SHARED STRATEGY FOR PUGET SOUND

EAST KITSAP WATERSHED CHAPTER

SALMON RECOVERY & CONSERVATION PLAN

v6

Kitsap County
City of Bainbridge Island
Suquamish Tribe
WA Department of Fish and Wildlife

2005 DRAFT

PREFACE

This document is DRAFT and was released for preliminary review by Shared Strategy for Puget Sound, the Puget Sound Chinook Technical Recovery Team, and NOAA Fisheries. Kitsap County, the City of Bainbridge Island, and the Suquamish Tribe, nor any other agency or organization has yet adopted this plan. Upon further revision, this plan is expected to be adopted by partnering agencies in the East Kitsap Watershed and used to guide salmon recovery and conservation.

ACKNOWLEDGEMENTS

Contributing Authors:

Peter Namtvedt Best, Planner – City of Bainbridge Island
Jim Bolger, Natural Resources Manager – Kitsap County
John Cambalik, Local Liaison – Puget Sound Action Team
Monica Daniels, Habitat Biologist – Kitsap County
Paul Dorn, Salmon Recovery Coordinator – Suquamish Tribe
Anne Nelson, Water Quality Specialist – WA Sea Grant
Doris Small, Watershed Biologist – WA Dept of Fish & Wildlife

Technical and Policy Assistance:

NOAA Technical Recovery Team
  Particularly Bob Furstenberg, liaison to East Kitsap
Shared Strategy for Puget Sound
  Particularly Margret Duncan, liaison to East Kitsap
Suquamish Tribe Fisheries Department, including:
  Alison O'Sullivan
  Jon Oleyar
  Jay Zischke
City of Bainbridge Island, including:
  Aaron Claiborn – Natural Resource Team
  Jalyn Cummings – Natural Resource Team
  Larry Frazier – Planning Director
  Ross Hathaway – Natural Resource Team
  Melva Hill – Natural Resource Team
  Libby Hudson – Natural Resource Team
  Jim Brennan – Environmental Technical Advisory Committee
  John Inch – Natural Resource Team
  Darlene Kordonowy – Mayor
  Deborah Rudnick – Environmental Technical Advisory Committee
  Chuck Krumheuer – Natural Resource Team
  Stephanie Moret – Natural Resource Team
  Steve Morse – Natural Resource Team
  Randy Witt – Public Works Director

ACRONYMS AND ABBREVIATIONS

BIMC – Bainbridge Island Municipal Code
CAO – Critical Areas Ordinance
COBI – City of Bainbridge Island
GSRO – Governor's Salmon Recovery Office
LFA – Limiting Factors Analysis (see Haring, 2000)
NMFS – National Marine Fisheries Service (a NOAA sub-agency)
NOAA – National Oceanic and Atmospheric Administration
NOAA Fisheries – (the new name for NMFS)
PFC – Properly Functioning Conditions
PSAT – Puget Sound Action Team
SMMP – Shoreline Management Master Program
SRFB – Salmon Recovery Funding Board
TRT – NOAA Fisheries, Puget Sound Chinook, Technical Recovery Team
VSP – Viable Salmonid Population
WDFW – Washington State Department of Fish and Wildlife
WRIA – Water Resource Inventory Area

TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF FIGURES

LIST OF TABLES

1.0 - INTRODUCTION

Salmon conservation and recovery in the East Kitsap Watershed[1] is a matter of addressing both the habitat needs of specific species listed under the Endangered Species Act (i.e. Puget Sound Chinook), and maintaining and restoring the processes and habitat that sustain all species of salmon in the watershed and adjacent nearshore areas.

Similarly, local, state, Federal, and Tribal governments, businesses, community organizations, and individuals all have a role to play in the conservation and restoration of salmon in the watershed and the region as a whole. It is neither the responsibility nor within the authority of any single stakeholder to manage and restore our watershed and nearshore ecosystems so they support salmon into the future. Recovering salmon to healthy and harvestable population levels will continue to be a collaborative effort involving all parties using the tools of education, voluntary restoration, incentive and regulatory programs that exist today or that will be developed in the future.

[Insert map of East Kitsap Watershed within Puget Sound]

Conserving and restoring salmon habitat in the East Kitsap Watershed is primarily implemented through locally coordinated and implemented projects and programs. The Suquamish Tribe as well as state resource agencies such as WDFW, PSAT and the WA Sea Grant Program, provide critical support and technical assistance for much of these efforts. This report is intended to reflect the approaches used primarily by Kitsap County and the City of Bainbridge Island, in partnerships with other local jurisdictions and community organizations, to protect and restore salmon habitat in the East Kitsap Watershed.

1.1 - Vision

Citizens of incorporated and unincorporated areas of the East Kitsap Watershed, through extensive public involvement processes, have described how they see their communities today and into the future. Consistently, the visions expressed include a future in which natural systems and fish and wildlife habitat are protected, water quality is excellent and a diversified economic base supports good jobs and affordable housing choices for future generations. More specifically, our communities envision a future in which viable communities, with healthy economies, coexist with and maintain viable salmon populations sustained at harvestable levels.

Elements of the Kitsap County and City of Bainbridge Island comprehensive plans specifically recognize the importance of the natural environment through inclusion of the following elements:

"Protection and enhancement of the natural environment, including wetlands, streams, wildlife habitat, water quality and natural resource activities;" (Kitsap County Comprehensive Plan, 2002)

[1] For the purposes of this chapter, the East Kitsap Watershed includes those watershed and nearshore areas in the eastern portion of Kitsap County, including Bainbridge Island and Blake Island.

"Development should not be haphazardly imposed upon the landscape, but should be sensitive to its natural environs, recognizing the natural carrying capacity of Bainbridge as an Island, based on the principle that the Island's environmental resources are finite and must be maintained at a sustainable level." (City of Bainbridge Island Comprehensive Plan, 1994)

Additional goals and policies that support these respective community visions are included under various elements of the County and City of Bainbridge Island comprehensive plans and shoreline master programs. (See Appendices D & E)

Kitsap County and local municipalities, including the City of Bainbridge Island, have also adopted County-Wide Planning Policies (2003; See Appendix F) for salmon recovery that state:

"The County and the Cities shall preserve, protect, and where possible restore the functions of natural habitat to support ESA-listed species, through the adoption of comprehensive plan policies, critical areas ordinances, shoreline master programs and other development regulations that seek to protect, maintain or restore aquatic ecosystems[,] associated habitats and aquifer[s] through the use of management zones, development regulations, incentives for voluntary efforts of private landowners and developers, land use classifications or designations, habitat acquisition program[s] or habitat restoration projects.

The County and the Cities shall provide incentive-based non-regulatory protection efforts such as [the] acquisition of priority habitats through fee-simple and conservation easements from willing sellers.

The County and the Cities shall jointly establish and implement monitoring and evaluation program[s] to determine the effectiveness of restoration, enhancement, and recovery strategies for salmonids[2] including ESA-listed species. Each jurisdiction shall apply an adaptive management strategy to determine how well the objectives of listed species recovery and critical habitat preservation/restoration are being achieved."

In addition, the East WRIA 15 Lead Entity has adopted in its East Kitsap Peninsula Salmon Recovery Strategy (2004) a mission statement "to ensure local salmon habitat is preserved and restored to support salmon populations and human communities." The goal of the strategy is to "restore healthy, self-sustaining wild populations of the salmon species native to the streams and shorelines of [the] Kitsap Peninsula. Healthy [salmon] populations depend on the condition of local habitat, the level of harvest, hatchery practices and oceanic conditions."

1.2 - Timeframe

Consistent with the timeline recommended by the Shared Strategy for Puget Sound, this plan for the East Kitsap Watershed is generally intended to be implemented over a period of 5-10 years.

[2] The terms "salmon" and "salmonid" are used interchangeably throughout this document and refer generally to all species belonging to the broader salmon family, including Chinook, coho, chum, sockeye, and pink salmon as well as steelhead and cutthroat trout.

Realistically, conservation and recovery of salmon species, including some species that have likely been in decline for a period greater than 100-years, is expected to take much longer than 5-10 years. Therefore, this plan will be iteratively reviewed and updated periodically based on the knowledge gained from its active implementation. Additionally, this plan includes many actions that are intended to be continued (and improved) in perpetuity in order to maintain viable salmonid populations at harvestable levels.

The content of this plan includes:

- a description of the East Kitsap Watershed, subwatersheds, and nearshore areas;
- a description of local salmon species and their population status;
- existing actions supporting recovery;
- an identification of gaps, opportunities, benefits and risks;
- a sub-area plan for the eastern portion of Kitsap County; and
- a sub-area plan for Bainbridge Island.

2.0 - WATERSHED SUMMARY

The East Kitsap County and Bainbridge Island provide a uniquely diverse geography for salmon. Between the backbones of the Kitsap Peninsula and Bainbridge Island and their shorelines, a narrow strip of land results in many short streams that drain to the west side of Central Puget Sound. The size of the East Kitsap Watershed, and the many small estuaries also provides an extensive and very diverse shoreline.

The streams are typical lowland type streams with generally moderate gradients. Considerable deciduous growth, interspersed with stands of conifers, farmland, and urban/suburban development is common on all streams. Many of the streams originate from lakes, ground water run-off, or swamp-like headwater wetlands (Williams et al. 1975). None of the streams are supported by snow runoff, as the maximum elevation in East Kitsap is less than 500 meters. Stream profile characteristics are, for the most part, pool-riffle in nature with water quality and aquatic insect production highly conducive to anadromous fish production (Williams et al. 1975).

The quantity of fresh water draining the East Kitsap Watershed and the number of salmonids utilizing the habitat are roughly the same as is found in a major river draining a similar sized territory. However, rather than flowing into a single large river, the water runs through many independent, short streams, directly into the Puget Sound. Salmon spawn and rear in approximately 86 of these stream systems. Though small, the streams are highly productive for salmon because of their low gradient and extensive associated wetlands. Our geography results in spatially diverse salmon populations, widely distributed in many small streams throughout the region. Spatial diversity is a key component of healthy salmonid populations and will be critical to regional salmonid recovery and conservation.

The East Kitsap Watershed is fortunate to enjoy a diverse 192 miles of marine shoreline. This nearshore habitat plays a critical role in the productivity of salmon stocks throughout Puget Sound. All salmon species, but particularly Chinook and chum, spend many months as juveniles feeding in the highly productive nearshore waters in preparation for their ocean migration. Although the importance of estuaries and other nearshore habitats to salmon have been largely underestimated in the past, we are now discovering that these nearshore environments are as important to salmon productivity as the freshwater streams where they are born.

The climate is characterized by mild, wet winters, and warm, dry summers. The average summer temperature range is 70-80° F during the day and 50-60° F at night. The average winter temperature is 40-50° F in the day and 30-40° F at night. Precipitation patterns are characterized by frequent rainfalls of low intensity. Precipitation varies from 39 inches at Bremerton to greater than 50 inches near Alexander Lake/Green Mountain.

2.1 - Geologic History

(modified from PSCRBT 1994)

The East Kitsap Watershed is geologically and topographically similar to other areas in the Puget Sound region, reflecting the influences of mountain building and glacial activity. During the

Eocene Epoch (approximately 38-55 million years ago), the East Kitsap Watershed was located at the western edge of the North American continent. Sediments were deposited in the coastal environment to the west of North America. Plate tectonic movement of the oceanic plate under the North America plate caused ocean and continental shelf rocks and sediment to be scraped off. These attached onto North America approximately 7-12 million years ago. Continued eastward movement uplifted these rocks and formed the hills and mountains of the Olympic Peninsula and the underlying Kitsap Peninsula. The underlying volcanic bedrock is overlaid with several thousand feet of marine sedimentary rocks. Green and Gold mountains, located west of Bremerton, are composed of these ocean floor rocks. The Pleistocene Epoch (or Ice Age), which began about 2 million years ago, formed most of the geologic features present in the watershed today. Cordilleran Ice Sheets, which originated in the coast and insular mountains of British Columbia, moved south to the southern end of the Puget Sound basin near Olympia. Up to 3,500 feet of glacial ice covered the Kitsap Peninsula. Geologic units from at least five major and several minor glacial advances have been identified in the Puget Sound basin, although only three are exposed (visible) in Kitsap County.

Each glacial advance is characterized by a similar set of geologic events. Advancing ice blocked rivers, which normally drained to the north and formed lakes in the southern portion of the Puget Sound basin. These lakes drained to the south. Widespread, fine-grained, lacustrine sediments were deposited by meltwater streams. Glacial till (a compact unsorted mix of clay, sand, and gravel, looking much like concrete) was then deposited directly under the glacier as it overrode the outwash sediments. Local recessional outwash sand and gravel deposits later formed from melt water as the front of the ice sheet receded to the north. Non-glacial intervals between the advances are characterized by fluvial (stream) sediments and peat.

The Fraser Glaciation, which occurred from 15,000 to 13,500 years ago, was the last glacial advance in the central Puget Sound basin (Deeter 1979). It eroded or covered much of the previous deposits. Deposits from the Fraser Glaciation in the area are characterized by silt and clay overlain by thick advance outwash sand, abundant till cover, and only local recessional outwash. Recessional meltwater outwash streams, much larger than present day streams, eroded and formed the larger valleys in the area. Valleys with “underfit” streams and estuaries or drowned river mouths were formed by the greater flow rates of outwash streams and a lower sea level during the Fraser Glaciation.

Following the final retreat of the Fraser Glaciation, erosional and depositional processes sculptured, and continue to shape, the landscape. Bluffs along the Puget Sound are being eroded and re-deposited as beaches and spits. Streams are eroding their banks and then depositing sediments in floodplains, wetlands, and bays.

2.2 - Marine Waters and Nearshore of East Kitsap County

The marine nearshore area of East Kitsap County and Bainbridge Island is irregular and composed of numerous bays, harbors, and lagoons, with varied topography and slope. The nearshore in the East Kitsap Watershed includes Colvos Passage, Sinclair Inlet, Dyes Inlet, Port Orchard Bay, Liberty Bay, Miller Bay, Appletree Cove, Port Madison, Bainbridge Island, Blake Island, Point No Point shoreline and the east side of Foulweather Bluff. Combined, there are approximately 192 miles of marine shoreline in the East Kitsap Watershed. The majority of East

Kitsap shoreline is relatively protected from severe weather conditions, although the east side of Bainbridge Island, Port Madison, and the east shoreline of Foulweather Bluff are exposed to high wind and wave energy.

The East Kitsap nearshore constitutes a significant portion of the nearshore habitat in central Puget Sound. The many estuaries and other shoreline habitats are used not only by the salmon produced in our own streams but also by juveniles from major rivers throughout Puget Sound as they migrate towards the open ocean. Use of this migration pathway by juveniles from various Puget Sound and Georgia Basin rivers is well documented (Fresh et al. 2003; Dorn & Best, 2005). The East Kitsap shoreline is probably even more important today than in historic times due to the highly urbanized shorelines along the east side of Puget Sound and the extensive loss of estuarine and nearshore habitats there. One result of the large number of streams that drain into the East Kitsap nearshore is an unusually diverse nearshore habitat with many small and medium sized estuaries, spaced relatively closely along the coast. This distributed network of estuaries provides a rich migration path for young salmon. These habitats are maintained by natural physical, chemical & biological processes which have generally been compromised by development of shorelines.

Examples of East Kitsap habitat types:

Salt Marshes: Salt marshes range from narrow fringes to fairly extensive areas. Salt marshes throughout Puget Sound have been significantly impacted. By some estimates over 70% of marshes have been lost in Puget Sound. Observational information suggests that significant and wide-ranging impacts have occurred to marshes within the East Kitsap Watershed. Losses have not been quantified, although they could by making comparisons between existing marsh areas and historic marsh areas documented fairly accurately in late 1800's US Coastal and Geodetic Surveys.

Salt Marshes:

- Point No Point Wetland
- Mouth of Eglon Creek
- Applecove Point
- Carpenter Creek Saltmarsh/Appletree Cove
- Doe-Keg-Wats Saltmarsh, Port Madison
- Nooschkum Point, Miller Bay
- Dogfish Bay Saltmarsh
- Virginia Point, Scandia Area
- Steele Creek Estuary, Burke Bay
- Mouth of Mosher Creek
- Illahee Creek Saltmarsh
- Barker Creek Estuary
- Chico Bay Saltmarsh
- Gorst Estuary
- Little Clam Bay Estuary

Salt Marshes:

- Olalla Creek Estuary
- Mouth of Clear Creek
- Clear Creek Lagoon
- Curley Creek Estuary
- Harper Estuary
- Beaver Creek Estuary
- Ross Creek Saltmarsh
- Blackjack Creek Estuary
- Point Monroe Pocket Estuary
- Battle Point Pocket Estuary
- Fletcher Bay Estuary
- Cooper Creek Estuary, Eagle Harbor
- Eagle Harbor (fringe marshes)
- Port Madison Bay (fringe marshes)
- Schel-Chelb Estuary, Rich Passage
- Blakely Harbor Log Pond
- Manzanita Creek Estuary, Little Manzanita Bay
- Manitou Beach Marsh, Murden Cove
- Murden Creek Estuary, Murden Cove

Feeder Bluffs: The Coastal Zone Atlas shows locations of feeder bluffs and erosion scars from past slope failures and the Bainbridge Island Nearshore Assessment identified additional actively eroding feeder bluffs (Small, 2002). Notable eroding bluffs include the shoreline from Foulweather Bluff to Port Madison Bay, Murden Cove to Point Monroe, Wing Point to Murden Cove; Fletcher Bay to Arrow Point, Manzanita Bay to Agate Point.

Tideflats: Extensive tidal flats are present in Kitsap County and Bainbridge Island in such areas as Carpenter Creek/Appletree Cove, Miller Bay, Liberty Bay, Dyes Inlet, Sinclair Inlet, Clam Bay, Pleasant Cove, Manzanita Bay, Murden Cove, Rolling Bay to Point Monroe, Fletcher Bay, Blakely Harbor, and Eagle Harbor.

Submerged Aquatic Vegetation: Eelgrass beds (*Zostera marina* and *Zostera japonica*) occur along approximately 48% of East Kitsap shorelines and kelp beds occur along approximately 21% of the shoreline (WDNR, 2001). While East Kitsap shorelines support aquatic vegetation the aerial extent and condition of eelgrass and kelp has not been accurately determined. Known losses include bull kelp forests in Rich Passage near Point White and eelgrass beds that once extended well into Eagle Harbor (Peter Namtvedt Best, personal communication).

Native Riparian Vegetation: There has been a significant loss of riparian function along the East Kitsap marine shoreline. According to the ShoreZone database (WDNR, 2001), only 23 percent of the East Kitsap shoreline has overhanging riparian vegetation. The ShoreZone estimates of overhanging vegetation on Bainbridge Island were consistent with the 27 percent documented during a recent on-the-ground inventory (Best, 2004). The Bainbridge Island

Nearshore Assessment also found that only 54 percent of the Island's marine riparian zone remains naturally vegetated and 23 percent is covered by impervious surfaces. Much of the shoreline of the Point No Point nearshore remains forested and nearshore areas remain largely unaltered by human activity. This area may likely represent some of the highest quality nearshore habitat remaining on the western side of the upper Puget Sound.

2.3 - East Kitsap County Subwatershed Descriptions

2.3.1 - Colvos Passage/Rich Passage Subwatershed

This area lies between the KGI (Key Peninsula, Gig Harbor, and Islands) subwatershed to the south and the Sinclair Inlet subwatershed to the west, including streams flowing to the west side of Colvos Passage and Rich Passage. From Point Glover in Rich Passage to just south of Olalla Creek in the Colvos Passage includes approximately 20 miles of saltwater shoreline. In spite of cumulative impacts of shoreline development along Colvos Passage, there is still a rich diversity of habitats, including intertidal marsh, mud flat, sand spits, and other nearshore features, as well as the estuaries of several streams (Curley, Olalla, and Beaver Creeks).

2.3.2 - Sinclair Inlet Subwatershed (from PSCRBT 1990)

The Sinclair Inlet watershed drains an area of 27,492 acres, including the creeks that flow into Sinclair Inlet (primarily along the southern shore) and the Beaver Creek watershed to the east. The watershed includes 57 miles of saltwater frontage, approximately 46 lakes with 9.7 miles of shoreline, and >62 miles of streams. The watershed is characterized by many small streams that drain relatively small areas. Gorst and Blackjack creeks are the main dischargers of freshwater into the Inlet (TetraTech 1988, as cited in PSCRBT 1990). Estimates of freshwater runoff into Sinclair Inlet have ranged from 335 cfs in January to 5 cfs in August. The contribution of groundwater flow to the inlet is unknown but thought to be substantial (Lincoln and Collias 1975, as cited in PSCRBT 1990).

Forest land covers 7,626 acres or about 28%of the watershed (20% is in public ownership, 68% in private woodlots, 12% in commercial forest land) (PSCRBT 1990). In 1990, >95% of the forest land was stands over 10 years of age. Rural/agricultural areas cover 10,627 acres, or about 37% of the watershed (35% covered with grass/shrubs, 65% covered with trees).

A management guideline for animal grazing is one animal unit (AU, defined as one 1000-pound cow and calf) per acre of pasture for a 7-month growing period. As rural lots become smaller, the number of AUs increases, which increases the potential for pollution. Pastures with high densities of livestock also tend to be in the worst condition. PSCRBT (1990) identified 76% of the farms and 75% of the pasture land acreage in the Sinclair Inlet watershed as being in poor or only fair condition, mostly the result of higher densities of grazing than the land can support. Another major problem associated with animal keeping activities is direct livestock access to streams. PSCRBT (1990) identified that 37% (54) of the farms as having streams of ditches on or adjacent to them, of which 80% still allowed livestock access to the streams. Animal access to streams results in direct discharge of wastes trampling of streambanks, and loss of riparian vegetation.

Bremerton and Port Orchard are the major urban areas with additional retail centers at Gorst, Manchester, and Annapolis. Kitsap County designates approximately 6,658 acres (24%) of this watershed as urban. The remainder of the watershed is characterized by large parcels of pasture, forest, single-family homes, small farms, and low-intensity commercial uses.

Most of the watershed consists of low, rolling hill topography. Slopes in the upper watershed are moderate, with some steep slopes (>50%) occurring in the City of Bremerton watershed.

Agricultural areas in the Blackjack creek drainage are gently rolling to nearly flat. Very steep bluffs dominate the shorelines of Port Orchard Narrows, and portions of Sinclair Inlet and Rich Passage. The highest point in the watershed is approximately 1,360 feet, about one mile west of Alexander Lake.

The USFWS has classified 5,012 acres of wetlands in the Sinclair Inlet watershed, with 17% being freshwater and 83% being marine. The PSCRBT identified an additional 57 acres of freshwater wetlands (ponded water and hydrophytic vegetation) using aerial photography, and an additional 1,560 acres of hydric soils using soils interpretation.

Sinclair Inlet and Rich Passage have a surface area of 4,668 acres. The main basin of Sinclair Inlet is deepest near the eastern end (130 feet) south of Point Herron, but the head of the bay is <10 feet deep. Tideflats present at the head of the inlet are exposed during low tides. The currents of Sinclair Inlet are relatively weak, at only 0.8 knots (Determan 1980, as cited in PSCRBT 1990). The estimated total flushing time is approximately 14 days for Sinclair Inlet (Lincoln and Collias 1975, as cited in PSCRBT 1990), assuming that none of the waters leaving the inlet on ebb tides returns on flood tides. In reality, some waters do return and waters from Sinclair and Dyes inlets mix in an area off Annapolis. The volume that mixes and returns on flood tides to Sinclair Inlet is unknown (TetraTech 1988, as cited in PSCRBT 1990).

2.3.3 - Dyes Inlet Watershed (from PSCRBT 1989)

The Dyes Inlet subwatershed drains an area of 30,289 acres, including the creeks that flow into Dyes Inlet and Port Washington Narrows. Approximately 40% of the watershed is within the urban area (12,231 acres) designated by Kitsap County. Bremerton and Silverdale are the major urban areas, with smaller retail centers at Chico, Tracyton, and Kitsap Lake. The Jackson Park Navel Reservation, Camp Wesley Harris, and parts of the Bangor Naval Reservation are located within the watershed. The remainder of the watershed is characterized by large parcels of land used for pasture, forest, wetlands, single-family homes, small farms, and low-intensity commercial uses.

Most of the watershed consists of low, rolling-hill topography. Slopes in the upper watershed are moderate, with the steepest slopes (>60%) occurring in the Lost Creek drainage. The highest point in the watershed is on Green Mountain (1,500 feet). Agricultural areas in the Clear Creek drainage are nearly flat. Steep, sloping sea cliffs and bluffs dominate the Port Washington Narrows shoreline.

The Dyes Inlet watershed is characterized by many small streams that drain relatively small areas. Clear, Barker, and Chico creeks are the main dischargers of freshwater into Dyes Inlet.

Freshwater runoff into Dyes Inlet varies considerably throughout the year. The contribution of groundwater flow to the inlet is unknown, but thought to be substantial (Lincoln and Collias 1975, as cited in PSCRBT 1990).

The Chico Watershed alternative futures analysis is a natural resource assessment approach for guiding community planning and natural resource protection. This project is Kitsap County's first attempt to develop a landuse plan based on a watershed boundary and natural watershed functions. This process provides a forum for community members to better understand landuse and water resource issues and to articulate their own vision for the future. These future visions are displayed in a series of land use maps and assumptions. Once these alternative futures have been created the maps are analyzed for their potential effects on the natural resources of the watershed. Results for effects on hydrology, channel conditions and wildlife habitat will be used to guide the development of a sub-area plan for the Chico watershed. The alternative futures approach is intended to help local governments simplify the task of integrating numerous land use planning and natural resource protection objectives into a coherent, scientifically supported, vision of the future. This approach integrates watershed and land use planning to address the impacts of growth and to align the goals of community planning with long-term sustainability. Alternative Futures Planning is a technique designed to analyze the relationships between human activities and changes that occur in the natural environment. The result of the process is a watershed management plan that is based on watershed function and natural resource protection and designed around a vision of the future that is articulated by the citizens of the watershed.

The Dyes Inlet watershed contains a diverse array of land uses. Land use in the watershed was estimated to be 25% forested, 29% rural/agricultural, 40% urban, and 6% other (lakes, wetlands, military, parks, etc.)(PSCRBT 1989). There has been extensive conversion of rural/agricultural/forest land to urban (residential and commercial) area since 1989, particularly in the Clear Creek and Barker Creek watersheds. The USFWS classified 5,785 acres of wetlands in the Dyes Inlet watershed, with 20% being freshwater and 80% being saltwater. Because of inventory methods, this does not constitute a complete list of existing wetlands. The PSCRBT identified and additional 78 acres of freshwater wetlands, and an additional 1,207 acres of hydric soils.

Over 75% of the soils in the Dyes Inlet watershed are included in the Alderwood/Kapowsin/ Shelton soil classification. These soils are nearly level to rolling, formed in material weathered from glacial till. The subsurface layers are gravelly sandy loams over a cemented hardpan at a depth of 20-40 inches. Permeability is moderate to moderately rapid above the hardpan and very low through the hardpan. This results in a perched water table. Runoff is slow and erosion hazard is slight. On-site sewage disposal systems often fail or do not work properly during periods of high rainfall because of these limitations, resulting in runoff that can carry animal waste, nutrients and other pollutants. Approximately 15% of the soils in the Dyes Inlet watershed are in the Indianola/Dystric Xerorthents soil classification. These occur on broad uplands and along side slopes or river valleys, formed in glacial outwash. These soils are somewhat excessively drained with rapid permeability. Runoff is slow and erosion is slight on lower slopes; however, on slopes >45% there is a potential for runoff and erosion. These soils are also poor for on-site sewage treatment, as they provide poor filter material, with greater potential to pollute groundwater. Approximately 8% of the soils in the Dyes Inlet watershed are in the

Kilchis/Schneider soil classification. These soils occur on the steep mountain slopes and crests found in the upper watershed, formed in material weathered from basalt. The surface layer is typically a very gravelly sandy loam, with a depth to bedrock of 20-40 inches. Runoff is rapid and erosion hazard is moderate to severe. These soils are also not suitable for on-site sewage disposal due to slope and depth to bedrock.

Dyes Inlet and the Port Washington Narrows have a surface area of 4,642 acres. The main basin of Dyes Inlet is deepest near the center (150 feet), but the adjacent bays are typically <35 feet deep (PSCRBT 1989). Tideflats present in the small bays and at the head of the inlet are exposed during low tides. The currents of Dyes inlet are relatively weak, but those of Port Washington Narrows are strong (4 knots)(NOAA 1988, as cited in PSCRBT 1989). The estimated total flushing time is approximately four days for Dyes Inlet (Lincoln and Colias 1975, as cited in PSCRBT 1989), assuming none of the waters leaving the Inlet on ebb tides returns on flood tides. In reality, some waters do return and waters from Sinclair and Dyes inlets mix in an area off Annapolis. The volume that mixes and returns on flood tides to Dyes Inlet is unknown (Tetra Tech 1988, as cited in PSCRBT 1989).

2.3.4 - Port Orchard Subwatershed

The Port Orchard subwatershed lies between the Sinclair Inlet and Dyes Inlet subwatersheds (to the south and west) and the Liberty Bay/Miller Bay subwatershed to the north. It includes those streams that flow from the west to Port Orchard from the Kitsap peninsula, and those that flow from the west side of Bainbridge Island on the east side of Port Orchard. The Bainbridge Island streams are included in the Bainbridge Island subwatershed discussion. No existing descriptions of this subwatershed area were located.

2.3.5 - Liberty Bay/Miller Bay Subwatershed (from PSCRBT 1994)

The Liberty Bay/Miller Bay watershed drains an area of 27,629 acres. Approximately 48% (13,224 acres) of the watershed was identified as residential land use in 1994, with parcels varying from <1 acre to 10 acres, with 52% of the platted residential area developed at that time. Poulsbo and the marine waterfront have the highest concentrations of residential use. Land use was estimated to be: 21% (5,654 acres) commercial forest land, 9% (2,587 acres) agricultural land (mostly small non-commercial farms), 1% (325 acres) commercial/industrial land, 2% (466 acres) military land, and 2% (640 acres) miscellaneous land use. An additional 17% (4,733 acres) was identified as open land that is likely being held for recreational purposes or as future real estate investments. This watershed experienced rapid development from 1980 to 1990, with an increase in housing units and population of 29%. This rapid rate of development has continued through the 1990s.

Over 75% of the soils in the Liberty Bay/Miller Bay watershed are included in the Poulsbo/Alderwood soil classification. Soils in this group occur on slopes ranging from flat to moderately steep. Creeks draining this soil group generally have little or no floodplain. This group is characterized by a moderately permeable, uncompacted till layer, 20-40 inches deep, overlying very compacted till material (hardpan). The soils are well drained above the hardpan, with low permeability through the pan. As a result, precipitation drains quickly to the hardpan then flows laterally to an outlet in a depression, hillside seep, creek, or road cut. Water often collects above the hardpan creating a seasonal high water table during the winter months. Approximately 17% of the soils in the Liberty Bay/Miller Bay watershed are in the Ragnar/Indianola soil classification. The soils in this group formed in glacial outwash. These soils have rapid permeability. Runoff is slow and erosion is slight on lower slopes; however, where the Ragnar soil is mapped on slopes >6%, the hazard of water erosion is severe. These soils are also poor for on-site sewage treatment, as they provide poor filter material, with greater potential to pollute groundwater. Approximately 10% of the soils in the Liberty Bay/Miller Bay watershed are in the Norma/McKenna soil classification, formed in a variety of materials. Surface water saturates and ponds on these soils during winter months. Runoff is slow and the hazard of water erosion is slight, except for likely streambank erosion on alluvial soils, where vegetation is removed by livestock or residents. The Kitsap soil group covers 5% of the watershed, in concentrations in the Scandia area, around Poulsbo, and in uplands in the Big Valley and Grovers Creek area. This silt loam soil formed in sediment from glacial lakes. Permeability is low with a seasonal high water table. This soil has a high potential for slippage on slopes >8%. Soils in many of the creek corridors in the Liberty Bay/Miller Bay watershed are prone to slumps, slides, or severe water erosion.

Liberty Bay is a relatively narrow shallow embayment (<60 feet deep). The bay is considered to be poorly flushed, with a tendency to concentrate pollutants PSCRBT 1994). Miller Bay is the second largest embayment in the watershed area, and is also shallow and poorly flushed. Many homes are located near the shore zone of the watershed, increasing possible septic effluent loading and other nonpoint pollutants to marine waters.

Portions of Liberty Bay have been classified as a conditionally approved shellfish harvest area since 1967. In 1994, 681 acres of shellfish beds within Liberty Bay were classified as restricted, with an additional 610 acres classified by the Dept. of Health (1991) as prohibited due to animal wastes, nearby marinas, and other nonpoint sources. These restrictions are due primarily to elevated fecal coliform contamination. Five potentially significant sources of pollutants were identified in Liberty Bay (PSCRBT 1994), including; the Dogfish Creek watershed, the unsewered west shoreline of Liberty Bay, stormwater runoff from the eastern Liberty Bay shoreline, raw sewage from boats moored in four area marinas, and an EPA Superfund site on the Keyport Naval Undersea Warfare Engineering Station

Longshore drift, caused by oblique wave action causing currents parallel to the beach, causes sediment to move along the shore to a bay or river mouth where the sediment is deposited to form a spit (PSCRBT 1994). Beach erosion results if the sediment normally transported by the drift is cut off. This scenario is likely in the Miller Bay spit-Indianola area if cliffs to the east, that naturally erode and provide the sediment, are protected by structures such as marine bulkheads. Building protective structures is only an expensive, short-term control measure, which usually results in the need to build additional protective structures. Restoring the natural sediment load is needed to stop beach erosion.

