within the district. The boundaries of the Historic District correlate with Segment C.

A number of houses and commercial buildings potentially considered as important cultural and architectural resources are documented along the Gig Harbor Bay shoreline, in the downtown district and in the Millville historic neighborhood, both within Segment C. A comprehensive cultural resource inventory jointly completed by the Pierce County Department of Planning and Natural Resource Management, the Pierce County Preservation Officer, and the Washington State Department of Archaeology and Historic Preservation (DAHP) was conducted between 1978 and 1983. The study results are kept in DAHP's files in Olympia and by the Pierce County Department of Planning and Natural Resources Management (City of Gig Harbor website, 2001). An Intensive Level Cultural Resource Survey of the historic Millville neighborhood and adjacent landmarks in the City's zoned historic district was completed in 2009 (Andrews History Group, 2009). This data will be used to update the City's historic district boundaries and refine the area's historic architectural characteristics.

Austin Estuary Park and associated sandy shoreline may include the historical location of a Puyallup Indian Village that occupied the site until 1883.

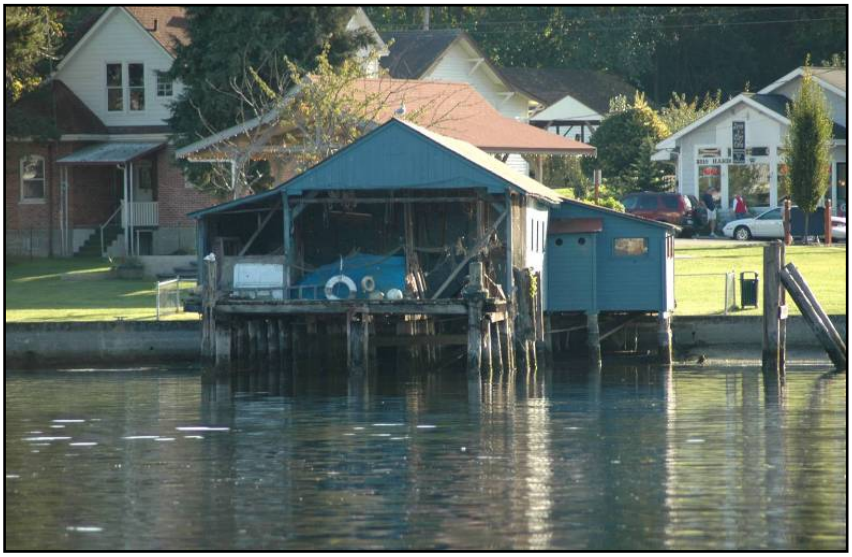
A cultural resources assessment was conducted as part of a proposed Donkey Creek Park Project in March 2002 (LAAS, 2002). The inventoried area falls within Segment C, near the Donkey Creek outlet into Gig Harbor Bay at the west end of the main harbor embayment. The cultural resources overview and archaeological assessment evaluated the probability for hunter-fisher-gatherer, historic period archaeological resources; historic buildings; historic structures; and traditional cultural places in the area known as Donkey Creek Park and Austin Estuary. The area was identified as an archaeological site and the home of an early Native American village with two historic buildings that are no longer standing. The Larson report suggests that there is a high probability for significant historic period archaeological resources in the shoreline area near the

Donkey Creek outlet into Gig Harbor Bay and for that reason they have recommended that the Puyallup Tribe be allowed the opportunity to identify cultural places prior to construction in the area, and that a professional archaeologist conduct a field reconnaissance.

There are approximately 18 small, modest, over-water historic homes that line the shoreline at the toe of a steep bluff just outside the bay in Segment D. This area has been referred to as Nesika Beach. Originally built in the late nineteenth and early twentieth centuries, many of these wood structures are built on wood pilings. Most were historically used as summer cabins, and continue to be used as such today. Most are accessible only by water, or by walking the beach from the Harborview Drive street end at the Old Ferry Landing. Most cabins do not have water or electricity, but are powered with propane lanterns and stoves and utilize composting pit toilets approved by the state Department of Health. At least two homes are used as permanent residences. These homes have electrical power and sanitary sewer, conveyed up the bluff. These properties are accessed by Craig Lane (a private driveway) via Ryan Street. Residents park on the upland portion of the property and access the homes by a staircase along the face of the bluff.

3.7.2 Net Sheds

Net sheds are over-water structures built on wood-piles that are used by fisherman to store nets and fishing gear. There are 16 net sheds along the western shoreline of Gig Harbor Bay in Segment C. One net shed is located in Segment D, just south of the old ferry landing (City of Gig Harbor, 2006b). The approximate locations of the net sheds are shown on Figure 4. Historically, net sheds served as gathering places for skippers, crews and their families. Net sheds were built by Gig Harbor's prominent fishing families, most of whom emigrated from the Dalmatian Coast of Croatia. Net sheds still located on the shoreline were built between 1910 and 1970. They range in size (on average) from 800 to 1,600 square feet. The net sheds were listed on the 2008 Most Endangered Historic Properties List by the Washington Trust for Historic Preservation (City of Gig Harbor, 2008b). With the decline of the commercial fishing industry in recent decades, Gig Harbor has experienced a loss of net sheds through lack of maintenance and conversion to other uses. In response to this loss, an Inventory of Historic Net Shed Sites in Gig Harbor was prepared by the city in 2006 and updated in 2008 that addressed the city's existing net shed stock (City of Gig Harbor, 2006a). A second inventory was developed by city staff in 2009 at the request of the SMP Update Stakeholders Committee to identify and address issues



Skansie Net Shed in Skansie Brothers Park

such as use, alterations, zoning requirements, historic registry, structural integrity and useable uplands at each net shed location. The purpose of this effort was to 1) identify opportunities to maintain net sheds to support commercial fishing operations; and 2) to identify issues and strategies to be addressed through the SMP update process to allow the adaptive reuse of the structures while preserving their historical significance. The complete net shed inventory and recommendations is included as Appendix C to this report.

Fifteen of the seventeen net sheds are currently in use. Seven are solely being used to support commercial fishing, six solely for other purposes, two for both fishing and other uses, and two are currently vacant. Other uses for net sheds include over water office space, restaurant and café, marina hall, and personal storage. Additionally, five have been legally altered, one illegally altered, and two have been both legally and illegally altered. The specific name, location, and current use of each historic net shed are shown in Table 3-3 below.

Table 3-3. Historic Net Sheds of Gig Harbor

Net Shed Name	Location	Present Use
Blair / Moeller (Gilich)	3813 Harborview	Working Netshed
Lovrovich (Morin)	3811 Harborview	Working Netshed
Bujacich	3825 Harborview	Part-Time Support (Fishing Vessel Moorage & Storage)
Ivanovich	3617 Harborview	Working Netshed (F/V Equator)
Ancich / Tarabochia	3615 Harborview	Working Netshed & Offices
Rainier Yacht (Ancich)	3518 Harborview	Working Netshed Prior To Sale – Now Vacant
Millville Marina (Condos)	8200 Novak Street	Private Lockers For Condos
Puratich	3421 Harborview	Netshed Storage & Office
Ellsworth (Stanich)	8205 Dorotich	Office
Arabella / Clubhouse (Gilich)	3323 Harborview	Marina Clubhouse
Arabella / Isamira's (Novak)	3313 Harborview	Office / Restaurant
Whittier (Ross)	3309 Harborview	Private Residential Use
Skansie Park	3207 Harborview	Working Netshed Prior To Sale – Now Vacant
Rickard (Babich)	2915 Harborview	Working Netshed
Pond (Babich)	2911 Harborview	Working Netshed
Morris (Skansie)	2809 Harborview	Storage For Private Residence
Tarabochia (Mojean)	2788 Harborview	Working Netshed

The net shed inventory notes that ten of the net sheds would qualify for listing in the city's Register of Historic Properties; four do not qualify due to alterations to the architectural integrity of the exterior; and three would require further evaluation. Adaptive reuse opportunities may be limited by the amount of developable uplands and/or parking capacity. Thirteen of the net sheds have accessible uplands associated with them. Of those thirteen, nine are currently being utilized for off-street parking to some capacity. Others have accessible on-street parking located within street right-of-way in close proximity.

The continued use and reuse of overwater structures such as net sheds is generally supported by the current SMP. The SMP allows and encourages facilities that directly support the local commercial fishing industry such as net sheds and moorage facilities. Additionally, overwater commercial uses are permitted given the use provides adequate visual access to the shoreline, required parking is provided, and the development is water-dependent or water-oriented.

Adaptive re-use opportunities for net shed structures are limited due to a variety of factors, including: 1) existing local and state SMP use restrictions that prohibit overwater residential development and limit commercial development to water-dependent and water-oriented uses; and 2) existing parking requirements for commercial development. The net shed inventory recommends a number of potential changes to the City's SMP and other land use regulations that could be considered in order to encourage preservation and adaptive reuse of these structures. Potential changes could address allowable uses, including residential or extension of residential "accessory" uses provided design criteria are met and the structure becomes listed on the City's Register of Historic Properties. Similarly, non-water oriented uses within net sheds could be allowed as a conditional use, provided the structure becomes listed on the City's register and public access is provided. Other potential regulatory changes needed may include revisions to the City's standard parking requirements and developing design guidelines or criteria specific to historic net sheds (Appendix C).

Washington Department of Archaeology and Historic Preservation (DAHP) is conducting a feasibility study to apply for a National Maritime Heritage Area designation for Puget Sound. A national heritage area is a place designated by the National Park Service (NPS) and approved by the U.S. Congress where natural, cultural, historic and recreational resources combine to form a cohesive, nationally distinctive landscape (National Park Service, 2008). The net sheds in Gig Harbor represent the commercial fishing industry which had an important role in maritime development throughout Puget Sound.

3.8 Water-Dependent Uses and Potential Use Conflicts

Water-dependent uses in Gig Harbor primarily consist of commercial fishing related uses and marinas. The composition of water-dependent uses in Gig Harbor has been in transition for several decades. Historically, most over-water piers, docks, and structures (such as net sheds) supported the commercial fishing industry. According to commercial vessel registration data from the Alaska Commercial Fisheries Entry Commission (CFEC), at least 83 different vessels have designated Gig Harbor as their home port for at least one year between 1978 and 2009 (Alaska CFEC, 2009). As of 2009, CFEC data indicates 14 vessels list Gig Harbor as their home port. Commercial fisherman Gregg Lovrovich indicates at least another 13 vessels call Gig Harbor home today. The harbor does not have canneries or other upland fish-processing facilities. These vessels primarily use the harbor for moorage and storage of equipment (i.e., working net sheds).

As the commercial fishing industry has declined in the Puget Sound region, marina development has flourished regionally and in Gig Harbor. Historic aerial photos provided by the City of Gig Harbor and the University of Washington Library depict this transition. Figure 5 depicts aerial images of the harbor between 1944 and 2008. The 1940s predate recreational/pleasure-craft

moorage in the form of marinas in Gig Harbor. By 1961, the first marina (what is now the Peninsula Yacht Basin facility) was developed at the head of the bay. By 1974, additional marinas with covered moorage were developed on the west side of the bay, primarily south of Dorotich Street. By the late 1980s, several marinas had been developed along the west side of the bay. According to aquatic land lease ("encumbrance") data from Washington Department of Natural Resources (WDNR, 2008a), there are approximately 34 leases associated with marinas in Gig Harbor. Of those, 12 are noted as being open to the public, the balance being noted as private or commercial but not open to the public. These numbers may be misleading; it is possible that individual marinas may hold more than one lease from WDNR. It is estimated that there are approximately 10 to 12 marinas in Gig Harbor Bay providing recreational or pleasure-craft moorage. The City of Gig Harbor conducted a marina survey (see Appendix D) that tallied the number of boat slips (leased, available or transient) and live aboards associated with each marina in Gig Harbor Bay. City staff asked several marinas about their expansion plans and whether boats could be hand launched from the marina. The following are the general findings of the marina survey:

- Gig Harbor Bay has 29 commercial marinas, commercial fishing moorage, and moorage associated with upland condominiums.
- There are a total of 722 boat slips in the bay.
- Majority of marinas are operating at or close to permitted capacity.
- Majority of current marinas are fully "built-out" or have no plans for expansion.

Building on the inventory work completed to date, the results of this research will be factored into the City's cumulative impact analysis to consider the potential for future marina development and expansion in the harbor, and how such development would be regulated under the proposed amendments to the SMP.

At least two other marina developments are in the process of permitting but have not been built. One is located the Rainier Yacht harbor site, located between Novak Street and Stinson Avenue. The Rainier Yacht (Ancich) net shed is located on this property and it has been listed on the City's Historic Preservation Register. The marina development is expected to maintain this structure as part of the marina design. The second marina development is located just north of the northern terminus of Soundview Drive. This is the former Stutz fuel site and the marina development is known as Madison Shores.

The aerial images also illustrate the development of piers, docks, and floats in the bay (mostly in unincorporated Pierce County) for single-family residential uses during this same period. Many individual anchored mooring buoys are on the east side of the bay as well. There are 38 docks/piers associated with single-family homes in the bay. The development of marinas, private docks and mooring buoys in the bay has created potential use conflicts between recreational boating and commercial fishing operations. Both uses are considered preferred, water-dependent uses under the SMA and State shoreline management guidelines. Nearly 30 commercial fishing vessels use the harbor for moorage and storage. With the development of marinas and installation of mooring buoys, issues related to navigability and, at times, noise from operations have been raised by members of the community.

In order to evaluate the potential for future marina development and/or expansion, the demand for marinas and availability of suitable waterfront property has been analyzed. An economic demand analysis has not been prepared specifically for water-dependent uses in Gig Harbor. However, a waterfront lands analysis for the City of Tacoma was recently prepared that contains some information based on county-wide trends that is relevant to Gig Harbor (BST Associates, 2008). Tacoma's analysis focused on water-dependent industrial uses located primarily in the Port of Tacoma Manufacturing and Industrial Center. The analysis also addresses demand for marinas and associated services. It found that Tacoma's marinas are well utilized (a 96 percent occupancy rate) and several have waiting lists. Dry-stack operations for upland moorage in Tacoma have also been successful. Over the past 13 years, boat builders have experienced an average annual increase (inflation adjusted) in gross revenues of 9.3 percent. Between 1990 and 2007 Pierce County has experienced sustained growth in boat registrations. For boats ranging from 21-feet to over 60-feet in length, the number of registered boats in the County grew by 1.4 percent per year. The analysis also notes strong growth (7.6 percent per year) in the number of sales for hand-powered watercraft (e.g., kayaks and canoes). The analysis for Tacoma projects that demand for wet moorage could increase by as many as 500 slips by 2025. Generally, the analysis concludes that there is a need for additional transient and permanent wet moorage; a need to preserve and enhance recreational boating and upland support activities; and a need for improved facilities serving hand-launched boats and boats which must be hauled by trailer (i.e., boat launches) (BST, Inc., 2008). While this analysis was focused on the City of Tacoma, some of the trends reflect conditions throughout Pierce County and are relevant to the City of Gig Harbor's SMP update.

Assuming demand for marinas and recreational moorage and launch facilities is present and is expected to continue, parcel-based GIS analysis and air photo interpretation was used to evaluate the availability of waterfront space for additional marina development in Gig Harbor. Pierce County Assessor data (2008) was used to determine present use of individual waterfront parcels. The analysis was limited to those waterfront parcels in the City of Gig Harbor that would allow marinas or related commercial services (boat sales and service) under current zoning designations and boundaries (Waterfront Commercial (WC), Waterfront Millville (WM), and Commercial-1 (C-1)). Air photos were used to qualitatively evaluate the amount of over-water space available, based on proximity of neighboring piers, docks, and marinas, and the waterward extent of the outer harbor line as mapped by Washington DNR (see Figure 6).

Table 3-4 summarizes existing land uses per Pierce County Assessor records for the approximately 92 waterfront parcels in the WC, WM, and C-1 zones.

Table 3-4. Waterfront Parcels and Present Use

Present Use	Number of Parcels / Notes
Resource Land / Fishing Activities	16 parcels are noted as Resource Land – 11 of which are noted as "Fishing Activities." These locations are associated with commercial fishing activities.
Commercial/ Service - Marinas	12 parcels noted as commercial/service use as marinas.
Commercial/Service – Other	33 parcels noted as commercial/service, with uses other than marina (retail, restaurant, office, etc.)
Residential	8 parcels (2 multi-family and 6 single-family)
Unknown (condos with marinas or moorage)	9 parcels are classified as "unknown"; air photos indicate multi-family residential apartments and condominiums with associated moorage or marina development
Educational Services	2 parcels (noted as Gallery Row)
Open Space/ Recreation	1 parcel (Jerisich/Skansie Brothers Park)
Vacant	11 parcels (includes undeveloped areas with wetlands; several parcels are actually park areas such as Austin Estuary Park and Eddon Boat Park)

As shown on Figure 6, most of the marina development in the harbor is already built out to the outer harbor line. WDNR will not lease aquatic lands beyond this line for development of marinas or extensions of over-water structures. Noting the two marina developments currently being permitted, the potential for marina development at other parcels currently designated as "vacant" would be limited, constrained, or prohibited due to several factors. In some cases, these parcels include estuarine wetlands, and/or are associated with city-owned parks. This includes tidelands near the mouth of Donkey Creek, and parcels adjacent to the Eddon Boat site. Zoning at these locations may allow for marina development, but the current SMP either prohibits dredging or the city's critical areas ordinance protects the estuarine wetlands. In other cases, the parcel width, orientation to the shoreline, or neighboring parcels with over-water structures do not provide adequate surface water space to develop marinas while still maintaining navigability. Availability of upland parking to support marinas may also be a limiting factor for these properties. In summary, based on existing SMP, critical area regulations, and zoning designations, there appears to be limited opportunity for additional marina development in Gig Harbor Bay. Due to the regional demand for marinas and recreational boating, marina redevelopment or expansions may be anticipated in cases where docks and slips have not been extended to the outer harbor line. In order to limit potential conflicts of navigability, the City could consider requiring larger "side-yard" setbacks for marina developments or expansions where the neighboring dock supports commercial fishing operations or moorage.

4.0 NEARSHORE PHYSICAL CHARACTERIZATION

Much of the physical and biological characterization information contained in this report has been compiled from the Washington Department of Natural Resources *ShoreZone Inventory* GIS database (WDNR, 2001) and the *Key Peninsula, Gig Harbor, and Islands Watershed Nearshore Salmon Habitat Assessment* (KGI Habitat Assessment) GIS database, prepared by Pentec Environmental (2003). Detailed tables of information from these sources have been compiled relative to the shoreline planning segments and are contained in Appendix A. This information has been summarized in the text that follows. Newer data sources related to drift cell mapping and bulkhead mapping are in development through the Puget Sound Nearshore Ecosystem Restoration Program (PSNERP), but are not available at this time for public distribution or use for this project. Tables A-1 through A-16 are contained in Appendix A. All photos are contained in Appendix B.

4.1 Geologic Units

The city is located on a peninsula that extends south into Puget Sound from the northern border of Pierce County (Figure 1). Most of the City's topography is flat-topped hills and ridges that lie between 200 and 300 feet above sea level (City of Gig Harbor, 2002). Bluffs are located on all three sides of the peninsula. The City's shoreline jurisdiction includes these bluff areas as well as the relatively protected areas of Gig Harbor Bay and Henderson Bay.

The sequence of unconsolidated and partially consolidated sediments in the Gig Harbor vicinity was created by a series of glacial advances and recessions, as well as fluvial and lacustrine deposition during long interglacial periods (City of Gig Harbor, 2002). The thickness of the glacial and interglacial deposits is estimated to be at least 2,000 feet (City of Gig Harbor, 2002). Glacial till, deposited under the glacier as it advanced, contributes significantly to the sands and gravels that were deposited on beaches in the City's shoreline jurisdiction. The typical glacial sequence in the city, from most recent to least recent, includes:

- Recessional outwash (well-graded loose sand and gravel, becomes finer upward within the unit);
- Till (poorly sorted, compacted silty sand and gravel); and
- Advance outwash (well-graded sand and gravel, becomes finer with depth). (City of Gig Harbor, 2002).

