NATURAL RESOURCES

Fidalgo Bay Environmental Aquatic Reserve Management Plan

April 2008

WASHINGTON STATE DEPARTMENT OF
Natural Resources
Doug Sutherland - Commissioner of Public Lands

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WASHINGTON STATE DEPARTMENT OF
Natural Resources

DOUG SUTHERLAND
Commissioner of Public Lands

April 2008

Dear Reader,

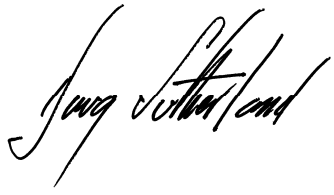
I'm pleased to present you with the Fidalgo Bay Aquatic Reserve Management Plan. This new plan will serve as a guide for the continuing protection, restoration, monitoring, environmental education and public enjoyment of the more than 650 acres of within this aquatic reserve.

This plan identifies the characteristics and numerous natural resource assets of this ecosystem, as well as opportunities for habitat restoration and enhancement that exist within Fidalgo Bay. The southern reaches of Fidalgo Bay are biologically rich, with expansive areas of eelgrass and tide flats. This estuary supports spawning and rearing of Pacific herring, surf smelt and sand lance as well as serving as a home and feeding area for migratory birds, Dungeness crab, and animals threatened with extinction and protected under the federal Endangered Species Act, such as the bald eagles, peregrine falcons, and Puget Sound Chinook salmon.

The planning effort has brought together a diverse array of partner agencies and organizations that have worked cooperatively to help us in its development. They are partners that also will help us improve the habitat in and around Fidalgo Bay for the long term.

I appreciate the participation of the communities and stakeholders in this process. With their—and your—continued interest and involvement, these high-quality tidal and marine habitats of Fidalgo Bay will continue to provide a healthy ecosystem, beauty and enjoyment into the future.

Sincerely,



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Fidalgo Bay Environmental Aquatic Reserve Management Plan

Skagit County
Washington

April 2008

Prepared by
Aquatic Resources Program

WASHINGTON STATE DEPARTMENT OF
Natural Resources
Doug Sutherland - Commissioner of Public Lands

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Acronyms

DNR	Washington State Department of Natural Resources
Ecology	Washington State Department of Ecology
ET&S	Endangered, Threatened and Sensitive Species
NOAA	National Oceanographic and Atmospheric Administration
PSI	Puget Sound Initiative
RCW	Revised Code of Washington
SEPA	State Environmental Policy Act
WAC	Washington Administrative Code
WDFW	Washington State Department of Fish and Wildlife

Figure 1: Fidalgo Bay Aquatic Reserve and Vicinity

1. Executive Summary

The Fidalgo Bay Aquatic Reserve is established as an environmental reserve to ensure protection of the unique habitats and native species identified in the area.

This plan identifies the habitats and species in the Fidalgo Bay Aquatic Reserve and the management actions that will be employed by the Washington State Department of Natural Resources (DNR) to conserve these resources with the management emphasis on environmental protection above all other actions.

In general, within its statutory authority, DNR will not approve new uses in the reserve with the exception of habitat restoration, research and monitoring, and aquatic species enhancement. There are presently no authorized activities within the reserve. DNR management authority extends only to the state-owned aquatic lands; and therefore this plan does not apply to privately owned property.

The following management goals are established for the Fidalgo Bay reserve:

- Conserve, at a minimum, and enhance, where there are opportunities, native habitats and associated plant and wildlife species, with a special emphasis on forage fish, salmonids, and migratory birds.
- Protect and restore the functions and natural processes of nearshore ecosystems in support of the natural resources of the reserve.
- Promote stewardship of riparian and aquatic habitats and species by providing education and outreach opportunities and promoting coordination with other resource managers.

The management plan will be reviewed and updated as necessary every ten years throughout the 90-year term of the reserve designation. Changes in ecosystem condition and existing uses of state-owned aquatic lands will be included in the updates. Research and monitoring data will be used to guide DNR in determining whether management actions are meeting the goals and objectives of the reserve. If management actions are not supporting the objectives of the reserve, in accordance with adaptive management strategies,

they will be modified, monitored, and evaluated during the next 10-year review process.

This plan is based on a collection of existing data, and other scientific information on the aquatic resources at the site, and on more than 18 months of public outreach to gather ideas and concerns about the site. Interests were expressed by the citizens of Skagit County, local, and state government, the Samish Tribe, the Swinomish Tribal Community, non-government organizations and industry. Their ideas regarding how to promote the conservation of aquatic resources and maintain or enhance the ecosystem health at the site helped guide the development of this plan.

2. Introduction

Washington's Department of Natural Resources

The Washington State Department of Natural Resources (DNR) manages about 2.6 million acres of state-owned aquatic lands. This includes 1,300 miles of tidelands, 6,700 acres of harbor areas (established in the state constitution), all of the submerged lands below extreme low tide, and freshwater shorelands and bedlands of navigable water bodies. In addition there is an undetermined amount of freshwater shorelands and bedlands that may be navigable and fall under DNR management.

DNR is directed by the Revised Code of Washington (RCW) to manage state-owned aquatic lands to provide a balance of public benefits that include encouraging public access, fostering water-dependent use, ensuring environmental protection, and utilizing renewable resources. In addition, DNR is directed to generate revenue from state-owned aquatic lands when it is consistent with the other public benefits. DNR also is to manage the state's sensitive aquatic lands and to remove them when necessary from conflicting uses. As part of this authority, under Washington Administrative Code (WAC) 332-30-151 DNR can establish environmental, scientific, and education aquatic reserves. The Fidalgo Bay Aquatic Reserve was established as an environmental aquatic reserve in 2000, and confirmed as a reserve candidate in 2003, to conserve and enhance important habitats and species.

Aquatic Reserves Program

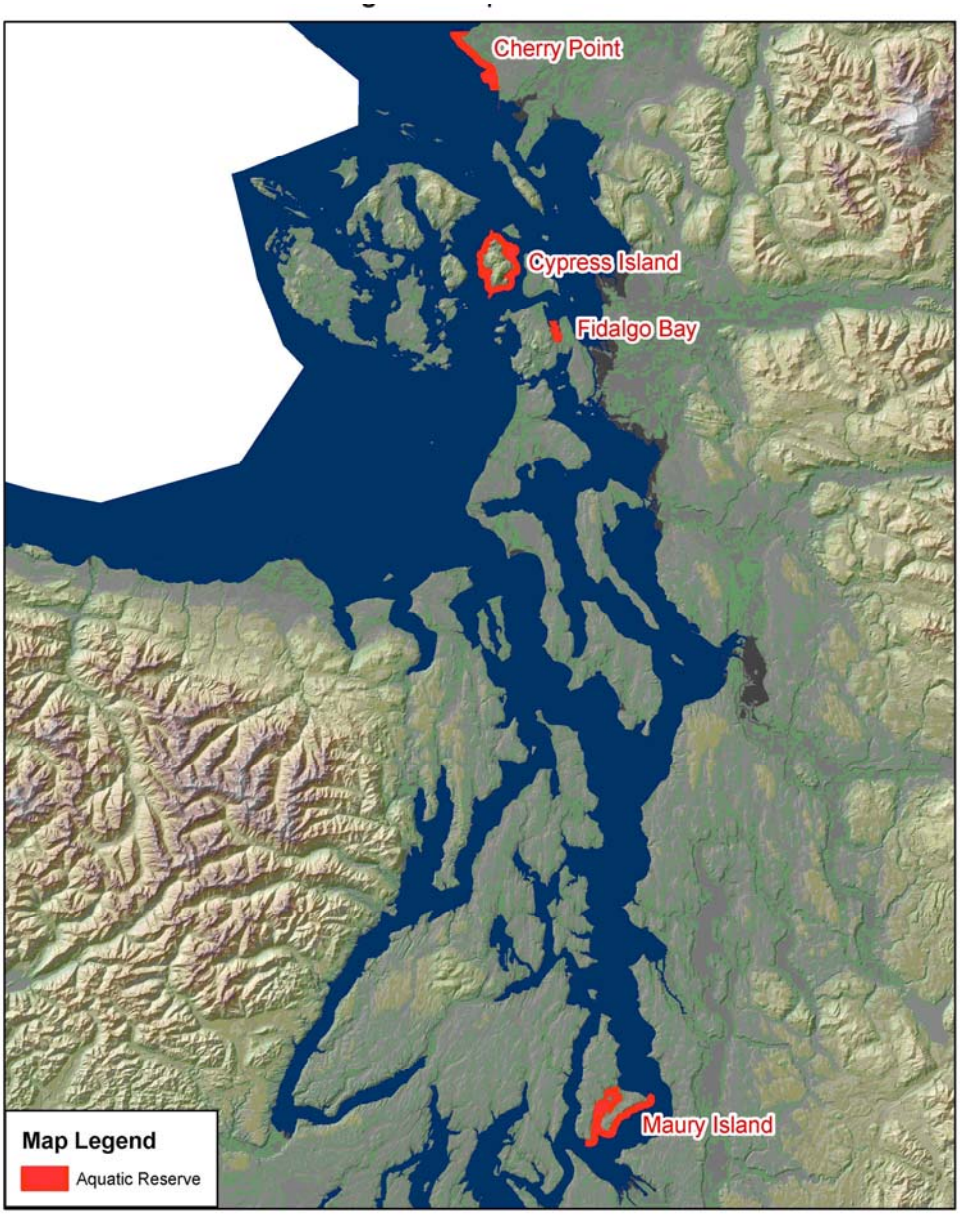
In efforts to promote preservation, restoration, and enhancement of state-owned aquatic lands that provide benefits to the health of native aquatic habitats and species in the state of Washington, DNR established the Aquatic Reserves Program.

By examining past success in site-based conservation, the Aquatic Reserves Program can help ensure that aquatic reserve status is applied when it is the most appropriate management tool.

Three types of aquatic reserves may be established through the Aquatic Reserves Program: environmental, scientific, or educational. The objectives for each reserve category can be found in the *Aquatic Reserve Program Implementation and Designation Guidance*, on DNR's webpage www.dnr.wa.gov

DNR and its partners will manage each reserve in a manner consistent with the goals for the type of reserve established and site-specific management plans.

Figure 2: Washington State Aquatic Reserves



Legal Authorities for Establishing State Aquatic Reserves

One of DNR's primary directives for the management of state-owned aquatic lands is RCW 79.105.030, which identifies environmental protection as the overarching goal of the Aquatic Reserves Program. WAC 332-30-151 directs DNR to consider lands with educational, scientific, and environmental values for aquatic reserve status, and identifies management guidelines for aquatic reserves. WAC 332-30-106(16) defines environmental reserves as sites of environmental importance, which are established for the continuance of environmental baseline monitoring and/or areas of historical, geological, or biological interest requiring special protective management. RCW 79.10.210 further authorizes DNR to identify and withdraw from all conflicting uses public lands that can be utilized for their natural ecological systems.

Fidalgo Bay Aquatic Reserve Boundary

The Fidalgo Bay Aquatic Reserve encompasses approximately 650 acres of state-owned tidelands and bedlands. The reserve boundaries extend from the southern end of Fidalgo Bay north to a line drawn east and west from Crandall Spit (Figure 1, page viii). Section 3 of this document provides a more thorough geographic, physical and biological description of the Fidalgo Bay Aquatic Reserve.

Legal Boundaries

For a complete legal description of the Fidalgo Bay Aquatic Reserve boundaries please refer to Appendix B.

Purpose of the Fidalgo Bay Aquatic Reserve Management Plan

This plan describes the habitats and species identified for conservation in the aquatic reserve and the actions that will be employed to protect these resources. The management emphasis will place protection of these resources above other management actions.

The Fidalgo Bay Aquatic Reserve Management Plan has been developed in accordance with the State Environmental Policy Act (SEPA). This plan will serve as DNR's primary management guidance for the 90-year term of the reserve. Every ten years after the adoption of the plan, it will be reviewed and, if necessary, updated with current scientific, management, and site-specific information. During the development of each subsequent update, DNR will work with other jurisdictions, Tribes, interest groups, adjacent landowners, and local citizens to establish cooperative management for activities within and

adjacent to the reserve—activities that conserve, enhance and restore habitats and species within the reserve.

Decision making and planning regarding management of the aquatic reserve will be guided primarily by the following three sections of this plan, generally described here:

- **Fidalgo Bay Environmental Aquatic Reserve:** This serves as an introduction to the site. Resource characteristics are identified and current ecological conditions are described for the site. Potential impacts and data gaps are also identified in this section.
- **Management Goals and Objectives**: This section identifies the desired future ecological conditions. Goals and objectives are also identified that will aide in the site management decision making.
- **Management Actions**: The various management actions to be taken that will allow the desired future ecological conditions to be achieved. Opportunities for protection, enhancement and restoration will be identified. Monitoring of ecological conditions will be discussed and prohibited and allowable uses of the site will be set.

Adaptive Management

'Adaptive management' is a systematic process for continually improving site management by learning from the results of past management actions. To ensure that the future conditions of the aquatic reserve site are met and adaptive management is being implemented, the management plan will be reviewed and updated every ten years throughout the 90-year term of the reserve designation. Adaptive management will help DNR integrate changes in scientific knowledge concerning the site, conditions of habitats and species, and existing uses of state-owned aquatic lands. Knowledge gained from research and monitoring activities also will be used to guide DNR in determining if management actions are meeting the goals and objectives of the reserve. If management actions are not successfully contributing to the goals and objectives for the reserve, then they will be modified, monitored, and evaluated during the following 10-year review process. DNR will include new scientific findings in management plans, and new inclusions and adaptations will not be restricted to every 10 years.

Fidalgo Bay Ownership

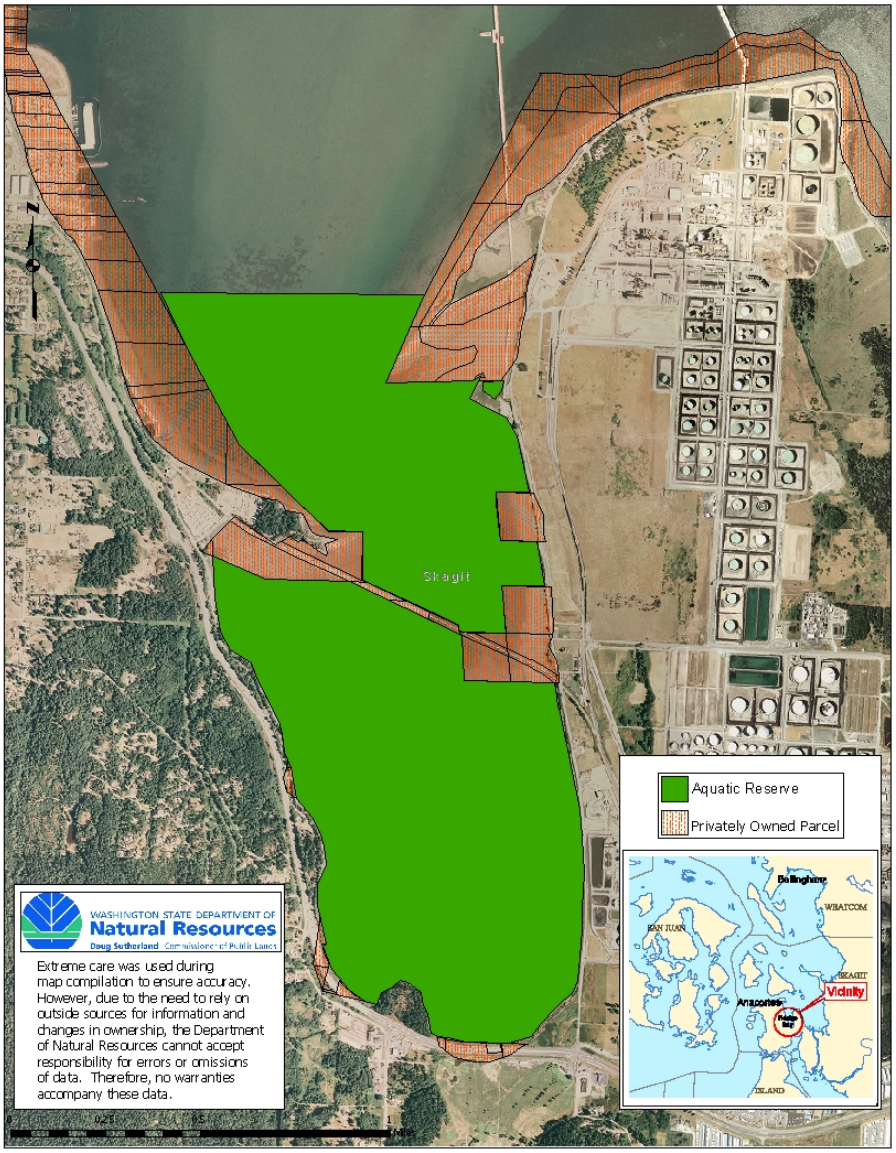
This region encompasses a mix of commercial, residential and forested uplands, and includes a portion of the Similk Beach golf course (Anacortes S. March Pt. Annexation Comprehensive Drainage Study, 1999).

Approximately 12 private tideland parcels exist within Fidalgo Bay adjacent to the current aquatic reserve boundaries (Figure 3, pg. 8). Three of the tideland

parcels adjacent to the reserve are owned by the Swinomish Indian Tribal Community, and five are owned by the Samish Tribe. About 11 private parcels exist on the uplands surrounding Fidalgo Bay aquatic reserve, four of which are owned by the Samish Indian Tribe. DNR will attempt to work cooperatively with these property owners to ensure proper protection for the Aquatic Reserve.

In 2000 the Skagit Land Trust acquired the area south of the railroad trestle. Ownership of this area was transferred to the state to be managed by DNR with a conservation easement held by Skagit Land Trust. The easement requires that the site be managed solely for preservation of habitat for fish and wildlife uses, and limited human uses.

Figure 3: Fidalgo Bay General Ownerships



Relationship to Federal, State, Local, and Tribal Management

The successful management of the Fidalgo Bay aquatic reserve will require coordination and collaboration with public and private entities as well as local, state, federal, and Tribal government, and non-government organizations. The following provides information regarding ongoing management interests at or near Fidalgo Bay.

Cypress Island Aquatic Reserve

DNR established the Cypress Island Aquatic Reserve in 2000 and adopted a management plan for this site in 2007. The reserve is located about 6 miles northwest of Fidalgo Bay Aquatic Reserve in the extreme northwest corner of Skagit County. The site contains a diverse assemblage of habitats and species including; rocky reefs, eelgrass and kelp beds, pocket beaches, rocky shorelines, abalone, sea urchins, scallops, sea cucumbers, crabs, reef dwelling and demersal ground fish, salmon and forage fish.

The close proximity of the Cypress Island Aquatic Reserve to the Fidalgo Bay Aquatic Reserve may provide some level of habitat connectivity for those species that are found at both sites, such as forage fish, salmon, and crabs. However, no data currently exists to verify this relationship.

Tribal Interests at Fidalgo Bay

The following Tribes have asserted a claim to usual and accustomed areas in Fidalgo Bay:

1. Lummi
2. Nooksack
3. Suquamish
4. Tulalip
5. Swinomish

In addition, the Samish Tribe owns 40 acres of tidelands and 30 acres of upland properties on Weaverling Spit. The Samish Tribe has historic and cultural ties to Fidalgo Bay and the surrounding area and has expressed a strong interest in restoration of forage fish spawning habitat, improving water quality, restoration of native shellfish populations and restoration of natural shoreline processes in Fidalgo Bay.

The Swinomish Indian Tribal Community owns 26 acres of tidelands adjacent to the eastern shore of the reserve and March Point Road. This community also has historic and cultural ties to Fidalgo Bay and the surrounding area. The Swinomish Tribe is actively working on several nearshore restoration projects in and around Fidalgo Bay.

Conservation goals and management activities identified in this management plan are not meant to conflict with Tribal treaty, natural resource, or cultural interests. DNR will continue to engage in a government-to-government dialog with the Tribes to ensure that treaty rights are upheld, and that historical and cultural ties to Fidalgo Bay are maintained**.**

Padilla Bay National Estuarine Research Reserve

The Padilla Bay National Estuarine Research Reserve was designated in 1980 and is located approximately 3 miles east of Fidalgo Bay Aquatic Reserve. The Padilla Bay Reserve is one of 27 in the National Estuarine Research Reserve System which was established to provide for research and education about estuaries around the coastal United States and Puerto Rico. The Padilla Bay Reserve offers educational programs for school groups and the general public, monitors natural resources and promotes research in Padilla Bay.