2.3.6 - Port Madison to Foulweather Bluff Area

This area extends from Miller Bay, at the northwest corner of Port Madison, north to Foulweather Bluff, including the Point No Point nearshore and Appletree Cove in Kingston, Washington and includes approximately 20 miles of saltwater shoreline. Much of the shoreline of the Point No Point nearshore remains forested and nearshore areas remain largely unaltered by human activity. This area represents some of the highest quality nearshore habitat remaining on the western side of the upper Puget Sound. Carpenter Creek drains into a natural estuary and into Appletree Cove. In spite of two undersized culverts within the estuary that restricts saltwater exchange and natural sediment transport to the outer estuary, the estuary remains in relatively good shape. There is an active watershed group in the Carpenter Creek drainage, and plans are underway to replace the culverts with bridges of sufficient length to restore near historical estuarine functions.

2.4 - Bainbridge Island Subwatersheds & Nearshore Areas

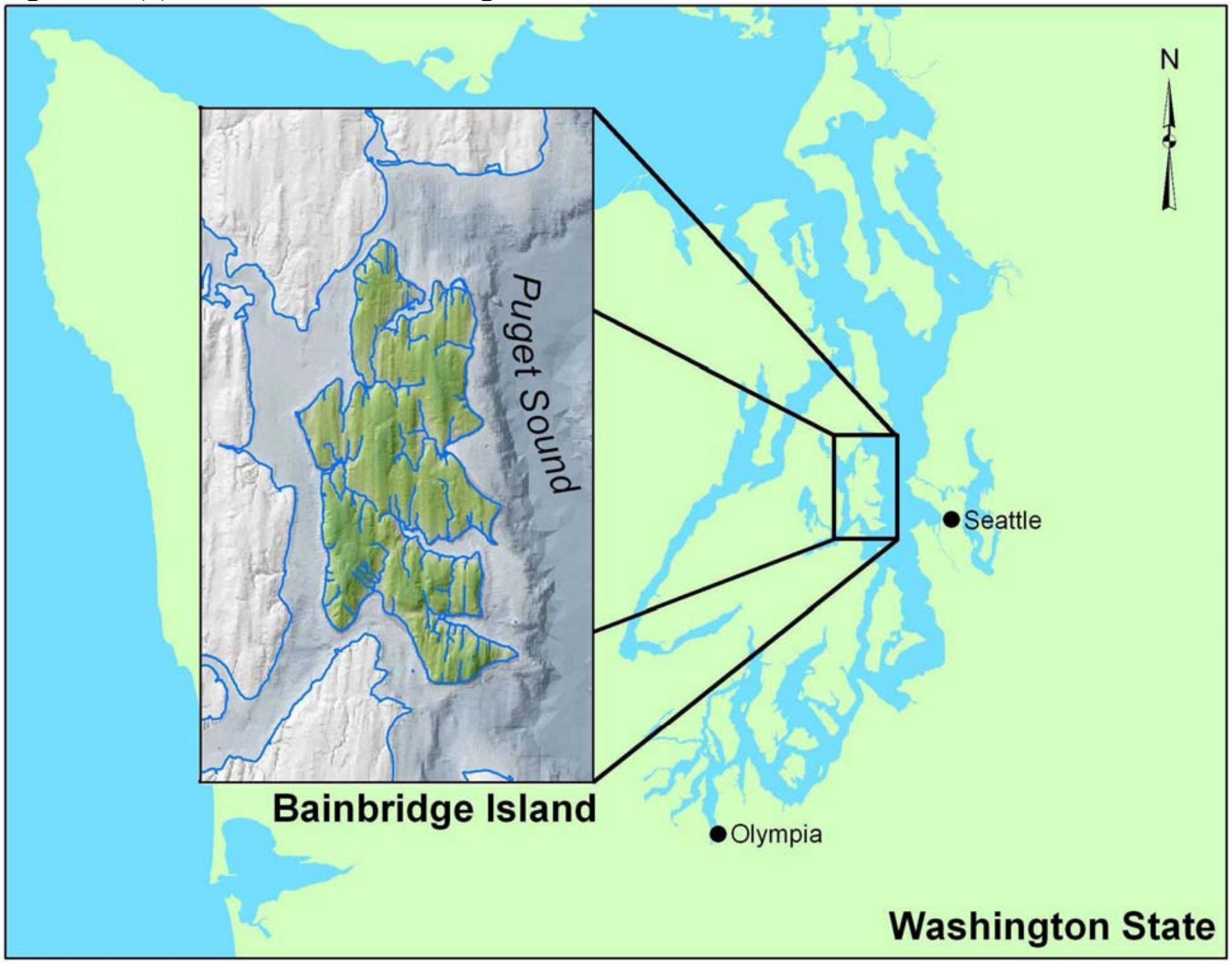
(*modified largely from PSCRBT 1995; Kato & Warren 2001; Williams et al 2003; and Williams et al 2004*)

Bainbridge Island is located east of the Kitsap Peninsula and west of the City of Seattle (see Figure 2.4(a)) in the Central Puget Sound. The Island is approximately 5 miles wide and 10 miles long, encompassing approximately 17,800 acres, or 28 square miles, and is one of the larger islands in Puget Sound.

Euro-American settlement of the Island began in the mid-1800's and was predominantly focused around large saw mills in Port Madison Bay and Blakely Harbor and ship building that first occurred in Blakely Harbor and later moved to Eagle Harbor. The Island's two saw mills had shut down by the early 1900's but ship repair and maintenance has remained a significant industrial presence in Eagle Harbor. Military installations and creosote wood treatment were significant industries for most of the 20th century. Agriculture (largely strawberries) became a significant Island industry in the early 1900's and continued through the mid 1900's. A large number of steam powered ferries known as the Mosquito Fleet connected the Island to the rest of Puget Sound until the early 1950's and significantly influenced development patterns along the shoreline. In 1950 SR-305, the Agate Pass Bridge, and the Washington State Ferry Terminal in Winslow were built and influenced a broadening of development and increased growth across the Island.

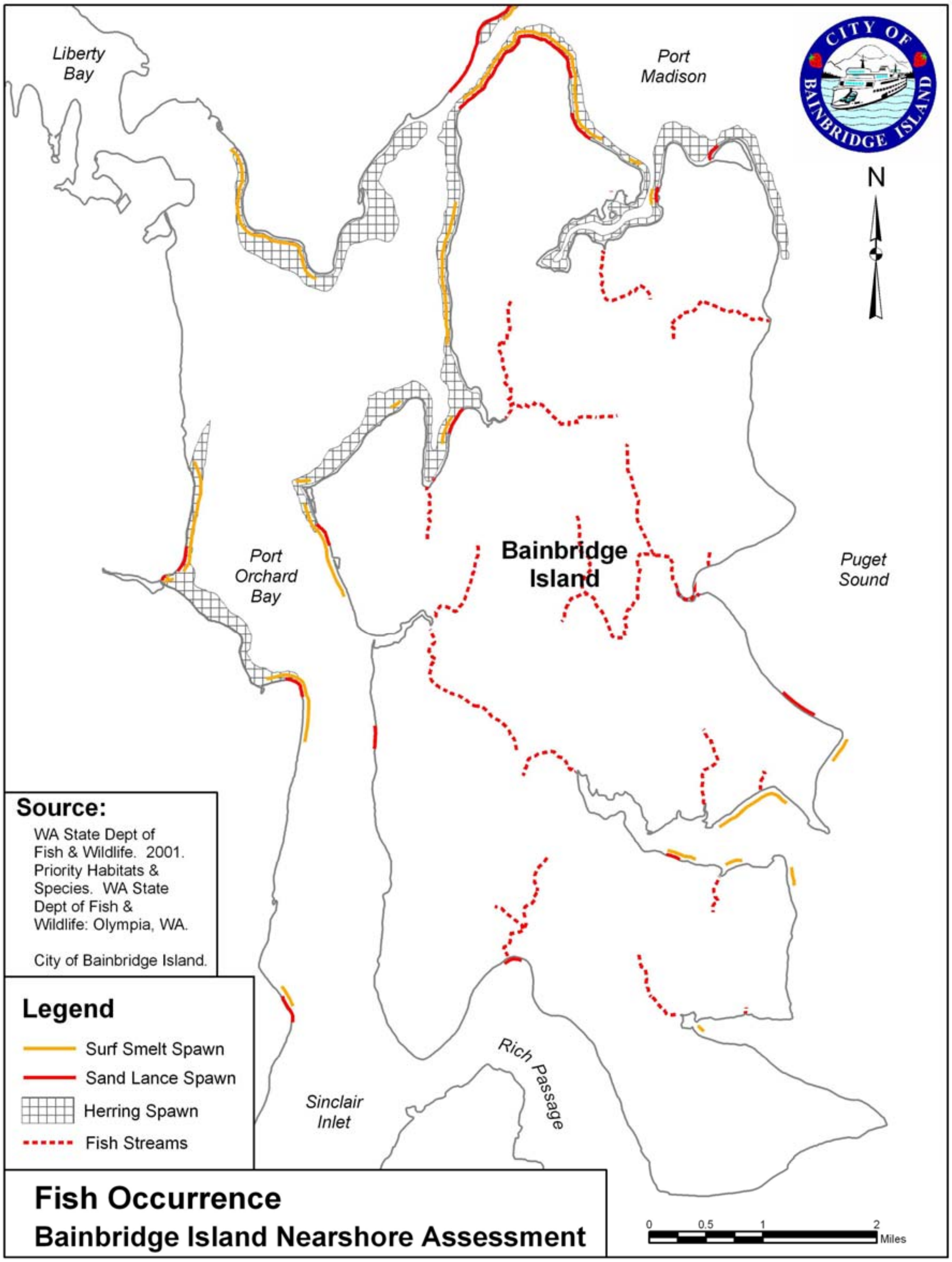
Since that time, the Island has experienced periods of rapid growth, particularly in recent decades, increasing from a population of 4,132 in 1950 to a population of 20,308 in 2000 (US Census). The population is projected to grow to nearly 28,660 by the year 2025 (Puget Sound Regional Council forecast), an increase of 41 percent from the 2000 census. This population growth is likely driven by the Island's semi-rural and small-town ambiance, public school system, and proximity to Seattle, the State's largest employment base. A significant portion of the Island's population commutes to work in Seattle via ferry.

Figure 2.4(a). Location of Bainbridge Island.



The Island was mostly part of unincorporated Kitsap County until 1991, when the unincorporated portions of the Island ware annexed by the City of Winslow and became the City of Bainbridge Island. The Island is predominantly residential, with the majority of development concentrated in and around Winslow (the Island's urban core), Neighborhood Service Centers, a few light manufacturing areas, and along the shoreline. Outside of the Winslow area, the interior of the Island is predominantly zoned for a residential density of one unit per 2.5 acres and the shoreline is predominantly zoned for a residential density of one or two units per acre. The Bainbridge Island Comprehensive Plan (COBI 2004) calls for 50% of population growth to be absorbed within Winslow.

Figure 2.4(b). Fish Occurrence on Bainbridge Island.
(*From Williams et al 2003*)



2.4.1 - Bainbridge Island Subwatersheds

Bainbridge Island's subwatersheds are largely the product of our regions glacial history. The rolling topography of Bainbridge Island contains several north to south oriented points and ridges that were largely shaped by glacial advances and retreats. Low-lying valleys occur between many of the ridges. The elevation ranges from sea level to approximately 400 feet. While most of the Island has typical lowland Puget Sound glacial geology, the geology of the southern portion of the Island is dominated by highly fractured sedimentary bedrock formations consisting of shale, sandstone, and conglomerates that are thought to be inclined between 45 and 90 degrees. This change in geology can be attributed to uplift of the southern portion of the island resulting from activity along the Seattle fault; an extension of the Seattle fault line crosses east-west through Blakely Harbor and the southern portion of the Island. Sedimentary bedrock formations are prevalent along the southern shoreline of the Island.

The Island is subdivided into 12 subwatersheds[3], each containing several small, perennial and intermittent streams (Figure 2.4.1(a)). According to Kato & Warren (2001), half the Island's streams appear to be perennial and the other half intermittent. Precipitation ranges from approximately 35 inches on the north end of the Island to about 45 inches on the south end. Approximately 75 percent of annual precipitation falls between October and March with only about five percent of annual precipitation during July and August. The average flow of most of the Island's streams is thought to be less than one cubic feet per second (cfs), but no long-term flow measurements are known to have been collected prior to the installation of a stream gauge on Springbrook/Fletcher/Island Center Creek in 2004. Some streams (e.g. Cooper Creek and Dripping Water Creek) appear to have a significant base flows maintained by springs and seeps. Freshwater wetlands, some extensive, occur throughout the Island and along the shoreline. The Islands subwatersheds are predominantly forested and generally zoned for residential land use.

Bainbridge Island's water supplies are primarily from groundwater withdrawals. Although surface and reservoir water rights exist, virtually no new surface water rights have been approved since the 1960's and the extent of actual surface water currently withdrawn is undocumented (Kato & Warren et al 2000). Presently, two streams, Springbrook/Fletcher/Island Center Creek (Stream #0340 & 0342) and Murden/Grisdale/Woodward/Meigs Creek (Stream #0322 & 0323), are closed to further surface water allocations (Kato & Warren et al 2000; WAC 173-515-040).

Coho, chum, cutthroat, and steelhead are known to use Bainbridge Island streams (Figure 2.4(b); Haring 2000; Appendix C) although the full distribution of these species, including upstream extent has not been adequately documented. Some efforts have been made to identify fish passage barriers (Haring 2000, Kato & Warren 2001; WDFW 2002b) throughout the subwatersheds. However, these do not appear to be comprehensive, do not use a repeatable/comparable evaluation method, and are not prioritized for corrective actions. Figure 2.4.1(b) summarizes the best information currently available regarding the location and rating of fish passage barriers. The lack of a comprehensive, well documented, and prioritized list of fish passage barriers is an important data gap that should be filled.

[3] The term "subwatershed" is used in this report as a means of maintaining a consistent nomenclature that readily conveys geographical hierarchy to the reader. Locally, subwatersheds on Bainbridge Island are commonly referred to as "watersheds" or as "basins" in some technical reports.

Comprehensive water quality and stream flow monitoring and on-the-ground assessments of salmonid habitat have not been conducted in the Island's subwatersheds, but a study of general subwatershed characteristics was conducted in 1995 by the Puget Sound Cooperative River Basin Team (PSCRBT 1995) and in the 2003 Kitsap Peninsula Salmonid Refugia study (May and Peterson 2003) included Bainbridge Island watersheds. Table 2.4.1(a) summarizes some of the 1995 PSCRBT subwatershed characterizations. The refugia study is discussed in section 2.5 of this chapter below. Table 2.4.1(b) summarizes the non-point source pollution concerns reported in the 1995 PSCRBT characterization. Haring (2000) conducted a limiting factors analysis of Bainbridge Island, which was largely based on qualitative inforation due to the lack of qualitative habitat assessments. Table 2.4.1(c) summarizes the habitat condition ratings from the Limiting Factors Analysis report (Haring 2000)

Figure 2.4.1(a). Bainbridge Island Subwatersheds.

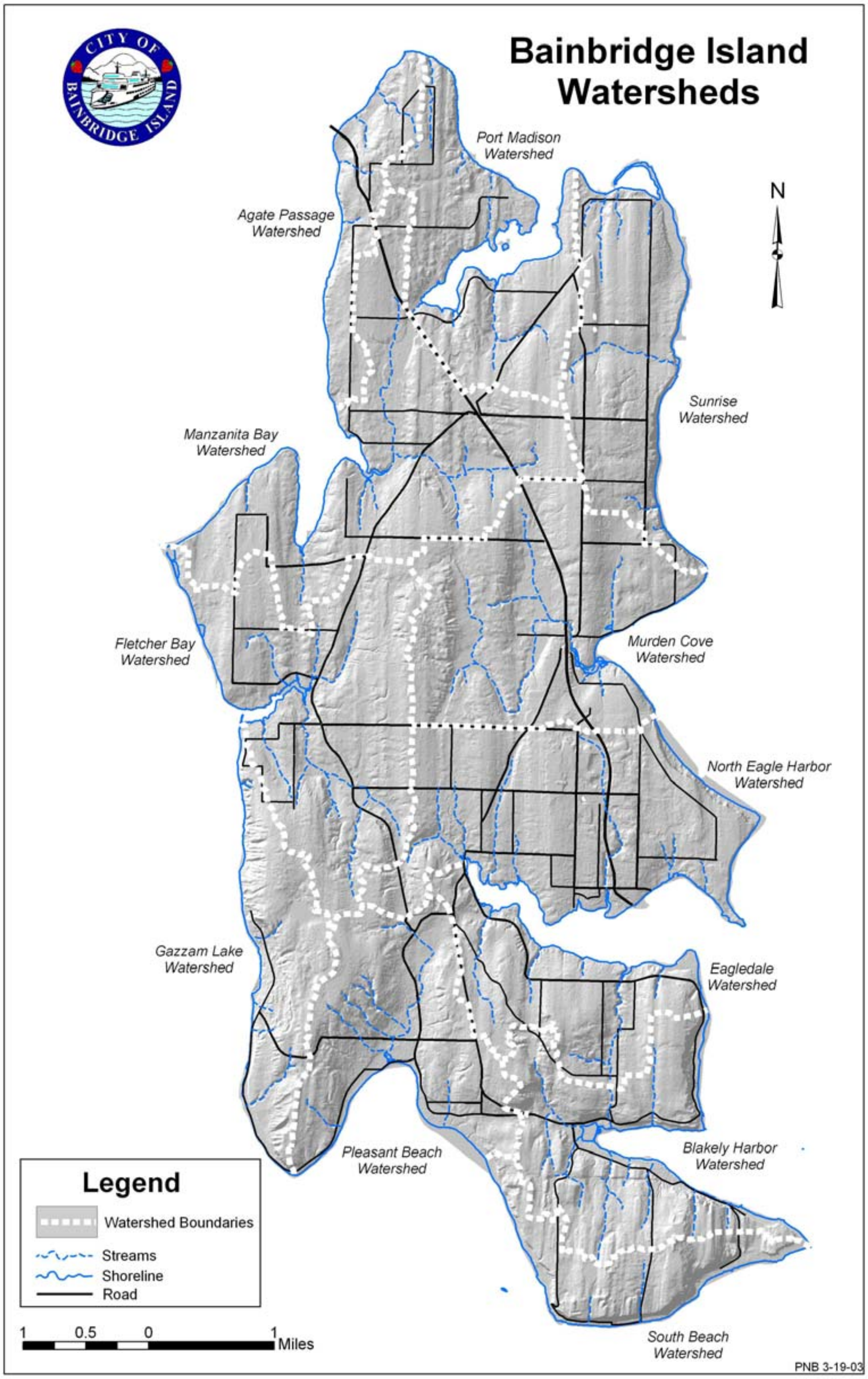


Table 2.4.1(a). Bainbridge Island Subwatershed Characteristics.

(*From PSCRBT 1995*)

Subwatershed	Total Acreage	Land Cover				Land Use							
		Wetlands	Forested	25-50% Impervious	> 50% Impervious	Residential	Open	Recreation	Transportation	Agriculture	Commercial/ Industrial	Designated Forestland	Public Facility
Agate Passage	573	6	458	1	-	497	-	-	49	12	3	-	12
Port Madison	1,522	86	1,274	17	8	988	194	153	84	61	22	16	4
Sunrise	1,347	79	980	19	26	1,063	18	24	69	86	1	58	28
Murden Cove	1,967	218	1,353	43	24	1,208	108	229	152	162	14	-	94
Eagle Harbor/ Eagledale	3,276	226	2,004	445	186	2,210	197	144	277	114	157	15	162
Blakely Harbor	1,422	86	1,191	52	-	275	1,012	46	59	21	-	-	9
South Beach	728	17	513	78	7	333	113	226	34	15	1	-	6
Pleasant Beach	1,513	109	1,174	102	7	1,009	157	-	87	70	47	134	9
Gazzam Lake	920	15	792	18	-	530	335	2	36	-	-	17	-
Fletcher Bay	2,129	157	1,603	-	22	1,429	131	165	87	223	20	70	4
Manzanita Bay	2,210	258	1,507	34	23	1,397	78	233	150	241	60	29	22
Total	17,607	1,257	12,849	809	303	10,939	2,343	1,222	1,084	1,005	325	339	350
% of Total	n/a	7%	73%	5%	2%	62%	13%	7%	6%	6%	2%	2%	2%

Note: The accuracy of these figures is unknown, methods and data sources are not well documented in the report.

Table 2.4.1(b). Bainbridge Island Nonpoint Pollution Concerns by Subwatershed.

(*From PSCRBT 1995, pg. 204*)

	Agate Passage	Port Madison	Sunrise	Murden Cove	North Eagle Harbor/ Eagledale	Blakely Harbor	South Beach	Pleasant Beach	Gazzam Lake	Fletcher Bay	Manzanita Bay
Potential Failing OSS											
- Poor Filtration	X		X			X		X			
- Bedrock						X	X				
- Slop/Soils with Slow Percolation		X			X	X	X		X		
- Threats to Bays Likely		X	X	X						X	X
Residential/Urban Runoff Transported to Bays			X		X					X	X
Marinas					X						

	Agate Passage	Port Madison	Sunrise	Murden Cove	North Eagle Harbor/ Eagledale	Blakely Harbor	South Beach	Pleasant Beach	Gazzam Lake	Fletcher Bay	Manzanita Bay
Superfund Site					X						
Discharge of Minimally or Untreated Effluent							X	X			
High Development Potential						X[1]					
Steep Slopes											
- Past/Potential Landslides			X		X	X		X	X		
- Current/Potential Surface Erosion			X	X	X	X	X	X	X		
Farms with Mod to High Pollution Potential										X	X
Shallow Aquifer											X
Major road Runoff				X							
Potential Timer Harvest on Designated Forestlands								X		X	
Landfill Under Investigation								X[2]			

[1] While Blakely Harbor still has relatively high development potential, a significant reduction in the total future development occurred with the 2001 acquisition of 255 acres for the IslandWood environmental learning center and 40 acres for the Blakely Harbor Park.

[2] The Vincent Road Landfill remediation was completed in 2003.

Figure 2.4.1(c). Habitat Condition Rating Based on Limiting Factors Analysis
[*From Haring 2000, pg 282-283]*

Stream	Fish Access	Floodplain Connectivity	Channel Conditions				Water Quality			Hydrology		Estuarine	Lack of Nutrients
			LWD	Pools	Substrate	Riparian Condition	Temp/DO	Fecal	Toxics	Peak Flow	Low Flow		
Coho Ck	P	G	G	G	G	G	*	*	*	*	*	P	*
Dripping Water Ck	G	*	*	*	*	*	*	*	*	*	*	*	*
Murden (Grisdale/ Woodward/ Meigs) Ck	*	G	*	*	P	P	*	*	*	P	CL	*	*
Ravine Ck	P	P	*	*	*	*	*	*	*	P	*	*	*

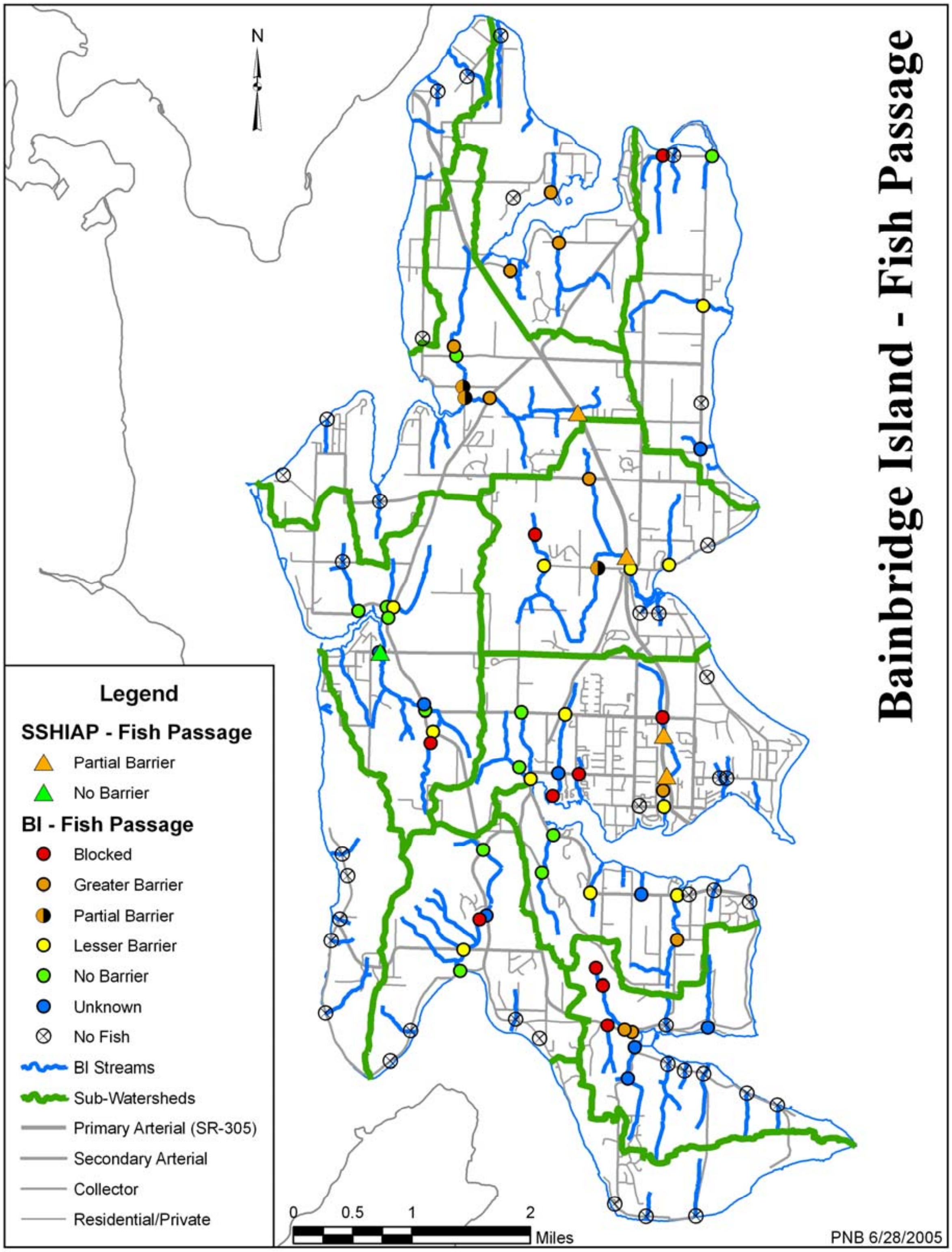
Weaver Ck	*	*	*	*	*	*	*	*	*	*	*	*	*
Hirakawa (Sportsmen's Club Pond) Ck	P	*	*	*	*	*	*	*	*	*	*	*	*
Cooper Ck	P	*	P	*	P	P-G	*	*	*	*	*	*	*
Blakely Falls Ck	G	*	*	*	*	*	*	*	*	*	*	*	*
Mac's Dam Ck	P	*	*	P-G	P-G	P-G	*	*	*	*	*	*	*
Unnamed 15.0332	*	*	*	*	*	*	*	*	*	*	*	*	*
Schel-Chelb Ck	*	*	*	*	*	*	*	*	*	*	*	G	*
Springbrook (Fletcher/ Island Center) Ck	F	P	*	*	P	P-G	*	*	*	*	CL	*	*
Manzanita Ck	P	P	*	*	*	P-G	*	*	*	*	*	*	*

Key: * = Data Gap
G = Average habitat condition considered to be good for the listed watershed
F = Average habitat condition considered to be fair for the listed watershed
P – Average habitat condition considered to be poor for the listed watershed
CL = Year-round closure to further surface water withdrawals

Note: Stream names updated for consistency with local usage and consistency in this report

Note: Due to the widespread lack of quantitative assessments, this table is largely based on the qualitative observations and experience of technical staff consulted by Haring (2000). Therefore, the timeliness, accuracy, and comparability of this data is unknown.

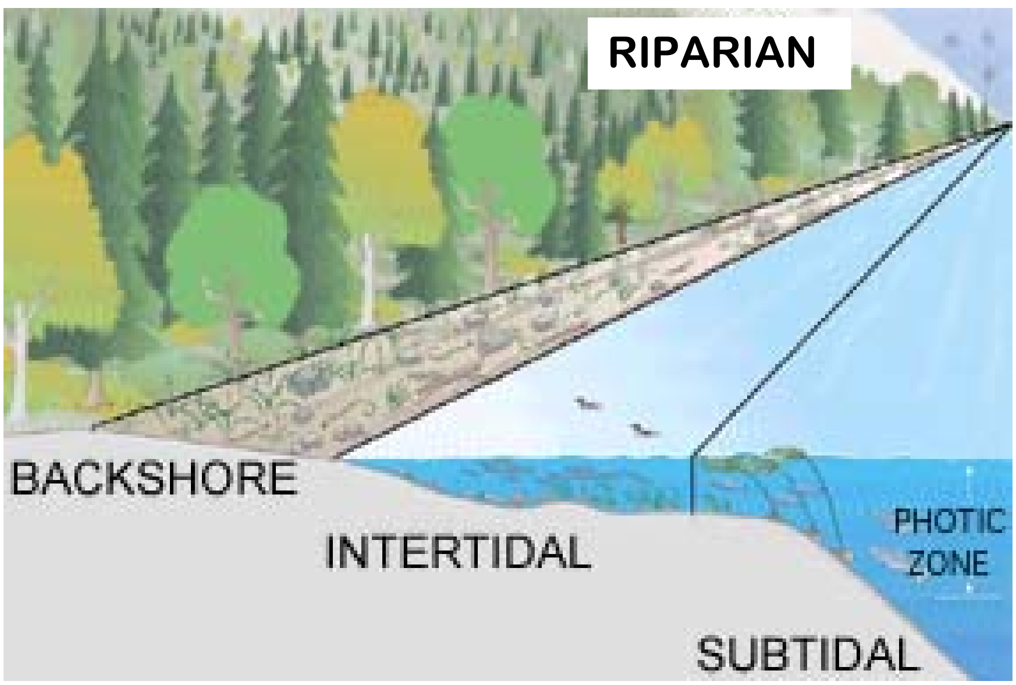
Figure 2.4.1(b). Bainbridge Island Fish Passage



2.4.2 - Bainbridge Island Nearshore

Bainbridge Island has approximately 53 miles of shoreline (Best, 2004). The shoreline is irregular, with numerous bays, inlets, and a significant diversity of other costal land forms (i.e. spits, bluffs, dunes, lagoons/pocket estuaries, cuspate forelands, tombolos, tide flats, stream and tidal deltas, islands, and rocky outcrops) (see Figure 2.4.2(a)). Major sand spits form Point Monroe and Battle Point. Extensive rocky shorelines, which are uncommon in Central Puget Sound, exist in portions of Blakely Harbor, Restoration Point, and along Rich Passage. The shoreline topography varies form relatively flat or gently sloping to high, nearly vertical bluffs. The nearshore geomorphology of Bainbridge Island is mapped in Figure 7.3.2(c).

The nearshore is the narrow strip of water and land where direct functional interactions occur between the aquatic and terrestrial environments. The nearshore extends subtidally to the depth of the photic zone (generally to a maximum depth of 30 meters MLLW). The nearshore includes all of the intertidal and backshore zones and extends upland to include the marine riparian zone. The landward extent of the marine riparian zone in Puget Sound has not been well defined by the scientific community, but the Bainbridge Island Nearshore Assessment utilized a reasonable distance of 200 feet landward of the ordinary high water mark because it is generally consistent with the scientific literature and it is the jurisdictional extend of shoreline management within the State of Washington. (Williams et al 2003 & 2004)



(*Image source: King County*)

Chinook, coho, chum, pink, cutthroat, and steelhead as well as forage fish (surf smelt, sandlance, and herring) are known to use the Bainbridge Island nearshore (Figure 2.4(b); Dorn & Best 2005; Williams et al 2003 & 2004). Forage fish spawning beaches have not been thoroughly documented (Williams et al 2003 and 2004) and should be comprehensively surveyed.

Williams et al (2003) summarized the best available science related to the Bainbridge Island nearshore and provides most of the technical basis for our scientific understandings and hypotheses about the nearshore ecosystem and ultimately provides the basis for evaluating the condition of the nearshore ecosystem. Williams et al (2003) identified nearshore habitats and discussed associated habitat structure, diagnostic species, functions, and stressors. These habitats include:

- Eelgrass Meadows
- Kelp Forests
- Flats
- Tidal Marshes
- Subestuaries (stream mouths and deltas)
- Sand Spits
- Beaches and Backshore
- Banks and bluffs
- Marine Riparian Zone.

Williams et al (2003) also identified and discussed nearshore physical processes and biological resources, and how they relate to habitat. Additionally, they summarize current scientific knowledge about the effects of nearshore modifications on physical processes, habitats, and biological resources, including salmon. Williams et al (2003), in its entirety, is located in Appendix H of this document. In order to avoid duplication, the reader is directed to that document for a thorough discussion of physical processes, habitat, and biological resources in the nearshore and the effects of human modification on them.

The City of Bainbridge Island conducted a very detailed inventory of nearshore modifications (including location and descriptive information) as well as selected nearshore biological and physical characteristics during the summer of 2001 (Best 2004; COBI 2001). Figures 2.4.2(g) and 2.4.2(h) show the distribution and density of most shoreline modifications inventoried along the shores of Bainbridge Island. Williams et al (2004) used that inventory information as well as other data representing biological resources and additional shoreline modifications (see Figures 2.4.2(b) through 2.4.2(f)) to conduct a comprehensive habitat characterization and ecological function assessment of the Bainbridge Island nearshore using a refined version of the conceptual model developed by Williams and Thom (2001), which is discussed further in section 7.3.3 below.

The assessment used two nested landscape scales as shown in Figure 7.3.3(b), including 9 Shoreline Management Areas (aggregations of drift-cells) and 201 shoreline reaches (Williams et al 2004; areas of generally homogenous geomorphology largely based on ShoreZone units, see WDNR 2001). Figure 2.4.2(i) shows the qualitative results of the assessment for ecological impacts by Management Area and reach. At the management area scale, most of the Island's nearshore is considered at risk (i.e. rated as moderate impact), which indicates that there is opportunity to improve the nearshore to an ecological condition considered to be properly functioning, however it also indicates that further impacts could result in an ecological condition considered to be not properly functioning. Two management areas (Murden Cove and Blakely Harbor) are somewhere between a properly functioning and at risk condition (i.e. rated as low/moderate impact). The assessment results indicate that no shoreline management area is considered to be properly functioning (i.e. no or low impact). Table 2.4.2 summarizes basic Management Area characteristics.