Geologic mapping of the Gig Harbor vicinity, due to be published in the near future, includes the *Geologic Map of the Gig Harbor 7.5-minute quadrangle, Washington: U.S. Geological Survey Miscellaneous Field Investigations Map, scale 1:24,000 (*K. G. Troost, D. B. Booth, and R. Wells, in review), and *Geologic Map of the Olalla 7.5-minute quadrangle, Washington: U.S. Geological Survey Miscellaneous Field Investigations Map, scale 1:24,000* (D. B. Booth and K. G. Troost, in press).

4.2 Soils

Soils types in the City's shoreline jurisdiction are depicted in Figure 7. Soils in Segments A and D are mapped as coastal beach flanked by bluffs of Xerochrepts, with very steep slopes of 45 to 75 percent slopes. These soils were mainly formed in glacial till, but some formed in sandy and gravelly outwash. Inclusions of the Kitsap-Indianola complex may occur in the areas mapped as Xerochrepts (USDA SCS, 1983).

In contrast to the steep bluffs in Segments A and D, most of Segment B is mapped as Hydraquents, and is level. Other soils include Indianola loamy sand, 0 to 6 percent slope, Harstine gravelly sandy loam, 6 to 15 percent slopes, and Harstine gravelly sandy loam, 15 to 30 percent slopes. Hydraquents are described as low-lying, brackish areas within the overflow limits of high tides. Hydraquents are deep deposits of alluvium (including silts, clays, and muck), while Indianola loamy sand was formed in sandy glacial outwash, Harstine gravelly sandy loam was formed in sandy glacial till (USDA SCS, 1983).

Harstine gravelly sandy loam, 6 to 15 percent slopes and 15 to 30 percent slopes, are the most common mapped soil types in Segment C. Other soils surrounding Gig Harbor Bay in Segment C include two areas of fill, between Stinson Avenue and the Donkey Creek outfall, as well as east of Pioneer Way. Steeper areas include Harstine gravelly sandy loam, 15 to 30 percent slopes, Kitsap silt loam, 8 to 15 percent slopes, and Kitsap silt loam, 15 to 30 percent slopes.

The shoreline of Segment E is mapped as coastal beach and Hydraquents, level, flanked by Harstine gravelly sandy loam, 6 to 15 percent slopes. Segment F is mapped almost entirely as Harstine gravelly sandy loam, 6 to 15 percent slopes, with the exception of the Purdy Creek outlet, which is mapped as Hydraquents, level.

4.3 Nearshore Processes

Gig Harbor beaches represent a commonly occurring beach character found in the Puget Sound, as having two distinct foreshore components: a high-tide beach and a low-tide terrace (Downing 1983). The high-tide beach consists of a relatively steep beachface with coarse sediment and an abrupt break in slope at its waterward extent. Sand in a mixed sand and gravel beach is typically winnowed from the high-tide beach by waves (Chu 1985) and deposited on the low-tide terrace. Extending seaward from the break in slope, the low-tide terrace typically consists of a gently sloping accumulation of poorly sorted fine-grained sediment (Komar 1976, Keuler 1979). Lag deposits derived from bluff recession are also found in the low tide terrace. These deposits are typically comprised of larger clasts, ranging from cobbles to boulders.

Puget Sound beach composition is dependent upon three main influences; wave energy, sediment sources, and relative position of the beach within a littoral cell. Wave energy is controlled by fetch; the open water over which winds blow without any interference from land. Wind-generated wave action gradually erodes beaches and the toe of coastal bluffs, leading to landslides. These coastal bluffs are the primary source of sediment for most Puget Sound beaches, including the Gig Harbor study area. Fluvial sources of sediment are typically of only local significance in comparison to bluff sediment sources, which reportedly account for roughly

90% of beach material (Keuler 1988, Downing 1983). Bluff composition and wave energy influence the composition of beach sediment. Waves sort coarse and fine sediment and large waves can transport cobbles that small waves cannot. Additionally beaches supplied by the erosion of coarse gravel bluffs will differ in composition from those fed by the erosion of sandy material. The exposed strata of the eroding bluffs in the study area are largely composed of sand, gravel, and silt (WDNR 2001, DOE 1979). These same materials dominate sediment found on the beaches, with the exception of silt (and clay), that is winnowed from the beachface and deposited in deeper water.

Wind-generated waves typically approach the shore at an angle, creating beach drift and longshore currents and transporting sediment by a process called littoral drift. Net shore-drift refers to the long-term, net result of littoral drift. Net shore-drift cells represent a sediment transport sector from source to deposition along a portion of coast. Each drift cell acts as a system consisting of three components: a sediment source (erosive feature) and origin of a drift cell; a transport zone where materials are moved alongshore by wave action with minimal sediment input; and an area of deposition (accretion area) that acts as the drift cell terminus. Deposition of sediment occurs where wave energy is no longer sufficient to transport the sediment in the drift cell. Drift cells in the Puget Sound-Georgia Strait region range in length from 5 or more miles to just a few hundred feet.

The Washington Coastal Atlas (Ecology website, 2008) maps net-shore drift direction, or the prominent drift direction, including divergence zones and areas of "no appreciable drift" (which include highly modified, protected harbor shorelines) (Figure 8). The Gig Harbor UGA contains all or part of seven net shore-drift cells and one region of negligible net shore-drift. The general pattern of littoral transport largely reflects the shore orientation relative to the predominant (strongest) wind and wave conditions. Shores that are exposed to the south typically have northward net shore-drift due to predominant southerly winds. Shores exposed only to the north are within the wind and wave shadow of strong southerly wind conditions, but are exposed to lighter northerly winds, resulting in southward transport. Shores oriented east and west are similarly influenced by their shore orientation relative to direction from which the greatest fetch is derived. No appreciable net shore-drift occurs within enclosed shorelines such as the inner shores' barrier-fronted embayments in Gig Harbor.

Coastal feeder bluffs are the primary source of sediments contributing to and maintaining the structure and function of Gig Harbor marine shoreline. Therefore, coastal bluffs and riparian areas play an important role in maintaining nearshore processes (EnviroVision et al., 2010). Riparian areas influence the marine shoreline by controlling sediment loss and erosion, as well as maintenance of hydrology and slope stability. Additional riparian functions supporting nearshore functions include maintenance of water quality through filtration and processing of contaminants, inputs of large woody debris (LWD) and other organic input, development of nearshore shade, and providing fish and wildlife habitat (WDFW, 2009; EnviroVision et al., 2010; Knight, 2009; PSP, 2010).

The marine shores that are encompassed within the Gig Harbor UGA include shores located within Colvos Passage, Gig Harbor and Henderson Bay. Conditions are slightly contrasting within each of these geographic areas. The shores of Colvos Passage are generally comprised of exposed, high-gradient bluffs fronted by narrow sand and gravel beaches. Coastal feeder bluffs

make up a large portion of these shores (Pentec 2003). These shores are exposed to predominant southerly, and less common northerly, wind and wave conditions as well as the strong currents, most notably through the Tacoma Narrows. The wave and current induced erosion likely enhances erosional processes throughout the Tacoma Narrows, and Colvos Passage to a slightly lesser extent, specifically with regard to current-induced erosion.

Gig Harbor Bay is distinct from Colvos Passage and Henderson Bay shores in that these shores are largely encompassed with the protected shores of the barrier fronted embayment. This area is also unique in that the protected banks are low- to moderate- height and considerably more dense development occurs within the bay. This portion of the study area also has minimal large woody debris (LWD) recruitment and very little marine riparian vegetation, relative to the other shores within the shoreline planning area. Shore modifications are also abundant and largely preclude net shore-drift along the north and southwest shore of Gig Harbor Bay.

The Henderson Bay portion of the northern city limits and UGA is primarily depositional in (geomorphic) character. Segments E and F encompass the northern extent of a single, long net shore-drift cell that originates at Allen Point, south of the study area. Up-drift feeder bluffs, located south of the study area, supply much of the sediment that maintains and creates the beaches and nearshore habitats within the Henderson Bay portion of the northern city limits and UGA. The deep, north-south trending fjordal inlet of Henderson Bay is comprised of long stretches of open shore with several small embayments and sub-estuaries. Spits, also termed barriers, front several of these shoreforms. Most are comprised of finer sediments, have broad intertidal and backshore areas, and are associated with a source of freshwater such as a perennial or ephemeral stream.

Table 4-1 summarizes the primary shoreform (i.e., erosional or accretional beaches) and predominant drift direction in the Gig Harbor shoreline jurisdiction. Additional details are contained in Tables A-3 and A-4, Appendix A.

Table 4-1. Shoreline Sediment Sources and Mobility

Segment	Shoreform and Sediment Stability	Netshore Drift Direction
A	Erosional (north end); Stable	• Divergence zone (north end); west (south end to form spit)
B	Stable (most of segment); Accretional (Crescent Creek)	• South/southwest (south end to form spit) • Divergence zone; • North along east side of Gig Harbor Bay • No appreciable drift along mouth of Crescent Creek.
C	Stable (most of segment); Accretional (Donkey Creek)	• No appreciable drift direction.
D	Accretional (opposite the spit near entrance to Gig Harbor Bay); Erosional (middle of segment); Stable (south end of segment)	• North (north end near entrance to Gig Harbor Bay); • Divergence zone (middle of segment); • South (south end of segment).
E	Stable; Accretional (McCormick Creek)	• North
F	Stable; Accretional (Purdy Creek)	• North

Source: WDNR, 2001; Ecology, 2003

Tides and currents also affect sediment transport and movement of detritus and organic material. Tides in the Puget Sound are diurnal, with two highs and two lows each day. Mean and diurnal tide ranges are about 8.2 feet and 11.8 feet, respectively, in the vicinity of Gig Harbor (City of Gig Harbor, 2001a). At the harbor entrance, maximum ebb and flow currents are 1.2 knots and 0.2 knots, respectively (City of Gig Harbor, 2001a). Currents funneled through the restricted channel of the Tacoma Narrows can reach velocities of up to 4.7 knots (480 feet per minute) (KGI Watershed Committee, 1999).

4.4 Shoreline Modifications

Five white papers have been prepared in recent years which summarize the current knowledge and technology pertaining to marine and estuarine shoreline modifications and which may assist in the update of shoreline management protocols, namely: *Overwater structures: Marine issues* (Nightingale and Simenstad, 2001), *Marine and Estuarine Shoreline Modification Issues* (Williams and Thom, 2001), *Beaches and Bluffs of Puget Sound* (Johannessen and MacLennan, 2007), and *Protecting Nearshore Habitat and Functions in Puget Sound* (EnviroVision et al, 2010). These documents, along with *Reconnaissance Assessment of the State of the Nearshore Report: Including Vashon and Maury Islands (WRIAs 8 and 9)* (King County DNR, 2001) and the findings of two surveys, the Washington Department of Natural Resources (DNR) ShoreZone inventory (2001) and the *Key Peninsula, Gig Harbor, and Islands Watershed Nearshore Salmon Habitat Assessment* (KGI Habitat Assessment) (Pentec Environmental, 2003) were incorporated into this section. A field visit in August 2003 verified modifications along portions of the shoreline providing public access.

Shoreline modifications refer to structural alterations of the shoreline's natural bank, including levees, dikes, floodwalls, riprap, bulkheads, docks, piers or other in-water structures. Such modifications are typically used to stabilize the shoreline and prevent erosion. The most commonly occurring shore modification is termed shoreline armoring, which typically refers to shore parallel structures such as armoring or riprap used to protect coastal property from erosion (Johannessen and MacLennan 2007). These modifications also alter natural process dynamics, leading to beach narrowing, lowering and decreased driftwood abundance (Johannessen and MacLennan, 2007; EnviroVision et al., 2010; Knight, 2009). Shoreline armoring typically impedes sediment supply to down-drift beaches and nearshore habitats. This sediment starvation can cause or heighten erosion along down-drift shores, and can lead to changes in nearshore substrate composition from sand or mud to coarse sand, gravel, and finally hardpan. This may, in turn, decrease eelgrass and increase kelp abundance. Construction of shoreline armoring may cover or destroy eelgrass meadows and overwater structures may deprive eelgrass of light. Dredging can excavate eelgrass or cause excessive turbidity and permanent filling of eelgrass meadows (King County DNR, 2001). Bulkheads and piers may also affect fish life by diverting juvenile salmonids away from shallow shorelines into deeper water, thereby increasing their potential for predation (Nightingale and Simenstad, 2001). Mooring buoys generally have less ecological impact to marine habitat versus construction of piers; however areas of intensive buoy-based moorage can impact shellfish beds and potentially other aquatic habitats (Jefferson County and WDNR, 2010). Mooring buoy use and intensification, which is already common through Gig Harbor, should be considered for potential impacts on aquatic resources, including shellfish resources (Jefferson County and WDNR, 2010).

Alternatives to hard (bulkhead and riprap) shoreline armoring do exist, with several state and regional reports identifying alternative erosion protection techniques (sometimes referred to as soft bank protection or bioengineering) (Zito, 2000; EnviroVision et al., 2010). Alternative shore stabilization techniques include use of appropriate riparian vegetation, beach nourishment, anchored logs, as well as benched, setback, and/or buried revetment structures. The overall intent is to allow for shoreline stabilization while maintaining riparian functions and enhancing shoreline habitat (Gerstel and Brown, 2006). Application of alternative shoreline protection techniques have become more common over the last two decades, with numerous examples documented in Zito, 2000 and Gerstel and Brown, 2006.

4.4.1.1 Shoreline Armoring

Approximately 95 percent of the City's shoreline adjacent to Gig Harbor Bay and Puget Sound is lined with bulkheads (Figure 8) (Haring, 2000). The WDNR ShoreZone Inventory (2001) indicates that portions of Segment A contain concrete and wooden armoring, covering up to 50 percent of the shoreline area. Segment B is predominantly concrete bulkhead and riprap. Segment C contains wooden bulkheads and landfill between Crescent and Donkey Creeks and predominantly concrete bulkheads south of Donkey Creek. Up to 50 percent of Segment D, near the entrance to Gig Harbor Bay, contains concrete bulkheads, with fewer modifications (0 to 30 percent) along the southern portions of the segment. Segments E and F on Henderson Bay are largely modified with concrete and wooden seawalls[1] and bulkheads. Landfill is documented along the mouth of Purdy Creek in Segment F (Figure 8). Total percent of modified shoreline, and primary modification type was derived from the ShoreZone Inventory (WDNR, 2001) and presented in Figure 8. Shoreline modifications are described in further detail in the planning segment discussion (Sections 7 through 12) with references to photographs contained in Appendix B, and in tables A-8 and A-9 (Appendix A).

4.4.1.2 Docks, Piers, and Over-Water Structures

Information gathered from City orthophotos (1998) and Ecology oblique aerial photographs (1992-1997; 2006), indicates that there are approximately 70 docks and piers along the perimeter of Gig Harbor Bay within the City's shoreline jurisdiction. One dock is present along the shoreline of Henderson Bay, within the City's UGA. Ownership of the docks and piers is divided between private and public entities. There are also numerous over-water structures located in Gig Harbor Bay that include boat launches, moorages, and net sheds (Figures 11 through 13). Over the years, ownership of the docks and piers has been in transition with the economic decline of the commercial fishing industry in Puget Sound. Many piers, docks, and net sheds have been sold by the fishing families that originally settled and developed Gig Harbor.

Washington Department of Natural Resources, Aquatic Lands Division, has developed a spatial database (GIS) depicting over-water and in-water structures and activities for which the state holds an aquatic land lease for state-owned aquatic lands. The dataset includes the activity type

[1] Terms that are used interchangeably in Puget Sound, bulkheads are generally considered structures to retain soil along a shoreline, whereas seawalls are specifically designed to resist the action of waves and currents (Shipman, 2003).

and, for most records, whether a facility is public or privately owned. Table 4-2 summarizes WDNR "Encumbrance" data for Gig Harbor's shoreline planning segments.

Table 4-2. WDNR State Owned Aquatic Land Encumbrance Data

Segment	Activity Type	Conditions/Use	Number of Lease Records
B	Complex - marina	Private marina	2
B	Overwater Structure - boat ramp/launch	Public fishing piers, public waterfront parks, public use beaches, aquariums available to the public, underwater parks and reefs, public viewing areas and walkways, parks	1
B	Overwater Structure - dock	County R/W Easement for Bridges, Roads, Ferry, etc.	1
B	Overwater Structure - dock	Private recreational dock	2
B	Overwater structure - mooring buoy	Private Mooring Buoy	1
C	Aquaculture - fin fish	Commercial marina	1
C	Complex - marina	Commercial marina	6
C	Complex - marina	Structure - Retail Outlet, Restaurant, Bar Office Buildings, etc	2
C	Complex - marina	Private marina	12
C	Complex - marina	Public marina	8
C	Complex - marina	Commercial recreation dock and other associated amenities.	2
C	Complex - marina	Transportation and commerce facilities: Includes terminal and transfer facilities, ferry terminals, fish processing, irrigation pumping plants, navigational aids, wood products manufacturing, sand and gravel processing facilities, petroleum refining facilities and other commercial and industrial facilities.	
C	Complex - marina	Not defined	4
C	Overwater Structure - dock	Public fishing piers, public waterfront parks, public use beaches, aquariums available to the public, underwater parks and reefs, public viewing areas and walkways, parks	1
C	Overwater Structure - dock	Commercial recreation dock and other associated amenities.	1
C	Overwater Structure - dock	Private recreational dock	2
C	Overwater Structure - dock	Transportation and commerce facilities: Includes terminal and transfer facilities, ferry terminals, fish processing, irrigation pumping plants, navigational aids, wood products manufacturing, sand and gravel processing facilities, petroleum refining facilities and other commercial and industrial facilities.	1
C	Overwater Structure - nearshore building	Commercial marina	1

Additional descriptions of over-water structures are presented in Tables A-8 and A-9 (Appendix A), and summarized in the Segment descriptions.

4.5 Water Quality

The Washington Department of Ecology maintains a 303(d) list of waterbodies where tested pollutants exceed thresholds established by the state surface water quality standards (WAC 173-201A). Section 303(d) of the federal Clean Water Act requires Washington State to periodically prepare a list of all surface waters in the state for which beneficial uses of the water, such as drinking, recreation, aquatic habitat, and industrial use, are impaired by pollutants. Waterbodies that do not appear on the 303(d) list may fall short of that pollutant threshold, but may not be free of pollutants. In addition, not all waterbodies are tested as part of this process. Therefore, absence from the 303(d) list does not necessarily indicate that the waterbody is not impaired.

Ecology's 2002/2004 Water Quality Assessment identifies and reports on tested waterbody segments as they relate to state water quality standards for a variety of parameters, including temperature, pH, dissolved oxygen, metals, etc. Waterbody segments are classified as Category 1, 2, 4, or 5. Category 5 waters are polluted waters that require a TMDL study. In November 2005 the U.S. Environmental Protection Agency approved the list of Category 5 waters, which represents the state's 303(d) list of impaired waters. Category 4 waters are polluted but do not require a TMDL study (because a TMDL or pollution control plan is already in place or the waterbody is impaired by a non-pollutant such as low streamflow, dams, etc.). Category 2 waters are considered "waters of concern," where pollution is present but may not violate state water quality standards. Category 1 waters meet tested standards for clean waters, but may not be free of all pollutants.