Padilla Bay is an "orphaned" estuary, cut off from its major freshwater sources by conversion of salt marshes to agricultural land in the late 1800s and early 1900s. The Padilla Bay Research Reserve encompasses 11,000 acres, 7,500 of which are eelgrass meadows, important nursery areas for juvenile fish and crab, as well as feeding areas for migratory shorebirds and waterfowl, such as the black brant. The National Estuarine Research Reserve program is joint federal and state, and is housed within the U.S. Department of Commerce, N.O.A.A., Office of Coastal Resource Management, Estuarine Reserves Division. The Reserve is managed by the Washington State Department of Ecology (Ecology).

Many of the shore birds and waterfowl known to occur in Padilla Bay also can be found in Fidalgo Bay. In addition, the close proximity between Fidalgo Bay and Padilla Bay provides good habitat connectivity for several species of out-migrating juvenile salmonids.

Hat Island NRCA

Hat Island Natural Resource Conservation Area (NRCA) is one of the eastern most islands in the San Juan group, located about 2.5 miles northeast of the Fidalgo Bay aquatic reserve. The 91-acre island contains Douglas fir, Pacific madrone and Pacific yew-dominant forests, and grass headlands composed of blue wildrye, red fescue, camas and clover. The conservation area provides habitat for bald eagles, sea and shore birds. The island is located in the Padilla Bay National Estuarine Research Reserve and provides research and education opportunities.

Local Land Use Designations

Most of the Fidalgo Bay Aquatic Reserve site is within the Anacortes city limits or the urban growth area of Anacortes. The area of Fidalgo Bay south of the trestle is designated as Conservancy and the northwest shore of Weaverling

Spit is designated as Urban in the City of Anacortes Shoreline Master Plan. The Conservancy designation of south Fidalgo Bay is consistent with the state aquatic reserve designation and will provide another level of protection from development. However, the urban designation for the northwestern portion of the bay may allow for further low density development along the northwest boundary of the reserve. The shoreline master plan designations of Urban 2 extend 200 feet landward of the ordinary high water mark. Additionally the uplands adjacent to the reserve south of the trestle are zoned as light manufacture, and the uplands on Weaverling Spit are zoned as commercial marine (City of Anacortes, in review late 2007).

The uplands of March Point are zoned Urban Development; this designation allows for residential and commercial development. Two oil refineries currently operate in this area.

Residential development adjacent to the site is limited to 1 unit per 3 acres. Presently, ten single-family residences and the 12-acre Fidalgo Bay RV Resort are located along the western and southwestern shoreline of the site.

Potential impacts to the reserve from local land use designations are discussed in section 3 of this plan. DNR will work with the local governments and Tribes to address those impacts through shoreline master plan development and other mechanisms.

3. Fidalgo Bay Aquatic Reserve

Site Characterization

The Fidalgo Bay Aquatic Reserve (Figure 1, pg. viii) contains diverse physical habitats that include tidal flats, salt marshes, sand and gravel beaches, and expansive native eelgrass beds. These habitats are recognized as essential contributors to the reproductive, foraging, and rearing success of many fish and bird species. A primary goal for creating the Fidalgo Bay Aquatic Reserve is the preservation of critical herring spawning habitat. Because of local losses in eelgrass due to development in northern portions of the bay and uncertainty regarding factors limiting the Fidalgo Bay herring population, the protection of herring spawning habitat is a critical resource issue in Fidalgo Bay and statewide.

The following section provides an overview of the environmental and natural resource characteristics for the Fidalgo Bay Aquatic Reserve and the adjacent areas. Physical and biological characteristics within or adjacent to the reserve, including physical processes, habitat, species, water and sediment quality are summarized in the following section. Understanding the processes and functions in Fidalgo Bay will help guide decisions regarding aquatic land management that influence the reserve and its associated ecological relationships.

Geographic Description

The Fidalgo Bay Aquatic Reserve is located in northern Puget Sound in northwestern Skagit County. The reserve boundaries extend to the north and west from State Route 20 and to the east from March Point Road. The northern boundary extends across Fidalgo Bay from Crandall Spit (Figure 1, pg. viii).

The reserve area includes the bedlands and the majority of the tidelands south of Weaverling Spit and the bedlands and about 80 acres of tidelands north of the spit and extending north to a line drawn west from Crandall Spit. DNR acquired tidelands north of the trestle during the fall of 2006, after this site had been recommended for Aquatic Reserve designation. Those additional tidelands will be included within the reserve. The total acreage of the reserve is 686 acres, of which 220 acres are located north of the trestle and 465 acres are located south of the trestle. All of the area south of the trestle and 80 acres of

tidelands north of the trestle are included in a conservation easement with the Skagit Land Trust. This conservation easement requires that the site be managed solely for protection of habitat for fish and wildlife, and limited human uses. This area cannot be used for any other purposes.

Ecosystem Description

Physical Processes

There are no major freshwater streams that flow into the Fidalgo/Guemes area. Runoff is predominantly non-point sources, small creeks, and outfalls. Direct seepage around the bay is likely the major freshwater contributor during low precipitation periods (City of Anacortes, 2000).

Fidalgo Bay experiences a semi-diurnal tidal cycle, with a mean range of 1.5 meters, and with strong tidal currents and various wave regimes (National Ocean Survey Tide Tables 1980). Shallow depths and large tide ranges drive water movement in the Guemes Channel/Fidalgo Bay area. The bay is open to northerly and southerly winds but greater wave heights occur when northerly winds combine with the larger north fetch distance. The bay is well-mixed vertically with temperatures, salinity and dissolved oxygen measurements similar to regional values (Antrim et al. 2003).

Figure 4, page 37 details the net shore drift of the Fidalgo Bay area. Extensive shoreline modifications have greatly reduced sediment input to the shorelines of the bay (Appendix A, Figure 5), resulting in sediment starved beaches and depositional landforms (Johannessen 2007). Generally, there are few remaining natural sources for shoreline sediment along the drift sectors influencing the bay.

Habitat Characteristics

Fidalgo Bay occupies an ancient delta of the Skagit River consisting of shallow mudflats dropping off steeply from Cap Sante Head (City of Anacortes, 2000). Spits form prominent features on both sides of the bay. Weaverling Spit projects from the western shore, and Crandall Spit and Little Crandall Spit project west from March Point. A late 1800s revetment and railroad trestle—since converted to a pedestrian foot path—crosses the bay at Weaverling Spit. Extensive intertidal sand/mudflats occupy nearly all the tidal area south of the railroad trestle (Appendix A, Figure 4). The area north of the trestle contains both intertidal beaches and a deeper subtidal channel with a depth of about 4 meters below mean lower low water (City of Anacortes, 2000).

Fidalgo Bay intertidal substrates (Appendix A, Figure 4) include mud, sand, and gravel/cobble sediments and limited areas of bedrock and artificial hard substrates such as pilings and riprap. Sand, silt and clay mixed with organic soils make up the salt marsh substrates. The inner bay tideflats are composed

of mixed fine clays, silts and sands. Subtidal sediments include mud bottoms with varying amounts of sand, gravel or cobble substrates, as well as hard bottom areas, that are both natural and man-made (City of Anacortes 1999).

Eelgrass (*Zostera marina*) covers a large portion of Fidalgo Bay at various densities (Appendix A, Figure 6). Laminarian kelps and other macroalgae are present in lower intertidal and shallow subtidal areas, sometimes associated with eelgrass. Salt marsh habitat, dominated by pickleweed (*Salicornia virginica*) and saltgrass (*Distichilus spicata*) can be found along Fidalgo Bay shorelines (Appendix A, Figure 7). Spit/berm habitats exist in areas of Crandall and Weaverling Spits and in narrow fringes or small patches in the inner bay. Subjected to salt spray and infrequent inundation, these habitats promote a different plant community including dune grass (*Leymus mollis*), gumweed (*Grindellia integrifolia*), Yarrow (*Achillea*), and Silver burweed (*Ambrosia chamissonis)*.

Fish and Wildlife Resources

Despite alteration in the associated uplands, much of the aquatic lands within the reserve support spawning, rearing and foraging habitat for numerous fish, migratory and resident bird, and marine invertebrate species. Extensive aquatic vegetation, diverse substrates, and ecological processes within the upland-marine interface provide for these productive habitat areas. These similar values can be found in adjacent bays.

In neighboring Padilla Bay and the nearby waters, at least 57 species of fish have been identified (UDC, 1980) Many of these species are likely to use nearby Fidalgo Bay with its similar habitat. Appendix A, Table 1 is a partial list of species observed in Fidalgo Bay.

Fidalgo Bay's tideflats contain productive microalgae and macroalgae (Appendix A, Figure 6), providing important habitat for juvenile salmonids and their prey resources (i.e. harpacticoids, copepods, and amphipods). Juvenile chum (*Oncorhynchus keta*) and Chinook salmon (*O. tshawytscha*) are known to occur in Fidalgo Bay during spring out-migrations (Beamer In review, Washington DNR technical memo 2007). These are likely Skagit and Samish River-derived stocks. No published information exists on the occurrence of bull trout (*Salvelinus confluentus*) in Fidalgo Bay. However the area is located in the proposed critical habitat for coastal bull trout (Federal Register, 2005b).

Three species of forage fish—Pacific herring (*Clupea pallasi*), surf smelt (*Hypomesus pretiousus*) and Pacific sand lance (*Ammodytes hexapterus*)—use intertidal and shallow subtidal areas in Fidalgo Bay for spawning habitat (Appendix A, Figure 8) and constitute a major portion of the diets of salmon, seabirds, marine mammals, and other fish. Adult herring are reported to congregate in the area to the east of Guemes and Hat Islands before periodic

migrations into Fidalgo Bay for spawning (Appendix A, Figure 8). Herring larvae are present in the south bay after hatching, and after the first summer they likely vacate the immediate area to grow and mature.

Herring spawn has been found wherever eelgrass exists in the bay, even in areas where eelgrass is distributed only sparsely (Penttila 1995). Red algae (*Gracilaria pacifica*) often intermix with or are adjacent to eelgrass beds and used as herring spawn deposition. Red algae also provides habitat for invertebrates and fish and is considered a key habitat component of the bay (Pentec 1994).

Marine flatfish such as starry flounder (*Platichthys stellatus*), rock sole (*Pleuronectes bilineatus*), and sand sole (*Psettichthys melanostictus*) typically use the mudflats and shallow embayments found in Fidalgo Bay. English sole (*Pleuronectes vetulus*) also are present, and most of these species may remain nearshore even as adults (City of Anacortes 2000). For a list of fish observed in the bay, see Appendix A Table 1.

Fidalgo Bay provides foraging and resting grounds for resident and migratory shorebirds and waterfowl. Brant geese, cormorants, peregrine falcons, and bald eagles, as well as many shorebirds and dabbling and diving ducks comprise the majority of the 239 birds that have been identified in Padilla, Samish, and Fidalgo Bays (See list of observed species, Appendix A Table 1). In addition, a large great blue heron rookery is located on the southeast side of March Point. Birds from this rookery are known to feed in Fidalgo Bay (Antrim et al. 2003). Diverse and abundant bird species use is primarily due to the Bay's location within the Pacific flyway. Eight of the species know to use this area meet the listing criteria for State Endangered, Threatened, or Sensitive Species: the common loon (*Gavia immer*) and Brandt's cormorant (*Phalacrocorax penicillatus*), bald eagle (*Haliaeetus leucocephalus*), Peregrine falcon (*Falco peregrinus*), great blue heron (*Ardea herodias*), osprey (*Pandion haliaetus*), common murre (*Uria aalge*), and marbled murrelet (*Brachyramphus marmoratus*).

Invertebrates such as marine worms, snails, clams, crabs, shrimp and other crustaceans provide vital links in the Fidalgo Bay food chain. These primary consumers help support the local populations of birds, fish and mammals. For a list of other marine invertebrates found in the bay, see Appendix A, Table 1.

Eight seal haul outs are located within the Fidalgo and Padilla Bay area. These sites are used year round as resting sites and serve as pup rearing sites from mid-June through mid-August (Appendix A, Figure 8). Harbor seals regularly hauled out on once-present log rafts but no longer have regular use of the shoreline as haul-out areas (Antrim et al. 2003). Along shoreline areas, Fidalgo Bay also provides typical foraging habitat for river otters.

Non-native Fauna and Flora

A wide-variety of non-native invertebrates persist in the area including Pacific oysters (*Crassostrea gigas*), purple varnish clams (*Nuttallia obscurata*), and the abundant Asian mud snail (*Battilaria attramentaria*) (Antrim et al. 2003). *Spartina anglica* was observed in Fidalgo Bay for the first time in 1999 but has since been removed. *Sargassum* and the common *Z. japonica* have been observed in the vicinity. Japanese littleneck (*Venerupis phillipenarum*), bryozoans (*Bugula*) and invasive tunicates (*Botrylloides violaceus*) comprise the remaining non-native species (Cohen et al. 1998).

Current Conditions

The overall ecological site condition is modestly compromised and degraded. Shoreline modifications, including filling of upper intertidal areas, shoreline armoring, over-water structures (i.e., the railroad trestle), and loss of shoreline riparian vegetation, primarily contribute to altered physical processes and reduction in critical habitat for several species in the bay (Appendix A, Figure 5).

Significant loss of eelgrass and of herring spawning habitat has occurred in Fidalgo Bay, primarily from dredging and filling of the shoreline areas (Williams et al 2003). Additionally, smaller areas of eelgrass and macroalgae have been eliminated by shading from overwater structures, such as the March Point piers and the railroad trestle. Because of these losses and the uncertainty regarding factors limiting the Fidalgo Bay herring population, the Washington Department of Fish and Wildlife considers the protection of herring spawning habitat to be a critical resource issue in Fidalgo Bay (DNR 1999).

Adjacent and slightly northwest of the reserve, industrialization of the shoreline north of Weaverling Spit has contributed to the degradation of local sediment and water quality through deposition of wood waste and industrial debris (Pentilla 1995). Additionally, intertidal and shallow subtidal habitats for native hardshelled clams have been reduced or eliminated in areas by shoreline fill or other alterations to the substrate (Williams et al 2003).

Although contributing biomass and productivity, a variety of non-native invertebrates and plants threaten the ecological integrity of the bay. Common non-native species that can compete with native species for space and food are *Nuttalia obscurata, Battilaria attramentaria*, *Spartina anglica,* and two species of tunicates.

Previous water and sediment quality studies have shown that sediment quality within Fidalgo Bay meets the sediment management standards established by the State of Washington (Johnson 1997 and 2000, Newton et al. 1998). However, polycyclic aromatic hydrocarbons (PAH) constituent concentrations

were estimated to be two to four times higher in the Fidalgo Bay area than in reference areas (Johnson 2000).

Although several documented oil spill incidents have occurred in the Fidalgo Bay area over the past several decades the primary source of these compounds is attributed to be atmospheric deposition from combustion sources rather than oil spills in the area. The overall sediment quality of the area managed by DNR appears to be clean with some diversity in grain size. Prior studies in the area have determined that, with the exception of the PAH constituents discussed above, the levels of metals and organic compounds in Fidalgo Bay sediments are comparable or lower than levels in sediments from reference areas in Puget Sound that are removed from sources of contamination.

Despite the anthropogenic effects on natural processes (e.g. restrictions on tidal currents and sediment transport from the trestle and reduced sediment input from bulkheading), critical habitat areas are still being maintained in the nearshore environment. The area remains an important and viable resource for migratory and resident organisms.

Potential Future Impacts

The population of Anacortes has increased by about 50 percent since 1990, and is projected to continue this rapid growth rate. The current population is approximately 16,000 (2005 estimate). This rapid growth is the main focus of anticipated future impacts to the aquatic reserve (City of Anacortes 2000).

Land Use Scenarios

Increased growth results in potential impacts through ground water withdrawal and sewage treatment. The City of Anacortes is updating its Stormwater Management Plan to accommodate proposed buildout and land use changes (City of Anacortes, in review). Development in the southern portion of Fidalgo Bay should stay limited due to the refinery on the east side of the Bay and topographical limits of the west side. The area of Fidalgo Bay south of the trestle is designated as Conservancy and the northwest shore of Weaverling Spit is designated as Urban in the City of Anacortes Shoreline Master Plan. These master plan designations extend 200 feet landward of the ordinary high water mark. Beyond this 200-foot boundary, the uplands adjacent to the reserve south of the trestle are zoned as light manufacture, and the uplands on Weaverling Spit are zoned as commercial marine (City of Anacortes, in review). A variety of proposals including shipyard development, residential units and dock and marina construction, and shoreline trail development exist for the western and southern portions of the Bay (City of Anacortes 2000). Depending on approved activities, such uses could further alter the shoreline processes, habitat and species. However, Skagit Land Trust ownership in the southern portion of the bay will buffer development activity in that area.

Oil Spill Scenarios

Two oil refineries on March Point currently operate adjacent to the eastern boundary of the reserve. One of the pipelines transporting crude and processed oil to and from oil tankers runs adjacent to the reserve along most of the eastern boundary. The refineries have necessary procedures and technologies in place to significantly reduce the likelihood of oil spills or minimize spill volume. However, small scale spills have occurred in the past and the possibility exists for future spills. Washington Department of Ecology's (2003) Oil Spill Response Plan established booming strategies to protect sensitive areas of the Bay, including Crandall and Weaverling Spits.

Increased Recreational Use Scenario

Anacortes proper and associated waterways will continue to see increased recreational boat traffic—supported by the boat building industry, favorable docking and mooring sites, and close proximity to other desirable recreational boating destinations. Increased boating traffic increases the likelihood of impacts such as litter, and physical and chemical impacts to nearshore environment (including prop scour, chronic lubricant and fuel leakage, and shading of aquatic vegetation).

Water and Sediment Quality Impact Scenarios

The combined potential effects of the above scenarios keep Fidalgo Bay at risk of water and sediment quality impairment. Current residual effects of past oil spills or other contamination are minimal or non-existent in the water and sediment column (Johnson 1997 and Johnson 2000). However, the effects this has had on nearshore vegetation and associated biota over time is unknown.

Increased intensity of storm water outflow, typically resulting from increased impervious surface area, can alter biotic communities that have adapted to the salinity regime around outfalls. Increased storm water outflow also can reduce the upland's ability to store water through groundwater recharge, which can negatively affect the freshwater inputs into the bay during dry periods. Increased development also could create a scenario for increased contaminant runoff during early fall rains when oil and other contaminant buildup are released from impervious surfaces into overland flow. In heavily populated areas, such intense contaminant-laden runoffs have been known to result in localized fish kills in the freshwater environment.

Additionally, large-scale sediment translocation from dredging activity can alter the hydrodynamics of the bay. These activities likely will occur north of the reserve area. However, if significant elevation changes are made from the spoils, Fidalgo Bay's current regime could be negatively affected, potentially changing sediment distribution in the bay.

Climate Change Scenarios

Global climate change is likely to impact the Fidalgo Bay Reserve if future predictions of sea-level rise and increased storm events and flooding occur. Future sea-level rise due to anthropogenic climate change is expected to increase in the Puget Sound Region, and estimates regarding the northern Puget Sound indicate an annual increase of 1- to 2.5 millimeters per year. This rise in sea-level will result in increased coastal erosion, changes in the tidal prism and salinity of embayments and wetland inundation, migration and salinization (Canning 2001).

Archeological, Cultural and Historic Resources

During late historic times, Fidalgo Bay and the surrounding area was occupied by two Coast Salish Lushootseed-speaking groups. The territories of the aboriginal Samish and Swinomish Tribes included lands on Fidalgo Island adjoining Fidalgo Bay (City of Anacortes 2000).

Several historically important sites have been identified north of the Fidalgo Bay aquatic reserve in the city of Anacortes. However, no historical, archeological or culturally important sites have been identified within the reserve by the Washington Department of Archeology & Historic Preservation.

4. Management Goals & Objectives

The primary focus in managing the Fidalgo Bay Aquatic Reserve is to protect and restore the bay's natural biological communities, habitats, ecosystems and processes, and the ecological services, uses and values they provide to current and future generations. This section of the plan identifies the desired future conditions of the site and provides goals and objectives to help ensure that these desired conditions can be met.

Desired Future Conditions

Desired Future Conditions describe the overall target conditions for a landscape and provide guidance for developing management goals and objectives. The following describes the future environmental conditions expected at the Fidalgo Bay Aquatic Reserve when the management goals and objectives in the plan are achieved.