The Bainbridge Island Nearshore Characterization and Assessment report, in its entirety, is located in Appendix H of this document. In order to avoid duplication, the reader is directed to that document for a thorough discussion of the existing conditions of the Bainbridge Island nearshore.

Figure 2.4.2(a). Bainbridge Island Nearshore Geography.
(*From Williams et al. 2003*)

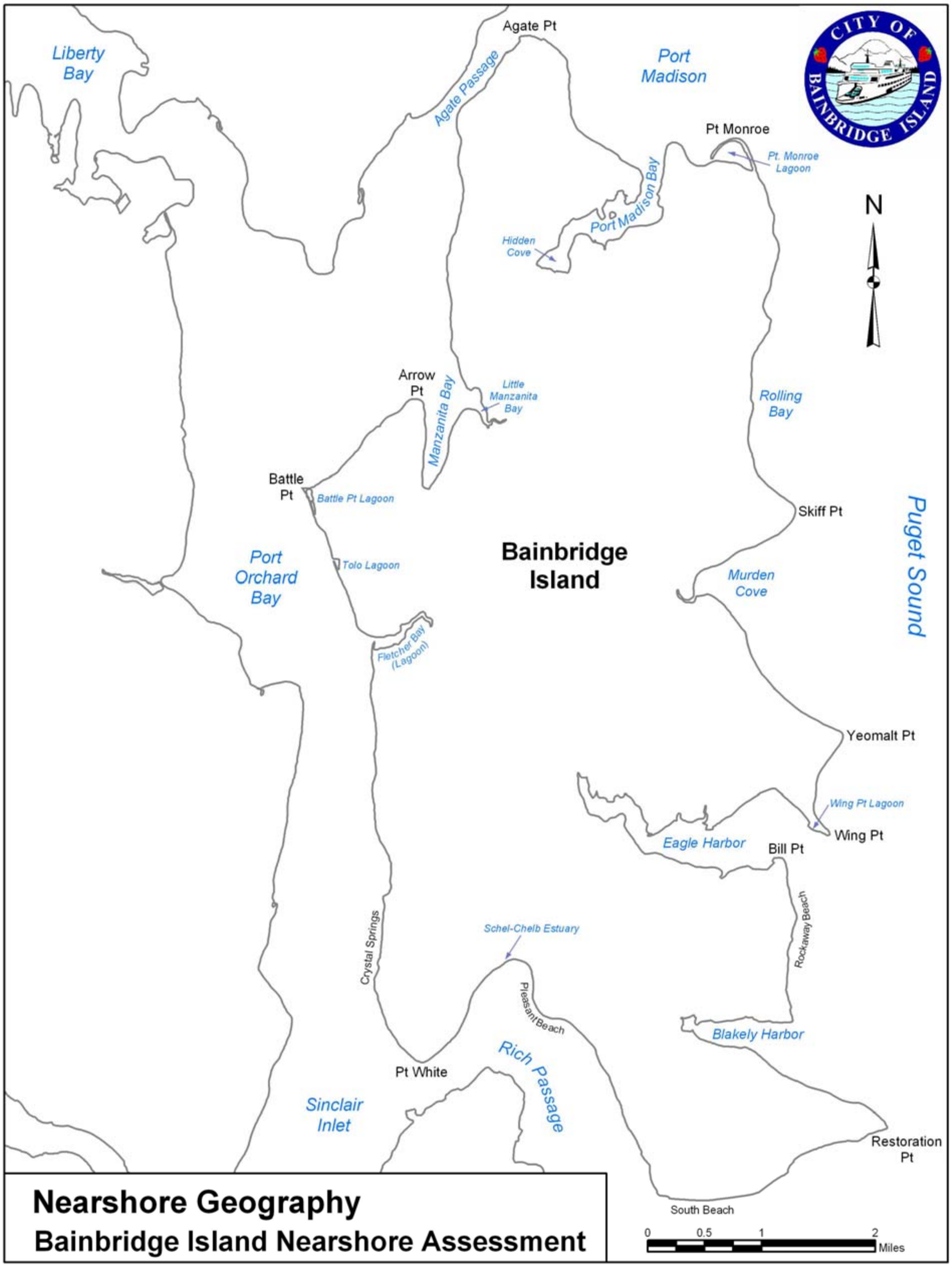


Figure 2.4.2(b). Bainbridge Island Sediment Sources and Wave Exposure
[*From: Williams et al 2004*]

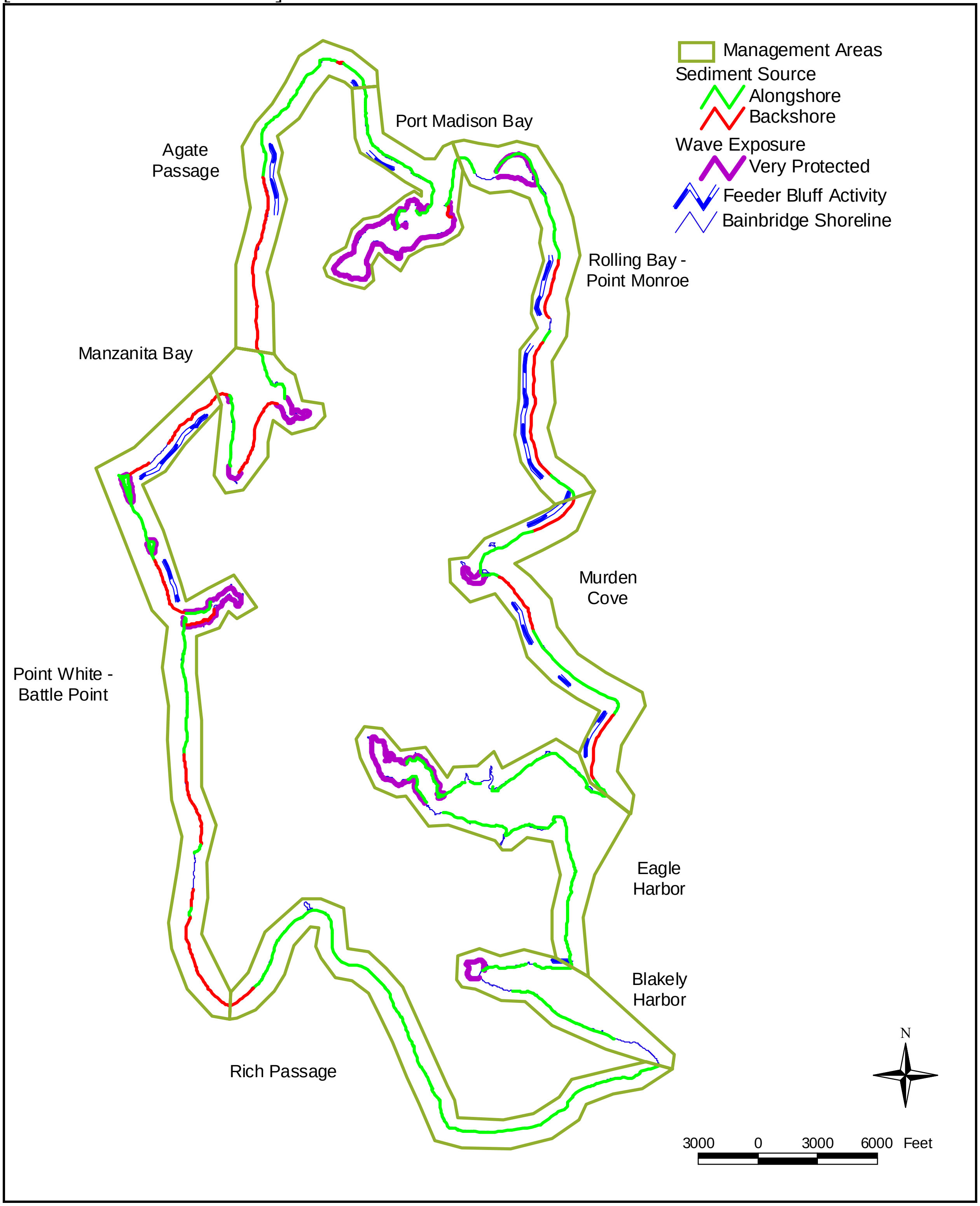


Figure 2.4.2(c). Bainbridge Island Overhanging Riparian and Saltmarsh Vegetation
[*From: Williams et al 2004*]

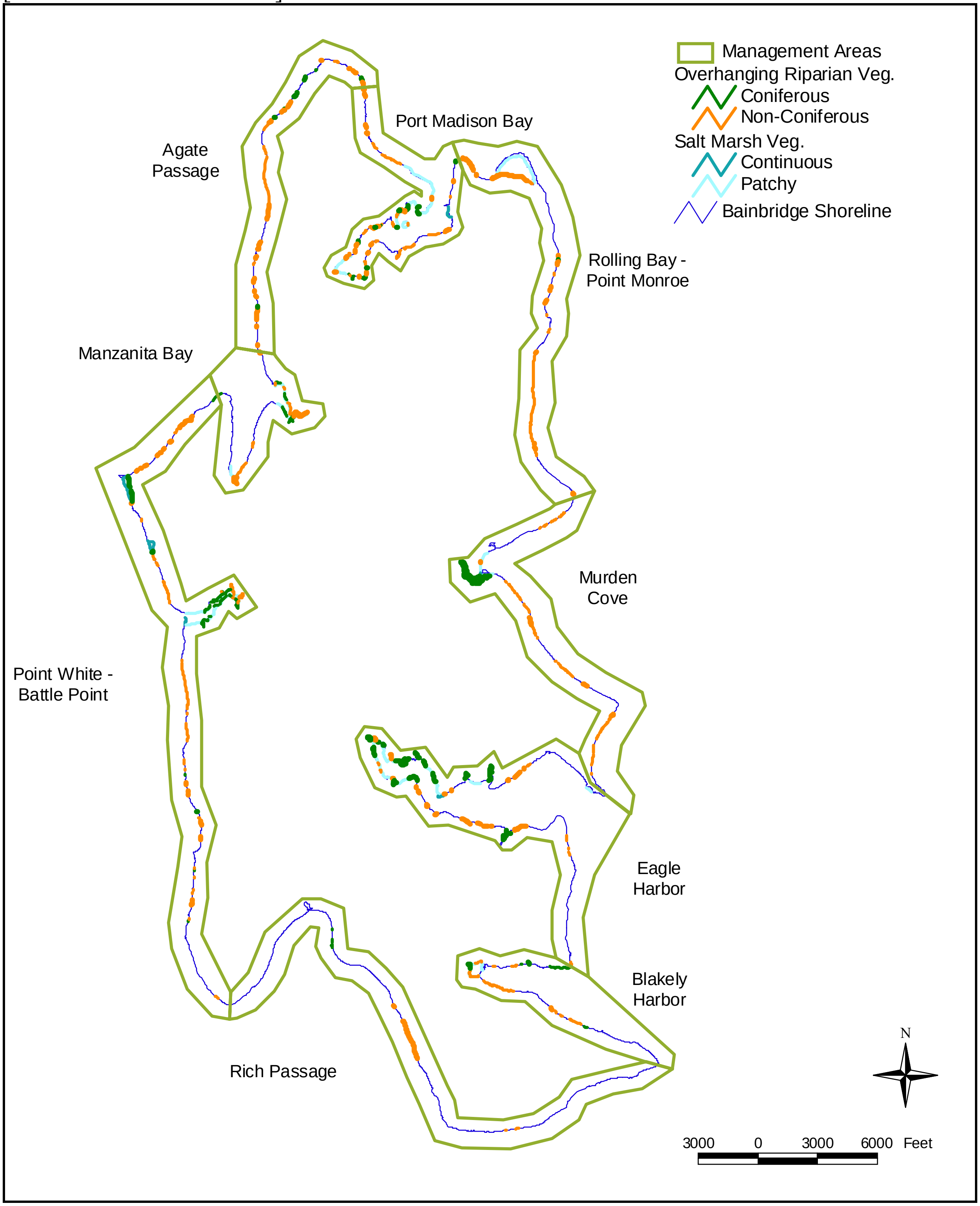


Figure 2.4.2(d). Bainbridge Isalnd Eelgrass, Kelp, and Seaweed Distribution
[*From: Williams et al 2004*]

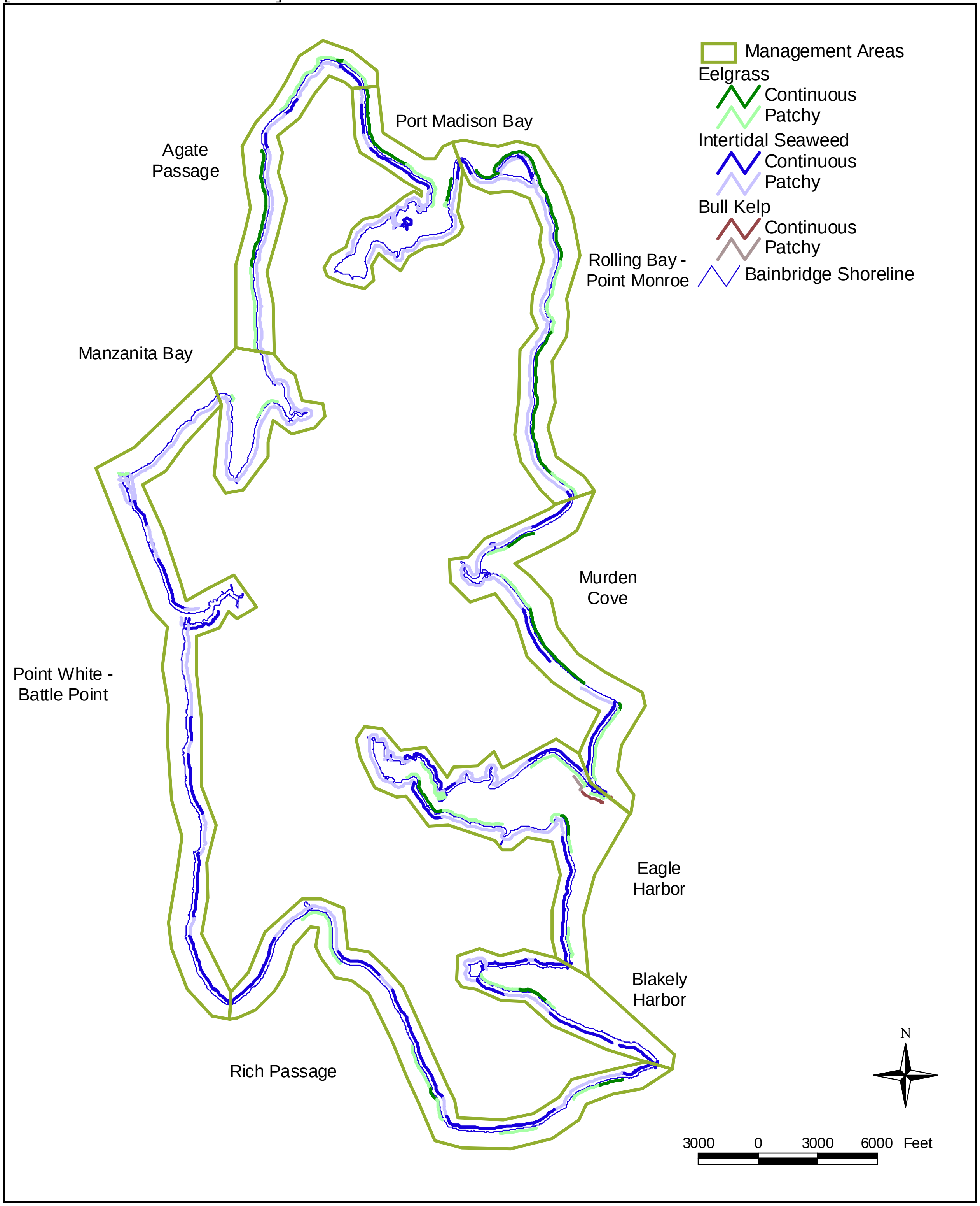


Figure 2.4.2(e). Bainbridge Island Riparian Zone Land Cover Classes
[*From: Williams et al 2004*]

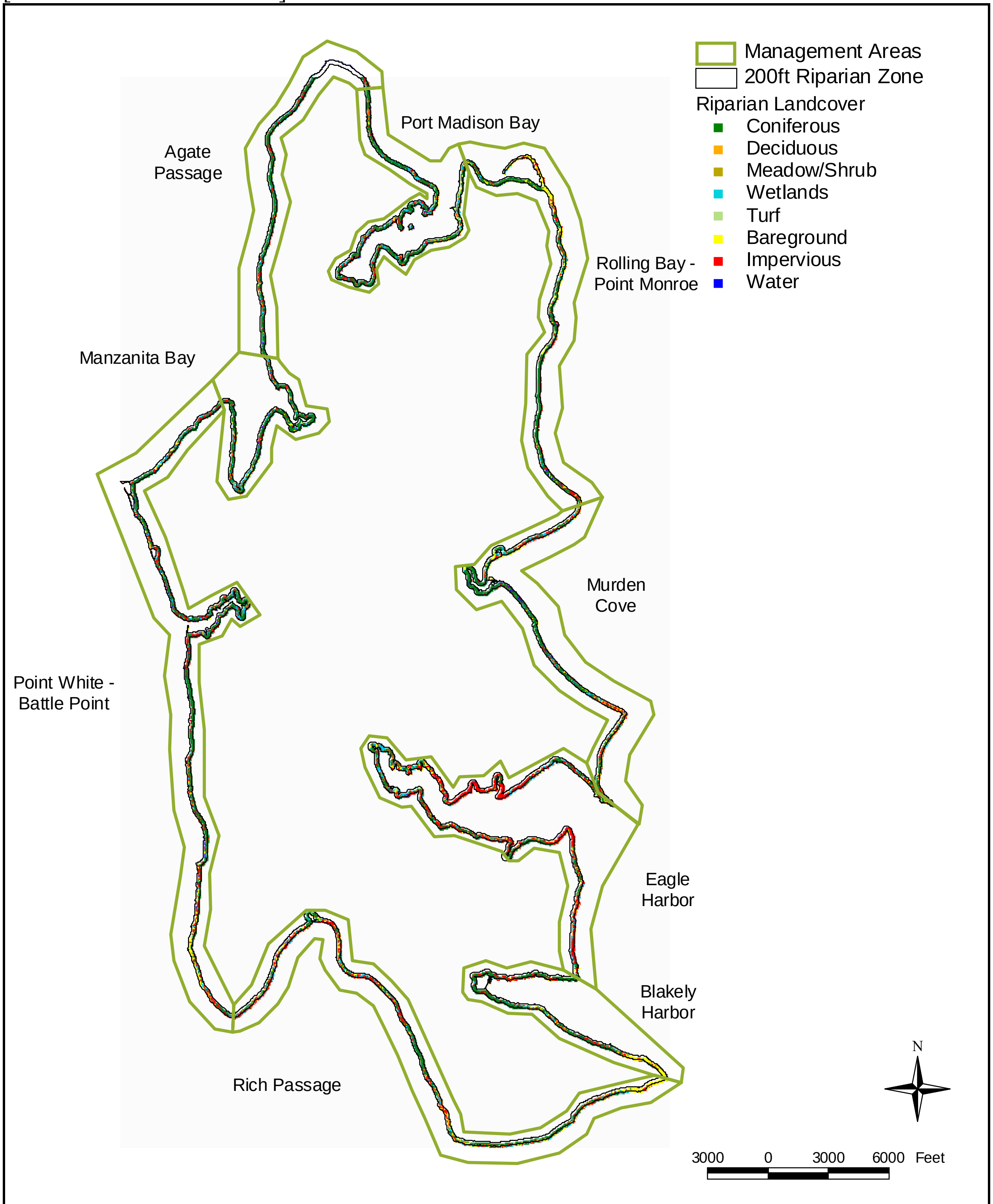


Figure 2.4.2(f). Bainbridge Island Shellfish Closures, Dredging, Tidal Constrictions, Urban Waterfront, Fish Farms, and Marina Locations
[*From: Williams et al 2004*]

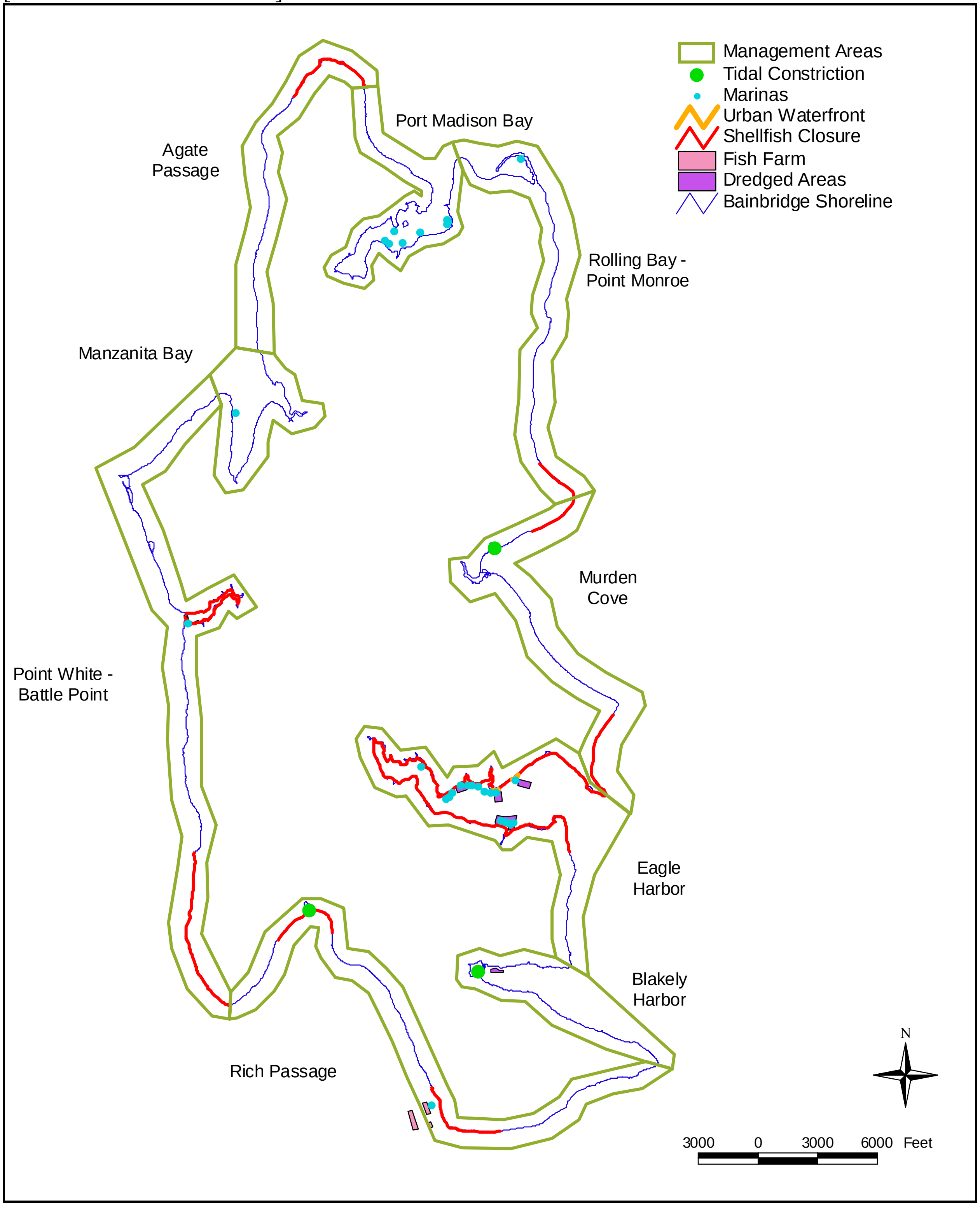


Figure 2.4.2(g). Bainbridge Island Shoreline Armoring and Armoring Encroachment. (*From Williams et al. 2004*)

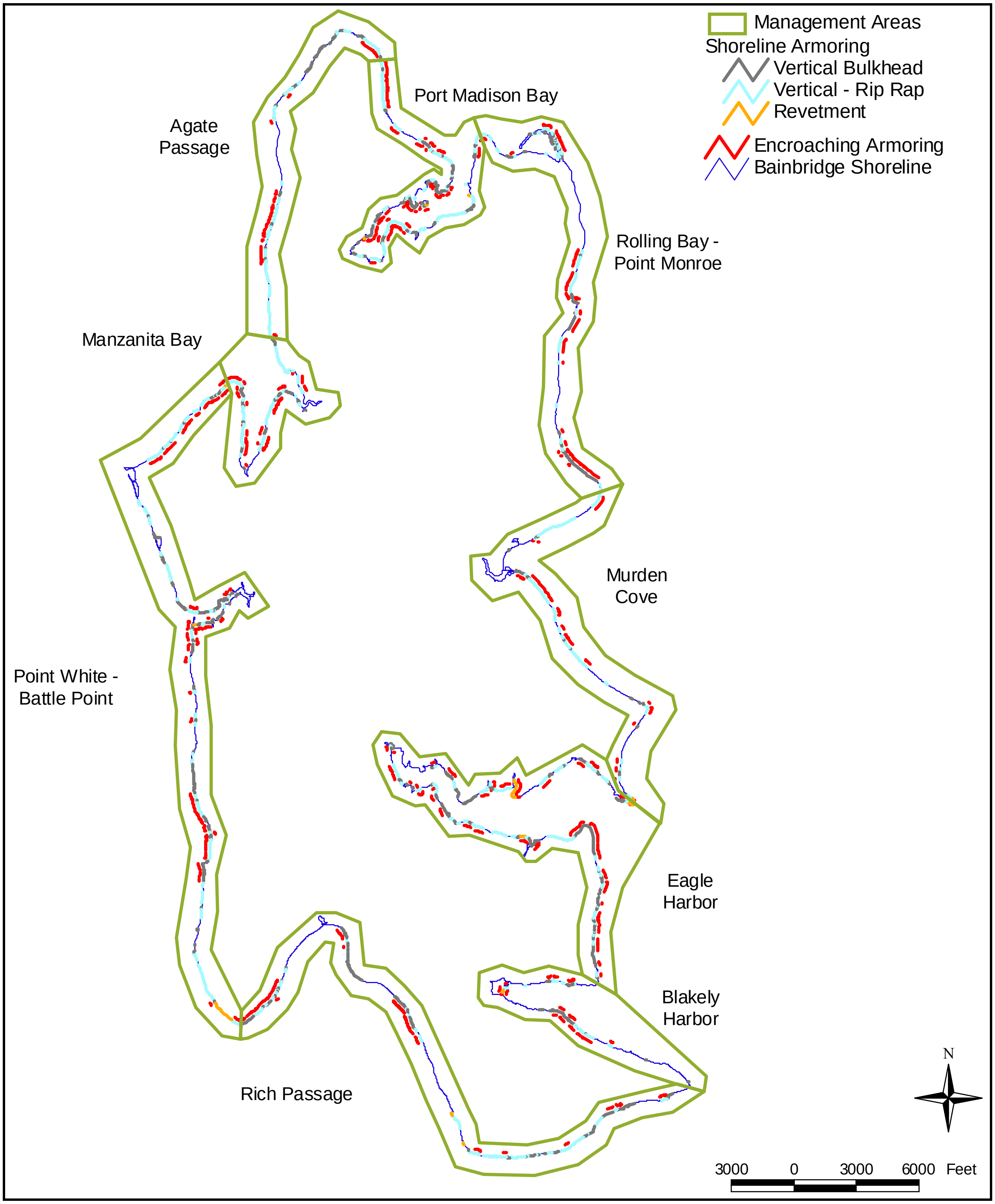


Figure 2.4.2(h). Bainbridge Island Point Modifications.
(*From Williams et al. 2004*)

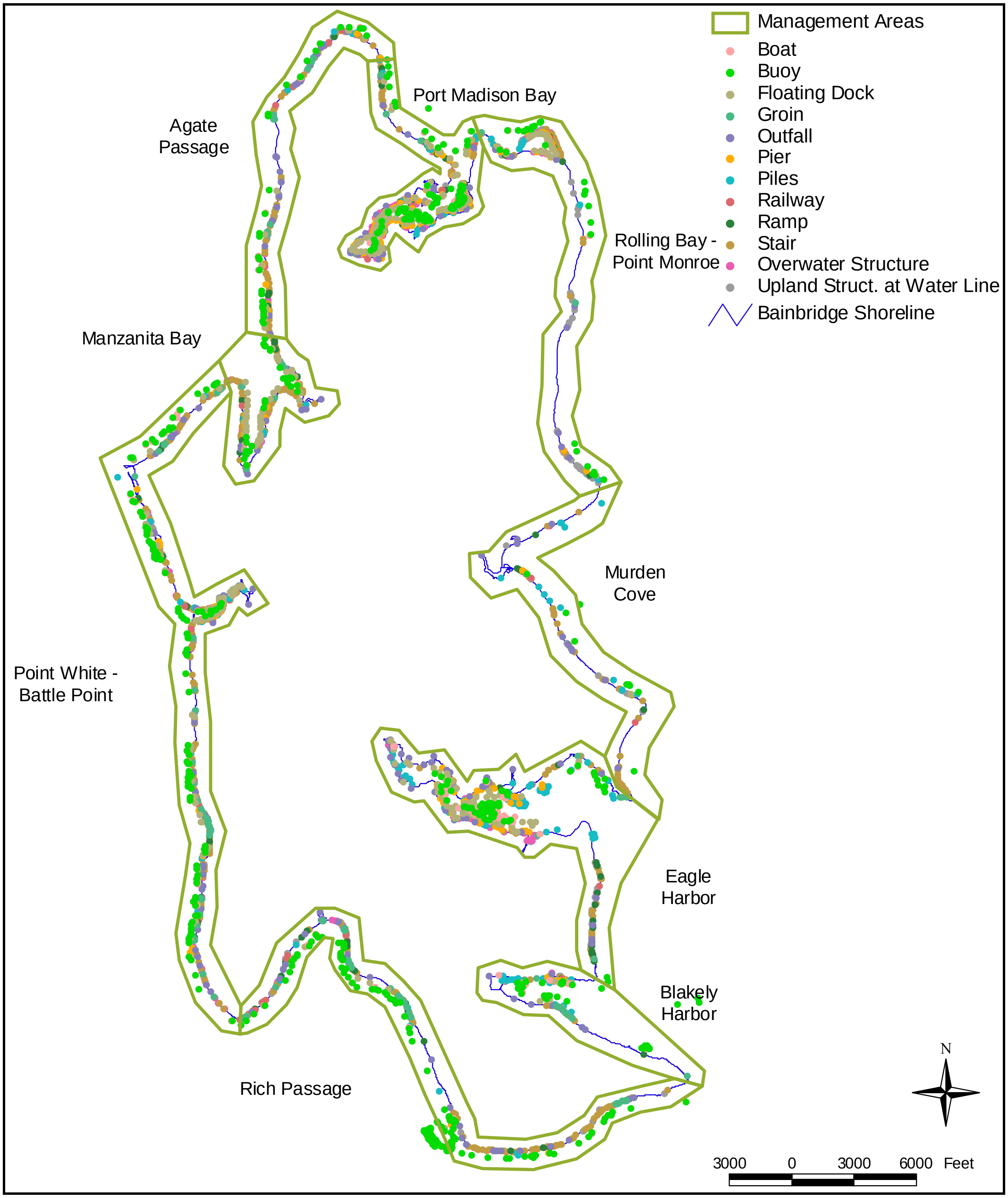


Figure 2.4.2(i). Bainbridge Island Qualitative Rating of Ecological Impact to Reach and Management Areas.
(*From Williams et al. 2004*)

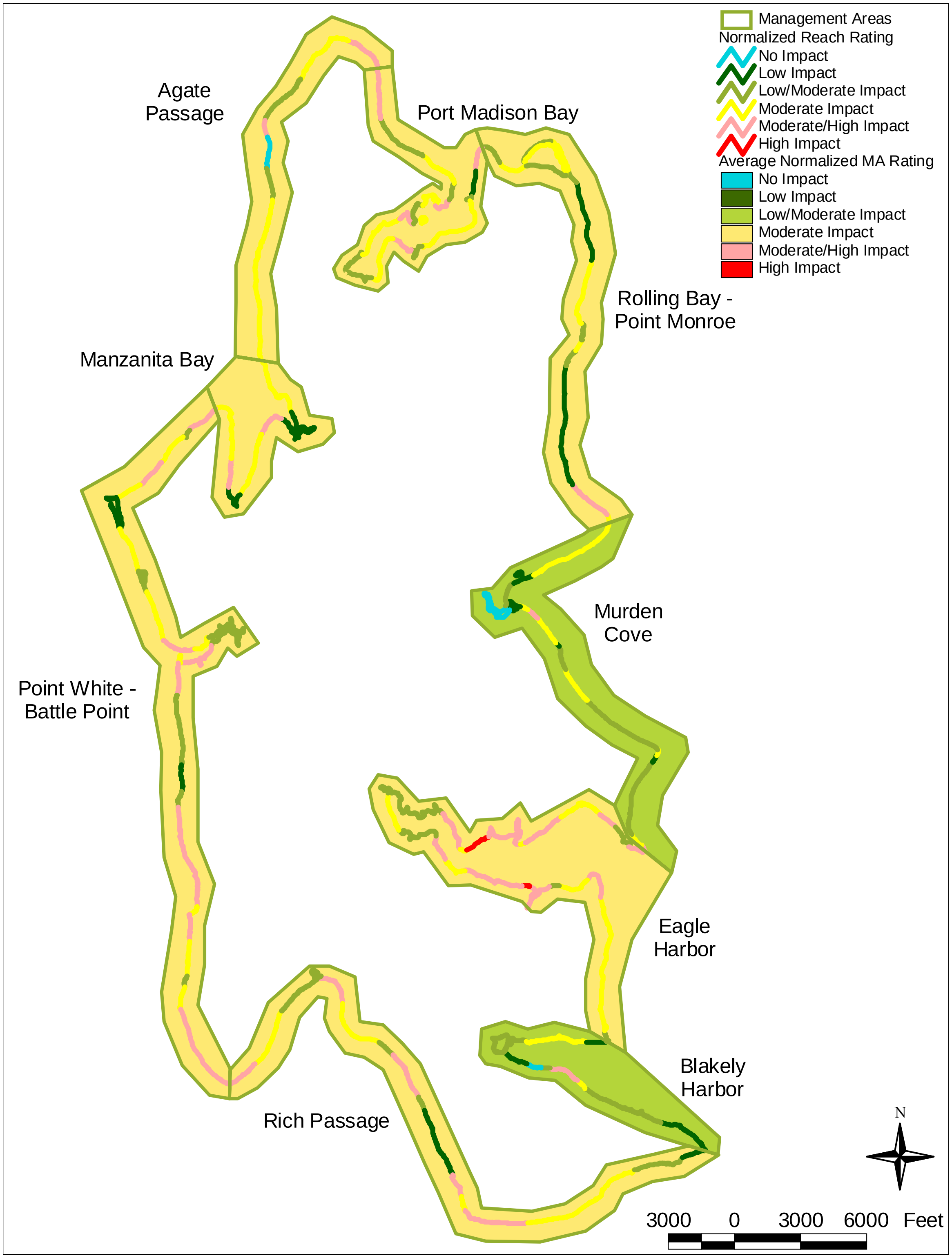


Table 2.4.2. Bainbridge Island Nearshore Characteristics by Management Area.