Table 4-3 shows the waterbodies within or in proximity to the City UGA marine shoreline that were evaluated for the 2002/2004 Water Quality Assessment and appear on the approved 303(d) list, and/or appear on the proposed 2008 303(d) list (submitted to the Environmental Protection Agency for review). The Tacoma Narrows, Gig Harbor, Henderson Bay, and Donkey and Purdy Creeks (not shorelines of the state) are included on the list.

Table 4-3. 2002/2004 Water Quality Assessment near Gig Harbor, WA

Waterbody	Category Listing	Water Quality Parameter
Tacoma Narrows/Colvos Passage (offshore of Segments A & D)	5	Total PCBs (observed in quillback rockfish tissue)
	2	Dissolved oxygen
	1	Mercury
Gig Harbor	4C (impaired by non-pollutant)	Fish Habitat (Year 2000 biological survey showed continuous cover of ulvoid macroalgae impairing aquatic life from human causes)
Donkey Creek (aka North Creek; lower reaches and mouth in Segment C)	5	Lead
Purdy Creek (lower reaches near mouth and Segment F)	4B (pollution control plan in place)	Fecal coliform
Henderson Bay/Burley Lagoon (off shore near Segment E)	5	Fecal coliform
	2	Dissolved oxygen
	1	pH; Temperature; Ammonia-N

Source: Washington State Department of Ecology, Proposed 2008 Section 303(d) List and Integrated 2004 Section 303(d) List – WRIA 15.

Water quality sampling in the KGI Watershed has been undertaken by Stream Team volunteers and by URS Corporation technicians on behalf of Pierce County Water Programs (KGI, 2002). Samples were taken on June 1, 2000 and July 31, 2001. Fecal coliform bacteria levels in Crescent Creek were found to be in excess of the state water quality standard of 100 cfu/100ml. Nitrate levels in Goodnough Creek were slightly elevated, with levels ranging between 1.7 and 1.86 mg/L, and likely indicate the presence of nutrients or fertilizers in the system (KGI, 2002). Potential water quality hazards exist at marinas and boat moorage facilities due to fuel spills, increased nutrients from sewage pump-out activities, increased presence of pollutants due to hull scraping and use of anti-fouling paint on boat hulls, and high concentrations of creosote-treated wood pilings and structures.

The scale of water quality and associated habitat impacts resulting from in-water creosote-treated structures vary depending on environmental (current and shore drift velocities; presence of sensitive wildlife populations) and application (wood treatment technique, installation method) factors; however overall analysis from a recent study completed for NMFS concluded that such structures do have the potential to accumulate in and cause toxicity to aquatic organisms (Stratus Consulting, 2006). For example, toxic compounds released by creosote (primarily polycyclic aromatic hydrocarbons [PAHs], phenols, and creosols) are processed and released rapidly by most higher order organisms (including most fish); however are known to accumulate and harm shellfish and some bottom feeding fishes (Stratus Consulting, 2006; WDNR, 2008b). Exposure to creosote in a laboratory setting was found to have acute toxic effect on the development of

Pacific herring embryos (Vines et al., 2000). Generally the spatial extent of impacts associated with creosote-treated wood structures is relatively small (in the immediate vicinity of the treated in-water structure) with lasting impacts (accumulation and potential for biotic uptake) in sediments as opposed to the water column (Poston, 2001; Stratus Consulting, 2006)[2].

[2] The Washington State Department of Natural Resources' Creosote Removal Program is a potential source of funding and resources to implement removal of washed-up creosote-treated debris and in-place (derelict or otherwise unused) creosote-treated structures (WDNR, 2011).

5.0 CRITICAL AREAS

Critical areas are defined in the State's Growth Management Act (RCW 30.70.170) and in Chapter 18 of the GHMC. Per Chapter 18.08 of the GHMC, critical areas are defined as "*those lands which are subject to natural hazards, contain important or significant natural resources or which have a high capability of supporting important natural resources.*" Critical areas in Gig Harbor include wetlands, streams, critical fish and wildlife habitat areas, aquifer recharge areas, hillsides, ravine sidewalls, bluffs, landslide and erosion areas, seismic hazard areas, and flood hazard areas. Wetlands in the City's shoreline jurisdiction are tidally influenced, and are discussed in the context of their habitat function in section 5.6.1.8 below.

Table 5-1 summarizes the documented presence of critical areas by each segment. Sections 5.1 through 5.6 detail each critical area definition and describe which shoreline planning segments include documented critical areas. Figures 9 and 10 show critical hazard areas and fish and wildlife habitat mapping data.

Table 5-1. Summary of Critical Areas by Shoreline Segment

Segment	Critical Area Type					
	Bluffs, Hillsides, Ravine Sidewalls	Landslide/ Erosion Hazard Areas/Unstable Slopes	Seismic Hazard Areas	Flood Hazard Areas	Aquifer Recharge Areas Mapped	Critical Fish and Wildlife Areas
A	X	X		X		X
B	X	X		X		X
C	X	X		X		X
D	X	X		X		X
E	X	X		X		X
F		X	X	X		X

Source: City of Gig Harbor 1994b, 2001c

5.1 Bluffs, Hillsides, and Ravine Sidewalls

5.1.1 Bluffs

Bluffs are defined in Chapter 18.08.030 (GHMC) as "*a steeply rising, near vertical slope which abuts and rises from the Puget Sound shoreline. Bluffs occur in the east area of the city, fronting the Tacoma Narrows, and are further identified in the Coastal Zone Atlas, Volume 7, for Pierce County. The toe of the bluff is the beach and the top is typically a distinct line where the slope abruptly levels out. Where there is no distinct break in a slope, the top is the line of vegetation separating the unvegetated slope from the vegetated uplands, or, if the bluff is vegetated, that point where the bluff slope diminishes to 15 percent or less.*"

The City further identifies bluffs based on designated contour elevation maps. Chapter 18.08.190 establishes a buffer equal to the height of the ravine sidewall or bluff from the top, toe and sides of all ravine sidewalls and bluffs. Development is prohibited within the buffer. The buffer may be reduced (to no less than the rear-yard setback (typically 30-feet in the R-1 and R-2 zones) if a qualified professional and supporting environmental information demonstrate that construction would not adversely impact the stability of the bluff, increase the potential for erosion and mass movement, use construction techniques which minimize disruption of existing topography and vegetation, and includes measures to overcome any geological, soils and hydrologic constraints of the site (GHMC 18.08.190 A.1.c.). Very steep slopes (40 percent or steeper), arising from the Puget Sound shoreline, are mapped in Segment A along Colvos Passage and Segment D along the Narrows (Figure 9). Steep bluffs in Segment D are approximately 100-feet high. Existing development on top of the bluff is set back 100-feet or more in most cases.

5.1.2 Hillsides

Hillsides are defined in Chapter 18.08.030 (GHMC) as "*geologic features with slopes of 15 percent or greater.*" The Critical Areas Ordinance codified in the GHMC defines four classes of hillsides to differentiate between the levels of protection and the application of development standards. The four categories are based on the slope of the site or adjacent properties and are categorized by the following slope increments: 0 to 15 percent, 15 to 25 percent, 25 to 40 percent, and greater than 40 percent.

The City requires topographic surveys from project applicants to determine hillside slopes. The *City of Gig Harbor Comprehensive Plan* (1994b) maps areas where slopes exceed 15 percent and slopes that exceed 40 percent. Slopes of 15 percent or greater exist in every shoreline planning segment (Figure 9). Slopes exceeding 40 percent primarily fall within Segments A along the Colvos Passage shoreline and throughout most of the Segment D shoreline area along the Narrows (Figure 9). In a regulatory context, hillsides do not have a prescriptive buffer, but require site analysis and recommendations related to ground disturbance, storm drainage and erosion control, and seismic stability. Where hillsides coincide with bluffs as defined above, development standards (e.g., buffers) for bluffs apply.

5.1.3 Ravine Sidewalls

Ravine sidewalls are defined in Chapter 18.08.030 (GHMC) as "*a steep slope which abuts and rises from the valley floor of a stream and which was created by the normal erosive action of the stream. Ravine sidewalls are characterized by slopes predominantly in excess of 25 percent although portions may be less than 25 percent. The base of a ravine sidewall is the stream valley floor. The top of a ravine sidewall is a distinct line where the slope abruptly levels out. Where there is no distinct break in slope, the top shall be that point where the slope diminishes to 15 percent or less.*"

The City currently identifies ravine sidewalls through examination of topographic surveys. Development near ravine sidewalls are regulated similarly to mapped bluff areas, as described above. Based on contour maps and designated steep slope maps, ravine sidewalls within the

shoreline area fall within Segment C along the southern shoreline associated with Donkey Creek and within Segment E along the southern shoreline associated with McCormick Creek (Figure 9).

5.2 Landslide and Erosion Hazard Areas

The City identifies landslide and erosion hazard areas based on the Pierce County GIS mapping. In addition to steep slopes, landslide and erosion hazard areas are also based on a combination of geologic, soil, hydrologic, vegetative, and human impact features. Pierce County mapping of the Gig Harbor area groups landslide and erosion hazards together and distinguishes these areas based on two separate categories that include 15 to 30 percent slope and greater than 30 percent slope (City of Gig Harbor, 2001c). However, some of the slope areas identified by Pierce County are inconsistent with the steep slope mapping contained in the City's Comprehensive Plan, Stormwater Comprehensive Plan, and Wastewater Comprehensive Plan (City of Gig Harbor, 1994b, 2001a, 2002) as additional slope areas are identified that are not shown on City maps. This discrepancy is particularly prominent along the shoreline reaches associated with Segments E and F. Pierce County mapping of landslide and erosion hazard areas were not available for inclusion in this map folio because it is based on a hard copy map based on third-party data sources (City of Gig Harbor, 2001c).

5.2.1 Landslide Hazard Areas

Landslide hazard areas are defined in Chapter 18.08.030 (GHMC) as *"those areas which are susceptible to risk of mass movement due to a combination of geologic, topographic and hydrologic factors."*

A specific slope percentage is not designated in the GHMC to define a landslide hazard area; rather, the City identifies landslide hazard areas based on Pierce County mapping. Pierce County mapping identifies landslide hazard areas within each of the six shoreline segments. Generally the steepest areas (where the slope exceeds 30 percent) occur along the bluffs associated with Colvos Passage and the Narrows (Segments A and D), and along the ravine associated with McCormick Creek in Segment E (Figure 9).

The *City of Gig Harbor Comprehensive Plan* (2007a) lists the following goal related to landslide areas: *"protect soils in steep slopes which are composed of poor compressive materials, or have shallow depths to bedrock, or have impermeable subsurface deposits or which contain other characteristic combinations which are susceptible to landslide or land slumps."* The GHMC (18.08.192) regulates development and establishes standards in areas identified as landslide or erosion hazard areas. Proposals for development in such areas require a geotechnical assessment and the maintenance of a buffer equal to the height of the hazard area as described for bluffs and ravine sidewalls.

5.2.2 Erosion Hazard Areas

Erosion hazard areas are defined in Chapter 18.08.030 of the GHMC as "*those areas which are vulnerable to erosion due to natural characteristics including vegetative cover, soil texture, slope, gradient or which have been induced by human activity.*" Areas classified as having severe or very severe erosion potential according to the USDA Natural Resource Conservation Service (NRCS), formerly Soil Conservation Service, Soil Survey for the Pierce County Area (USDA, 1983) are included.

Soils mapped by the NRCS are depicted in Figure 9. Bluff areas along part of Segment A and most of Segment D contain soils mapped as "very severe" erosion hazard. Soils mapped as "severe to very severe" erosion hazard are mapped along McCormick Creek in Segment E.

Protection of erosion hazard areas, according to the *City of Gig Harbor Comprehensive Plan* (2007a), is to be enforced through performance standards governing possible land use development on soils that have moderate to steep slopes and are composed of soils, ground covers, surface drainage features, or other characteristics susceptible to high erosion risks. The GHMC (18. 08.192) regulates development and establishes standards in areas identified as landslide or erosion hazard areas, as described above.

5.2.3 Shoreline Slope Stability

The Department of Ecology Coastal Zone Atlas (Ecology website, 2003) includes maps that characterize slope stability of the entire shoreline along Gig Harbor and its UGA (Figure 9). These maps were originally developed in the mid-1970s. Although the City does not regulate shoreline development based on slope stability characterization, the maps provide an additional source of documented landslide areas and provide a general indication of the percent of slope along the shoreline. This is beneficial for the City since landslide and erosion hazard areas, bluffs, hillsides, and ravine sidewalls are regulated based on slope value.

Slope stability is described in terms of six separate categories: stable, intermediate, unstable, unstable recent landslide, unstable old landslide, and modified (Ecology, 2003). Table 5-2 defines slope stability categories (Ecology website, 2003). Similar to the landslide and erosion thresholds established by the City, slope percentage (in part) also distinguishes the stable slope from the intermediate slope categories.

Table 5-2. Ecology Slope Stability Map Designations

Slope Stability Designation	Definition
Stable	Generally rise less than 15 percent in grade, except in areas of low groundwater concentration or competent bedrock. Include rolling uplands and lowlands underlain by stable material (i.e. unweathered till and/or peat deposits) with no significant slope.
Intermediate	Generally steeper than 15 percent except in areas where weaker material and/or abundant material exist. These areas include slopes of sand and gravel, till, or thin soils over bedrock with no known failures.
Unstable	Slopes that are considered unstable due to geology, groundwater, slope, and/or erosional factors which include areas of landslide and talus too small or obscure to be mapped.
Unstable Recent Landslide	Recent or historically active landslide areas (based on surveys conducted in the late 1970s).
Unstable Old Landslide	Identifies post-glacial but prehistoric landslide areas.
Modified	Slopes that are highly modified by human activity and include areas of significant excavation or filling. Response of the slope to a combination of human activity and natural processes may be unpredictable.

Generally, slope stability in the City's shoreline jurisdiction is characterized as stable surrounding Gig Harbor Bay and along Henderson Bay (Segments B, C, and E), modified near the Purdy Spit in Henderson Bay (Segment F), and unstable with recent or historic slide activity along Colvos Passage and the Narrows (Segments A and D) (Figure 9).

5.3 Seismic Hazard Areas

Seismic hazard areas are defined in Chapter 18.08.030 of the GHMC as "*those areas that are susceptible to severe damage from earthquakes as a result of ground shaking, slope failure, settlement or soil liquefaction.*" The City uses Pierce County GIS mapping data to determine seismic hazard areas in the City and UGA limits (GIS data depicting seismic hazard areas were not available for inclusion in the map folio).

The only documented seismic hazard area within the City's shoreline jurisdiction is located in Segment F near the SR-302 bridge, where an area along the shoreline is characterized as a "high potential liquefaction hazard area" (Pierce County Department of Planning and Land Services website, 2002). The *City of Gig Harbor Comprehensive Plan* (2007a) does not list goals for the protection or development of areas characterized as seismic hazard areas.

5.4 Flood Hazard Areas

Flood hazard areas are defined in Chapter 18.08.030 of the GHMC as "*those areas within the City of Gig Harbor which are determined to be at risk of having a one percent or greater chance of experiencing a flood in any one year, with those areas defined and identified on the Federal Emergency Management Agency (FEMA) flood insurance rate maps for the City of Gig Harbor.*"

The location and extent of 100-year flood hazard areas, as mapped by FEMA, are shown on Figure 9.

The entire shoreline is mapped as a 100-year floodplain (FEMA, 1995). With the exception of the developed area at the Donkey Creek outlet, the stream corridors of Crescent Creek (Segment B), Donkey Creek (Segment C), McCormick and Goodnough Creeks (Segment E), and Purdy Creek (Segment F) are also mapped as a 100-year floodplain (FEMA, 1995). There have been no recent flooding occurrences in the City's shoreline jurisdiction (Chris Munter, personal communication, 2002).

The *City of Gig Harbor Comprehensive Plan* (2007a) calls for the protection of alluvial soils, tidal pools, retention ponds and other floodplains or flooded areas from land use developments that would alter the pattern or capacity of floodways, or interfere with the natural drainage process.

5.5 Aquifer Recharge Areas

Aquifer recharge areas are defined in GHMC 18.08.030 as "*those areas which serve as critical ground water recharge areas and which are highly vulnerable to contamination from intensive land uses within these areas.*" Per Chapter 18.08.188, the boundaries of aquifer recharge areas within the City "*shall consist of the two highest DRASTIC zones which are rated 180 and above on the DRASTIC index range. Any site located within these boundaries is included in the aquifer recharge area.*"

"DRASTIC" zones refer to a model developed by the National Water Well Association and Environmental Protection Agency used to measure aquifer susceptibility to contamination. The City assesses Pierce County GIS DRASTIC mapping to determine the location of sensitive aquifer recharge areas. According to Pierce County mapping, no aquifer recharge areas occur in the shoreline jurisdiction.

5.6 Critical Fish and Wildlife Areas

Critical fish and wildlife habitat areas are defined in GHMC 18.08.030 as "those areas identified as being of critical importance in the maintenance and preservation of fish, wildlife and natural vegetation including waters of the state, and as further identified in GHMC 18.08.186." Critical fish and wildlife habitat areas are further described in Chapter 18.08.186.A. as follows:

1. *Areas with which federal or state endangered, threatened and sensitive species of fish, wildlife and plants have a primary association and which, if altered, may reduce the likelihood that the species will maintain and reproduce over the long term.*
2. *Habitats and species of local importance, including:*
   a. *Areas with which state-listed monitor or candidate species or federally listed candidate species have a primary association and which, if altered, may reduce the likelihood that the species will maintain and reproduce over the long term*
   b. *Special habitat areas which are infrequent in occurrence in the City of Gig Harbor and which provide specific habitats as follows:*

   i. *Old growth forests*
   ii. *Snag-rich areas*
   iii. *Category 2 wetland areas*
   iv. *Significant stands of trees that provide roosting areas for endangered, threatened, rare or species of concern as identified by the Washington Department of Wildlife.*
3. *Commercial and public recreational shellfish areas.*
4. *Kelp and eelgrass beds.*
5. *Herring and smelt spawning areas.*
6. *Naturally occurring ponds under 20 acres and their submerged aquatic beds that provide fish or wildlife habitat.*
7. *Lakes, ponds and streams planted with fish by a governmental agency, and agency-sponsored group or tribal entity.*
8. *State natural area preserves and natural resource conservation areas.*

Critical fish and wildlife habitats in the City's shoreline jurisdiction are characterized in the following sub-sections.

5.6.1 Priority Habitats and Habitats of Local Importance

Nearshore habitats span supralittoral[3], intertidal[4], and subtidal[5] zones (Battelle Marine Sciences Laboratory, 2002; WDNR, 2001). The following description of nearshore habitats located in the City and UGA shoreline jurisdiction is based primarily on the findings of two surveys, the Washington Department of Natural Resources (DNR) ShoreZone inventory (2001) and the *Key Peninsula, Gig Harbor, and Islands Watershed Nearshore Salmon Habitat Assessment* (KGI Habitat Assessment) (Pentec Environmental, 2003). This discussion was further guided by reviewing the *Reconnaissance Assessment of the State of the Nearshore Report: Including Vashon and Maury Islands (WRIAs 8 and 9)* (King County DNR, 2001), the *Final Report: Northwest Straits Nearshore Habitat Evaluation* (Anchor Environmental and People for Puget Sound, 2002), and the *Bainbridge Island Nearshore Assessment Best Available Science* (Batelle Marine Sciences Laboratory, 2002). A field visit in August 2003 verified characterizations along portions of the shoreline providing public access.

5.6.1.1 Marine Riparian Zones

Marine riparian vegetation is defined as vegetation overhanging the intertidal zone (King County DNR, 2001). Marine riparian zones function by protecting water quality; providing wildlife habitat; regulating microclimate; providing shade, nutrient and prey; stabilizing banks; and providing large woody debris (Anchor Environmental and People for Puget Sound, 2002; Knight, 2009; EnviroVision et al., 2010).