The Fidalgo Bay Aquatic Reserve Management Plan ensures strong protection of the state-owned aquatic lands in an effort to prevent further habitat degradation. The plan also emphasizes restoration to reduce current habitat degradation and restore natural processes that support a healthy nearshore environment. Shoreline and pocket estuary restoration efforts will lead to improved spawning and rearing habitat for important fish species such as salmon, herring, surf smelt and sand lance. Improved ecological conditions also should increase foraging opportunities for resident and migratory birds and waterfowl.

Emphasis also will be placed on building partnerships with adjacent land owners and land managers in an effort to address negative effects from conditions of adjacent areas on the Fidalgo Bay Aquatic Reserve. Efforts will focus on reducing water quality impacts to the aquatic reserve and the adjacent nearshore areas.

Although the Fidalgo Bay Aquatic Reserve is established as an environmental reserve, the accessibility of the site provides for environmental education opportunities with the local educational community, and such opportunities will be supported and fostered.

To achieve these future conditions, the following goals and objectives have been adopted.

The objectives are a product of the research, analysis, advisory committee meetings, and public input during the Fidalgo Bay management planning process. These objectives are unique to the management of Fidalgo Bay and are consistent with the local Shoreline Master Plan.

Goal One: Preserve, restore, and enhance the functions and natural processes of aquatic nearshore and subtidal ecosystems of the aquatic reserve.

Objectives

1.1 Protect and restore natural processes that promote region-wide biological diversity in the areas' marine environments.

1.2 Rely upon, and avoid interference with, those natural processes that result in the restoration and maintenance of natural conditions, native habitats, and native species diversity.

1.3 Maintain and, if possible, reduce the existing levels of alteration to Fidalgo Bay's shorelines and aquatic areas.

1.4 Where necessary and appropriate, enhance habitat functions and processes to provide benefit to species.

1.5 Inventory and remove derelict creosote piles, other derelict structures, and debris from Fidalgo Bay.

1.6 Identify potential impacts to aquatic reserve from adjacent land uses, and establish management actions—in cooperation with adjacent landowners and land managers—to address and reduce any potential impacts

Goal Two: Protect habitat for Sensitive, Threatened and Endangered species

Objectives

2.1 Give high priority to inventory, enhancement, and protection of habitat for Sensitive, Threatened and Endangered species as dictated by federal law, state legislative mandates, and DNR policy goals.

2.2 Partner with other agencies, organizations and landowners to identify habitat protection opportunities adjacent to the reserve.

2.3 Routinely survey Fidalgo Bay for Sensitive, Threatened and Endangered species and their associated habitat, and following any new listings.

2.4 Invite other agencies/tribes/organizations with appropriate expertise to work cooperatively in the inventory, monitoring, and management of native species.

2.5 Use site restoration and enhancement to encourage re-establishment of plants and animals native to Fidalgo Bay and surrounding tidelands and bedlands.

Goal Three: Identify aquatic habitats and associated plant and wildlife species, with special emphasis on mudflats, sandflats, forage fish habitat, and eelgrass beds.

Objectives

3.1 Develop an initial baseline inventory of aquatic habitat and species that use the area of the reserve.

3.2 Develop ongoing monitoring plans to evaluate the trend of aquatic resources identified for conservation.

3.3 Survey sites that appear to have suitable habitat for surf smelt or sand lance spawning, and verify whether spawning activity occurs at these sites.

3.4 Develop appropriate management actions to protect and/or restore identified spawning areas.

3.5 Survey sites that appear to have suitable habitat for native oysters and develop opportunities to enhance establishment of native populations.

Goal Four: Provide opportunities for outdoor environmental education

Objectives

4.1 Work with city of Anacortes, Samish Tribe and Shell to place interpretive signs at both ends of the Tommy Thompson Trail, the RV parks at Weaverling Spit and Little Crandall Spit.

4.2 Use education facilities to inform the public of important ecological, geologic, cultural, and historic components of Fidalgo Bay. Consult with local tribes in developing interpretive materials that address culturally sensitive resources/topics.

5. Management Actions

Management actions address the goals and objectives identified in section 4. This section details the actions that should be carried out over the initial 10 years of reserve designation. The management actions are intended to improve the ecological condition of the reserve and assist in the adaptive management process that occurs after the first 10 years of implementation.

The reserve management can be divided into four primary categories of activities:

- Resource protection, enhancement and restoration;
- Monitoring and research activities within the reserve;
- Allowable public uses of the reserve; and
- Prohibited uses within the reserve.

Baseline inventories were completed for many ecological components within in the Fidalgo Bay Aquatic Reserve. However, several of these inventories were conducted in the mid-1990s and current inventories may be warranted. Herring, surf smelt and Pacific sand lance surveys were conducted by WDFW in the mid-1990s and several spawning locations were identified along the eastern shore of the bay within the reserve boundaries (Lemberg et. al 1996).

Emphasis will be placed on conducting additional surveys to identify current spawning habitat used by herring, surf smelt and sand lance. Surveys also will be conducted to identify salmonid use of the aquatic reserve. Baseline water quality data currently is being collected by the Samish Indian Tribe at numerous locations within Fidalgo Bay. In addition, environmental assessment work was recently completed by the Swinomish Tribe on the bioaccumulation of toxic chemicals in shellfish in Fidalgo Bay (SITC 2006). The above-mentioned data along with forage fish and salmonid survey data will be used to develop and implement specific quantifiable goals.

Since negative impacts to sensitive habitats and species within the reserve may also be attributed to activities over which DNR does not have explicit authority or control, DNR will seek cooperation and collaboration from other public and

private entities, specifically local governments and citizens. DNR will work cooperatively with the Samish and Swinomish Tribes, WDFW, Skagit County, and the City of Anacortes and others to incorporate relevant 'best management practices' into the management of the reserve.

Resource Protection, Enhancement, and Restoration

Management actions for Fidalgo Bay are based on goals for protection and restoration of sensitive aquatic resources, planning for existing and future uses of state-owned lands, public use, stewardship, research, and monitoring. DNR will seek cooperation and collaboration from other state agencies, local governments, tribes, local businesses and property owners. Restoration activities will focus on re-establishing the natural processes and, where management is necessary and feasible, enhancing habitat and ecosystem quality or reversing and mitigating degradation.

Classification and Mapping of ecosystem

Previous efforts by various entities have resulted in a number of GIS mapping layers with species and habitat data for the site, as described in section 3. Appendix A provides the maps that have been developed to identify the habitats, species and potential impact to the ecosystem of the Fidalgo Bay Aquatic Reserve and surrounding areas. DNR will continue to classify and map the ecosystem within and around Fidalgo Bay to aid in management of the reserve.

Meets objectives 1.5, 1.6, 2.1, 2.3, 2.4, 3.3, 3.5

Protection

Where opportunities arise, DNR will partner with state and local governments, tribes, non-profit organizations, businesses and adjacent landowners to identify and implement protection of adjacent aquatic areas and uplands. When appropriate, DNR will facilitate the development of site-specific habitat protection plans. Habitat protection efforts may include;

- Placement of important habitat on adjacent lands into conservation easements.
- Acquisition of tidelands and shoreline property through gifts.

Meets objectives 1.1, 2.2, 2.4, 3.4

Enhancement

DNR will facilitate and encourage the restoration of natural processes and habitats; however, if restoration is not currently feasible or if habitat degradation needs to be addressed more quickly, enhancement of habitat and

species may be conducted to prevent further degradation. Enhancement plans will be developed and will include involvement from all relevant parties including state and local governments, tribes, non-profit organizations, businesses and affected landowners. Enhancement efforts could include;

- Placement of beach nourishment along sediment-starved shorelines.
- Olympia oyster population enhancement.

Meets objectives 1.4, 2.1, 2.5

Restoration

DNR will develop restoration plans for specific areas and species in Fidalgo Bay. DNR will partner with state and local governments, tribes, non-profit organizations and adjacent landowners, where possible, to assist in the development and guidance of restoration plans. Specific areas where restoration efforts are being considered and/or pursued by DNR or others include;

- A DNR/Swinomish cooperative proposal to the Texaco Restoration Fund to restore natural shoreline processes through removal of shoreline armoring structures, and restoration of historic pocket estuaries. If carried out, this proposal will benefit both forage fish spawning and rearing habitat, and juvenile salmon habitat.
- The Samish Tribe is conducting a feasibility study about reducing the impacts of the old railroad trestle and revetment, potentially restoring more natural tidal flow to the south basin of Fidalgo Bay, while still maintaining the pedestrian trail that currently exists on the trestle. This study is being funded by Ecology through the Puget Sound Initiative.
- A DNR/Samish cooperative effort to identify and address water quality impacts to Fidalgo Bay through a watershed assessment. This effort is being partially funded through a Direct Implementation Fund grant awarded to DNR by Ecology.
- DNR-led removal of derelict and creosote structures.
- Ecology/DNR-led effort to clean up contaminated sediments at several sites within the aquatic reserve, and north of the reserve in Anacortes. This effort is funded through the Puget Sound Initiative, and should result in improved sediment quality within the aquatic reserve.
- The Skagit County MRC is working on several restoration and education efforts within and adjacent to Fidalgo Bay Aquatic Reserve, including, native Olympia oyster restoration, restoration of shoreline processes on east March Point, and environmental education of marine environments in the region.

Meets objectives 1.2, 1.3, 1.5, 2.5, 3.5

Monitoring and Research

There are four components to research and monitoring within the aquatic reserve:

- Data gap analysis;
- Establishing baseline conditions
- Trend monitoring to determine the effectiveness of management activities and document natural variation; and
- Research, to better understand observed changes and the interactions between management activities and natural resource conditions.

Data gap analysis will help managers determine baseline conditions that need to be established. After baseline conditions have been identified, continued monitoring for trends in habitat and species conditions should be conducted. Research can compliment trend monitoring by providing possible answers for why species and habitats may be declining or improving.

The following sections further describe each of the four components of monitoring and research, and identify potential areas were they should be conducted.

Data Gap Analysis

Adaptive management of Fidalgo Bay Aquatic Reserve relies on having appropriate data. Through the development of the management plan DNR has identified areas where data is not available, current or complete. Data gaps that currently exist for the aquatic reserve include:

- Blue Heron population status and changes.
- Eelgrass distribution status.
- Federal listed salmon usage.
- Comprehensive sediment quality characteristics.

Identification of data gaps will help guide monitoring and research efforts within and adjacent to the reserve.

Meets objectives 2.1, 2.3, 2.4, 3.1, 3.2, 3.3

Baseline Monitoring

In order to gauge the future success of management actions, the current quality of the Fidalgo Bay ecosystem needs to be established, including the baseline conditions. Baseline monitoring will document current conditions by combining existing data with inventories of resources and ecological processes that are not adequately documented.

In Fidalgo Bay, a substantial amount of baseline monitoring has been conducted on water quality. Between 2005 and 2007, the Samish Indian Tribe Department of Natural Resources has monitored water quality at more than 50 sites in the bay (Appendix A, Figure 9). This effort will continue to track trends in water quality for the next two years. Data is found in Appendix A.

DNR also has collected a substantial amount of data on vegetation in Fidalgo Bay. This data is represented in various GIS maps. However, much of this data is more than 10-years old, and current surveys may be necessary to establish a current baseline for nearshore vegetation.

In 2005, WDFW conducted a forage fish spawning habitat survey in Fidalgo Bay. Figure 7 (Appendix A) identifies all current forage fish spawning habitat. Consistent long-term trend monitoring will be necessary to gauge the success of any future restoration efforts. Baseline monitoring being proposed for Fidalgo Bay includes:

- Great blue heron population status.
- Current eelgrass population distribution and status.
- Ecology/Puget Sound Initiative-led effort to collect comprehensive baseline data of sediment quality.
- Modeling the effects of climate change on water quality parameters and sea level rise.

Meets Objectives 2.3, 2.4, 3.1, 3.3, 3.5

Trend Monitoring

After baseline conditions have been identified, DNR intends to continue monitoring to identify ecological trends that will be used to assess whether management actions attain or exceed the goals identified in this plan. DNR will partner with local and state government, tribes, local non-profits and businesses to identify and conduct trend monitoring for ecological conditions in and around Fidalgo Bay. If funding is available, monitoring plans will be developed to establish ecologic trends and conditions. Current and future trend analysis data that will help guide management of the aquatic reserve include:

- Monitoring for increase or decrease in nearshore vegetation
- Forage fish spawning surveys conducted by WDFW, DNR, Samish Tribe and Swinomish Tribal Community.
- The Samish Tribe continues to conduct water quality monitoring within Fidalgo Bay. This effort continues to establish a baseline condition and track the water quality trends of Fidalgo Bay.
- Sediment quality monitoring.

Meets Objectives 3.2, 3.3, 3.5

Research

DNR will seek to partner with local and state governments, tribes, universities, non-profit organizations and the local community to identify and develop research projects within the reserve. All research activities that occur within Fidalgo Bay Aquatic Reserve must not result in damage to the ecosystem and must meet the goals and objectives of the reserve. Examples of research opportunities may include:

- Effects of beach sediment nourishment on forage fish spawning habitat.
- Effects of introduction of shade bearing vegetation on forage fish spawning success.
- Identifying socioeconomic incentives for private preservation, restoration, and enhancement around the aquatic reserve.
- Determining the nearshore habitat usage of Fidalgo bay by federally listed salmonids species.

Meets Objectives 2.5, 3.4

Allowable Uses

Following are the only uses of state-owned aquatic lands that DNR will consider in the Fidalgo Bay Aquatic Reserve:

Research and Monitoring

Management Actions

- Ecological monitoring will be allowed within the aquatic reserve if conducted under a monitoring plan that is approved by DNR.
- DNR Aquatic Resources Program staff will work with anyone interested in proposing research that supports of the reserve's goals and objectives.

Meets Objectives 2.1, 2.3, 2.4, 2.5 3.1, 3.2, 3.3, 3.4, 3.4

Restoration

Management Actions

- DNR will partner with various entities to develop restoration plans for Fidalgo Bay. DNR's Aquatic Reserve Program also will evaluate and approve new proposals for restoration projects. Only those proposals determined to be consistent with the management of the reserve will be allowed.

Meets Objectives 1.2, 1.3, 1.5, 2.5, 3.5

Environmental Education & Public Access

Management Actions

- DNR will partner with various entities to develop environmental education opportunities for Fidalgo Bay and ensure appropriate access is allowed.
- Seek grants for development of educational opportunities at Fidalgo Bay Aquatic Reserve.

Meets Objectives 4.1, 4.2

Commercial and Recreational Fishing

Management Actions

- Commercial and recreational fisheries within the reserve will be managed by WDFW, responsible Tribal governments, and DNR shellfish section staff (recreational and tribal shellfish only).

Meets Objectives 2.4

Environmental Education

Management Actions

- Public access will be allowed for the aquatic reserve. DNR will work to place educational signage at established public access areas around Fidalgo Bay Aquatic Reserve.
- Environmental education opportunities will be allowed and encouraged with in the Aquatic Reserve. All educational activities must be consistent with the management of the reserve.

Meets Objectives 4.1, 4.2

Prohibited Uses

Management Actions

- No other uses, other than those identified in Section 5 above, will be considered by DNR unless they are consistent with the purpose of the reserve and management goals and objectives described in Chapters 2 and 4 respectively. Any uses proposed on state-owned aquatic lands adjacent to the reserve must not conflict with the purpose of the reserve designation and specifically with the habitat and species identified for conservation within the reserve.

Meets Objectives 1.1, 1.2, 1.3

6. Glossary

Aquatic Lands: For the purposes of this publication, all state-owned tidelands and the bedlands of marine waters.

Bedlands: Those marine lands lying below the line of extreme low tide.

Biological Diversity: The various plant and animal species representative of and native to a site. ("Regional biological diversity" is protected when habitat is provided to species that are becoming locally rare due to loss of habitat.)

Critical habitat: Those areas necessary for the survival of sensitive, threatened, and endangered species, as designated under the Federal Endangered Species Act and other state and local regulations.

Cultural resources: Archeological and historic sites and artifacts, whether previously recorded or still unrecognized, as administered by the Department of Archeology and Historic Preservation, and protected under Title 27 of the Revised Code of Washington.

Ecosystem: An ecological community consisting of all the living and non-living components of the physical environment.

Enhance site conditions: To intentionally re-create elements that existed on site before disturbance, or introduce new functions or characteristics to a site.

Habitat: The components of the ecosystem upon which a plant or animal species uses during its life cycle.

Maintain site conditions: To protect natural site characteristics and ecosystem processes, such as wildlife habitat, soil conservation and succession of native plant communities.

Monitor: To collect and analyze data for the purpose of answering management questions. A baseline is established and periodic measurements are taken to determine the extent and rate of change over time. Topics include: Beneficial and negative impacts of stewardship activities, natural events and public use.

Natural processes: Phenomena that shape the landscape's appearance and habitat potential. At Fidalgo Bay, natural processes include: movement of sand and sediments carried along the shoreline and into the mudflats by tidal and wave actions, relatively free movement of wildlife among a dynamic mosaic of the area's terrestrial and marine habitats, and more.

Restore site conditions: To recover natural features and processes that existed on site prior to disturbance.

Sensitive, Threatened, and Endangered Species: Plants and animals protected under the federal Endangered Species Act or state designation, with the species level of risk from lower to higher.

Tidelands: Marine lands between the lines of ordinary high tide and the line of extreme low tide.

Uplands: Lands, including lakes, wetlands and streams, above the line of ordinary high tide.

Wetlands: Lands where saturation with water is the dominant factor determining soil development and the types of plant and animal communities living in the soil and on its surface.

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Appendix A – Site Characteristics

The Fidalgo Bay Aquatic Reserve, (hereafter referred to as the Reserve), contains diverse physical habitats that include tidal flats, salt marshes, sand and gravel beaches, and expansive native eelgrass beds. These diverse habitats are recognized as essential contributors to the reproductive, foraging, and rearing success of many fish and bird species. A primary motivation for creating the Reserve is to preserve critical herring spawning habitat. Due to development in northern portions of the Bay, and uncertainty regarding factors negatively affecting the Fidalgo Bay herring population, protection of herring spawning habitat is a critical resource issue in Fidalgo Bay, as it is throughout the marine nearshore of western Washington.

This section provides an overview of the physical and biological characteristics within or adjacent to the reserve. The major physical processes described are tidal regime, circulation, wave and current exposure, net shore drift, fresh water and sediment input. These processes — coupled with landforms and sediment types — provide the foundation and constraints for the biological community within and adjacent to the Reserve. A brief description of the predominant habitats, species and their distribution summarizes the ecological conditions, and finally, some of the risks to the Reserve are identified. Understanding the processes and functions in Fidalgo Bay helps guide decision making regarding aquatic land management that influences the Reserve and its associated ecological relationships.

ENVIRONMENTAL SETTING

Physical Environment

Regional Physiography

Fidalgo Bay occupies an ancient delta of the Skagit River consisting of generally shallow mudflats that drop off steeply away from an arc that runs south and east from Cap Sante Head (City of Anacortes 2000). Spits form prominent features on both sides of Fidalgo Bay. Along the northeastern shore are Crandall Spit and the less prominent Little Crandall Spit. Weaverling Spit protrudes from the west shoreline and projects out to the southeast about a

third of the way across the bay. Structural remnants of a railroad trestle, constructed in the 1890s (City of Anacortes 2000), bisect the bay at Weaverling Spit, constricting water and sediment movement in the southern portion of the bay. Extensive intertidal sand/mudflats occupy nearly all the tidal area south of the railroad trestle (Figure 4). The mudflats north of the trestle, are mostly subtidal with depths shallower than 12 feet below mean low lower water (MLLW).

The general bathymetry north of the bay consists of a fairly deep channel reaching depths greater than 10 fathoms (60 feet) within Guemes Channel and extending eastward to Hat Island, where it turns northward. The oil docks located off March Point have been constructed to reach these deeper waters and regular dredging maintains a minimum channel depth of approximately 40 feet in this area. A deep, circular hole lies between Cap Sante — the southeast point on Guemes Island — and Hat Island, with depths in excess of 40 fathoms (City of Anacortes 2000).

Across the northern portion of the bay, two navigation channels have been dredged providing medium draft boats clear passage to marinas and industrial properties along the eastern shoreline (City of Anacortes 2000). Along the northeastern shoreline of the bay about a quarter mile offshore, a natural channel about 15- to 20-feet deep (MLLW) continues south maintaining a narrow channel under the railroad trestle. Steadily shoaling south of the trestle the channel diffuses into a fan-shaped, permanently flooded area of approximately 4-6 feet deep (MLLW). About a quarter of the way into the south bay, continued shoaling gives rise to extensive mud and sand flats creating this dominant feature of the inner bay.