(*From Williams et al. 2004*)

	Agate Passage	Port Madison Bay	Rolling Bay - Point Monroe	Murden Cove	Eagle Harbor	Blakely Harbor	Rich Passage	Point White - Battle Point	Manzanita Bay	Island Total
Total Length (ft)	19,495	32,037	29,707	28,843	46,054	20,345	34,565	51,650	18,879	281,575
Armored (%)	57%	61%	38%	34%	53%	22%	52%	50%	57%	48%
Armor Encroaching (%)	21%	35%	27%	19%	30%	17%	21%	22%	29%	25%
Point Modification Density (#/1000ft)	12.1	13.9	9.8	3	11	6.5	11.6	11.9	11.5	10.4
Overhanging Riparian Veg (%)	36%	26%	29%	36%	23%	29%	8%	32%	35%	27%
Forest Cover in Riparian Zone (%)	72%	66%	57%	58%	36%	59%	42%	56%	70%	54%
Total Impervious Surface in Riparian Zone (%)	17%	14%	17%	18%	45%	19%	26%	22%	12%	23%
Geomorphology										
- High Bluff (%)	80%	32%	57%	52%	15%	0%	0%	29%	28%	30%
- Low Bank (%)	20%	16%	5%	4%	9%	31%	11%	14%	19%	13%
- Marsh/ Lagoon (%)	0%	33%	12%	16%	42%	15%	4%	29%	41%	23%
- Spit/Barrier/ Backshore (%)	0%	19%	27%	28%	34%	18%	79%	28%	13%	32%
- Rocky (%)	0%	0%	0%	0%	0%	36%	6%	0%	0%	2%
Ecological Impact										
- No	7%	0%	0%	14%	0%	4%	0%	0%	0%	2%
- Low	0%	4%	32%	17%	0%	24%	12%	12%	34%	13%
- Low/Mod	21%	30%	25%	35%	25%	47%	22%	27%	0%	26%
- Moderate	57%	45%	36%	31%	31%	18%	36%	24%	50%	35%
- Mod/High	14%	22%	7%	3%	41%	8%	30%	37%	15%	23%
- High	0%	0%	0%	0%	4%	0%	0%	0%	0%	1%

2.5 - Kitsap Salmonid Refugia

The Kitsap Salmonid Refugia Report (May & Peterson 2003) identified and characterizes areas that are critical for salmon. Areas that qualify as refugia typically have habitat features such as intact streamside forests, undeveloped floodplains, wetlands, and natural shorelines. Refugia are used intensively by salmon compared to non-refugia areas – they are biological "hot-spots." For more information on the identification and categorization process refer to the full report or Appendix B (Executive Summary).

The 29 streams and nearshore areas (in bold) that contain Category A, B & C refugia are shown in Table 2.5(a). In Category D there are 15 streams and 7 nearshore areas that are considered potential future refugia due to significantly degraded habitat conditions (see Table 2.5(b)). The nearshore designations should be considered interim results because at the present time, our knowledge of nearshore salmonid utilization is relatively basic and is rapidly expanding. In addition, the database on nearshore salmonid habitat conditions is also relatively sparse. Therefore the nearshore salmonid conditions should be considered as "interim" until more and better data is developed, such as the Bainbridge Island Nearshore Habitat Assessment.

Table 2.5(a). East Kitsap Refugia (nearshore in bold)

Highest Category	Stream/Nearshore Name	Subwatershed
A	Chico Creek	
A	**Point No Point Nearshore**	
B	Anderson Creek	
B	Barker Creek	
B	Blackjack Creek	
B	**Foul-Weather Bluff Nearshore**	
B	**Murden Cove Nearshore**	Bainbridge Island
B	**Rolling Bay Nearshore**	Bainbridge Island
B	Steele Creek	
C	Beaver Creek	
C	Blakely Harbor Creek (Mac's Dam Ck)	Bainbridge Island
C	**Burley Lagoon Nearshore**	
C	Carpenter Creek	
C	**Case Inlet Nearshore**	
C	Coulter Creek	
C	Curley Creek	
C	Fletcher Creek (Springbrook/Island Center Creek)	Bainbridge Island
C	Gazzam Creek	
C	Gorst Creek	
C	Grovers Creek	
C	Illahee Creek	
C	Indianola Creek	
C	Kitsap (North) Creek	

C	Minter Creek	
C	Olalla Creek	
C	Rocky Creek	
C	Salmonberry Creek	
C	Silver Creek	
C	Steele Creek	

Table 2.5(b). East Kitsap "Potential Refugia" (nearshore in bold)

Category	Stream/Nearshore Name	Subwatershed
D	**Agate Passage**	Bainbridge Island
D	Bjorgen Creek	
D	**Brownsville**	
D	Burley Creek	
D	Clear Creek	
D	**Colvos Passage**	
D	Cowling Creek	
D	Dogfish Creek	
D	**Dyes Inlet**	
D	**Eagle Harbor**	Bainbridge Island
D	Fern Creek	
D	**Fletcher Bay**	Bainbridge Island
D	Hudson Creek	
D	**Illahee Estuary**	
D	Lemolo Creek	
D	Manzanita Creek	Bainbridge Island
D	Murden Creek (Grisdale/Woodward/Meigs Ck)	Bainbridge Island
D	Sam Snyder Creek	
D	Schel-Chelb Creek	Bainbridge Island
D	Spring Creek	
D	Wright Creek	

3.0 - DISTRIBUTION AND CONDITION OF SALMON STOCKS

(Modified from: Haring 2000 and WDFW 2002)

The streams in East Kitsap WRIA 15 are generally small lowland streams. Many of the streams are short, but collectively the streams in East WRIA 15 provide over 215 miles of known salmonid use (including West Pierce County). Because of the low stream gradient and productive wetlands, the streams of East WRIA 15 rival the salmon productivity of many of the large river systems in Puget Sound. The diverse 270 mile marine shoreline of East Kitsap and Bainbridge Island also provides habitat for juvenile salmon.

The numerous streams in East Kitsap WRIA 15 primarily support chum and coho salmon, steelhead, and cutthroat trout. In addition, Williams et al. (1975) identified Chinook use in some of the larger streams. The only stream with consistent pink salmon returns in east Kitsap is Minter Creek (Williams et al. 1975). Sockeye are sporadically observed in several streams, but no established populations of sockeye have been observed in any WRIA 15 streams (Williams et al. 1975).

Nearshore waters of East Kitsap support Chinook, chum, pink, cutthroat, and some steelhead. East Kitsap and Bainbridge Island have about 270 miles of shoreline, including many inlets with quiet, shallow waters ideal for foraging and rearing habitat for juvenile salmon. Juvenile salmon are present along the shoreline in high numbers from March through July and in lower numbers throughout the year.

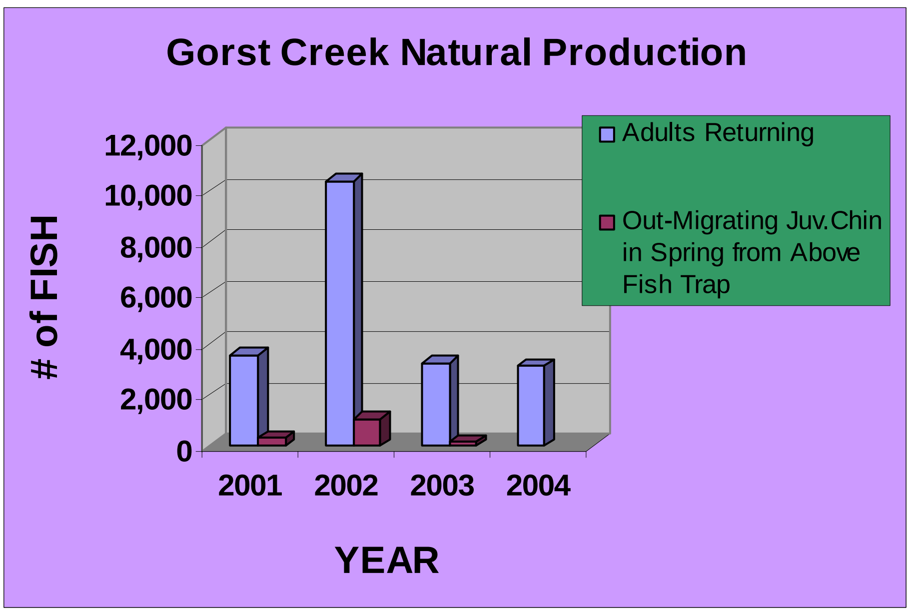
East WRIA 15 freshwater salmon, steelhead and cutthroat distribution (all species combined) is identified in Map 1, Appendix C (Haring, 2000) and general fish occurrence on Bainbridge Island is additionally identified in Figure 2.4(b). Adult and juvenile salmonid distribution is limited by natural and human-caused migration barriers, but may also be significantly influenced by decreased numbers of returning spawning adults (the extent of stream area utilized may decrease as adult or juvenile fish abundance declines), or by impaired habitat conditions that do not provide suitable spawning or rearing conditions. Most current distribution knowledge is based on contemporary stock assessment work (since 1965-1970), and likely represents a more confined distribution than occurred historically, when habitat and fish populations were healthier.

Anadromous salmonid distribution is limited in many East WRIA 15 streams by presence of natural (e.g. falls, cascades) and human-induced (e.g. culverts, dams, tide gates, reduced instream flow, etc.) fish passage barriers. Due to the low-gradient nature of East WRIA 15 streams, few natural barriers have been identified; most of the known barriers are human induced.

East WRIA 15 Fish passage barriers are on Map 7 of Appendix C (Haring, 2000) and additional fish passage barriers on Bainbridge Island are discussed in section 2.4.1.

3.1 - Chinook

East Kitsap streams lack the typical riverine Chinook habitat found in larger Puget Sound mainstem rivers. However, spawning adult Chinook are observed on a regular basis in numerous East Kitsap streams such as Coulter, Rocky, Minter, Burley, Gorst, Curley, Clear and Dogfish creeks. Chinook spawning in Gorst Creek has been increasing in recent years due to limited commercial value of salmon in terminal fishery. Most of these fish are believed to be returns from hatchery Chinook released from the Gorst rearing ponds; survival of progeny of naturally spawning fish appears to be low (Jay Zischke, Suquamish Tribe, personal communication). An escapement of 17,000 to the inlet (fishery plus stream escapement) in 2002 was the highest on record, with over 10,000 in Gorst Creek. Returns to the stream in the previous three years averaged around 2400 adult Chinook (Jay Zischke, Suquamish Tribe, personal communication). An out-migrant fish trap in Gorst Creek has been collecting juvenile Chinook data for the last 4 years. All indications point to poor natural Chinook production from this system as the following graph by Jon Oleyar, Suquamish Tribe, illustrates.

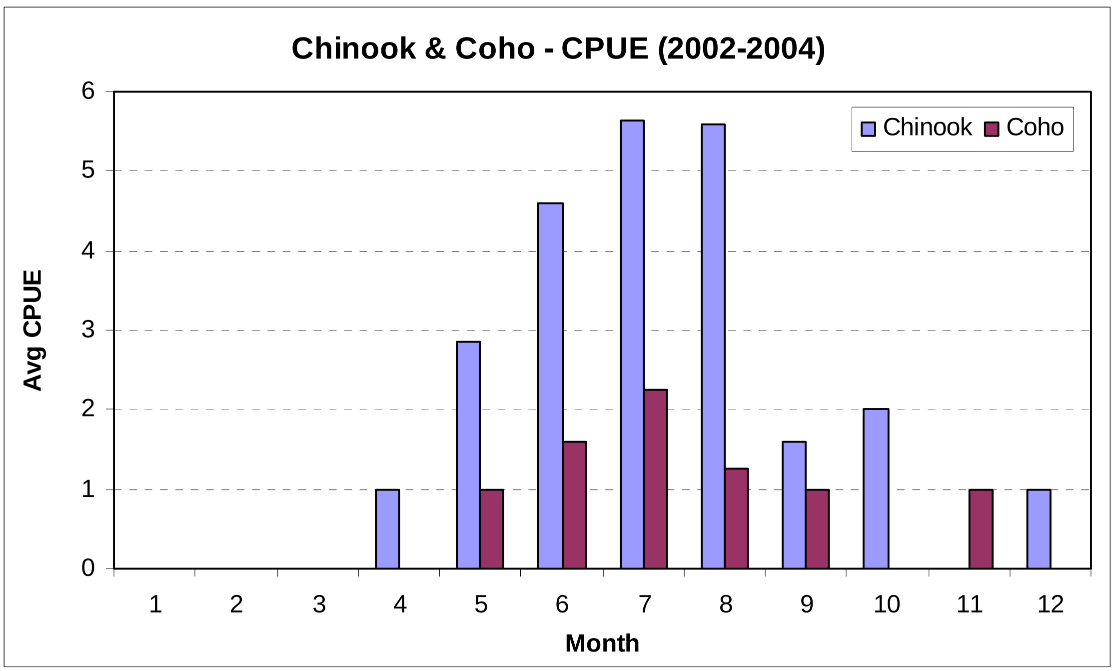


In addition to the larger drainages, recent observations indicate small numbers of adult Chinook straying into smaller streams such as McCormick, Crescent, Olalla, Blackjack, Clear, Barker, Steele, and Grovers creeks (WDFW & Suquamish Tribe, unpublished data). Chinook tend to utilize lower mainstem areas with large quantities of gravel and greater flows. Use of other smaller independent drainages in East Kitsap by Chinook is minimal, since these streams exhibit very low flows during the normal Chinook migration and spawning periods (Williams et al. 1975). Current returns of spawning adult Chinook are thought to be primarily the result of returns from Chinook enhancement programs (hatcheries, netpens, juvenile outplants). It is unknown whether, or to what extent, adult Chinook returns are the result of natural spawning. To identify naturally spawning Chinook, the CoManagers mass mark all E Kitsap Chinook, except a double index component of Grovers Creek Chinook production, and monitor the adult

Chinook returns to the hatcheries and local streams for presence, or absence, of marks as well as cwt's.

Upstream migration of adult fall Chinook in these lowland streams typically extends from early September through October, depending on stream flows and water temperature. Peak spawning occurs between mid-September and mid-October, and is usually completed in all small streams by the end of October (J. Oleyar, pers. comm.). Following incubation and subsequent fry emergence, the majority of Chinook fry rear in these lowland systems for 3-4 months and enter the estuaries around May or early-June, depending on the spring runoff flows.

Juvenile Chinook from small stream systems typically move into marine waters in late spring. Shallow nearshore waters provide protection from predators and support prey items. Recent beach seine studies by WDFW, Suquamish, and the City of Bainbridge Island indicate that Chinook salmon occupy the nearshore regions of East Kitsap nearly year-round with peak abundance from May through August as shown in the following tables from Dorn and Best, 2005 (Appendix ?):



In addition to Chinook from local streams, East Kitsap shorelines are host to juvenile Chinook from river systems throughout Puget Sound. Coded-wire tag recoveries of subyearling hatchery Chinook indicate that fish from Nisqually to the Fraiser River in Canada inhabit Sinclair Inlet during shoreline migration (Fresh et al. 2002). Coded wire tag recoveries from terminal commercial fisheries within this same area also show a mixed-origin of adult Chinook and coho. The shallow, protected waters of East Kitsap are likely important for wild salmon from other Puget Sound watersheds as well as hatchery fish. The following table summarizes the origins of cwt Chinook recovered in the COBI beach seining during 2002 – 2004:

Table 3: Chinook CWT Origin (2002-2004)

WRIA	Release Location	2002	2003	2004	**Total**
9	Big Soos (Green River)	5			**5**
10	Clarks Creek			1	**1**
15	Clear Creek			1	**1**
15	Gorst Creek	1	4	2	**7**
15	Grovers Creek		13	4	**17**
8	Issaquah Creek		2		**2**
15	Minter Creek			2	**2**
11	Nisqually River	1			**1**
10	Voight Creek			1	**1**
7	Wallace River			3	**3**
10	White River	1			**1**
Total		**8**	**19**	**14**	**41**

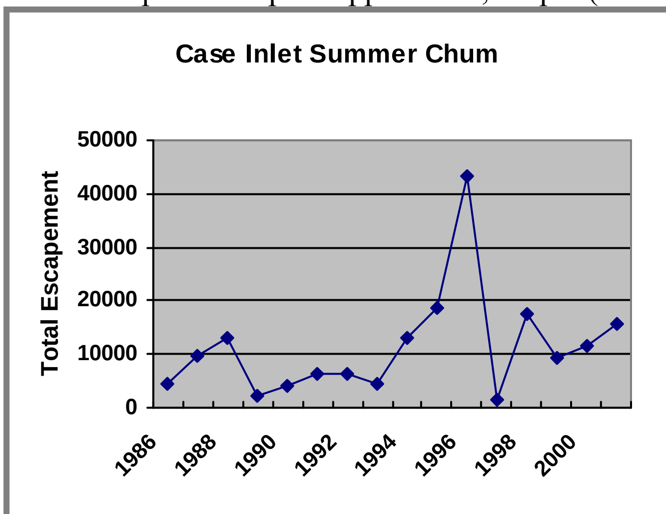
The Salmon and Steelhead Stock Inventory (SaSI 2002) identifies the South Sound Tributaries Summer/Fall Chinook stock as including Chinook production from East Kitsap streams and Case and Car Inlets in WRIA 15, as well as other south Puget Sound streams. It also identified that there are no genetic stock identification data for naturally spawning South Sound Chinook. The grouping of seemingly widely distributed Chinook was based on a history of extensive stock transfers from basin to basin and considerable hatchery outplants and associated straying of hatchery–origin Chinook in south Puget Sound. In SaSI 2002, the fall Chinook spawning aggregations observed in south Puget Sound independent tributaries are not rated. The Co-managers support this action with the following rationale: (1) The independent tributaries in south Puget Sound are not typical Chinook habitat because of relatively small stream size and low flows during the late summer/early fall spawning season. (2) The current low escapements (outside of streams that support on-station Chinook production programs) are likely the result of past hatchery plants or straying from either current South Sound hatchery production or viable South Sound natural populations. (3) Fall Chinook likely were not historically self-sustaining in these habitats and have little chance of perpetuating themselves through natural production. Distribution of Chinook in East WRIA 15 streams is shown on the chum species map in Appendix C, Map 2 (Washington Conservation Commission 2000).

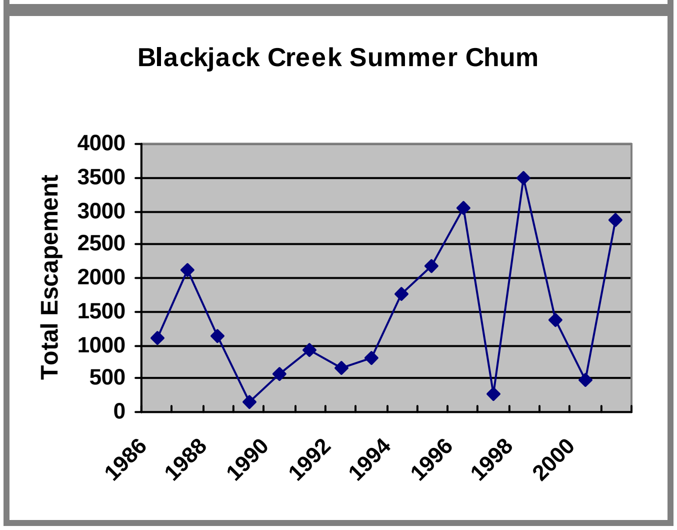
3.2 - Chum Salmon

Kitsap Peninsula streams produce large numbers of chum salmon. The low gradient streams of the area provide good spawning area. Chum rear in shallow nearshore waters prevalent on shorelines of East Kitsap and Bainbridge Island. Chum salmon abundance in the nearshore is very high during March through June with smaller numbers of fish present until early fall. Some of these fish enter marine waters at very small size (around 30 mm) with yolk-sac absorption not entirely complete.

3.2.1 - Summer Chum

SaSI identifies two distinct summer chum stocks as present in WRIA 15 streams: Case Inlet Summer Chum (this stock also includes summer chum spawning in several streams in WRIA 14) and South Sound-Blackjack Creek Summer Chum. Each of these stocks is identified as a separate stock because they are isolated from other Puget Sound stocks by geographic and temporal separation and are genetically distinct. Case Inlet summer chum spawn from September to late October; Blackjack Creek summer chum spawn during October. There are no directed fisheries on these stocks; however, these fish are impacted by mid-Puget Sound coho net fisheries. The status of both of these summer chum stocks is designated in SaSI as Healthy. The Coulter Creek hatchery was used to supplement wild summer chum spawning in Case Inlet streams, and is thought to have been a major contributor to large returns of wild summer chum into Coulter Creek. The supplementation project was discontinued in 1992 (Haring, 2000). Distribution of chum (summer and fall stocks combined) in East WRIA 15 streams is shown on the chum species map in Appendix C, Map 3 (Haring, 2000).





(SaSI 2002)

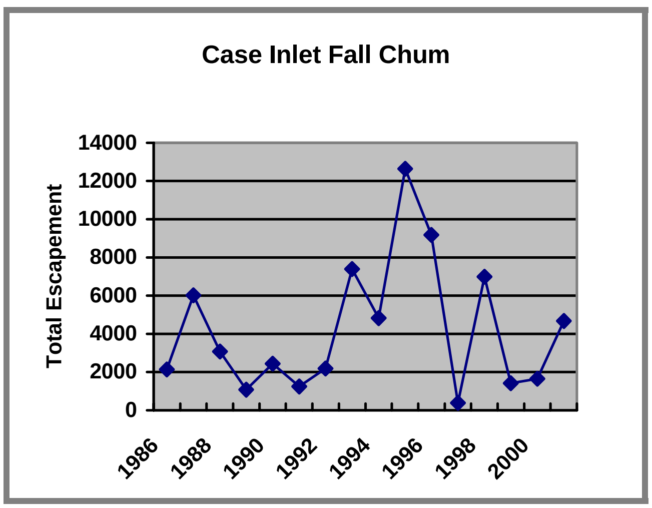
<u>Note:</u> In 2002 the Suquamish Tribe took genetic samples of chum salmon in Curley Creek and in March of 2003 the WDFW genetics lab confirmed that the Curley Creek Chum stock is a

genetically distinct run of summer timed chum, which spawn in October. – stock status is healthy (J. Oleyar, pers. comm.).

3.2.2 - Fall Chum

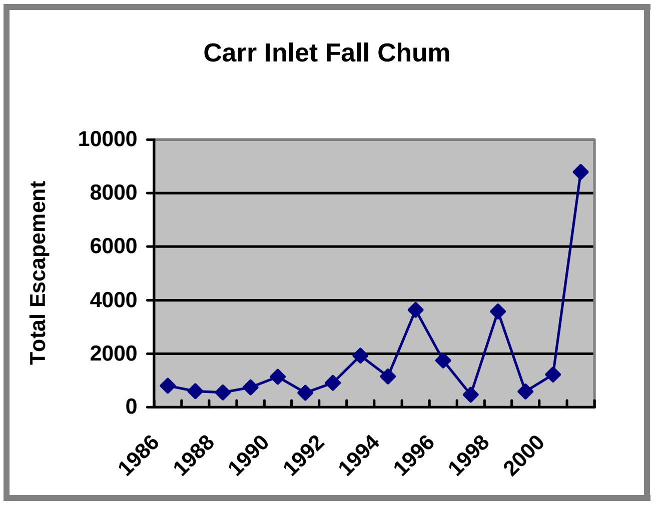
SaSI 2002 designates five distinct fall chum stocks for East WRIA 15 streams. These include the Case Inlet and Carr Inlet fall chum stocks in South Sound, and the Gig Harbor/Olalla Creek, the Dyes Inlet/Liberty Bay, and the Sinclair Inlet fall chum stocks in South Sound/East Kitsap.

Case Inlet fall chum were identified as a distinct stock based on isolation from other Puget Sound stocks by geographic separation and run timing, and because they have distinct genetic characteristics. Returns of spawning adult wild fall chum to Coulter, Sherwood (WRIA 14), and Rocky Creeks are specifically identified in SaSI, although fall chum are found in numerous other creeks in Case Inlet (Washington Conservation Commission 2000). Spawning occurs from early December to mid-January, reflecting a temporal separation from other Puget Sound stocks. Past hatchery releases have been made into most area streams (Washington Conservation Commission 2000). Juvenile chum plants to Sherwood Creek used local native brood stock, but non-local chum from Minter Creek were planted into Coulter Creek for at least two years. It is unknown to what extent the native stock may have been changed from its original form (SaSI). The stock status is identified in SaSI 2002 as being Healthy.



(SaSI 2002)

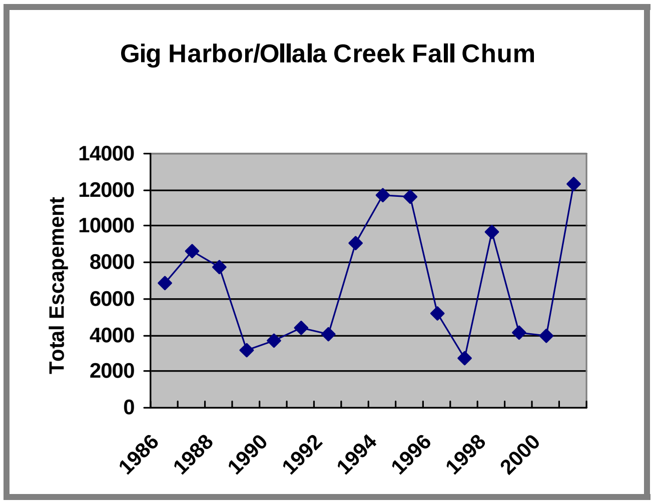
Carr Inlet fall chum are identified as a separate stock based on isolation from other Puget Sound stocks by geographic distribution (SaSI 2002). Spawn timing is from mid-November to early January. SaSI specifically identifies Carr Inlet fall chum presence in Burley and Lackey creeks, although fall chum are present in numerous other tributaries to Carr Inlet (Washington Conservation Commission 2000). In addition, several streams on the south side of the Gig Harbor Peninsula and on Anderson Island that support chum were identified during the preparation of the East Kitsap Limiting Factors Analysis (Washington Conservation Commission 2000), but that are not specifically included in any of the designated SaSI fall chum stocks. Escapements increased substantially beginning in 1995 and have remained at high levels, primarily because of a successful chum salmon enhancement program at the Minter Creek Hatchery. Heavy hatchery introductions and straying of Minter Creek hatchery origin chum has probably influenced the genetic makeup of wild spawning fish in most Carr Inlet streams. Prior to 1992, the Minter Creek Hatchery reared and released fall chum of Hood Canal origin. By 1992, this stock was replaced with the South Sound-origin Elson Creek Hatchery stock. SaSI indicates that the stable fall chum escapement to Lackey Creek may represent the lone remaining fall chum native to Carr Inlet. The aggregate Carr Inlet fall chum stock is considered mixed native/hatchery with stock status designated as Healthy (SaSI).



(SaSI 2002)

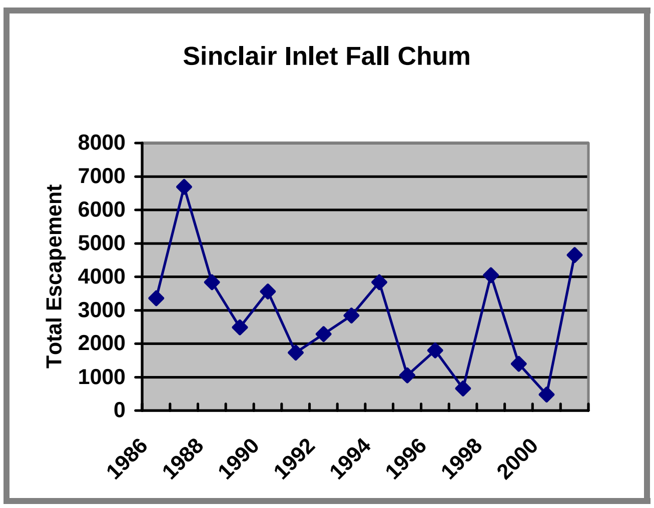
Gig Harbor/Olalla fall chum are identified as a stock based on isolation from other Puget Sound fall chum stocks by geographic and temporal distribution (SaSI 2002).

SaSI specifically identifies presence of this stock in North (Donkey), Crescent, Olalla, and Curley creeks although fall chum are present in several other small creeks in this geographic area (Washington Conservation Commission 2000). *(Curley Creek chum have subsequently been genetically distinguished as a summer stock. See the note following the summer chum discussion above related to early spawning times and genetic testing of Curley Creek chum.)* This stock spawns mainly from late-November through December, although Olalla fall chum may spawn as late as mid-January. Escapements increased substantially beginning in 1995 and have remained at high levels, primarily because of the contributions of a local hatchery program (SaSI 2002). North (Donkey) Creek production has been supported by the Minter Creek Hatchery. Prior to 1989, the hatchery released fall chum of Hood Canal origin. These fish were replaced by Elson Creek Hatchery fall chum (a South Sound stock) by 1992. Chum in Olalla, Curley and Crescent creeks may be native. Adult spawning chum in these streams may also include fall chum strays from the Minter Creek Hatchery. The stock is considered to be a mixed-origin stock, and the stock status is designated as Healthy (SaSI 2002).



(SaSI 2002)

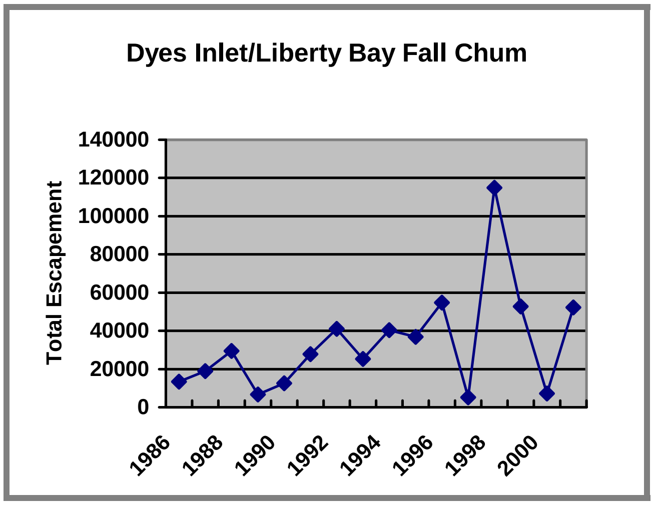
Sinclair Inlet fall chum are genetically similar to Chico Creek stock, but are identified as a stock based on isolation from other Puget Sound stocks by geographic distribution, and similarity in spawn timing of individual Sinclair Inlet streams. Spawning occurs from December through mid-January, creating a temporal separation from the earlier-spawning Dyes Inlet/Liberty Bay stock. SaSI identifies major spawning tributaries as including Gorst, Anderson, Ross, and Blackjack creeks, although fall chum are present in several other small creeks in this geographic area (Washington Conservation Commission 2000). The stock is considered to be of native origin, and the stock status is designated as Healthy (SaSI 2002).



(SaSI 2002)

Dyes Inlet/Liberty Bay fall chum were identified as a single stock because of similar spawn timing between the two inlets, and because of isolation from other Puget Sound stocks by geographic distribution and to some degree temporal separation (SaSI). SaSI identifies the major streams for this chum stock as Chico, Clear, Barker, Dogfish, Steele, Scandia, and Grovers creeks, although fall chum are present in numerous other creeks in this geographic area (Washington Conservation Commission 2000). The stock spawns in November (peak in mid-November), which is somewhat early for fall chum. The tributaries of both Dyes Inlet and Liberty Bay have historically had significant hatchery plants from the Suquamish Tribe's

Cowlings Creek Hatchery. The origin of the Cowlings Creek hatchery stock was Chico Creek fish, so this hatchery stock is considered a native stock within Dyes Inlet. Releases of the Cowling Creek hatchery stock into the tributaries of Liberty Bay have probably established a mixed stock with native remnant components. The stock status is designated as Healthy (SaSI). Although the 1997 and 2000 escapements of this salmon stock were low, 5,038 and 7,191 spawners respectively, (orcas took about 18,000 fish in Dyes Inlet in 1997), other recent escapements have been higher than the normal range for this stock. (SaSI 2002).