[3] Supralittoral or backshore – habitats that are outside the typical range of tidal influence, and may be wet only occasionally from spray or irregular flooding. Above mean high water of spring tides (MHWS).

[4] Intertidal – habitats between MHWS and extreme lower low water (ELLW). These areas are regularly inundated by the fluctuation of tides.

[5] Subtidal – Shallow Subtidal includes those habitats rarely uncovered by low tide, and Deep Subtidal includes habitats that are never uncovered by low tide.

The marine riparian zones of all City shoreline segments have been impacted by land clearing and shoreline armoring. Segment A along Colvos Passage retains between 51 and 100 percent marine vegetation; however, this riparian band is disconnected from the intertidal zone by shoreline armoring in areas (Table A-1, Appendix A; Figure 8). Trees are predominantly deciduous, including red alder, Pacific madrone, and big leaf maple (Photo A2, Appendix B). In areas where armoring occurs in less than 25 percent of the shoreline, these trees represent a future source of LWD to the beach (Figure 8). Segments B and C are landscaped or developed, and retain little riparian vegetation (Photo B-1, Appendix B). The exceptions are a small band of big leaf maple, red alder, and western redcedar trees at the mouth of Crescent Creek in Segment B, and several small pockets of willow trees scattered throughout Segment C. The steep slopes along Segment D retain between 51 and 100 percent mixed deciduous and coniferous trees (Table A-1, Appendix A; Photos D-1 through D-3). More than 9,000 feet of Segment D remains unarmored, providing a high potential for future LWD (Table A-1, Appendix A; Figure 8). The area north of Goodnough Creek, which includes a portion of both Segment E and Segment F, is approximately 51 to 100 percent vegetated (Table A-1, Appendix A). The adjacent beach retains an estimated LWD density of one piece per 90 feet of shoreline (Table A-1, Appendix A). Even though the KGI Habitat Assessment (Pentec Environmental, 2003) indicates medium density riparian vegetation and beached wood in the northernmost portion of Segment F, this segment currently appears to be landscaped or almost entirely cleared of riparian vegetation (Table A-1, Appendix A; Photos F-2 and F-3).

Correspondence received from the Washington State Department of Natural Resources (WDNR, 2002) indicates there are no known endangered, threatened, or sensitive plant species in the City's shoreline jurisdiction.

Activities that remove or alter marine riparian vegetation may impact shoreline ecological functions in the following ways (EnviroVision et al., 2010):

- Loss of function due to direct removal or disturbance during clearing and grading activities;
- Reduction in functional value due to decreases in vegetated riparian area width and plant diversity or density;
- Reduction or loss of riparian function through pruning overhanging pieces and/or removal of large trees;
- Increased pollutant load due to change from established native community to non-native landscaping requiring use of fertilizers and pesticides;
- Increased incidence of invasive species due to site disruption;
- Increased beach substrate temperatures during low tide in summer due to removal of overhanging vegetation; and
- Reduction or loss of localized terrestrial insect input from shoreline vegetation due to vegetation removal.

5.6.1.2 Banks and Bluffs

Banks and bluffs are part of the riparian zone and can be a source of sediment to adjacent beaches, provide habitat to bluff-dwelling animals, rooting area for riparian vegetation, and a source of groundwater seepage to marine waters (King County DNR, 2001). Shoreline development and armoring, vegetation clearing, and changes in hydrology, among others, can adversely impact bluffs.

The ShoreZone Inventory (WDNR, 2001) maps high, steep cliffs of glacial till in Segments A and D (Tables A-11 and A-14, Appendix A). These are described as erosional features. The KGI Habitat Assessment (Pentec Environmental, 2003) also documents active feeder bluffs, or cliffs contributing sediment to the beach from the backshore, along segments A and D (Table A-2, Appendix A). As described above, Segment D retains a relatively intact band of native vegetation, which provides valuable slope stabilization. Segment A is also relatively well vegetated. Analysis of the orthophoto (1998) and Ecology's aerial photos (Ecology website, 2000) reveal potential slide areas in both Segments A and D.

5.6.1.3 Beaches and Backshore

Beaches are generally steeper than tidal flats (King County DNR, 2001). Backshore areas are immediately landward of beaches and are zones inundated by storm-driven tides. A typical profile of an undisturbed shoreline in Central Puget Sound would include an upper backshore or storm berm area that collects logs, algae, and other debris during storms (King County DNR, 2001). The intertidal portion of the beach is typically relatively steep and comprised of a mixture of cobbles and gravel in a sand matrix (King County DNR, 2001). Little to no LWD was described along beaches in Segments A, B, and C (Table A-1). LWD along the unarmored section of beach in Segment D have been documented at an estimated density of one piece per 90 feet of shoreline (Table A-1). Similar densities are described in the vicinity of the Goodnough Creek outlet, in Segments E and F. Sediment abundance throughout the shoreline segments is characterized predominantly as "moderate" (some mobile sediment, but not likely to rapidly move), with the exception of the stream mouths (fluvial sediment source), where sediment abundance is characterized as "abundant" (Table A-3, Appendix A). Accretional areas are described in Segments B and C along the eastern bank of the Crescent Creek outlet; in Segment C opposite the spit; in Segment E at the mouth of McCormick Creek; and in Segment F along the spit at the mouth of Purdy Creek. Beach sediments in shoreline jurisdiction are characterized in Tables A-3 and A-4, as well as Tables A-11 through A-16, Appendix A. The WDNR ShoreZone Inventory utilized the British Columbia ShoreZone Mapping System, which classifies the shoreline into homogeneous stretches (or units) based on key physical controlling factors (WDNR, 2001). Table 10 summarizes the general beach or shoreline substrate composition, based on the British Columbia (BC) classification, for each shoreline planning segment (WDNR, 2001).

5.6.1.4 Sand Spits

Waves transport sediment alongshore until conditions or shore orientation changes so that there is no longer sufficient wave energy to do so, at which point sediment deposits, often forming

shoreforms such as spits. Spits are commonly found fronting embayments and subestuaries, and are documented by KGI Habitat Assessment (Pentec Environmental, 2003) and WDNR (2001) in Segments A, E and F. Sediments deposited on the sand spit in Segment A originate from eroding bluffs along Colvos Passage (Figure 9; Photo A-1). Sediments deposited on the sand spit along Segment E originate from sediment transported alongshore from the south, with minor sediment contributed from McCormick Creek (Photo E-2). The spit in Segment F was developed with sediment derived from up-drift bluffs and alongshore sediment transport, but was augmented with fill to allow for construction of the commercial businesses now presently located atop the spit (Photo F-3). Historic T-sheet no. 1674 (US Coast and Geodetic Survey, 1878) shows that the landward, southern extent of the spit was historically salt marsh beneath what is now fill.

Table 5-3. ShoreZone Classification (WDNR, 2001)

Segment	BC Classification*
A	• Sand and gravel beach, narrow.
B	• Sand and gravel beach, narrow (north of spit); • Sand flat; • Mud flat and organic/fines (associated with Crescent Creek mouth).
C	• Mud flat and organic/fines (associated with Crescent Creek mouth); • Sand and gravel flat or fan (between Crescent and Donkey Creek mouths); • Organic/fines (associated with Donkey Creek mouth); • Mud flat (southwest side of Gig Harbor Bay)' • Sand and gravel beach, narrow (near entrance to Gig Harbor Bay.
D	• Sand and gravel beach, narrow.
E	• Organic/fines (near McCormick Creek mouth); • Sand flat; • Sand and gravel flat or fan
F	• Sand and gravel beach, narrow (south of Burley Lagoon); • Organics/fines (associated with Purdy Creek and Burley Lagoon); • Sand beach (north of Burley Lagoon); • Mud flat (north end of Segment F).

*British Columbia Physical Mapping System (Howes et al, 1994 *in* WDNR, 2001)

Any activity that alters erosion or wave energy and changes the supply or distribution of sediments along the shore can alter the form and maintenance of banks and bluffs; beaches and backshore; and sand spits, resulting in impacts such as:

- Loss of backshore due to shoreline armoring;
- Direct loss of beach through downcutting (often caused by shoreline armoring);
- Indirect loss of beach through armoring of updrift bluffs, the resultant loss of sediment supply followed by changes in beach substrate character and downcutting;
- Loss of nearshore vegetation and shading;

- Simplification of habitat structure due to removal of large wood, overhanging branches, and boulders;
- Substrate modification due to piling placement (shellhash formation) and grounding of boats and/or structures;
- Reduced bluff and beach stabilization, and increased erosion due to vegetation removal; and
- Loss or change to beach substrate and conditions that support aquatic and riparian vegetation and spawning habitat for forage fish (EnviroVision et al., 2010).

5.6.1.5 Flats

Flats generally include gently sloping sandy or muddy intertidal or shallow subtidal areas (King County DNR, 2001), and are used by juvenile salmonids, shorebirds, and shellfish, among others. Flats are generally located at the mouths of streams where sediment transported downstream is deposited, and in areas of low wave and current energies where longshore waves and currents deposit sediment (King County DNR, 2001). Mud flats are mapped in Segments B and C (in the vicinity of the Crescent Creek outlet), Segment C, and Segment F, within Burley Lagoon. Sand flats are mapped in Segment B (in the vicinity of the Randall Street boat launch), and along much of the shoreline of Segment E.

Shoreline activities that may impact tidal flats (King County DNR, 2001) include:

- Unnatural erosion or deposition of sediment;
- Harvesting of shellfish and other marine life;
- Fecal and chemical contamination;
- Physical disturbances from shoreline armoring, marina construction, and upland development practices;
- Shading from overwater structures; and
- Loss of emergent and riparian vegetation.

5.6.1.6 Eelgrass Meadows

The importance of eelgrass has been described in various sources, including the *Reconnaissance Assessment of the State of the Nearshore Environment* (King County DNR, 2001). Eelgrass beds are found in intertidal areas and provide feeding and rearing habitat for a large number of marine organisms. Eelgrass beds have been documented in Henderson Bay within the City and northern UGA shoreline jurisdiction (Evans-Hamilton, Inc. and D.R. Systems, Inc., 1987).

More recent documentation of eelgrass occurrence was conducted by Pentec Environmental for the KGI Habitat Assessment (2003) (Table A-5, Appendix A). This study found no eelgrass present in Segments A, B, C, or D. The study found that eelgrass was present throughout Segment E, continuing approximately 300 feet north into Segment F. The densest occurrence of

eelgrass is mapped between the outlets of Goodnough Creek and McCormick Creek in Segment E.

Shoreline activities that may impact eelgrass (King County DNR, 2001) include:

- Clam harvesting;
- Propeller scour and wash;
- Physical disturbances from shoreline armoring;
- Shading from overwater structures; and
- Physical disturbances from dredging and filling.

5.6.1.7 Kelp Forests

The function of kelp has been described in *Reconnaissance Assessment of the State of the Nearshore Environment* (King County DNR, 2001). Kelp provides habitat for many fish species, including rockfish and salmonids, potential spawning substrate for herring, and buffers to shoreline from waves and currents, among other functions. The Puget Sound Environmental Atlas documents the presence of kelp beds in and near Gig Harbor Bay and Henderson Bay. Changes in kelp distribution may indicate the coarsening of shallow subtidal sediments (such as that caused by erosion related to a seawall) or an increase in nutrient loading (such as from sewage effluent. Kelp is found in all shoreline planning segments (Tables A-11 through A-16) (King County DNR, 2001).

Shoreline activities that may impact kelp densities (King County DNR, 2001) include:

- Physical disturbances from shoreline armoring, marina construction, and harvesting;
- Shading from overwater structures;
- Beach nourishment; and
- Nutrient loading.

5.6.1.8 Tidal Wetlands

Tidal marshes include salt and freshwater habitats that experience tidal inundation (King County DNR, 2001). Wetlands have been mapped by various sources in the City's shoreline jurisdiction. According to the 1987 National Wetlands Inventory (NWI), the entire intertidal area of the City's shoreline jurisdiction in the City limits and UGA boundary is classified (per the Cowardin classification system) as an "estuarine intertidal regular unconsolidated shore" wetland (City of Gig Harbor, 2001b). Two priority estuarine habitat areas are called out on the Priority Habitats and Species (PHS) maps, in Segment B at the mouth of Crescent Creek, and in Segment C at the mouth of Donkey Creek. The estuarine wetland located along the shoreline of Henderson Bay extends throughout Segments E and F, and ranges in width from approximately 175 feet near the northern city limits to approximately 1,000 feet near Highway 302. The entire estuarine environment north of Highway 302, known as Burley Lagoon, is classified as an estuarine wetland according to the NWI (USFWS, 1987). Burley Lagoon is mapped as an open

lagoon, beginning in the northern section of Segment F, north of Highway 302. The partially enclosed lagoon is formed by freshwater inflow from Purdy Creek, maintaining a stream channel through sand bars formed by alongshore deposition.

The Inventory of Streams and Wetlands Report (Adolfson, 2005) includes in-field verification of many of the areas inventoried by the NWI, the PHS database, and as discussed in the City's Stormwater Comprehensive Plan (City of Gig Harbor, 2001a). The Adolfson 2005 Inventory confirmed that prevalent tide marsh vegetation is present near the mouths of Donkey Creek and Crescent Creek (on Gig Harbor Bay) and at the mouth of Purdy Creek, extending northward into Burley Lagoon. These areas are shown as wetlands on the figures prepared for the 2005 Inventory (and shown on Figure 10). However, many of the other areas assessed during in-field verification efforts that had previously been characterized as tidal wetland were observed as being cobble beach and mudflat environments. As noted within the Adolfson, 2005 Inventory, unvegetated areas of mudflat or other tidal lands would not be considered wetland by the Washington State Department of Ecology. According to the 2005 Inventory, beaches or mudflats that lack a prevalence of macrophytic vegetation are designated as "special aquatic sites" in the State of Washington. They do not, however, meet the definition of wetland. The 2005 Inventory included in-field observations only when access was possible. As such, the report notes that other areas of tidal wetland may exist.

The KGI Habitat Assessment (Pentec Environmental, 2003) documents tidal marshes at the mouth of Crescent Creek in Segment B and Purdy Creek in Segment F. Tidal marshes were also noted to be relatively wide in Segment B adjacent to the Randall Street boat launch. Vegetation noted in this area during an August 2003 field visit consisted of pickleweed adjacent to the armored shoreline. Pickleweed has also been observed along the northwesterly shoreline frontage of the Russell Foundation site (southerly of Pioneer Way extended to the east) in Segment C. Wetlands are depicted on Figure 10.

5.6.1.9 Non-tidal Wetlands

Although no non-tidal wetlands are shown on National Wetland Inventory (NWI) or Pierce County inventory mapping within shoreline jurisdiction, the *City of Gig Harbor Stream and Wetland Inventory* documents several potential non-tidal wetlands that would be within the shoreline jurisdiction (Adolfson, 2005). As depicted on Figures 1-A and 1-B of the Adolfson 2005 Inventory, potential wetland areas (documented as wetland numbers 82 and 83) occur in the shoreline environment along the southwestern shore of Gig Harbor Bay. Similarly, a potential wetland area occurs near the mouth of Purdy Creek (documented as wetland 84) that would likely be within the shoreline planning area. Verification that these areas met all wetland criteria did not occur during field verification efforts; however, areas were mapped in the Adolfson 2005 Inventory because observations of one or more wetland indicators provided a high degree of confidence that wetlands were present. These wetlands are shown on Figure 10.

5.6.1.10 Streams

Streams provide valuable wildlife corridors, a source of fluvial sediments to the marine shoreline (moved along the shoreline by waves), and support a range of fish species. The Gig Harbor shoreline jurisdiction is located in Water Resource Inventory Area (WRIA) 15, the Kitsap Watershed. Information on stream conditions was drawn in particular from the following four documents: *City of Gig Harbor Stream and Wetland Inventory* (Adolfson, 2005); *Salmonid Habitat Limiting Factors, Water Resource Inventory Area 15 (East) Final Report* (Haring, 2000), *Gig Harbor Basin Plan* (Pierce County, 2002), and the KGI Habitat Assessment (Pentec Environmental, 2003). Information on streams in the City is also found in the *Stormwater Comprehensive Plan* (City of Gig Harbor, 2001a). Stream-specific information is included in individual segment discussions in Sections 7 through 12. Streams are depicted on Figure 10.

5.6.2 Priority Species and Species of Local Importance

Over 40 types of wildlife species and 50 types of fish may be present in the estuarine environment near the mouths of Crescent and Donkey Creeks (City of Gig Harbor, 2001a).

5.6.2.1 Shellfish

Hardshell intertidal clams are documented along Colvos Passage in Segment A and within Burley Lagoon in Segment F (WDFW, 2007). Sea urchins are documented along Colvos Passage and the Narrows, within Segments A and D (WDFW, 2007). Burrowing organisms found in the nearshore environment, from mean high water (MHW) to subtidal areas, include native and introduced clam species such as little neck, manila, cockle, butter, and horseclams. Geoduck clams, shrimp, oysters, red rock crab, and Dungeness crab also inhabit shoreline areas of Gig Harbor Bay and Puget Sound (City of Gig Harbor, 2001a). Oysters, clams, and mussels are documented within the waters of Burley Lagoon (Washington State Department of Health website, 2001).

The Washington State Department of Health restricted the harvest of shellfish beds in Burley Lagoon in 1981 due to high levels of bacterial contamination. Shellfish harvest in the lagoon was upgraded to conditionally approved in 1993, yet, in January 1999 harvesting was again restricted due to high levels of fecal coliform bacteria (Haring, 2000). In 2001, 110 acres in the southern area of Burley Lagoon was re-opened to shellfish harvesting since water quality in the southern half of Burley Lagoon met state and federal water quality standards (Washington State Department of Health website, 2001). Southern areas of Burley Lagoon remain open to shellfish harvesting, however central and northern areas of the lagoon remain closed due to pollution (Washington State Department of Health website, 2008).

In addition, the Washington State Department of Health has closed the entire area of Gig Harbor, and some areas of Colvos Passage immediately outside of the harbor, permanently due to pollution (Washington State Department of Health website, 2008).

5.6.2.2 Salmonids

The *Salmonid Habitat Limiting Factors: Water Resources Inventory Area (WRIA) 15 (East) Final Report* (Haring, 2000) and the Kitsap *WRIA #15 WDFW – Salmonid Stock Inventory* mapping (Ecology, 2008) identify the known presence of salmon in local streams[6]. Chinook salmon, listed as threatened under the ESA, are present in Crescent, and McCormick Creeks. Critical Habitat for Chinook salmon has been designated in estuarine and nearshore marine areas and includes areas contiguous with the shoreline from the line of extreme high water out to a depth of 30 meters relative to mean lower low water. Steelhead trout, listed as threatened under the ESA, are present in Crescent, McCormick, Purdy, and Donkey Creeks. Coho, a federal species of concern may be found in Purdy, McCormick, Crescent, and Donkey Creeks. Chum salmon are present in Purdy, Crescent, Donkey, and McCormick Creeks. Cutthroat trout are ubiquitous throughout the watershed and are believed to be present in most streams (Haring, 2000). Bull trout listed as threatened under the ESA are potentially present within marine areas surrounding Gig Harbor. Gig Harbor Bay and Henderson Bay provide habitat for rearing and outmigration (WDFW, 2007). Nearshore habitat is an important environment for juvenile salmonids, where the shallow water depth obstructs the presence of larger, predator species (City of Gig Harbor, 2001a).

5.6.2.3 Forage Fish

Three primary sources were referenced in compiling information on potential forage fish spawning areas within the City's shoreline jurisdiction: Marine Resource Species (MRS) data maintained by WDFW (2003), the *Key Peninsula, Gig Harbor, and Islands Watershed Nearshore Salmon Habitat Assessment* (Pentec Environmental, 2003), and the *Final Report: Northwest Straits Nearshore Habitat Evaluation* (Anchor Environmental and People for Puget Sound, 2002).

