City of Port Orchard Shoreline Resource Analysis and Inventory

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1.0 Introduction

The purpose of this study was to conduct a baseline inventory of shoreline conditions within the City of Port Orchard, Washington. This included an inventory and analysis of shoreline conditions consisting of land use, public access, environmentally sensitive areas and fish habitat, including habitat for species listed as threatened or endangered under the federal Endangered Species Act. More specifically, the shoreline inventory was conducted by collecting and analyzing existing plans, surveys, studies, inventories and other information and data applicable to the City's shorelines. A physical inventory of land use and shoreline modifications was also conducted. This included an evaluation of shoreline functions and ecological processes with recommendations for enhancement and restoration projects. This inventory report documents those functions of the shoreline that are more natural in nature and those that, because of past modifications, are no longer natural and have compromised the rearing, migration and feeding of salmon. The report also includes findings and recommendations regarding data needs, data gaps that may exist, and new data which needs to be collected in support of the Shoreline Master Program (SMP) development as part of a Coastal Zone Management Grant to comply with the Shoreline Management Act guidelines.

The report will be a building-block upon which the City can further continue the SMP revision process or pursue other grant opportunities to fill identified data gaps. This report is intended to be summary in nature and not highly technical or analytical.

1.1 Study Area Boundary

This inventory area includes the shoreline of Sinclair Inlet and several hundred feet upstream in both Ross Creek and Blackjack Creek corridors that fall within Port Orchard City limits (Figure 1). The approximate 3.5 miles of Port Orchard marine shoreline of Sinclair Inlet and 0.1 river miles of both Ross and Blackjack Creeks were studied. This study encompasses Sections 25, 26, 27, and 34 of Township 24 and Range 1E.

Figure 1: Vicinity Map of the City of Port Orchard Shoreline.

1.2 Methodology

The Washington State Department of Ecology (Ecology) provided the City and its consultant team with guidance through meetings and correspondence on conducting a shoreline inventory under the shoreline management guidelines. This inventory was prepared using that guidance.

The new shoreline guidelines provide a list of elements that can be addressed in shoreline inventories. Efforts were taken to address those elements applicable to the city of Port Orchard's heavily developed shoreline. These elements include physical components such as geologic hazard areas, erosion areas, and other physical features of the shorelines. The shoreline inventory also included a number of biological components such as fish and shellfish presence, fish habitat for spawning or rearing, vegetation, wetlands, and other wildlife habitat. In addition, "altered" conditions including existing land uses, public access sites, and bulkheads were documented. Table A, included in Appendix A, provides the inventory elements listed in the shoreline guidelines and reference where each element has been addressed in this document.

A number of state and federal agency data sources, City of Port Orchard records, and technical reports were reviewed, including but not limited to the following:

- City of Port Orchard Critical Areas Ordinance (City of Port Orchard 1999)
- City of Port Orchard Zoning Ordinance (City of Port Orchard 1993)
- City of Port Orchard, Blackjack Creek Comprehensive Plan (City of Port Orchard 1997)
- City of Port Orchard Ross Creek Management Plan (City of Port Orchard 1992a)
- City of Port Orchard Shoreline Master Program (City of Port Orchard 1992b)
- City of Port Orchard Comprehensive Park Plan (City of Port Orchard 1988)
- City of Port Orchard Urban Waterfront Walkway (City of Port Orchard 1985)
- City of Port Orchard Comprehensive Plan (City of Port Orchard 1995)
- East Kitsap Refugia Descriptions DRAFT Report (City of Port Orchard 2001)
- Salmon and Steelhead Stock Inventory (SASSI);
- The Catalog of Washington Streams and Salmon Utilization, Volume 1, Puget Sound Region (Williams, et al 1975)
- Sinclair Inlet Water Quality Assessment (1991)
- Sinclair Inlet Watershed Characterization (1992)
- The Sinclair Inlet Watershed Action Plan (1994)
- WAC 173-26
- City of Sumner Shoreline Inventory (2001)
- Guidance on Watershed Assessment for Salmon (Joint Natural Resources Cabinet 2001)
- Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Watershed Scale (NMFS 1996)
- Marine and Estuarine Shoreline Modification Issues (Williams and Thom 2001)
- The Snohomish Salmon Overlay–A Tool for Regional Habitat Restoration Planning (City of Everett 2001)

- Identifying Priority Areas For Salmon Conservation In Puget Sound Basin (Frissell 1999)
- Pacific Salmon and Wildlife - Ecological Contexts, Relationships, and Implications for Management. Special Edition Technical Report (Cedarholm et al. 2000)
- WRIA 15 Limiting Factors Report
- City of Bainbridge Island Best Available Science (AES 2002)
- Aquatic Habitat Guidelines: An Integrated approach to Marine, Freshwater, and Riparian Habitat Protection and Restoration (WDFW 2001)

The City (and Kitsap County) provided the team a number of valuable and informative base mapping products. Base map information included:

- Kitsap County GIS map products (Kitsap County 2002) that included the assessors base map layer with critical areas overlay. Critical areas included DNR water types, Geologic hazard areas, hydric soils, national wetland inventory, and Class I wildlife Conservation Areas.
- DNR ShoreZone (2001)
- LIDAR (light detection and ranging) map that provides a three dimensional view of the area.
- Space Imaging map products,
- Department of Ecology 2001 aerial photographs.
- Utility locations (storm sewer, culverts etc.) provided by the City of Port Orchard
- FEMA Firm Maps (1979)
- Shellfish closure area maps (WDOH 2001)
- Drift cells and littoral drift from the Washington State Department of Ecology
- Sediment Contaminant information from SEDQUAL
- WDFW priority habitats and species maps (WDFW 2002).

Aerial photographs of the study area were consulted, and several field days investigating the study area were conducted. Field methodology for the Port Orchard inventory was set during a meeting with the City, AES, Ecology and WDFW personnel. This valuable meeting set the scope of work, field methods for data collection and sampling schedule (March 5, 6, and 7th, 2002) for this project.

<u>Data Collection – Preparation for and Application of Field Work</u>
Element we collected in the field include: riparian and substrate descriptions, eelgrass and algal bed locations, wetland and riverine locations and conditions, bulkhead/riprap locations and condition, fill and dredge areas, storm and sewer outfall areas, and culverts. Roughly half of these elements were determined by the Ecology and WDFW review team to be data gaps we could realistically collect in the field in the three days allotted.

AES prepared six separate data forms to collect nearshore information along the approximate 3.5 miles of Port Orchard marine shoreline and 0.1 river miles of both Ross and Blackjack Creeks. Sample data forms are found in Appendix B. These data types were identified as potential data gaps based upon our collective experience with other shoreline inventories and upon review of the Port Orchard baseline map information. The specific parameters assessed included:

- Shoreline Hardening - Bulkheads – Identified with start and stop coordinates
  - Material type (concrete, riprap or wood)
  - Slope of bulkhead
  - Estimated elevation of toe of slope of armoring
- Feeder Bluffs - Identified with start and stop coordinates
- Sediment Source Coordinates
- Stream Mouth Coordinates
- Dolphin Coordinates
- Mooring Buoys Coordinates
- Floats and Barges Coordinates
- Marina Coordinates
- Pier Coordinates
- Substrate data and shifts from upper intertidal to low tide using the Wentworth (1922) scale
- Riparian and Nearshore Marine Vegetation Data – Identified with start and stop coordinates
  - Percentage of shade rank
  - Percentage of vegetated width rank
  - Species rank (invasive, non-native, native deciduous, mixed deciduous/coniferous, coniferous)
  - Large woody degree (LWD) ranking
  - Marsh vegetation presence or absence

Nearshore data was collected in two ways. Using a boat, video and GPS data were collected form an offshore position to generate a continuous photographic record. Secondly, the shoreline was studied at certain locations not fully documented by the offshore effort. Still photographs and GPS data were collected from shore. Shoreline elements within Ross and Blackjack Creek corridors were documented with video, still images and GPS coordinate recordings. The GPS coordinates were in NAV 83 horizontal and Washington State Plane North as required by the Ecology contract with the City of Port Orchard.

1.3 Report Organization

This report is divided in to six main sections.

- Section 1.0 which provides background, introductory information, literature and map products cited and field methodology,
- Section 2.0 discusses existing land use and zoning along the City's regulated marine shoreline and a segment of both Ross and Blackjack Creeks.
- Section 3.0 discusses biological resources and critical areas within the shoreline environment.
- Section 4.0 provides a segment-by-segment analysis of shoreline conditions.

- Section 5.0 provides recommendations for restoration, preservation and future work.
- Section 6.0 Map products, labeled as figures, and other appendices.

1.4 Study Segments

For the purposes of categorizing distinct segments of the City's shorelines for planning purposes, the shoreline was classified into seven relatively homogeneous segments. These segments were based generally on the level of ecological functions provided by each segment, as well as existing and projected land uses. Table 1 indicates the location of shoreline segments. Segments are also shown on Figure 2.

Table 1. Study Segments of the Port Orchard Shoreline

Shoreline Segment	Location	Approximate Length
Segment 1	From the western edge of the City to just past Thompson's Marina/Dock	1850 feet
Segment 2	From Thompson's Marina/Dock, around Ross Point to near Wilkins fuel dock	6175 feet
Segment 3	West of Wilkins fuel dock to just west of Seattle Street	4875 feet
Segment 4	From just west of Seattle Street to the east end of the parking lot of the West Sound Center	2430 feet
Segment 5	From the east end of the parking lot of the West Sound Center to the east end of the City at Annapolis	2600 feet
Segment 6	Ross Creek (0.1 river mile)	530 feet
Segment 7	Blackjack Creek (0.1 river mile)	530 feet

2.0 Land Use and "Altered" Conditions

2.1 Historic Land Use and Watershed Conditions

Port Orchard's history is based on the use of natural resources by native peoples, and later by early European settlers. Prior to the 1880's, Port Orchard and much of south Kitsap were inhabited primarily by the Shak-Tabsh Indians, and branch tribe of the Suquamish Indians (City of Port Orchard 1995). In 1883 the transcontinental railroad was completed and people were drawn to Tacoma and beyond. Originally settled as "Sidney", Port Orchard became the first incorporated city in the county. The Mosquito Fleet passenger vessels were the chief form of transportation due to the dense forests (City of Port Orchard 1995). Through efforts associated with this project, an 1881 map of Sinclair Inlet was located and it is included here due to its uniqueness (Figure 3). The projection on the map does not appear to line up perfectly with the shoreline, but it is close, and illustrates changes in the shoreline over time.