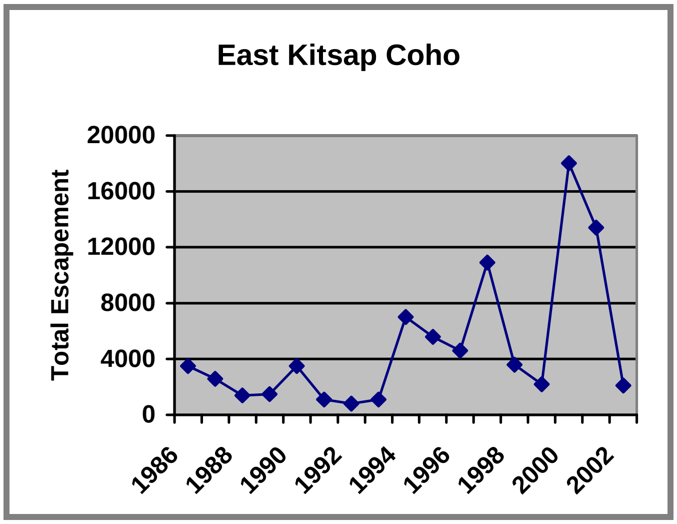
(SaSI 2002)

Distribution of chum (summer and fall stocks combined) in East WRIA 15 streams is shown on Map 3 in Appendix C (Washington Conservation Commission 2000).

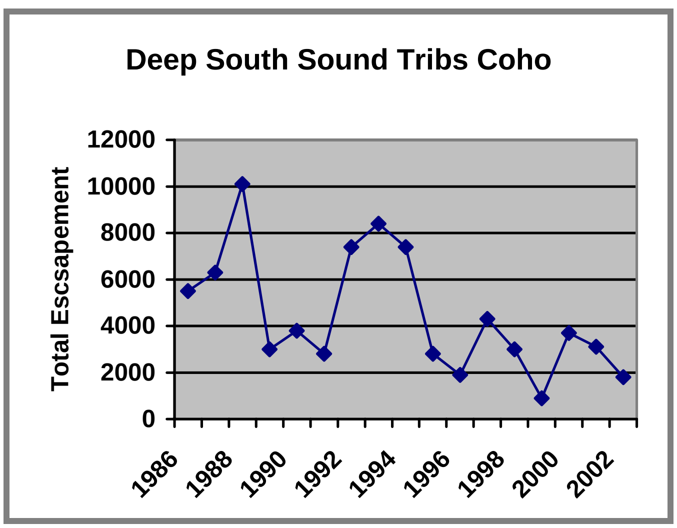
3.3 - Coho

All of the accessible independent lowland streams of the Kitsap Peninsula are utilized by coho salmon. Spawning occurs in every independent stream and tributary where suitable conditions exist, particularly in the upper headwaters. Since coho are well adapted to the typical lowland-type streams found in this basin, they inhabit the most remote and extreme rivulets, as well as the springs, swamps, and marshes forming the upper headwaters and high water overflow areas on many of these drainages. Coho juveniles rear throughout the accessible lengths of these streams and in the associated estuaries and marine habitats (Williams et al. 1975).

SaSI designates two stocks of coho in East WRIA 15; Deep South Sound Tributaries Coho, and East Kitsap Coho. Each of these stocks is defined on the basis of geographic spawning distribution (SaSI). Neither stock exhibits any documented unique biological characteristics, and spawn timing is typical of coho stocks with most spawning occurring from mid-Novemeber to late-December. Various non-native hatchery-origin coho have been released into South Sound streams. Additionally, adipose fin-clipped fish and coded-wire tags recovered from carcasses during spawning ground surveys in this region indicate a high level of adult straying into the natural spawning population from regional hatchery programs (SaSI 2002). The primary harvest management focus for East WRIA 15 coho (both stocks) is harvest of hatchery surpluses, with secondary protection provided for remaining natural-origin coho in the extreme terminal bays (Puget Sound Salmon Management Plan).



The Deep South Sound Tributaries coho stock includes all coho south of the Tacoma Narrows, excluding coho in the Chambers Creek (WRIA 12), Nisqually (WRIA 11), and Deschutes (portion of WRIA 13) basins. The stock includes coho in a portion of WRIA 13 (excluding the Deschutes), all of WRIA 14, and southern WRIA 15 drainages to southern Puget Sound. There have been substantial releases of hatchery-origin coho within this area, with significant off-station yearling plants from the early 1950s to the mid-1970s (SASSI). Off-station fingerling/fry plants occurred annually from the mid-1950s to 1996. There are also annual on-station yearling releases from the Minter Creek Hatchery and from various pen-rearing programs throughout the basin. The stock origin is considered to be mixed, and the stock status is designated as Healthy (SaSI).



(SaSI 2002)

Juvenile coho salmon are captured in nearshore waters primarily during spring and summer months in East Kitsap studies (Suquamish Tribe, WDFW, City of Bainbridge Island,

unpublished data). Ocean-type coho salmon are not considered to be as nearshore dependent as Chinook and chum salmon (Duffy 2003). Beach seine catch of coho in East Kitsap nearshore waters is low by comparison to chum and Chinook.
Distribution of coho in East WRIA 15 streams is shown on the coho species map, Appendix , Map 4 (Washington Conservation Commission 2000).

3.4 - Pink

The typical lowland type streams of the East Kitsap Watershed are not normally inhabited by pink salmon, as they seem to prefer drainages that are of glacial origin. Minter Creek is the only East WRIA 15 stream to record a meager return of pink salmon each odd year (Williams et al. 1975). Return of pink salmon to Minter Creek was not recognized in SaSI 2002. Pink salmon have also been observed irregularly in several of the larger East Kitsap streams on high abundance years (Suquamish, unpublished data 2004).

Pink salmon were observed in the nearshore in high numbers from March through May 2004 during beach seining efforts on Bainbridge Island shorelines (Bainbridge Island Beach Seining Project, unpublished data). The pink return to central Puget Sound in 2003 was very high and may account for the high numbers of juvenile pink salmon on Bainbridge shorelines this spring.

3.5 - Sockeye

No persistent sockeye salmon stocks are identified in SaSI as present in East Kitsap streams, although periodic presence of low numbers of sockeye has been noted in several streams. Observed sockeye are likely stray adults originating from other river systems (Haring 2000).

3.6 - Steelhead

No summer steelhead stocks are identified in East Kitsap. Two distinct stocks of winter steelhead are identified in SaSI: Case/Carr Inlet steelhead and East Kitsap steelhead. Wild winter steelhead in each stock are of native origin. Run timing of these stocks is generally from December through mid-March, and spawn timing is generally from early-February to mid-April. Each stock is comprised of a historically small number of steelhead, with insufficient information to classify its status as Healthy, Depressed, or Critical. As small stocks, they could be especially vulnerable to any negative impacts. The stocks are identified as distinct stocks due to the geographical isolation of the spawning populations; there is little or no information available to indicate whether these are genetically distinct stocks (SaSI 2002).

Distribution of Case/Carr Inlet winter steelhead is identified in SASSI as including Sherwood (WRIA 14), Coulter, Rocky, Dutcher, Artondale, Jones, Minter, Burley, Purdy, McCormick, and Lackey creeks. The status of the stock is identified in SaSI as Unknown.

Distribution of East Kitsap winter steelhead is identified in SaSI as including Olalla, Crescent, Curley, Gorst, Blackjack, Ross, Barker, Clear, Chico, Scandia, Dogfish, and Grovers creeks, although winter steelhead are present in several other creeks in this geographic area (Washington Conservation Commission 2000). The status of the stock is designated in SaSI as Unknown.

Distribution of winter steelhead in East WRIA 15 streams is shown on the steelhead species map on Map 5 of Appendix C (Washington Conservation Commission 2000).

3.7 - Cutthroat Trout

Cutthroat trout are present throughout East WRIA 15 streams, with distribution typically extending further upstream than anadromous salmon, and presence in additional streams where anadromous salmon presence is not known. At this time, distribution differences between resident and sea-run cutthroat are not known, except upstream of anadromous barriers, and they have been considered as a composite stock for the purposes of this report. No stock assessment data are available with which to estimate cutthroat population size.

Fewer recorded observations exist for cutthroat than for other salmon species. Cutthroat are thought to be ubiquitous throughout the low gradient watersheds of East WRIA 15. However, since so little is known regarding the extent of cutthroat presence, cutthroat presence is presumed at least to the uppermost extent of any other identified anadromous salmonid presence.

Cutthroat salmon of various sizes are regularly caught in beach seines and recreationally along East Kitsap shorelines. Little is known about cutthroat use in nearshore waters.

Distribution of cutthroat in East WRIA 15 streams is shown on Map 6 of Appendix C (Washington Conservation Commission 2000).

3.8 - Char (Bull Trout/DollyVarden)

No char presence is identified for East WRIA 15. Streams in this area are all low elevation streams, which are not likely to meet the low water temperature spawning requirements of char.

Bull trout also use nearshore waters. Forage fish commonly spawn along East Kitsap beaches and are important prey items for bull trout. Although bull trout have not been documented in local beach seine studies or local recreational or commercial fishing, these fish are quite mobile and may be missed in traditional catch methods. Bull trout use of East Kitsap nearshore waters is unknown.

Month	Chinook	Coho	Chum	Pink	Herring	Surf Smelt	Sand Lance
1							
2				7			
3			593	174			3
4	1		1,734	771	2	58	117
5	20	1	2,136	567	3	123	22
6	69	8	32	7	192	133	5,153
7	107	18	6		27	94	320
8	84	5	10		15	123	313
9	8	1	5		3	9	12
10	6				8	151	720
11		1	1		31	279	2
12	1				3	22	
Total	296	34	4,517	1,526	284	992	6,662

Table 2: Total Catch of Juvenile Salmonids and Forage Fish (2002-2004)

4.0 - EXISTING ACTIONS SUPPORTING RECOVERY & CONSERVATION

4.1 - Habitat

There are a number of programs and activities in the watershed directed at conserving and restoring salmon habitat. These actions include programs that identify, prioritize and implement habitat restoration and preservation projects; develop and conduct education programs, which assist the public in recognizing how our activities impact salmon and how these actions can be modified to be more salmon-friendly; and policies and programs designed to conserve existing, functioning habitat. This section provides a description of locally developed information sources that support these efforts and brief descriptions of the regulatory, non-regulatory and education and outreach programs being implemented that benefit salmon and their habitats.

4.1.1 - Local Information Sources

East Kitsap has long recognized the intrinsic value of its forested watersheds and the surrounding marine environment. Over the past twenty years, as population has grown and urban areas have expanded, local officials recognized the need for more comprehensive information to support decision making. This recognition has resulted in East Kitsap either partnering or commissioning the assessment of its natural resources and the watershed functions that support viable salmon populations. It is important to note, that several of these studies have been undertaken without a state or federal mandate, and that these studies form the basis for Kitsap's strategy to recover salmon. The following list includes assessments and reports that are intended to further the effort of salmon recovery in the Kitsap region of the Puget Sound.

<u>East Kitsap Peninsula Salmon Recovery Strategy (Kitsap County, 2004; see Appendix G)</u>

The mission of the East Kitsap Lead Entity is to ensure local salmon habitat is preserved and restored to support salmon populations and human communities. The goal of this strategy is to restore healthy, self-sustaining wild populations of the salmon species native to the streams and shorelines of the Kitsap Peninsula. Four objectives include:

- Increase population levels
- Maintain geographically diverse populations
- Promote the preservation and restoration of healthy, functioning ecosystems
- Increase public understanding and support for salmon recovery

This strategy addresses local habitat conditions and is therefore an integral part of the larger regional salmon recovery effort. ()

<u>Kitsap Salmonid Refugia Report (Chris May and Gretchen Peterson, 2003; see Appendix B)</u>

The goal of the refugia study was to identify and characterize potential salmonid conservation and restoration areas located within Kitsap County. After identifying these areas, a primary objective was to analyze and prioritize salmonid refugia to assist in conservation, enhancement, and restoration efforts. One major aim of the Refugia study was to support early salmon recovery actions necessary to preserve the remaining areas of high-quality salmonid spawning and rearing habitat in the region. Protecting the "last best places" is an essential part of the salmon recovery process.

Salmonid Habitat Limiting Factors WRIA 15 East (Haring, 2000)

The goal of this report was to identify habitat factors limiting production of salmon in the East Kitsap portion of WRIA 15, which includes "conditions that limit the ability of habitat to fully sustain populations of salmon". This report addresses habitat conditions that support anadromous salmon and steelhead, based on the stock status designations identified in the Salmon and Steelhead Stock Inventory (SaSI). This report provides information that is used in the development of salmonid habitat protection and restoration strategies.

Bainbridge Island Nearshore Assessment (Williams et al 2003 & 2004; see Appendix H)

The primary objective of this effort is to provide baseline data upon which to develop and implement nearshore management strategies (including restoration and conservation) and measure management success. A science-based conceptual model was used to characterize the status of shoreline ecological functions based upon systematic evaluations of shoreline modifications, controlling factors, habitat structure, and habitat processes. This information was synthesized to determine human impacts, locating critical areas for conservation or restoration, and identifying nearshore ecosystems most at risk to cumulative impacts.

Kitsap Peninsula Habitat Assessment (Washington Department of Fish and Wildlife, in prep.)

The purpose of this study is to improve natural resource protection through time while balancing the need to provide for growth by integrating science-based landscape conservation tools with county-based planning and implementation strategies. This project intends to meet the following objectives:

- Develop a spatially explicit, GIS-based landscape-level natural resource assessment for the Kitsap Peninsula.
- Develop landscape analysis tools that result in science-informed planning decisions.
- Integrate resource assessments and landscape analysis tools into Kitsap County's growth management and watershed planning processes.
- Develop landscape management guidance to inform county planning and land use decisions.

Addressing conservation planning at the landscape scale is more efficient and effective than site-by-site conservation or single-species management, which is why WDFW has engaged in ecoregional conservation assessments and county planning. This habitat assessment, specifically, will develop landscape tools and guidance that addresses the needs of fish and wildlife resources within the context of Kitsap's growing communities.

It is the County's intent to continue to provide its land use planners and natural resource managers with the best available information and analysis tools to continue to make informed decisions while planning for the future of its citizens, landscapes and fish and wildlife. As an example of this dedication, Kitsap County, through its Lead Entity, is organizing a nearshore assessment for the remaining unassessed 139 miles of marine nearshore. This assessment will address a major data gap and allow Kitsap to continue moving forward with its efforts to recovery salmon populations in Puget Sound.

4.1.2 - Policy & Regulatory Programs

Kitsap County and the municipalities in the East Kitsap Watershed have adopted a variety of policy directives and implementing ordinances that give special consideration to salmon and their habitats. The focus of these programs is primarily the protection of existing habitat from the impacts of development and other land use activities. Comprehensive Plans, Shoreline Master Programs, and the Critical Areas, Stormwater and Zoning Ordinances represent the major policy and implementing regulatory programs in East Kitsap. Summaries of specific Kitsap County and City of Bainbridge Island policies and regulatory programs are contained in Appendix I.

4.1.3 - Non-Regulatory Programs

Non-regulatory programs meet the duel needs of protecting existing habitat and restoring degraded areas. Programs such as open space land designation under the Current Use Tax Benefit Rating System provides property owners the opportunity for property tax relief by enrolling their property that contains important fish and wildlife resources. Similar incentive programs also exist for agricultural and forest lands. Other programs, like the City of Bainbridge Island Open Space Bond, allow local jurisdictions to work with local land trusts and park districts to purchase fee-title property or conservation easements for conservation purposes, including properties that contain important fish and wildlife resources.

The U.S. Department of Agriculture also supports a number of programs through the Natural Resource Conservation Service that are implemented locally through the Kitsap Conservation District. Many of these programs offer technical assistance, cost-sharing and use conservation easements to protect, enhance and restore watershed health. The Conservation District currently works both in unincorporated areas as well as some of the cities, such as Bainbridge Island, to implement these and habitat restoration programs

In addition to critical areas ordinances, habitat restoration in the East Kitsap Watershed provides one of the most significant contributions to the conservation and restoration of salmon populations in the watershed. Kitsap County's Public Works Department aggressively works to identify, prioritize and replace County-owned culverts blocking salmon from reaching spawning and rearing habitats. Similarly, the Kitsap Conservation District actively works to identify passage barriers on private property, and then works with landowners to design and identify funding to fix them. More detailed summaries of existing programs are provided in Appendix J.

The East Kitsap Watershed, including those portions of Pierce and Mason Counties not addressed in this report, is a Lead Entity salmon recovery area. Through the lead entity process, over $10 million dollars worth of projects have been funded through state and federal dollars awarded by the Salmon Recovery Funding Board and matching contributions by local project sponsors (See Appendix K). The East Kitsap Peninsula Salmon Recovery Strategy, cited above, identifies the salmon recovery priorities for the Lead Entity. The East Kitsap Lead Entity specifically addresses the VSP parameters of abundance and spatial diversity by including objectives to increase population levels and maintaining geographically diverse populations.

Additionally, the Lead Entity identifies nearshore habitat conservation and restoration projects as high priorities for action. With the exceptions of Bainbridge Island and the City of Port Orchard, much of the nearshore areas in the watershed have not been assessed to identify and quantify habitat types, evaluate levels of impaired habitat or ecosystem processes, or determine spatial and temporal use of the nearshore by salmonids. Kitsap County is currently developing an assessment program in collaboration with Battelle Marine Science Laboratory. This program proposes to utilize a similar and complimentary methodology as that used to conduct the City of Bainbridge Island's Nearshore Assessment. In the absence of this information however the East Kitsap Lead Entity has developed a preliminary prioritized list of nearshore projects for the watershed based on criteria that was adapted from Correa (2002). The preliminary list of projects and a description of the prioritization method are included in Appendix X.

4.1.4 - Watershed Planning

There are currently two watershed planning processes underway in the East Kitsap Watershed that address issues related to salmon recovery. The first and most expansive process is the development of a watershed plan for WRIA 15 under the Watershed Planning Act (RCW 90.82). The WRIA 15 plan is addressing the mandatory element of water quantity and the optional elements of water quality, instream flows and habitat. The WRIA 15 Planning Unit is currently developing recommendations with a final plan to be adopted in 2005. Similar to other sub-areas within the WRIA 15 Watershed Planning area, Bainbridge Island plans on adopting a sub-area plan, which will be based on our Level II Assessment (Kato & Warren et al 2000) and its recommendations (see Appendix O).

Kitsap County is also implementing a watershed planning process that integrates watershed assessment with subarea planning. Informally known as "planning by watershed" or "alternative futures" this program provides a science-based and community-based approach to developing community or subarea plans for areas in the county for subsequent adoption into the County's Comprehensive Plan. This process is designed to base future land use planning on a foundation of conserving watershed processes and functions by evaluating alternative development scenarios for their impact on parameters such as watershed hydrology, water quality, fish and wildlife habitat using a variety of models. The initial use of this process has been in the Chico Watershed, with adoption of a subarea plan scheduled for the fall of 2005. Additional funding has been secured to commence the process for the Barker Creek Watershed in the fall of 2004 with subarea plan adoption in 2006.

4.1.5 - Education & Outreach

Education and outreach are the cornerstones of successful salmon recovery and conservation. In direct response to the ESA salmon listings, education in all arenas became an urgent and necessary element to address salmon recovery and conservation. Suddenly landowners, policymakers and educators all needed to comprehend how salmon used their habitat, that same habitat in which humans co-exist. Education is the critical link to meeting the demands of salmon recovery in all realms of regulation, restoration, conservation, and research efforts. At its core, outreach related to salmon is most effective when it places topics into the context of stewardship. Understanding of systems and their processes is fundamental to comprehending how human action can augment salmon recovery.

Outreach and education programs in East Kitsap are steeped in strong collaborative, partnership-based efforts emanating from both government and non-governmental organizations. Partnerships mobilized to address initial salmon listings are still in existence today; continually educating on salmon and strategies for recovery. As the science of salmon habitat usage and life history evolves, education co-evolves and disseminates new information to decision-making bodies and the public. This trend is expected to continue as new assessments and studies emerge and evaluation of past restoration and outreach efforts can be incorporated into directing future efforts.

East Kitsap has strong programs targeting public awareness coupled with action-oriented work plans. Programs range the spectrum from:

- Teachers addressing the salmon life cycle in elementary school
- Volunteers planting native riparian vegetation
- Adults annually visiting spawning habitat and learning from local biologists
- Educators making the connection between household activities and salmon habitat
- Working collaboratively to address stormwater runoff in innovative ways
- Integrating community outreach into restoration projects

For highlights of prominent outreach and education efforts directed at salmon recovery in the East Kitsap Watershed see Appendix L. The list is not intended to be exhaustive but representative of the excellent programming underway. New efforts begin regularly and others have evolved into other programs. Education takes numerous forms: elementary students studying salmon for an entire unit; community groups working in unison with agencies to restore degraded stream or nearshore habitat; a parent and child stopping the car at a pull out to watch salmon spawning.

4.2 - Hatcheries

The co-managers (WDFW and Treaty Tribes) operate several hatchery programs in the East Kitsap region. These include both Chinook production facilities as well as enhancement programs for other species including coho, and chum salmon. The co-managers Chinook programs are described below followed by the Suquamish Tribe's coho and chum program descriptions.

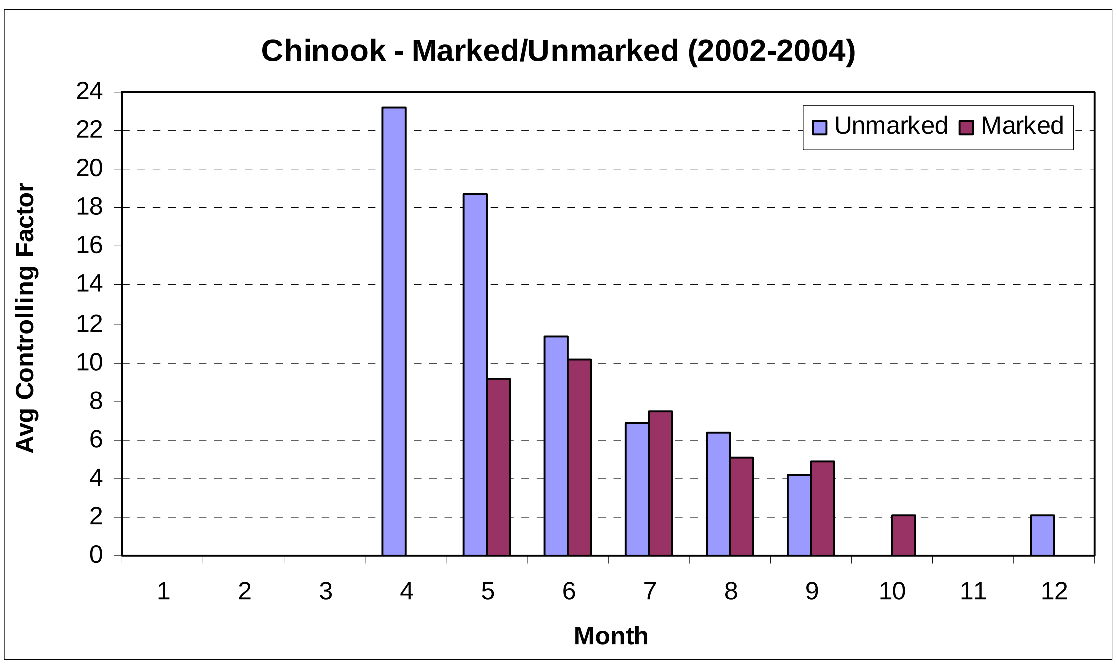
4.2.1 - General Description of Chinook Hatchery Production - East Kitsap Region

There are currently 7 enhancement facilities operating in the East Kitsap area. The Suquamish Indian Tribe operates four facilities and three are operated by WDFW. Table 1 lists the facilities that support chinook production; the number of fish released and the watershed fish are released into. The Tribe's Chinook program is detailed in Appendix R in a paper by Dorn, et al, 1997.

Table 1. Chinook production in East Kitsap Region (information from the 2003-04 Future Brood Document)

Production Facility	**Fall Chinook Released Sub-yearling**	**Yearling**	**Spring Chinook Released Sub-yearling**	**Yearling**	**Watershed**
Grovers Creek	500,000				Grovers
Gorst Creek	2,100,000	150,000			Gorst
Webster's Pond	200,000				Dogfish
Clear Creek	50,000				Clear Crk
Coulter Creek	Transfer to Tumwater Falls Hatchery. 2,800,000				
Minter Creek	1,800,000				Minter
Hupp Springs			250,000	85,000	Minter
Total Production	4,650,000	150,000	250,000	85,000	

The recent E Kitsap beach seining research undertaken by the COBI and Tribe attempts to document the interaction of natural (unmarked) with hatchery (marked) chinook salmon by using the observed condition factor (length/weight). The following data taken from Dorn and Best, 2005, illustrates a significant difference between the natural and hatchery Chinook early in the year, but their convergence to similar condition factors by mid-summer:



The Comprehensive Management Plan for Puget Sound Chinook, current version dated March 1, 2004, provides a framework for co-managers to set chinook production and harvest goals for management years 2004 - 2009. This document will be updated as discussed in the Harvest section into a Comprehensive Chinook Management Plan to guide recovery of Chinook in Puget Sound. The primary purpose of enhancement programs in the East Kitsap Region is to augment harvest opportunities. The goal of harvest programs is to provide for recreational, commercial and tribal fishing opportunity. The operation at Hupp Springs is a conservation program that seeks to support the recovery of the White River spring chinook salmon (Hatchery Reform recommendations, Feb. 2002).

4.2.2 - General Description of Coho and Chum Hatchery Production – East Kitsap Region

Coho

Agate Pass Coho Salmon Net Pens: The purpose of this coho salmon rearing program, which is operated by the Suquamish Tribe in cooperation with WDFW, is to provide harvest for Suquamish tribal members, non-Treaty sport fishers and commercial fisheries. The production objective of this program is to release 600,000 yearling coho salmon from the Agate Pass net pens. The program was temporarily reduced in 2003 and 2004 to 100,000 fish, which were raised at Manchester with the support of the U.S. Navy. Agate Pass Seapens operation was suspended by the Tribe in 2005 due to program budget constraints and is currently dormant. All Agate Pass Seapen coho brood stock collection, spawning, incubation, and early rearing was done at WDFW's Minter Creek Hatchery. Fingerling coho salmon are transferred from WDFW to net pens at Agate Pass in February or March when fish are physiologically ready to adapt to the salt water. Fish were fed daily until they are approximately 10 fish/pound in size. They are released in early June. This coho program is described in detail in Appendix S in a paper presented by Dorn, et al, 1996. The Tribe reserves the option to reactivate this program in the future.

The effects of this program on Chinook salmon are most likely minor. Impacts from the program, if they occur, would occur only in the nearshore environment in common with those from many other stocks where potential impacts have been hard to quantify. The program does not impact Chinook salmon by brood stock collection because it does not collect its own brood stock (see WDFW Minter Creek Coho Salmon program for details of brood stock collection). Potential disease impacts of the program are controlled through regular monitoring by professional pathologists from the Northwest Indian Fisheries Commission and treatment if necessary. Delayed release of coho salmon in June is intended to minimize potential impacts on migrating salmon that may be in the area. With the coho program releases ceasing in 2005, the Tribe will be able to document any changes in local Chinook hatchery returns compared to the historic returns of local Chinook while Agate Pass production was at full capacity.

Chum Salmon

Cowling Creek Fall Chum Salmon: The purpose of this program, operated by the Suquamish Tribe, is to support tribal treaty fisheries by restoring chum salmon to local East Kitsap Peninsula streams. The production objectives were to release 1,200,000 fed fry into South and North Cowling creeks and 600,000 unfed fry from satellite incubation boxes into independent East Kitsap tributaries of Dogfish, Clear, Barker, and Steele creeks, but has recently been reduced to approximately due to budget constraints and high natural adult chum returns. The program was started in 1977 with broodstock from Hood Canal (Quilcene River). Returning adults were not spawned, however, and subsequent brood fish were collected from Chico Creek, a local stream, beginning in 1978. Approximately 4,000 brood fish are currently collected annually from adults returning to Cowling Creek. Fish are spawned at the Cowling Creek facility. Eggs for release from satellite incubation boxes in Dogfish, Clear, Barker, and Steele creeks are transferred as water-hardened eggs to the incubation boxes. Most of the eggs are incubated under natural conditions in Netarts rearing troughs in South Cowling Creek. After hatching, fry are allowed to volitionally migrate into circular ponds for initial feeding. Once fry are actively feeding, they are allowed to migrate downstream to an earthen rearing pond on South Cowling Creek where they can grow under natural conditions. Fish are released from Cowling Creek into the estuary on high tides in late April or May. The Tribe has shifted some Cowling Creek chum production to Grovers Creek Hatchery due to budget constraints. The Tribe reserves the option to increase the Cowling Creek chum program in the future. The historic chum program is described in detail in Appendix T in a paper by Dorn, 1997.

The effects of the chum program on Chinook salmon are minimal. Brood stock collection has no negative impact on Chinook salmon. No Chinook salmon occur in Cowling Creek, which is small and has inadequate flows for Chinook. Self-sustaining populations of Chinook salmon do not occur in this area of the Puget Sound and no adult Chinook salmon have ever been captured at Cowling Creek Hatchery in its 29 years of operation. Potential disease effects of the program are controlled through regular monitoring by professional pathologists from the Northwest Indian Fisheries Commission and treatment if necessary. Potential competition between chum salmon and Chinook salmon from mid-Puget Sound stocks in the nearshore is minimized by releasing the chum salmon into the estuary where they can disperse quickly over a large area. Because of life history and developmental differences, predation by juvenile chum on Chinook salmon would be extremely unlikely.

4.2.3 - Operational Guidance for Hatcheries in the East Kitsap region of Puget Sound

Several documents provide operational guidance, direction, or program descriptions for hatcheries in the East Kitsap region. These include the Future Brood Document, the Co-Managers Salmonid Disease Control Policy, the Hatchery Genetic Management Plans (HGMPs) for each salmon species, and the Resource Management Plans.

Resource Management Plans

The co-managers have submitted to NOAA's National Marine Fisheries Service (NMFS) two Resource Management Plans (RMPs) for Puget Sound. One Resource Management Plan discusses hatchery programs that produce chinook salmon. The other Resource Management Plan describes steelhead, coho, pink, chum, and sockeye hatchery programs. Comments and suggestions are invited from all interested parties to ensure that the EIS considers the full range of related issues and alternatives to the proposed action. The RMPs and HGMPs and other information are available online at http://www.nwr.noaa.gov/lsrd/Propagation/.

The Resource Management Plans are the proposed frameworks through which the co-managers would jointly manage Puget Sound region salmon and steelhead hatchery programs while meeting conservation requirements specified under the Endangered Species Act (ESA). The Plans describe 113 hatchery programs and evaluates their effects on Puget Sound chinook and summer chum populations protected as threatened species under the ESA. In addition, the Plans describe the scientific foundation and general principles for continued innovation in response to new information. Appended to the Plans are individual HGMPs for each of the 113 hatchery programs. The HGMPs describe each hatchery program in more detail, including specific measures for research, monitoring, and evaluation activities that would guide future program adjustments.

NMFS' ESA determination on the co-managers' Resource Management Plans is the federal action requiring National Environmental Policy Act (NEPA) compliance. Consistent with NEPA, a single EIS will be prepared for the two Plans. NMFS' NEPA determination for the Plans will be in effect for 15 years. The EIS will consider potential impacts on listed and non-listed animal and plant species and their habitats, water quality and quantity, socioeconomics, and environmental justice. The EIS will also include information regarding potential impacts on other components of the human environment, including air quality, human health, transportation, and cultural resources.

NMFS will rigorously explore and objectively evaluate a full range of reasonable alternatives in the EIS, including the Proposed Action (implementation of the co-managers' Resource Management Plans) and a No Action alternative. Additional alternatives could include the following: (1) a decrease in artificial production in selected programs that have a primary goal of augmenting fisheries, and (2) an increase in artificial production in selected programs that have a primary goal of augmenting fisheries.

Future Brood Document

The Future Brood Document (FBD) is a pre-season planning document for fish hatchery production in Washington State for the upcoming brood stock collection season. The FBD is coordinated between WDFW, the Northwest Indian Fisheries Commission (NWIFC), and Federal fish hatcheries. Hatchery production by volunteers, schools, and Regional Fisheries Enhancement Groups are represented by WDFW. Every Puget Sound hatchery program is listed in the document by facility location, species, race, brood year, stock and WRIA number. Each program lists the egg take goal, transfers that occur throughout the year and the planting goal. Dates, fish size and pounds produced are listed for each transfer and plant. This document is reviewed annually and the co-managers agree to production numbers. Changes to the FBD require submission of an FBD change form and approval by the co-managers.

Co-Managers Salmonid Disease Control Policy

This policy was developed between the Co-Managers in order to provide guidance and policy control of how hatcheries will operate to minimize the risk of importation, dissemination, and amplification of pathogens known to adversely affect salmonids. The policy divides the state into eight egg health management zones and 14 fish health management zones. The Policy provides direction for the care of broodstock, egg collection, egg and fish transfers within and between health zones.

Hatchery Genetic Management Plans

Listing of Puget Sound Fall Chinook as threatened under the Endanger Species Act required all hatcheries in Puget Sound to develop a Hatchery Genetic Management Plans (HGMPs). All chinook programs in South Sound have an HGMP. The HGMP’s describe, in a format prescribed by NOAA Fisheries, the operation of each artificial production program for salmon and steelhead in the Puget Sound region and the potential effects of each program on listed species. The HGMP's have been provided to NOAA Fisheries for consideration as significant measures under Section 4 (d) of the Endangered Species Act.

The following chinook HGMP's are listed for the East Kitsap facilities:

Grovers Creek Hatchery and Satellite Rearing Ponds
White River Spring Chinook (Minter Creek and Hupp Springs)
Minter Creek/Coulter Creek Fall Chinook Fingerling Programs

The Suquamish Tribe also has a Cowling Creek Chum Salmon HGMP and an Agate Pass Seapens Coho Salmon HGMP.

HSRG Recommendations

Currently, hatchery programs in Washington State are undergoing an extensive operational review by the Hatchery Scientific Review Group (HSRG). The task of the HSRG is to assemble, organize and apply the best available scientific information available to provide guidance and recommendations to the policy makers and technical staff who are responsible for implementing hatchery reforms.

A review of the East Kitsap region hatchery programs was completed by the HSRG in 2003. The HSRG recommended both Area-wide and Regional improvements.