The *Final Report: Northwest Straits Nearshore Habitat Evaluation* (Anchor Environmental and People for Puget Sound, 2002) identified the following key features to be considered when evaluating and prioritizing potential forage fish spawning habitat. The three forage fish species most likely to occur in the City's shoreline jurisdiction include surf smelt, sand lance, and Pacific herring. Key habitat features include:

- Documented spawning activity;
- Appropriate sand or gravel spawning substrate;
- Protected bays or embayments;
- Sediment source in the form of bluffs adjacent to shoreline;
- Riparian fringe to shade incubating eggs;
- Presence of eelgrass for food and refuge and as a herring spawning substrate;

[6] Ecology's 2008 *Kitsap WRIA #15 WDFW – Salmonid Stock Inventory* includes Department of Fish and Wildlife salmon distribution and use data.

- Salt marsh as a food source and natural shoreline character;
- Kelp as a spawning substrate for herring and natural shoreline character; and
- Proximity to herring holding areas (herring typically spawn near their holding areas).

Different species utilize different parts of the intertidal and subtidal zones, with sand lance and surf smelt spawning primarily in the substrate of the upper intertidal zone, and Pacific herring spawning primarily on intertidal or subtidal vegetation (Anchor Environmental and People for Puget Sound, 2002). These three species account for over 50 percent of the diet of adult salmonids. Information on the three potential forage fish species within the City's jurisdiction is summarized in Table 5-4.

Table 5-4. Forage Fish Species.

Species	Documented presence	Spawning timing	Preferred spawning substrate	Spawning location
Pacific herring	None (nearest is Quartermaster Harbor (Vashon I.)	Quartermaster Harbor stock spawn Feb/March	Eelgrass	Upper high tide limits to depths of 40 feet (typically between 0 and –10 tidal elevation)
Sand lance	Segment D	November 1 to February 15	Fine sand, mixed sand and gravel, or gravel up to 3cm	From + 5 tidal elevation to higher high water line (from bays and inlets to current-swept beaches)
Surf smelt	Segments A and B	South Puget Sound stocks are fall-winter spawners (September to March)	Mix of coarse sand and fine gravel	Upper intertidal

Source: Pentilla, 1996; WDFW, 2007

Information on documented spawning activity was available from the WDFW (2007). No Pacific herring spawning areas are currently documented in any of the Gig Harbor inventory segments (WDFW, 2007). A sand lance spawning area is mapped along the Puget Sound Narrows shoreline, throughout most of Segment D (excluding the northernmost section, roughly corresponding with the area that is armored). Surf smelt spawning areas are mapped throughout most of Segment A along Colvos Passage and the seaward side of the spit, and along two sections of the eastern shoreline of Gig Harbor within Segment B, immediately inside the Gig Harbor Bay to the north of the spit. There are no documented sand lance or surf smelt spawning areas in Henderson Bay in Segments E and F (WDFW, 2007).

The KGI Habitat Assessment (Pentec Environmental, 2003) mapped potential spawning areas throughout the entire shoreline of Segments A and D, as well as in Gig Harbor at the mouth of Donkey Creek, in Segment C. Potential forage fish spawning habitat was also identified in Segment E.

Nearshore modifications impact potential forage fish habitat in the following ways:

- Development impacts the shoreline, particularly marinas and boat ramps which introduce the potential for repeated disturbance and potentially alter nearshore hydrology;
- Sewer outfalls introduce pollutants and nutrients to the nearshore;

- Overwater structures shade intertidal vegetation and may alter nearshore hydrology; and
- Rip-rap revetments and vertical bulkheads alter nearshore hydrology and may increase wave energy on intertidal areas.

The sand lance's habit of spawning in the upper intertidal zone of protected sand-gravel beaches particularly in the increasingly populated Puget Sound basin, make it vulnerable to the cumulative effects of various types of shoreline development. The WAC Hydraulic Code Rules (WAC 220-110) for the control and permitting of in-water construction activities in Washington State include consideration of sand lance spawning habitat protection.

5.6.2.4 Shorebirds and Upland Birds

Adjacent to the open waters of Puget Sound and Gig Harbor Bay, the upland terrestrial environment provides habitat for birds, amphibians, reptiles, and insects. A variety of shore birds utilize the nearshore environment for wintering and breeding. Shorebirds found along the City's shorelines include gulls, loons, grebes, and cormorants; diving birds include auklets, guillemots, murres, puffins, and oyster catchers (City of Gig Harbor, 2001a). In addition to these species, great blue herons, mallards, widgeons, shovelers, scaups, goldeneyes, buffleheads, scoters, and mergansers have also been documented in Burley Lagoon (Determan, et al., 1984). Seabird colony mapping by WDFW (WDFW, 2007) does not include any species in Gig Harbor Bay or Henderson Bay/Burley Lagoon in the City's planning area. However, City staff indicate that Caspian terns are now found in Gig Harbor in significant numbers.

The PHS maps also indicate a breeding occurrence of bald eagles is located within one half mile of the Gig Harbor Bay's shoreline in the vicinity of the northern city limits. A bald eagle breeding occurrence is documented within one half mile of the mouth of McCormick Creek. Correspondence received from the USFWS confirms that wintering bald eagles may also occur in the vicinity of the city's shoreline (USFWS, 2003).

5.6.2.5 Marine Mammals

Four populations of killer whales are known to occur in Washington: the Northern Resident, the Southern Resident, the transient, and the offshore (Wiles, 2004). Three of these populations periodically use the region around the San Juan Islands: the Southern Resident Population, Northern Resident Population, and the transient population. Less time is spent elsewhere in Puget Sound by these populations. The Southern Resident J pod is the only group known to regularly venture inside the San Juan Islands (Balcomb, unpublished data). NOAA Fisheries listed the Southern Resident Population killer whale as endangered in 2005. Transients, offshore, and Northern Resident populations are not listed under ESA at this time. NOAA Fisheries listed the Southern Resident Population of killer whale as depleted under the Marine Mammal Protection Act in May 2003 (Marine Mammal Commission, 2004).

In 2006, NOAA Fisheries designated Critical Habitat for the Southern Resident Population of killer whale, which includes all marine waters of Puget Sound in excess of 20 feet in depth relative to extreme high water.

Other federally listed marine mammals that may potentially occur in marine waters of Puget Sound, including those in proximity to Gig Harbor, include the endangered humpback whale and the threatened Steller sea lion. No Critical Habitat for either species has been designated in Washington State.

6.0 OPPORTUNITY AREAS

Opportunity areas identify areas in the shoreline jurisdiction that may be appropriate for protection and /or restoration, including elements such as wetlands, habitat, riparian (streamside or marine shores) vegetation, and riverbanks and marine shores modified by riprap or bulkheads. Opportunity areas were initially identified during the compilation of the critical areas materials described above by reviewing maps and relevant reports. Opportunity areas were further defined and identified from aerial photographs (2001 and 2006-2007) and a field reconnaissance of the study area in August 2003. The *Key Peninsula, Gig Harbor, and Islands Watershed Nearshore Salmon Habitat Assessment Final Report* (Pentec Environmental, 2003) was prepared to aid in establishing appropriate shoreline use designations, and in identifying high quality areas to be protected as well as those that have a high potential for restoration of former ecological functions. This assessment was incorporated into the opportunity areas identified in the City's shoreline jurisdiction.

The City could explore opportunities for protection, restoration, or increased public access through a variety of ways, including regulatory and non-regulatory methods. The City's current Parks, Recreation and Open Space Plan (2001) identifies proposed trails along the westerly shoreline of Puget Sound along Colvos Passage (North Beach) and the Tacoma Narrows (South Beach). This trail system would cross public tidelands and improve access to the shoreline within the city limits and its Urban Growth Area. The City maintains the greatest flexibility for implementing protection or restoration efforts in publicly owned land. Funding sources such as Salmon Recovery Funding Board (SRFB) and Estuary and Salmon Restoration Program (ESRP) grants are available for such projects. Restoration opportunities on privately owned land may be pursued through the development of an incentive-based redevelopment program, and/or a public education program. Incentive programs could be put in place to encourage property owners to choose habitat friendly erosion control structures such as soft-shore protection, to reduce adverse impacts of existing shore modifications (that may need maintenance or repair) or to remove unnecessary shore armoring where possible.

Opportunity areas are discussed in the segment summary sections that follow and shown on the opportunity area maps (Figures 11 through 13). Table 6-1 summarizes the opportunity areas by identifying their potential for protection or enhancement, the jurisdiction (inside city limits or UGA), and noting if the area was previously identified as a potential restoration area by the *Key Peninsula, Gig Harbor, and Islands Watershed Nearshore Salmon Habitat Assessment Final Report*. The table also identifies if protection or enhancement activities would primarily benefit habitat or improve public access opportunities. Restoration opportunities will be further explored and described in the Shoreline Restoration Planning element of the SMP update.

Table 6-1. Opportunity Area Summary

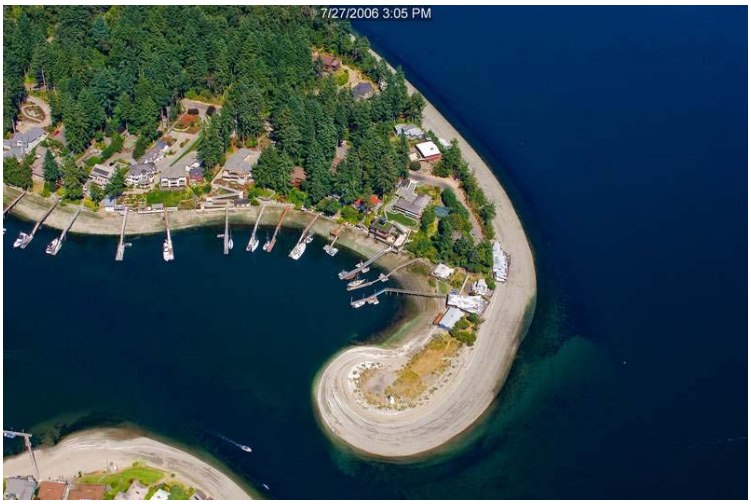
Opportunity Area	Protection	Enhancement	Restoration[7]	Jurisdiction	Potential to Enhance/Protect Habitat	Potential to Enhance Public Access/Education
A1	X			UGA	X	X
A2	X	X		UGA	X	X
B1	X			City Limits	X	
B2	X	X		UGA	X	
B3		X	X	UGA	X	
C1	X		X	City Limits	X	X
C2		X		City Limits	X	
C3		X	X	City Limits	X	
D1	X	X		UGA	X	X
E1		X	X	City Limits	X	
E2	X			UGA	X	X
E3		X	X	UGA	X	
F1	X		X	UGA	X	X
F2		X	X	UGA	X	
F3	X	X	X	UGA	X	
F4		X	X	UGA	X	

[7] Areas previously identified by the *Key Peninsula, Gig Harbor, and Islands Watershed Nearshore Salmon Habitat Assessment Final Report* for potential restoration in the form of marsh restoration, riparian enhancement, or relic structure removal.

7.0 SEGMENT A – COLVOS PASSAGE AND GIG HARBOR SPIT

Summary: Segment A is within the East Gig Harbor UGA (unincorporated Pierce County). Current land use in Segment A is mainly residential with some resource lands (fishing). This segment is characterized by a steep vegetated bluff fronted by a narrow mix of sand and gravel beach. The intertidal and subtidal areas provide documented surf smelt spawning and hardshell subtidal clam habitats. Chinook salmon and bull trout, both federally-threatened fish species, may occur in the offshore waters. The bluff is mapped as a feeder bluff and a divergence zone which indicates that it functions as a source of nearshore sediment both to the north and south. A spit is located at the entrance to Gig Harbor Bay. A small USGS-owned lighthouse is located on the spit. The shoreline in Segment A is 26 to 50 percent modified along the south length of the spit and 0 to 25 percent modified along the north side of the spit and along Colvos Passage. Impervious area in Segment A is calculated at approximately 40 percent.

7.1 Land Use Patterns



Land Use. This Segment is characterized by large single-family homes with views of the Harbor. Residences in this segment are located in the East Gig Harbor Neighborhood. Many of the parcels adjacent to the shoreline are one-quarter acre or smaller, while several large undeveloped lots occupy the upland areas (Pierce County Planning and Land Services, 2002).

Transportation. Access to the shoreline in Segment A is restricted to Goodman Drive NW, the only roadway in the East Gig Harbor Neighborhood that provides access to the vicinity of the spit. Based on tax parcel County Assessor records, twenty percent of the land area in Segment A is in road and/or utility right-of-way.

Wastewater and Stormwater Facilities. Currently, there are no major utility structures in the Segment A shoreline area. However, as previously discussed in Section 3.2, the City plans to extend the existing wastewater treatment plant outfall into Colvos Passage. The extended outfall through the sand spit would be constructed via directional drilling under the spit to avoid disruption of the intertidal areas (Cosmopolitan Engineering Group and Golder Associates, Inc, 2002).

7.2 Existing and Potential Public Access Sites

The USGS lighthouse, located at the terminus of the spit near the Gig Harbor Bay inlet, is the only public water access to the shoreline area in Segment A, as no land based access currently exists to the spit. The City Parks Plan (2001) has identified a proposed trail, the North Beach Trail, which would traverse from the lighthouse north along Colvos Passage, enhancing public access to the shoreline in Segment A.

7.3 Nearshore Characterization

In Segment A, the Colvos Passage shoreline supralittoral (or backshore) area is mapped as high, steep cliff (till) with riprap seawall at the base of the cliff (Table A-11, Appendix A). The intertidal area is mapped as a low, inclined cliff with fan (live trees overlying till), a sandy beach, bounded by the riprap seawall. Barnacles, green algae and sargassum were mapped by DNR along this Segment.

The south side of the spit is mapped as sandy beach berm and concrete seawall in the supratidal zone, and sand and pebble beach in the intertidal zone. The inner bay side of the spit is mapped as sandy beach berm in the supratidal zone, and sand and pebble beach in the intertidal zone. The spit is vegetated with dune grass, and green algae and kelp are mapped in this vicinity (Table A-11, Appendix A).

Hazard Areas. Hazard areas within Segment A are depicted on Figure 9 and include hillsides and bluffs, landslide and erosion hazard areas, and the 100-year floodplain.

Nearshore Habitat. The marine riparian zone in Segment A is a relatively wide band of deciduous trees. The aerial photo shows a large slide area along the bluff and the coastal zone atlas shows a recent slide mapped in the area (Photo A-2). Farther south the base of the bluff is predominantly armored with riprap and a concrete seawall. Feeder bluffs were mapped within this shore reach and it encompasses a divergence zone which is known to be erosive (Jacobson and Schwartz 1981, Figure 11). The beach is mapped as narrow, with sand, gravel, and pebble substrates, having a backshore berm and LWB (Table A-11, Appendix A). The spit protecting Gig Harbor Bay was formed from sediment originating from the eroding feeder bluffs to the north. The spit currently appears to be stable though if the sediment sources that maintain the shoreform are largely impounded behind shore armoring, erosion may be a problem in the future (Table A-11, Appendix A). No eelgrass was mapped in the Pentec survey (the most recent and extensive eelgrass survey for the shoreline vicinity); however, kelp is mapped by ShoreZone throughout most of this segment (WDNR, 2001).

Streams and Wetlands. No wetlands or streams are documented along Colvos Passage in Segment A (Figure 10).

Shellfish. Hardshell subtidal clams are present in Colvos Passage just north of the lighthouse on the Gig Harbor spit to the south until south of Sunrise Beach to the north (WDFW, 2007). Sea urchins are present along the western shorelines of Colvos Passage from south of the Tacoma Narrows bridge to the south past Sunrise Beach on the north (WDFW, 2007).

Forage Fish Spawning Areas. A Pacific herring holding area is located in Colvos Passage (outside of shoreline jurisdiction) from north of Segment A to mid-Segment D (WDFW, 2007). A documented surf smelt spawning area extends from outer Gig Harbor north through the rest of the Segment A shoreline (WDFW, 2007).

Federally-Listed Species and Species of Local Concern. Marine intertidal, nearshore, and sub-tidal areas provide critical habitat for salmonids, particularly for juvenile salmonid smolts as they migrate from freshwater to marine environments (Haring, 2000). Salmonids that may be present include chinook, chum, pink, and sockeye salmon along with sea-run cutthroat, bull trout, and steelhead trout. Waters in excess of 20 feet in depth may be used by the Southern Resident Population of killer whale for foraging. Steller sea lions could also potentially forage within the marine nearshore area.

7.4 Shoreline Modifications

The northernmost portion of Segment A along Colvos Passage is approximately 10 percent armored with riprap, and 10 percent with wooden bulkhead (Table A-9, Appendix A). Some development occurs at the toe of the bluff; however, approximately 75 percent of this portion of the segment retains riparian vegetation overhanging the intertidal zone (Photo A-2). No boat ramps, or docks or piers are mapped along Colvos Passage in Segment A. Up to 50 percent of the Colvos Passage side of Segment A contains concrete bulkheads (Table A-9). Coastal processes in this reach have been degraded as a result of these shore modifications, however some sediment sources remain intact. The inner-harbor portion of the spit does not contain modifications (Photo A-1).

7.5 Opportunity Areas

Opportunity A-1 (*Protection).* This area is a potential source of future LWD to the beach (Table A-1, Appendix A; Figure 11). Protecting existing shoreline vegetation would enable future LWD recruitment, and enhance slope stability, which may offer protection to existing shoreline development. This segment is mapped as surf smelt spawning area (WDFW, 2007). Limiting shoreline armoring along the mapped feeder bluff would allow the continued input of optimal spawning sediments from the bluff to the beaches, and overhanging vegetation to shade incubating eggs. Limiting shoreline armoring will also preserve the sediment that supplies and maintains the downdrift spit. Because the shoreline along Colvos Passage is a relatively high energy zone, setbacks from the top of the bluff would provide more adequate protection of upland development than shoreline armoring. Opportunities may exist for public education to limit impacts to spawning beaches between September and March. The 2001 Park, Recreation and Open Space Plan envisions an informal trail along this segment, which would increase public access to the shoreline. The trail as envisioned would not include construction other than installation of signage near the end of Youngs Landing Road for wayfinding to access the beach.

Opportunity A-2 (*Protection and Enhancement*[8]). The spit provides public access (from the water), as well as being part of the ongoing process of alongshore sediment transport. This area contains intermittent bulkheads throughout, with some development located at the toe of the bluff slope, as well as on the spit. The City could limit further development of bulkheads by exploring opportunities for soft armoring. This would have the potential to significantly improve habitat in this area.

[8] Enhancement can include increasing the size of existing habitat or the improvement of the functioning of existing habitat conditions.

8.0 SEGMENT B – EAST GIG HARBOR

Summary: Segment B is within the East Gig Harbor UGA (unincorporated Pierce County). Segment B is characterized by single family residential development, fronted by riprap and concrete seawalls. Northward drift predominates the reach, though a small drift cell exhibiting southward drift is found in the southern end of Segment B, leeward of the spit that marks the entrance to Gig Harbor Bay. Public access is provided at two road-ends in this segment, including Wheeler Street and the Randall Street boat launch. Two documented surf smelt spawning areas are located in this segment, and Crescent Creek provides wetland and riparian habitat, as well as upstream spawning habitat for chum and coho salmon. Chinook salmon and bull trout, both federally-threatened fish species, may occur within Gig Harbor Bay in this segment. With the exception of the Crescent Creek outlet, the shoreline of Segment B is 76 to 100 percent modified, primarily by concrete bulkheads and private docks and piers. Impervious area in Segment B is estimated at approximately 40 percent.

8.1 Land Use Patterns

Land Use. The shoreline along Segment B is largely developed with large-acreage single family residences. There are also undeveloped parcels along this segment. Zoning is single-family and waterfront-residential.