The Sinclair watershed is largely rural and forested, and is characterized by its flat and rolling topography with many small streams. Two main discharges of freshwater draining into the inlet occur from Gorst and Blackjack Creek. These streams provide spawning and rearing habitat for Coho, Chinook, Chum, and Steelhead Salmon (Sinclair Inlet Watershed Management Committee 1994). Within the shoreline study area boundaries, Blackjack Creek (Type 1) and Ross Creek (Type 2) streams, provide habitat for salmon and wildlife and discharge into the Sinclair Inlet. In the 1970's, the Kitsap Peninsula consisted of primarily of second and third-growth forest cover (Williams et al. 1975). Now, most forest cover in Kitsap occurs in the Gorst Creek watershed which is the drinking water source for Bremerton and therefore protected. East Kitsap (Bainbridge Island, Port Orchard, etc.) shorelines are all residentially developed. Inland, southeast Kitsap has lower residential density and therefore more trees, but not as it was in 1975 when Williams wrote his report. The Port Orchard vicinity is experiencing an increasing amount of urban development (WCC 2000). Forestry practices, agriculture and residential development have degraded salmon habitat quality in many of these lowland streams. As notable exceptions, some areas have been protected to supply a municipal water source (Gorst Creek watershed) or as old-growth timber refugia (Chico Creek watershed).

Sinclair Inlet is a shallow, poorly flushing estuary, several miles of saltwater frontage. The flushing rate is approximately 14 days (Hayes et al. 1992). This slow period of discharge and replenishment is a factor influencing water and habitat quality in the inlet (Sinclair Inlet Watershed Action Plan 1994). Sinclair Inlet is one of the most polluted waters in the Puget Sound (Hayes et al. 1992). Fecal coliform contamination, mostly from non-point source pollution, in addition to significant chemical contamination that includes high levels of mercury and PCB's have been documented in the Sinclair Inlet (DOE 1996).

2.2 Existing Land Use

Port Orchard is a waterfront residential community by plan and design. The City has made it a priority to balance the growing commercial service needs, the increasing residential neighborhoods while enhancing the opportunities for enjoyment of the shoreline environment (City of Port Orchard 1995). Current land use in Port Orchard is a mix of residential, commercial, light industry and manufacturing. The Sinclair Inlet watershed, of which Port Orchard is a section, is largely rural (37%) and forested (27%) (Envirovision 1991). The City of Port Orchard has a much higher percentage of residential and infrastructure areas than rural or forested areas (City of Port Orchard 1995).

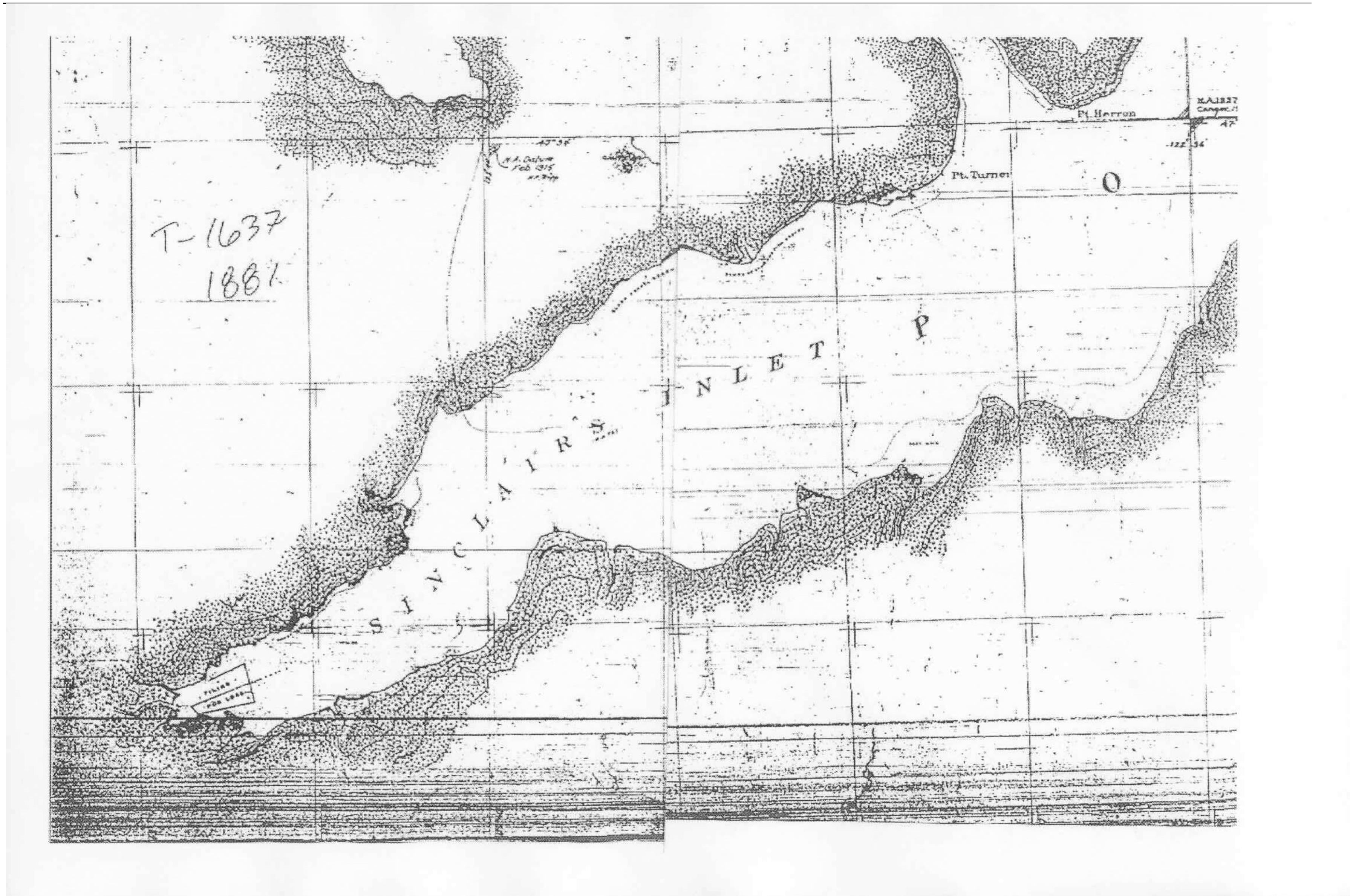


Figure 3: 1881 Map of the Port Orchard Shoreline

Table 2 provides a rough estimate of current land use by shoreline segment based upon interpretation from air photos and from City personnel verified information. Existing land use designations are general descriptions only. Figure 4 illustrates land use within the City of Port Orchard.

Table 2. Current City of Port Orchard Shoreline Existing Land Use

Shoreline Segment	Existing Land Use	Approximate Percent Coverage
Segment 1	Marina / Light industry and manufacturing Residential Forested	38% 10% 30-40%
Segment 2	Forested Light industry and manufacturing	75-85% 15-20%
Segment 3	Commercial Light Industry and manufacturing Multiple Marinas	40% 5% 45%
Segment 4	Commercial High density residential	75-80% 20-25%
Segment 5	High density residential	100
Segment 6	Forested	100%
Segment 7	Commercial Forested	50% 50%

2.3 Comprehensive Plan

The 1995 City of Port Orchard Comprehensive Plan has five general land use designations used within the city. These are: Low Density Residential, High Density Residential, Public and Community Spaces, Commercial and Industrial/Manufacturing. Table 3 describes the comprehensive plan designations of the shoreline divided by segment.

Table 3. Current City of Port Orchard Shoreline Use Under Comprehensive Plan Designations

Shoreline Segment	Existing Land Use	Approximate Percent Coverage
Segment 1	Low Density Residential Commercial	40 60
Segment 2	Green Belt	100
Segment 3	Commercial	100
Segment 4	Commercial Public and Community Spaces	85 15
Segment 5	High density residential	100
Segment 6	Green Belt	100
Segment 7	Public and Community Spaces	100

2.4 Shoreline Master Plan

For over 100 years the shoreline area of downtown Port Orchard has been developed and modified. Fill of the Bay Street area was actively pursued throughout the 1940s and 1950s (Lee Caldwell pers. comm. 2002). The shoreline has been altered through development of the parking lots, several marinas, businesses, and residential housing. The shoreline of Port Orchard has been built up and retained with large riprap materials. Limited vegetation has been retained through the development of the central business district. This highly compact and dense urban development pattern continues today, and is recognized and encouraged as stated in the goals of the 1992 Shoreline Master Program (City of Port Orchard 1992b).

The shoreline environment in the City of Port Orchard has been delineated into eight shoreline designations. The downtown area was divided into upland and marine environments, which represent areas landward and waterward of the Ordinary High Water Mark (OHWM) respectfully. Six of the eight environment designations address upland areas (Natural, Conservancy, Rural, Urban, Urban Maritime, and Downtown Upland). The remaining two of the eight environment designations consist of the Aquatic and Downtown Marine environments, both of which are located waterward of OHWM (City of Port Orchard 1992b). Table 4 describes the comprehensive plan designations of the shoreline divided by segment.

Table 4. City of Port Orchard Shoreline Segments by Shoreline Designations

Shoreline Segment	Comprehensive Plan Designation	Approximate Percent Coverage
Segment 1	Urban Maritime	100
Segment 2	Conservancy Rural	75 25
Segment 3	Downtown Urban Maritime	50 50
Segment 4	Urban	100
Segment 5	Urban	100
Segment 6	Conservancy Rural	50 50
Segment 7	Natural	100

2.5 Zoning Designation

The City of Port Orchard's zoning designations generally follow land use designations from the city's comprehensive plan, discussed above. Ten land use designations have been provided for in the City of Port Orchard Zoning Map, adopted December 28, 1998, to moderate development within the urban growth area in an attempt to balance the city's needs. The following designations are outlined below as they are found within the shoreline segments:

- GB-Greenbelt Including Conservation and Open Space: Public spaces, public and private schools, churches, hospitals, parks, outdoor recreation use, government and cultural or educational institutions.
- RMH – Residential Mobile Home Park
- Residential (R 4.5): 4.5 units / net useable acre.
- Residential (R 8): 8.0 units / net useable acre.
- Residential (R 12): 12.0 units / net useable acre
- Residential (R 20): 20.0 units / net useable acre.
- CO - Commercial – Retail and Office: Economic centers of the city providing retail, professional office facilities, tourist, and related services.
- MXD - Mixed Use District:
- EO - Employment – Industrial / Office: Commercial storage, shipping and processing operations, appliance storage and repair, bulk goods storage, upholstery and furniture refinishing shops, laboratories, wholesale and warehousing, light manufacturing, contractor storage and fabricating yards
- CF – Community Facilities:

Overall, Commercial – Retail and Office land occupies the largest area in the City, followed by low-density residential (R4.5) designations. Table 5 documents zoning coverage by shoreline segment as well as by total regulated shoreline area.