Area-wide

- Take a regional approach to managing hatchery programs
- Operate hatcheries within the context of their eco-system
- Measure success in terms of contribution to harvest and conservation goals
- Emphasize quality, not quantity in fish releases
- Incorporate flexibility into hatchery design and operation
- Evaluate hatchery programs regularly to ensure accountability for success
- Develop a system of wild steelhead management zones
- Use in-basin rearing and locally adapted broodstock
- Take eggs over the natural period of adult return
- Develop spawning protocols to maximize effective population size
- Take into account both freshwater and marine carrying capacity in sizing hatchery program

Regional Recommendations

The HSRG made over 1,000 Regional recommendations. Of those many were specific for South Sound programs. These recommendations included program reductions or facility closures, broodstock collection adjustments and facility improvements. Currently a number of these recommendations have been carried out and several are ongoing.

These include:

- Grovers Creek develop on-site incubation capability to eliminate the need for egg transfers to and from Minter Creek.
- Discontinue backfilling Grovers program with Minter Creek eggs
- Review program needs and size to fit
- Elimination of Agate Pass coho program at Coulter Creek
- Elimination of Coulter Creek chinook releases
- Elimination of pink production at Minter Creek
- Reduction of coho production at Minter creek
- Discontinue the transfer of chum eggs from Minter Creek for the Donkey Creek program
- Adjusting Chinook broodstock returning timing at Minter Creek
- Evaluation and monitoring of each hatchery stocks through coded-wire tagging and mass-marking
- Provides for improved predator control measures to ensure accurate pond inventory at release
- Purchase of fish counters for evaluation and monitoring of juveniles released from hatcheries
- Purchase of equipment to improve operational effectiveness such as fish pumps

The HSRG review is providing a framework to improve operational efficiency and facility improvements to minimize the impacts our hatchery programs may have on listed stocks in the Puget Sound region.

4.2.4 - Summary

Hatcheries in the East Kitsap Region of Puget Sound have a dual role in salmon management: first, selected facilities work to conserve and enhance threatened or depressed stocks (White River Spring Chinook) and, secondly, to provide harvest opportunities for recreational, commercial and tribal fishers. Hatcheries also play a key role in the educational and regional enhancement projects located throughout the East Kitsap area.

4.3 - Harvest

4.3.1 - Chinook

The Co-managers (WDF&W and Treaty Tribes) in conjunction with NOAA have developed a Harvest Management Plan for Puget Sound Chinook (PS Indian Tribes & WDFW March, 2004. The document is envisioned as one element (harvest management component) of a Comprehensive Management Plan for Puget Sound Chinook to guide the recovery of Chinook. The Plan is anticipated to adequately address limit 6 of the 4(d) Rule (50 CFR 223:42476) under the ESA for the term covering management of fisheries from 2004-2009.

The Plan guides the implementation of fisheries in Washington, under the co-managers' jurisdiction, but it considers the total harvest impacts of all fisheries, including those in Alaska and British Columbia, to assure that conservation objectives for Puget Sound management units are achieved. Accounting of total fishery-related mortality includes incidental harvest in fisheries directed at other salmon species, and non-landed Chinook mortality.

The fundamental intent of the Plan is to enable harvest of strong, productive stocks of chinook, and other salmon species, and to minimize harvest of weak or critically depressed chinook stocks. However, the Puget Sound ESU currently includes many weak populations. Providing adequate conservation of weak stocks will necessitate foregoing some harvestable surplus of stronger stocks

The Plan's objectives can be stated succinctly as intent to:

> *Ensure that fishery-related mortality will not impede rebuilding of natural Puget Sound chinook salmon populations, to levels that will sustain fisheries, enable ecological functions, and are consistent with treaty-reserved fishing rights.*

This Plan will constrain harvest to the extent necessary to enable rebuilding of natural Chinook populations in the Puget Sound evolutionarily significant unit (ESU), provided that habitat capacity and productivity are protected and restored. It includes explicit measures to conserve and rebuild abundance, and preserve diversity among all the populations that make up the ESU.

While the plan identifies 15 separate Chinook management units, none of those represent drainages within the East Kitsap Watershed Chapter. However, the constraints imposed by weak management units restrict harvest from the ocean, straits of Juan de Fuca and Puget Sound resulting in reductions in preterminal interceptions of Kitsap bound salmon stocks. The lack of significant independent Chinook populations in East Kitsap provides flexibility for terminal directed harvest to take advantage of abundant hatchery fish. Programs such as the Gorst Chinook rearing facility provide isolated harvest opportunities for both Tribal and recreational fishers. Stock composition derived from 15 years of fishery sampling indicates 98% of Sinclair Inlet directed Chinook harvest are fish from local enhancement efforts.

4.3.2 - Coho, Sockeye, Chum, and Pink

Other salmon directed fisheries are guided by the Pacific Salmon Treaty (U.S. Canada 1999), the Magnuson Stevens Fisheries Conservation and Management Act (1976) and the Puget Sound Salmon Management Plan (1985). These regulatory forums limit fishery impacts based on conservation and sharing principles implemented annually within fishing plans adopted by the U.S. Department of Commerce and Canadian government. In most cases, weak stock management drives limitations on regional interceptions. System by system escapement objectives are defined for the majority of stocks directing fishery management decisions based on annual abundances.

Chum and coho stocks returning to East Kitsap are vulnerable to outside interception in mixed stock areas. However recent escapement trends in these basins indicate total spawner abundance at or above escapement goals with the exception of the deep south sound tributary coho which reflect an aggregate of stocks south of this chapters geography.

5.0 - GAPS

The combination of programs described above being implemented by various entities in the East Kitsap Watershed represent a comprehensive effort to conserve and restore salmon habitat from a multi-species perspective. These efforts undoubtedly represent a significant contribution to the recovery of Puget Sound Chinook, yet quantifying that contribution is difficult for a number of reasons. These reasons can be categorized as gaps in information, processes, and resources. This section will identify gaps and discuss the mechanism by which they are being or could be addressed.

5.1 - Information Gaps

No independent populations of Chinook have been identified in the streams of the East Kitsap watershed. While there is a documented presence of naturally spawning Chinook in some East Kitsap streams, it is unclear whether these fish originated from local enhancement programs, as is widely assumed, or whether they represent "sink" populations derived from independent populations of wild Chinook using local streams during times of higher abundance. Understanding the origins of these fish is critical to understanding East Kitsap's role in the recovery of Puget Sound Chinook throughout the ESU. As marked brood years begin returning to the area it should be possible to determine the levels of escapement that represent fish from independent populations using East Kitsap streams (Jay Ziske, Suquamish Tribe, pers. comm.).

The assumption of spawner origin from local enhancement has created an isolated hatchery management area for co-managers driven by hatchery escapement goals for Chinook in the watershed (Jay Ziske, Suquamish Tribe, pers. comm.).

Without locally identified independent populations of Chinook, yet a variety of populations from other watersheds using East Kitsap nearshore areas, it is difficult at this time to assess the effectiveness of existing or future recovery actions on populations.

There is a growing body of evidence suggesting that Puget Sound Chinook from various independent populations are using the nearshore areas and estuaries for rearing and migration. Local beach seining data suggests that the greatest number of fish in the East Kitsap nearshore from independent populations originate from Central and South Sound (Dorn & Best 2005, Fresh et al DRAFT). Unfortunately, the lack of a comprehensive habitat assessment of East Kitsap's nearshore/estuarine areas makes it difficult to determine with certainty where and how Chinook are using these systems.

Similarly, there is no comprehensive monitoring program for the watershed that enables managers to track progress on salmon recovery resulting from actions currently being taken or planned for the future. Bainbridge Island does not currently have a comprehensive water quality and stream flow monitoring program, although a permanent stream gauge was installed in 2004 and there are limited historic water quality and stream flow data.

Although it is unlikely that the issues of population and planning targets will be resolved by parties within the East Kitsap Watershed, the latter issues of nearshore habitat assessments and comprehensive monitoring can be addressed by local stakeholders. As noted above, Kitsap County is currently developing a nearshore assessment project that when completed and combined with the existing Bainbridge Island Nearshore Habitat Assessment should provide the capacity to identify and take specific actions needed to protect (most certain), restore, rehabilitate or create (least certain) habitat conditions favorable to salmon recovery. Likewise, as our existing efforts expand over time it will become even more critical to develop and implement a comprehensive monitoring program to assess the outcomes of our actions and adaptively manage our programs based on the results.

5.2 - Process Gaps

Also contributing to the difficulty in the recovery of Puget Sound Chinook is the lack of an on-going stakeholder process to participate in salmon recovery at the various levels needed to address recovery. While Kitsap County and the City of Bainbridge Island have a strong and successful tradition of public involvement, recovery has never been addressed on all fronts with a core group of stakeholders being exposed to everything from the voluntary restoration efforts to regulatory programs or development issues. Many of the stakeholder groups simply lack resources or interest to actively participate in comprehensive, salmon related, watershed forums. This is in part due to the fragmentation of natural resources management programs in the East Kitsap Watershed caused by the variable geographic configurations of the watershed. For example, WRIA 15 watershed planning boundaries encompass the entire Kitsap Peninsula, yet for Lead Entity purposes (and Shared Strategy) the peninsula is split between Puget Sound and Hood Canal drainages. Similarly, it is more difficult to catalyze stakeholder involvement around approximately 200 miles of shoreline, much of which is broken into numerous inlets and bays, than it is around a single waterbody such as a major river system.

Fortunately, growing integration of natural resource programs at the County and City-levels are creating a more efficient network of programs that draw on shared information and expertise. Programs like integrated watershed and community planning are serving to address a multitude of community issues, including salmon recovery, into a single process. As this program grows, it should consolidate larger areas of the East Kitsap Watershed into complimentary and consistent processes, facilitating greater recovery planning.

The Kitsap Nearshore Coordination Group works to foster collaboration between nearshore researchers, habitat managers and educators. Participants from the tribes, state and local agencies and community groups meet to share current work and support each others projects to better understand the Kitsap nearshore. This collaboration has resulted in sharing of resources, ideas and partnership opportunities and has helped strengthen the work of individual entities. Growing coordination with regional nearshore efforts is necessary to ensure efforts are aligned with Puget Sound wide recovery actions. In the future this effort could be the technical support arm of a citizen-based Marine Resources Committee modeled after the Northwest Straits Commission program.

5.3 - Resource Gaps

One of the major obstacles to adequately assessing the contribution of existing and proposed actions to the recovery of Puget Sound Chinook and the conservation of other species is a general lack of resources. This issue has an effect on the other categories of gaps discussed above, but also impacts the certainty of potential future actions. Lack of resources is the primary reason why cities in the East Kitsap Watershed, other than Bainbridge Island, have not been actively engaged in salmon recovery plan either in their respective jurisdictions or regionally. There is a general lack of funding for local government to support natural resource programs. This is particularly true of non-mandated efforts such as Shared Strategy and the Lead Entity program.

6.0 - EAST KITSAP COUNTY SUB-AREA PLAN

6.1 - East Kitsap County Conceptual Model for Salmon Habitat Restoration

Development of a simple conceptual model is useful to illustrate the interaction of existing information sources and programs with ecological factors that drive salmon habitat conservation and restoration in East Kitsap County (Fig. 6.1). While our knowledge of habitat forming processes in the watershed and how salmon use various habitats is increasing, there is insufficient information to develop a more sophisticated, multi-species model that evaluates the interactions of salmon with various habitats over space and time. Despite the lack of empirical information to develop a more comprehensive model, there is emerging agreement that certain population characteristics can be used to define viable salmon populations (VSP). VSP parameters and their respective importance in supporting viability are described in McElhaney, et al. (2000).

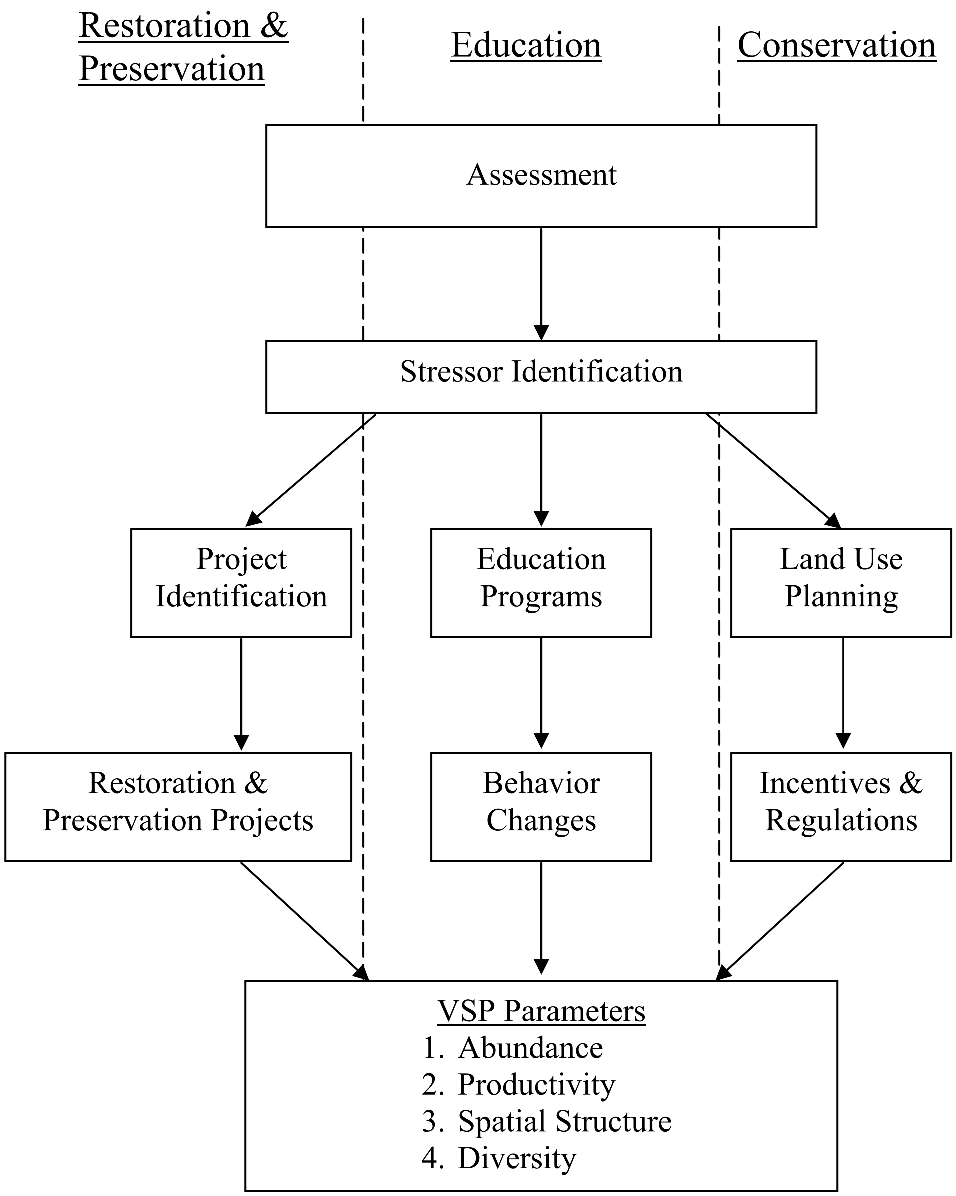
Briefly, the four VSP parameters are:

- Abundance – larger populations are at less risk than smaller ones of going extinct.
- Population growth rate – populations that are regularly replacing themselves are at less risk of extinction.
- Spatial structure – may affect populations' ability to adapt to environmental changes (metapopulations with associated subpopulations)
- Diversity – among and within populations, it allows species to use a wider variety of environments, protects (survival) against short-term disturbance and long-term changes in the environment.

Figure 6.1 illustrates the various levels and processes used, in-part, to direct habitat management decisions in East Kitsap County. As will be described in more detail below, programs or activities currently supporting salmon recovery in the watershed can be categorized as restoration, education and conservation. These three categories characterize a three-track approach to habitat management in East Kitsap County. This conceptual model assumes that the activities and programs associated with the three tracks and described below are sufficient to maintain and restore habitat for viable salmon populations.

Common to all three tracks is the assessment of habitat types and quality, as well as stock assessments for the various species of salmonids found in the watershed. These assessments are undertaken as resources allow and vary in their scopes including assessments of watershed and nearshore processes (Chico Watershed Planning Project, 2003), instream and nearshore habitat quality (May & Peterson, 2003; Bainbridge Island Nearshore Habitat Assessment, 2004; WRIA 15 East Kitsap Limiting Factors Analysis, 2000) and stock assessments (Salmon and Steelhead Inventory, 2002).

Figure 6.1. Conceptual Model for Salmon Habitat Recovery in East Kitsap County



Also common to all three tracks and resulting in part from assessments is the identification of stressors. Stressors are factors typically resulting from human actions that may directly or indirectly affect or limit VSP parameters. Stressors are also identified through a growing body of scientific information from other areas. For example, there is a growing body of scientific evidence linking the presence of pesticides in aquatic ecosystems with deleterious neurological effects on salmon (Scholz, N.L. et al., 2000), yet this type of work has not been conducted in the watershed to determine the extent of its impact on local or transient stocks of salmon.

The identification of stressors or factors limiting VSP parameters drives programs and projects in the three respective tracks. For example, physical stressors, such as riparian area degradation, are addressed through the identification, prioritization, design and implementation of voluntary restoration projects. Practices such as home and garden use of pesticides are improved through education programs and resulting behavior changes. While natural resource and land use planning help identify opportunities for communities to accommodate growth while maintaining watershed and nearshore processes and protecting habitat by identifying areas appropriate for more intensive land use and creating development standards and incentive programs to safeguard existing habitats.

By addressing stressors through the application of restoration/preservation, education and conservation actions, VSP parameters are supported for local species of salmon as well as the life stages of salmon originating from other watersheds that use our estuarine and nearshore areas during migration out to sea and back again.

6.2 - Nearshore Hypotheses

The Regional Nearshore Salmon Recovery Plan, currently under development by the Puget Sound Action Team (PSAT), focuses on two of the VSP parameters, diversity and spatial structure. The PSAT has recognized that further evaluation of how habitats and stressors affect these parameters will require additional "landscape analysis" of populations and/or marine sub-regions of Puget Sound. Given that PSAT has not yet undertaken these landscape analyses, they have proposed two hypotheses for salmon in the nearshore that focus on functions provided to individual salmon (primarily outmigrant juveniles) rather than the viability of populations. These working hypotheses relate to individuals and are NOT extended to populations, life history types expressed (or potentially expressed) in these populations, or the specific Puget Sound nearshore and marine landscapes over which these populations range. While PSAT recognizes that these hypotheses and analyses are incomplete, the hope is that they will help to define and generate concurrence about the building blocks that will be used in landscape analyses to evaluate effects of stressors and potential habitat protection and restoration efforts on chinook populations.

In an effort to be consistent with the developing Regional Nearshore Salmon Recovery Plan, we have made an attempt to apply these two hypotheses, namely the Habitat-Based and Stressor-Based Hypotheses, to the East Kitsap nearshore.

6.2.1 - Habitat-Based Hypotheses

East Kitsap nearshore habitats provide four functions for individual juvenile salmon:

- feeding and growth (rearing),
- refuge from predation and extreme events,
- physiological transition, and
- migratory corridors.

Viable salmon populations require that East Kitsap nearshore and marine landscapes provide these functions for a diversity of life history types.

East Kitsap nearshore habitat can be categorized into four broad landscape classes with primary focus on juvenile salmonids. These include:

1. Open Exposed Shorelines
2. Protected Shorelines
3. Pocket Estuaries
4. River Mouth Estuaries and Deltas

Each of these broad classes includes a number of embedded smaller scale habitat types such as mudflats, eelgrass, blind channels, etc. Specific salmon habitats can occur in more than one of the four landscape classes. For example, eelgrass may be found in pocket estuaries, along protected shorelines. Blind channel networks can be found in pocket estuaries.

If specific habitat features are lost (either naturally or by human causes), the landscapes may provide lesser functions for salmon, which may result in the elimination of a particular life history type within a population (Fresh, pers. comm.). This also means that the consequences of habitat losses to salmon populations are not limited to the on-site effects, but can extend to distant areas. For example, the loss of river estuary and proximal nearshore habitats can eliminate the pocket estuary fry from a population even though high quality pocket estuaries may be abundant in the marine sub-basin (B. Graeber, NOAA-TRT, personal communication).

6.2.2 - Stressor-Based Hypotheses

The stressor-based hypothesis in the developing Regional Nearshore Salmon Recovery Plan does not address how stressors affect the viability of specific populations of Puget Sound chinook. Rather, depending on the severity and geographic and seasonal distribution of the loss of habitat functions, the viability of populations might be at risk due to concerns about:

- abundance (e.g., if reduced food production would limit the number of fish that could be supported in the area over which a population is distributed);
- productivity (e.g., if reduced refuge increased the rate of mortality of outmigrant juveniles due to predation);
- spatial structure (e.g., if reduced distribution of habitat features that provide food for outmigrant juveniles would limit the geographic area over which a population was successfully foraging); and
- life history diversity (e.g., if reduced refuge appropriate for fry and fingerling migrants increased the mortality of these life history types).

Future efforts at landscape analysis by PSAT (and others) will help us to develop hypotheses about how specific life history types of individual populations are affected by stressors in various marine sub-regions of Puget Sound, including the East Kitsap nearshore. No matter which habitat type or landscape a juvenile salmon encounters in the East Kitsap nearshore, it is likely that human-induced stressors may have impaired some of the habitats' attributes. Stressors are compounded in estuarine and nearshore (presumably) areas because the fish are already stressed due to physiological changes (from fresh to salt water environment) (from Aitken 1998). Using an adapted version of the proposed classification scheme from the developing Regional Nearshore Salmon Recovery Plan, examples of key stressors that limit habitat function along the East Kitsap nearshore include:

Shoreline Development

- **Shoreline Armoring/Bulkheading:** Marine shorelines in East Kitsap are extensively armored/bulkheaded. The East Kitsap shoreline is estimated to be approximately 80% developed and Bainbridge Island shorelines are approximately 48% armored. Activities associated with shoreline development include filling of intertidal mudflat, salt marsh, and lagoon habitat, shoreline armoring, removal of riparian vegetation. These activities have altered natural shoreline processes, including recruitment of sediment and woody debris from eroding bluffs and sediment transport and deposition along the shoreline.
- **Landfill:** Fill of upper intertidal often results in direct elimination of saltmarsh habitat and reduces tidal influence. Based on Washington Department of Ecology Oblique Photographs (2000-2001), fill has altered nearshore processes along East Kitsap Shorelines. However, the extent of alterations has not been determined.
- **Dredging and Conversion of Nearshore Habitat to Deepwater Habitat:** Marinas with boat moorage facilities are present throughout East Kitsap; there are 17 marinas in the Kitsap County. Most marinas involve at least some dredging of intertidal and shallow subtidal habitat to provide sufficient depth for navigation and boat moorage. In addition, many marinas have breakwater structures that extend from the upper intertidal well out into the subtidal area. Overwater shading of moored boats, boathouses, and docks and piers can also affect the benthic productivity, and may also affect nearshore migration behavior of juvenile salmonids. Marinas are also known to have increased incidence of water quality problems, including fuel spills, increased nutrients and toxics.
- **Alteration of Intertidal/Shallow Subtidal Vegetated Habitat:** Intertidal and aquatic vegetated habitat is impacted by a variety of activities in East Kitsap. Fill of upper intertidal areas often results in direct elimination of saltmarsh habitat and alteration of natural sediment transport processes from estuaries (e.g., Carpenter Creek, Clear Creek) has resulted in sedimentation in the estuary, with associated loss of saltmarsh habitat. Loss of eelgrass (*Zostera marina*) habitat in the intertidal/shallow subtidal area is a concern. These habitats are directly impacted by fill or dredging, overwater structures and loss of natural shoreline sediment process. Remaining eelgrass meadows also appear to be at risk of eutrophication and elimination due to the increasing presence of ulvoid mats (*Ulva spp*.). Storm water outfalls may also alter eelgrass and aquatic macroalgae beds. The mechanisms for these alterations are not well understood, but are likely related to both water quality impacts as well as reduced salinity near the storm water outfalls.
- **Loss/Lack of Shoreline Riparian Vegetation:** There has been significant loss of riparian functions along the East Kitsap shoreline, associated with development. Marine shoreline riparian vegetation provides similar functions to those in the freshwater environment: bank stability, shade, detrital/nutrient input, and contribution of large woody debris (LWD).

Spills and Discharges to Marine Waters

- **Discharges Impacting Water Quality:** There are a number of marine water quality problems in East Kitsap County, with many streams being listed on the Clean Water Act

303(d) list. (Discharges are from both point and nonpoint pollution sources including stormwater.)

- **Oil and Toxic Spills:** The marine shorelines and resources of East Kitsap are at risk of significant adverse impacts from oil spills and other toxic spills in the marine environment. There are numerous marinas and docking facilities. In addition, transport, storage, and transfer of large volumes of fuel occur at the PSNS and the Navy Fuel Depot at Manchester. All of these pose a significant risk of chronic (small volume) or catastrophic toxic spills.

Legacy Contamination in East Kitsap Sediments

- **Marine Sediment/Water Quality:** There are several sediment quality (and water quality) problems associated with current and previous Navy facilities. Sediment contamination has been indicated at the PSNS, Keyport, Manchester, and Jackson Park. In addition, Dyes Inlet/Port Washington Narrow, Port Orchard/Agate Passage/Rich Passage, and Sinclair Inlet have been on the 303(d) list for exceeding a broad variety of water quality parameters. There are also several water quality and sediment quality problems associated with industrial activity, including the Wyckoff/Eagle Harbor Superfund Site.

Shellfish and Finfish Aquaculture

- **Netpen Facilities:** There are salmonid netpen facilities at several locations, including Manchester and at the southern end of Bainbridge Island. Netpen installations are known to affect sediment quality due to shading, and due to accumulation of excess food and fish feces that accumulate on the bottom in the vicinity of the netpen.

Hatchery Fish Interactions

- Refer to hatchery section (P. Dorn, pers. Comm.).

Non-Native Invasive Species

- Several invasive species may pose a threat to salmon at various life stages either through direct alteration of habitat or indirect ecosystem implications such as displacement of native species. The presence of spartina infestations in several local estuaries has physically changed the habitat structures in portions of these areas.

Urbanization of Smaller Independent Freshwater Drainages

PSAT has noted that Graeber (NOAA-TRT, personal communication) has observed urbanization (structures, impervious surfaces, land use, over-water structures, etc) in many of the small drainages throughout Puget Sound. With urbanization, Fresh (personal communication) reported an increase in the magnitude and frequency of floods, as well as an altered hydrologic cycle (e.g., new peak runoff events). As a result of these alterations, additional sediments are transported to estuaries more frequently which may lead to filled-in marsh channels and buried vegetation (Fresh personal communication) that can affect juvenile salmon. For example, chum salmon often utilize and spawn in many of the smaller independent freshwater drainages of Puget Sound (some streams are even intermittent); “many of these small systems that have been heavily impacted by effects of urbanization” (Fresh personal communication).

The cumulative effect of the urbanization of smaller independent freshwater drainages (not connected to larger estuaries) like those in East Kitsap, may alter hydrology and sediment processes. Urbanization affects water quantity and water quality, and sediment composition, and which affect the nearshore habitats upon which salmon depend (e.g., reduced opportunities to utilize habitats). Thus, the effects on juvenile salmon include altered feeding and growth (e.g., reduced food sources available to salmon), affected refuge locations from predators and extreme events, and affected physiological transition areas. The resulting effects on the functions of juvenile salmon affect one or more life history trajectories of one or more of the listed salmon populations.

The role of stormwater and water quality on salmon habitat is an evolving body of literature. Stormwater links to acute fish kills in other parts of the Puget Sound region are identified, yet which constituent(s) of the stormwater that proved lethal is as yet undetermined. Increased urbanization is associated with degraded water quality and increased contaminants, such as heavy metals and pesticides, are deemed hazardous to salmon, yet our scientific knowledge is limited due to the complexity and expense of thorough toxicological studies. As this research base increases, we will have an increased understanding of urbanization impacts on salmon. The USGS studies of the Puget Sound Basin over the last decade have found potential impacts to salmon linked to urbanization via water quality and decreased invertebrate productivity (Ebbert, J.C., et al. 2000).

6.3 - Future Actions

Future actions to be undertaken in the East Kitsap Watershed by Kitsap County primarily consist of the continuation of existing programs described above. These programs are a combination of mandated updates to the County’s Comprehensive and Shoreline Master Plan goals and policies as well implementing ordinances, such as the Critical Areas Ordinance, and non-mandated programs such as watershed planning and coordination of the East Kitsap Lead Entity.

Specifically, Kitsap County will update both its Comprehensive Plan and Shoreline Master Program in 2011 to include policies based upon best available science (BAS) giving special consideration to conservation or protection measures necessary to preserve or enhance anadromous fisheries as required under the Growth Management Act (RCW 36.70A. 172). Also in 2011, Kitsap County will revise its Critical Areas Ordinance, again based upon BAS and providing special consideration for salmon.

The implementation of non-mandated recovery related programs are dependent on available local, state and federal funding to support these actions. These actions will include the continued implementation of prioritized nearshore and watershed restoration and protection projects identified in the East Kitsap Peninsula Salmon Recovery Strategy and Lead Entity process.

As the WRIA 15 Watershed Plan is developed and adopted in the coming years, recommendations from the plan and technical assessments will be used to inform local natural resource management and land use planning processes to better manage water resources to support the needs of people and salmon.

With the continuation of integrated watershed and land use planning, Kitsap County will develop land use plans that accommodate population growth and the resulting development in ways that minimize the impact to natural watershed process and fish and wildlife habitats.

6.4 - Estimated Costs -TBD

- Administration
- Programs
- Projects

7.0 - BAINBRIDGE ISLAND SUB-AREA PLAN

Salmon are important to the residents of Bainbridge Island as an ecological, cultural, recreational and commercial resource and they are one of the most iconic symbols of the region we call home. Healthy salmon populations are an indicator of overall environment health – and are therefore a measure of the success or failure of our long-term environmental stewardship.

The approach taken by Bainbridge Island for salmon recovery and conservation is guided by City Council Resolution 2000-31 (see inset), which directs the City administration to pursue salmon recovery and conservation primarily through the fulfillment of existing State mandates and the implementation of the City's Comprehensive Plan.

RESOLUTION No. 2000-31

A RESOLUTION of the City Council of the City of Bainbridge Island, Washington, stating the Council's intent to conserve and recover the Puget Sound Chinook salmon and to protect habitat for the Puget Sound Chinook salmon.

WHEREAS, the federal government has listed Puget Sound Chinook salmon as threatened by extinction under the Endangered Species Act; and

WHEREAS, the shoreline environment of Bainbridge Island contains critical habitat utilized by Puget Sound Chinook salmon and other important fish and wildlife species; and

WHEREAS, the protection of habitat critical for the survival of salmon and other fish and wildlife species is a priority of the City of Bainbridge Island, as stated in the City's Comprehensive Plan and Shoreline Master Program; and

WHEREAS, the City's Comprehensive Plan is currently undergoing review as mandated by the State of Washington, the City's Shoreline Master Program and Stormwater Management Plan will also undergo extensive review as mandated by the State upon the State's adoption of final rules for its stormwater and shorelines programs; and

WHEREAS, in the interest of maximizing the city's limited staff and financial resources to comply with various federal and state mandates which protect and conserve our natural environment;

THE CITY COUNCIL OF THE CITY OF BAINBRIDGE ISLAND HEREBY RESOLVES:

The City of Bainbridge Island shall provide for the conservation and recovery of the Puget Sound Chinook salmon through the scheduled review and revision of the Comprehensive Plan, the Shoreline Master Program and the Stormwater Management Plan, and through a comprehensive review of its Roads Maintenance and Operations Program and other activities which may impact salmon and salmon habitat. During these reviews, activities believed to impact salmon and nearshore habitat will be addressed first and will receive priority for revision and implementation. The City will monitor the efforts of Kitsap County, the State of Washington and the National Marine Fisheries Service and will give due consideration to any clear and rational regulations or requirements proposed by these agencies.

Kitsap Countywide Planning Policies (see Appendix F) and the City's Comprehensive Plan (see Appendix E), specifically policy FW 1.6 (see inset), further guides the approach taken by Bainbridge Island for salmon recovery and conservation and guides the City's involvement in the development of a regional salmon recovery and conservation plan.

Comprehensive Plan Policy FW 1.6

The City shall undertake appropriate, adequate, and timely actions to protect and recover state priority species, species listed under the federal Endangered Species Act, local species of concern, and their habitats located within the City to 1) avoid local extirpation of such species from the lands or fresh waters or nearshore of the City and 2) contribute to the protection and recovery of such species throughout the greater region in cooperation with federal, state, and other local agencies.

Discussion: Local extirpation means the elimination of self-sustaining residential populations from the entire Island and its waters, or adequate habitat to sustain use of the Island's lands and waters by transitory or migratory populations.

This plan is the implementation of the policy direction and guidance discussed above by the City administration and is the primary tool for:

- ***Coordinating and integrating the various activities required to be implemented,***
- ***Providing a sound technical basis for their implementation,***
- ***Monitoring their effectiveness, and***
- ***Identifying outstanding issues that need to be further addressed.***

7.1 - Scope of the Bainbridge Island Sub-Area Plan

Extirpation and extinction of salmon populations have occurred within Puget Sound and a significant number of salmon populations (aka: stocks) are considered depressed or critical (WDFW 2002). Extirpation of salmon from a limited number of Bainbridge Island streams has potentially already occurred based on known habitat impacts and fish passage barriers, but has not been documented. Important habitat capacity for salmon within the Island's nearshore areas has been lost, primarily due to historic filling, armoring, and water quality impacts. However, high quality freshwater and nearshore habitats remain and there is great and wide-spread potential for habitat improvements.