Transportation. Randall Drive NW and Goodman Drive NW provide local access to residences and shoreline public access areas along Segment B. Approximately 11 percent of the shoreline area in Segment B is road right-of-way.

Wastewater and Stormwater Facilities. No major wastewater or stormwater facilities are located in Segment B. Along most of the Segment B shoreline area, stormwater facilities do not discharge directly into Gig Harbor Bay. However, the storm drainage system associated with the single family residential development along the northern portion of Segment B, near the Crescent Creek estuary, consists mostly of roadside ditches and culverts that drain directly into Gig Harbor Bay or Crescent Creek (City of Gig Harbor, 2001a).

8.2 Existing and Potential Public Access Sites

Two roadway street-ends provide public access along the shoreline along Segment B; the Randall Street boat launch and the Wheeler Street road end (Figure 11). City Park at Crescent Creek is located near the northern terminus of Segment B. These facilities are further described in Section 3.5, Existing and Potential Public Access Sites.

8.3 Nearshore Characterization

Segment B encompasses two diverging drift cells, and one region of no appreciable drift located near the mouth of Crescent Creek. Drift is predominantly northward through the reach, excluding the southernmost (approximate) 1,000 feet, where drift is to the south. Within Segment B, the Crescent Creek outlet and wetland area to the south (Table A-12, Appendix A) are mapped as high marsh (peat and organic litter). The wetland area is partially bounded by a riprap seawall (Table A-12, Appendix A). The adjacent intertidal area closest to the stream mouth is mapped as mud with a low tide terrace, and as a beach comprised of a veneer of pebble overlying fines of mud and sand and delta fan (organic litter overlying fines of mud) south of the stream mouth (Table A-12, Appendix A). Vegetation in these areas includes sedges, salt marsh, rockweed, and green algae; barnacles occur here (Table A-12, Appendix A). A narrow band of wetland vegetation continues to the south towards the Randall Street boat launch, and is bounded by concrete seawall. This area is mapped as high marsh (peat overlying fines of mud and sand) (Photo B-5). The intertidal beach adjacent to the wetland is mapped as fines of mud and sand. Vegetation in this area is mapped as sedges, salt marsh, rockweed and green algae, with barnacles also present. The remaining shoreline in this segment is mapped as concrete and riprap seawall, with an intertidal beach comprised of mixed sand, pebble, and cobble. Shore modifications impound nearshore sediment supply throughout the majority of this reach, which has likely degraded and diminished the volume of beach sediment found along these shores. Vegetation in this area is mapped as dune grass, sedges, salt marsh, rockweed, kelp, eelgrass, and green algae, with barnacles also noted. No eelgrass was noted in the more recent KGI Habitat Assessment.

Hazard Areas. Mapped hazard areas in Segment B are depicted on Figure 9, including hillsides and bluffs, and landslide and erosion hazard areas.

Nearshore Habitat. Riparian vegetation along Segment B consists mainly of ornamental trees retained in residential yards. The beach near the spit is mapped as sand, pebble, and cobble, transitioning to sand flat and mud flat towards the Randall Street Boat Launch (Table A-12, Appendix A). The area near the mouth of Crescent Creek is characterized in the ShoreZone data as a delta fan. No eelgrass was mapped in the Pentec survey.

Wetlands. A narrow fringe of pickleweed lines the base of the armored shoreline. Vegetation in the wetland at Crescent Creek outlet includes Lyngby's sedge, pickleweed, and dune grass. There is approximately one acre of wetlands in the Segment B shoreline area. Wetlands are depicted in Figure 10.

Streams. Crescent Creek discharges to Gig Harbor Bay in Segment B. Salmonid species documented in Crescent Creek include chum, coho, steelhead, and sea run cutthroat trout (WDFW, 2007; Adolfson, 2005). Chinook salmon, listed as threatened under the ESA, were documented as present in Crescent Creek; however, the last documented native chinook salmon was documented in the 1940's. Present day chinook found in Crescent Creek are likely planted (Haring, 2000). WDFW (2007) documents Crescent Creek as supporting healthy spawning areas for chum salmon in the lower portion of Crescent Creek and healthy coho salmon spawning areas up to Lake Crescent. Streams are depicted in Figure 10.

Shellfish. There are no mapped shellfish beds in Gig Harbor Bay.

Forage Fish Spawning Areas. Two surf smelt spawning areas are documented in Gig Harbor Bay, one immediately north of the spit, and one adjacent to the Randall Street Boat Launch (WDFW, 2007).

Federally-Listed Species and Species of Local Concern. Gig Harbor Bay is a migration route for anadromous fish, including chum salmon, sea-run cutthroat trout, coho salmon, and steelhead trout that originate in Donkey Creek and Crescent Creek. Chinook salmon and bull trout may also be present in Gig Harbor Bay. Gig Harbor Bay has been identified as Critical Habitat for both Chinook salmon and the Southern Resident Population of killer whale.

8.4 Shoreline Modifications

According to WDNR ShoreZone mapping, armoring in Segment B is predominantly concrete bulkheads, with areas of riprap. Landfill has also been documented near the mouth of Crescent Creek (WDNR, 2001). A number of private docks and piers are also found in Segment B, as well as numerous mooring buoys located 400 feet or more offshore through the central portion of the Harbor. The northern portion of shoreline in Segment B, north of the Randall Street boat launch and associated with the Crescent Creek estuary is less modified. Fewer piers and docks are located in this portion and there is less bulkheading and riprap armoring of the shoreline, compared to areas south of the Randall Street boat launch.

8.5 Opportunity Areas

Opportunity B-1 (*Protection).* The shoreline at the mouth of Crescent Creek is mapped as 51 to 100 percent vegetated (Table A-1, Appendix A, Figure 11). Protection of this vegetated riparian and wetland area would help maintain good quality refuge habitat for juvenile salmonids, as well as other wildlife (Photos B-3 and B-4). Part of the wetland complex associated with the lower reach and mouth of Crescent Creek is located on property adjacent to City Park, which the City of Gig Harbor has recently purchased.

Opportunity B-2 (*Protection and Enhancement).* There are opportunities to protect surf smelt spawning areas documented by WDFW (2007). Opportunities may include limiting additional bulkheads or overwater structures in the intertidal area (Photo B-5). Exploring opportunities for soft armoring and beach nourishment within the most heavily modified area would provide the greatest improvement in habitat conditions. Many shore modifications within this segment of shore are likely not required for erosion control due to the sheltered conditions of the Bay, therefore many of these structures are essentially landscaping features. Reducing the impact of overwater structures would also provide an opportunity to improve habitat conditions in the reach, especially where structures lay directly over the beach substrate, which both reduces access to the beach substrate (habitat) and can reduce alongshore transport of sediment.

Opportunity B-3 (*Enhancement).* Enhancements to the area north of the boat launch would provide moderate improvement over existing habitat conditions. The area south of the boat launch is more heavily developed. Enhancements in this area have the potential for significant habitat improvements (Photo B-6). The City could explore re-development design standards to increase light penetration of over-water structures. Options may include increasing the structure height over the water, modifying the structure orientation, minimizing the structure size, using grating as a surface material, placing floating docks in deeper water to avoid grounding during low tides, and considering the potential for carefully placed community docks (Nightingale et al, 2001). Reducing the impact of shore armoring would also provide the opportunity to improve habitat conditions. This could be done by removing unnecessary shore armoring, and where erosion control is necessary using soft-shore protection or building structures higher within the beach profile (well beyond mean higher high water). Enhancing marine riparian vegetation could also benefit these areas.

9.0 SEGMENT C – DOWNTOWN GIG HARBOR

Summary: Segment C correlates to the incorporated portions of Gig Harbor Bay and the designated waterfront Historic District. Land use in Segment C is a mix of commercial and single family residential. Segment C largely encompasses a region of no appreciable drift due to the heavily modified nature of the shoreline, combined with the protected conditions of Gig Harbor Bay. A number of commercially-operated marinas, a yacht club, and commercial fishing operations are located within Segment C. The existing City Wastewater Treatment Plant outfall extends from the shoreline at Ruth M. Bogue View Park. Several locations offer public access (physical and visual) to the shoreline within this segment. Donkey Creek enters Gig Harbor Bay in this segment. This stream provides upstream spawning habitat for chum and coho salmon. Chinook salmon and bull trout, both federally-threatened fish species, may occur within Gig Harbor Bay in this segment. Segment C is dominated by a highly modified (76 to 100 percent) shoreline, consisting of primarily landfill near the mouths of Crescent and Donkey Creeks, wooden and concrete bulkheads, and marinas, docks, and piers. Impervious area in Segment C is estimated at approximately 63 percent.

9.1 Land Use Patterns

Land Use. The shoreline within Segment C is extensively developed and includes a mixture of single-family residences and commercial businesses associated with waterfront activities. Zoning is consistent with existing land uses, including waterfront residential and commercial and downtown business designations. Also included along this segment is the area known as the historic "Millville" District.

Transportation. This urbanized area is served locally by North Harborview Drive, and Harborview Drive. Access to retail, commercial, and public properties along Segment C is provided along Harborview Drive. Numerous street-ends provide public access to the shoreline adjacent to Harborview Drive. Road right-of-way occupies almost 30 percent of the shoreline area.

Wastewater and Stormwater Facilities. The existing City Wastewater Treatment Plant outfall extends from the shoreline at Ruth M. Bogue View Park (Figure 11). As previously mentioned in the Segment A discussion, the City is proposing to modify the existing outfall, which would result in a temporary closure of the public viewing platform associated with the Park. At the project completion, an existing wastewater pump station would be relocated within the park, above the high water mark (Cosmopolitan Engineering Group and Golder Associates, Inc., 2002). The outfall extension would traverse Gig Harbor Bay along a portion of Segment C.

9.2 Existing and Potential Public Access Sites

No other segment contains more public marinas and parks within Gig Harbor than Segment C (Figures 3 and 11). Marinas along this segment, from north to south, range in size from six moorage slips at the MacIntosh Marina to 106 slips at the Gig Harbor Marina (City of Gig Harbor website, 2001).

Parks and public access locations in Segment C, as described in Section 3.5, include:

- Finholm View Climb
- Ruth M. Bogue Viewing Platform
- Donkey Creek Park
- Austin Estuary Park
- Murphy's Landing Condominiums/Marina
- Eddon Boat Park
- Jerisich Park
- Skansie Brothers Park
- Novak Street end
- Arabella's Landing Marina
- Dorotich Street end
- Russell Foundation Building

Potential public access improvements include improvements to existing public street-ends, including:

- Soundview Drive street-end is located between existing and proposed/permitted commercial uses; however, access to this site by pedestrians is described as "complicated by cars and delivery vehicles";
- The terminus of Peacock Hill Road could provide public beach access near the Peninsula Yacht Basin Dock. However, the site is described as very confined and steep.

Additionally, the City may continue to provide public access through the shoreline permit process as waterfront uses transition or redevelop in the future.

9.3 Nearshore Characterization

Most of Segment C is encompassed within a large region of no appreciable drift due to contiguous shore armoring and fill. In Segment C, the Donkey Creek supratidal area is mapped as fill, wooden seawall, and sandy river channel (Table A-13, Appendix A). This area is bounded by high marsh (peat overlying fines or mud and sand). The adjacent intertidal area is mapped as tidal flat (fines of mud and sand). Vegetation in this area is mapped as sedges, salt marsh, kelp, and green algae (Table A-13, Appendix A). Wetland extends to the Segment C side of Crescent Creek. This area is mapped as high marsh (organic litter overlying sand and fines of mud and pebble) and inclined beach of sand and fines of mud and pebble, abutted by fill and a wooden seawall. The intertidal beach adjacent to this wetland is mapped as sand and fines of mud and pebble with a low tide terrace. A concrete boat ramp is located in this area. Vegetation is mapped as sedges, salt marsh, rockweed, and green algae, with barnacles also noted. The supratidal area is fill, wooden wharf, and wooden seawall. The intertidal zone is wharf and tidal flat (sand and pebble with mud fines).

Most of Segment C is armored with wooden seawalls, wooden wharf and riprap (Table A-13, Appendix A). Most of the beach is mapped as being comprised of sand and mud (and wharf), with a small area mapped as a mix of sand, pebble, and cobble (and wharf). Vegetation in much of this protected area is mapped as rockweed, green algae and kelp (Table A-13, Appendix A). The Donkey Creek outlet vicinity is mapped as seawall of concrete, wood, and riprap fronted by a beach of sand and pebble (Table A-13, Appendix A). Vegetation in this vicinity includes green algae, kelp, and sargassum (Table A-13, Appendix A). Three wooden wharfs are documented in the subtidal zone of Segment C, the downtown area marinas (Table A-13, Appendix A).

Hazard Areas. Mapped hazard areas in Segment C are depicted on Figure 9 and include ravine sidewalls associated with Donkey Creek, and isolated areas of hillsides and bluffs

Nearshore Habitat. Very little riparian vegetation occurs within Segment C. The shoreline in this segment is developed with marinas and piers and shoreline armoring. The ShoreZone data characterizes this area as mostly mud flat and sand flat, with organics/fines dominant in the vicinity of the Crescent Creek and Donkey Creek outlets (Table A-13, Appendix A). An area of narrow sand and gravel beach is mapped towards the mouth of the Gig Harbor Bay, between the Soundview Drive ROW and the Old Ferry Landing.

Streams. Donkey Creek is depicted on Figure 10 and documented to support chum and coho salmon along with steelhead trout and is presumed to support cutthroat trout (Adolfson, 2005). For over 30 years, a volunteer group made up of members from the Gig Harbor Commercial Fishermen's Civic Club has been raising and releasing approximately 1.0 million chum in this drainage on an annual basis (Haring, 2000). Donkey Creek runs through a culvert under Harborview Drive located near the northwest corner of Donkey Creek Park. Further down the stream a 300-foot length, 30-inch diameter pipe runs under North Harborview Drive to connect the stream to the estuary at the outfall of Donkey Creek into Gig Harbor Bay. Salmonid access into Donkey Creek is limited by the 300-foot culvert and restricted at RM 0.75 due to a documented impassable natural cascade (Haring, 2000). A narrow, intact stream buffer is present in the City park near the mouth, and a well vegetated buffer predominates the stream corridor further upstream (Adolfson, 2005).

Wetlands. Figure 10 depicts a less than five-foot-wide band of wetland vegetation along the northeastern shoreline of the Gig Harbor Bay and none along the remainder of the Segment. An estuarine wetland is present at the mouth of Donkey Creek, and two small non-tidal potential wetlands were documented within the City's 2005 Inventory (Adolfson, 2005). A total of 1.4 acres of potential wetland area is located in Segment C.

Shellfish. None mapped within Gig Harbor Bay.

Forage Fish Spawning Areas. No forage fish spawning areas are documented by the WDFW within Segment C; however, Pentec Environmental (2003) identified potential forage fish spawning habitat at the mouth of Donkey Creek.

Federally-Listed Species and Species of Local Concern. Gig Harbor Bay is a migration route for anadromous fish, including chum salmon, sea-run cutthroat trout, coho salmon, and steelhead that originate in Donkey Creek and Crescent Creek. Chinook salmon and bull trout may also be present in Gig Harbor Bay. Purple martins nest near the Donkey Creek outlet (WDFW, 2007). Waters in excess of 20 feet in depth may be used by the Southern Resident Population of killer whale for foraging. Steller sea lions could also potentially forage within the marine nearshore area. Critical habitat has been designated within Gig Harbor Bay for both Chinook salmon and the Southern Resident Population of killer whale.

9.4 Shoreline Modifications

The shoreline between the Crescent Creek and Donkey Creek mouths in Segment C is mapped as up to eighty percent wooden bulkheads with some riprap, and also includes an area of landfill. The shoreline in Segment C south of Donkey Creek is heavily modified (50-100 percent along the segment), containing concrete and wooden bulkheads and riprap (Photos C-2 through C-6). The Donkey Creek outlet is mapped as fifty percent landfill and forty percent wooden bulkhead (Photos C-1 and C-3). A bridge on wooden piles constructed over Donkey Creek is buried under what is now North Harborview Drive near the corner of Austin Street and Harborview Drive North. Aside from the portions of the segment near Crescent Creek and Donkey Creek, little riparian vegetation exists along Segment C (WDNR, 2001).

Segment C contains a large concentration of piers, docks, marinas, and moorage slips (Photo C-2). Between 10 and 30 percent (and up to 50 percent in some locations) of the littoral area in Segment C is shaded by in- or over-water structures (Pentec Environmental, 2003). The abundance of shore modifications within this shore reach has significantly degraded coastal processes and in many cases little upper beach sediment remains intact. In addition to over-water moorage structures, Segment C also contains numerous mooring buoys located 400 feet or more offshore through the central portion of Gig Harbor.

9.5 Opportunity Areas

Opportunity C-1 (*Protection).* Protect remaining estuarine wetlands near Crescent Creek and Donkey Creek. This will include protection of remaining purple martin habitat (WDFW, 2007). Pentec Environmental (2003) identified potential forage fish spawning habitat at the mouth of Donkey Creek. Opportunities may exist for habitat enhancement where the outlet of Donkey Creek retains 25 to 50 percent vegetation (Table A-1, Appendix A; Photos C-7 and C-8, Appendix B). The acquisition and development of the Austin Estuary Park through the Pierce County Conservation Futures Program will continue to protect this area of salt marsh. The City has also developed preliminary plans for daylighting Donkey Creek. There are also a number of shore modifications that are likely not necessary for erosion control and could potentially be removed or replaced with soft shore protection. Marine riparian vegetation could also be enhanced through much of the shore reach.

Opportunity C-2 (*Enhancement).* The City could consider soft shore protection and marine riparian habitat enhancement opportunities at Ruth M. Bogue View Park. Currently, this area retains little to no riparian vegetation (Table A-1; Appendix A). Opportunities may exist to incorporate habitat enhancements as part of the wastewater outfall extension project.

Opportunity C-3 (*Enhancement).* The City could consider soft shore-protection, marine riparian and habitat enhancement opportunities adjacent to remnant vegetated pockets and public access areas (Photos C-9 and C-10). The Eddon Boat Park improvements currently in development include the creation or restoration of a pocket estuary.

10.0 SEGMENT D – THE PUGET SOUND NARROWS

Summary: Segment D includes the southern most shoreline area in the City of Gig Harbor, and the southern UGA. Land use in Segment D is predominantly single family residential, and includes a community of over-water homes at the toe of the bluff that pre-date the city's SMP. Public access to the beach is provided at the Old Ferry Landing/Harborview Drive street end. Segment D is characterized by a steep vegetated bluff fronted by a narrow, sand and gravel beach. Net shore-drift through the reach is predominantly southward, but also includes a short cell with northward drift into Gig Harbor Bay. The intertidal and subtidal area provides documented sand lance spawning habitat. Chinook salmon and bull trout, both federally-threatened fish species, may occur in the offshore waters. The high gradient bluffs encompass areas mapped as feeder bluffs, with numerous recent slide areas delivering sediment and organic material (LWD) to the nearshore. Only the northernmost section of this segment is armored; this section provides approximately 1.8 miles of unarmored, natural beach. Several landslides can be seen in the aerial photos of Segment D. Segment D is 26 to 50 percent modified in the northern portion of the segment, primarily with wooden bulkheads, and unmodified for the majority of the segment. Impervious area in Segment D is estimated at approximately 41 percent.

10.1 Land Use Patterns

Land Use. The shoreline along Segment D is developed with waterfront single-family development. Zoning is consistent with existing land uses, including single-family and medium-density residential designations. Known as Nesika Beach, a community of approximately 18 over-water single-family dwellings are located on pilings at the base of the bluff, south of the Old Ferry Landing. The homes pre-date the establishment of the Gig Harbor Shoreline Master Program and are legally pre-existing (per Section 3.15-Residential/ Gig Harbor Shoreline Master Program) but are non-conforming in relation to buffers and setbacks from bluffs established by the city's critical area regulations (GHMC 18.08.190). Most are used as summer cabins only; a few are used as year round primary homes. Access is provided by a road on top of the bluff and along the beach via the Old Ferry Landing/Harborview Drive street end.

