SHORELINE INVENTORY AND CHARACTERIZATION REPORT

San Juan County

Prepared for

San Juan County Community Development and Planning Department

~~2012~~April 2013

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Prepared for

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Community Development and Planning Department
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April 2013Final

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Glossary

Accretionary shoreform – Low-lying areas along the shoreline that consist of accumulated drift.

Anthropogenic – Caused either directly or indirectly by human activity.

Archipelago – A group or cluster of islands. San Juan County is an archipelago.

Barrier beach – A shoreform typified by a beach berm backed (landward of) a flat low backshore. Barrier beaches can be depositional or erosional, but are more typically a region of active transport between erosional and depositional areas.

Beach profile – A profile of elevations perpendicular to the shoreline.

Bedrock – Bedrock is a general term that includes any of the generally indurated or crystalline materials that make up the earth's crust.

Breakwater – A fixed structure placed within or below intertidal areas to reduce the amount of wave energy reaching the shoreline.

Ditch – An artificial channel that is designed to convey water and drain perennially or seasonally wet areas.

Downdrift – In the direction of dominant along shore sediment transport.

(Glacial) Drift – Sediment deposited under (often marine) water during periods where the islands were close the glacial front. Sediment can be highly variable in grain size, ranging from muddy sediments to gravel.

(Glacial) Drift terrace – A prism of sediment emplaced when sea level was locally much higher than it is now. These terraces are often flat and sandwiched between bedrock outcroppings. This material from these terraces serves as the primary source for nearshore sediment in many areas in the County.

Drumlin – A positive (elevated) glacial feature produced by glaciers that is aligned with the direction of glacial motion.

Estuarine – Those areas that are partially protected from marine circulation and waves and possess some of amount of freshwater input.

Everson Interstade – The time period immediately after the collapse of the Puget Lobe when the terminus of the Cordilleran ice sheet was at or near the modern-day town of Coupeville (approximately 10,000 to 13,000 years before present). The exact position of the ice front near the County is largely unknown, but thought to be quite complicated.

Feeder bluff – An eroding bluff that supplies a significant portion of the sediment transported downdrift from it along the shoreline. Typically feeder bluffs in San Juan County are comprised of glacially derived sediments.

Fetch – The distance over which the wind blows to generate a given wave field.

Foreshore – The steep part of the beach that is generally composed of gravel, although it can contain sand or even boulders. The foreshore on the shoreline of the County typically extends from approximately 1 to 3 feet above MLLW to MHHW. It is the most sedimentologically active portion of the nearshore (Finlayson 2006).

Isthmus – A narrow strip of land connecting two larger land areas bounded by water. In the County, isthmuses are often associated with **tombolos**.

Low-tide terrace – A broad, flat portion of the nearshore that extends from a few feet above to a few feet below MLLW. The low-tide terrace is finer grained that the foreshore above it, although there are places in the County where is the low-tide terrace is bedrock or glacial hardpay with a very thin veneer of sediment.

Management Area – A management area is an area of shoreline typically distinguished by similar characteristics relating to the relative intensity of land use, the physical landscape and/or critical hydrogeomorphic or biological processes. Management areas are comprised of smaller units called reaches.

Mean higher-high water (MHHW) – The average elevation of the two high tides in each day over a tidal epoch (19 years).

Mean lower-low water (MLLW) – The average elevation of the two low tides in each day over a tidal epoch (19 years).

Nearshore – The nearshore generally extends from the top of shoreline bank or bluff to the depth offshore where light penetrating the water falls below a level supporting plant growth, and upstream in estuaries to the head of tidal influence. It includes bluffs, beaches, mudflats, kelp and eelgrass beds, salt marshes, gravel spits, and estuaries.

Ophiolite – Rock from oceanic crust. Ophiolites originate far below the surface of the earth, sometimes in the mantle. They are often rich in minerals rarely found elsewhere on the earth's surface. While often being crystalline (hard), they are susceptible to chemical weathering.

Ordinary high water mark – On all lakes, streams, and tidal water is that mark that will be found by examining the bed and banks and ascertaining where the presence and action of waters are so common and usual, and so long continued in all ordinary years, as to mark upon the soil a character distinct from that of the abutting upland, in respect to vegetation as that condition exists on June 1, 1971, as it may naturally change thereafter, or as it may change thereafter in accordance with permits issued by a local government or the department: provided, that in any area where the ordinary high water mark cannot be found, the ordinary high water mark

adjoining salt water shall be the line of mean higher high tide and the ordinary high water mark adjoining fresh water shall be the line of mean high water.

Pocket beach – A small beach that is contained between two bedrock headlands that exhibits little to no net longshore transport (Shipman 2008). Transport can be significant in a cross-shore sense.

Pocket estuary – Small estuaries within the Puget Sound that form behind spit or barrier beach landforms at submerged, tectonically- or glacially-derived valleys or at small creek deltas.

Priority Fish Spawning Areas – priority fish spawning areas are large geographic regions composed of numerous forage fish spawning sites.

Progradation rate – The rate at which a delta grows from sediment deposition into the sea.

Puget Lobe – The southernmost finger of the Cordilleran Ice Sheet that advanced into and fills the Puget Lowland.

Puget Lowland – The low area between the Olympic and Cascade mountain ranges.

Reach – A segment of shoreline that has a similar geomorphic context used for assessment of ecological conditions. Reaches are smaller units that comprise the management areas.

Salish Sea – All of the inland waters surrounding the islands, including Puget Sound, the Strait of Georgia and the Strait of Juan de Fuca.

Shoreline Armoring – Placing a fixed, immobile structure along the shoreline to protect uplands from current- and wave-induced erosion by marine circulation and waves. Armoring can include, but is not limited to seawalls, bulkheads, and placed rock.

Southern Whidbey Island Fault Zone – A large fault complex that extends from Victoria, British Columbia to Woodinville, Washington. It passes just south of San Juan County.

Surf – The area of the nearshore where waves have broken (collapsed). The surf zone is very sedimentologically active area, often devoid of vegetation.

Swash – The up-and-back movement of the water surface on the beach. Considerable sediment transport occurs in the swash zone. Swash also leads to the formation of the foreshore on mixed-sediment and pocket beaches.

Swell – Long-period (10-second) waves originating in the open ocean. Swell is typically much larger in amplitude and period than locally generated wind-waves.

Tombolo – A depositional landform in which an island, usually bedrock is attached to the mainland by a narrow piece of land comprised primarily of beach sediments.

Updrift – In the direction opposite of dominant along shore sediment transport.

Vashon Stade – The time period between 20,000 and 13,000 years before present of glacialinundation of the Puget Lowland at the end of the last ice age.

Limitations

As with any report, there are limitations (inherent or otherwise) that must be acknowledged. This report is limited to the subjects covered, materials reviewed, and data available at the time the report was prepared. The authors and reviewers have made a sincere attempt to provide accurate and thorough information using the most current and complete information available and their own best professional judgment.