The Bainbridge Island Sub-Area Plan applies to multiple salmonid species in the subwatershed and nearshore areas within the jurisdictional boundaries of the City of Bainbridge Island. The salmon species and applicable life-stages addressed by this plan are summarized in Table 7.1. This plan is primarily focused on juvenile rearing and migratory life-stages as well as the adult spawning life-stage since these are the periods of the salmon life cycle that are affected by local habitat conditions. Bull Trout are not specifically addressed by this plan because they do not occur within the Island's small streams and are not known to occur along the shorelines of Bainbridge Island (see Section 3.10). Since this plan uses an ecosystem-based approach, actions benefiting the targeted species are expected to benefit Bull Trout that may utilize the Bainbridge Island Nearshore. The Islands subwatersheds are not utilized by Chinook and sockeye salmon and historically did not contain suitable habitat for these species. Sockeye salmon may utilize the Island's nearshore but have not been documented to do so during almost four years of beach seining, although all seining has occurred during the day and juvenile sockeye are thought to migrate at night. Pink salmon have not been documented in Island streams (Haring 2000; WDFW 2002) but could potentially utilize some Island streams. Freshwater resident steelhead trout, known as rainbow trout, have not been documented in Island streams, which are not likely to provide suitable habitat.

Table 7.1. Species and Life-Stage Addressed by the Bainbridge Island Sub-Area Plan

Species	Life-Stage		ESA Status
	Subwatersheds	Nearshore	
Chinook	None	Juvenile rearing & migration	Threatened
Coho	Egg incubation; Juvenile rearing & migration; Adult spawning	Juvenile rearing & migration	Candidate
Chum	Egg incubation; Juvenile rearing & migration; Adult spawning	Juvenile rearing & migration	
Pink	Not Documented, but possible: Juvenile rearing & migration; Adult spawning	Juvenile rearing & migration	
Sockeye	None	Not Documented, but possible: Juvenile rearing & migration	
Cutthroat	Egg incubation; Juvenile rearing & migration; Adult spawning & residence	Juvenile rearing & migration; Adult residence	
Steelhead	Juvenile rearing & migration; Adult spawning	Juvenile rearing & migration	

This sub-area plan is the beginning of an iterative and adaptive resource management process, one in which the City has been engaged for years in many respects but not previously in such an integrated and focused way. Therefore, some actions and programs identified in this plan are already being implemented and should be continued and/or modified while other proposed actions should be implemented over various time scales ranging from the very near term (1-5 years), mid-term (5-15 years), and some long-term actions likely to continue at various frequencies in perpetuity. The focus of this plan (iteration #1) is on the near to mid-term with particular emphasis on integrating/modifying existing efforts, filling important gaps, improving the technical basis for long-term planning, and implementing priority projects.

7.2 - Goals, Objectives, & Principles

"Ecosystem Management is management driven by explicit [objectives], executed by policies, protocols, and practices, and made adaptable by monitoring and research based on our best understanding of the ecological interactions and processes necessary to sustain ecosystem composition, structure, and function.

Ecosystem Management must include the following:

1. Long-term sustainability as [a] fundamental value,
2. Clear, operational [objectives],
3. Sound ecological models and understanding,
4. Understanding complexity and interconnectedness,
5. Recognition of the dynamic character of ecosystems,
6. Attention to context and scale,
7. Acknowledgment of humans as ecosystem components, and
8. Commitment to adaptability and accountability."

Christienson et al. 1996 (see Appendix M)

Overall Goal

The goals and objectives of this plan provide the framework for the implementation of salmon recovery and conservation on Bainbridge Island consistent with the vision and timeframe articulated in Section 1.1; specific policy guidance provided by the City Council and the Bainbridge Island Comprehensive Plan (see Sections 7.0 and Appendix E); and technical guidance provided by the Puget Sound Technical Recovery Team, Shared Strategy for Puget Sound, Washington State Department of Fish and Wildlife, and the Suquamish Tribe.

Goal: Restore and conserve self-sustaining and harvestable wild salmon populations on the Island and contribute to regional salmon recovery and conservation in a manner that is ecologically sound and socially equitable; does not jeopardize other species; and enhances our community, our quality-of-life, and our economy.

When combined and if successfully achieved, the following objectives and principles will result in the accomplishment of the overall goal. Objectives are split into three categories for organizational purposes and numbered for reference, but are not listed in any particular order.

7.2.1 - Ecosystem Objectives

> **“Sound ecological models and understanding.** Ecosystem management is based on sound ecological principles and emphasizes the role of processes and interconnections. Ecosystem management should be rooted in the best current models of ecosystem function. … Ecosystem Management depends on research performed at all levels…, from investigations of the morphology, physiology and behavior of individual organisms, through studies of the structure and dynamics of populations and communities, to analysis of patterns and processes at the level of ecosystems and landscapes.
>
> **Complexity and connectedness.** … Biological diversity and structural complexity of ecosystems are critical to such ecosystem processes as primary production and nutrient cycling. Complexity and diversity also impart resistance to and resilience from disturbance, and provide the genetic resources necessary to adapt to long-term change. …
>
> With complexity comes uncertainty. Some of our uncertainty regarding or lack of precision in predicting ecosystem behavior derives from the fact that we do indeed have more to learn. However, we must recognize that there will always be limits to the precision of our predictions set by the complex nature of ecosystem interactions and strive to understand the nature of those limits. Ecosystem management cannot eliminate surprises or uncertainty; rather, it acknowledges that, given sufficient time and space, unlikely events are certain to happen.
>
> **Recognition of the dynamic character of ecosystems.** Sustainability does not imply maintenance of the status quo. Indeed, change and evolution are inherent characteristics of ecosystems, and attempts to "freeze" ecosystems in a particular state or configuration are generally futile in the short term and certainly doomed to failure in the long term. Crises associated with the management of our forests, fisheries, and wildlife have driven home the points that individual resources cannot be managed outside of the context of the full array of ecosystem components and processes and that the spatial and temporal domains of critical ecological processes are rarely congruent with the spatial boundaries and temporal schedules of management.
>
> **Context and scale.** Ecosystem processes operate over a wide range of spatial and temporal scales, and their behavior at any given location is very much affected by the status and behavior of the systems or landscape that surrounds them (*citation ommitted*). There is no single appropriate scale or timeframe for management.”
>
> *Christienson et al. 1996 (see Appendix M)*

(*The following objectives are largely adapted from: Lake Washington/Cedar/Sammamish Watershed (WRIA 8) Steering Committee, 2004 and Spence et al 1996*)

E-1: Maintain and restore watershed and nearshore processes that create and sustain habitats and ecological functions necessary to sustain healthy salmon populations.

E-2: Maintain and restore habitat necessary to sustain healthy salmon populations during all life-stages and life-histories as well as functional corridors linking these habitats.

E-3: Maintain and restore a well-dispersed network of high-quality refugia habitats necessary to sustain core salmon populations and serve as centers for population expansion.[4]

E-4: Maintain and restore connectivity between high-quality refugia habitats to allow for recolonization and salmon population expansion.

E-5: Maintain genetic diversity and integrity within and among salmon populations and species.

7.2.2 - Community Objectives (People and Economy)

"Ecosystem Management acknowledges the role of humans, not only as the cause of the most significant challenges to sustainability, but as integral ecosystem components who must be engaged to achieve sustainable management goals (*citations omitted*). Human effects on ecosystems are ubiquitous. Although we should strive to reduce deleterious impacts, current trends in population growth and demand for natural resources will undoubtedly require more intensive and wiser management, particularly to support human needs in a sustainable way. Thus, identifying and engaging stakeholders in the development of management plans is a key ecosystem management strategy. Humans who are part of the ecosystems will, of necessity, define the future of those ecosystems."

"[A]ny corporate manager knows that, when inventories are depleted and the physical plant is allowed to deteriorate, it is possible to make money in the short term while watching your net worth waste away. Such is the road to bankruptcy. Businesses routinely make decisions with short-term costs, but obvious benefits to their long-term sustainability.

This metaphor captures the sense of intergenerational equity and the stewardship responsibilities that are central to an ecosystem management philosophy. Ecosystem management is the ecological analog to the economic stewardship of a trust or endowment dedicated to benefit all generations.

Ecosystem management is not a rejection of the anthropocentric for a totally biocentric world view. Rather, it is management that acknowledges the importance of humans needs while at the same time confronting the reality that the capacity of our world to meet those needs in perpetuity has limits and depends on the functioning of ecosystems."

Christienson et al. 1996 (see Appendix M)

[Add discussion summarizing applicable info from Community Values Survey and about social and economic costs and benefits associated with salmon recovery – see "Saving Salmon, Sustaining Prosperity"]

Responses to 2000 Community Values Survey:

- **Over 2/3 of respondents characterized the Island as suburbanizing**

[4] May & Peterson (2003) evaluates watershed and nearshore refugia throughout the East Kitsap Watershed. Since the Bainbridge Island Nearshore Assessment (Williams et al 2004) provides a more detailed nearshore ecological evaluation, it will be used to evaluate nearshore refugia within the Bainbridge Island Sub-Area.

- **Respondents split nearly 50/50 over negative or positive feelings about growth**
- **Characteristics that most contribute to Island's Character:**
    - **Most (30%) said Forested Land**
    - **4th (9%) said Open Space**
    - **Last (3%) said Wildlife**
- **Characteristics most valued**
    - **Most (42%) said Sense of Community**
    - **Second (28%) said Open Natural Space**
- **Characteristics least valued**
    - **Least (2%) said Open Natural Space**
    - **Second least (3%) said Sense of Community**
-

C-1: Maintain and build community appreciation and support for salmon recovery and conservation.

C-2: Use salmon recovery and conservation activities as opportunities to improve our community and sense-of-place. Integrate signage, public access, and community participation whenever possible and at appropriate scales on public lands and willing private lands.

C-3: Utilize a broad and appropriate range of management tools (e.g. policy, planning, regulation, incentives, assistance, easements, and acquisition) to fairly and equitably share the burdens and benefits of salmon recovery and conservation in a manner that respects private property rights.

C-4: Integrate watershed and nearshore conservation and restoration into land use plans and developments in a way that enhances overall community character, livability, and does not degrade property values.

C-5: Communicate with the community about salmon recovery and conservation activities in a timely manner and provide easy access to information, reports, and data.

C-6: Make wise and strategic public and private investments that result in overall fiscal benefits (e.g. increased value, decreased costs) and social benefits (e.g. aesthetics, quality-of-life, recreation, clean water, etc) to the community and result in overall benefits to salmon.

C-7: Avoid future salmon recovery costs and minimize mitigation costs by avoiding and minimizing adverse impacts to ecosystem processes and salmon habitats in the first place.

C-8: Work with WDFW and the Suquamish Tribe to integrate habitat, harvest, and hatchery management activities in a manner that is equitable, respects treaty rights, and minimizes risks to salmon populations in the Bainbridge Island Sub-Area.

7.2.3 - Adaptive Management Objectives

> "As in all areas of science, current models and paradigms of ecosystem function are provisional and subject to change. Ecosystem managers must acknowledge that our knowledge base is incomplete and subject to change. Management goals and strategies must be viewed as hypotheses to be tested by research and monitoring programs that compare specific expectations against objective measures of results (*citations omitted*).
>
> Adaptability and accountability are central elements of ecosystem management. Managers must be able to adapt to the unique features or needs of a particular area and to inevitable temporal changes as well. Management must also be able to adapt to new information and understanding. To be adaptable and accountable, management objectives and expectations must be explicitly stated in operational terms, informed by the best models of ecosystem functioning, and tested by carefully designed monitoring programs that provide accessible and timely feedback to managers. Public understanding and acceptance of the experimental nature of all natural resource management are critical to the implementation of ecosystem management protocols."
>
> *Christienson et al. 1996 (see Appendix M)*

(The following objectives are partially adapted from: Lake Washington/Cedar/Sammamish Watershed (WRIA 8) Steering Committee, 2004)

AM-1: Approach the development and implementation of management plans and actions in a scientifically rigorous manner, including the articulation of appropriate hypotheses.

AM-2: Employ scientifically rigorous monitoring, including implementation, effectiveness, and validation monitoring, at appropriate scales to measure how well management actions achieve goals and objectives. As necessary, employ corrective actions to achieve goals and objectives.

AM-3: Conduct research and investigations necessary to improve the understanding of ecosystem conditions as well as the watershed and nearshore processes that are critical to the formation of salmon habitat.

AM-4: Review and update management plans at defined intervals (or more frequently as necessary) based on the results of monitoring, research, and literature review.

AM-5: Take action in the face of scientific uncertainty provided that the action is rigorously planned, designed, and monitored; that the costs and risks are worth the benefits of learning from possible mistakes and failures; and that corrective actions will be employed, if necessary, to achieve goals and objectives.

7.2.4 - Guiding Principles

(The following principles are partially adapted from: Lake Washington/Cedar/Sammamish Watershed (WRIA 8) Steering Committee, 2004)

The principles listed below are intended to further guide how objectives will be met, particularly when there are many potential management actions and not enough time or resources to implement them all. They are numbered for reference, but listed in no particular order.

P-1: Priority should be given to actions that mitigate risks to resources that benefit salmon.
- Risk is a cumulative function of both the potential *magnitude* that an impact will have and the potential *frequency* that the impact will occur. For example, a large oil spill from a ship or truck poses a risk of great magnitude, but at a low frequency while heavy metals and other hazardous materials emitted from vehicles onto roads ways and into stormwater may have a low magnitude, but occur at a very high frequency.

P-2: Priority should be given to actions that will result in a high level of benefit related to its associated cost. The following factors should be considered when evaluating cost:
- Fiscal Value – Is the cost of the action discounted (below market rate), market rate, or at a premium (above market rate)?
- Opportunity cost – Will the cost of the proposed action be less/greater than if it were implemented at an alternative site or time? If the activity can occur only in one or possibly a few locations or if the proposed location is highly essential to achieve an important objective or reduce significant risk, then the cost of forgoing the opportunity would be very high.
- Community Value – Does the project incur unacceptable or inequitable community costs or does it enhance the character and quality-of-life in the community?

P-3: Whenever possible, priorities should be based on the results of a comprehensive assessment of a system (i.e. subwatershed or shoreline management area), a modeling of system-wide benefits to salmon, estimated costs, and capacity to implement the range of necessary actions.

P-4: Priority should be given to species that are listed or are candidates for listing under the Federal Endangered Species Act or by the Washington State Department of Fish and Wildlife. Priority should also be given to species who are at risk of extirpation from Bainbridge Island.

P-5: Priority should be given to the conservation of remaining high quality habitat because it is generally the most cost-effective approach; it provides the greatest certainty that habitats and ecological processes will be sustained; and minimizes impacts to existing community and private infrastructure.

P-6: Restoration projects should seek to return ecological processes and habitat functions to conditions that allow for natural long term variation whenever possible.
- Records of historic conditions provide the best template for the scale and scope of restoration projects. In the absence of a historic record or in systems where historic conditions are not achievable, best professional judgment and the use of various technical tools (i.e. models, etc) will be necessary to determine the best approach.
- This does not imply that all historic functions will be or must be restored. However, restoration of adequate function and capacity for natural variation will minimize risks to salmon populations, reduce long-term maintenance cost, reduce

potential risks to the community (i.e. flooding, landslides, etc), and reduce potential future restoration or enhancement cost.

P-7: Develop and implement a process and the capacity to shift priorities and resources, or pull on reserved contingency resources, when unplanned or unanticipated opportunities and risks arise.

P-8: Capitalize on the opportunities provided from continued population growth to maintain and restore habitat.

- Seek legally appropriate and socially responsible opportunities to incorporate habitat conservation and restoration when property is developed or redeveloped.
- Evaluate potential revenue opportunities that could be derived from the economic expansion associated with continued population growth.
- Focus education and outreach efforts, in part, on new residents and the industries associated with growth and development (real estate, developers, contractors, etc).

P-9: As a tool to improve equity in the benefits and burdens created by management actions, the greater public should make investments in community infrastructure (e.g. docks, beach access, etc) where management actions (i.e. regulations, legal agreements) have restricted or limited the development of private infrastructure in areas where such private development may likely and reasonably occur (i.e. dock or beach access is not likely or reasonable in muddy back bays, but is likely and reasonable in areas with access to navigable waters or sandy/gravel beaches).

P-10: Avoid adverse impacts from salmon recovery and conservation activities to existing habitat that could lead to the local extirpation of other species from the Island.

- Note that salmon recovery and conservation on Bainbridge Island is focused on restoring ecosystems and therefore should pose very limited, if no, risk to other species. However, risks to other species could occur in extreme cases where, for example, watersheds or nearshore areas are so modified that habitat enhancement or creation would be the principle method of increasing the viability of salmonid populations and where such projects would adversely impact the habitat of a native species that is itself on the brink of extirpation. Based on our current knowledge about the existing ecological conditions in the Bainbridge Island Sub-Area, this type of scenario is not expected to arise.

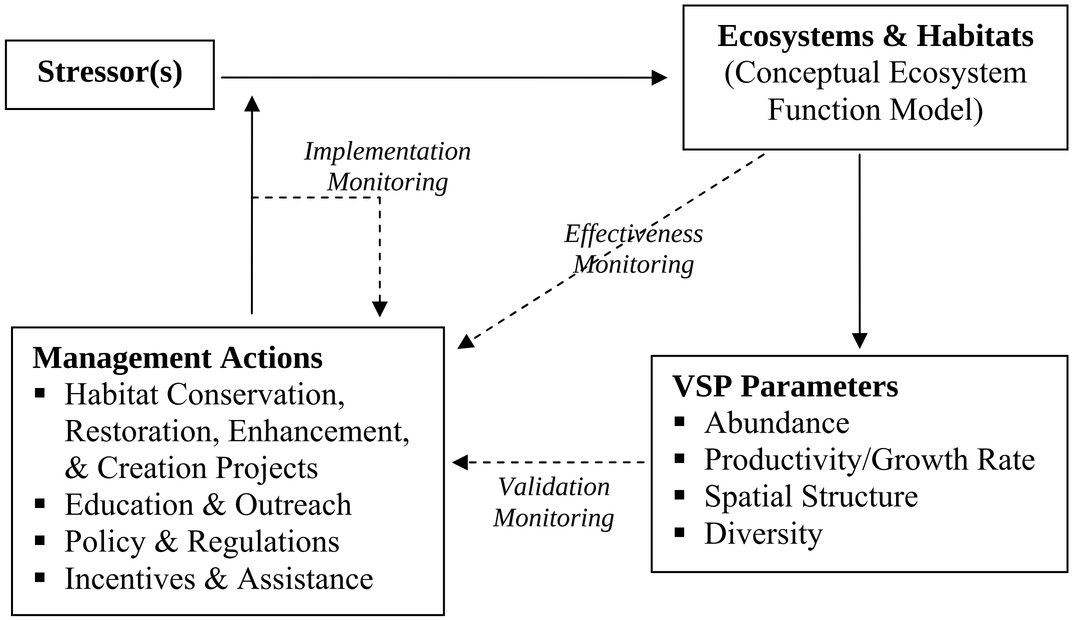
7.3 - Conceptual Models for Salmonid Habitat Restoration and Conservation

> "Knowing exactly what to expect from complex systems is a nontrivial challenge, and models are essential to meeting this challenge. Models may take the form of simple compartment diagrams that provide a means of organizing information or expressing connections and relationships, or they may be developed as complex computer simulations that allow us to depict processes operating through time and across landscapes.
>
> It is not possible to design monitoring programs to measure the dynamics of every species and ecosystem process. Models can be useful in identifying particularly sensitive ecosystem components or in setting brackets around expectations for the behavior of particular processes. They can be especially useful in identifying indices and indicators that provide a measure of the behavior of a broad suite of ecosystem properties. Finally, models often provide useful tools for exploring alternative courses of action."
>
> *Christienson et al. 1996 (see Appendix M)*

Conceptual models are used to build scientifically defensible frameworks for resource management, especially when existing empirical knowledge alone is not adequate. The conceptual models presented below capture the overall management approach to salmon recovery and conservation on Bainbridge Island. Fundamentally, this approach is ecosystem-based because the long-term recovery and conservation of salmon is dependent upon the availability and maintenance of the ecosystem processes that create and maintain habitats as well as the ecological functions provided by the habitats those species occupy. Particularly since salmon utilize a broad range of habitats throughout their various life-stages and life-histories, including many habitats that reach extensively throughout developed and developing watersheds and nearshore areas.

A conceptual management model for both subwatersheds and nearshore areas is presented in Figure 7.3 and is organized in the following general way. The model hypothesizes that stressors (e.g. urbanization, habitat modification, pollution, harvest, hatcheries, storms, floods, landslides, climate variability, etc.) exert direct, indirect, and cumulative effects to varying degrees on ecosystems and therefore the viability of salmon populations that exist in those ecosystems. These models also hypothesize that various management actions can be used to avoid, minimize, or mitigate the effects exerted by stressors on ecosystems, habitat, and viable salmonid populations.

Figure 7.3. Conceptual Management Model for Ecosystem-Based Salmon Recovery and Conservation in the Bainbridge Island Sub-Area



The management model includes conceptual ecosystem function models used to relate these stressors to effects on ecosystems and habitats. The application of these ecosystem function models to the assessment of existing conditions or hypothesized future conditions can then be used to evaluate the potential effects (impacts and benefits) that stressors and management actions have on ecosystems, habitats, and the viability of salmon populations. The results of these assessments, in conjunction with appropriate monitoring, can be used to refine existing management actions or develop and implement new management activities (i.e. adaptive management).

7.3.1 - Definition & Characteristics of a Viable Salmonid Population (VSP)

> "A VSP is an independent population that has a negligible risk of extinction due to threats from demographic variation, local environmental variation, and genetic diversity changes over a 100-year time period"
>
> (Ruckelshaus et al 2003, citing McElhany et al. 2000).

The four key characteristics of a viable salmonid population are:
(*Modified from Ruckelshaus et al 2003, citing McElhany et al 2000*)

1. Abundance – *the number of individuals in the population at a given life stage or time*

Abundance is recognized as an important parameter because, all else being equal, small populations are at greater risk of extinction than large populations, primarily because several processes that affect population dynamics operate differently in small populations than they do in large populations. These processes are deterministic density effects, environmental variation, genetic processes, demographic stochasticity, ecological feedback, and catastrophes.

2. Productivity/Population Growth Rate – *the actual or expected ratio of abundance in the next generation to current abundance*

Productivity/population growth rate (i.e., productivity over the entire life cycle) and factors that affect population growth rate provide information on how well a population is "performing" in the habitats it occupies during the life cycle. Estimates of population growth rate that indicate a population is consistently failing to replace itself are an indicator of increased extinction risk. Although our overall focus is on population growth rate over the entire life cycle, estimates of stage-specific productivity – particularly productivity during freshwater life-history stages – are also important to comprehensive evaluation of population viability.

Other measures of population productivity, such as intrinsic productivity and the intensity of density-dependence may provide important information for assessing a population's viability. The guidelines for population growth rate are closely linked with those for abundance.

3. Spatial structure – *the number of individuals and their distribution at any life-stage among available or potentially available habitats*

Spatial structure must be taken into account for two reasons: 1) Because there is a time lag between changes in spatial structure and species-level effects, overall extinction risk at the 100-year time scale may be affected in ways not readily apparent from short-term observations of abundance and productivity, and 2) population structure affects evolutionary processes and may therefore alter a population's ability to respond to environmental change. Spatially structured populations in which "subpopulations" occupy "patches" connected by some low to moderate stray rates are often generically referred to as "metapopulations". A metapopulation's spatial structure depends fundamentally on habitat quality, spatial configuration, and dynamics as well as the dispersal characteristics of a population.

4. Diversity – *the variety of life histories, sizes, and other characteristics expressed by individuals within a population*

Diversity exists within and among populations, and this variation has important effects on population viability. In a spatially and temporally varying environment, there are three general reasons why diversity is important for species and population viability. First, diversity allows a species to use a wider array of environments than they could without it. Second, diversity protects a species against short-term spatial and temporal changes in the environment. Third, genetic diversity provides the raw material for surviving long-term environmental change.

7.3.2 - Applying the Management Model in Subwatersheds

Conceptual Ecosystem Function Model

For the recovery and conservation of salmonids in the subwatersheds of Bainbridge Island, the management model (see Section 7.3) integrates Properly Functioning Conditions (PFC - see Appendix N) as the ecological function model used to evaluate the effects of stressors and management activities to viable salmonid populations[5]. Consistent with the guidance provided by NMFS (1996), the specific criteria and thresholds for stressors and their effects that are contained in Appendix N should be reviewed and modified, if appropriate, before used to assess the condition of Bainbridge Island subwatersheds. This model, combined with other guidance (NMFS 1999) can be used to generally evaluate the effects of stressors and management activities on salmon populations.

Effects of Stressors and Management Actions on Viable Salmon Population (VSP) Parameters

The subwatersheds of Bainbridge Island have not been assessed using the subwatershed ecosystem function model and local population status has not been evaluated. Therefore, it is not currently possible to discuss the effects of stressors or management actions on the viability of local salmon populations based in a comprehensive manner. This is a fundamental data gap that needs to be filled soon.

The existence of such significant data gaps, however, should not prevent the pursuit of meaningful management actions. In the absence of a comprehensive subwatershed assessment based on the ecosystem function model, the effects of stressors and management actions on VSP parameters should be hypothesized based on:

- Any known information about salmon population status and the potential carrying capacity of the subwatershed,
- Any known information about the existing conditions of ecosystem processes and habitat,
- Best available science, and
- Best professional judgment.

7.3.3 - Applying the Management Model in the Nearshore

[Modified from: Williams et al 2004]

Conceptual Ecosystem Function Model for the Nearshore

The conceptual nearshore ecosystem function model for the recovery and conservation of salmonids in the nearshore areas of Bainbridge Island is defined and thoroughly discussed in the Bainbridge Island Nearshore Assessment (Williams et al 2004), which has been provided, in its

[5] A compatible or possibly alternative model might be the Ecosystem Diagnosis and Treatment (EDT) model, which has been used in many watersheds to analyze the effects of stressors as well as identify and analyze the benefits of management actions. Prior to implementation of any subwatershed ecological function assessment and analysis, the PFC and EDT models should be more fully evaluated.

entirety, in Appendix H to this document and the reader is directed to that document for a thorough discussion of the model. This section summarizes the key aspects of the model.

The nearshore conceptual model assumes that stressors exert effects to varying degrees on a nearshore ecosystem's controlling factors (Figure 7.3.3(a); Table 7.3.3). Controlling factors (e.g. light level, wave energy) are physical processes or environmental conditions that control local habitat structure and composition (e.g. vegetation, substrate), including where habitat occurs and how much is present. In turn, habitat structure is linked to support processes, such as primary production or landscape connectivity, which influence ecological functions. Thus, impacts that affect controlling factors within an ecosystem are reflected in changes to habitat structure, and ultimately are manifested as changes to functions supported by the habitat and the species that rely on that habitat. The effect at the functional level depends upon the level of disturbance and the relative sensitivity of the habitat to the disturbance. Controlling factors are defined and discussed below. The nearshore model is applied using nearshore landscapes and geomorphic classification, which are also discussed in more detail below.

Figure 7.3.3(a). Conceptual Ecological Function Model for the Nearshore
(*from Williams et al. 2004*)

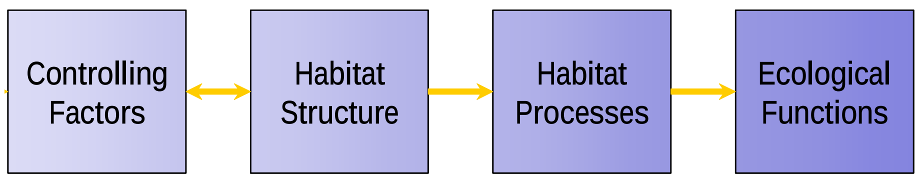


Table 7.3.3(a). List of Major Controlling Factors, Habitat Structure, Habitat Processes, and Ecological Function Metrics.

Controlling Factors	Habitat Structure	Habitat Processes	Ecological Functions
▪ Wave Energy ▪ Light (Increase) ▪ Light (Shading) ▪ Sediment Supply ▪ Substrate ▪ Depth/Slope ▪ Pollution/Nutrient ▪ Hydrology ▪ Physical Disturbance	▪ Density ▪ Biomass ▪ Length/Size ▪ Diversity ▪ Landscape Position ▪ Patch Shape ▪ Patch Size	▪ Production ▪ Sediment Flux ▪ Nutrient Flux ▪ Carbon Flux ▪ Landscape Connectivity or Fragmentation	▪ Prey Production ▪ Reproduction ▪ Refuge ▪ Carbon Sequestration ▪ Biodiversity maintenance ▪ Disturbance Regulation ▪ Migration Corridors

Controlling Factors and their Stressors

Below, each of the nine controlling factors is defined and discussed in context of typical stressors. See Williams et al (2004) for a more in-depth discussion of these controlling factors as well as the criteria used to evaluate them.

1. Wave Energy
Wave energy primarily describes the reflective energy of waves, which can be modified by the composition, encroachment, and vertical design of shoreline armoring structures. Reaches with a high percentage of shoreline composed of armoring are assumed to have relatively higher wave reflective energy than those with less armoring. Wave reflection forces generally increase as armoring methods intensify, with higher impacts to beach processes in areas with solid vertical or re-curved seawalls, and lower impacts in areas using graded or porous structures (e.g., revetments and rip-rap) or dynamic "soft" solutions. Hardened armoring approaches, such as bulkheads and revetments, represent the types of shoreline modifications most likely to affect wave-energy regimes. Encroachment of the structure into the intertidal zone also may increase the reflective energy of waves. Wave exposure and geomorphic context provide appropriate guidance on reaches more likely to be affected by these shoreline modifications.

2. Light Regime (Loss of Natural Shade)
Light regime (loss of natural shade) primarily describes a loss of shading that affects natural temperature and desiccation rates, especially when anthropogenic alteration removes overhanging marine riparian vegetation. Reaches with intact, relatively undisturbed riparian zones are assumed to have a relatively high percentage of overhanging vegetation. Geomorphic context provides guidance on where overhanging riparian vegetation would historically be an important shoreline feature (i.e., low bank, high bluff, and marsh/lagoon).

3. Light Regime (Artificial Shade)
Light regime (artificial shade) describes the diminishment of light, or shading, which is caused by anthropogenic modifications, such as piers, docks, and other floating or overwater structures. The availability of light for aquatic vegetation may be reduced by shoreline structures that are built in the intertidal and shallow subtidal zones and by floating structures that are found closer to the bottom. Structures such as piers or boardwalks built over the backshore zone can also affect light regimes important to dune and marsh vegetation. The orientation and composition of a structure affects the level of impact upon light regimes.

4. Sediment Supply
Sediment supply, defined as the abundance of sediment within a reach, is substantially affected by shoreline armoring and other stabilization structures. This influence is especially true in situations in which backshore sediment sources, such as feeder bluffs, have been documented, although upland use may also affect this factor. Groins, as well as some ramps and other structures built waterward of the OHWM, affect alongshore transport of sediment in a drift cell. Wave exposure and geomorphic context provides guidance on the type of reaches for which backshore or alongshore sediment supply is not especially relevant.

5. Substrate Type
Substrate type represents the direct modification or replacement of natural substrates from the addition of novel structural materials associated with shoreline modifications. An example would include situations in which mixed soft sediment (e.g., gravel and sands) is replaced by solid concrete or large rip-rap materials, or the addition of pilings or other hard structures that provide substrate for attaching macroalgae and invertebrates. Geomorphic context provides

guidance on the type of reaches in which existing substrates are already “hardened” (i.e., rocky shorelines).

6. Depth or Slope
Depth or slope reflects the change of natural beach slope, bottom depth, or intertidal zone area, and has associated impacts on the native vegetation and biota using these habitats. Structures exhibiting intertidal encroachment may have an affect on natural beach slope or depth more significantly than would other shoreline modifications. Bottom depth and slope is also significantly changed by dredging.

7. Pollution
Pollution, which includes toxic contaminants, fecal coliform bacteria, excessive nutrients, and altered salinity and temperature regimes, is often associated with proximity to outfalls and stream sources or in association with marinas and fish farms. Information on historic use (e.g., creosote wood treatment in Eagle Harbor) also provides useful guidance on site and landscape effects. Human use may contribute pollutants along heavily armored shorelines adjacent to upland areas with extensive development (e.g., industrial, commercial, residential, agricultural), impervious surfaces, and areas of reduced riparian habitat. Marine riparian vegetation provides a buffer analogous to freshwater systems that serves to filter nutrients, bacteria, and other pollutants from surface waters. In the absence of existing data for marine systems, it is assumed that the positive relationship between watershed imperviousness and pollution that exists for stream systems in the region largely applies to marine nearshore systems as well.

8. Hydrology
Hydrology refers to whether tidal inundation regimes or patterns of groundwater and surface water flow are impacted. Tidal encroachment by armoring structures displaces intertidal and subtidal vegetation, whereas the placement of outfalls may result in local patterns of sediment scouring. Alteration of groundwater and surface flows by development in the marine riparian zone may influence vegetation distribution and slope stability. Marine riparian vegetation provides a buffer analogous to freshwater systems that serves to moderate the effects of stormwater runoff, soil erosion, and water-level fluctuations. In the absence of existing data for marine systems, it is assumed that the positive relationship between watershed imperviousness and hydrology that exists for stream systems in the region largely applies to marine nearshore systems as well. Geomorphic context provides guidance on the types of reaches in which hydrologic alterations may not be especially relevant (i.e., rocky shorelines), or where tidal constrictions may have disproportionate effects by affecting flushing and inundation rates (i.e., marsh/lagoons).

9. Physical Disturbances
The definition of physical disturbances is limited to recurring physical disturbances associated with human activities in marine and riparian shoreline habitats, but does not include temporary construction impacts associated with various nearshore modifications. Recurring physical disturbances are primarily associated with the grounding of floating docks, mooring buoys (and chains), vessels that are inappropriately located relative to tidal elevation, and various activities associated with boat launch ramps (e.g., prop wash). These regular disturbances physically

distress local benthos and vegetation. A variety of human-derived physical disturbances are particularly relevant along urban waterfronts.