Transportation. Access to waterfront residential areas along Segment D is provided by Soundview Drive and Reid Drive NW (Figure 12).

Wastewater and Stormwater Facilities. Four stormwater outfalls discharge to Puget Sound in Segment D (Figure 12). A large portion of residential properties in Segment D currently use septic systems. The City Wastewater Comprehensive Plan (2002) has identified large portions of

Segment D as conveyance expansion areas for capital facilities planning. Most of the cabins at Nesika Beach do not have water, sewer, or electrical power. Propane stoves and lanterns and composting pit toilets approved by the Department of Health are utilized at most cabins. At least two homes are served by power and sewer, conveyed up the bluff to the upland area above the homes.

10.2 Existing and Potential Public Access Sites

Because of the extensive bluff system and developed private property along the Narrows, public access to the shoreline is restricted along the top of the bluff in Segment D. The Old Ferry Landing at the Harborview Drive street end (at the north end of Segment D) provides public access to the shoreline. The potential for a shoreline trail, connecting the Old Ferry Landing site to the cobble beach at the mouth of Gig Harbor Bay, and extending south along the Tacoma Narrows across public tidelands has been identified in the city's Park, Recreation, and Open Space Plan (City of Gig Harbor, 2001b). Formalizing the trail and potentially providing additional recreational amenities at the Harborview Drive street end has been identified as a priority through the current update to the City's parks plan.

10.3 Nearshore Characterization

The supratidal area at the mouth of the harbor in Segment D is high, steep cliff (till) with a wooden wharf extending into the intertidal area. The intertidal beach adjacent to the wharf is a mix of sand, pebble, and cobble, with some boulders (Table A-14, Appendix A). Vegetation in this area is mapped as dune grass, rockweed, kelp, sargassum, and green algae, with barnacles also noted. Most of Segment D is characterized as high, steep cliff (till) and steep cliff (live trees and dune grasses overlying till), as well as low inclined cliff (with fallen trees overlying till and sand) (Table A-14, Appendix A). The beach for both of these units is mapped as a veneer of pebble and cobble overlying sand overlying till. Vegetation in this area is mapped as rockweed, kelp, sargassum, and green algae, with barnacles also noted. Several buildings on pilings are located in the subtidal area of Segment D, including the Tarabochia Net Shed and a community of single-family homes as described above (Photos D-1 and D-4). Generally the high gradient bluffs are fronted by narrow mixed sand, pebble and cobble beaches. The least stable sections of bluff are devoid of vegetation along the bluff face, where active landslides preclude vegetation growth. Strong currents through the narrows combined with exposure to waves from both the north and south undermine bluffs which initiate landslides through this shore reach. Southward net shore-drift occurs throughout the majority of the reach and terminates south of the Gig Harbor UGA at Point Evans.

Hazard Areas. Mapped hazard areas within Segment D are depicted on Figure 9 and include extensive bluffs and hillsides and landslide and erosion hazard areas. The Washington Digital Coastal Zone Atlas identifies four areas in Segment D as unstable, recent or historic landslide locations (Ecology website, 2003).

Nearshore Habitat. Large deciduous trees overhang this segment, providing shade, prey in the form of insects, and a degree of bank stability. Large woody debris occurs on the beaches along this segment. The beaches are mapped as sand beach, or narrow sand and gravel beach.

Streams and Wetlands. No wetlands or streams are documented along the Narrows within Segment D, with the exception of two small drainages mapped on the Pierce County stream data (Figure 10) (Adolfson, 2005).

Shellfish. None mapped.

Forage Fish Spawning Areas. A sand lance spawning area is documented along the City's shoreline south of the limits of shoreline armoring (WDFW, 2007).

Federally-Listed Species and Species of Local Concern. Marine intertidal, nearshore, and sub-tidal areas provide critical habitat for salmonids, particularly for juvenile salmonid smolts as they migrate from freshwater to marine environments (Haring, 2000). Salmonids that may be present include chinook, chum, pink, and sockeye salmon along with sea-run cutthroat, bull trout, and steelhead trout. Waters in excess of 20 feet in depth may be used by the Southern Resident Population of killer whale for foraging. Steller sea lions could also potentially forage within the marine nearshore area. Critical habitat has been designated within the marine areas for Chinook salmon and the Southern Resident Population of killer whale.

10.4 Shoreline Armoring

The north end of Segment D is mapped as 30 percent wooden bulkhead with 40 percent overhanging riparian vegetation (Table A-9, Appendix A; Photo D-1). No shoreline armoring, boat ramps, or docks and piers are mapped along the Puget Sound Narrows along the entire southern portion of Segment D (Photos D-2 and D-3). As a result coastal processes are well-intact throughout this shore reach. Riparian vegetation overhanging the intertidal zone ranges from 5 to 60 percent in this segment (Table A-1, Appendix A).

10.5 Opportunity Areas

Opportunity D-1 (*Protection and Enhancement).* This segment has mapped feeder bluffs and retains high quality habitat in the form of lightly-developed, well-vegetated slopes (Photos D-2 and D-3). This area is a potential source of future LWD to the beach, and retains existing densities of wood on the beach of approximately 1 piece per 90 feet (Table A-1; Appendix A). Sand lance spawning habitat is documented south of the armored area (WDFW, 2007). This area also includes the mapped occurrence of mountain quail, a state priority species (WDFW, 2007). As with Segment A, minimizing development, management of upland groundwater, implementing adequate building setbacks (considering the erosive nature of the bluffs), and protecting existing shoreline vegetation and densities of wood on the beach would allow the potential for continued LWD recruitment, maintain high quality habitat for wildlife, and enhance slope stability which may offer protection to existing shoreline development. Limiting shoreline armoring would maintain sediment input of optimal sand lance spawning substrate from the bluff to the beaches, and overhanging vegetation to shade incubating eggs. Opportunities may exist for public education to limit impacts to spawning beaches between November and February.

11.0 SEGMENT E – HENDERSON BAY

Summary: Segment E is in Gig Harbor's northern city limits (near McCormick Creek) and North UGA (unincorporated Pierce County). Land use in Segment E is predominantly single-family residential. Public access to the beach is possible in the vicinity of the Goodnough Creek outlet. This reach is encompassed within one net shore-drift cell, which exhibits northward drift. Goodnough Creek and McCormick Creek outlet to Henderson Bay within this shoreline segment. A recent survey indicated the presence of eelgrass throughout this segment, and potential to provide habitat for forage fish spawning. Chinook salmon and bull trout, both federally-threatened fish species, may occur in the offshore waters. The shoreline in Segment E is 76 to 100 percent modified, primarily with concrete bulkheads, except near the mouth of Goodnough Creek. Impervious area in Segment E is estimated at approximately 40 percent.

11.1 Land Use Patterns

Land Use. The shoreline along Segment E is mostly developed with single-family residences throughout. Zoning designates single-family residential throughout the segment.

Transportation. Unlike the previous shoreline segments discussed, numerous roads acces the shoreline along Segment E. No roadway parallels the shoreline, rather separate roadways terminate near the shoreline or are separated by individual land parcels. Approximately 14 percent of the shoreline area in Segment B is road right-of-way.

Wastewater and Stormwater Facilities. No major wastewater or stormwater facilities are located within Segment E.

11.2 Existing and Potential Public Access Sites

Public access to the shoreline is limited along this segment due to the medium-density residential development that currently exists along the shoreline in this area. During periods of low tide, public access to the shoreline is available from the Purdy Sand Spit recreational area, located north in Segment F.

11.3 Nearshore Characterization

Hazard Areas. Mapped hazard areas within Segment E are depicted on Figure 9 and include ravine sidewalls associated with McCormick Creek, and landslide and erosion hazard areas along most of the shoreline in the segment (not shown on Figure 9; City of Gig Harbor, 2001c).

Nearshore Habitat. This area is characterized low bank backshores and beaches comprised of a mix of sand, cobble, and pebble, fronted by sand flats with deposits of organics/fines at the stream outlets (Table A-15, Appendix A). A low-lying beach berm with driftlog deposits over sand and pebble occurs north of the Goodnough Creek outlet (Photo E-4). Northward net shore-drift occurs throughout this segment. The drift cell that encompasses the reach originates south of Allen Point, placing this segment within the terminal region of the drift cell, which is commonly more depositional in nature.

Streams and Wetlands. McCormick Creek contains chinook, coho, and chum salmon along with steelhead and cutthroat trout (Adolfson, 2005; Pierce County Water Programs, 2000). McCormick Creek is one of the largest coho salmon producing streams within the Gig Harbor watershed. A small population of wild native winter-run steelhead trout also occurs within McCormick Creek (Pierce County Water Programs, 2000). McCormick Creek runs through a steep ravine within an intact forested buffer and riparian wetland observed during the 2005 inventory effort (Adolfson, 2005). Upper reaches of McCormick Creek enter an intact Douglas fir and hemlock forest, which is designated by the Washington Department of Natural Resources' Natural Heritage Program (WDNR, 2008a).

Goodnough Creek supports coho and chum salmon for the approximately 450 feet above the mouth, the only area accessible to fish passage. The lowest reach of the stream has been channelized, and runs along the back of the beach parallel to the shoreline for approximately 250 feet. Wetland vegetation was noted at the mouths of these two streams; however, no riparian wetlands were noted upstream of Highway 302 (Figure 10). More than two acres of potential wetland are located within Segment E.

Shellfish. There are no shellfish areas mapped in this portion of Henderson Bay.

Forage Fish Spawning Areas. No forage fish spawning areas are documented in Segment E (WDFW, 2007); however, Pentec Environmental has mapped the length of the segment as potential forage fish spawning habitat.

Federally-Listed Species and Species of Local Concern. Marine intertidal, nearshore, and sub-tidal areas provide critical habitat for salmonids, particularly for juvenile salmonid smolts as they migrate from freshwater to marine environments (Haring, 2000). Salmonids that may be present include chinook, chum, pink, and sockeye salmon along with sea-run cutthroat, bull trout, and steelhead trout. Waters in excess of 20 feet in depth may be used by the Southern Resident Population of killer whale for foraging. Steller sea lions could also potentially forage within the marine nearshore area. Critical habitat has been designated within the marine areas for Chinook salmon and the Southern Resident Population of killer whale.

11.4 Shoreline Armoring

Much of Segment E is mapped as armored with concrete bulkheading fronting residential development (Figure 8). The ShoreZone data characterizes this area as 90 percent modified, with a combination of concrete and wooden bulkheading, and some riprap (Table A-9, Appendix A). Armored shores within this reach were not likely sources of considerable nearshore

sediment prior to modification; however the level of shore modifications is likely to have adverse impacts to the beach such as beach lowering, accelerated rates of sediment transport and substrate alteration (Johannessen and MacLennan 2007).

11.5 Opportunity Areas

Opportunity E-1 (*Enhancement).* The potential for stream and riparian enhancement exists at the mouth of McCormick Creek, as identified in the KGI Habitat Assessment. The KGI Habitat Assessment also identifies the opportunity for bulkhead removal at this location. A combination of soft armoring, stream channel enhancement, and riparian plantings would contribute to the habitat value of this area.

Opportunity E-2 (*Protection).* This area provides opportunities for protection and for public education (Photos E-1 and E-2). It is mapped in the KGI Habitat Assessment as a potential forage fish spawning area, and as vegetated with eelgrass (Tables A-5 and A-7, Appendix A).

Opportunity E-3 (*Enhancement).* This area retains existing densities of wood on the beach of approximately 1 piece per 90 feet; however, limited opportunities exist to improve on future large woody debris recruitment due to the narrow width of the riparian vegetation (Table A-1, Appendix A; Photos E-3 and E-4). A combination of soft armoring, stream channel enhancement incorporating the mapped sand spit, and riparian plantings would contribute to the habitat value of this outlet to Goodnough Creek.

Opportunity E-1 through E-3 (*Enhancement*). The less erosive nature of the shoreline throughout Segment E suggests that many of the shore armoring is not necessary for erosion control and could potentially be replaced with soft shore protection. Future armoring of these shores should be prevented if possible and opportunities to replace existing shore armoring with soft shore protection should be explored where property owners are willing.

12.0 SEGMENT F – BURLEY LAGOON

Summary: Segment F is in Gig Harbor's North UGA (unincorporated Pierce County). This segment is relatively densely developed with a commercial area including a gas station built on the spit adjacent to the Purdy Creek outlet. Segment F encompasses the drift cell terminus of a cell with northward drift that originates south of Allen Point, and is largely depositional in character. The shoreline in Segment F is 76 to 100 percent modified along most of the segment, primarily with concrete and wooden bulkheads, and landfill along the Burley Lagoon. Impervious area in Segment F is estimated at approximately 55 percent.

12.1 Land Use Patterns

Land Use. The Henderson Bay/Burley Lagoon shoreline along Segment F is almost completely developed with a mix of single-family residences and commercial development associated with waterfront activities. Zoning includes single-family, waterfront commercial, general business, employment and public institution designations.

Transportation. Purdy Drive NW provides access to shoreline properties within the Gig Harbor UGA south of the SR 302 bridge, while individual roads provide shoreline access to shoreline properties north of the SR 302 bridge to the UGA boundary. Fifty percent of the Segment F shoreline area is road right-of-way.

Wastewater and Stormwater Facilities. No major wastewater or stormwater facilities are located within Segment B. Individual stormwater outlets discharge into Purdy Creek.

12.2 Existing and Potential Public Access Sites

As discussed in Section 3.3, the Purdy Sand Spit near the SR 302 bridge provides public access to the shoreline. A boat launch and fishing opportunities exist at this popular site.

12.3 Nearshore Characterization

Hazard Areas. Mapped hazard areas in Segment F include a small area of 15 percent-or-greater-slope east of Burley Lagoon (Figure 9). Pierce County mapping (not shown on Figure 9) also includes landslide and erosion hazard areas along Segment F (City of Gig Harbor, 2001c).

Nearshore Habitat. This area is characterized as a mixed sand and gravel spit fronted by mud flat to the north within Burley Lagoon, a sand beach to the immediate north, and the outlet of Purdy Creek (Table A-16, Appendix A). Located at the site of two converging drift cells and the

mouth of an estuarine embayment, this shore is depositional in nature and therefore unlikely to be actively eroding.

Streams and Wetlands. Purdy Creek discharges to Burley Lagoon in this segment (Figure 10). The southern bank of the stream and wetland was filled in the past; however, the stream mouth retains dendritic channels and associated wetland vegetation, including Lyngby's sedge and pickleweed (Photo F-5). Purdy Creek is documented as supporting coho and chum salmon, as well as cutthroat and steelhead (Adolfson, 2005). A small potential wetland is described in the City's Inventory near the mouth of Purdy Creek; this wetland is likely in shoreline jurisdiction (Adolfson, 2005). Almost four acres of potential wetland area is located in Segment F.

Shellfish. Intertidal hardshell clams are the only shellfish species mapped in Burley Lagoon by WDFW (WDFW, 2007). Washington Department of Health currently classifies the portion of Burley Lagoon in Segment F as approved for commercial shellfish growing. Other portions of Burley Lagoon north of the City's UGA are classified as restricted by species, and unclassified (WDOH, 2006). No portion of Burley Lagoon is classified as biotoxin closure zone (WDOH, 2005).

Forage Fish Spawning Areas. No potential or documented forage fish spawning areas are mapped in Segment F (WDFW, 2007; Pentec Environmental, 2003).

Federally-Listed Species and Species of Local Concern. Marine intertidal, nearshore, and sub-tidal areas provide critical habitat for salmonids, particularly for juvenile salmonid smolts as they migrate from freshwater to marine environments (Haring, 2000). Salmonids that may be present include chinook, chum, pink, and sockeye salmon along with sea-run cutthroat, bull trout, and steelhead trout. Waters in excess of 20 feet in depth may be used by the Southern Resident Population of killer whale for foraging. Steller sea lions could also potentially forage within the marine nearshore area. Critical habitat has been designated within the marine areas for Chinook salmon and the Southern Resident Population of killer whale.

12.4 Shoreline Armoring

The southern portion of Segment F is extensively modified with a concrete seawall and with riprap (Figure 8; Photos F-1 through F-3). Armoring in this southern portion is characterized as a mix of concrete and wooden bulkhead, with some riprap as a secondary modification (Table A-9, Appendix A). North of the Purdy Creek outlet, armoring is mostly wooden bulkhead, with some concrete armoring (Table A-9, Appendix A). Sediment sources are largely located up-drift of these shore modifications (south of Segment F), so the armoring does not impound sediment sources. However, the depositional nature of Segment F makes shore armoring largely unnecessary in terms of protection from erosion. Nearshore habitats are degraded as a result of shore armoring due to substrate modification, loss of shoreline connectivity and beach narrowing (Johannessen and MacLennan 2007, Thom et al 2001).

12.5 Opportunity Areas

Opportunity F-1 (*Protection).* The area contains bulkheads throughout (Photo F-1, F-2 and F-3). However, this area offers public access opportunities. Densities of wood on the beach occur at approximately 1 piece per 90 feet; but offers limited opportunities to improve on future LWD recruitment due to the narrow width of the riparian vegetation (Table A-1, Appendix A; Photo F-1). Habitats could be improved by replacing existing shore armoring with soft shore protection combined with dune and riparian vegetation planting.

Opportunity F-2 (*Enhancement).* The KGI Habitat Assessment identifies the opportunity for bulkhead removal in this vicinity (Photo F-1 and F-4).

Opportunity F-3 (*Protection and Enhancement).* This stream and wetland complex is riprapped along Highway 302 and along the commercial area on the south bank (Photos F-1 and F-5). Fill, pilings, and wooden bulkheads are located on the spit at the stream mouth (Photo F-4). Protection of the outlet of Purdy Creek will ensure the continuation of rearing and foraging opportunities for juvenile salmonids, among other organisms. This area was identified as a potential restoration area in the KGI Habitat Assessment (Pentec Environmental, 2003).

Opportunity F-4 (*Enhancement).* This residential area, within the sheltered Burley Lagoon, may provide future opportunities for soft armoring and enhanced riparian plantings (Photo F-6).

13.0 SHORELINE MANAGEMENT RECOMMENDATIONS

The following recommendations synthesize the area-specific opportunities identified in Sections 7 through 12 above and provide additional shoreline management recommendations in the context of other local and regional planning activities. These recommendations are intended to inform the update to the City's shoreline master program by identifying opportunities for ecological conservation and restoration and policy issues related to future shoreline use and development.

- The development of the Shoreline Master Program and shoreline environment designations should be consistent with both the 2003 state shoreline guidelines (WAC 173-26) and the 2008 Comprehensive Plan. If conflicts between the two are identified, the SMP update may result in the need for revision of Comprehensive Plan policies. In order to meet shoreline management objectives as well as goals for historic preservation and waterfront design criteria, a unique shoreline environment designation for the downtown waterfront and historic district may need to be developed.

- The City could explore developing a community education and incentive program to identify and develop restoration opportunities on private property which support the overall goals of shoreline management.

- Incentives to maintain net sheds could be established to encourage adaptive re-use and preservation of these historic overwater structures. The history and cultural heritage of Gig Harbor is tied closely to its settlement as a fishing village. As the commercial fishing fleet has declined in recent decades, over-water structures increasingly serve recreational boating and tourism. A potential use conflict exists between preservation of the City's last few parcels of working waterfront and state agency regulatory requirements for water-dependent uses. Adaptive re-use of the historic net shed structures with water-oriented or non-water dependent uses could be allowed when combined with other SMA policy objectives, such as enhanced public access; education, historic and cultural preservation; and/ or restoration of degraded shoreline ecological functions.