Due to its salinity profile, proximity to the ocean, and at least occasional freshwater runoff, Fidalgo Bay exhibits estuarine water regime characteristics (Dethier 1990). From June to September 2006, Samish Indian Nation environmental staff recorded salinities throughout the bay. They collected five deeper water sample sites located within the Aquatic Reserve boundaries, and recorded salinities between 28.55 parts per thousand (ppt.) and 29.36 ppt. These data represent higher transitional salinities than of an estuarine regime. However, geographic location, the biological assemblage, and predominantly estuarine processes keep it in an estuarine water regime category (DNR 1996).

Watershed-Drainage Basin description

The south Fidalgo Bay drainage area flows primarily north into the bay and encompasses approximately 1,575 acres. The area is divided into two primary sub-basins with two additional sub-basins. The largest sub-basin is located west of Highway 20 and is primarily forested, with small residential and commercial facilities in the vicinity of Highway 20 and the Highway 20 spur to Anacortes. There are several crossings of the Highway 20 spur, all of which discharge into Fidalgo Bay almost immediately after crossing the road. The

area east of Highway 20 also drains into Fidalgo Bay. This region encompasses a mix of commercial, residential and forested uplands, and includes a portion of the Similk Beach golf course (Anacortes S. March Pt. Annexation Comprehensive Drainage Study 1999).

Two smaller sub-basins are located north of Highway 20: One sub-basin drains westerly via ditches and culverts into an area at the southeastern side of the bay. This area is separated from the bay by a dike. The fourth sub-basin, on the east side of the bay, drains westerly from the ridge crest of the March Point Peninsula towards Fidalgo Bay.

Surface water and Runoff

There are no major freshwater streams that flow into the Fidalgo/Guemes area. Most freshwater input is limited to runoff into the bay (non-point sources), a few small creeks, and numerous outfalls. Surface water input at the south end of the bay has been cut-off by Highway 20. Runoff throughout the southwest basin is primarily collected in roadside ditches and conveyed towards the golf course, where it is pumped across Highway 20. The pump station, owned by Skagit County, consists of a pump house located between Similk Beach Golf Course and Highway 20. The pump station is surrounded by ditches, which run adjacent to Highway 20, and a large pond that is incorporated into the golf course. According to information received from the County, the runoff discharges through an 18-inch water main at up to 7,500 gallons per minute. The estimated drainage area contributing to the pump station is 536 acres. During extreme storm events, water that backs up behind the pumping facility will pass through a culvert beneath Highway 20 and discharge into Fidalgo Bay (City of Anacortes, South March Pt. Annexation Comprehensive Drainage Study 1999).

On the Shell Oil Refinery property (east side of the bay), surface run-off from 558 acres of the refinery area is collected and directed to the refinery's water treatment plant. In the areas of the Shell property where there is not exposure to processing units, the run-off goes to their "clean-water system" to remove solids (settling ponds). Water quality is monitored, treated, and then discharged through an outfall approximately one mile out into Guemes Channel, (Brian Rhodes, personal communication 2007). The remaining area draining into the east side of the bay includes a few small intermittent streams which form during times of high precipitation, and small areas with limited surface run-off which drain into ditches along the March's Point Road and discharges into the bay (City of Anacortes 2000).

The city of Anacortes, to the west, has three combined sewer overflows that discharge into Guemes Channel, to the north and west of the reserve. However, the stormwater outfall collected from city streets and parking lots drain untreated into the Fidalgo Bay (City of Anacortes 2000).

Groundwater

Information regarding groundwater-monitoring wells installed near March's Point Road by Cascade Drilling, Inc. states that groundwater was first encountered at a depth of approximately 15 feet below land surface (Murnane, J. 1999, *personal communication*). In this same vicinity, Shell Oil has 128 groundwater wells on their property, some are regularly monitored and others intermittently monitored (20 percent have been decommissioned). Groundwater depths on the west side of March's Point vary between approximately 20-to 30 feet below the surface. (Brian Rhodes, *pers. comm*. 2007). Given suitable soil types, the groundwater surface in an unconfined aquifer will mimic local topography, and groundwater will flow toward topographic lows (DNR 1999), the direction of shallow groundwater flow is predominantly toward Fidalgo Bay. Brian Rhodes, with Shell Oil, reports (personal communication 2007), the ground water flow rate towards Fidalgo Bay is approximately 110 feet per year. A portion of freshwater flow, originating from groundwater flows, still seeps directly into the bay, particularly in the south end of the bay.

Upland Surficial Geology

In general, the soils within the Fidalgo Bay drainage area consist of moderately deep (poorly drained and moderately drained), level-to-steep soils on terraces and hills. The soil groups include approximately 44 percent Bow soils, 21 percent Coveland soils, and 20 percent Swinomish soils. The remaining 15 percent are components of minor extent.

Bow soils overlay glacial remnant terraces, and are described as very deep and somewhat poorly drained. The surface layer is gravelly loam over very gravelly sandy loam about 14 inches thick. The upper layer of the subsoil is gravelly loam about 8 inches thick. The lower part of the subsoil, to a depth of 60 inches or more, is clay loam over silty clay. Coveland soils are located on swales on glaciated hills and are described as very deep and somewhat poorly drained. The subsoil and substratum to a depth of 60 inches or more are silty clay.

Swinomish soils are located on glaciated hills. The soils are characterized as moderately deep and moderately well drained. The surface layer and upper part of the subsoil are gravelly loam about 20 inches thick. The lower part of the subsoil and the substratum are very gravelly sandy loam about 11 inches thick over dense glacial till. Depth to dense glacial till ranges from 25 to 40 inches (U.S. Department of Agriculture Soil Conservation Service 1989). There are a few areas of exposed bedrock (sedimentary rocks including sandstone and breccias), along the south and western sides of the bay.

Intertidal and Subtidal substrate

Intertidal substrates within Fidalgo Bay include mud, sand, and gravel/cobble sediments, as well as, limited areas of natural bedrock and artificial hard

substrates such as pilings and riprap. Along the south fringe of the bay, associated with the rim of salt marsh plants, the substrate consists of sand, silt and clay mixed with decomposed organic matter. It includes peat deposits and locally inter-bedded layers of volcanic material (Pessl et al. 1989). The inner bay encompasses large tide flats of mixed fine clays, silts and sands that are predominant within the lower intertidal zone (approximately 2 feet above MLLW, to approximately -4.0 feet below). Subtidal sediments include mud bottoms with varying amounts of sand, gravel or cobble substrates, as well as, hard bottom areas that are both natural and man-made (City of Anacortes 1999).

Mixed sand and gravel substrates dominate the upper intertidal shoreline along both sides of the bay. The western shore has a few areas where there is exposed bedrock, but the surficial deposits are dominant and vary between 0-to-3 meters deep (Pessl et al. 1989). Along the eastern shore of the bay including Crandall, and little Crandall spits to just south of the trestle a narrow patchy band of pea gravel and coarse sand exists in the upper intertidal zone. These substrates are well suited for forage fish spawning and have been documented as regular surf smelt spawning areas. A few zones of predominantly “fluffy sands” also are utilized as sand lance spawning substrate.

Additionally, DNR’s Intertidal Habitat Inventory includes a classification of intertidal substrate types for Fidalgo Bay (DNR 1996, also see Figure 4). These polygon delineations were made on a scale that does not depict finer scale variations in substrate composition, such as upper intertidal mixed sand and pea gravel necessary for forage fish spawning habitat.

Shoreline Characteristics

The majority of the shoreline in Fidalgo Bay has been modified and armored. Shoreline armoring, such as “riprap”, concrete bulk heading and fill, dominate the eastern and western shorelines in the bay. Of the 6 linear shoreline miles in or directly adjacent to the Reserve, 4 miles have been anthropogenically modified. Williams et al. (2003), report that most of the shoreline has been filled and approximately 73.8 percent of the shoreline in the greater Fidalgo Bay area has been armored. This includes the highly developed northwest shoreline from inside Cap Sante Head, south to slightly north of Weaverling Spit. Less armoring and fill have taken place in the rest of the bay, however the percent of shoreline armored is greater than 60 percent (Williams et al. 2003).

The backshore areas and most of the adjacent upland surrounding the bay is cut-off by shoreline armoring, which prevents the natural sediment re-nourishment of the beaches. Also, the associated riparian vegetation has been denuded along a great percentage of the shoreline. Some bluffs of unconsolidated materials are located just north of Weaverling Spit, however,

erosion of these bluffs and the sediment influx into the bay is practically eliminated by riprap armoring.

Physical Processes

Tides

Tides within the bay are semi-diurnal in nature, with two high and two low tides occurring daily. At Anacortes, the mean tide range, defined as the average difference in height between Mean High Water (MHW) and Mean Low Water (MLW), is approximately 5 feet (City of Anacortes 1999). The diurnal tide range, defined as, the average difference in height between Mean Higher High Water (MHHW) and Mean Lower Low Water (MLLW) is 8.5 feet. Each day 50- to 60 percent of the water in Fidalgo Bay is flushed out and refilled by tidal currents (Antrim et al. 2005). Flood tide currents flow northeast from Guemes channel, then south into Fidalgo Bay and reverse on the ebb tide. Observations of the subject property during high tide conditions revealed that the entire subject property is inundated with water, with the tops of several eelgrass patches exposed. Observations were subsequently made during a minus low tide condition approximately 6.5 hours later, revealing that approximately two thirds of the area south of the trestle is exposed tidal flat (Antrim et al. 2005).

Wave Energy

Energy classifications as defined by Bailey et al. (1993) describe the relative degree of physical energy from waves and currents. These energy designations are applied to broad areas and describe landscape-level characterization of the intertidal energy.

Fidalgo Bay fetch distances are generally short for westerly, easterly, and southerly winds. The strongest wind and wave energy originates from the northern part of Fidalgo Bay and travels most strongly towards March Point. The waves dissipate as they travel along the eastern shore of the aquatic reserve. Smaller waves generated from north Fidalgo Bay head directly south and are mostly deflected by Weaverling Spit. This northern portion of the bay is characterized as maintaining a “partly enclosed” energy level (DNR 1996 *per* Bailey et al. 1993). This classification refers to bays partially enclosed by headlands, bars, spits, or artificial obstructions reducing circulation. Wave action occasionally is strong enough to maintain a mixed sand/gravel intertidal substrate that is used for forage fish spawning. Crandall Spit and the railroad trestle also deflect and dissipate the wave energy from heading farther into the south end of the bay. Since this southern area is largely enclosed, it has been classified at the lowest wave energy level as a “lagoon”, receiving little wave or current energy.

Water Currents

Due to the shallow depth of the bay and relatively large tidal range, tidal currents dominate the movement of water into and out of Fidalgo Bay (City of Anacortes 1999). These currents are affected to some extent by winds. Freshwater within the system also affects the tidal circulation slightly. As freshwater enters nearshore areas, it begins moving seaward over several tidal cycles. In return, the more saline waters present at depth are drawn landward.

Current meter records available for Guemes Channel and Fidalgo Bay indicate that the apparent net flow within Guemes Channel is westward into Rosario Strait at all depths measured. Typical net flow velocities range from approximately 5- to 30 centimeters per second (0.1- to 0.6 knots). The deeper ocean water entering into the Fidalgo Bay region is most likely from Haro Strait, which then returns southward either via Rosario Strait or Samish Bay. Insufficient measurements are reported from within Fidalgo Bay to assess either the net circulation or tidal current strengths. However, drogue (apparatus used for current analysis) trajectories have shown movement of water during ebb tide conditions from the March Point piers almost directly northwestward toward Cap Sante. Drogue and drift stick observations available within the bay are of such short duration and areal extent, that they do not contribute greatly to an understanding of tidal circulation patterns within the bay (City of Anacortes 1999). In general, due to the bay's shallow depths, water entering and exiting the bay first follows or is drawn to the deeper channels. Once filled, and during slack tides, surface water movement is primarily wind driven.

North of the subject area, visual observations, plus drift stick and drogue trajectories performed in previous studies, revealed that generally strong flood tides pass through Guemes Channel and begin to spread out after passing Cap Sante. Those headed east split as they reach Hat Island, heading either north or southwest into Padilla Bay, and deeper waters stay within the deep channel headed north. After passing Cap Sante, a portion of the surface flow rotates southward into Fidalgo Bay, and a large clockwise rotating eddy is reportedly formed to the east and south of Cap Sante during flood tides, causing a northward-directed current along its eastern face (City of Anacortes 1999). Ebb currents that leave Fidalgo and Padilla Bays and are headed south from Samish Bay, join west of Hat Island. A convergence zone where surface debris collects is often located south to southwest of Hat Island during ebb tides. Due to the water leaving Fidalgo Bay, during ebb tides a small counterclockwise eddy likely exists just north of Cap Sante. During both strong flood and ebb currents, back eddies along both shorelines have been noted, especially shoreward of piers (City of Anacortes 1999).

Net shore-drift

A littoral drift cell occurs in the northwest sector of the bay, just south of the marinas, with net drift southward to the tip of Weaverling Spit. The shoreline

in this sector is completely modified and largely eliminates upland sediment input to the spit. Scouring has taken place along the northern base of the spit due to the limited sediment sources and increased energy down drift from the shoreline armoring (Aundrea McBride, *pers. comm*. 2007). On the east side of Fidalgo Bay, nearshore drift from the northern end of March Point is predominantly westward, (north of the reserve). The westward littoral drift sector forms Crandall Spit at the northeast corner of the reserve. Areas of deposition include the beaches at Crandall Spit, however recent analysis (Johannessen 2007) shows this drift sector is sediment starved by evidence of Crandall Spit shrinking in area. Since, there are few remaining natural sources for shoreline sediment along this drift sector, this appears to be affecting Little Crandall Spit as well. A northerly drift sector lies north of little Crandall spit along a lightly modified shoreline.

Within the south bay area, transport processes move lightly to the north along the eastern shoreline, but are severely disrupted by widespread shoreline armoring and man-made over-water structures, particularly the railroad trestle. Constructed in 1891 the railroad trestle is built on riprap fill and extends eastward from Weaverling spit about half way across the bay. Although the remaining portion of the trestle is built on piles that allow water flow, the entire structure has seriously hindered the natural flow patterns and continues to alter sediment distribution for the bay. The consequent and continual decrease in the tidal prism, with no appreciable drift at the head of the bay, has lead to significant sediment deposition in the south bay (Aundrea Mc Bride, *pers. comm*. 2007).

Biological Environment

Habitat Resources

For the purposes of this report, we are specifically focusing on the ecosystem continuum of nearshore habitats adjacent to or within the boundaries of the aquatic reserve. The processes presented in the previous sections — such as tidal regime, circulation, wave and current exposure, net shore drift, fresh water and sediment input, coupled with landforms, sediment types, and anthropogenic alterations — provide the foundation and constraints for the biological community found within and adjacent to the reserve. Nearshore areas serving key habitat functions within or adjacent to the bay range from the deep-water mud and sand bottoms of outer Fidalgo Bay, to the emergent salt marshes along the southern fringe of the inner bay. Most of the adjoining backshore areas and uplands have been cutoff from the bay by roads, shoreline armoring or other development.

Habitat Areas

Several distinct intertidal and shallow subtidal habitat areas exist within the bay. The upper intertidal areas intermittently support a fringe of emergent

marsh vegetation on mixed fine substrate. Below this fringing marsh, in the southern end of the bay, in the middle intertidal zone, there is a broad crescent shaped area of the silty tidal flats marked by a pattern of isolated pillar-like hummocks with sparse remnants of emergent marsh plants on top. Extensive tidal flats of fine unconsolidated sand, silt and clays are inundated by the highest tides and form the bulk of the intertidal area in the south bay and the majority of the intertidal area in the reserve. This extensive area provides foraging and resting grounds for resident and migratory shorebirds, waterfowl, and fish. Mudflats in shallow embayments are also particularly critical as nursery and foraging habitat for many species of fish, particularly flatfish and other juvenile fishes. These low energy tidal flats contain productive microalgae and macroalgae and provide prime habitat for juvenile salmonid prey resources such as harpacticoids, copepods, and amphipods (Corophium spp.) (Healy 1979; Healy 1980; Simenstad et al. 1980).

Other intertidal habitat areas within the bay include mixed fine, gravel/cobble beaches, as well as limited areas of natural bedrock and artificial hard substrates such as pilings and riprap. Other salmonids, specifically, steelhead, sea-run cutthroat and anadromous bull trout are likely to utilize the low energy mixed gravel and cobble beaches of the bay for foraging and shelter (Healy 1982). In addition, areas of sand to mud bottom between the lower intertidal zone (approximately 2 feet above MLLW, and approximately -4.0 feet below MLLW) support patchy to lush growths of eelgrass (*Zostera marina).* Often a variety of macroalgae and epiphytes grow in association with the eelgrass. Other areas in the same depth range, but with scattered gravel/cobble substrates, support dense growths of macroalgae that maintain a variety of habitat functions. Macroalgae beds, dominated by soft brown kelp species often grow intermixed with the eelgrass. Other subtidal habitats include mud bottoms with varying amounts of sand and gravel, and some hard bottom areas that are both natural and man-made (City of Anacortes 2000).

Eelgrass

Several distinct intertidal and shallow subtidal areas within the bay support lush growths of eelgrass (*Zostera marina*). Eelgrass covers a large portion of Fidalgo Bay at varying densities and is considered a key habitat component of the bay. The broad mud flats and areas of the bay with better circulation appear to support more or less continuous eelgrass beds (see Figure 6). The majority of the bay, however, maintains patchy eelgrass beds with relatively low stem densities compared to the densities and expanses found in nearby Padilla Bay (field observations 2006). Often a variety of macroalgae grow in close association with the eelgrass.

Eelgrass beds of varying size and densities in Fidalgo Bay-Guemes channel-Padilla Bay provide unique expanses of vegetated habitat with connectivity covering about 7,000 acres. This extensive eelgrass is the largest areal coverage of this habitat type in the greater Puget Sound.

Eelgrass as the prominent feature, and a primary ecologically important habitat in the reserve, supports multiple functions in the bay that include:

- providing substrate for epiphytic algae, and substrate for spawning of Pacific herring,
- providing rearing habitat for juvenile salmon, crab, other fishes, by providing shelter and an abundance of prey species, and
- providing shade and thus cooler water and higher dissolved oxygen during summer low tides.

Fidalgo Bay eelgrass is critical spawning habitat for a declining northern Puget Sound herring stock. Herring spawn has been found wherever eelgrass exists in the Fidalgo Bay, even in areas where eelgrass is only sparsely distributed. Eelgrass is found in the bay from +1 feet MMLW to -12 feet MLLW (Pentec 1994).

Significant loss of eelgrass and of herring spawning habitat has occurred in Fidalgo Bay, primarily from dredging and filling of the shoreline areas of Fidalgo Bay. Additionally, lesser areas of eelgrass and macroalgae have been eliminated by shading from over-water structures, such as the March Point piers and the railroad trestle. Because of losses such as these, and the uncertainty regarding factors limiting the Fidalgo Bay and other herring populations, the Washington Department of Fish and Wildlife considers the protection of herring and surf smelt spawning habitat to be a critical resource issue statewide, and in Fidalgo Bay (Penttila 1995; Bargmann 1998).

Macroalgae

Large intertidal and subtidal algae provide habitat for countless invertebrates and fish. Macroalgae provide similar ecological functions as eelgrass beds — such as adding more habitat structure, and contributing to the higher productivity of the ecosystem. The assemblage of macroalgae present in the study area is composed of many species adapted to a variety of habitat types which have a broader distribution both vertically and laterally than eelgrass.

Within the upper intertidal areas of the bay, on hard substrates starting below approximately 6 feet MLLW, dense growths of macroalgae are prevalent and are dominated by the perennial rockweed, *Fucus gardneri*. The predominant macroalgae in both intertidal and subtidal areas of unconsolidated mixed fine sediment is green algae, such as *Ulva*, *Ulvella* and *Enteromorpha*. These species are prevalent from the top of the intertidal zone with the green algae often extending into the lower intertidal zone and throughout the eelgrass beds. These species also provide a variety of functions including supporting microhabitats for invertebrates and releasing nutrients back to the marine environment. Frequently found intermixed with and adjacent to eelgrass beds are the red algae species, such as *Gracilaria pacifica*, and *Graciliariopsis* which also are widely used as a substrate for herring spawn deposition.