Executive Summary

This Inventory and Characterization Report was prepared for the San Juan County (County) Community Development and Planning Department under a Washington State Department of Ecology (Ecology) grant to help update the County's Shoreline Master Program (SMP). Washington's Shoreline Management Act of 1971 and its implementing State Guidelines adopted in 2003 require an update to the County's SMP, which was last approved in 1998. Under these Guidelines, the County must base the master program provisions on an analysis of the most relevant and accurate scientific and technical information (WAC 173-26-201(3)(c)and(d)). This includes meeting the mandate of "no net loss" of shoreline ecological functions as well as providing mechanisms for restoration of impaired shoreline functions. The Inventory and Characterization Report is not a binding regulatory document but rather provides guidance for potential future updates to the SMP.

The County's SMP update is a multi-year process, which begins with an inventory and characterization of existing environmental and land use conditions, otherwise known as a "baseline condition." As part of developing a "baseline" condition, this Inventory and Characterization Report contains an inventory of a variety of elements, including land use, landscape processes, and ecological functions. These elements are spatially catalogued using a Geographic Information System (GIS), where possible, and are presented as a Countywide Map Folio. Together, these elements define what is understood to be the existing present day condition and helps inform the review of current shoreline regulations and highlight areas where changes may be necessary to meet shoreline management goals to provide for water dependent uses, public access and the protection of natural resources.

Key information provided in this report include: characterization of existing ecological functions through an analysis of both physical and biological processes; an analysis of existing land uses, shoreline modifications, land capacity, public access, and areas under public ownership or preservation holdings; preliminary identification of restoration opportunities; evaluation of current shoreline environment designations, their purpose and criteria; and recommendations for the SMP to help meet the Guidelines.

1.0 Introduction

San Juan County's Shoreline Master Program (SMP) Update requires preparation of a shoreline inventory and characterization report to be used as a foundation for the SMP update process (*WAC 173-26-201(3)(c)and(d)).* This document was prepared to fulfill that requirement and serves to:

- Inform the review of current shoreline regulations required by the update process
- Highlight areas where shoreline resources protection measures and shoreline use designations could be improved to meet shoreline management goals

Information provided includes existing physical conditions as well as data and descriptions of watershed and shoreline attributes that pertain to the shoreline jurisdiction of San Juan County. In addition, existing ecosystem shoreline processes, land uses and development patterns are characterized. Descriptions of, shoreline functions and opportunities for restoration, public access and shoreline use are also provided.

1.1 Purpose

The San Juan County Shoreline Inventory and Characterization report accomplishes the following:

- Provides supporting information for determining updated environmental designations. This includes an analysis of existing ecological functions and a detailed inventory of existing physical and biological conditions per WAC 173-26-201 (3)(c).
- Establishes the baseline for "no net loss" of ecological conditions and thereby informs current and future policy development, land use planning, and regulatory effectiveness
- Identifies opportunities for protection, improving public access, and supporting water dependent uses
- Identifies degraded areas and restoration opportunities for incorporation into a separate comprehensive restoration plan.

1.2 Scope

The scope of this inventory and characterization includes all Shorelines of the State as defined by RCW 90.58.30. For San Juan County (County), this includes all marine areas and freshwater lakes greater than 20 acres (TWC 2011), excluding the shores of incorporated Town of Friday Harbor.

The marine shoreline areas included in this report are defined as all waters waterward of the ordinary high water mark and lands 200 feet upland of the edge of the shoreline, as defined by the ordinary high-water mark (OHWM) or mean higher high water (MHHW) if the OHWM cannot be determined, and associated tidelands and wetlands. All marine waters waterward of the line of extreme low tide in the Strait of Juan de Fuca north to the Canadian line are also designated as Shorelines of Statewide Significance. For Shorelines of Statewide Significance, the Shoreline Management Act (SMA) sets specific preferences for uses and calls for a higher level of effort in implementing its objectives.

Freshwater shoreline areas include the waterbody and all uplands within 200 feet from the ordinary high water mark of lakes greater than 20 acres and associated wetlands. San Juan County does not have any lakes that meet the 1,000-acre size threshold for classification as a shoreline of statewide significance. There are no rivers or streams with mean annual flow over 20 cubic feet per second (cfs) mean annual flow in San Juan County, so streams are not included in this report.

The extents of the shoreline jurisdiction covering both marine and fresh waters for the County are shown on Map 2a, b. and c of Appendix A. In total, the County has approximately 481 miles of shoreline in unincorporated parts of the County (i.e. excludes the Town of Friday Harbor). Marine shorelines constitute approximately 455 miles while freshwater shorelines add another 26 miles, Freshwater resources included in this characterization comprise portions of 12 lakes that were identified during the determination of shoreline jurisdiction (TWC 2011). For the purposes of the analysis of shoreline functions (see Chapter 3), islets of 0.5 acres or less (both marine and freshwater) were excluded. Therefore, the amount of shoreline analyzed in this report and discussed from here forward totals approximately 464 miles (439 miles of marine and 25 miles or freshwater).

This report provides information on the County's ecosystems, specific discussions on individual shoreline management areas (Chapter 4), including marine and lake shorelines, a use analysis identifying existing uses and potential future uses (Chapter 5), recommendations for shoreline management (Chapter 8), and data gaps that would be helpful to close for future planning (Chapter 7). First a general overview profiles larger scale ecosystem processes observed in the County including physical constraints such as climate, topography, geology, key processes related to shoreline ecosystem functions, and the types of habitats and species present. The general overview section is followed by detailed sections for each planning area (called management areas) that characterize physical and biological conditions in nearshore reaches, existing land uses, future uses based on the San Juan County Comprehensive Land Use Plan, shoreline modifications, historic and cultural resources, and fishing and public access potential.

Included within these sections are tabular data used for analysis of shoreline reaches and identification of potential restoration opportunities. Finally, shoreline management recommendations are provided at the end of this report to guide future changes or additions to the County's existing Shoreline Master Program (SMP).

2.0 Methods

2.1 Inventory Data and Information Sources

Analysis and conclusions presented in this report were based on a review of existing information including published studies, private and agency authored technical reports and databases, GIS-based information and mapping, aerial and oblique photography of the County's shorelines, as well as the recently published *Best Available Science for Marine Fish and Wildlife Habitat Conservation Areas for San Juan County* (Herrera and The Watershed Company 2011).

Development of a shoreline inventory is intended to record the existing or baseline conditions upon which the development of shoreline master program provisions will be examined to ensure the adopted regulations provide no net loss of shoreline ecological functions. Table 1 lists those inventory elements, as required by Ecology Guidelines, for which data is available and used for mapping and information purposes for the County's shorelines per WAC 173-26-201 (3)(c). A complete listing of mapping data and their sources is available in Appendix D: Key Data Sources for Shoreline Inventory Maps. Table 1 also describes the information collected for each of the required inventory elements. Maps depicting many of the inventory elements listed in Table 1 are provided in Appendix A: Map Folio.

Table 1. Required Shoreline Inventory Elements and Data Sources.