- Standards for all overwater structures could be explored to increase light penetration to the water below. Options may include increasing the structure height over the water, modifying the structure orientation, minimizing the structure size, using grating as a surface material, placing floating docks in deeper water to avoid grounding during low tides, and considering the potential for carefully placed community docks (Nightingale et al, 2001).

- For new shoreline stabilization projects, demonstration of the need for hard armoring approaches to shoreline stabilization could be required before approval. The use of alternative bank stabilization, and/or soft-shore armoring techniques could be encouraged in the City's shoreline master program.

- Incentive programs could be put in place to encourage property owners to replace existing hard armoring with habitat-friendly erosion control structures or to remove existing structures when shore armoring is unnecessary.

- Marine riparian zones of the city's shorelines should be protected and restored wherever possible. Several regulatory and non-regulatory approaches could be incorporated into the City's shoreline policies and regulations. Examples include requiring rear yard building setbacks to be measured from the bulkhead line or OHWM, rather than the rear property line which is often located waterward of the OHWM, providing landowners with on-site density transfers or off-site development rights transfers, requiring shoreline buffers to be protected by conservation easements, and providing technical assistance for restoration projects.

- Development of an "in-lieu fee" program to facilitate public access enhancements and shoreline recreational developments could be explored. This type of program would be utilized only after consideration of on-site public access opportunities at shoreline developments being proposed. Where on-site access would be infeasible, an in-lieu fee program may facilitate development of off-site enhancements identified as priorities through the SMP update and/or the City's Parks, Recreation, and Open Space Plan.

- In order to minimize potential navigational conflicts, the City could explore defining and maintaining an open-water navigable channel where individual mooring buoys would not be allowed. Similarly, the City could examine the potential for increased "side-yard" setbacks from proposed docks or marinas that would provide moorage for pleasure-craft where those developments are adjacent to docks supporting commercial fishing operations or moorage of commercial fishing vessels.

14.0 REFERENCES AND BIBLIOGRAPHY

Adolfson Associates, Inc. 2005. Stream and Wetland Inventory, City of Gig Harbor. Prepared for the City of Gig Harbor, WA.

Anchor Environmental, L.L.C. and People for Puget Sound. 2002. *Final Report Northwest Straits Nearshore Habitat Evaluation.* Prepared for Northwest Straits Commission (NWSC). Mount Vernon, WA.

Andrews History Group. 2009. Survey Report Intensive-level Survey of Historic Resources in Gig Harbor, WA. Principal Investigator: Mildred Andrews. June 2009.

Bahls, P., C. Kindberg, M. Wait, J. Glasgow. 2006. An Assessment of Error in State Shoreline Designation for Lakes in Washington. Northwest Watershed Institute and Washington Trout. August, 2006.

Balcomb, K. Center for Whale Research. Unpublished data. Friday Harbor, Washington.

Battelle Marine Sciences Laboratory. 2002. Bainbridge Island Nearshore Assessment: Summary of Best Available Science. Prepared for the City of Bainbridge Island, WA.

BST Associates, Inc. 2008. Tacoma Waterfront Lands Analysis. Prepared for City of Tacoma. Kenmore, WA.

Chu, Y.H.. 1985. Beach erosion and protection: a case study at Lincoln Park, Seattle, WA. Shore and Beach (53): 26-32.

City of Gig Harbor. 2010. *Gig Harbor Parks, Recreation and Open Space Master Plan*. Prepared by MIG, Inc. Gig Harbor, WA.

City of Gig Harbor. 2008a. *Gig Harbor Municipal Code*. Current through ordinance 1131 passed June 9, 2008. Gig Harbor, WA.

City of Gig Harbor. 2008b. *Gig Harbor's Netsheds Named to 'Most Endangered' List.* Press Release dated June 19, 2008.

City of Gig Harbor. 2007a. *City of Gig Harbor Comprehensive Plan*. Adopted in 2004. Revised in 2007. Gig Harbor, WA.

City of Gig Harbor. 2007b. Geographic Information Systems (GIS) Data.

City of Gig Harbor. 2006a. *Historic Netsheds Sites on Gig Harbor Bay*. PowerPoint Presentation Prepared in November 2006.

City of Gig Harbor. 2006b. Historic Net Shed Sites in Gig Harbor. Prepared by Lita Dawn Stanton. November 2006, updated September 2008.

City of Gig Harbor. 2002. *Wastewater Comprehensive Plan*. Prepared by Gray and Osborne, Inc. Gig Harbor, WA.

City of Gig Harbor. 2001a. *Stormwater Comprehensive Plan*. Prepared by Gray and Osborne, Inc. Seattle, WA.

City of Gig Harbor. 2001b. *Park, Recreation, & Open Space Plan, Gig Harbor, Washington*. Gig Harbor, WA.

City of Gig Harbor. 2001c. *City of Gig Harbor Shoreline Master Plan - Critical Areas Map.* Prepared by Pierce County GIS.

City of Gig Harbor. 1994a. *City of Gig Harbor Shoreline Master Program*. Gig Harbor, WA.

City of Gig Harbor. 1994b. *City of Gig Harbor Comprehensive Plan*. Gig Harbor, WA.

City of Gig Harbor. 1993. *City of Gig Harbor Wastewater Treatment Plant Facility Plan.* Prepared by Gray and Osborne, Inc. Gig Harbor, WA.

Clancy, M., I. Logan, J. Lowe, J. Johannessen, A. MacLennan, F.B. Van Cleve, J. Dillon, B. Lyons, R. Carman, P. Cereghino, B. Barnard, C. Tanner, D. Myers, R. Clark, J. White, C. A. Simenstad, M. Gilmer, and N. Chin. 2009. Management Measures for Protecting the Puget Sound Nearshore. Puget Sound Nearshore Ecosystem Restoration Project Report No. 2009-01. Published by Washington Department of Fish and Wildlife, Olympia, Washington.

Cosmopolitan Engineering Group and Golder Associates, Inc. 2002. *City of Gig Harbor Wastewater Treatment Plant Outfall Extension Biological Assessment.* Prepared for the City of Gig Harbor, WA.

Determan, T.A., B. M. Carey, W. H. Chamberlain, and D.E. Norton. 1984. *Sources Affecting Sanitary Conditions of Water and Shellfish in Minter Bay and Burley Lagoon, Draft*. Olympia, WA.

Downing, J. 1983. The Coast of Puget Sound. Its Processes and Development. University of Washington Press, Seattle, WA, 126 p.

EnviroVision, Herrera Environmental, and Aquatic Habitat Guidelines Working Group. 2010. Protecting Nearshore Habitat and Functions in Puget Sound. Revision to October 2007 Draft in June 2010.

Evans-Hamilton, Inc. and D.R. Systems, Inc. 1987. *The Puget Sound Environmental Atlas, Volume 1*.

Federal Emergency Management Agency (FEMA). 1995. *Q3 Flood Data, depicting Flood Insurance Rate Map, Pierce County, Washington.*

Gerstel, W.J. and J.F. Brown. 2006. *Alternative Shoreline Stabilization Evaluation Project – Final Report*. Prepared for Puget Sound Action Team. Olympia, WA.

Greiner C.M. 2010. Principles for Strategic Conservation and Restoration. Puget Sound Nearshore Ecosystem Restoration Project Report No. 2010-01. Published by the Washington Department of Fish and Wildlife, Olympia, Washington and the U.S. Army Corps of Engineers, Seattle, WA.

Haring, D. 2000. *Salmonid habitat limiting factors: Water Resources Inventory Area (WRIA) 15 (East) Final Report*. Washington State Conservation Commission. Olympia, WA.

IES Associates. 1992. *City of Gig Harbor Wetland Inventory Report.* Gig Harbor, WA.

Jefferson County and Washington Department of Natural Resources. 2010. *Mystery Bay Final Draft Management Plan*. March 9, 2010. Jefferson County, WA.

Jacobson, E. and M.L. Schwartz. 1992. The use of geomorphic indicators to determine the direction of net shore-drift. Shore and Beach 49:38-42.

Johannessen, J. and A. MacLennan. 2007. Beaches and Bluffs of Puget Sound. Puget Sound Nearshore Partnership Report No. 2007-04. Report No. 2007-04. Published by Seattle District, U.S. Army Corps of Engineers, Seattle, Washington. ,

Jones and Stokes. 2000. *City of Gig Harbor Wastewater Effluent Outfall Replacement, SEPA Environmental Checklist.* Gig Harbor, WA.

Keuler, R.F.. 1979. Coastal zone processes and geomorphology of Skagit County, Washington. Master's thesis, Western Washington University, Bellingham, WA. 123 p.

KGI Watershed Committee. 1999. *Key Peninsula-Gig Harbor-Islands Watershed Action Plan and Characterization Report.*

King County Department of Natural Resources (KCDNR). 2001. *Reconnaissance Assessment of the State of the Nearshore Report: Including Vashon and Maury Islands (WRIAs 8 and 9).* Seattle, WA.

Knight, K. 2009. *Land Use Planning for Salmon, Steelhead and Trout.* Washington Department of Fish and Wildlife. Olympia, WA.

Komar, P.D. 1976. Beach processes and sedimentation. Englewood Cliffs, NJ. Prentice-Hall. 429 p.

Larson Anthropological Archaeological Services (LAAS) Limited. 2002. *Donkey Creek Park Cultural Resources Overview and Archaeological Resources and Traditional Cultural Places Assessment, Gig Harbor, Pierce County, Washington.* Prepared for the City of Gig Harbor Planning and Building Services. Gig Harbor, WA.

Marine Mammal Commission. 2004. *Annual Report to Congress: 2003.* http://www.mmc.gov/reports/annual/

Munter, Chris. Department of Public Works, City of Gig Harbor. Personal Communication, telephone conversation with Deron Lozano, Adolfson Associates, Inc. January 2002.

Nightingale, B. and C. Simenstad. 2001. *Overwater structures: Marine issues*. Prepared for Washington Department of Fish and Wildlife, Washington Department of Ecology, and Washington Department of Transportation. University of Washington. Seattle, WA.

Pentec Environmental. 2003. *Key Peninsula, Gig Harbor, and Islands Watershed Nearshore Salmon Habitat Assessment*. Prepared for Pierce County Public Works and Utilities, Environmental Services, Water Programs. Tacoma, WA.

Pentilla, D. 1996. Surf Smelt/Sand Lance/Herring fact sheets. Washington Department of Fish and Wildlife, LaConnor, WA .

Pentilla, D. 2001. Effects of shading upland vegetation on egg survival for summer-spawning surf smelt on upper intertidal beaches in Puget Sound. *In* Proceedings of Puget Sound Research 2001. Puget Sound Water Quality Action Team. Olympia, WA.

Pentilla, D. 1995. Investigations of the spawning habitat of the Pacific Sand Lance (*Ammodytes hexapterus*) in Puget Sound. *In* Proceedings of Puget Sound Research 1995. Puget Sound Water Quality Authority. Olympia, WA.

Pentilla, D. 2000. Impacts of overhanging shading vegetation on egg survival for summer spawning surf smelt, *Hypomesus*, on upper intertidal beaches in Northern Puget Sound, Washington. Marine Resources Division, Washington Department of Fish and Wildlife. Olympia, WA.

Pierce County Department of Planning and Land Services. 2002. Gig Harbor Peninsula Community Plan. Adopted March 12, 2002. Available online at: http://www.co.pierce.wa.us/pc/services/home/property/pals/landuse/ghplan.htm.

Pierce County Water Programs. 2000. *Draft Gig Harbor Basin Study Characterization Report*. Gig Harbor, WA.

Pierce County. 2008. GIS Data.

Poston, T. 2001. *Treated Wood Issues Associated with Overwater Structures in Marine and Freshwater Environments (White Papter)*. Prepared for the Washington Department of Fish and Wildlife, Washington Department of Ecology, and the Washington Department of Transportation. Prepared by Battelle.

Puget Sound Partnership (PSP). 2010. Puget Sound Science Update. Prepared by the Science Panel.

Puget Sound Nearshore Ecosystem Restoration (PSNERP). 2009. Presentation on the PSNERP Nearshore Change Analysis Project.

Shipman, H. 2003. *Puget Sound Coastal Processes and Shoreline Stabilization Measures 2003 Workshop.* Coastal Training Program, WA.

Stratus Consulting, Inc. 2006. *Creosote-Treated Wood in Aquatic Environments: Technical Review and Use Recommendations*. Prepared for: NOAA Fisheries Southwest Division, Habitat Conservation Division (Joe Dillon). Boulder, CO.

Thom, Ronald M., and Gregory D. Williams. 2001. *Marine and estuarine shoreline modification issues*. Battelle Marine Sciences Laboratory. Sequim, WA.

United States Department of Agriculture, Soil Conservation Service (USDA SCS). 1983. *Pierce County Soil Survey*.

United States Department of the Interior (USDI). 1987. *National Wetlands Inventory, Gig Harbor, Washington 7.5-minute USGS Quadrangle*.

United States Fish and Wildlife Service (USFWS). Listed Federal Species Letter dated July 14, 2003.

United States Geological Survey (USGS). 1998. Determination of Upstream Boundaries on Western Washington Streams and Rivers Under the Requirements of the Shoreline Management Act of 1971. By David L. Kresch, Water-Resources Investigations Report 96-4208. Prepared in cooperation with Washington State Department of Ecology.

URS Corporation and Triangle Associates. 1987. *City of Gig Harbor Stormwater Master Plan.* Gig Harbor, WA.

Vines, C.A., T. Robbins, F.J. Griffin, and G.N. Cherr. 2000. *The effects of diffusible creosote-derived compounds on development in Pacific herring (Clupea pallasi).* Aquatic Toxicology: 51, pp 225-239.

Washington State Department of Ecology (WDOE). 1978 – 1980. Washington Sate Coastal Zone Atlas (12 Volumes). Washington Shorelands and Coastal Zone Management Program. Washington State Department of Ecology (Ecology). 2008. Kitsap Water Resource Inventory Area (WRIA) #15 WDFW - Salmonid Stock Inventory.

Washington State Department of Ecology (Ecology). 2010. Marine Shoreline Armoring and Puget Sound – Frequently Asked Questions. Prepared by the Shorelands and Environmental Assistance Program. Olympia, WA.

Washington Cooperative Fish and Wildlife Research Unit. 2000. *Pierce County GAP Application Pilot Project: A Biodiversity Plan for Pierce County, Washington*. Prepared for Pierce County Planning and Land Services. Prepared by Remote Sensing Applications Laboratory, Department of Urban Design and Planning, University of Washington in collaboration with the Washington Gap Analysis Project. Seattle, WA.

Washington State Department of Fish and Wildlife (WDFW). 2009. *Protection of Marine Riparian Functions in Puget Sound*, Washington. Prepared by Washington Sea Grant – J. Brennan, H. Culverwell, R. Gregg, and P. Granger. Olympia, WA.

Washington State Department of Fish and Wildlife (WDFW). 2007. *Priority Habitats and Species, "StreamNet", and Marine Resources Species databases*. Olympia, WA.

Washington State Department of Fish and Wildlife (WDFW). 1992. *Salmon, Marine Fish and Shellfish Resources and Associated Fisheries in Washington's Coastal and Inland Marine Waters*. Habitat Management Division. Olympia, WA.

Washington State Department of Fish and Wildlife and Western Washington Treaty Indian Tribes. 1994. *Salmon and Steelhead Stock Inventory (SASSI)*. Olympia, WA.

Washington State Department of Natural Resources (WDNR). 2002. Letter to Deron Lozano, Adolfson Associates, Inc., dated August 11, 2003. Washington State Department of Natural Resources, Olympia, WA.

Washington State Department of Natural Resources (WDNR). 2001. *Washington State ShoreZone Inventory*. Nearshore Habitat Program, Washington State Department of Natural Resources. Olympia, WA.

Washington State Department of Natural Resources (WDNR). 2008a. State Owned Aquatic Land Encumbrance feature GIS data. Encumbrance data through July 2006. Olympia, WA.

Washington State Department of Natural Resources (WDNR). 2008b. Brief Science of Creosote. Olympia, WA,

Wiles, G.J. 2004. *Washington State Status Report for the Killer Whale*. Washington Department of Fish and Wildlife, Olympia, WA.

Williams, R.W., R.M. Laramie, and J.J. James. 1975. *A Catalog of Washington Streams and Salmon Utilization, Volume 1, Puget Sound Region*. Washington Department of Fisheries. Olympia, WA.

Zelo, I., H. Shipman, and J. Brennan. 2000. *Alternative Bank Protection Methods for Puget Sound Shorelines*. Prepared for the Shorelands and Environmental Assistance Program, Washington Department of Ecology. Olympia, WA, Publication # 00-06-012.

WEBSITES:

48° North The Sailing Magazine. *Guide to Northwest Marinas, Region5…Gig Harbor*. Retrieved July 21, 2003, from the 48° North The Sailing Magazine, Web site: http://www.48north.com/.

City of Gig Harbor Website. 2008. Available online at: http://www.gigharborguide.com/ (accessed July 2008).

National Park Service. 2008. Available online at: http://www.nps.gov/history/heritageareas/FAQ/INDEX.HTM (accessed July 8, 2008).

Northwest Culture Website. "A Brief History of Gig Harbor." Available online at: http://www.nwculture.com/NWC/SmallTowns/GigHarbor/1HP/history.html (accessed January 2002).

Pierce County Department of Planning and Land Services Website. Seismic Hazard Areas map. Available online at: http://www.co.pierce.wa.us/xml/abtus/ourorg/dem/EMDiv/HIVA/seismicmap.pdf (accessed July 2003).

Pierce County Parks and Recreation Department. 2008. Available online at http://www.co.pierce.wa.us/pc/services/recreate/fac-list.htm (accessed July 8, 2008).

Washington State Department of Ecology (Ecology) Website. Oblique Aerial Photos, 2000 Series. Washington State Department of Ecology, Shorelands and Environmental Assistance Program. Olympia, WA. Available online at http://apps.ecy.wa.gov/shorephotos/index.html (accessed August 2003).

Washington State Department of Ecology (Ecology). Digital Coastal Zone Atlas. Available online at http://www.ecy.wa.gov/programs/sea/SMA/atlas_home.html (accessed August 2003).

Washington Department of Ecology Website. Proposed 2008 Section 303(d) List and Integrated 2004 Section 303(d) List – WRIA 15. Available online at: http://www.ecy.wa.gov/Programs/wq/303d/index.html (accessed July 2008).

Washington State Department of Health Website. 2001. "Commercial Shellfish Harvest to Re-Open in Burley Lagoon." Press Release. Available online at: http://www.doh.wa.gov/Publicat/2001_News/01-39.html (accessed February 2002).

Washington State Department of Health Website. 2008. Shellfish Safety Information webpage. Available online at: http://ww4.doh.wa.gov/scripts/esrimap.dll?name=bioview&Cmd=Map&Step=1 (accessed July 2008).

Washington State Department of Health (WDOH). 2006. Commercial Shellfish Growing Areas. GIS data.

Washington State Department of Health (WDOH). 2005. Biotoxin Closure Zones. GIS data.

Washington State Department of Natural Resources (WDNR). 2008. Natural Heritage Program database. Available online at: http://www.dnr.wa.gov/ResearchScience/Topics/NaturalHeritage/Pages/amp_nh.aspx Accessed July 2008.

Washington State Department of Natural Resources (WDNR), Aquatic Lands Division. 2007. Washington State Owned Aquatic Land Encumbrance (ENC_07; ENC_Plates). GIS dataset.

Washington State Department of Natural Resources (WNDR). 2011. Creosote Removal Program Webpage. Available online at: http://www.dnr.wa.gov/ResearchScience/Topics/AquaticClean-UpRestoration/Pages/aqr_creosote_removal_program.aspx