Nearshore Landscapes

On Bainbridge Island, the nearshore landscape is shaped by processes that affect sediment transport, water circulation and aquatic species movement patterns. It is apparent that these shoreline processes must continue to function appropriately across the entire landscape to manage nearshore habitats and ecological functions in a long-term, self-sustaining condition (Williams and Thom 2001 – cited in Williams et al 2004; Best 2003). With this in mind, the nearshore model is applied to nearshore processes at two landscape scales. The larger Shoreline Management Area (MA) is scaled to encompass aggregations of drift cells, analogous to upland watersheds, which define sediment transport processes that form the basis for establishing and maintaining habitat structure and function (Figure 7.3.3(b)). A Shoreline Management Area is comprised of multiple shoreline reaches (based largely on ShoreZone units, see WDNR 2001 – cited in Williams et al 2004), which are scaled to current or historic geomorphic conditions (Figure 7.3.3(b)). Geomorphology often defines or is commonly associated with distinct habitats.

Nearshore Geomorphology

The nearshore contains a diversity of geomorphic settings (e.g. high bluff, lagoon), each associated with various physical characteristics and habitats, which do not provide the same functions or respond to stressors in the same manner. Therefore, the nearshore ecosystem function model (Figure 7.3.3(a)) is refined by a shoreline's geomorphic setting to provide better predictive relationships between nearshore controlling factors and ecological function (Table 7.3.3(b)) and to provide context for comparing existing conditions with natural conditions and setting restoration goals. Each reach of Bainbridge Island shoreline was classified into one of five major geomorphic categories, following the shore types outlined by Terich (1987).

- Low Bank
- High Bluff
- Spit/Barrier/Backshore
- Marsh/Lagoon
- Rocky Shore

The distribution of geomorphic classes over Bainbridge Island is shown in Figure 7.3.3(c). Table 7.3.3(b) summarizes the influence of geomorphic context on each controlling factor.

Figure 7.3.3(b). Nearshore Landscapes: Shoreline Management Areas & Shoreline Reaches.
(*From: Best 2003*)

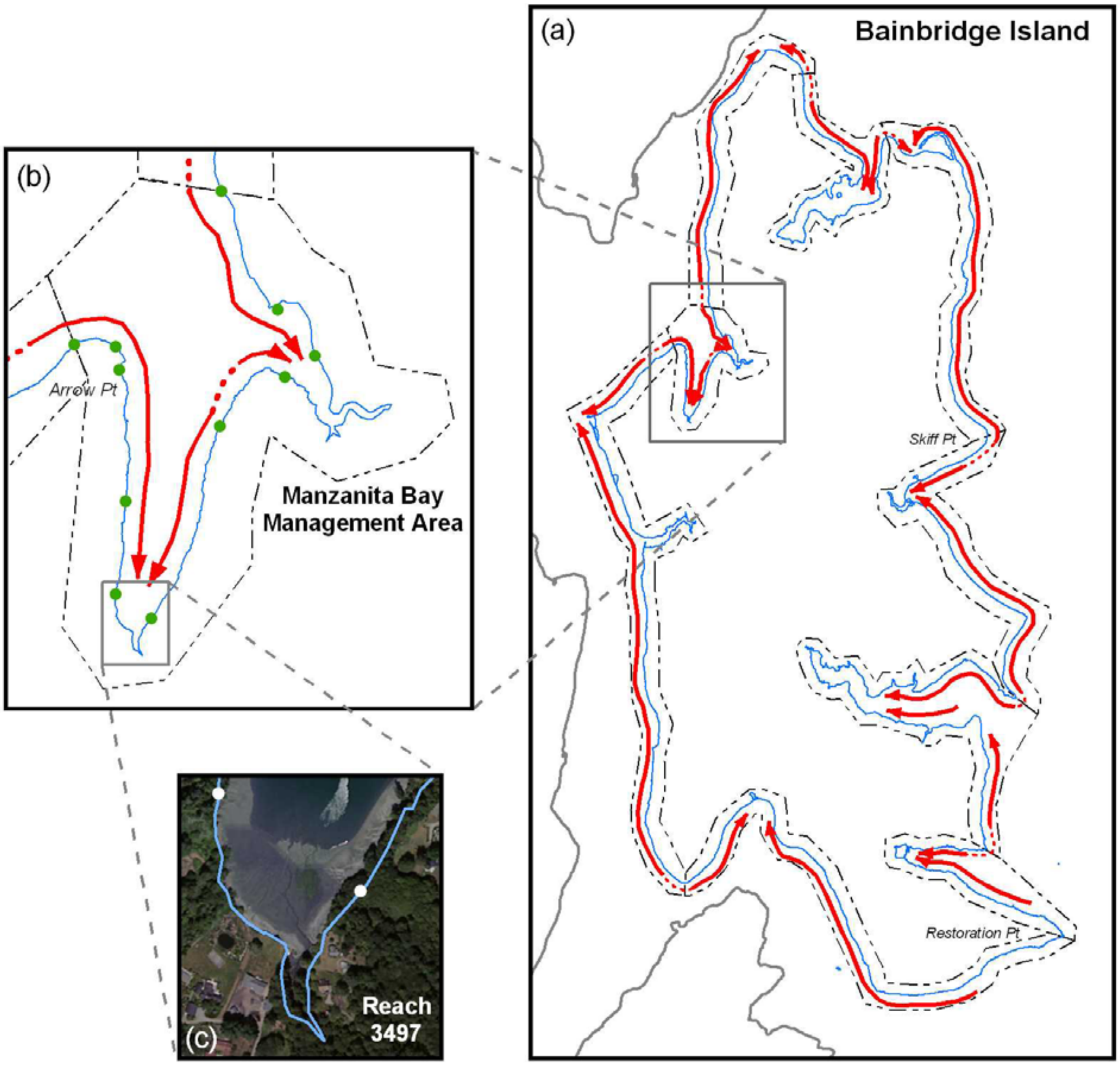
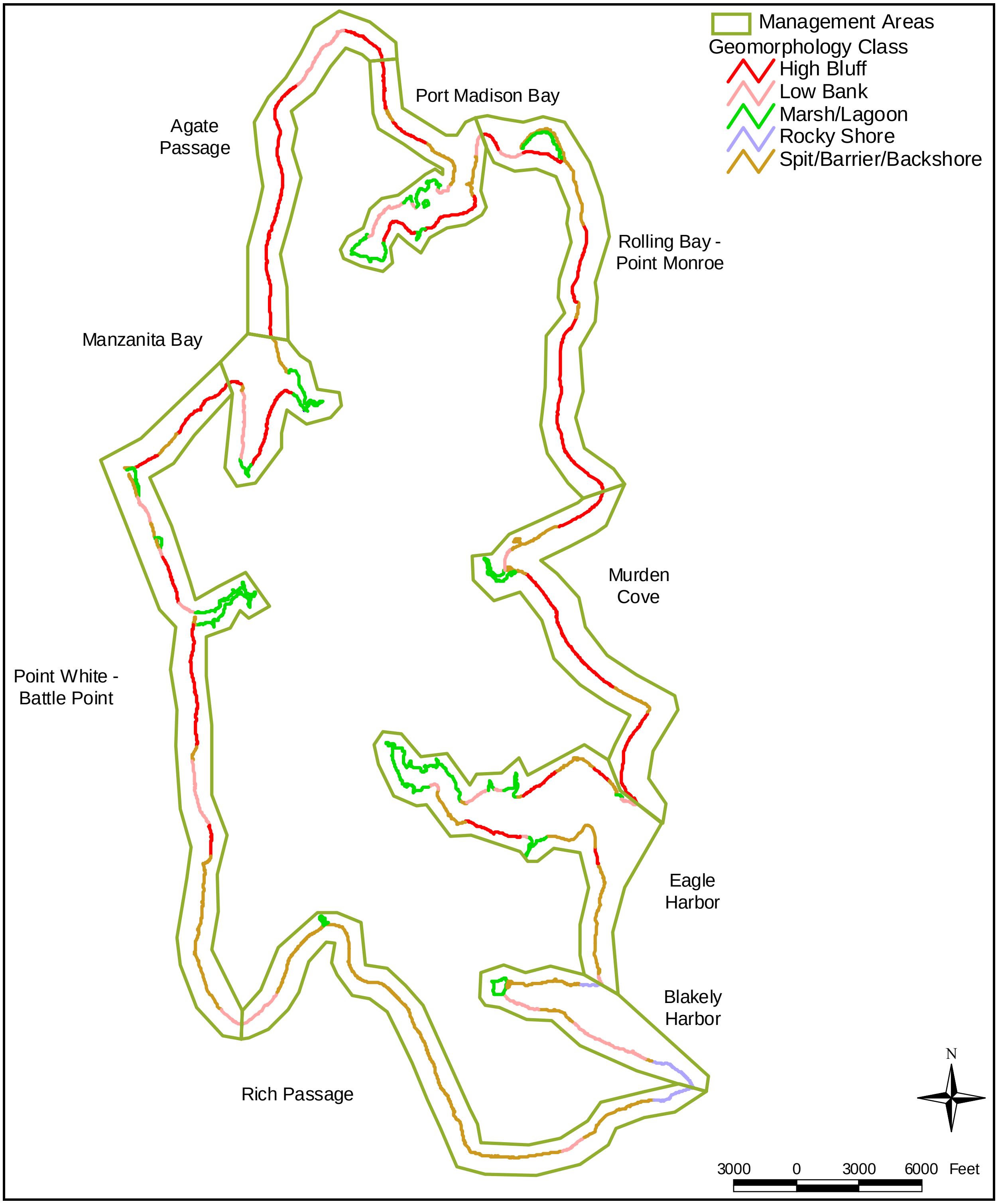


Figure 7.3.3(c). Distribution of Bainbridge Island Nearshore Geomorphic Classes.
(*From: William et al. 2004*)



Effects of Stressors and Management Actions on Viable Salmon Population (VSP) Parameters

[This section may be improved based on further discussions with biologists.]

Very limited guidance has been provided by NOAA Fisheries and the Puget Sound Technical Recovery Team relevant to how VSP parameters are affected by stressors in the nearshore. Until more comprehensive guidance is developed, the following types of effects from stressors on the VSP parameters have been hypothesized and integrated into the nearshore ecological function model relative to controlling factors and geomorphic settings (Table 7.3.2(b)) based on our current level of knowledge regarding juvenile salmonid use of the nearshore (Williams et al 2003 & 2004; Fresh, in prep).

- Altered osmoregulation – interference with osmoregulation can:
  - Reduce diversity and diminish abundance of life-histories that are more estuarine dependent,
  - Diminish productivity/population growth rate, and
  - Diminish overall abundance of the population
- Altered migration – interference with migration can:
  - Reduce diversity and diminish abundance of life-histories that are more dependent on the particular type of resource that has been altered,
  - Diminish productivity/population growth rate, and
  - Diminish overall abundance of the population
- Reduced prey – reduction in prey can:
  - Reduce diversity and diminish abundance of life-histories that are more dependent on the particular type of resource that has been altered,
  - Diminish productivity/population growth rate, and
  - Diminish overall abundance of the population
- Reduced refugia – reduction of refugia habitat can:
  - Reduce diversity and diminish abundance of life-histories that are more dependent on the particular type of resource that has been altered,
  - Diminish productivity/population growth rate, and
  - Diminish overall abundance of the population
- Increased predation – increases in predation can:
  - Reduce diversity and diminish abundance of life-histories that are disproportionately preyed upon,
  - Diminish productivity/population growth rate, and
  - Diminish overall abundance of the population

Due to existing knowledge gaps, the degree of these effects on the viability of salmonid populations cannot be calculated, but should be qualitatively considered relative to geographical scales and cumulative stressors. It is well recognized throughout the Puget Sound region that significant work remains to more fully understand the affects of nearshore stressors on VSP parameters. Additional work is necessary to understand the relative level of effects on different populations that originate from watersheds throughout Puget Sound. The responsibility for this level of work rest upon agencies and organizations with a regional focus such as WDFW and NOAA Fisheries, however efforts within watersheds can contribute valuable effort and information.

Table 7.3.3(b). Stressor Effects by Geomorphic Class and Controlling Factor (Shaded).

(*Adapted from: Williams et al. 2004*)

[This section will be completed based on further discussions with biologists.]

Geomorphic Class	Habitat Structure	Habitat Processes	Ecological Function	VSP Abundance	VSP Productivity/ Growth Rate	VSP Spatial Structure	VSP Diversity
Wave Energy							
Rocky	Generally not an issue, but may affect structure of attached macroalgae community.	Only as it affects macroalgal productivity.	May affect biodiversity maintenance.	Not likely to be an issue, but may Reduce prey Reduce refugia (aquatic vegetation)	Not likely to be an issue, but may Reduce prey Reduce refugia (aquatic vegetation)	Not likely to be an issue, but may Alter Migration Reduce prey Reduce refugia (aquatic vegetation)	Not likely to be an issue, but may Reduce prey Reduce refugia (aquatic vegetation)
Marsh/ Lagoon	Generally not an issue in these wave protected habitats, though habitat structure of marsh plant community could be affected by increased wave energy.	Loss of primary production and altered sediment flux.		Altered osmoregulation in proximity to natal stream Reduced prey Reduced refugia (LWD, aquatic vegetation)	Altered osmoregulation in proximity to natal stream Reduced prey Reduced refugia (LWD, aquatic vegetation)	Altered osmoregulation in proximity to natal stream Altered Migration Reduced prey Reduced refugia (LWD, aquatic vegetation)	Altered osmoregulation in proximity to natal stream Reduced prey Reduced refugia (LWD, aquatic vegetation)
Spit/Barrier/ Backshore	At critical tidal elevations or areas	Loss of primary production.	Loss of associated habitat functions,	Altered Migration	Altered Migration	Altered Migration	Altered Migration

Geomorphic Class	Habitat Structure	Habitat Processes	Ecological Function	VSP Abundance	VSP Productivity/ Growth Rate	VSP Spatial Structure	VSP Diversity
Low Bank High Bluff	exposed to waves, turbulence may displace rooted aquatic vegetation (e.g., eelgrass), suspend and coarsen fine sediment, reduce LWD retention	Increased sediment and carbon flux. Landscape fragmentation.	including salmon prey production and refuge. Loss of eelgrass affects herring spawn; altered sediment composition may affect forage-fish spawning substrate.	Reduced prey Reduced refugia (LWD, aquatic vegetation)	Reduced prey Reduced refugia (LWD, aquatic vegetation)	Reduced prey Reduced refugia (LWD, aquatic vegetation)	Reduced prey Reduced refugia (LWD, aquatic vegetation)
Loss of Natural Shade							
Rocky	Light increase generally not an issue (little riparian vegetation)	N/A	N/A	N/A	N/A	N/A	N/A
Marsh/ Lagoon	Loss of riparian vegetation affects habitat complexity. Increased light levels reaching marsh/mudflats increases desiccation and temperature regimes.	Loss of primary productivity from riparian litterfall. Carbon flux alteration and landscape fragmentation.	Loss of biodiversity, prey production (terrestrial insects), and refuge. Increased water temperatures in lagoons may affect herring embryo development.	Altered osmoregulation Reduced prey Reduced refugia (LWD, aquatic vegetation)	Altered osmoregulation Reduced prey Reduced refugia (LWD, aquatic vegetation)	Altered osmoregulation in proximity to natal stream Altered migration (Increased temperatures may affect estuarine dependent life-histories/life-stages) Reduced refugia (LWD, aquatic vegetation)	Altered osmoregulation in proximity to natal stream Altered migration (Increased temperatures may affect estuarine dependent life-histories/life-stages) Reduced refugia (LWD, aquatic vegetation)
Spit/Barrier/ Backshore	Same as Rocky (low growing dune vegetation).	N/A	N/A	N/A	N/A	N/A	N/A

Geomorphic Class	Habitat Structure	Habitat Processes	Ecological Function	VSP Abundance	VSP Productivity/ Growth Rate	VSP Spatial Structure	VSP Diversity
Low Bank High Bluff	Same as Marsh/Lagoon.	Same as Marsh/Lagoon.	Same as Marsh/Lagoon. Increased temperatures and desiccation affects beach spawning forage-fish embryos.	Altered osmoregulation in proximity to Marsh/Lagoon Reduced prey Reduced refugia (LWD)	Altered osmoregulation in proximity to Marsh/Lagoon Reduced prey Reduced refugia (LWD)	Altered osmoregulation in proximity to natal stream Altered Migration (Increased temperatures may reduce use of habitat) Reduced refugia (LWD)	Altered osmoregulation in proximity to natal stream Altered Migration (Increased temperatures may reduce use of habitat) Reduced refugia (LWD)
Artificial Shade							
Rocky	Total light loss would impact attached macroalgae communities, including patch size, density, and shape.	Loss of primary productivity from macroalgae. Landscape fragmentation.	Loss of associated biodiversity, prey production, and refuge. Darkness may inhibit salmon migration.	Reduced prey Reduced refugia (aquatic veg) Increased predation	Reduced prey Reduced refugia (aquatic veg) Increased predation	Altered migration Avoidance of certain areas	Could affect smaller/earlier migrant life-histories more than larger/later migrant life-histories
Marsh/ Lagoon	Total light loss would impact vascular marsh plant, macroalgae, and eelgrass communities, including patch size, density, and shape.	Loss of primary production. Carbon flux alteration. Landscape fragmentation		Reduced prey Reduced refugia (LWD, aquatic vegetation) Increased predation	Reduced prey Reduced refugia (LWD, aquatic vegetation) Increased predation	Altered migration Avoidance of certain areas	Could affect smaller/earlier migrant life-histories more than larger/later migrant life-histories
Spit/Barrier/ Backshore	Total light loss would			Same as Rocky	Same as Rocky	Same as Rocky	Same as Rocky

Geomorphic Class	Habitat Structure	Habitat Processes	Ecological Function	VSP Abundance	VSP Productivity/ Growth Rate	VSP Spatial Structure	VSP Diversity
Low Bank High Bluff	impact eelgrass and marine vegetation, including patch size, density, and shape.			Same as Marsh/Lagoon	Same as Marsh/Lagoon	Same as Marsh/Lagoon	Same as Marsh/Lagoon
Sediment Supply							
Rocky	Generally not an issue, though blockage of alongshore transport may change some substrate characteristics.	Only as it affects sediment flux, if present.	May affect biodiversity.				
Marsh/ Lagoon	Excessive supply from fluvial sources likely to be issue. May affect beach slope and smother eelgrass beds and marsh vegetation.	Altered sediment flux. Loss of eelgrass and riparian primary production, carbon flux, and landscape connectivity.	Loss of eelgrass associated salmon refuge and prey production. Excessive sediments may smother benthos, reducing biodiversity.	Reduced prey Reduced refugia (aquatic veg)			
Spit/Barrier/ Backshore	Impoundment of backshore sediments may cause beach erosion, coarsening of sediments, and loss of rooted vegetation.		Loss of eelgrass associated salmon refuge and prey production. Substrate coarsening affects				

Geomorphic Class	Habitat Structure	Habitat Processes	Ecological Function	VSP Abundance	VSP Productivity/ Growth Rate	VSP Spatial Structure	VSP Diversity
Low Bank	Impoundment of backshore sediments may cause foreshore and alongshore beach erosion (due to loss of sediment source), bank steepening, and sediment coarsening. Loss or change of rooted vegetation.		biodiversity.				
High Bluff	Major issue. Same as Low Bank, but may be more significant along high bluffs, which are often important feeder bluffs.						
Substrate Type							
Rocky	Generally not an issue; modifications are often rock cobble or concrete.	N/A.	N/A	N/A	N/A	N/A	N/A
Marsh/ Lagoon	Change from soft sediments to novel hard substrates (e.g. rock, concrete, steel, wood) associated with structures. Attached macroalgae and biota (e.g., mussels and barnacles) subsume soft sediment-associated vegetation and animals.	Reduction in sediment flux and alteration of landscape connectivity. Also affects source of primary production and carbon flux.	Alters local biodiversity (especially vegetation and invertebrate communities) in favor of those attaching to hard stuctures. Also, potential loss of beach spawning habitat for forage fish.				
Spit/Barrier/ Backshore							
Low Bank							
High Bluff							

Geomorphic Class	Habitat Structure	Habitat Processes	Ecological Function	VSP Abundance	VSP Productivity/ Growth Rate	VSP Spatial Structure	VSP Diversity
Depth - Slope							
Rocky	May alter distribution of attached macroalgae and biotic (e.g., mussels, barnacles) communities depending upon encroachment. May also simplify habitat complexity.	May reduce landscape connectivity.	May alter biodiversity maintenance and salmon migratory corridors.				
Marsh/ Lagoon	Change in distribution of eelgrass, saltmarsh vegetation, and mudflat channels. Impacts to associated landscape metrics.	Same as above, as well as modification of sediment flux and reduction of primary production.	Same as above, as well as alteration of salmon prey production.				
Spit/Barrier/ Backshore	Encroachment and slope increase narrows distribution of eelgrass and other vegetation, simplifying or reducing habitat structure.						
Low Bank							
High Bluff							

<table>
<tr><th>Geomorphic Class</th><th>Habitat Structure</th><th>Habitat Processes</th><th>Ecological Function</th><th>VSP Abundance</th><th>VSP Productivity/ Growth Rate</th><th>VSP Spatial Structure</th><th>VSP Diversity</th></tr>
<tr><td colspan="8">Pollutants/ Nutrients</td></tr>
<tr><td>Rocky</td><td>Nutrients may initiate nuisance algal blooms and epiphyte growth. Herbicides, contaminants, or water quality impacts may affect kelp vegetation, cause disease outbreaks, and affect growth.</td><td rowspan="5">May fragment landscape, affect sediment nutrient, and carbon flux, and reduce habitat connectivity and primary productivity..</td><td rowspan="5">Direct toxicity to organisms, especially relevant to herring spawn, juvenile salmon, and their prey. Loss of vegetation causes reduction in salmon prey production and refuge. Affects biodiversity maintenance both in subtidal and riparian settings.</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Marsh/ Lagoon</td><td>Especially relevant in these settings with low flushing rates. Same impacts as noted above, especially as related to eelgrass, marsh, and marine riparian vegetation.</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Spit/Barrier/ Backshore</td><td>Same impacts as noted above, especially as related to eelgrass and dune vegetation.</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Low Bank</td><td rowspan="2">Same impacts as noted above, especially as related to eelgrass and riparian vegetation.</td><td></td><td></td><td></td><td></td></tr>
<tr><td>High Bluff</td><td></td><td></td><td></td><td></td></tr>
</table>

Geomorphic Class	Habitat Structure	Habitat Processes	Ecological Function	VSP Abundance	VSP Productivity/ Growth Rate	VSP Spatial Structure	VSP Diversity
Hydrology							
Rocky	Generally not an issue.	N/A	N/A	N/A	N/A	N/A	N/A
Marsh/ Lagoon	Constrictions may impact tidal influence and flushing rates, affecting the distribution and diversity of riparian, eelgrass, and marsh vegetation.	Affects primary production, carbon, nutrient, and sediment flux, landscape connectivity	Affects associated plant and animal biodiversity and disturbance regulation. Vegetation change alters migration corridors for birds, mammals, and fishes.				
Spit/Barrier/ Backshore	Encroachment into intertidal zone may alter tidal hydrology and displace dune vegetation		Same as Marsh/Lagoon. As well, altered hydrology may affect spawning success of forage fish (both via modifications to groundwater seeps and surface flow scour).				
Low Bank	Alteration of groundwater and surface flows may impact riparian vegetation distribution and slope stability, whereas tidal encroachment by structures and location of outfalls may displace or scour intertidal saltmarsh vegetation and eelgrass.						

Geomorphic Class	Habitat Structure	Habitat Processes	Ecological Function	VSP Abundance	VSP Productivity/ Growth Rate	VSP Spatial Structure	VSP Diversity
High Bluff	Same as Low Bank, though likely greater impacts to slope stability.						
Physical Disturbance							
Rocky	Benthic disturbances alter patch size, shape, and density of attached macroalgae and invertebrates (e.g. barnacles, mussels).	May fragment landscape and affect primary production associated with eelgrass or marsh communities. Altered carbon, nutrient, and sediment flux.	Biodiversity maintenance and natural disturbance regime.				
Marsh/ Lagoon	Unnatural or frequent disturbance of benthic habitats affects the distribution, size, shape, and density of eelgrass beds, macroalgae, and benthic communities.		Bottom disturbances affect benthic community biodiversity, salmon prey production and refuge, as well as disturbance regulation. May also affect spawn of forage fish. Human noise, activity, and sound may impact nesting and migration corridors of mammals and birds.				
Spit/Barrier/ Backshore							
Low Bank	Same as above. Also, vegetation removal affects structure and complexity of riparian cover.	Same as above. Also, reduced contribution of riparian primary production.					
High Bluff							

7.3.4 - Effects of Management Actions on Stressors and VSP Parameters

The purpose of implementing management actions is to avoid, minimize, and mitigate the effects of new stressors and to eliminate or reduce the effects of existing stressors on ecosystems, habitats, and the viability of salmon populations in subwatersheds and nearshore areas. The effects of management actions on stressors and VSP parameters can be determined by using the conceptual ecosystem function models to predict alternative ecological conditions based on a proposed set of management actions. Several simple examples are provided below. These models are particularly valuable for evaluating cumulative effects and should be used to evaluate the cumulative effects of various proposed management actions across a large landscape (i.e. subwatershed or shoreline management area).

Subwatershed Example: Existing Stressor

Management Action	Replace a culvert that blocks fish passage to properly functioning upstream habitats with a culvert that allows unimpeded fish passage (Note: this type of action is often in the public right-of-way, but would be dependent on a willing property owner if on private property)
Effect on Stressors	Eliminates the blockage to spawning and rearing habitat
Effect on VSP Parameters	Opening access to properly functioning spawning and rearing habitat is expected to increase abundance and spatial structure. If the opened area includes habitat that was not available in the previously accessible portions of the subwatershed, than potentially diversity could increase. Increased survival and expanded spawning should help improve population growth rates.

Subwatershed Example: New Stressor

Management Action	Require the conservation of a forested native vegetation riparian zone between a stream and adjacent development.
Effect on Stressors	Retaining the buffer will help maintain properly functioning conditions by limiting impacts on water temperatures, water quality and flows as well as maintain LWD and prey recruitment.
Effect on VSP Parameters	Maintaining properly functioning riparian zones is expected to help sustain abundance and spatial structure provided that other PFC criteria are also maintained. Maintaining healthy freshwater survival rates should help sustain population growth rates.

Nearshore Example: Existing Stressor

Management Action	Remove an encroaching bulkhead in front of a feeder bluff within the up-drift portion of a drift cell with reduced eelgrass abundance (Note: action dependent on a willing property owner if on private property)
Effect on Stressors	Reduces the loss (burial) of upper intertidal habitat, reduces the loss of sediment supply into the system, reduces the loss of finer sediments, conversion to deeper water and reduction of beach slope due to scouring, reduces intensified wave energy
Effect on VSP	Restoring natural sediment dynamics is expected to benefit VSP parameters in

Parameters	many, but often indirect ways. Restoration of finer sediments and beach slope is expected to increase eelgrass distribution and patch size, which in turn increases prey production and refugia habitat. Restoring finer sediment, beach slope, and access to upper intertidal habitat is expected to increase prey (e.g. forage fish) production and increase shallow migratory habitat. Therefore the management action is expected to support increased salmon abundance and spatial structure. Increased survival should help improve population growth rates.

Nearshore Example: New Stressor

Management Action	Build public and community docks in a location and manner that minimizes shading and substrate impacts. Public and community docks would be in lieu of private docks.
Effect on Stressors	Significantly reduces cumulative stress on aquatic vegetation from artificial shade and benthic organisms from sediment displacement and ongoing physical disturbances (i.e. prop wash/scour).
Effect on VSP Parameters	Helps maintain the abundance of prey, refugia and migratory habitats, and may reduce the amount of predation on salmon. Therefore, the management action would help sustain abundance, spatial structure and diversity. Maintaining healthy nearshore survival rates should help sustain population growth rates.

7.4 - Recommended Management Actions

[This section incomplete]

No single management action will address existing and future stressors on the Island's subwatersheds and nearshore ecosystems. A combination of management actions will be necessary to successfully achieve the goals and objectives of this sub-area plan. Potential management actions are listed in no particular order in Table 7.4 and must be selected and implemented consistent with the goal, objectives, and principles of this plan.

Table 7.4. Management Action Toolbox

- Policy
    - Comprehensive Plan (land use, environment, transportation, water resources, etc)
    - Shoreline Management Master Program
    - Six-year Capital Improvement Plan
    - Harbor Management Plans
    - Transportation & Utility Plans
    - Watershed Management Plans (groundwater & surface water)
    - Park and Open Space Management Plans
- Regulations
    - Zoning (density, land use, land cover, etc)
    - Critical Areas Ordinance (buffers, reasonable use exceptions, etc)

- Shoreline Management Master Program (buffers, land use, land cover, etc)
- Surface and Stormwater Management Ordinance (water quality and flow measures)
- Vegetation Management Ordinance (clearing)
- Building Code (grading)
- State Environmental Policy Act
- Transportation Design Guidelines
- Enforcement

- Operations
  - Surface and stormwater management
  - Road and utility maintenance
  - Park and public land management
  - Private land management
- Acquisition (primarily for habitat conservation, but also for habitat restoration, enhancement, and creation)
  - Less than fee-title acquisition (e.g. conservation easements, TDR) from a willing seller/donor
  - Fee-title acquisition from a willing seller
  - Land exchange with a willing land owner
  - Immanent domain from an unwilling seller (note that this action is highly dependent upon legal constraints and community acceptability)
- Incentives
  - Tax reductions
    - Conservation tax classification
      - Open Space (i.e. Public Benefit Rating System)
      - Forest Land
      - Timber Land
      - Agricultural Land
    - Assessment adjustments (e.g. conservation easements, regulatory restrictions, TDR, etc)
    - Tax credits (e.g. land/TDR donations, conservation easements)
  - Conservation payments (e.g. CREP, etc)
  - Financial assistance
    - Grants
    - Partnerships (cost share, technical assistance, etc)
- Education & Outreach
  - Property owners
  - School children
  - Real estate and development professionals
- Habitat Restoration
- Habitat Enhancement
- Habitat Creation

[Summary of Recommended Management Actions located in Appendix Q will be inserted here with discussion that puts those actions in context]

[Add discussion about certainty of implementation and certainty of benefit to salmon]

7.5 - Revenue Sources

Revenue sources that, in part, funds activities that affect salmon recovery and conservation:

Category	Description	General Value
SSWM Utility Fees	Fees are currently collected at a rate of $78 per unit equivalent (single-family residential/duplex/condo unit or 3,000 sq. ft. of commercial/mixed-use impervious surface) before applicable reductions. Rates are automatically adjusted for inflation annually unless the City Council resolves on an annual basis that the adjustment not occur. (BIMC 13.24) This revenue can be used to fund capital, maintenance, and operations of surface and storm water facilities, including facilities that can affect fish passage, water quality (surface, ground, and nearshore waters), stream flows, and salmonid habitat (stream & nearshore). ➲ SSWM Utility Fees collected between 1996 and 2004 have covered only 49.7% (54.4% projected for 2005-2010) of SSWM expenditures. Transfers from the City's general fund, real-estate excise taxes, low-interest loans, and grants have supplemented SSWM Utility revenues in all years (1996-2005) except for 1997.* ➲ $118,000 of this revenue was used to fund capital projects.*	$900,000* .
Open Space Bond	General obligation bond supported by 70% of voters. Used to acquire opens space for conservation, recreation, and agricultural purposes. Approximately $1 million of the bond remains unspent, but is anticipated to be spent in 2005. ➲ Since 2002, City has spent ~$3.5 million of Open Space Bond money on acquisition of shoreline habitat ▪ With match from grants and private donations, total cost for acquisitions is ~$9.2 million (approximately a 62% match) ▪ Adds up to ~1-mile of shoreline, and ~100-acres of land	$8,000,000

	▪ Habitats include marshes, tideflats, rocky reefs, feeder bluffs, forage fish spawning beaches, riparian forest ➲ The community should consider another bond in the coming years that again combines a range of priorities, including salmon habitat conservation with priorities guided by nearshore and subwatershed assessments.	
Real-Estate Excise Tax	This tax is assessed at a rate of ½ of 1 percent (0.5%) on the sale of real-estate and is restricted to funding capital projects. ➲ $575,000 of this revenue was used to fund SSWM capital projects.*	$1,677,000*
General Fund	General funds are derived from property taxes, sales tax, B&O tax, utilities tax, and other sources. General funds are used for a wide-range of City operations and projects. These funds are unrestricted and can be transferred to other funds for salmon recovery and conservation projects. ➲ $450,000 of general funds were used for SSWM operations.*	$13,702,400*
State Public Works and Transportation Fund	This revenue is low-interest loans competitively awarded to the City by the State Department of Ecology. ➲ $827,675 of this revenue is for the construction of a new decant facility in 2005*, which will replace the existing facility near a salmon stream which is under a Kitsap Health District clean up order. Proper decant is essential to reduction of pollutant load entering streams and nearshore. ➲ $1,937,650 of this revenue is part of $5,600,000 in total PWTF loans for expansion of the South Island Sewer*, which will be repaid largely by LIDs. This project will correct areas of failing septic systems and result in some net improvements to water quality, but may also reduce local ground water recharge and interflow that could have an effect on streams.	$6,534,525*
Grants	Grants are received from governmental and potentially private foundation sources. ➲ $198,650 from the State Centennial Clean Water Fund* that will be used to help design and test a Comprehensive (Island-wide) Surface and Nearshore Water Quality Monitoring Program. ➲ $45,750 from the State Office of Community, Trade, Economic Development* helped update the City's	$834,400*

	Comprehensive Plan and Critical Areas Ordinance. ➲ $250,000 from Salmon Recovery Funding Board to help acquire the Close Property (total purchase price $2.5 million).	

* Source: 2005 City of Bainbridge Island Budget.

Other potential revenue sources:

Category	Description	Value
Grants	NOAA Restoration Program – various grants	varies
Grants	USFW – various grants	varies
Grants	WDFW – various grants	varies
Grants	IAC – various grants	varies
Grants	NFWF – various grants	varies