Inventory Element	Information Used	Data Sources	Map Location
Shoreline and adjacent land use patterns	Land ownership	County	Maps 3A, B & C
		Washington State Parks	
	Land use districts	County	Maps 4A, B & C
	Exising shoreline environment designations		
	Current land use	County	Maps 5A, B & C
	"Vacant" shoreline parcels	County	Maps 35A, B & C
	Parcels with potential nonconforming shore structures	County	Maps 36A, B & C
Transportation	Roads	County	Maps 2 - 41
Surface water systems	Water bodies	County	Maps 8A, B & C
		Department of Ecology	
	Watercourses	Department of Ecology	
	Culverts	County	
	Ditches		
	Tidegates		
	Dams	Puget Sound Nearshore Ecosystem Restoration Project	

Inventory Element	Information Used	Data Sources	Map Location
	Streams	Wild Fish Conservancy	Maps 40A, B, & C
Soils	Soils	Natural Resources Conservation Service	Maps 16A, B & C
	Hydric soils		
Geology and geologic hazards	Geologic units	Department of Natural Resources	Maps 15A, B & C
	Unstable bluffs	Department of Ecology	Maps 17A, B & C
	Shoreline slope stability		
	Erosion-prone soils	County	
	Slopes exceeding 40%		
	Liquefaction susceptibility	Department of Natural Resources	Map 18
	Tsunami inundation	Scientific literature analysis	No map available
Land cover	Land cover (including vegetation and estuarine habitats)	National Oceanic and Atmospheric Administration	Maps 19A, B & C
	Percent impervious		Maps 20A, B & C
Critical areas	Tidal wetlands	Adamus Resource Assessment, Inc and EarthDesign, Inc in collaboration with SJC	Maps 12A, B & C
	Non-tidal wetlands		
	Floodplain	Federal Emergency Management Agency	
	Critical aquifer recharge areas (CARAs)	County	No map available
Habitats and species	Habitats and species regions	Department of Fish and Wildife	Maps 22A, B & C
	Outer line of eelgrass	Friends of the San Juans	Maps 23A, B & C
	Bull kelp		
	Non-floating kelp	Department of Natural Resources	
	Species observations (points)	Department of Fish and Wildife	Maps 24A, B & C
	Species observations (areas)		
	Harbor seal haulout sites		
	Seabird colonies		
	Bald eagle buffers		
	Fish distribution		Maps 25A, B & C
	Pacific herring adult holding areas		
	Pacific herring spawning areas		
	Rocksole spawning areas		

Inventory Element	Information Used	Data Sources	Map Location
	Sand lance intertidal spawning habitat		
	Surf smelt intertidal spawning habitat		
	Forage fish spawn beaches		
	Shellfish		Maps 26A, B & C
	Fish presence probability - wild juvenile Chinook salmon	Beamer and Fresh 2012	Maps 27A, B & C
	Fish presence probability - juvenile chum salmon		Maps 28A, B & C
	Fish presence probability - juvenile pink salmon		Maps 29A, B & C
	Fish presence probability - juvenile lingcod and greenling		Maps 30A, B & C
	Fish presence probability - juvenile surf smelt		Maps 31A, B & C
	Fish presence probability - juvenile Pacific sand lance		Maps 32A, B & C
	Fish presence probability - juvenile Pacific herring		Maps 33A, B & C
Shoreline types and processes	Feeder bluffs	Pulling It All Together project	Maps 13A, B & C
	Marine net shore drift	Coastal Geologic Services	
	Current marine shoreform types	Puget Sound Nearshore Ecosystem Restoration Project	Maps 14A, B & C
	Shoreline types (used for fish presence probability)	Beamer and Fresh 2012	Maps 34A, B & C
	Pocket beaches	Pulling It All Together project	Maps 41A, B & C
Shoreline modifications	Marine overwater structures	Department of Natural Resources	Maps 9A, B & C
	Armoring	Friends of the San Juans	
	Marinas, jetties, breakwaters		
	Groins		
	Improved boat ramps		
	Moorings (buoys and floats)		
	Pilings		
	Dams	Puget Sound Nearshore Ecosystem Restoration Project	
Water quality	Septic systems	County	Maps 10A, B & C
	Category 4 and 5 waters	Ecology	Maps 11A, B & C
Public access	Parks and open space with publicly accessible marine shoreline	County Washington State Parks	Maps 6A, B & C

Inventory Element	Information Used	Data Sources	Map Location
	Road ends		
	Facilities (campgrounds, docks, floasts, ramps)		
	Trails and paths		
	Priority trail corridors		Maps 7A, B, & C
Restoration opportunities	Potential restoration actions	Scientific literature analysis	No map available
Historical and cultural resources	Sites and structures on the Washington State Heritage Register	Washington State Department of Archaeology and Historic Preservation	No map available
Ecology permitted sites	Ecology permitted sites	Department of Ecology	Maps 21A, B & C

2.2 Delineating Management Areas and Reaches

Shorelines in the County were characterized using a nested system of reaches and management areas, following Ecology guidance (Ecology 2011c). A management area is an area of shoreline typically distinguished by similar characteristics relating to the relative intensity of land use, the physical landscape and/or critical hydrogeomorphic or biological processes. The use of management areas take the place of "hydrologic units" used in more typical Puget Sound shoreline inventories and serve to divide the County into large units that can be discussed in general narrative form to help organize the body of information as well as make comparisons or note differences between the County's islands or regional areas. The management areas are also used to organize a restoration strategy. However, the delineation of management areas are not intended to be used for regulating management areas differently (shorelinedesignations are used for that purpose).

Reaches are smaller units that comprise the management areas and provide a means in which to evaluate shoreline conditions that relate more closely to shoreline designations. A reach is a segment of shoreline that has a similar geomorphic and land use context that can be used for assessment of existing ecological and land use conditions.

Reaches were evaluated using a GIS-based scoring system for various physical and ecological metrics. The reach scores are indicators of existing conditions but do not, however, represent absolute metrics for a single parcel. The level of accuracy provided by the GIS data in this report does not warrant a parcel by parcel analysis. Rather, the GIS data is most appropriately assimilated at the reach and management area scale to provide indicators of existing conditions. The scoring for each reach is summarized in a table found within each management area discussion within Chapter 4. The specifics of how management areas and reaches were delineated are described below.

2.2.1 Management Area Delineation Methodology

Following Ecology guidance (Ecology 2011c), the County was divided into a total of 20 management areas that were used to inventory, analyze, and characterize San Juan County shorelines. These management areas are mapped in Figure 1 and listed in Table 2. The

management areas are also shown in more detail at the beginning of each management area description in Chapter 4 and boundaries depicted on the Map Folio (Appendix A). Although a shoreline inventory would typically be characterized at a watershed scale (called a hydrologic unit), because there are no streams in the County that fall under shoreline jurisdiction (used to define a hydrologic unit), management areas were defined based on boundaries of land use, the physical landscape and/or critical hydrogeomorphic or biological processes.