Table 5. City of Port Orchard Shoreline Segments by Zoning Designation

Shoreline Segment	Zoning	Percent Coverage
Segment 1	Employment – Industrial / Office Commercial – Retail and Office Residential (R 4.5)	30 50 20
Segment 2	Commercial – Retail and Office Residential (R 4.5) Greenbelt Including Conservation and Open Space	30 60 10
Segment 3	Employment – Industrial / Office Commercial – Retail and Office Mixed Use District	5 65 30
Segment 4	Commercial – Retail and Office Residential (R 8) Greenbelt Including Conservation and Open Space	60 30 10
Segment 5	Residential (R 8)	100
Segment 6	Greenbelt Including Conservation and Open Space	100
Segment 7	Greenbelt Including Conservation and Open Space	100

*Interpretation from City of Port Orchard Zoning Map, December 28,1998.

2.6 Parks and Open Space

Existing open space within City shorelines includes both public and private utilities and facilities. Among the many goals and objectives of the City of Port Orchard, the Comprehensive Park Plan goal focuses on developing and maintaining adequate and convenient parks, recreation and open space areas and facilities (City of Port Orchard 1988). The waterfront goal is more specific in its directive to preserve and protect the waterfront to public use. To that end, in viewing Figure 5, it is clear that much of the shoreline of Port Orchard is available for public use through a variety of public unimproved to improved parks and open spaces. It should be noted that access to the shoreline is not necessarily publicly owned. For example,

- The majority of Ross Point is unimproved shoreline access area paralleling Hwy 160 for roughly a mile (Segment 2).
- A public dock by Twetens Restaurant is open for wildlife viewing and fishing (Segment 3).
- Port Orchard has one municipal boat ramp to allow public access to Sinclair Inlet (Segment 3). A small public park with restrooms is associated with the boat ramp.
- A downtown waterfront park is located along Bay Street, north of the business district and includes an old-fashioned boardwalk, a covered lighted outdoor stage and seating area, and some picnic tables (Segments 3 and 4). This park is maintained by the Port of Bremerton and is a popular spot for locals and visitors alike due to its proximity to the library and foot ferry (City of Port Orchard, 1995).
- Segment 5, along Bay Street North includes unimproved shoreline access and the public fishing dock at Annapolis.
- Segments 6 and 7 are Open Space associated with Ross and Blackjack Creeks respectively.

2.7 Impervious Surfaces

The shoreline area (within 200 feet of Sinclair Inlet) of City of Port Orchard contains a large amount of impervious surfaces as observed on the air photos provided by the City. Estimates and calculations of the impervious area was not part of this scope of work. The City has already digitally compiled some of this data with the remainder scheduled for completion as part of another City program later this year (Personal communication with Rob Wenman – City of Port Orchard 2002).

In general, impervious surfaces such as roads, rooftops and parking lots cause more rain to run off at rates above pre-developed conditions and less water seeps into the soil (Leedy and Adams 1984). Stormwater is a major force behind soil erosion in urban and developed areas.

Currently, existing impervious surfaces along portions of Bay Street are not treated for stormwater runoff and flow directly into Sinclair Inlet. However, improvements are being made, for example, a crosswalk improvement project is underway at the corner of

Frederick Avenue and Bay Street. Associated improvements with this project include treatment of stormwater from new and existing impervious surfaces prior to discharge into Sinclair Inlet.

2.8 Filled Areas

The shoreline of the City of Port Orchard received fill in two phases beginning in 1946. This stage of fill proceeded west to east starting approximately at the current location of Kitsap Bank on Frederick Street. Phase 2 began in the early 1950s and resulted in the present shoreline. Figure 6 illustrates filled areas of Port Orchard estimated from aerial photographs and map interpretation. Filled areas are identified by the presence of bulkheads, revetments, piers, seawalls and other hard shoreline retention structures. Very little of the Port Orchard shoreline is natural and not hardened. The largest fill areas are associated with commercial developments along the shoreline (buildings and marinas). Topography of the Port Orchard shoreline is relatively steep and comparison of today's shoreline configuration with historical maps indicates that the amount of fill extension into the aquatic environment is much less than that commonly experienced in other Puget Sound communities.

2.9 Roads and Bridges

Port Orchard's shoreline zone contains numerous roads, (Figure 1). The major roadways in the shoreline area are State Highway 166 and Bay Street and the major arterials (Bethel Road SE, Port Orchard Boulevard, Mitchell Road, for example) that intersect with them. Bay Street is a two-lane, high volume road, serving the central business district along the south shore of Sinclair Inlet (City of Port Orchard 1995). In a 1982 traffic study, Bay Street experienced 25,000 vehicles daily (Hayes et al 1992).

2.10 Bulkheads, Levees, and Dikes

GIS maps, aerial photographs and fieldwork showed that the Port Orchard shoreline has a 61-100 percent modification (Figure 6). Table 6 illustrates the amount of modification done in each segment.

Table 6. Current City of Port Orchard Shoreline Modifications

Shoreline Segment	Percent of Shoreline with Modifications
Segment 1	61-80% and 81-90%
Segment 2	61-90%
Segment 3	91-100%
Segment 4	81-90%
Segment 5	91-100%
Segment 6	N/A
Segment 7	N/A

2.11 Docks, Piers, and Overwater Structures

Within the City of Port Orchard study area limits, there are numerous docks, piers and overwater structures. Docks are fixed structures floating upon water bodies. Piers are fixed, pile-supported structures. Floats are floating structures that are moored, anchored, or otherwise secured in the water and are not connected to the shoreline. Docks, piers, and floats that serve more than six residences or have more than six boats regularly moored are considered marinas (City of Port Orchard 1992b).

Figure 5 contains a visual illustration of the docks, piers and overwater structures. City of Port Orchard personnel identified eighteen separate overwater structures were counted along the shoreline of Port Orchard.

2.12 Stormwater and Sewer Outfalls

The City of Port Orchard has many stormwater outfalls that discharge directly into Sinclair Inlet.

> "In a study conducted by the Bremerton Kitsap County Health Department in 1988, urban stormwater was determined to be the single largest source of fecal coliform loading in three Kitsap County Watersheds. Among these three watersheds, Sinclair Inlet Watershed was found to have the highest loadings of fecal coliform." – from Sinclair Inlet Watershed Characterization. Joanne M. Hayes, for the Kitsap County Department of Community Development, 1992

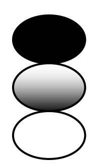
One sewage treatment plant is located along the shoreline, north of segment 5 and outside the study area, in what is commonly referred to as Annapolis.

3.0 Biological Resources And Critical Areas

<u>The Importance of Marine Nearshore Habitat</u>
The State of Washington has nearly 2,300 miles of marine shoreline and contains 800,000 acres of nearshore marine habitat (Salmon Review Funding Board (SRFB 2000). These environments support hundreds of marine species including estuarine plants, fish and wildlife. Many fish and wildlife species depend on marine nearshore habitats for at least a portion of their life cycles. Marine nearshore species that are both used by and dependent upon salmon, such as forage fish and eagles, require functioning marine nearshore environments to feed and reproduce. Salmon utilize the entire marine nearshore fringe at various points in their life cycles. As juveniles, they require functional subestuaries within the marine nearshore habitat to undergo the transition from fresh to salt water. Furthermore, juvenile salmon require these and other nearshore habitats for rearing and feeding. Juvenile and adult salmon utilizing nearshore areas prey upon other species that are dependent on these habitats (such as sand lance, herring, and surf smelt) and are also preyed upon by certain species (e.g. Great Blue Heron, Bald Eagle, etc.). Salmon also require shallow water along marine shorelines for successful migration to and from spawning streams. Marine nearshore sediment and water quality conditions can be important factors to salmon survival (WCC 2000). Chum and Chinook salmon, which were listed for Puget Sound under the ESA, are the most estuarine-dependent of the Pacific salmon species, while coho and sea-run cutthroat trout also forage and rear in a variety of marine nearshore habitats. Decaying salmon carcasses also provide a significant component of the nutrient cycle in most marine nearshore habitats (SRFB 2000).

The following table (Table 7) illustrates species expected to be present in or near the City of Port Orchard. This list is in no way all-inclusive. There may be species not listed in this table that have the same habitat characteristics and/or habitat use, but were not found in the literature search. For each species listed in this table the scientific name, life cycle and habitat use during that cycle, and a measurement of the species' sensitivity to the nearshore environment are presented. The species' sensitivity to the nearshore environment is ranked using the following scale:

high sensitivity -
moderate sensitivity -
low sensitivity -



Through understanding when in the species' lifecycle it makes use of the nearshore habitat and why/how they use this habitat, we can further understand how sensitive the species is to changes in the nearshore environment.

Table 7. Species List and Associated Sensitivity in the Nearshore.

Species Common Name	Scientific Name	**Life Stages/Habitat Use**	**Sensitivity in the Nearshore**
	Raptors		
Bald Eagle	*Haliaeetus leucocephalus*	Adult, Juvenile/Foraging, Nesting	●
Peregrine Falcon	*Falco peregrinus*	Adult, Juvenile/Foraging, Nesting	○
Waterfowl			
Black Brandt	*Branta bernicla*	Adult, Juvenile/Foraging, Nesting	●
Bufflehead	*Bucephala albeola*	Adult, Juvenile/Foraging, Nesting	●
Canada Goose	*Branta canadensis*	Adult, Juvenile/Foraging, Nesting	●
Common Loon	*Gavia immer*	Adult, Juvenile/Foraging, Nesting	●
Cormorants	*Phalacrocorax sp.*	Adult, Juvenile/Foraging, Nesting	●
Goldeneyes	*Bucephala sp.*	Adult, Juvenile/Foraging, Nesting	●
Great Blue Heron	*Ardea herodias*	Adult, Juvenile/Foraging, Nesting	●
Greater Scaup	*Aythya marila*	Adult, Juvenile/Foraging, Nesting	●
Western Grebe	*Aechmophorus occidentalis*	Adult, Juvenile/Foraging, Nesting	●
Common Merganser	*Mergus merganser*	Adult, Juvenile/Foraging, Nesting	●
Scoters	*Melanitta sp.*	Adult, Juvenile/Foraging, Nesting	●
Spotted Sandpiper	*Actitus macularia*	Adult, Juvenile/Foraging, Nesting	●
Marbled Murrelet	*Brachyramphus marmoratus*	Adult, Juvenile/Foraging, Nesting	●
Gulls			
California Gull	*Larus californicus*	Adult, Juvenile/Foraging, Nesting	●
Western Gull	*Larus occidentalis*	Adult, Juvenile/Foraging, Nesting	●