Other lower intertidal and shallow subtidal areas with scattered hard substrates support dense growths of laminarian kelps, with the most conspicuous species being *Saccharina lattisimaa* (*Laminaria saccharina),Costaria costata* and *Desmerestia*. Additionally, juvenile salmon utilize the shallow subtidal macroalgae beds, for refuge and foraging areas.

Salt marsh

In more sheltered areas of the bay, salt marshes are important feeding and rearing areas for many species of fish and wildlife. Although there are no large expanses of salt marsh in the bay, salt marsh — dominated by pickleweed (*Salicornia virginica*) and saltgrass (*Distichilus spicata*) rims the head of the bay. Small patches of salt marsh are dispersed along the shoreline on both sides of the inner bay including a pocket in the south corner of Weaverling Spit. Crandall and Little Crandall Spits also have small areas of upper intertidal salt marsh. A rim persists beneath the beach berm on both sides of the Crandall Spit and in a little "pocket estuary" encompassed by the spit.

Although limited in area, this habitat is extremely important to estuarine ecosystems like Fidalgo Bay (reference). The salt marsh bordering the southern boundary of the bay provides the necessary transition zone between freshwater and saltwater. Likewise, this area furnishes connectivity to the terrestial system adjacent to the reserve. This habitat also serves the functions of providing a source of tidally exported detritus throughout the bay, an impediment to erosion, and shelter and foraging ground for marine invertebrates, fish, and birds.

Spit/Berm

Additional smaller spit/berm areas are interspersed throughout the bay on both Crandall and Weaverling spits, in narrow fringes or small patches in the inner bay. These are either backshore spit or berm features that are not regularly inundated. Since these locales are subject to salt spray and infrequent inundation, a different plant community subsists in this zone. The plant species identified in the bay are dune grass (*Leymus mollis*), gumweed (*Grindellia integrifolia*), Yarrow (*Achillea*), and *Ambrosia* The substrate is usually a mixture of sand and smaller gravel, with drift logs often present.

Wetlands

A few brackish and freshwater wetland areas have been identified in Fidalgo Bay and adjacent to the Aquatic Reserve. A map (Figure 7) details wetlands identified and classified under the National Wetlands Inventory and verified in subsequent mapping efforts. At the southeastern corner of the bay is a small seep wetland that is dominated by cattails (*Typha latifolia*). It is bisected by March Point Road and is also associated with stormwater runoff from the north side of Highway 20. This wetland is separated from the bay by a dike. As with many wetlands, this area functions as a water retention and filtration buffer, improving water quality. On the bay side of the wetland, along the inner edge

of the dike is a continuous, but narrow band of obligate salt marsh plants indicating salt water seepage through the dike into the wetland.

Fauna

Most of the lands within the aquatic reserve area support a wide range of migratory and resident birds, fish and marine invertebrates. The extensive eelgrass beds are used on an annual basis by a significant herring spawning stock. Additionally, Fidalgo Bay has been noted as a juvenile and larval rearing ground for Dungeness crab, salmonids, and other marine fish. A large number of great blue herons feed in the bay year-round and substantial numbers of migratory birds are found in the bay in the winter. Extensive mudflats and fringing salt marsh attract shore birds and juvenile fishes while the large, intact sand spits — Crandall and Weaverling Spits — are important for forage fish spawning and marine bird refuge. The bay supports habitats and species similar to two other local bays — Samish Bay and Padilla Bay. Padilla Bay is a National Estuarine Research Reserve jointly managed by the National Oceanic and Atmospheric Administration (NOAA) and state Ecology.

In neighboring Padilla Bay and the nearby waters, at least 57 species of fish have been identified (UDC, 1980). Many of these species are likely to use nearby Fidalgo Bay with its similar habitat. Appendix A**,** Table 1 is a partial list of species observed in Fidalgo Bay.

Fishes

Salmon

Limited observations have been made on salmonid distribution and abundance within the study area, however, more regular surveys are planned (Beamer et al. 2006). Chinook, chum, and coho primarily use the eelgrass habitat as nursery and shelter (Dan Doty, biologist WDFW *personal communication*). However, based on studies in Skagit Bay, the Swinomish Channel, and northern Fidalgo Island (in Guemes channel), it may be assumed that salmon are present during the major spring migrations out of the Skagit and Samish Rivers (City of Anacortes 1999). Although the number of salmonids using the bay has not been quantified, the greatest abundance of juvenile salmon in Fidalgo Bay usually occurs from April through June. The lush and dense eelgrass beds provide both shelter and an abundant food supply for smaller juvenile salmon. Additionally, juvenile salmon utilize the shallow subtidal macroalgae beds as well as the low energy tidal flats that are well known foraging areas for amphipods, such as *Corophium*. Although the broader muddy sand flats without eelgrass also may support an abundant prey base they are less used by juvenile salmon since they lack cover for refuge.

Other species of salmonids, such as steelhead, sea-run cutthroat, and anadromous bull trout likely utilize the low energy mixed gravel and cobble beaches for foraging and shelter. Although there is no published information

on the occurrence of bull trout in Fidalgo Bay, the area is located in the proposed critical habitat for coastal bull trout (Federal Register, 2005b).

Forage fish

Forage fish are a vital link in the food chain and constitute a major portion of the diets of salmon, seabirds, marine mammals, and other fish. Three important species of forage fish utilize intertidal and shallow subtidal areas in Fidalgo Bay for spawning habitat.

Pacific herring (*Clupea pallasi*), is an important baitfish and commercial fish in the northern Puget Sound Region. Adult herring are reported to congregate in the area to the east of Guemes and Hat Islands before spawning. Small groups reportedly move south into Fidalgo Bay intermittently as each group matures. Spawning is more or less continuous from early February into April and deposition of spawn is consistently reported as "very light" to "trace" in the state Fish and Wildlife rating system (City of Anacortes 1999). Herring deposit their eggs indiscriminately on eelgrass or algae (particularly, *Gracilaria pacifica*). Herring spawn has been found wherever eelgrass exists in Fidalgo Bay, and even in areas where eelgrass is sparsely distributed. Figure 8 shows the areas of identified herring spawning beds within Fidalgo Bay.

Herring roe on eelgrass provides critical seasonal feeding opportunities for waterfowl and other fish. Herring eggs hatch approximately 2 weeks following deposition, and many larvae appear to remain in the bay for several months. The back or southern portion of the bay, contains large numbers of herring larvae at the end of March (Dan Penttila, *personal communication* 2006). Herring larvae provide nutrients to out-migrating salmon smolt and other fish species that use these nearshore waters for nursery and feeding grounds. After their first summer, it is uncertain where the maturing herring go to complete their growth and maturation before returning to spawn 3 to 4 years later.

Surf smelt (*Hypomesus pretiousus*) also are an important forage fish in the greater Puget Sound. During the winter months, surf smelt, possibly from the Fidalgo Bay spawning populations, are the subject of a vigorous recreational jig fishery in the La Conner area, and along the March Point shoreline. Surf smelt spawn at middle to upper intertidal elevations (+ 5 feet MLLW to mean higher high water, MHHW) on pea gravel and coarse sandy beaches. Spawning grounds have been documented all around March Point and south of the trestle. On the eastern side of Fidalgo Bay there are two areas that have been documented as smelt spawning habitat. The other sites are located on the western side of the bay. Spawning tends to occur year round in Fidalgo Bay. Presently, approximately 4.3 lineal miles of surf smelt spawning beach have been identified within the bay. Much of the smelts' remaining habitat exists as narrow, patchy strips at the base of armored shoreline. This habitat is very vulnerable to disturbance. Figure 8 illustrates the locations of documented surf

smelt spawning beaches in Fidalgo Bay. Little is known of the larval and post-larval life history of surf smelt in Fidalgo Bay.

Pacific sand lance (*Ammodytes hexapterus*) have been found to spawn in the upper intertidal area on several beaches throughout the bay. In Fidalgo Bay, sand lance spawning grounds have been documented in some of the same areas as surf smelt spawning grounds. Spawning occurs between early November through mid February with eggs present into March. Sand lance tend to utilize similar substrate types as surf smelt, preferring pea gravel, shell hash, and sand. In addition, sand lance demonstrate a preference for well aerated soft sand; spawning in the bay is reported primarily in this soft sand. Spawning beaches have been identified at the northeast tip of March Point, south of Crandall Spit, and on the eastern end of Weaverling Spit. (WDFW 2005).

Other Marine Fish

WDFW does not have specific information on flatfish use of Fidalgo Bay. However, mudflats and shallow embayments such as Fidalgo Bay are considered to be the most important habitat for these fish. Many flatfish — such as starry flounder, rock flounder, and sand sole — show a distinct preference for shallow waters and may remain near the shore even as adults. Flatfish spawn is found in small quantities within the bay. In the bay, the two flatfish of greatest commercial importance are starry flounder (*Platichthys stellatus*), and English sole (*Pleuronectes vetulus*). For a list of fish observed in the bay, see Appendix A, Table 1.

Marine Invertebrates

Many species of marine worms, snails, clams, crabs, shrimp, and other invertebrates provide vital links in the Fidalgo Bay food chain. These primary forage species help support the local populations of birds, fish and mammals. For a partial list of marine invertebrates found in the bay, see Appendix A, Table 1.

Shellfish

No complete surveys of Fidalgo Bay have been conducted for hardshelled clams. Several species of clams — including the butter clam (*Saxidomus giganteus*), native littleneck (*Protothaca staminea*), Japanese littleneck (*Venerupis philippinarum*), horse clam (*Tresus*), and the cockle (*Clinocardium nuttalli*) — are common at locations within Fidalgo Bay, especially those containing a significant amount of gravel mixed with silt and mud. Hard-shelled clams also are likely to be found on the western shore of March Point south of Crandall Spit (Dan Penttila, WDFW, *personal communication* 2006).

During the 1950s, Fidalgo Bay supported extensive oyster culture operations until they died out or moved in the 1960s to more favorable grounds to the north in Samish Bay. Limited amounts of Pacific oysters were consistently found in Fidalgo Bay. However, a large recruitment of oysters occurred in the

early 1990s that has again made oysters available on hard substrates in many parts of the bay (City of Anacortes 1999).

The Olympia oyster (*Ostrea conchaphila*) is a native oyster once found at scattered sites throughout Puget Sound. Shells of Olympia oysters have been found in Fidalgo Bay area beaches suggesting that this species once may have been found in the bay. South Fidalgo Bay was selected as a planting site to restore a population of Olympia oysters in the region. The bay appeared to be good habitat and unlike other bays in the area is free both from a significant population of Pacific oysters, and particularly the associated and devastating Japanese oyster drills (Robinette and Dinnel 2004). Since 2002, Olympia oyster seed has been planted and monitored in the bay. Oysters have been growing successfully and the local Marine Resources Committee will continue to monitor and maintain the oysters. During 2005 monitoring of Olympia oysters a significant natural recruitment of Pacific oysters from 2004 was discovered (Dinnel et al. 2005). Additionally, it is now clear that the native oysters are naturally recruiting to the restoration bed adjacent to the trestle, (Dinnel, *pers. comm*. 2007).

The geoduck *(Panopea abrupta*) is likely to be present in the deeper regions of the bay (Munce et al. 2000). WDFW as yet has not conducted any geoduck surveys in the area. Provided with the appropriate substrate types, mainly sand and silts, geoducks are generally found from the lower intertidal zone to at least 360 feet (110 meters) in water depth.

Dungeness crab (*Cancer magister*) are widespread throughout the Fidalgo Bay area, and are expected to use all habitats below a depth of approximately 2 feet above MLLW, except perhaps for bedrock outcrops and other hard bottom areas where the red rock crab (*Cancer productus*) is expected to be more abundant (City of Anacortes 1999). Eelgrass beds, macroalgal beds, and areas with an abundance of broken shell material provide preferred areas for juvenile crabs.

A significant feature of the Fidalgo Bay and Guemes Island area is over-wintering of ovigerous female Dungeness crabs (Armstrong et al. 1987). Female crabs spend most of a 3-to 4-month period between November and April buried in the sediment in the eelgrass between 0.5 meters and 4 meters in depth (MLLW). The total population of ovigerous crabs in 1985/86 was estimated to be 60,000, with about 25 percent found in Ship Harbor. Although very few of these crabs have been documented in nearby bays, the unique importance of this sensitive life stage and proximity to Fidalgo Bay reinforces the importance of minimizing negative impacts to these habitats. Armstrong et al. (1986) found that young-of-the-year Dungeness crabs use vegetated portions of Fidalgo Bay as rearing habitat before moving to deeper waters.

Birds

Approximately 239 birds have been identified for Padilla, Samish, and Fidalgo Bay (UDC 1980). The main species of bird-life that use Fidalgo Bay's rich and productive habitat include Brant geese, cormorants, peregrine falcons, great blue herons, and bald eagles, many shorebirds and dabbling and diving ducks (Antrim et al. 2000). Fidalgo Bay is part of an area that is recognized as one of the most important waterfowl wintering spots along the Pacific flyway, providing critical habitat connectivity for migratory and over-wintering waterfowl. Large populations of wintering Pacific Brants exclusively depend on eelgrass as fodder and need the shallow areas to pull themselves out of the water and collect gravel for digestion. Dabbling ducks (American widgeons, mallards, pintails, and canvasbacks) primarily feed on eelgrass and associated community (See Appendix A, Table 1 for a list of observed bird species).

Eight species of birds that specifically use Fidalgo Bay and adjacent areas meet the listing criteria given for species listed by Washington State as Sensitive, Threatened, or Endangered. These are listed below with general status and habitat descriptors:

1. Common Loon (*Gavia imm*er) is a State Candidate species that utilizes the shallow protected areas of the reserve for staging and wintering.
2. Brandt's Cormorant (*Phalacrocorax penicillatus*) is a State Candidate species found in the aquatic reserve.
3. Bald eagle (*Haliaeetus leucocephalus*) nesting sites are located on Weaverling Spit and others occur near Fidalgo Bay, primarily near West Guemes Channel, Hat Island, and Guemes Island. Eagles utilize the bay for foraging.
4. Peregrine falcon (*Falco peregrinus*) is a State Endangered Species. Peregrine falcons from a nest on Guemes Island feed in the bay.
5. Great Blue Heron (*Ardea herodias*) maintain a rookery located on the southeastern portion of March Point. This is the largest heron rookery in the state, and has been increasing in size. This heronry is becoming more critical for their survival as it becomes larger in size at the expense of other smaller ones (Essinger *in draft*). Herons routinely feed on small fish in the shallow waters of Fidalgo Bay, and use the shoreline in the bay including upper intertidal habitat, shoreline perches and riparian vegetation. During diurnal high tide periods, herons seek foraging opportunities in the upper reaches of the intertidal zone. Large woody debris and floating rafts serve as platforms for individual herons foraging at high tide. Areas of undeveloped shoreline offer greater shoreline habitat complexity and less human disturbance for foraging herons. Saltmarshes also provide habitat for both foraging and loafing.
6. Osprey (*Pandion haliaetus*) nest sites have been located inland in close proximity to the bay. One-mile Island has an osprey nest and osprey regularly feed on fish from the waters of Fidalgo Bay.
7. Common Murre (*Uria aalge*) is a State Candidate species. The common murre feeds on small forage fish that are found in Fidalgo Bay.

8. Marbled murrelet (*Brachyramphus marmoratus*) is a State Endangered Species. Annual aerial surveys from 1992-99 (Nysewander, WDFW) consistently observed 1 to 2 marbled murrelets in Fidalgo Bay.

Marine Mammals

Eight seal "haul outs" are located within the Fidalgo and Padilla Bays. These sites are used year round as resting sites and serve as pup rearing sites from mid-June through mid-August. Figure 8 illustrates areas utilized by the above-mentioned wildlife in Fidalgo Bay.

Non-native Fauna and Flora

Fidalgo Bay and adjacent environs have been colonized by a wide variety of non-native species. The variety of species and their abundance have not been fully described but are known to include common non-native species such as Pacific oysters *(Crassostrea gigas)*, purple varnish clams (*Nuttallia obscurata*), the Asian mud snail (*Battilaria attramentaria*), (Antrim et al. 2003). Battillaria was first recorded in Padilla Bay in the 1960s, however the invasion likely occurred sometime earlier. Today, the Asian mud snail is the most abundant macrofauna on mudflats in both Padilla (PSWQAT 2000) and Fidalgo Bays. Exclusion experiments suggest that Battilaria may facilitate the invasions of other non-native species including Asian eelgrass (*Zostera japonica*) and another mud snail (*Nassarius faterculus*) (Wonham et al. 2003).

Spartina anglica was first discovered in Fidalgo Bay in 1999 with two smaller infestations in the bay, along the southeastern shore and on the north side of Weaverling Spit; both areas were reportedly treated and eradicated (2005). Since *Spartina* is an invasive aquatic plant species that can degrade the quality of the tide flats, threatening native marine marsh plants and encroaching on critical shorebird habitat, vigilant monitoring and eradication are necessary. For several of the other non-native species, the long-term detrimental effects are undetermined or controversial. *Sargassum muticum* and Z*ostera japonica* have been observed in the vicinity of the site. Only *Z. japonica* is expected to be present within the reserve (City of Anacortes 2000).

Puget Sound Expedition (Cohen et al. 1998), a collaborative rapid assessment of non-indigenous species in Puget Sound, had an assessment site at Cap Sante Marina. Although this site is located within Fidalgo Bay, it is 1.4 miles north of the reserve boundary. Several invasive species listed below were observed. Most of these are known to degrade the quality of the habitat and/or compete with native species. To date, no systematic survey has been attempted to assess which species are within the reserve boundaries. Non-native species observed or present at Cap Sante Marina include:

1. *Spartina anglica*
2. *Zostera japonica*
3. Bryozoan (*Bugula*)
4. Tunicate (*Botrylloides violaceus*)

5. Japanese littleneck (*Venerupis phillipenarum*)
6. Pacific Oyster (*Crassostrea gigas*)
7. Horn shell snails (*Battillaria attramentaria)*
8. Varnish Clam (*Nutallia obscurata)*

Environmental Quality

Existing Conditions

The current overall ecological condition of the site has been compromised and degraded by human use and development — primarily shoreline alteration, including filling of upper intertidal areas, over-water structures (i.e., the railroad trestle), and other shoreline armoring that have compromised physical processes and reduced available critical habitat for several plant and wildlife species in the bay. Adjacent and slightly north of the reserve, industrialization of the shoreline on the west side of Fidalgo Bay north of Weaverling Spit has contributed to the degradation of local sediment and water quality through massive deposition of wood waste and industrial debris.

Additionally, intertidal and shallow subtidal habitat for native hardshelled clams has been reduced or eliminated in areas by shoreline fill or other alterations to the substrate. Another factor compromising the healthy functioning of the bay is the intrusion of a variety of non-native invertebrates and plants. Ecology recently re-confirmed 1977 findings that sediments on the west side of the inner bay were all below state Sediment Quality Standards (DOE 2000). This study was done in part for DNR in preparation for the acquisition of intertidal land in the south end of Fidalgo Bay.

Shoreline armoring and filling

Williams et al. (2003) report that within Fidalgo Bay, 45 acres were altered at depth, 47 acres have been filled, 8 acres have been dredged, 8 acres are affected by over-water structures and 5.6 of 8.7 miles of shoreline have been armored. All dredging activity has taken place to the north of the reserve, however, tideland filling, shoreline armoring and overwater structures are present throughout the bay (Figures 2 and 3). The head of the bay, adjacent to Highway 20, has been severely altered and freshwater inflows are significantly reduced. In addition, the reduction of net-shore drift volumes in the bay due to bulkheads and other shoreline modifications also has caused a significant aerial loss to Crandall and Weaverling Spits (Johannessen 2007). The biological consequences of these activities are varied and the cumulative impacts are uncertain. However, the loss of eelgrass (*Zostera marina*) and macroalgae habitats within Fidalgo Bay is potentially significant because it may represent the loss of spawning habitat for Pacific herring (Williams et al. 2003).

Overwater structures

Several areas within the aquatic reserve maintain prevalence of creosote pilings. Many of the remnant pilings are the original railroad trestle. In addition to a section of trestle elevated by pilings, a significant portion of the trestle is built on riprap fill that permanently reduced intertidal habitat and obstructs intertidal processes and aquatic vegetation establishment. The structure alters other physical processes such as the Fidalgo Bay's tidal, current and sediment dynamics.