Overall, management areas were subdivided by island (e.g. Blakely, Decatur, Shaw) and included small islands or islets within close proximity. For example, the Decatur management area includes James, Center, and Trump Islands due to their proximity to Decatur Island, similarities in geomorphic condition, and associated land use. However, the three largest islands, San Juan, Orcas, and Lopez, are too large to fit within one management area (i.e. they are very diverse in land uses and physical and biological processes). Therefore, these three islands were further delineated to better characterize the wide range of ecological and physical conditions found there. Where intra-island divisions were made, management area boundary extents sought to lump those shorelines with similar development patterns, and geological and physical environments. In the case of San Juan Island, four distinct management areas have been delineated. These consist of Roche Harbor, San Juan Channel, Friday Harbor, and Strait of Juan de Fuca management areas. The management area boundaries are derived based on the combinations mentioned above. For instance, the separation between Roche Harbor and Strait of Juan de Fuca management areas occurs at the outer entrance to Mitchell Bay, which forms a natural geomorphic separation between the primarily rocky shorelines of the strait from the protected bays within the Roche Harbor area. Beyond the geomorphology, specific separation points are then derived based on the types of land uses within these two management areas which are also variable (i.e. the Strait of Juan de Fuca lacks significant protected bays which are more suitable for marinas and other overwater structures). The selection of management area breaks were made on a case-by-case basis. As mentioned above, these breaks are derived for organizational and discussion purposes and do not represent or indicate that these management areas should be regulated differently from one another.

Lakes were handled separately in two broad categories based upon ownership and use, and were classified as public or private lakes.

Weaknesses in the Approach

By creating management areas for the organizational and descriptive purposes of this report, it is enherently possible for a reader to incorrectly assume that these management areas are being proposed for regulatory purposes.

Figure 1. Marine and Lake Management Area Boundaries, San Juan County, Washington.

Table 2. List of Management Areas

Management Area	Island or Portions of Island Found in Management Area
Blakely Island	Blakely Island
Decatur Island	Decatur Island
Doe Bay	Orcas Island
East Sound	Orcas Island
Fisherman Bay	Lopez Island
Friday Harbor	San Juan Island
Mud Bay	Lopez Island
North Coast Eastsound	Orcas Island
Olga	Orcas Island
Roche Harbor	San Juan Island
San Juan Channel	San Juan Island
Shaw Island	Shaw Island
Spencer Spit	Lopez Island
Strait of Juan de Fuca	San Juan Island and Lopez Island
Stuart Island	Stuart Island
Turtleback	Orcas Island
Waldron Island	Waldron Island
West Sound	Orcas Island
Private Lakes	San Juan, Orcas, Blakely and Lopez islands
Public Lakes	Orcas Island

2.2.2 Reach Delineation

The specifications for reach delineation by Ecology are more explicit than for management area delineation. Here the guidance (Ecology 2011c) suggests the use of drift cells as a way to delineate marine shorelines throughout Puget Sound where (glacial) sediment-rich soils are common. However, a considerable portion of the County marine shoreline is bedrock, and cannot be mapped into drift cells (MacLennan et al. 2010). Even where littoral sediment exists, it exhibits different characteristics than in Puget Sound. In addition, several features are found in the San Juans (such as tombolos and pocket beaches) that do not readily fall within the drift cell model. These features and many others common in the County often cross drift cells. Therefore, the shoreline was classified into geomorphic units described by Shipman (2008), which allowed for a broader scope that better addressed the range of shoreline conditions found in San Juan County than a traditional drift cell-based reach delineation. In addition to these physical characteristics, other aspects of land use were used to specify further the location of reach boundaries including: zoning, parcel density, and existing riparian cover and structures along the shoreline, as recommended by Ecology (2011c).

Finally, several rules were made to standardize the delineation of reaches that are unusual, if not unique, to the County. They include:

- Tombolos, a common geomorphic feature in the County, were grouped into rocky headland and beach connectors, which sometimes span both shorelines.

- Marsh complexes were typically kept in a single reach, even though this often spanned drift cells.

- Large pocket beaches were typically kept in a single reach, even if this spanned drift cells.

- Small pocket beaches were often grouped into larger reaches where they occurred frequently. These areas are typically mapped in the available databases as bedrock despite the presence of sediment (sand, gravel, and/or cobble).

- Bedrock shorelines were grouped into those with small pocket beaches (i.e., smaller than typical parcel size) and those with "plunging" (no sediment whatsoever) shorelines, per Shipman (2008).

- Nearshore small, undeveloped islets were grouped with protected or public counterparts of similar geology and physical environment (e.g. Barnes and Clark Islands off the northeast coast of Orcas Island).

- Small developed islands with a relatively uniform parcel distribution were typically grouped as a single island reach even though environments on the island could be diverse (e.g. Center Island).

- Islets, when grouped with a larger island, in all cases were physically reflective of the larger island (i.e., they are always bedrock of the same type of rock as the larger island, and the oceanographic conditions were similar).

- Nearly all reaches were delineated by parcel boundary. There were only a handful of exceptions where shoreline types varied significantly within a single large parcel (such as changing from marsh to bedrock).

An example is provided below for reaches 295 through 300 on Stuart Island to help understand the reach delineation methodology. Each reach is identified by the defining characteristics driving the reach delineation.

- Reach 295: bedrock shoreline with one small pocket beach. This reach is not within an area of appreciable drift. Primarily private ownership and low-density residential use.

- Reach 296: primarily bedrock shoreline but documented within drift cell boundary and contains large pocket beach at west end of Reid Harbor. Primarily public ownership (DNR and WA State Parks) but some private low-density residential development along the south shoreline.

- Reach 297: primarily bedrock shoreline with no appreciable drift. Currently vacant privately owned parcels with potential residential use.

- Reach 298: primarily bedrock shoreline with no appreciable drift. One small pocket beach located along east end of reach but within area of denser residential development. Most parcels currently developed with single-family residential uses, including several overwater structures.

- Reach 299: primarily bedrock shoreline with no appreciable drift. However, several large pocket beaches are located within the reach on either side of the point. The area contains some residential development but consists of only four large parcels.

- Reach 300: nearshore small undeveloped islets of Cemetary and Gossip Islands

Weaknesses in the Approach

Reach delineations are inherently subject to debate regarding their precise location. As presented in this reach methodology, several factors weigh in these decisions, all of which can be argued to be the most important. In the case of this study, the use of hydrogeomphology was the primary factor determining the reach break locations, followed by land use changes and other physical and biological elements. One of the main weaknesses of the reach creation approach is the lack of a distinct formula to develop environment designations. While reach scale analysis of ecological functions is one aspect of evaluating appropriate environment designations (see discussion in section 2.4), several other inventory elements also play a significant role. As noted throughout this report, ecological function scores at the reach level are intended to be indicators of function and not an absolute metric.

2.3 Method for Characterizing Ecosystem-Wide Processes and Shoreline Functions

The approach to characterizing ecosystem-wide processes and shoreline functions was primarily process-based, involving an examination of existing conditions reported in the literature as well as an assessment of documented human modifications that follows WAC 173-26-201 (3)(d)(i). This information is described in Chapter 3. The principal basis followed is that physical processes lead to the formation of recognizable and classifiable geomorphic features that are then colonized by biota. To obtain this information, scientific literature involving all aspects of shoreline processes and ecology relevant to the San Juan Archipelago were identified and examined. Literature were placed within the context of human modifications identified in earlier investigations by comparing recent aerial photographs with three pre-European-settlement topographic sheets (T-sheets, or shoreline map) dating from the late nineteenth century (U.S. Coast and Geodetic Survey 1888a,b; 1889a,b,c,d; 1894a,b,c; 1895a,b,c). Finally, the effects on nearshore conditions from human modifications were based on impacts from similar land-use practices found elsewhere in western Washington (summarized in literature reviews by Herrera 2007a,b, 2008, Herrera and The Watershed Company 2011).