Forage Fish			○
Anchovy	*Engraulis mordax*	Adult/Spawning	●
Pacific Herring	*Clupea pallasii*	Adult/Spawning Juvenile/Foraging	●
Pacific Sand Lance	*Ammodytes hexapterus*	Adult/Spawning Juvenile/Foraging	●
Surf Smelt	*Hypomesus pretiosus*	Adult/Spawning Juvenile/Foraging	
Rockfish			○
Brown Rockfish	*Sebastes auriculatus*	Juvenile/Shelter, Foraging	○
Copper Rockfish	*Seabstes caurinus*	Juvenile/Shelter, Foraging	○
Quillback Rockfish	*Sebastes maliger*	Juvenile/Shelter, Foraging	
Salmonids			●
Bull Trout	*Salvelinus confluentus*	Adult, Juvenile/Migration, Foraging	●
Chum Salmon	*Oncorhynchus keta*	Adult/Return Migration Juvenile/Migration	●
Coho Salmon	*Oncorhunchus kisutch*	Adult/Return Migration Juvenile/Migration	●
Cutthroat Trout	*Salmo clarkii*	Adult, Juvenile/Migration, Foraging	●
Puget Sound Chinook Salmon	*Oncorhyncus tshawytscha*	Adult/Return Migration Juvenile/Migration	○
Steelhead	*Salmo gairdnerii*	Adult, Juvenile/Migration, Foraging	
Groundfish			●
English Sole	*Parophrys vetulus*	Juvenile/Shelter, Foraging	○
Lingcod	*Ophiodon elongates*	Adult, Juvenile/Shelter, Foraging	●
Pacific Cod	*Gadus macrocephalus*	Adult, Juvenile/Shelter, Foraging	○
Pacific Hake	*Merluccius productus*	Adult, Juvenile/Shelter, Foraging	●
Rock Sole	*Lepidopsetta bilineata*	Adult, Juvenile/Shelter, Foraging	○
Walleye Pollock	*Theragra chalcogramma*	Adult, Juvenile/Shelter, Foraging	

Shellfish			
Butter Clam	*Saxidomus gigantea*	Adult, Juvenile/Shelter, Feeding	
Cockles	*Clinocardium nutalli*	Adult, Juvenile/Shelter, Feeding	
Geoducks	*Panopea generosa*	Adult, Juvenile/Shelter, Feeding	
Horse Clam	*Tresus sp.*	Adult, Juvenile/Shelter, Feeding	
Macomas Clam	*Macoma sp.*	Adult, Juvenile/Shelter, Feeding	
Manilla Clam	*Tapes philippinarum*	Adult, Juvenile/Shelter, Feeding	
Native Littleneck Clam	*Protothaca staminea*	Adult, Juvenile/Shelter, Feeding	
Mammals			
California Sea Lion	*Zalophus californianus*	Adult, Juvenile/Foraging, Resting	
Harbor Seal	*Phoca vitulina*	Adult, Juvenile/Shelter, Feeding	
Other Invertebrates			
Common Goose Barnacle	*Lepas anatifera*	Adult, Juvenile/Foraging	
Blue Mussels	*Mytilus edulis*	Adult, Juvenile/Foraging	
Chiton	*Tonicella lineata*	Adult, Juvenile/Foraging	
Crab species	*Cancer sp.*	Adult, Juvenile/Foraging	
Limpet	*Collisella pelta*	Adult, Juvenile/Foraging	
Sea Urchin	*Strongylocentrotus purpuratus*	Adult, Juvenile/Foraging	
Sea Star	*Pisaster sp.*	Adult, Juvenile/Foraging	

3.1 Nearshore Resources

3.1.1 Sinclair Inlet

The Sinclair Inlet nearshore area supports native salmonids, both adults and juveniles, as well as Puget Sound baitfish and other important marine species. The primary salmon run in Sinclair Inlet is from the Gorst Creek Chinook salmon hatchery. This program is operated by the Suquamish Indian Tribe in cooperation with the Washington State Department of Fish & Wildlife (WCC 2000). Sinclair Inlet has been designated as a nearshore refugia that includes portions of the north and south shorelines. The refugia provides migration, foraging, and rearing habitat for multiple salmonid species and other marine wildlife. This designated nearshore refugia also includes the Ross and Blackjack Creek estuaries, which are contained within the shoreline study segments. This shoreline is moderately to significantly impacted by development with very small patches of relatively natural nearshore habitat remaining in and immediately adjacent to the creek systems. The Puget Sound Naval Shipyard (PSNS) area has had a negative impact on the nearshore habitat in Sinclair Inlet. Marine sediments are contaminated (WCC 2000), periodic dredging occurs to support the shipyard activities, and stormwater runoff from ship decks and the industrial shipyard facility is significant. In addition to PSNS, several existing areas of development in the Bremerton, Gorst, and Port Orchard areas have existing and substantial stormwater runoff that pose potential water quality impacts to the nearshore area (May 2001).

3.1.2 Substrate Conditions

The majority of the substrate along the Port Orchard shoreline consists of fine sediments in front of the various types of bulkheads, revetments and seawalls (see Figure 7). Several stretches of native cobble/pebble sediments are present, notably along the north shore of Ross Point and just west of Retsil Point, and provide suitable spawning habitat for surf smelt and sandlance. The Ross Point area is a popular sport dip-net fishery for surf smelt. Even these areas of "native" substrate lie in front of road revetments and bulkheads.

Shorelines along Port Orchard also have active feeder bluffs. Feeder bluffs are areas of natural erosion and sedimentation that provide critical spawning substrate for many species. Alteration of bluffs such as grading or vegetation removal that have historically provided substrate and large woody debris to nearby beaches and sand bars has resulted in loss of important marine nearshore habitat. Shoreline armoring in particular, such as bulkheads and other shoreline structures, can have a dramatic effect on these processes, accelerating erosion of beaches by altering sediment flow patterns and preventing beach renourishment. This causes a sediment deficit on shorelines that destroys production of intertidal spawning and rearing habitat (SRFB 2000).

3.1.3 Marine/Nearshore Vegetation

Marine shoreline riparian vegetation (Figure 8) provides similar functions to those in the freshwater environment: bank stability, shade, detrital/nutrient input, and contribution of large woody debris (LWD) to the marine shoreline. The shading from shoreline riparian vegetation to marine waters is limited to higher tidal elevations. The importance of functional marine shoreline riparian zones has received less attention, and perhaps is less understood, than their freshwater counterpart. To date, shoreline managers have focused on human development of shorelines due to the highly desirable commercial and residential location.

Until recently, the State of Washington had not completed sufficient research on forage fishes to document the actual spawning habitats and their relationships to marine riparian vegetation (Pentilla 2000). Riparian vegetation and LWD are important at all sites because of their role in providing shoreline stability and providing detrital/nutrient input that supports the nearshore food web (Williams et al. 2001). Shoreline riparian vegetation is particularly important on shorelines known to support surf smelt and sandlance spawning, where overhanging riparian vegetation shading the upper beach reduces desiccation of eggs that have been spawned at upper tidal elevations (Pentilla 2000). It is important to note that in addition to retaining riparian buffers along the upper tidal elevation, it is also important to retain riparian buffers on feeder banks and at the top of feeder bluffs, as they provide the sources of LWD recruitment to the beaches below. LWD is a critical element of many shorelines. Beach berms and back berms are formed by LWD accumulations. Often, LWD accumulations promote wetland stability and formation along the upland portion of the shoreline and increase the habitat complexity of the entire shoreline zone.

3.1.4 Intertidal Algae

A key nearshore habitat concern is the loss of eelgrass (*Zostera marina*) habitat in the intertidal/shallow subtidal area. Eelgrass provides valuable habitat for a variety of marine species, including very productive rearing habitat for juvenile salmonids, crabs, shrimp, and spawning habitat for herring to note a few. These habitats are directly impacted by physical alterations, such as nearshore fill or dredging. In addition they are adversely affected by overwater shading from piers, docks, floats, marinas, netpens, moored vessels, log rafts, boathouses, etc. The 6 marinas (Goodwin and Farrell 1991), in addition to associated docks, piers, access ramps and moored boats, that result in overwater shading, potentially impair the growth of aquatic vegetation. Overwater shading is different that riparian shade. Overwater shading can pose a complete shift in the solar light penetration into the nearshore along the productive zone well beyond the upper intertidal. Full shade (as opposed to partial riparian shade as the sun traverses the sky) starves vegetation and phytoplankton from solar exposure and limits growth and therefore productivity in the shaded area (Army Corps of Engineers 2000). The disruption of natural shoreline sediment processes due to shoreline armoring, has likely resulted in a loss of potential eelgrass habitat. Remaining eelgrass meadows also appear to be at risk of eutrophication and elimination due shifting substrate composition from sandy gravel to gravel and cobble that leads to the increasing presence of ulvoid mats (*Ulva spp*.) and *Sargassum spp.* Currently, no eelgrass beds were found by AES scientists during the three day site investigation.

UIva (spp) are an opportunistic green macroalgae (Figure 9) that form dense mats which reduce light and oxygen, creating an anoxic environment (Shaffer and Burge 1999). Ulvoid blooms, promoted by nutrient loading (commonly associated with human freshwater inputs such as septic leachate and stormwater), appear to have a negative impact on nearshore invertebrate and fish communities, as well as other vegetated habitats such as eelgrass beds (Shaffer and Burge 1999). Ulvoid mats may affect habitat conditions by changing the physical hydrography of the intertidal area. Physical changes may include a decrease in water flow, increased sedimentation, and a decrease in tidal flushing. Ulvoid mats may also prevent access to benthic prey organisms by creating a barrier over the substrate, and may result in mortality of benthic organisms and shellfish by smothering and creating low oxygen/anoxic conditions (Shaffer and Burge 1999).

3.1.5 Baitfish

Juvenile salmonids and baitfish (Figure 10) use of nearshore and subtidal marine habitats of East WRIA 15 is presumed to be everywhere the elevation and substrate are suitable (Fresh et al 1981). Baitfish, upon which chinook and coho salmon prey, are particularly susceptible to impacts of shoreline armoring.

Surf smelt and sand lance spawn at higher intertidal elevations. Surf smelt spawn high in the intertidal zone from +7 ft mean lower low water (MLLW) to extreme high-high water (EHHW) in fine grained substrate. Sand lance form localized schools that are usually associated with clean sandy bottoms in the intertidal elevations from +5 feet MLLW to mean high-high water (MHHW) (Canning and Shipman 1995, as referenced in the Washington Conservation Commission 2000). These two critically important forage fish are particularly susceptible to permanent habitat loss if beach slope, freshwater inputs, and substrate characteristics change because of human actions. Surf smelt and sand lance spawning was documented on the Sinclair Inlet shoreline north of Gorst Creek in work done in 1936, but this spawning area has been totally lost due to the railroad fill, which has eliminated the natural intertidal shoreline (Pentilla 2000). Similar spawning losses have occurred elsewhere where shoreline armoring has extended into the intertidal area enough to eliminate the mid- and upper-portions of the natural intertidal zone.