Sediment assessment

The following section provides an overview of the findings for the Fidalgo Bay Aquatic Reserve's environmental assessment conducted by Tetra Tech on behalf of the Washington State Department of Natural Resources. This assessment was conducted based on the scope of services and assessment objectives identified by DNR, and in general accordance with the specifications established by American Society for Testing and Materials (ASTM) Standard Practice E 1527-97 for real estate transfer due diligence. In addition, available background documentation regarding previous sediment and water quality studies were reviewed to aid in understanding the current environmental status of the area.

Ecology has performed sediment sampling near the property. Sample locations were selected based on known or suspected areas of potential upland and offshore impacts. A total of 12 samples were collected within the subtidal and intertidal zone on June 14, 1995. Low tide conditions permitted sampling without the assistance of a boat. These sediment samples were collected from the top 10 centimeters of substrate and submitted for laboratory analysis. Tests were performed for the presence of semi-volatile organic compounds (SVOCs) and polycyclic aromatic hydrocarbons (PAHs). Results for SVOC, PAH, and polychlorinated biphenyls (PCB) compounds were reported after being normalized, based on total organic carbon. Results for sediment samples analyzed for SVOC and PAH compounds revealed that the detected concentrations were below both sediment quality standards (SQS), and minimum cleanup levels (MCUL). The reported PCB concentration of 40.42 mg/kg exceeded the quality standard but was below the minimum cleanup level. Sediment samples analyzed for metals content revealed that no inorganic elements were present above either of the cleanup standards.

Tetra Tech reviewed 14 previous sediment and surface water quality investigations conducted within the project area. For the purposes of this effort, those sampling stations lying within the area south of a line drawn from the northern terminus of the March Point refinery docks to the north tip of Fidalgo Island were identified as being pertinent to the assessment. This area was selected based on proximity to the subject properties proposed for the aquatic reserve, and the potential for current and tidal influences to transport sediment and surface water to the intertidal areas of south Fidalgo Bay. The

previous sediment quality investigations reviewed provided analytical information from 67 sample stations within the identified area of interest. These studies were conducted between 1986 and 1997. Of these 67 samples, a total of 10 sampling stations were located in the area south of the Burlington Northern railroad trestle, predominantly in the central and eastern sections of the subject property. The samples collected from within the south Fidalgo Bay area have been analyzed for the following parameters:

1. Conventional parameters — including sediment grain size, total organic carbon content, total solids, and total volatile solids
2. inorganic elements for which sediment management standards have been established by Ecology
3. semi-volatile organic compounds
4. total petroleum hydrocarbons
5. polychlorinated biphenyls

Samples exceeding Ecology's sediment management standards have been identified within the aquatic reserve. The nearest station to the subject properties at which an exceedance was noted was identified during the a 1997 Ecology survey conducted on behalf of DNR to assess residual impacts within Fidalgo Bay related to the 1991 crude oil spill from the former Texaco Refinery facility (Johnson et al 1997). This sample station was located within 0.1 mile north of the railroad trestle, and within an equivalent distance of the eastern shore of Fidalgo Bay. At this location, elevated concentrations of total petroleum hydrocarbon (TPH) in the motor oil range were identified, along with exceedances of standards for several PAH constituents. This sample station is near the location of the 1991 crude oil spill. However, the report also states that roadway runoff from a nearby culvert may have contributed to the contaminants present at this location, THP analysis of the sediment samples from the site did not show evidence of crude oil. Other sediment samples that exhibited concentrations of contaminants exceeding Washington State sediment management standards are primarily associated with the Cap Sante Marina area and the refinery outfall discharge areas. Of the seven sample stations in the Fidalgo Bay area where criteria were exceeded, five revealed elevated concentrations of PAH constituents. Of the remaining two stations, one station exceeded established criteria for the inorganic element cadmium only and one exceeded criteria for the semi-volatile organic compound bis (2-ethylhexyl) phthalate(BEHP) only.

In general, the prior surveys conducted in the study area indicate that sediment contaminant concentrations are comparable to levels of these constituents in reference areas of Puget Sound removed from sources of contamination. Oil spills have been minimal, with the last occurring in 1991. Johnson (1997) reported little evidence of significant contamination and found that the area meets the sediment management standards established by the State of Washington other than one nearshore area contaminated with motor oil and PAH. The PAH concentrations throughout the study area are generally higher than the

reference areas, and those elevated levels may be related to deposition resulting from combustion sources (Johnson et al 1997). The 200-barrel spill in 1991 threatened to contaminate the beach. Remediation along the spill-affected eastern shoreline of the beach included excavation and removal of all the sediment suspect to contamination. This segment of shoreline is documented to support surf smelt spawning and was replenished with clean sand, pebble, and pea gravel (Penttila 1991). Ecology reports that there do not appear to be any significant residual impacts present in the subject area as a result of the prior oil spill incident along March Point (Johnson 2000). However, it is unclear if the vegetation within the subject tideland areas has fully recovered from this event.

Wood Waste

The primary source of wood waste in the reserve is from bark and branches from large log rafts anchored throughout Fidalgo Bay (during much of the last century through about the 1970s). Log rafting is documented to have occurred north of the railroad trestle, on the central east shore and northwest shore of the reserve. Penttila (1995) identifies historic log-raft storage areas as an additional area where intertidal habitat within the aquatic reserve has been adversely affected. Many log-raft areas were historically vegetated, and aquatic vegetation communities in these areas are still recovering.

Water Quality

A monitoring station in northern Fidalgo Bay found all water quality parameters, including fecal coliform, dissolved oxygen and nutrient levels to be within acceptable state standards (Newton et al. 1998).

With the application of the new Department of Ecology Fecal Coliform state guidelines in , results overall have failed for the majority of the freshwater outfalls tested for fecal coliform by the Samish Tribe in 2006.

Air Pollution

The Northwest Pollution Authority monitors sulfur dioxide in the March Point area. The records review conducted for assessment by Tetra Tech for DNR indicates that the existing commercial and industrial operations in the area are in general compliance with their respective operating and air quality permits. The air quality is generally considered good although on occasion one of the large industries will release an excess amount of pollutants accidentally. For the most part, Fidalgo Bay is within an area that currently attains all minimum criteria for air pollutants (DNR 1999).

Marine Vegetation

The salt marsh in the southeastern corner of Fidalgo Bay was heavily oiled during the 1991 spill. Clean-up measures taken were relatively non-invasive and recovery of the salt marsh vegetation has been relatively good (Hoff et al. 1995).

Environmental Quality Assessment

This area of Puget Sound has been identified as providing an important ecological resource for both fishery and biological resources. Previous water and sediment quality studies have noted that the prevalence of strong currents and tidal activities near the mouth of the bay and within Guemes Channel restrains the deposition of significant quantities of fine-grained sediments that would be deposited in the bay during tidal cycles. These past studies also have shown that sediment quality within the subject area meets the sediment management standards established by the State of Washington. However, PAH constituent concentrations have been estimated to be two to four times higher in the Fidalgo Bay area than in reference areas (DNR 1999). Although several documented oil spill incidents have occurred in the Fidalgo Bay area, the primary source of these compounds has been attributed to be atmospheric deposition from combustion sources rather than historic oils spills. In general, sediment quality of the area managed by DNR is in compliance with sediment quality standards. Prior studies have found that the levels of metals and organic compounds in Fidalgo Bay sediments are comparable or lower than levels in sediments from reference areas in Puget Sound removed from sources of contamination, with the exception of the PAH constituents discussed above. The following additional conclusions have been developed based on the findings of the environmental assessment (DNR 1999):

1. There is one NPDES-permitted outfall located in the aquatic reserve. This is an emergency outfall that is required by Ecology to prevent physical overtopping of the final pond dike as the Equilon Puget Sound Refinery treatment plant. There have been no known discharges from this outfall in the past 15 years, as it is for emergency use only. The nearest active outfalls are those associated with the Equilon Puget Sound Refinery and the Tesoro Petroleum Refinery located on March Point, and the Cap Sante Marina facility located approximately 1 mile northwest of the reserve properties.
2. There are no active or inactive landfills reported to be located within one mile of the reserve.
3. Based on past studies reviewed by Tetra Tech (1999), there do not appear to be any significant impacts present (in the reserve area), as a result of the prior oil spill incident along March Point. However, it is unclear if the vegetation has fully recovered.
4. More recent water quality sampling (2006) conducted by the Samish tribe has shown elevated levels of fecal coliform at one site on the east side of the bay.

5. The area currently meets air quality standards for all pollutants.(DNR 1999).

Shoreline armoring, overwater structures, dredging, filling and other related shoreline and bay-associated development practices have eliminated eelgrass and macroalgae vegetative cover and consequently herring spawning and nursery habitat.

RISK ASSESMENT AND POTENTIAL IMPACTS

Risks from Development

Beautiful landscapes and a strong maritime community have led Anacortes to become one of the top residential and retirement communities in the region. Anacortes' population has grown by about 50 percent since 1990. The city of more than 16,000 (2005 estimate) is rapidly approaching its population ceiling of 18,300 assigned by the Growth Management Act. This population growth and resulting development increases negative impacts to Fidalgo Bay from water withdrawal, contaminated stormwater run-off, and sewage treatment. The City of Anacortes is updating its Stormwater Management Plan to accommodate proposed build-out and land use changes (City of Anacortes 2000). Depending on approved activities, uses potentially could affect shoreline processes. Bay-adjacent road management is minimizing the amount of marine riparian areas that could establish. This is also the case in the refinery area where vegetation management is heightened due to security and fire hazard prevention. Predicting the comprehensive impacts and potential negative affects of such land use is beyond the scope of this assessment.

Development in the Aquatic Reserve Area-of-Influence

Prospective development areas within the bay include the north shoreline of Weaverling Spit and the possible expansion of a small recreational facility on Crandall Spit. Water dependent uses such as boat moorage or storage typically increase with population growth. Other areas of Fidalgo Bay likely will be considered for marina expansion or new construction. The associated real and potential impacts from such a project are formidable and include significant habitat loss or alteration — including habitat fragmentation and potential loss of the associated benthic flora and fauna. Other long-term or temporary impacts include degradation of water quality from suspended sediment and loss of habitat from dredging, filling, shoreline armoring, and overwater structures. During construction phases and on-going operation of a facility, noise, lighting, pollutants, and increased human activity can instigate avoidance behaviors by wildlife, and disrupt fish and wildlife from accessing spawning, rearing and feeding areas.

While there currently are no development proposals for the refineries along the eastern shore of the bay, it is likely that upgrades will continue to occur at these facilities. Additionally, roads are adjacent to much of the reserve site and management associated with roads including brush clearing and application of herbicides, negatively affects the reserve. The presence of refineries adjacent to the reserve represents an ongoing source of concern for natural resources.

Oil Spills

The sediment and water quality of Fidalgo Bay are continually threatened by potential oil spills from the two refineries. Vessels carrying oil and oil-derived products berth to the north of March Point where currents typically flush materials into Guemes Channel. However, spills have occurred at these refineries in the past. Ecology (1999) has reported that sub-standard operation of tankers in the Fidalgo Bay area have been known to occur and are likely to occur in the future. The appropriate Oil Spill Response Plans are in place to prevent further impacts (Ecology 2003). The response plans describe a booming strategy that effectively partitions the site using the railroad trestle as a booming boundary to block spills. Other areas targeted for booming protection include Crandall and Weaverling Spits. The goal for all booming strategies in Fidalgo Bay is to exclude oil from particularly sensitive areas.

Both refineries are highly regulated by numerous federal and state regulations designed to specifically prevent and manage for oil contamination. Fidalgo Bay is impaired by Benzo(a) Anthracene and Chrysene. The National Toxic Rule criterion was exceeded for both pollutants in composite testing of 50 littleneck clam soft-parts (Johnson 2000). This type of contamination will the potential to minimize some of the other multiple-use aspects of Fidalgo Bay.

Threats to Sediment Quality

It is difficult to anticipate the potential for future negative environmental impacts to aquatic reserve given the wide range of factors that influence such occurrences (e.g., changes in development and land use scenarios, spill scenarios). However, there are factors that both support the likelihood of the environmental integrity of the area, and pressures of growth and development that threaten the future integrity of the bay.

Regarding maintaining the present environmental status of the bay sediments, the nature of the reserve's intertidal area precludes the use of the bay for direct discharge of wastewater from current or future commercial or industrial development in the area. In addition, the prevailing currents within Guemes Channel and the mouth of the bay appear to limit the potential for future deposition of contaminated sediments into the subject area. The records review conducted for the sediment assessment (Johnson 2000) indicates that the existing commercial and industrial operations in the area are in general compliance with their respective operating, discharge, and air quality permits. The potential for an environmental release to occur in the aquatic reserve as a

result of catastrophic incident may be elevated to some extent by the presence of the major industrial activities on March Point, however, the number of incidents of this nature has apparently been quite limited in the past, and prevention and preparedness planning is ongoing at these facilities. Continued efforts to maintain this status will serve to minimize these environmental threats.

Wood Waste

Although most of the area impacted by wood debris is north of the reserve boundary, substantial volumes of wood debris have been found at the Scott Paper mill site (Antrim et al 2003). Removal of much of the surface deposits is likely with the impending development in this area. Examples of potential impacts to eelgrass and macroalgae from this activity are increased turbidity, prop scarring or prop wash, dredge barge footprint during removal of wood waste and during the subsequent construction of the facility.

Creosote Pilings

Creosote from pilings has been documented to be toxic to some marine biota and can readily leached into the aquatic environment (Vines et al. 2000, Xaio 2002). Researchers from the Bodega Marine Lab at University of California / Davis, found that nearly all herring eggs collected from creosote pilings at their study site failed to develop properly and died (Estuary 1997). Further, there was an effect observed on spawn deposited near the pilings as well. Egg hatching success was found to be reduced by 50 percent at creosote concentrations of 50 parts per billion (ppb). Sibley et al. (2004) found that creosote leached from impregnated pilings deployed under typical conditions (e.g., wharves) may cause toxicity to benthic communities shortly after deployment.

Water Quality

Fecal coliform contamination from local livestock has been found to be affecting the water quality at a southern location in the bay. Typically, livestock grazing properties introduce nitrogen and other nutrients into adjacent waterways. More generally, since the reserve is in close proximity to Highway 20, marinas and industrial operations, there is always the potential of accidental discharge or spill of pollutants.

Risks to Ecosystem Processes

The head of the bay, adjacent to Highway 20, has been severely altered, and freshwater inflows are reduced and possibly impacted by fertilizers and herbicides from the golf course on the south side of Highway 20. The inner bay (south of the railroad trestle) has been significantly affected by the trestle structure, constricting both incoming and outgoing water and sediment flow. Crandall Spit (outside of the proposed site) has been shown to be sediment starved, (Beamer *in draf*t 2007) and there are few remaining natural sources

for shoreline sediment within the site. On a larger scale, Guemes Channel is a candidate area for tidal energy evaluation. There is uncertainty about the proposed project scale and potential effects to current regimes in the area.

Shoreline Armoring Stressors

Shoreline modifications, almost without exception, damage the ecological functioning of the nearshore coastal systems (Thom et al 1994). There is extensive shoreline armoring and filling along the shoreline of Fidalgo Bay which interrupts natural processes, such as erosion and accretion of sediments. In some places, this has led to the deflation of beach and tidal flat sediments, due to a reduction in the upland sediment supply.

Because armoring structures cut off the sediment supply they eventually alter the habitat structure at many levels, (potentially shifting to higher energy levels, lower elevations and coarser sediments). In some circumstances, upper intertidal spawning habitat for forage fish is lost by filling or coarsening of the adjacent substrate. In addition to altering the composition of the substrate, the loss of riparian vegetation can reduce egg survival of surf smelt (Penttila 2000).

In a few locations in the bay, the surface sediment has been eroded to expose hardpan (Antrim and others, 2000), which eliminates habitat for infaunal organisms (creatures that live under the sea floor, including most clam species). It has been shown that clam populations are negatively affected by bulkheads, with significantly lower abundances below them than otherwise similar adjacent natural areas (Yoshinaka and Ellifrit 1974). Shoreline armoring also reduces the beach area, loss of organic debris, stability, and prey production functions of the upper intertidal habitats utilized by juvenile salmon during migration (Thom et al 1994). In Fidalgo Bay, the reduction of net-shore drift volumes due to bulkheading and other shoreline modifications has caused an aerial loss to Crandall and Weaverling Spits (Johannessen 2007).

Highway 20, and Fidalgo Bay and March Point Roads all border the reserve and contribute to pollution by particulate and liquid car-emission and noise pollution. Particularly, severe armoring alteration at the head of the bay, adjacent to Highway 20, has significantly reduced freshwater inflows by effectively creating a berm. Impounded water eventually makes it to the bay through groundwater routing, however, the toxins and nutrients in the form of fertilizers and herbicides from the golf course can be concentrated during storms after long periods of drought.

Risks to Species

Stressors from non-native species

Spartina anglica and several other non-native species pose a continual threat to physical and biological habitat areas and functions within the bay. Monitoring and control of deleterious species is essential for maintaining the existing

health status of the bay. Presently, with the Pacific oyster taking hold and the introduction of the Olympia oyster, it is important to monitor for such species as oyster drills. Other non-native species that are in close proximity, such as the tunicates found at Cap Sante Marina (and likely at the other local marinas) also can pose a threat by enveloping appropriate substrates used for settlement by indigenous sessile species and stifling other species.

The non-native polycheate worm *Clymnella torquata* (bamboo worm) is a more recent invader of Samish Bay flats and poses a serious threat to the quality of substrate and the ecology of the existing epibenthic and infaunal communities in areas with extensive sand and mud flats.

Risks to Forage Fish habitat

Shoreline developments, i.e., fill, riprap, and other shoreline armoring have more than likely had a negative impact on the extent of forage fish spawning in the bay (Antrim 2003). Prior to shoreline development, the entire shoreline from Weaverling Spit to Cap Sante may have been one continuous mixed sand/gravel beach and supported forage fish spawning. Penttila suggests that most of the shoreline would have supported surf smelt spawning, however, most of this area has been eliminated by marina and breakwater construction. Most of the remaining habitat is vulnerable to disruption, existing as a narrow patchy band at the toes of riprap shoreline.

Risks to Great Blue Heron

The potential impact of a major oil spill on the regional heron population could be significant due to the close proximity of major breeding centers and foraging grounds to oil ports and refinery complexes. The largest breeding colony in the state and its associated feeding areas are located directly adjacent to the March Point facilities.

Given unexplained recent mass abandonment of colonies (Eissinger *in draft*), major geographic shifts in breeding population and population decline in certain areas, consistent monitoring and status of the Great Blue Heron population is necessary in order to document changes. Standard methods of data collection both for productivity estimates and accurate post-season colony nest counts are vital to monitoring this population over time. Annual colony monitoring is also necessary to track colony success and changes, since colonies may fail, abandon, fragment or relocate in any given year.

Recommendations

The environmental sediment and water quality status of the state-owned properties managed by DNR within Fidalgo Bay have been discussed above. However, development of a thorough and current baseline for sediment quality within the subject property is recommended. Much work already has been done by Ecology. The analytical procedures used during the previous sampling events were reasonably comprehensive in nature; however, the areas sampled

largely have been limited to the central and eastern portions of the subject property. The development and continued maintenance of a more comprehensive baseline will enable DNR to effectively monitor and maintain sediment quality, and will provide a definitive basis to measure impacts should a contaminant release to Fidalgo Bay occur. At a minimum, the baseline sampling effort should include semi-volatile organic compounds (including the PAH constituents), metals, nutrients, such as organophosphorus and nitrogen — along with total organic carbon content. The Samish Nation is in the process of designing a water quality sampling plan for many of chemical pollutants in the bay and DNR will collaborate with their efforts.

An appropriate measure for maintaining and/or re-establishing shoreline habitat is through the removal of artificial barriers (armoring). In some areas of the bay, this would reestablish a beach (in a previously filled upper intertidal zone) at the "targeted" tidal zone for spawning fish. Also, reconnecting the upland sediment supply will perpetuate the natural processes allowing long-shore transport to maintain and re-nourish areas along the shoreline.

Future studies should be directed to enhance our understanding of the biological consequence associated with commercial and residential development along the shoreline.

Removal of creosote pilings serving no structural function — including those associated with the trestle — should be removed and replaced with concrete or other non-contaminating materials.