2.4 Method Used to Inventory and Characterize Management Areas

This characterization of ecological systems in San Juan County is supplemented by a variety of existing and ongoing studies that are unique to the County's shorelines (see discussions in Chapter 3) and provide valuable data and insight into the existing physical and biological conditions. As noted in WAC 173-26-201 (3)(d)(i)(A) and the SMP Handbook (Ecology 2011c), this characterization contains three main steps with a corresponding approach detailed below:

1. Identification of ecosystem processes (provided in Ecology's Guidelines) that affect ecological functions with shoreline jurisdiction.
   Approach: Tables 5a and 5b provide a list of the various ecological functions to be addressed per WAC 173-26. In addition, this table includes analytical methodology for assessing each function utilizing the most relevant and reasonably available information for San Juan County. A rationale for each quantitative breakdown is included in these tables. Additionally, shoreline processes are discussed in greater detail in section 3.3.

2. Assess these processes to determine the relationship to shoreline functions and identify which functions are healthy and which have been altered or eliminated.
   Approach: Chapter 4 provides a detailed discussion by management area which includes physical and biological processes (e.g.shoreline types, critical areas, water quality concerns, etc.), existing land uses (e.g. land uses, designations, shoreline modifications, and public access), and restoration opportunities.

3. Identify measures to protect and/or restore ecological functions and ecosystem-wide processes.
   Approach: Shoreline management recommendations are included in Chapter 8 and follow the discussions and data analysis provided in Chapter 3 and 4. Where measures to protect and/or restore ecological processes and functions have been identified (e.g. limitations on new shoreline armoring and emphasis on minimizing impacts from existing armoring), management recommendations are provided.

Analysis and conclusions presented in this report for each management area were based on a review of existing information detailed in the Inventory Data and Information Sources section and a review of GIS data covering a wide variety of environmental data describing the County. These materials were synthesized for each management area and are displayed in a Map Folio found in Appendix A. The reach assessment of ecological functions and shoreline use patterns provide the context for management area characterization of the County's marine shoreline. The assessment method follows Ecology's *Shoreline Master Program Guidelines* (173-26 WAC).

Conceptually, ecosystem functions are those aspects of the ecosystem that are beneficial biologically, either economically, or aesthetically. Ecosystem functions are dependent on the range of ecosystem processes present in a reach. Ecosystem processes are defined as "…the

suite of naturally occurring physical and geological processes of erosion, transport, and deposition; and specific chemical processes that shape landforms within a specific shoreline ecosystem and determine both the types of habitat and the associated ecological functions" (WAC 173-26-020-12). Ecosystem processes are interrelated, with each process interacting with the others.

Ecosystem processes are also dependent on natural and anthropogenic controlling factors or ecosystem stressors. Ecosystem stressors refer to the physical, chemical, and biological constraints on the productivity of species and habitats. In a properly functioning ecosystem, the stressors are within a naturally occurring range under which the ecosystem evolved, and the ecosystem in turn provides the suite of naturally occurring associated functions. Effectively managing ecosystem stressors is necessary to maintain ecosystem processes that allow nature to sustain a suite of beneficial functions.

Table 3 summarizes the primary ecosystem processes and stressors considered relevant to management of both marine and lacustrine shorelines in the County. Ecological functions of the County's marine and lacustrine shoreline are summarized in Table 4. Tables 3 and 4 are organized based upon the functions of marine systems described in Ecology's *Comprehensive Process to Prepare or Amend Shoreline Master Programs* (WAC 173-26-201). Note that the ecological functions of the County's lacustrine shorelines are identical to those of the marine shorelines with the exception of attenuating tidal energy.

The information provided in Table 4 includes a list of two major categories of functions: 1) physical, and 2) habitat. These are further broken down into more discrete functions, which were in turn used as the criteria to score reach functional performance. Tables 5A and 5B provide the physical and habitat function scoring criteria for marine and lacustrine shorelines respectively. The basis of the scoring criteria vary depending on conditions typical of San Juan County and, when available, scientific studies. Details are provided in the *Notes* column for each function listed in the tables.

The scoring of physical and habitat functions are one means to help evaluate existing conditions along the County's shorelines. In addition to this scoring, several data sets (shoreline type, juvenile fish presence probabilities, armoring, etc.) have been analyzed in a direct comparative form using tables to compare management areas. This information is presented in section 3.7 (Marine Shoreline Types) and 3.11 (Predicted Juvenile Fish Presence Based on Shoreline Type).

Existing land uses are described within each management area discussion based on the County's Assessor's data. The County's future land use plans are contained in the County's Comprehensive Plan and give a specific picture of likely future activities on the shorelines. The inventory of existing land uses and the understanding of potential future uses and development lead to the evaluation of the shoreline's land capacity. The evaluation of land capacity is a gauge of the potential level of development that may occur in the future along shorelines given adopted Comprehensive Plan land use designations and is intended to provide an understanding of the future level of intensity that may occur given current plans and regulations. Detailed methodology for land use analysis is provided in Chapter 5.

Restoration opportunities are described within each management area section. Restoration opportunities were assembled from previous databases and grant efforts by the County, from conversations with County staff and local residents, and from analysis of current aerial photographs in light of predevelopment conditions seen in historic maps provided in the T-sheets. However, the restoration sections are not comprehensive as a separate detailed restoration plan will be prepared in addition to this report.

Table 3. Shoreline Processes and Stressors.

1. Physical Processes	**Physical Stressors**
▪ Bluff erosion ▪ Beach erosion ▪ Sediment transport ▪ Sediment deposition ▪ Sediment stabilization ▪ Flow and movement of water including wave energy and tidal currents ▪ Recruitment, redistribution and reduction of woody debris and other organic material ▪ Nutrient cycling ▪ Energy cycling ▪ Toxic substance removal	▪ Ground clearing ▪ Excavation ▪ Bank alteration ▪ Bank hardening ▪ Impervious surfaces ▪ In-water structures ▪ Shoreline filling ▪ Point source pollution ▪ Non-point source pollution ▪ Riparian vegetation removal ▪ Freshwater inputs
2. Habitat Processes	**Habitat Stressors**
▪ Physical space and conditions for naturally occurring species and their various life history stages ▪ Access to spawning, rearing, and migration habitat for naturally occurring species ▪ Temperature maintenance ▪ Food production and delivery	▪ In-water structures ▪ Overwater structures ▪ Riparian vegetation removal ▪ Shoreline alterations ▪ Seafood harvesting ▪ Invasive species

Table 4. Shoreline Functions.

1. Physical Functions
▪ Transporting and stabilizing sediment ▪ Attenuating wave (and tidal) energy ▪ Removing excess nutrients and toxic compounds ▪ Recruitment, redistribution, and reduction of woody debris and other organic material ▪ Maintaining temperature
2. Habitat Functions
▪ Physical space and conditions for species and their various life history stages ▪ Food production and delivery

Scoring of each function was based on both quantitative data results derived from the GIS inventory information listed in Table 1, and, where GIS data were unavailable, a qualitative assessment from aerial photography. As described previously, the shoreline was divided into reaches based on sediment transport drift cells, geomorphic units, and land use or shoreline condition factors. Each reach and group of reaches within each management area were scored an overall (or aggregate) rating for ecological functions based on the available and relevant

GIS information and the corresponding quantitative and qualitative evaluation. As described below, these scores should be considered as indicators of relative functions and not absolute metrics.