3.1.6 Shoreline Modifications

Shoreline modifications (Figure 6) to the nearshore include activities such as paving of roads and parking lots; construction of bulkheads; over-water structures such as docks and piers; and the removal of nearshore vegetation (SRFB 2000). In general, compared with historical Port Orchard conditions, there is very little intact “native” marine nearshore habitat remaining. Along Bay Street, development has encroached to the water’s edge with little to no remaining riparian vegetation on the shoreline or woody debris on the beach (WCC 2000). Alteration through clearing, dredging, filling, diking, straightening, and armoring have been the major factors eliminating or degrading marine nearshore habitats. Bay Street, which parallels the shoreline of Port Orchard, is almost completely armored to protect the roadway (WCC 2000). Additionally, the construction of marinas and other over-water structures have drastically changed the physical appearance of the shoreline and affect primary productivity dependent upon solar light penetration.

Most of the activities described above have a direct negative impact on critical habitat and the species that live in that habitat. For example, over-water structures can harbor predators of salmon, such as seals. Derelict fishing gear such as ghost nets can tangle and possibly kill migrating salmon (and other fish and wildlife) in the marine nearshore (SRFB 2000).

3.2 Creek Systems

Streams within this region (Figure 4) originate in the lowland hills of the Kitsap Peninsula and empty into several large inlets within western Puget Sound. Although this region contains no major river systems, many of these streams historically supported substantial salmon runs (Williams et al. 1975). Currently, several stream systems contribute significantly to the salmon production of this region even though nearly all watersheds on the eastern Peninsula have been impacted by some degree of land use (WCC 2000). This region is not affected by high-elevation snow melting events because it is located within the rainshadow of the Olympic Mountains, and low flows often limit salmon production within this region (Williams et al. 1975).

The National Marine Fisheries Service (NMFS 1996) has identified six significant environmental "pathways," or factors that are important for the survival of anadromous salmonids regarding stream systems. These pathways include water quality, habitat access, habitat elements, channel conditions, flow/hydrology, and watershed conditions. These pathways are further broken down into "indicators." Indicators are generally of two types; (1) standards of measurement that have associated numeric values (e.g., six pools per mile); and (2) descriptive indicators (e.g. adequate habitat). The purpose of having both types of indicators is that numeric data are not always readily available, in those cases, a description of overall condition may be the only method available to evaluate salmonid habitat.

3.2.1 Blackjack Creek

Blackjack Creek, classified a Type 1 stream (Type F under new rules), is 6.9 miles long flowing in a northerly direction mostly parallel to Bethel Road and Highway 16. There are over 17 miles of mainstem and tributaries with the Blackjack watershed with two dominant tributaries: Ruby Creek and Square Creek. The drainage area to Blackjack Creek is approximately 12.3 square miles (PSCRBT 1990). The primary land uses adjacent to the creeks are private woodlots (38%), grassland/pasture (23%), forested urban (15%), and commercial timber (11%) (PSCRBT 1990). Much of the upper portion of the creek lies in a broad valley where gradient is shallow. Below this, the lower 2.5 miles of stream has moderate gradient as it flows into a steep wooded ravine dividing the City of Port Orchard. (Williams et al. 1975, FishPro 1987). The lower portion of Blackjack Creek is primarily a chum spawning reach, with a limited Chinook use also reported (PSCRBT, 1990). The Chinook are believed to be hatchery and/or wild strays (Frissell et al. 1999). The estuarine portion of Blackjack Creek has been highly altered by significant fill (several acres) of historic estuary for shopping mall and auto dealership construction. Both banks of the estuary are also highly armored (WCC 2000).

The Blackjack Creek watershed is known to support coho, chum, and cutthroat (Sinclair Inlet Watershed Management Committee 1994) making it one of the major fish producing streams in East Kitsap County. There is also limited use by steelhead and chinook reported in the creek. WDFW also recognizes Blackjack Creek as supporting a unique, "regionally distinct" stock of summer chum salmon. Other streams in this region only support populations of chum and coho. Steelhead stocks for East Kitsap are recognized within SASSI as a native stock of "unknown" status (WDF et al. 1993). Blackjack Creek is the only creek in the area that has deliberately not been planted annually with coho fry. The Suquamish Tribe had a chum egg box program for several years (ended in ~1990) on Ruby Creek, using Gorst Creek chum stock (WCC 2000).

3.2.2 Ross Creek

Ross Creek is an independent drainage originating south of the SR 16/Tremont interchange in a large wetland system, flowing 1.5 miles to Sinclair Inlet just east of Ross Point. In addition, a small intermittent tributary enters the left bank at RM 0.5, originating approximately 2.5 miles to the southwest near North Lake (USGS 1981,). The majority of the creek corridors in the Ross Creek watershed are forested (46% woodlots, 26% urban forested, 15% commercial forestland)(PSCRBT 1990). The drainage supports chum, coho, steelhead, and cutthroat. Chum spawning escapements from 1981-1991 averaged 722 adults (City of Port Orchard 1992)

3.3 Priority Habitats And Species

The Washington State Department of Fish and Wildlife (WDFW) was contacted to obtain a listing of the Priority Habitats and Species (PHS) program to inventory potential state or federally proposed, threatened, or endangered species as well as other "priority" species of state concern. The United States Fish and Wildlife Service have indicated both wintering and breeding bald eagles *(Haliaeetus leucocephalus)* in the area, and bull trout *(Salvelinus confluetus)* may be present in the vicinity as well. WDFW biologists however do not believe that there are bull trout found in Kitsap County (per. comm. from Kalinowski 2000). WDFW considers all anadromous fish species and their critical habitats as a priority management focus (WDF 1991).

3.3.1 Salmonid Fishes

Table 8 lists those fish species found within Blackjack and Ross Creeks within the limits of the City of Port Orchard.

Table 8. Salmonid Fish Species found within Blackjack and Ross Creeks

Species		Stream name
Fall chinook	*Oncorhynchus tshawytscha*	Blackjack Creek
Chum Salmon	*Oncorhynchus keta*	Blackjack Creek
Coho Salmon	*Oncorhynchus kisutch*	Blackjack Creek
Searun Cutthroat	*Oncorhynchus clarki clarki*	Blackjack Creek
Winter steelhead	*Oncorhynchus mykiss*	Blackjack Creek
Resident Cutthroat	*Oncorhynchus clarki clarki*	Blackjack Creek
Chum Salmon	*Oncorhynchus keta*	Ross Creek
Coho Salmon	*Oncorhynchus kisutch*	Ross Creek
Resident Cutthroat	*Oncorhynchus clarki clarki*	Ross Creek

Although coho (Weitkamp 1995 as referenced in Frissell et. al. 1999) and chum (Johnson et al. 1997 as referenced in Frissell et. al. 1999) populations have been assumed to be relatively genetically homogenous due to natural straying and hatchery introductions throughout the East Kitsap region, some evidence suggests that unique evolutionary stocks may persist within this region. Genetic analysis by Phelps et al. (Frissell et al. 1999) recognized regionally distinct summer and fall chum populations for Blackjack Creek (draining into Sinclair Inlet near the city of Port Orchard). Although SASSI listed

Blackjack Creek's summer chum as a "native, wild, healthy" stock (WDF et al. 1993), it did not recognize the fall chum populations distinguished by Phelps (Frissell et al. 1999) at this scale. Instead, SASSI identified fall chum within the Sinclair Inlet and categorized this population as "native, wild, and healthy" (WDF et al. 1993).

3.3.2 Other Threatened and Endangered Species
WDFW has indicated the presence of breeding bald eagles *(Haliaeetus leucocephalus)*, osprey *(Pandion haliaetus*) and purple martin (*Progne subis*) in the watershed area (Sinclair Inlet Watershed Action Plan 1994, WDFW 2002). WDFW has listed these species as "special animal species" in that they require special habitat. The United States Fish and Wildlife Service indicated the presence of bull trout *(Salvelinus confluetus)* in the area, but specific information on bull trout does not exist on the WDFW Priority Habitat and Species maps.

3.4 Geologically Hazardous Areas

City of Port Orchard defines geologically hazardous areas in their critical areas regulations (City of Port Orchard 1999), as those areas with slopes greater than 30 percent (City of Port Orchard 1999). For this inventory, steep slope information was provided by Kitsap County.

A number of steep slopes are found within Port Orchard: Ross Point, Ross Creek, and the Blackjack Creek ravine are the most prominent steep locations. Figure 11 illustrates these areas. It is understood at both the City and County level that there are still some transposition issues associated with this GIS layer as displayed on Figure 11.

3.5 Wetlands

Wetland information for this project was derived from a number of sources: Kitsap County GIS, City of Port Orchard Critical Areas Map (2000), City of Port Orchard Wetlands Inventory (City of Port Orchard 1990), the National Wetlands Inventory (USFWS 1987) and by direct field observation. Wetland areas within the nearshore study area of Port Orchard are classified as estuarine subtidal and estuarine intertidal shoreline of Sinclair Inlet or wetlands associated with both Blackjack and Ross Creeks.

Figure 12 illustrates the wetland conditions associated with the nearshore area of the City of Port Orchard.

4.0 Ecological Functions And Conditions By Inventory Segment

A discussion of baseline inventory conditions for each of the seven inventory segments in Port Orchard is provided in the following pages. Each segment discussion identifies where baseline conditions appear to be functioning or where they have been altered to the point that they are limiting or threatening species survival and recovery.

Current land use, comprehensive land use and shoreline master plan designations and zoning are already addressed by segment in Chapter 2. This chapter will focus on critical resources and field inventory results for each segment. Other parameters, such as percentage of vegetative cover, substrate type, presence of large woody debris, and overwater structures are discussed. Opportunity areas (areas available for preservation, enhancement or restoration) will be identified for each segment in Chapter 5.

4.1 General Discussion of Ecological Functions And Conditions

A point of reference to begin to analyze the shoreline of Port Orchard is to provide an expanded definition of ecologically intact shorelines. Further information from WAC 173 (and others) define ecologically intact shorelines as:

> "those shoreline areas that retain the majority of their natural shoreline functions, as evidenced by the shoreline configuration and the presence of native vegetation. Generally, but not necessarily, ecologically intact shorelines are free of structural shoreline modifications, structures, and intensive human uses. In unmanaged forested areas, they generally include native vegetation with diverse plant communities, multiple canopy layers, and the presence of large woody debris available for recruitment to adjacent water bodies."