Table 1: Supplemental Biological Resources Information
Species Observed in Fidalgo Bay

Species			Listing Status	
Group	Common Name	*Scientific Name*	Federal	State
	Pacific sand lance	*Ammodytes hexapterus*		
	Penpoint gunnel	*Apodichthys flavidus*		
	Tubesnout	*Aulorhynchus flavidis*		
	Speckled sanddab	*Citharichthys stigmaeus*		
	Pacific herring	*Clupea harengus pallasi*		
	Shiner perch	*Cymatogaster Aggregata*		
	Buffalo sculpin	*Enophrys bison*		
	Threespine stickleback	*Gasteristeus aculeatus*		
	Surf smelt	*Hypomesus pretiosus*		
	Staghorn sculpin	*Leptocottus armatus*		
	Snake prickleback	*Lumpenus sagitts*		
	Great Sculpin	*Myoxocephalus polyacanthocephalus*		
	Tidepool sculpin	*Oligocottus masculosus*		

Species			Listing Status	
Group	Common Name	*Scientific Name*	Federal	State
	Chinook salmon	*Oncorhynchus tshawytscha*	Endangered/ Threatened	Candidate
	Chum salmon	*Oncorhynchus keta*		
	Pink salmon	*Oncorhynchus gorbuscha*		
	English sole	*Perophrys vetulus*		
	Crescent gunnel	*Pholis laeta*		
	Saddleback gunnel	*Pholis ornata*		
	Starry flounder	*Platichthys stellatus*		
	Rock sole	*Pleuronectus bilineatus*		
	English sole	*Pleuronectus vetulus*		
	Tadpole sculpin	*Psychrolutus paradoxus*		
	Pile Perch	*Rhacochilus vacca*		
	Bull trout/Dolly Varden	*Salvelinus confluentus*	Threatened	Candidate
	Bay pipefish	*Syngnathus Leptorhynchus*		
Birds (observed to utilize Fidalgo Bay)	Cooper's hawk	*Accipiter cooperii*		
	Western grebe	*Aechmophorus occidentalis*		
	Red-winged Blackbird	*Agelaius phoeniceus*		
	Northern Pintail	*Anas acuta*		
	American widgeon	*Anas americana*		
	Northern shoveler	*Anas clypeata*		
	Green-winged Teal	*Anas crecca*		
	Mallard	*Anas platyrhynchos*		
	Gadwall	*Anas strepera*		
	Snow Goose	*Anser caerulescens*		
	Great blue heron	*Ardea herodius*		
	Black Turnstone	*Arenaria melanocephala*		
	Lesser Scaup	*Aythya affinis*		
	Ringed-necked Duck	*Aythya collaris*		
	Greater Scaup	*Aythya marila*		
	Willow Flycatcher	*Bombus fervidus*		
	American Bittern	*Botaurus lentiginosus*		
	Marbled murrelet	*Brachyramphus marmoratus*	*Threatened*	Threatened
	Black brant goose	*Branta bernicla*		
	Canada Goose	*Branta canadensis*		
	Bufflehead	*Bucephala albeola*		
	Common Goldeneye	*Bucephala clangula*		
	Barrow's Goldeneye	*Bucephala islandica*		
	Sanderling	*Calidris alba*		
	Dunlin	*Calidris alpina*		
	Western sandpiper	*Calidris mauri*		
	Pigeon Guillemot	*Cepphus columba*		
	Vaux's Swift	*Chaetura vauxi*		

Species			Listing Status	
Group	Common Name	*Scientific Name*	Federal	State
	Western Snowy Plover	*Charadrius alexandrinus nivosus*	*Threatened*	Endangered
	Killdeer	*Charadrius vociferus*		
	Black tern	*Chlidonias niger*	Species of Concern	Monitored
	Northern Harrier Hawk	*Circus cyaneus*		
	Long-tailed Duck	*Clangula hyemalis*		
	American/NW Crow	*Corvus brachyrhynchos*		
	Common Raven	*Corvus corax*		
	Trumpeter Swan	*Cygnus buccinator*		
	Yellow Warbler	*Dendroica petechia*		
	Brewer's Blackbird	*Euphagus cyanocephalus*		
	Merlin	*Falco columbarius*		
	Peregrine falcon	*Falco peregrinus anatum*		
	Pacific Loon	*Gacia pacifica*		
	Common loon	*Gavia immer*	Not listed	Candidate
	Red throated loon	*Gavia stellata*		
	Bald eagle	*Haliaeetus leucocephalus*	Threatened	Threatened
	Harlequin duck	*Histrionicus histrionicus*		Species of concern
	Mew Gull	*Larus canus*		
	Ring-billed Gull	*Larus delawarensis*		
	Glaucous-winged Gull	*Larus glaucescens*		
	Western Gull	*Larus occidentalis*		
	Bonaparte's Gull	*Larus philadelphia*		
	Long-billed Dowitcher	*Limnodromus scolopaceus*		
	Hooded Merganser	*Lophodytes cucullatus*		
	Surf Scoter	*Melanitta perspicillata*		
	Song Sparrow	*Melospiza melodia*		
	Common Merganser	*Mergus merganser*		
	Red-breasted Merganser	*Mergus serrator*		
	Savannah Sparrow	*Passerculus sandwichensis*		
	California brown pelican	*Pelecanus occidentalis*	Endangered	Endangered
	Double Crested Cormorant	*Phalacrocorax auritus*		
	Pelagic Cormorant	*Phalacrocorax pelagius*		

Species			Listing Status	
Group	Common Name	*Scientific Name*	Federal	State
	Brandt's Cormorant	*Phalacrocorax penicillatus*		
	Black-bellied Plover	*Pluvialis squatarola*		
	Horned Grebe	*Podiceps auritus*		
	Red-necked Grebe	*Podiceps grisegena*		
	Eared Grebe	*Podiceps nigricollis*		
	Pied-bill Grebe	*Podilymbus podiceps*		
	Purple Martin	*Progne subis*		
	Caspian Tern	*Sterna caspia*		
	European Starling	*Sturnus vulgaris*		
	Ruddy Duck	*Tadorna ferruginea*		
	Greater yellowlegs	*Tringa melanoleuca*		
Mammals -	River Otter	*Lutra canadensis*		
	Racoon	*Procyon lotor*		
	Pacific Harbor Seal	*Phoca vitulina*		
Macro Invertebrates	Bamboo worm	*Axiothella rubrocincta*		
	Acorn barnacle	*Balanus glandula*		
	Barnacles	*Balanus sp.*		
	Horn shell	*Batallaria attrementaria*		
	Graceful crab	*Cancer gracilis*		
	Dungeness crab	*Cancer magister*		
	Red rock crab	*Cancer productus*		
	Skeleton shrimp	*Caprellid amphipod*		
	Small acorn barnacle	*Chthamalus dalli*		
	Heart Cockles	*Clinocardium nuttallii*		
	Crab	*Crangon sp.*		
	Japanese oyster	*Crassostrea gigas*		
	Slipper shell	*Crepidula dorsata*		
	Oregon pill bug	*Gnorimosphaeroma oregonensis*		
	Bubble shell	*Hamonea* spp.		
	Purple shore crab	*Hemigrapsus nudus*		
	Green shore crab	*Hemigraspus oregonensis*		
	Broken-back shrimp	*Heptacarpus sp.*		
	Eelgrass isopod	*Idotea sp.*		
	Olive green isopod	*Idotea wosnesenskii*		
	Top Snail	*Lirularia sp.*		
	Checkered periwinkle	*Littorina scutulata*		
	Sitka Periwinkles	*Littorina sitkana*		
	Finger limpet	*Lottia digitalis*		
	Shield limpet	*Lottia pelta*		
	Clam	*Macoma sp.*		
	Mossy chiton	*Mopalia muscosa*		

Species			Listing Status	
Group	Common Name	*Scientific Name*	Federal	State
	Pacific blue mussel	*Mytilus trossulus*		
	Common blue mussel	*Mytilus* spp.		
	Ghost shrimp	*Neotrypea californiensis*		
	Large variegated limpet	*Notoacmea persona*		
	Purple varnish clam	*Nuttalia obscurata*		
	Beach hopper	*Orchestia transkiana*		
	Decorator crab	*Oregonia gracilis*		
	Olympia oyster	*Ostrea conchaphila*		
	Coonstripe shrimp	*Pandalus danii*		
	Ochre sea star	*Pisaster ochraceus*		
	Native littleneck clam	*Protothaca staminea*		
	Kelp crab	*Pugettia producta*		
	Arrow worm	*Sagitta elegans*		
	Washington butter clam	*Saxidomus giganteus*		
	Horse clam	*Tresus capax*		
	Amphipods	unidentified spp.		
	Japanese littleneck clam	*Venerupis philippenarum*		
	Piddock clam	*Zirfaea pilsbryii*		
Macrophytes (plants) Salt marsh Plants	Eelgrass	*Zostera marina*		
	Japanese eelgrass	*Zostera japonica*		
	Fat-hen	*Atriplex patula*		
	Lyngby's sedge	*Carex lyngbyei*		
	Salt marsh dodder	*Cuscuta salina*		
	Turfted hairgrass	*Deschampsia cespitosa*		
	Saltgrass	*Distichlis spicata*		
	American dunegrass	*Leymus mollis*		
	Saltwort	*Glaux maritima*		
	Gumweed	*Grindelia integrifolia*		
	Seaside plantain	*Plantago maritima*		
	Pickleweed	*Salicornia virginica*		
	American bullrush	*Scirpus americanus*		
	Cordgrass	*Spartina anglica*		
	Sorrel	*Rumex sp.*		
	Seaside arrow-grass	*Triglochin maritimum*		
	Common cattail	*Typha latifolia*		
Macro algae	Sea moss-green tuft	*Cladophora* sp.		
	Seersucker kelp	*Costaria costata*		
		Desmerestia ligulata		
	(green)	*Enteromorpha linza*		
	Green mat algae	*Enteromorpha* spp.		
	Rockweed(brown)	*Fucus gardneri*		

Species			Listing Status	
Group	Common Name	*Scientific Name*	Federal	State
		Gracilaria pacifica		
		Gracilariopsis sioestedtii		
	Sugar wrack kelp	*Laminaria saccharina*		
		Laminaria sp.		
		Mastocarpus papilatus		
	Diatoms	*Navicula distans*		
		Odonthalia washingtonensis		
		Porphyra spp.		
	Succulent seaweed	*Sarcodiotheca gaudichaudii*		
	Red fringe	*Smithora naiadum*		
	Sea lettuce(green)	*Ulva lactuca*		
		Vaucheria spp.		