Documented presence of priority species was taken as an additional function following Ecology guidance on reach evaluation methods. Priority species were scored based on actual presence or on presence of suitable habitat. For example, fish, birds, eelgrass, kelps, and shellfish were scored based on observed species presence, whereas Pacific herring, sand lance, rock sole and surf smelt were scored based on presence of documented spawning habitat. Some species were grouped, such as bird species. Certain priority fish spawning habitats were grouped and included sand lance, rock sole and surf smelt; however, Pacific herring spawning habitat was scored separately.

Ratings ranged from "absent" or "low" to "high" function where:

- 0 = Absent
- 1 = Low
- 2 = Low/Moderate
- 3 = Moderate
- 4 = Moderate/High
- 5 = High

Weaknesses in the Approach

When data were available, but reported that a given parameter was not present, then a score of "0" was used. However, some of the data sets used are based upon very few observations such that absence could be an artifact of the number of observations. In a few cases, this could mean that the habitat is so degraded that the species is no longer present or has not been observed in the past, but in most cases, it simply means that the species of interest has not been documented in the reach. In addition, because many of the reaches throughout the County are in remote locations, the remoteness of the site could have an influence on whether the species was observed there. While unfortunate, this issue is problematic for all shoreline inventories and likely means that presence and habitat for some species is underreported.

Scores were calculated for individual reaches as well as aggregated for each management area. The aggregate ratings from the characterization should be viewed skeptically as they are a simple summation of the best available data sets for each species. With the limitations of the data used aside (and described in detail below), in reality, the interrelationships of the species evaluated are often complex and nonlinear. They are also often unknown. Therefore, it is appropriate to view the characterization as an oversimplification of existing ecological conditions, and be aware that it does not fully reflect the complex nature of the County's ecosystem. Future data collection and analysis is necessary to understand fully the complex relationships between physical structure and habitat functions.

With this important caveat, the scores are informative about existing human caused modifications on the nearshore ecosystem. Several checks were performed on the scores to see if they matched generally known ecological conditions, and past

regulation of specific reaches. These analyses demonstrated that in a broad sense (e.g., average values of given classes of shorelines, etc.), the overall health of the ecosystem is well characterized by the scoring of each function. However, given the necessary simplified approach, the comparison of the total scores of any given two reaches is generally not appropriate, nor is the precise overall measure of any one reach. The intent is rather that the scores be a general guide for future land use, regulatory and restoration planning. Similarly, scores for management areas are useful for obtaining an overall sense of how different areas of the County function ecologically, however they do not necessarily reveal significant variations within each management area.

Finally, in the case of fish species, existing datasets only cover fish use of County streams and lakes (WDFW 2010b) so fish presence is only scored for the Private Lakes and Public Lakes management areas. There is no comparable dataset covering marine fish use of the County's shorelines. Therefore, the use of County marine shorelines by salmonids and other fish is based on data from a County sponsored study of Chinook salmon, chum salmon, pink salmon, herring, sand lance, surf smelt, lingcod, and greenling. These species were studied based on 1,350 beach seine sets made at 80 different locations representing different shoreline types within the County. The collected data were used to develop a statistical model that predicts juvenile fish presence based on geomorphic shoreline types (Beamer and Fresh 2012). The results of this study are discussed in the Ecosystem Profile Section 3.11 as well as within the discussions of individual management areas in Section 4.0, but are not included in the ecological functional scoring analysis.

Table 5A. Ecological Function Scoring Criteria for Marine Shorelines.

Functions	Score Criteria						Notes
	0	1	2	3	4	5	
Physical Conditions							
Natural sediment transport patterns	>2 jetties or groins	2 jetties or groins		1 jetty or groin		No impediment to sediment transport (no jetties or groins)	Jetties and groins are well documented to interrupt alongshore sediment transport on a variety of shoreline types, partly because that is their original design intention (Dean and Dalrymple 1992). While other activities not documented in County datasets could influence these transport patterns (e.g., dredging), work in other locales has demonstrated that structures like jetties are the dominant disruption to alongshore transport (Morang et al. 2011). Because of this, even one jetty or groin in a reach can exert a significant effect on reach sediment transport, thus one jetty or groin is scored as a 3. Following that, the distribution of scores reflects the range of conditions present in the County. For instance, there are many reaches that have one or two groins, but only a few have more than three. In this scoring, bedrock shorelines without pocket beaches are given a score of not applicable. Source data: Jetties, groins - Friends of the San Juans
Shoreline sediment input alterations – Feeder bluffs	>50% of feeder bluffs armored	31%-50% of feeder bluffs armored	21%-30% of feeder bluffs armored	10%-20% of feeder bluffs armored	<10% of feeder bluffs armored	No shoreline alterations to sediment input from feeder bluffs	Feeder bluffs are the primary source of sediment to the nearshore in the County and even small alterations to relatively short lengths of these bluffs can have detrimental impacts to sediment supply (MacLennan et al. 2010). Therefore, even feeder bluffs which have less than 10% armoring are still considered impacted. The level of impact

Functions	Score Criteria						Notes
	0	1	2	3	4	5	
							becomes incrementally more significant as armoring increases and thus the percentage range is linearly variable up to 50%. Drift cells with armoring percentages greater than 50% are expected to have significant geomorphic impacts (Herrera 2011). Source data: Feeder bluffs - Pulling It All Together project; Armoring - Friends of the San Juans
Shoreline sediment input alterations – Pocket beaches	>50% of pocket beaches armored	31%-50% of pocket beaches armored	21%-30% of pocket beaches armored	10%-20% of pocket beaches armored	<10% of pocket beaches armored	No shoreline alterations to sediment input from pocket beaches	Pocket beaches are extremely important sources of sediment locally, especially in areas where sediment supply is extremely limited. However, there is no scientific literature that describes the incremental ecological impact of armoring of pocket beaches on western Washington nearshore ecology, but small alterations to these areas can have large impacts and the scoring reflects this sensitivity in a similar manner as feeder bluffs. Source data: Pocket beaches - Pulling It All Together project; Armoring - Friends of the San Juans
Shoreline sediment input alterations – Barrier beaches	100% of barrier beaches armored	76%-99% of barrier beaches armored	51%-75% of barrier beaches armored	25%-50% of barrier beaches armored	<25% of barrier beaches armored	No shoreline alterations to sediment input from barrier beaches	Barrier beaches contribute sediment to the nearshore (Finlayson 2006), but to a lesser degree than feeder bluffs and pocket beaches. Therefore, the scoring is less sensitive to prevention of sediment flow to the shoreline. However, there is no systematic, quantitative study documenting the relative sensitivity of these shoreforms to sediment loss and ultimately nearshore habitat conditions. Because their reduced importance and sensitivity as compared to