Sites that deviate from this ideal of an ecologically intact shoreline lose some of the functions that are important or critical to aquatic species. The magnitude of shoreline losses and their effect on species are being studied and quantified by others, with currently no resolution as to how much is too much and what are the threshold levels for ecosystems or species (NMFS 2001). It is known that there is a continuum of ecological conditions ranging from near natural conditions to totally degraded and contaminated sites and that individual species and stocks respond differently to the set of conditions to which they are presented. For the analysis of the Port Orchard nearshore, the ideal conditions have been separated to quantify the deviations from the ideal situation within each shoreline segment. Deviations from "natural" shorelines per segment will be summed and divided into a ranked (high, medium and low) category. For this shoreline inventory, high functional scores correlate to a low deviation from natural conditions.

Each shoreline segment has its functions but to compare them to a pristine ecologically intact shoreline condition will skew most urban/rural sites to the medium to low end of the scale. A more practical way to look at this issue would be to acknowledge that all urban areas can be improved toward a more ecologically intact condition, but to prepare a range of values, given the current conditions of Port Orchard. For example, in terms of the assessed parameters, the area just south of Ross Point may turn out to be the most 'pristine' or most likely functioning of all conditions around Port Orchard. Whereas the downtown waterfront may turn out to be the most at risk or non-functioning segment based on specific and identifiable reasons.

With a realistic scale as described here, segments can be described in terms of a scale of overall ecosystem function. Numerical values ranging from 1 to 10 (1 is low, 10 is high) have been placed on several critical shoreline condition parameters throughout this nearshore assessment process. Numerical assessments were derived from fieldwork, video interpretation of the shoreline and from aerial photography. This numerical value is then multiplied by the percentage of the segment that contains that assessment parameter. Table 9 describes this ranking. These rankings do not cover all possibilities, professional judgment also applies as necessary. Rankings for Blackjack and Ross Creeks follow a similar format as the criteria outlined below. Rankings for creek specific, i.e. water quality, estuarine, etc., categories were determined following review of the literature available on these areas.

Table 9. Matrix of Ecological Parameters for Port Orchard Nearshore Assessment of Segments 1-5

Assessment Criteria	Assessment Characteristics and Values
Shoreline modification	Vertical abutment below OHWM – 1 Sloped (riprap) stabilization below OHWM – 3 Vertical abutment at OHWM – 5 Sloped (riprap) stabilization at OHWM – 7 Soft bank protection at OHWM – 9 Natural, unmodified condition - 10
Substrate Characteristics (upper intertidal)	Riprap – 1 Cobble - 3 Mixed sand and cobble -5 Sand - 8 Gravels (surf smelt spawning size) - 10
Sediment Input	None – 1 Creek mouth or depositional area – 5 Feeder bluff area – 5 Both creek mouth or depositional area and feeder bluff area –10
Overwater Structures (includes marinas, docks, piers, vessels, etc.)	100 percent covered (out 100 feet from shore) – 1 50 percent covered – 5 No overwater structures - 10
Upslope Modification/Structures	Commercial / Industrial – 1 High Density Residential – 3 Low Density Residential – 6 Roads w/ vegetated shoulders - 7 Natural for 50 foot depth – 8 Natural for 100 foot depth – 10

Riparian Condition	No vegetation –1 Grass or shrub layer 25 feet or less – 2 Grass or shrub layer 25 feet or more – 4 Mixed shrub /forested layer 25- 100 feet - 6 Forested canopy layer 100 feet or less – 8 Forested canopy layer 100 feet or more – 10.

Others (City of Everett 2001) have developed technical assessment criteria that involve multiple pages of assessment parameters. The City of Port Orchard was requested to use or prepare a less rigorous tool for it's shoreline assessment (roundtable discussion with AES, City staff, Ecology and WDFW, 2002).

4.2 Nearshore Conditions per Segment

The following subsections contain the results of the nearshore field assessment for each segment conducted by AES in March 2002. These data were used to derive the numerical evaluation of the shoreline functions. Segments with a low rating for function and process received a score less than 20. Moderate scores were 20 to 30. Highly functioning areas (in the context of Port Orchard) received a score greater than 30. Table 10 provides a brief summary of the functional rating for each segment. Segments 6 and 7, Ross and Blackjack Creeks, were not scored for this inventory because they serve a different function than the other shoreline segments. Comparing riverine function to shoreline function is neither compatible nor practical for the Port Orchard shoreline inventory. A detailed explanation of each segment's function can be found in Tables 11-17.

Table 10: Summary of Individual Shoreline Segments Functional Score

Segment	**Functional Score**	**Deviation from Natural**
1	27.1	Medium
2	38.6	Low
3	14.55	High
4	23.5	Medium
5	27.7	Medium
6- Ross Creek		
7- Blackjack Creek		

4.2.1 Nearshore Features and Conditions – Segment 1

Segment 1 extends from the western edge of the City of Port Orchard to just past Thompson's Marina/Dock Land.

Table 11 Nearshore Features and Conditions – Segment 1

Feature	**Present Y/N**	**Notes**
Shoreline Modification	Yes	Primary material: Rip Rap Percentage of segment: 40% Additional notes: Both Kitsap and Suldans Marina's were built out into beach. The shoreline stabilization in this segment is well maintained and stabilizes primarily the road and commercial development. **Functional Score: 5.4**
Sediment Input	Feeder Bluff	Percentage of segment: 40% **Functional Score: 2**
Substrate Characteristics		Upper intertidal substrate is fines **Functional Score: 7.5**
Overwater structures	Yes	Type: Marina, piers, docks Percentage of segment: 40% **Functional Score: 6.4**
Upslope Modification /Structures	Yes	Roads w/ vegetated shoulders- 60% Commercial- 40% **Functional Score: 4.6**
Riparian Condition	Yes	Type: Invasive Percentage of segment: 30% Effectiveness: **Functional Score: 1.2**
Wetlands	Yes	Type: Estuarine Intertidal Percentage of segment: 100%
Priority Species	Yes	Type: Bald Eagle
Priority Habitats	Yes	Type: Wetlands
Other Habitat Features		
TOTAL SEGMENT FUNCTIONAL SCORE		**27.1**

Segment 1 is impacted primarily through shoreline hardening and the two marinas. It retains a moderate functional score due to the roadside vegetation.

4.2.2 Nearshore Features and Conditions – Segment 2

Segment 2 extends from Thompson's Marina/Dock, around Ross Point to near Wilkins fuel dock.

Table 12 Nearshore Features and Conditions – Segment 2

Feature	Present Y/N	Notes
Shoreline Modification	Yes	Primary material: Rip Rap Percentage of segment: 60% Additional notes: Approximately 30% of the shoreline has vertical concrete bulkheads. The bulkheads are well-maintained and primarily stabilizes Rt. 166 and some commercial development. **Functional Score: 6.7**
Sediment Input	Feeder Bluff Ross Creek Mouth	Percentage of segment: 85% Percentage of Segment: 5% **Functional Score: 4.5**
Substrate Characteristics		Upper intertidal substrate is a mixture of cobble and fines **Functional Score: 7.5**
Overwater structures	Yes	Type: Vessels, Piers, Homes Percentage of segment: <5% **Functional Score: 9.5**
Upslope Modification /Structures	Yes	High Density Residential- 20% Roads w/ vegetated shoulders- 80% **Functional Score: 6.2**
Riparian Condition	Yes	Type: Mixed Deciduous/Coniferous; grass-shrub layer Percentage of segment: 60%; 30% Effectiveness: **Functional Score: 4.2**
Wetlands	Yes	Type: Estuarine Intertidal Percentage of segment: 100%
Priority Species	Yes	Type: Surf Smelt, Sandlance, Bald Eagle
Priority Habitats	Yes	Type: Wetlands
Other Habitat Features	Yes	LWD, small sand spit, fairly wide riparian habitat in places,
TOTAL SEGMENT FUNCTIONAL SCORE		**38.6**

Segment 2 has a high functional score due to a lack of major development along the shoreline. While the shoreline has been hardened, sediment input from feeder bluffs and Ross Creek add larger grains to the intertidal substrate providing spawning habitat for surf smelt and sandlance. Higher percentages of vegetation along the shoreline improve its function.

4.2.3 Nearshore Features and Conditions – Segment 3

Segment 3 extends from west of Wilkins fuel dock to just west of Seattle Street.

Table 13 Nearshore Features and Conditions – Segment 3

Feature	**Present Y/N**	**Notes**
Shoreline Modification	Yes	Primary material: Rip Rap Percentage of segment: 100% Additional notes: The bulkheads are well maintained and stabilize commercial developments and roads. Small areas of wood and concrete bulkheads can be found by the Port Orchard Yacht Club. **Functional Score: 4**
Sediment Input	Feeder Bluff	Percentage of segment: 5% **Functional Score: 0.25**
Substrate Characteristics		Upper intertidal substrate is a mixture of cobbles and fines **Functional Score: 5**
Overwater structures	Yes	Type: Marinas, Piers, Docks Percentage of segment 50% **Functional Score: 3**
Upslope Modification /Structures	Yes	Commercial- 95% Roads w/ vegetated shoulders- 5% **Functional Score: 1.3**
Riparian Condition	No	Type: None Percentage of segment: 100% Effectiveness: 0 **Functional Score: 1**
Wetlands	Yes	Type: Estuarine Intertidal Percentage of segment: 90%
Priority Species	Yes	Type: Surf Smelt, Sandlance, Bald Eagle
Priority Habitats	Yes	Type: Wetlands
Other Habitat Features		A nice, but small upper intertidal marsh is present by Wilkins dock.
TOTAL SEGMENT FUNCTIONAL SCORE		**14.55**

The majority of Segment 3 has been hardened and developed commercially. Several marinas, docks, and piers comprise 50% of the shoreline, reducing the overall function. Additionally, a lack of vegetation and sediment input decrease the functionality of Segment 3.

4.2.4 Nearshore Features and Conditions – Segment 4

Segment 4 extends from just west of Seattle Street to the east end of the parking lot of the West Sound Center.