Figure 4: Fidalgo Bay Sediments and Nearshore Drift

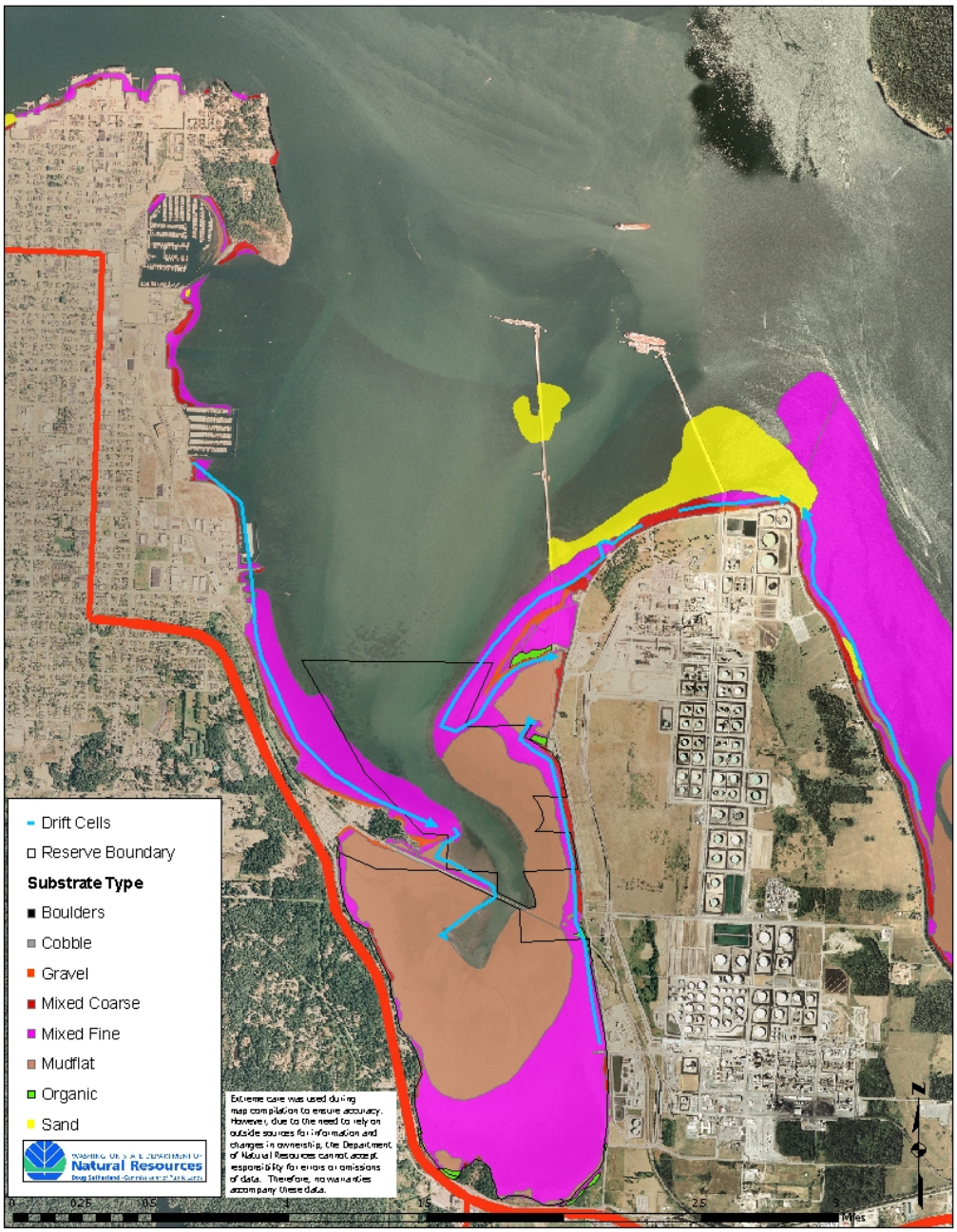


Figure 5: Fidalgo Bay Modified Shorelines

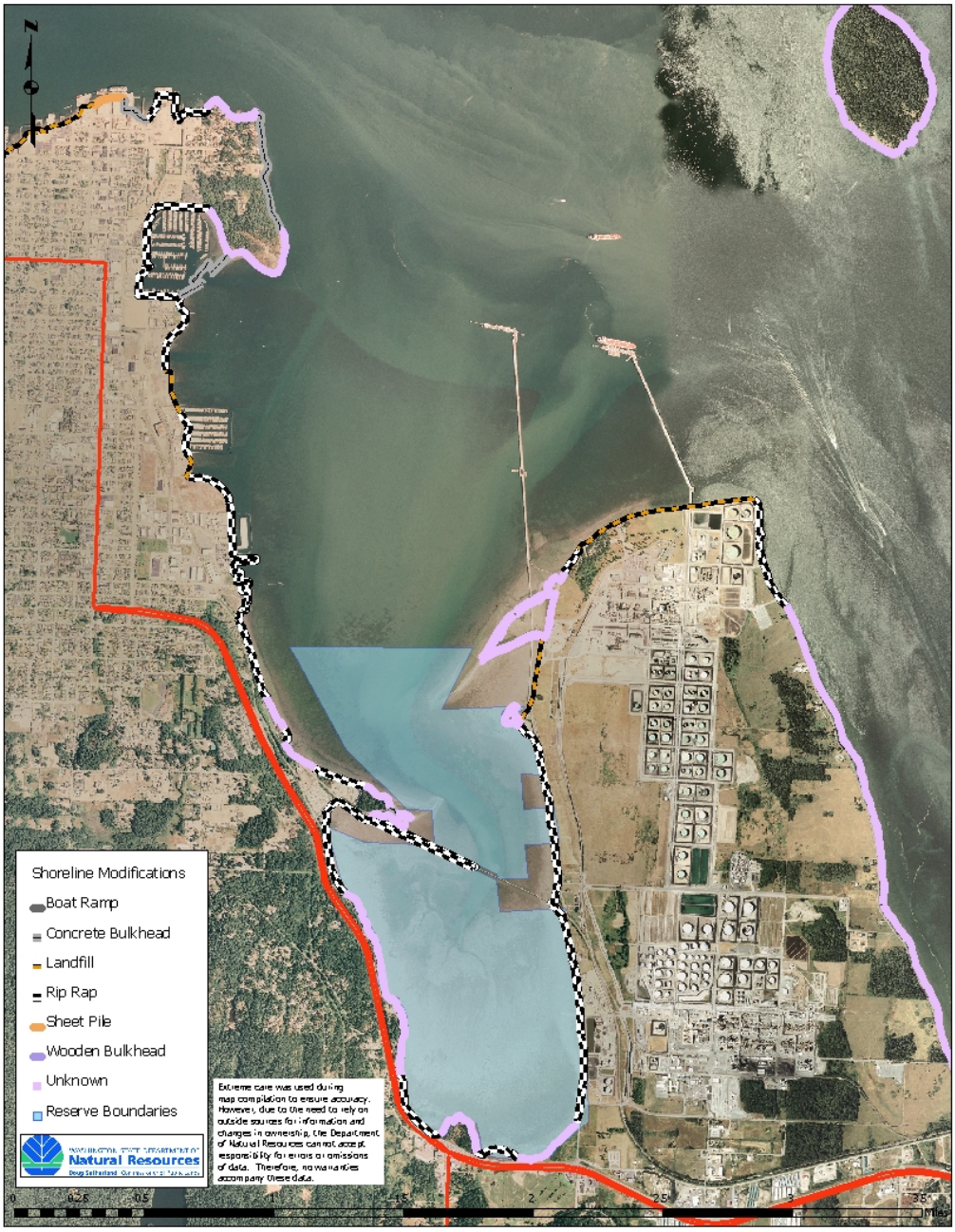


Figure 6: Submerged Aquatic Vegetation in Fidalgo Bay

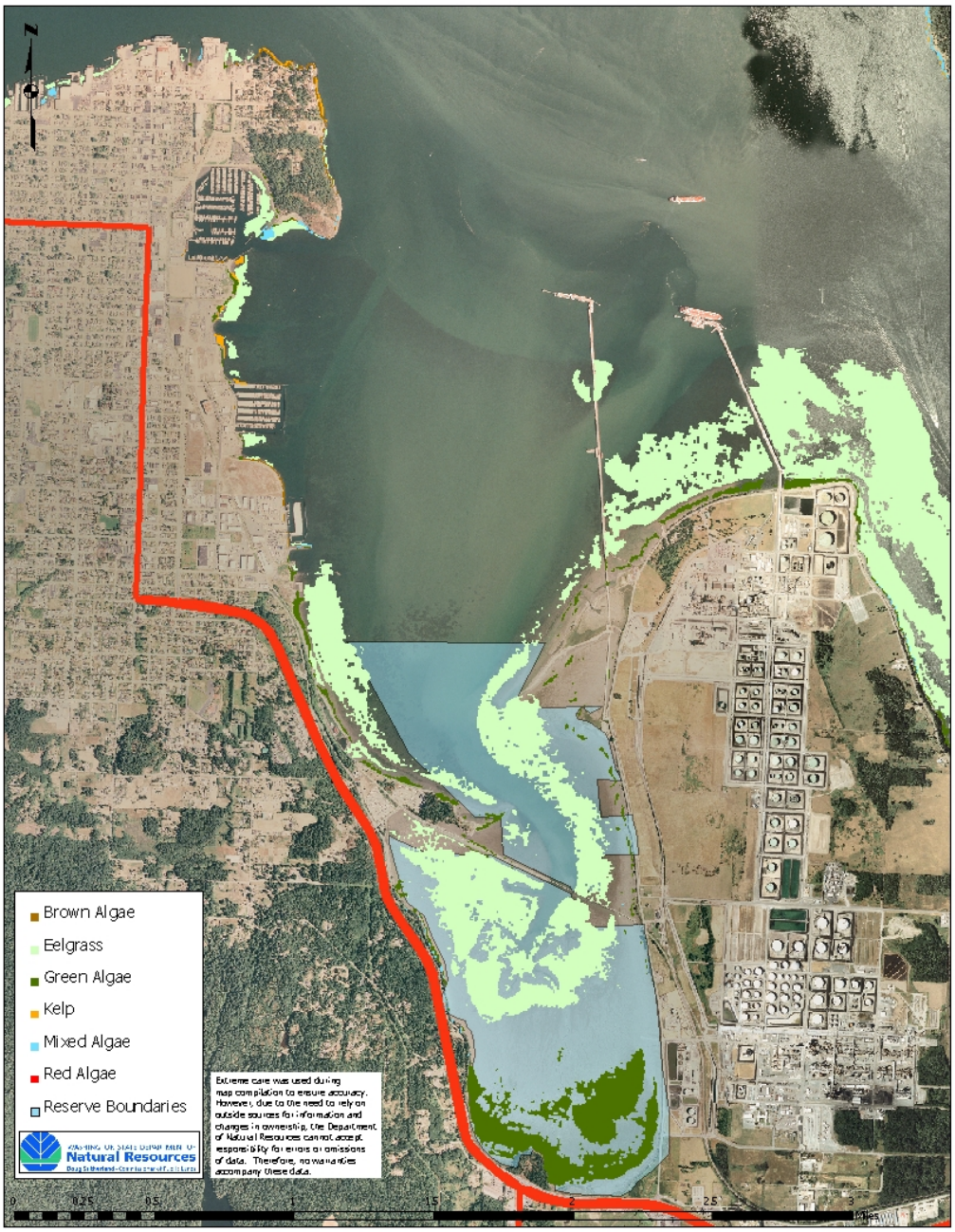


Figure 7: Fidalgo Bay Marsh Habitat

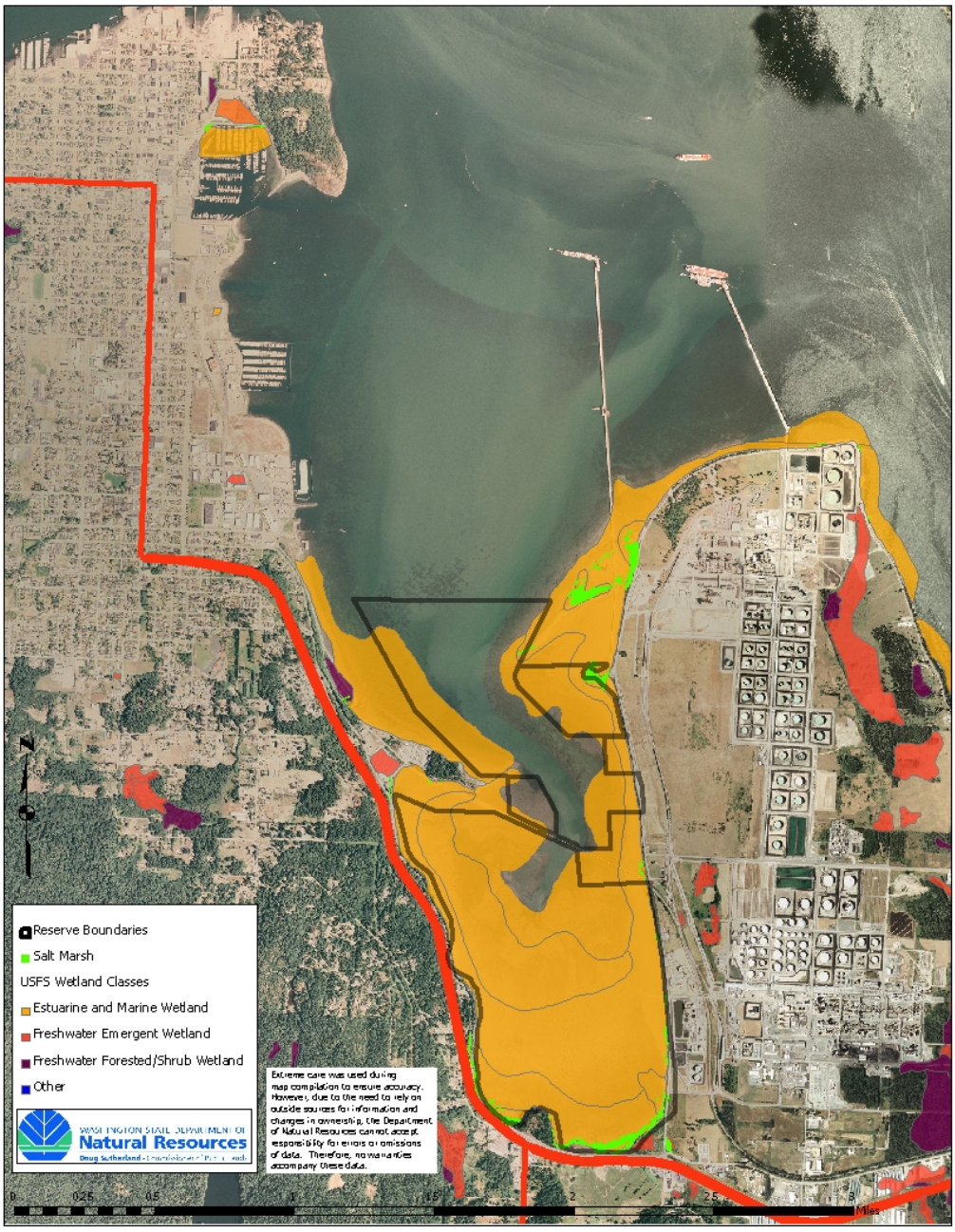


Figure 8: Marine Fauna Habitat Use in Fidalgo Bay

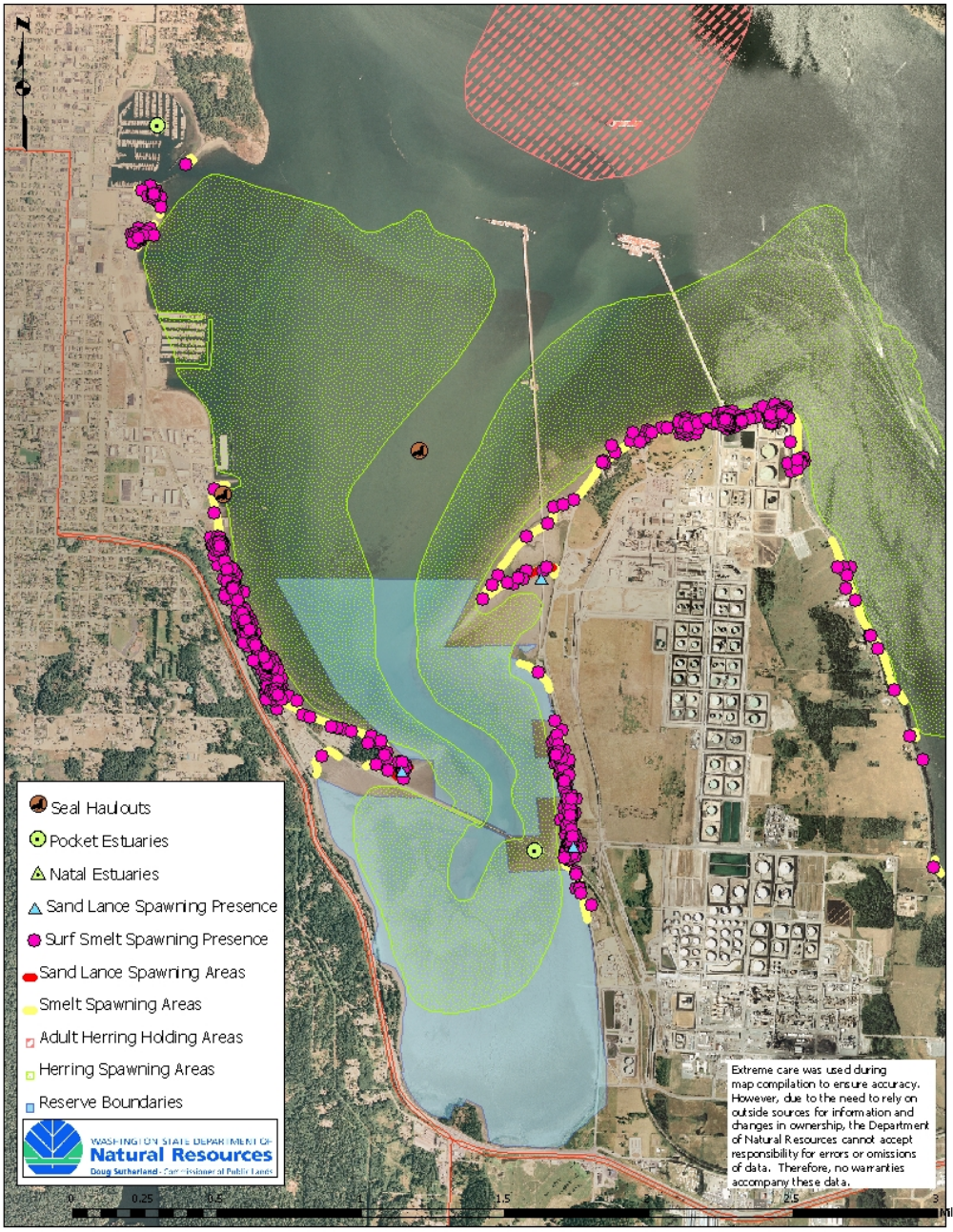
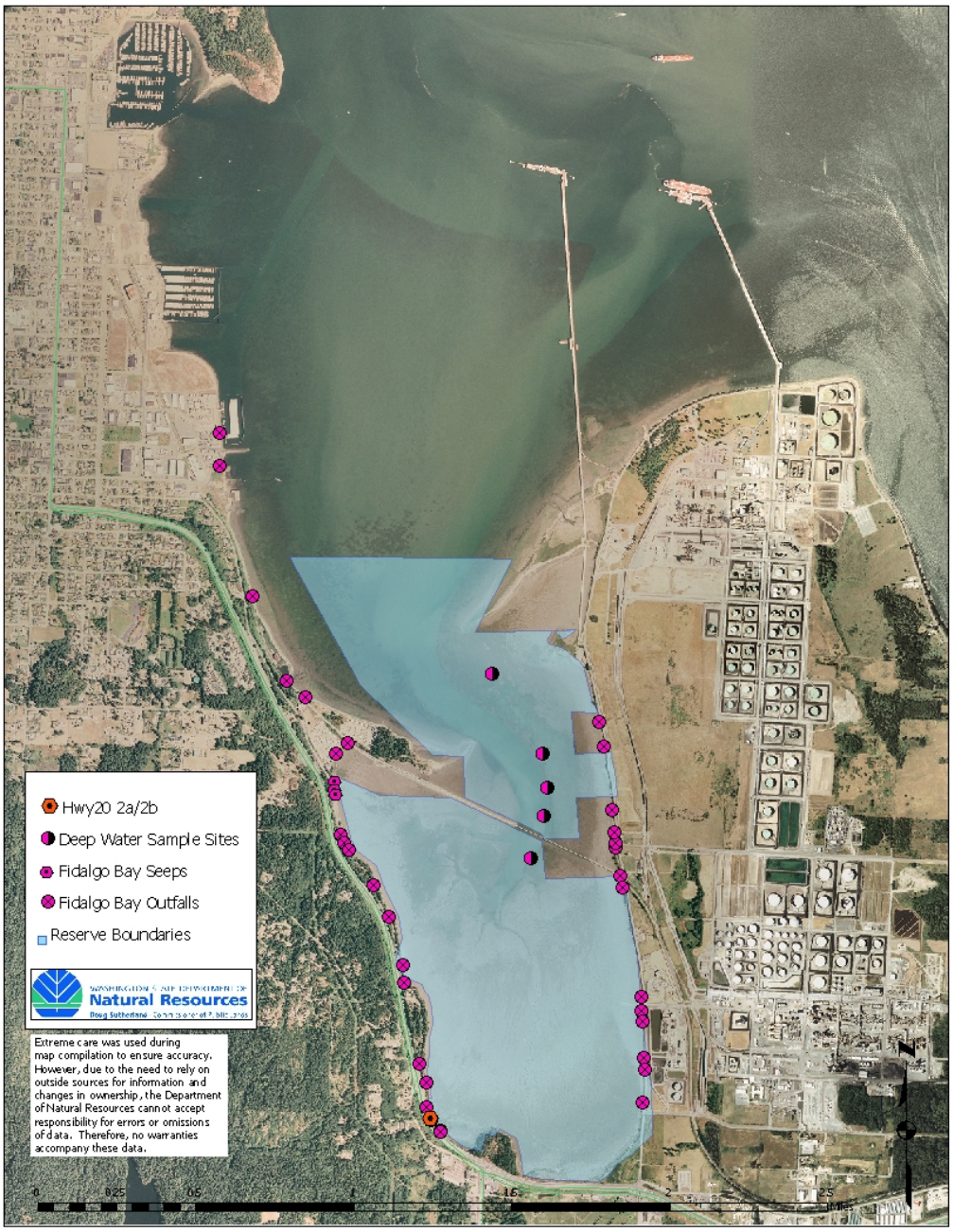


Figure 9: Samish Indian Tribe Fidalgo Bay Water Quality Monitoring Sites



Appendix B – Legal Description of Fidalgo Bay Aquatic Reserve

The properties included in the Washington State-owned Fidalgo Bay Aquatic Reserve include that portion of the harbor area, waterways and beds of navigable water in Fidalgo Bay owned by the State of Washington located within Section 5, Township 34 North, Range 2 East, W.M. and within Sections 29, 30, and 32 Township 35 North, Range 2 East, W.M. and further described as follows:

That portion of Fidalgo Bay lying southerly of a line beginning at the northeast corner of Tract No. 10 as shown on Plate 11 of the Tide and Shore Lands of Anacortes Harbor as filed by the Tideland Appraisers dated May 1, 1893 and said line extended easterly to terminate at the meander corner between government lots 2 and 3 of Section 29, Township 35 North, Range 2 East, W.M.;

EXCEPTING THEREFROM, that portion of the southerly end of the West Arm of Fidalgo Waterway which was vacated by Waterway Vacation No. 101 according to the Commissioner's Order dated April 29, 1959 for Primary State Highway No. 1 (State Route 20);

ALSO EXCEPTING THEREFROM, that portion of the southerly end of the East Arm of Fidalgo Waterway granted to the Department of Highways as shown on State Road Plat No. 941 dated January 18, 1961 for Primary State Highway No. 1 (State Route 20);

ALSO EXCEPTING THEREFROM, that 100 foot right of way for railroad purposes across said Fidalgo Waterway granted to the Seattle and Montana Railroad Company by decree filed March 2, 1904 according to Condemnation file No. A26;

TOGETHER WITH, those first class tidelands conveyed to the State of Washington according to the Statuary Warranty deed recorded on December 20, 1999 recorded under Auditor's File No. 199912200133, Skagit County Auditor's records and further described as follows:

Tracts 4, 5, 6, 7, 8, 9, and 10 of Plate 13; Tracts 8, 9, 10, 11, 12, 13, 14, and 15 of Plate 12; that portion of Tracts 16 and 17 of said Plate 12 and lying southerly of the Seattle and Montana Railroad Company by decree filed March 2, 1904 according to Condemnation file No. A26; said tracts and plates are according to of the Tide and Shore Lands of Anacortes Harbor as filed by the Tideland Appraisers dated May 1, 1893;

EXCEPTING THEREFROM; that portion of said first class tidelands, if any, conveyed to the State of Washington for Primary State Highway No. 1, Jct. S.S.H. No. 1-D (State Route 20) by deed recorded October 15, 1956 under Skagit County Auditor's file No. 542873; by deed recorded January 3, 1958 under Skagit County Auditor's file No. 560284, and by deed recorded February 7, 1961 under Skagit County Auditor's file No. 603915;

ALSO EXCEPTING THEREFROM, that 100 foot right of way for railroad purposes across said first class tidelands granted to the Seattle and Montana Railroad Company by decree filed March 2, 1904 according to Condemnation file No. A26;

TOGETHER WITH, those second class tide lands conveyed to the State of Washington according to the Statuary Warranty deed recorded on December 20, 1999 recorded under Auditor's File No. 199912200133, Skagit County Auditor's records and further described as follows:

All tide lands of the second class lying between the line of mean high tide and the line of extreme low tide, situate in front of and adjacent to, or abutting government lots 5 and 6, Section 32, Township 35 North, Range 2 East, W.M. and government lot 4, Section 4, Township 34 North, Range 2 East, W.M.;

ALSO TOGETHER WITH, tidelands of the second class, conveyed to the State of Washington according to the Statuary Warranty deed recorded on October 26, 2000 recorded under Auditor's File No. 200010260029, Skagit County Auditor's records and further described as follows:

Tidelands of the second class, extending from mean high tide to extreme low tide as conveyed by the State of Washington in deeds recorded in Volume 88 of Deeds, page 513 on May 21, 1912 and in Volume 102 of Deeds, page 550 on April 25, 1916 of Skagit County Auditor records, situate in front of, adjacent to, or abutting upon that portion of the government meander line described as follows:

Beginning at the northeast corner of Government Lot 1, Section 5, Township 34 North, Range 2 East, W.M.; thence South 28° West, 7.50 chains (495.00 feet); thence South 47° West, 17.50 chains (1155.00 feet) to the terminal point of this description.

Except that portion, if any, lying westerly of the easterly line of "East Arm Fidalgo Waterway" as shown on Plate No. 13, "Tide and Shore Lands in Section 5, Township 34 North, Range 2 East, W.M., Anacortes Harbor" as per the recorded plat thereof on file in the office of the Commissioner of Public lands, Olympia, WA.

ALSO Except that portion conveyed to the State of Washington for Primary State Highway No. 1, Jct. S.S.H. No. 1-D (State Route 20) by deed recorded January 10, 1961 under Skagit County Auditor's file No. 602917.

TOGETHER WITH, those bed lands, if any, lying westerly of the line of extreme low tide fronting and abutting the said second class tidelands situated in front of and adjacent to, or abutting government lots 5 and 6, Section 32, Township 35 North, Range 2 East, W.M. and government lot 4, Section 4, Township 34 North, Range 2 East, W.M.; and lying easterly of said east line of the East Arm of the Fidalgo Waterway;

TOGETHER WITH, those bed lands, if any, ling westerly of the line of extreme low tide fronting and abutting the second class tidelands situated in front of and adjacent to, or abutting government lot 7, Section 32, Township 35 North, Range 2 East, W.M. and lying easterly of the east line of said Fidalgo Waterway and the said east line of the East Arm of Fidalgo Waterway

EXCEPTING THEREFROM, that 100 foot right of way for railroad purposes across said bedlands, if any granted to the Seattle and Montana Railroad Company by decree filed March 2, 1904 according to Condemnation file No. A26;

TOGETHER WITH, second class tidelands and bedlands, if any, lying northerly of the north lateral sideline of said second class tidelands in front of and adjacent to, or abutting government lot 7, Township 35 North, Range 2 East, W.M. and lying southerly of the south line of Tract No. 2 as shown on Plate 12 of the Tide and Shore Lands of Anacortes Harbor as filed by the Tideland Appraisers dated May 1, 1893;

TOGETHER WITH, those bed lands, if any, lying westerly of the line of extreme low tide fronting and abutting the second class tidelands situated in front of and adjacent to, or abutting government lots 2, 3 and 4, Section 29, Township 35 North, Range 2 East, W.M. and the north 10.19 lineal chains along the meander line of government lot 8, Section 32, Township 35 North,

Range 2 East, W.M. and lying easterly of the inner harbor line of the easterly most harbor area within Fidalgo Bay as shown on the Map of Anacortes Harbor as filed by the Harbor Line Commission dated 1892;

EXCEPTING THEREFROM; those bedlands, if any, of said Tract 2 as shown on Plate 12 of the Tide and Shore Lands of Anacortes Harbor as filed by the Tideland Appraisers dated May 1, 1893 as conveyed by the State of Washington according to the deed dated April 17, 1908 within Volume 8 of Tide Land Deeds, page 370 on file in the office of the Commissioner of Public Lands;

ALSO EXCEPTING THEREFROM, those bedlands, if any, of Fidalgo Bay lying southerly of said line beginning at the northeast corner of Tract No. 10 as shown on Plate 11 of the Tide and Shore Lands of Anacortes Harbor as filed by the Tideland Appraisers dated May 1, 1893 and said line extended easterly to terminate at the meander corner between government lots 2 and 3 of Section 29, Township 35 North, Range 2 East, W.M.;

ALSO EXCEPTING THEREFROM; tidelands of the first class of said Tract 2 as shown on Plate 12 of the Tide and Shore Lands of Anacortes Harbor as filed by the Tideland Appraisers dated May 1, 1893 as conveyed by the State of Washington according to the deed dated April 17, 1908 within Volume 8 of Tide Land Deeds, page 370 on file in the office of the Commissioner of Public Lands;

All of the above-described lands are situated in Skagit County, Washington. A graphic portrayal of these boundaries is depicted in figure 1.