Functions	Score Criteria						Notes
	0	1	2	3	4	5	
							pocket beaches and feeder bluffs, scoring is linearly related to the extent of armoring. Source data: Barrier beaches - Beamer and Fresh 2012; Armoring - Friends of the San Juans
Natural current patterns	>3 outfalls	3 outfalls	2 outfalls	1 outfall		No alteration of current patterns (no outfalls)	Available outfall data includes tide gates and culverts. All tide gates are associated with a reach, even if the tide gate is outside of shoreline jurisdiction. In other Pacific Northwest estuaries, tide gates and culverts are shown to exert a strong influence on both water circulation and access for key fish species (Roegner et al. 2010), and this influence continues overtime. Because of this, even one outfall in a reach can exert a significant effect on reach current patterns, thus one outlet is scored as a 3. Every additional outfall is assigned a score indicating an incrementally and cumulatively negative effect on current patterns. Source data: Outfalls - County
Wave/current attenuation	100% armored shoreline	76%-99% armored shoreline	51%-75% armored shoreline	25%-50% armored shoreline	<25% armored shoreline	Natural shoreline (no armoring)	Armored shorelines have been shown to reflect more wave energy than unarmored shorelines (e.g., Miles et al. 2001), but these impacts are highly site specific. Detailed analysis of wave energy along County shorelines was beyond the scope of this characterization. Therefore, scoring was linearly related to the extent of armoring and included all shoreline types.

Functions	Score Criteria						Notes
	0	1	2	3	4	5	
							Source data: Armoring - Friends of the San Juans
Nutrient and toxics removal	303d Category 5 - Impaired, requires TMDL		305b Category 4 - Impaired, does not require TMDL	305b Category 2, waters of concern OR suspected sources of water quality concern		305b Category 1, no problems	The range corresponds to the same range prescribed by Ecology for categorizing water quality impairments. Source data: Water quality categories - Ecology
Shade	No shade	<10% shaded	10%-25% shaded	26%-50% shaded	51%-75% shaded	>75% shaded	Based on the presence of deciduous forest, evergreen forest, mixed forest, palustrine forested wetland, palustrine shrub/scrub wetland, and scrub/shrub land cover classes within 30 feet of the shoreline. The width of 30 feet is based on the ability to achieve 70 percent or greater effectiveness at providing shade, microclimate moderation, large woody debris, litterfall, and insect food sources to the nearshore (Christensen 2000; Bavins et al. 2000; Zhang et al. 2010). However, there is no scientific literature that describes the incremental ecological impact of shoreline vegetation removal on western Washington nearshore ecology, but small alterations to these areas can have large impacts and the scoring reflects this sensitivity. Source data: Shade (vegetation) - National Oceanic and Atmospheric Administration C-CAP
Habitat Conditions							
Total vegetation	No vegetation	<10%	10%-25%	26%-50%	51%-75%	76%-100%	Based on the presence of deciduous forest, estuarine aquatic bed, estuarine emergent wetland, evergreen forest, mixed forest, palustrine aquatic bed, palustrine emergent

Functions	Score Criteria						Notes
	0	1	2	3	4	5	
							wetland, palustrine forested wetland, palustrine shrub/scrub wetland, and scrub/shrub land cover classes within the entire shoreline jurisdiction. Shoreline or marine riparian vegetation is an important component for maintaining critical nearshore habitat functions throughout the Puget Sound region and San Juan County (Lemieux et al 2004, Levings and Jamieson 2001). MacLennan and Johannessen (2008) conducted geographically focused research in the San Juans and found an average 25 percent loss of marine riparian forest cover on San Juan, Orcas, Lopez and Stuart islands between 1977 and 2006. The degree of impact to the aquatic environment depends upon the magnitude of the vegetation removal or alteration (such as size and number of trees affected, and total area cleared of vegetation). At more severe levels, vegetation removal could have implications for species survival and overall habitat condition including altered shade and temperature regime, reduced bank and shoreline stability, altered organic material contributions, as well as reduced habitat complexity and increased habitat fragmentation. Incremental removal of vegetation on shorelines can have large impacts and the scoring reflects this sensitivity. Source data: Vegetation - National Oceanic and Atmospheric Administration C-CAP
Estuary habitat	No estuary habitat	<1 acre	1-2 acres	2-3 acres	3-5 acres	>5 acres	Based on the presence of estuarine emergent wetland. Nearshore habitats including estuaries and streams offer juvenile salmon

Functions	Score Criteria						Notes
	0	1	2	3	4	5	
							and other aquatic species refuge from predation, and increased food resources. While quantitative studies remain limited, recent surveys (Wyllie-Echeverria and Barsh 2007, Beamer et al. 2008) in combination with historical and anecdotal reports (Wyllie-Echeverria 2008a, 2008b) describe salmonid use of multiple estuarine and freshwater habitats in San Juan County. There are no published studies that could be used as a basis for the size range of scores, therefore, the general presence and areas of pocket estuaries found on the County's shorelines were used as the scoring basis. Source data: Vegetation - National Oceanic and Atmospheric Administration C-CAP
Birds	No WDFW documented species present	Only a single WDFW documented species present	Presence by two WDFW documented species	Presence by three WDFW documented species	Presence by four WDFW documented species	Presence by more than four WDFW documented species	Presence. Includes alcids, cormorants, seabird colonies, bald eagle, osprey, black oystercatcher peregrine falcon, purple martin, and wild turkey. Scoring reflects the incremental value of greater species use of habitats in reach. Source data: Birds - WDFW PHS
Haul-outs	Absent					Present	Presence. Source data: Haul-outs - WDFW PHS
Eelgrass	Absent					Present	Presence. Source data: Eelgrass - Friends of the San Juans
Floating kelp	Absent					Present	Presence.

Functions	Score Criteria						Notes
	0	1	2	3	4	5	
							Source data: Bull kelp - Friends of the San Juans
Understory Kelp	Absent					Present	Presence. Source data: Non-floating kelp - DNR
Forage fish priority spawning habitat	No spawning of priority species documented			Documented spawning by a single priority species		Documented spawning by multiple priority species	Includes documented priority fish spawning habitat for sand lance, surf smelt, and rocksole. Scoring reflects the incremental value of more species spawning within reach. Source data: Forage fish priority spawning habitat - WDFW PHS
Herring spawning habitat	Absent					Present	Presence. Source data: Herring spawning habitat - WDFW
Shellfish	No priority species documented to be present	Documented presence by a single priority species	Documented presence by two priority species	Documented presence by three priority species	Documented presence by four priority species	Documented presence by more than four priority species	Presence. Includes abalone, Dungeness crab, geoduck, hardshell clam, oyster beds, pandalid shrimp, and red sea urchin. Scoring reflects the incremental value of greater species use of habitats in reach. Source data: Shellfish - WDFW PHS

Table 5B. Ecological Function Scoring Criteria for Lacustrine Shorelines.