Table 14 Nearshore Features and Conditions – Segment 4

Feature	Present Y/N	Notes
Shoreline Modification	Yes	Primary material: Rip Rap Percentage of segment: 90% Additional notes: The bulkheads are well-maintained and stabilize primarily commercial developments, Blackjack Creek delta, and roads. **Functional Score: 5.5**
Sediment Input	Feeder Bluff Blackjack Creek Mouth	Percentage of segment: 10% Percentage of Segment: 10% **Functional Score: 1**
Substrate Characteristics		Upper intertidal substrate is fines, with some cobbles **Functional Score: 5**
Overwater structures	No	Type: Percentage of segment: **Functional Score: 10**
Upslope Modification /Structures	Yes	Commercial- 90% Residential High Density- 5% Residential Low Density- 5% **Functional Score: 1**
Riparian Condition	No	Type: None Percentage of segment: 100% Effectiveness: 0 **Functional Score: 1**
Wetlands	Yes	Type: Estuarine Intertidal Percentage of segment: 100%
Priority Species	Yes	Type: Surf Smelt, Sandlance, Bald Eagle
Priority Habitats	Yes	Type: Wetlands
Other Habitat Features	Yes	A small pocket beach is present at the edge of Sections 4 and 5. Some improvement has been done through planting behind the Holiday Inn Express, opportunity for more here too.
TOTAL SEGMENT FUNCTIONAL SCORE		**23.5**

Segment 4 received a moderate functional score primarily because of sediment input from Blackjack Creek. The large degree of commercial development along the shoreline has decreased the amount of vegetation present.

4.2.5 Nearshore Features and Conditions – Segment 5

Segment 5 extends from the east end of the parking lot of the West Sound Center to the east end of the City at Annapolis.

Table 15 Nearshore Features and Conditions – Segment 5

Feature	**Present Y/N**	**Notes**
Shoreline Modification	Yes	Primary material: Rip Rap Percentage of segment: 100% Additional notes: Bulkheads are well-maintained and stabilize primarily residential developments and roads. **Functional Score: 6**
Sediment Input	No	Percentage of segment: 0 **Functional Score: 1**
Substrate Characteristics		Upper intertidal substrate is mixture of cobbles and fines **Functional Score: 5**
Overwater structures	Yes	Type: Docks. Homes, Commercial Structures Percentage of segment: 25% **Functional Score: 8.75**
Upslope Modification /Structures	Yes	Commercial- 20% Residential High Density- 5% Residential Low Density- 15% Roads w/ vegetated shoulders- 60% **Functional Score: 5.45**
Riparian Condition	No	Type: Deciduous trees and shrubs Percentage of segment: 5% Effectiveness: **Functional Score: 1.5**
Wetlands	Yes	Type: Estuarine Intertidal Percentage of segment: 100%
Priority Species	Yes	Type: Surf Smelt, Sandlance, Bald Eagle
Priority Habitats	Yes	Type: Wetlands
Other Habitat Features		Between homes are small pocket beaches.
TOTAL SEGMENT FUNCTIONAL SCORE		**27.7**

Segment 5 has been developed primarily for residential use, making it easier to add in vegetation to improve its functionality. Sediment input is limited, but existing substrate is suitable for surf smelt and sandlance spawning.

4.2.6 Ross Creek Features and Conditions – Segment 6

Segment 6 extends from the mouth of Ross Creek upstream 0.1 river mile.

Table 16 Features and Conditions – Segment 6 - Ross Creek

Feature	Notes
Substrate	The amount of fine silts in the substrate of Ross Creek increases progressively upstream. From the mouth of Ross Creek to approximately RM 0.4, fines in the gravel were estimated to be <20% (City of Port Orchard 1992). Gravels migrating into the creek fill pools and have created a rather homogeneous shallow channel throughout the watershed, which offers very little habitat for resident fish. (WCC 2000).
Riparian Condition	Riparian vegetation in the lower 0.6 mile of Ross Creek is well developed and provides adequate shading and bank stabilization for the creek (WCC, 2000). Riparian vegetation is dominated by trees with a diameter of 12-24 inches. The dominant tree species is red alder, with additional presence of Douglas fir, western red cedar, and western hemlock. A number of windthrown trees were noted on the east wall of the ravine below the development from RM 0.4-0.55.
Estuarine	SR 166 crosses the mouth of the Ross Creek estuary, with the culvert under the road limiting the amount of tidal influence upstream of the culvert. The estuary upstream of SR 166 is in fairly natural condition, with salt marsh habitat, although increasing siltation and channel braiding is occurring as a result of inability to flush the sediments through the undersized culvert under SR 166 (WCC 2000). Some development encroachment has occurred on adjacent uplands to near the water edge.
Priority Species	Bald Eagle, Coho, Chum and Steelhead salmon, searun cutthroat trout
Fish Access	The culvert at the estuary is of insufficient size to pass sediment and maintain saltwater estuarine characteristics upstream of the culvert (WCC 2000).
Water Quality	Water quality samples taken in January 2000 indicate that dissolved oxygen (DO) and creek temperatures are adequate to provide suitable habitat for aquatic life (WCC 2000). They recommend that summer low flows should be monitored for DO and temperature. Fecal coliform measurements indicated elevated levels of fecal coliform present, both in the estuary and upstream, although point sources could not be fully identified (WCC 2000). The Bremerton-Kitsap Health District has been collecting water quality information at four locations in the Ross Creek watershed since 1996. No consistent water quality concerns were identified. However, high fecal coliform counts and dissolved oxygen levels

	<10 mg/l were frequently observed at the station off Cedar Ridge Court (WCC 2000).
Channel Condition	An inventory of natural habitat elements was conducted on the lower 0.6 mile (downstream of SR 16) of Ross Creek (City of Port Orchard 1992). The average channel width of lower Ross Creek is approximately 10 feet. Although percentage of habitat that is pools was not identified, within the 0.6 mile, there were 38 pools (43 pools per mile) and 52 riffles, with 80% of the pools identified as scour pools. Ninety-five percent of all riffles were classified as low gradient riffles. Pools and riffles in the sample area may be too shallow to provide adequate rearing habitat for resident salmonids or salmonids that require a longer amount of freshwater rearing time. The constant influx of gravel to the creek from the slumped hillsides and anthropogenic activities appear to continually fill in pools as they form and create a rather shallow wide run of moderate velocity water. All LWD estimated to be large enough to provide hydraulic control or fish habitat was counted in the sample reach. The expanded LWD estimate was 220 pieces per mile on lower Ross Creek. There was little evidence of bank cutting throughout the watershed.
Floodplain Modifications	Most all of the Ross Creek drainage is located within a deep confined ravine. There are areas where development has encroached to the edge of the ravine, resulting in blowdown of trees in the ravine and increased bank erosion and stormwater flows, but the natural floodplain of Ross Creek is within the ravine and generally intact.
Flow/Hydrology	In the Ross Creek watershed, there are a large number of wetlands in the vicinity of the SR 16/Tremont interchange. These wetlands store water and attenuate high flows (City of Port Orchard 1992). The total natural flow of Ross Creek and tributaries is required for protection and preservation of instream resources. These waters are closed year-round to further consumptive water appropriation (WAC 173-515-040).

The major problem with Ross Creek is the culvert at Rt. 166. Replacement of this culvert will restore fish access, improve sediment and LWD input, thereby restoring functionality of the segment.

4.2.7 Blackjack Creek Features and Conditions – Segment 7

Segment 7 extends from the mouth of Blackjack Creek upstream 0.1 river mile.

Table 17 Nearshore Features and Conditions – Segment 7

Feature	**Notes**
Substrate	The Puget Sound River Basin Team indicates there is currently a lot of gravel moving through the upper watershed. This condition is likely to be exacerbated with additional increases in peak flows that may result from further stormwater input. Agriculture in the upper watershed has caused erosion and silt deposition downstream (PSCRBT 1990). An intensive survey of the lower three miles of Blackjack Creek (FishPro 1987) found a lack of suitable fish spawning habitat and excessive sedimentation in the creek. Substrate condition in the lower portion of Blackjack Creek may be improving as the Puget Sound River Basin Team considered the substrate to be good, and that the FishPro (1987) study may not be representative of current conditions. Although recent slides have been contributing gravels and fines, large numbers of spawning fish appear to be keeping the substrate clean (WCC 2000).
Riparian Condition	The Suquamish Tribe has conducted surveys from the mouth to RM 3.0 of Blackjack Creek. This lower section of the creek is located in a steep ravine from just upstream of the mouth to Sedgwick Road and riparian conditions are considered to be fair, with mixed woody vegetation and limited trail access through the ravine.
Estuarine	The natural characteristics of the Blackjack Creek estuary have been highly altered. There has been significant fill (several acres) of historic intertidal estuary for shopping mall construction. Both banks of the estuary are heavily armored, and there is little natural remaining habitat. Development has encroached to the water's edge near Bay Street, with associated lack of riparian vegetation on the shoreline. Although the Bay Street crossing of the estuary limits natural tidal exchange upstream of the culvert, the Puget Sound River Basin Team participants indicate that there is sufficient tidal exchange to maintain some estuarine habitat upstream of Bay Street (PSCRBT 1990).
Priority Species	Bald Eagle, Chinook, Coho, Chum and Steelhead salmon, resident and searun cutthroat trout
Fish Access	There are no known barriers to fish and Blackjack Creek. Barriers and potential barriers do exist on several tributaries to the creek.
Water Quality	Blackjack Creek has good populations of freshwater mussels (some as large as 4-inches), typically an indicator of good water quality conditions (WCC 2000). However, Blackjack Creek is on the CWA 303(d) list for exceeding fecal coliform levels.

	The Bremerton-Kitsap Health District has been collecting water quality information at eight (five Blackjack, one Ruby, two Square) locations in the Blackjack Creek watershed since 1996. No consistent water quality concerns were identified. However, periodic high fecal coliform counts were observed downstream of the Bay Street culvert, downstream of Sedgwick Road, upstream of Sidney Road, and on Ruby Creek downstream of Sidney Avenue. In addition, dissolved oxygen level observations <10 mg/l were common downstream of Sedgwick Road, and on Ruby Creek downstream of Sidney Avenue.
Channel Condition	There is a large amount of garbage in lower Blackjack Creek, especially under the Lund Street bridge (WCC 2000). The presence of debris in the creek is likely the result of heavy development within the City of Port Orchard, which extends to the edge of the crest of the ravine (Dorn, as referenced in WCC 2000). The Puget Sound River Basin Team indicates that LWD condition is fair/good in the lower 3 miles of Blackjack Creek, and poor throughout most of the upper Blackjack Creek drainage, where LWD presence is limited (PSCRBT 1990). An evaluation of channel condition in lower Square Creek by Chris May (2001) indicates an unconfined channel with moderate sinuosity, a mean bankfull width of 5.3m, a mean bankfull depth of 0.42m, with 25-50% of the banks being stable. Pool spacing was 1 pool per 4.7 bankfull channel widths, a mean residual pool depth of 0.35m, and 21% of the sample area in pool habitat, yielding a quality rating of marginal. Riffle habitat was 52% of the sample area, with the riffle gravel estimated to be 10% embedded, yielding a substrate quality rating of optimal. LWD density in the sample area was estimated at 166.2 m3/km, with only 24% of the LWD being conifer, 40% >0.5 m diameter, and an LWD quality rating of marginal.
Floodplain Modifications	Along Sidney Road, Blackjack Creek was captured in a roadside ditch for approximately 600 feet, eliminating access to the floodplain on the roadside of the creek. However, it was restored to its original channel away from the road in 1999 (WCC 2000).
Flow/Hydrology	From 1947 through 1950, the USGS maintained a continuous recording gage on Blackjack Creek 0.4 mile upstream of Sinclair Inlet, although the measurements were taken only during the summer and early fall (representing mainly low flow conditions) (PSCRBT 1990). During this period of record, the maximum flow was 285 cfs, the minimum was 6.7 cfs, and the mean annual flow ranged from 20-26 cfs. Additional streamflow data for Blackjack Creek (as measured 0.5

	mile upstream of Bay Street) collected by Kitsap Public Utility District. Mean discharge and minimum discharge are approximately 1/3 less than they were prior to significant development in the basin. Blackjack Creek and tributaries have been closed to further consumptive water appropriation since 1960 (WAC 173-515-040). Water quality and quantity impacts are evident from stormwater in the Urban Growth Area (UGA) in the lower two miles of Blackjack Creek. Heavy development within the City of Port Orchard extends to the edge of the crest of the ravine, resulting in increased stormwater runoff directly to the creek. Most of the development is single family domestic, which is exempt from local stormwater ordinances.

Blackjack Creek is an important stream in Port Orchard due to the large numbers of anadromous fish that utilize the watershed. Improvements that could increase its functional score would be to revegetate the creek mouth where it runs through city developments.

5.0 General Shoreline/Nearshore Recommendations

Bay Street runs along the shoreline of Port Orchard, with most of the shoreline armored to protect the roadway. In addition, there is little remaining riparian vegetation or woody debris along the marine shoreline of Port Orchard. Although the habitat of the shoreline is compromised, this nearshore area supports native salmonids, both adults and juveniles, as well as Puget Sound baitfish and other important marine species.

Nearshore restoration projects should take into account issues such as land ownership, priority salmon stocks, and habitat connectivity. Restoration, producing the greatest success and benefit to salmon, involves performing protection and restoration activities at the same site. Other pathways toward restoration include reducing or eliminating harmful influences first, and then performing restoration activities at the site once harmful influences are eliminated or selecting projects that are easiest to accomplish or achieve the quickest results (SRFB 2000).

Key habitat impacts that limit nearshore/marine productivity include: shoreline armoring/bulkheading and nearshore fill, effects of overwater structures, dredging and conversion of intertidal/shallow subtidal to deepwater habitat, loss/lack of functional shoreline riparian vegetation, water quality and nearshore/marine sediment contamination (WCC 2000).

General shoreline recommendations that apply to any shoreline include:

- Protect existing functional nearshore habitat, and restore impaired nearshore function where possible.
- Protect integrity of existing shoreline riparian vegetation, including forested vegetation at the top of steep feeder bluffs; restore shoreline riparian function where possible.
- Minimize additional shoreline armoring, use soft-bank techniques where armoring is necessary; remove/pull back existing shoreline armoring where feasible.
- Maintain/restore shoreline sediment contribution from feeder bluffs; prevent further development (homes, roads) on shorelines below feeder bluffs, and restore/supplement impaired feeder bluff contribution where possible.
- Avoid/remediate stormwater impacts to nearshore habitat, including stormwater effects that increase the rate of shoreline bank erosion.

Specific Recommendations for Sinclair Inlet – Shoreline Segments 1-5

Some immediate measures that can be taken throughout the shoreline of Port Orchard to resolve the impacts include:

- Designate Sinclair Inlet as a Nearshore (NS) Refugia (May 2001).
- Further evaluate nearshore habitat conditions in this refugia and correct identified salmonid habitat limiting factors.
- Further evaluate nearshore modifications (bulkheads, docks, etc.) for their impact on ecological conditions and determine if any of these structures could be removed or modified to lessen their impact.
- Protect or restore natural riparian function throughout the nearshore zone.

- Protect or restore natural estuarine structure and function in critical contributing streams.
- Protect or restore stable natural hydrology in critical contributing streams.
- Address suspected or known water quality concerns with commercial and recreational vessel moorage and maintenance facilities.
- Remove creosote-treated pilings, where possible; use concrete or steel pilings for new construction and repair of existing structures.
- Proposed shoreline modifications should incorporate natural processes, consider historical processes, and minimize impacts on natural features and existing habitats in their design and construction.
- Replacement of shoreline structures (e.g., armoring) should strive to restore beach area, natural shoreline features, and shoreline processes. Removal of these structures is preferred.
- Pre-disturbance estuarine conditions (e.g., marsh elevation and distributary channel configuration) should be adopted as the basic template for successful long-term, self-maintaining estuarine restoration.
- Protect existing functional nearshore habitat, and restore impaired nearshore function where possible.
- Protect integrity of existing shoreline riparian vegetation, including forested vegetation at the top of steep feeder bluffs; restore shoreline riparian function where possible.
- Add grating to overwater structures.
- Conduct sediment cleanup projects to remove foreign debris (tires, etc) from seafloor and chemical contamination.
- Add LWD to areas devoid of LWD.
- Nourish beaches with clean, properly mixed sand and gravel.
- Transplant eelgrass into the system.
- Plant riparian trees and shrubs.
- Undertake public education workshops to communicate the importance of nearshore habitat and how to restore and protect it. Solicit volunteers!
- Promote better boating practices. Allow marina expansion at existing locations, prevent new marinas in critical nearshore zones and refugia.
- Remove and replace poorly operating road culverts to allow unrestricted fish passage.
- Construct and maintain better stormwater collection and treatment facilities.
- Inspect and regulate sewage pump-outs and other marina operations regularly and with enforcement power.
- Integrate and share environmental information between agencies, users and regulators. (Navy, Tribe, WDFW, Ecology, DNR, County, City, EPA, COE, USFWS, NMFS, NOAA, DOH, etc.)
- Remove and replace bulkheads with less damaging options such as sloped instead of vertical walls, sloped and vegetated shoreline structures (Mason County North Shore Road design drawings are an example), Structures that integrate logs and other natural materials, etc. are encouraged.
- Estimates of impervious surfaces within the city need to be completed. the city has access to a portion of digital information on the shoreline.

- Perform an update of the city's shoreline land use inventory.

Additional recommendations per segment include:

Table 18 Nearshore Shoreline Segments 1 through 7 Restoration, Preservation, and Protection Recommendations.

Segment	Recommendation
Segment 1	• Implement a pilot study of Kitsap and Suldan's Marinas monitoring and maintenance program to assess water quality. • Add riparian plants at any location feasible.
Segment 2	• Potential shoreline mitigation can include the clean-up of old homesite foundations and piles on intertidal area south of Ross Pt. Remove bulkhead, add gravel nourishment program along edges of surf smelt spawning zone and monitor for spawning expansion. • Rezone strip of land west of Ross Pt. from commercial to open space and replant vegetation to provide shade for spawning surf smelt and sandlance. • Add riparian plants at any location feasible. • Remove old creosote pilings just south of barge anchorage. • Beach Nourishment adjacent to barge anchorage (see above). Maintain beach nourishment through adaptive management.
Segment 3	• Add gravel/cobble to intertidal area around the boat launch where the slope of the bottom in ideal for surf smelt spawning • Add riparian plants at any location feasible.
Segment 4	• Rebuild the Blackjack Creek outlet and subestuary. Remove channel, rip rap and add more riparian vegetation. • Improve pocket beach for baitfish spawning at north edge of Mall parking lot next to informal parking lot. • Remove informal parking lot and replace with riparian vegetation. • Meet with motel owners and operators to gain cooperation with shoreline vegetation restoration program in pocket beaches and specific locations. • Remove concrete and asphalt along road end near Holiday Inn and revegetate with trees and shrubs.
Segment 5	• Beach nourishment along the entire stretch! • Add riparian plants at any location feasible. • Revegetate Annapolis Dock area • Add LWD
Segment 6	• Replace culvert at the SR 166 crossing with bridge or a much larger culvert that will restore saltwater tidal influence upstream and flush accumulated sediments to Sinclair Inlet • Restore functional estuarine habitat; eliminate or reduce encroachment from existing development and reestablish functional riparian buffers. • Implement low impact development, including stormwater water

	quantity control and water quality treatment for stormwater runoff; retrofit state-of-the-art stormwater quality and quantity best management practices to existing development in the watershed • Reduce impacts of road crossings, including identified fish passage barriers, increased stormwater runoff to surface waters, water quality impacts from stormwater runoff, and increased fine sediment delivery from road surfaces and associated ditch maintenance • Develop and implement a short-term LWD strategy to provide LWD presence and habitat diversity until full riparian function is restored • Identify and correct sources of fecal coliform contamination • Monitor dissolved oxygen levels, correct problems as warranted • Remove accumulated garbage and debris in Ross Creek. • Follow the management recommendations found in the Ross Creek Management Plan (City of Port Orchard 1992) • Some of the encroachment areas are currently owned by the City of Port Orchard, potentially providing **opportunities** for habitat restoration that would otherwise not be available. • Purchase old Clambake Restaurant, raze buildings, remove invasive species, install a trail system with signage. Remove undersized culvert at Hwy 166 and replace with at 3 sided box culvert. Apply for an IAC or similar grant to accomplish this.
Segment 7	• Reduce habitat impacts on agricultural lands upstream of SR 16, including development and implementation of farm plans that restore stream functions; identify and correct areas in the watershed that have unrestricted livestock access. • Reduce impacts of road crossings, including identified fish passage barriers, increased stormwater runoff to surface waters, water quality impacts from stormwater runoff.. • Implement low impact development, including stormwater water quantity control and water quality treatment for stormwater runoff; remediate existing stormwater impacts to the channel. • Protect high quality riparian habitat on Blackjack Creek. • Follow the management recommendations found in the Blackjack Creek Management Plan (FishPro 1987) • Protect and restore estuarine habitat (particularly upstream of Bay Street), including restoration of riparian function, and reduction of commercial encroachment, where feasible. • Remove accumulated garbage and debris in Blackjack Creek. • Identify and correct sources of fecal coliform contamination • Monitor dissolved oxygen levels downstream of Sedgwick Road, and on Ruby Creek downstream of Sidney Avenue, correct problems. • Perform continued stream assessments on Blackjack Creek to closely monitor its health and viability as a salmon stream. • Construct a viewing platform at the estuary to promote public awareness and education. Apply for an IAC or similar grant for funding.

6.0 Overall Report References and Appendices

Appendices

A: Required inventory items and elements and corresponding Shoreline Atlas (Figures)
B: Field Data Forms

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