Functions	Score Criteria						Notes
	0	1	2	3	4	5	
	Physical Conditions						
Shoreline modifications	100% armored	76%-99% armored	51%-75% armored	25%-50% armored	<25% armored	No shoreline alterations	No shoreline modification data were available for lakes. Therefore, level of alteration was based on the range of conditions observed on County lake shorelines using aerial photographic analysis. Armored shorelines have been shown to reflect more wave energy than unarmored shorelines (e.g., Miles et al. 2001), but these impacts are highly site specific. Detailed analysis of wave energy along County shorelines was beyond the scope of this characterization. Therefore, scoring was linearly related to the extent of armoring and included all lake shoreline types.
Natural current patterns	>3 outfalls	3 outfalls	2 outfalls	1 outfall		No alteration of current patterns (no outfalls)	Currents in lakes are responsible for the circulation and distribution of heat, dissolved substances, and some organisms. Outfalls can exert a strong influence on physical circulation, distribution, and access for key fish species (Reid 1961). Because of this, even one outfall in a reach can exert a significant effect on reach current patterns, thus one outlet is scored as a 3. Every additional outfall is assigned a score indicating an incrementally and cumulatively negative effect on current patterns. Source data: Outfalls - County
Nutrient and toxics removal	303d Category 5 - Impaired, requires TMDL		305b Category 4 - Impaired, does not require TMDL	305b Category 2, waters of concern OR suspected sources of water quality concern		305b Category 1, no problems	Range used here corresponds to the same range prescribed by Ecology for categorizing water quality impairments. Source data: Water quality categories - Ecology

Functions	Score Criteria						Notes
	0	**1**	**2**	**3**	**4**	**5**	
Shade	No shade	<10% shaded	10%-25% shaded	26%-50% shaded	51%-75% shaded	>75% shaded	Based on the presence of deciduous forest, evergreen forest, mixed forest, palustrine forested wetland, palustrine shrub/scrub wetland, and scrub/shrub land cover classes within 30 feet of the shoreline. The width of 30 feet is based on the ability to achieve 70 percent or greater effectiveness at providing shade, microclimate moderation, large woody debris, litterfall and insect food sources to the nearshore (Christensen 2000; Bavins et al. 2000; Zhang et al. 2010). However, there is no scientific literature that describes the incremental ecological impact of shoreline vegetation removal on western Washington nearshore ecology, but small alterations to these areas can have large impacts and the scoring reflects this sensitivity. Source data: Shade (vegetation) - National Oceanic and Atmospheric Administration C-CAP
Habitat Conditions							
Total vegetation	No vegetation	<10%	10%-25%	26%-50%	51%-75%	76%-100%	Based on the presence of deciduous forest, , evergreen forest, mixed forest, palustrine aquatic bed, palustrine emergent wetland, palustrine forested wetland, palustrine shrub/scrub wetland, and scrub/shrub land cover classes. Measurements are within the entire shoreline jurisdiction. Shoreline vegetation is an important component for maintaining critical nearshore habitat functions. The degree of impact to the aquatic environment from vegetation loss depends upon the magnitude of the removal (such as size and number of trees affected, and total area cleared of vegetation). At more severe levels, vegetation removal could have implications for species survival and overall habitat condition including altered shade and

Functions	Score Criteria						Notes
	0	1	2	3	4	5	
							temperature regime, reduced bank and shoreline stability, altered organic material contributions, as well as reduced habitat complexity and increased habitat fragmentation. Incremental removal of vegetation on shorelines can have large impacts and the scoring reflects this sensitivity. Source data: Vegetation - National Oceanic and Atmospheric Administration C-CAP
Wetland habitat	No wetland habitat	<5% wetland habitat	5%-9% wetland habitat	10%-20% wetland habitat	21%-50% wetland/ habitat	>50% wetland habitat	The range of scores was based on the general presence and areas of wetlands associated with lake shorelines in the County. Measurements are within the entire shoreline management area. Source data: Tidal and non-tidal wetlands - Adamus Resource Assessment, Inc and EarthDesign, Inc in collaboration with San Juan County
Birds	No WDFW documented species present	Only a single WDFW documented species present	Presence by two WDFW documented species	Presence by three WDFW documented species	Presence by four WDFW documented species	Presence by more than four WDFW documented species	Includes alcids, cormorants, seabird colonies, bald eagle, osprey, black oystercatcher peregrine falcon, purple martin, and wild turkey. Scoring reflects the incremental value of greater species use of habitats in reach. Source data: Birds - WDFW PHS
Salmonids	No priority species documented to be present			Documented presence of one priority species		Documented presence of multiple priority species	Includes coastal cutthroat trout, chum, kokanee and coho salmon, and rainbow trout. Chinook salmon, though present in the County, are not recorded in the existing County database. Note that fish use of streams and lakes in the County is limited by stream size, seasonal water flows, and accessibility. Use is predominantly by coho, chum, and coastal cutthroat trout. Scoring reflects the incremental value of greater species use of

Functions	Score Criteria						Notes
	0	1	2	3	4	5	
							habitats in reach. Source data: Fish distribution - WDFW PHS

Limitations

The use of GIS data for this report, even that which is the most relevant and reasonably available, has certain limitations which can affect the analytical methods and limit the accuracy of the resultant output. As noted throughout this report, the GIS analysis and corresponding results and interpretations should be considered as indicators rather than absolute metrics. Several data sets are known to be of relatively low resolution or contain incomplete information. Such cases lend justification for a reach level analysis rather than a definitive parcel by parcel analysis. For instance, the NOAA (2006) C-CAP land cover data is extremely thorough and widely used, but has a 30-meter pixel size. This data set is extremely useful in evaluating reach and management area characteristics for vegetation and impervious surface coverage, but quickly loses resolution at the parcel level.

Other limitations in the GIS data are the result of potentially incomplete data sets. For example, it has been noted that the County's location data for tidegates is not complete (see data gaps listed in Chapter 7) and the DNR overwater structures data does not include freshwater lakes in San Juan County except for Cascade Lake. Furthermore, other data sets which represent the best available inventories to date have not been field verified by the authors of this report. Such data includes the County's wetland inventory (Adamus Resource Assessment, Inc and EarthDesign, Inc 2010) and shoreline armoring (PIAT 2012). As noted on the maps provided in Appendix A and in comments throughout this report, GIS information which has been utilized for this study is approximate and intended for planning purposes only. Site specific information will be necessary at the parcel level at the time of an application.

The function elements in Tables 5A and 5B do not always translate directly to the scoring categories in Table 3 because there are certain limitations imposed by the data available. For instance, accumulation of wrack, while providing real habitat and physical benefits to the shoreline, could not be quantified with the data available. As such, the proxy, total vegetation, was used to provide a related measure to assess the ecological contribution of plant species. For example, more vegetation in an area would likely mean larger volumes of accumulated wrack. Note also that, the percentages and quantities associated with the criteria for each score are different and were categorized to maximize the spread in the scores.

How to use the reach and management area information

As mentioned at the beginning of Chapter 2, development of a shoreline inventory and the accompanying analysis of existing conditions is intended to record baseline conditions and inform what shoreline master program provisions may be necessary to properly protect intact shorelines or potentially offer improvements to impaired shorelines. While some of the information provided in this report is admittedly complex in its composition (i.e. ecological function scoring at the reach scale), the body of information provided within Chapters 4 and 5, along with some of the management area summary tables within Chapter 3, offer the reader detailed summaries on the physical and biological characteristics, existing land uses, potential development, and current public access. Combined, these summaries can provide guidance on potential environment designations (e.g. new designations or changes to existing designations), management recommendations on potential key issues, areas of potential conflict, and restoration opportunities, to name a few.

Environment designations are one of the main topic areas that benefit from the wealth of information provided by the Inventory and Characterization of the County's shorelines. One mechanism in this evaluation utilizes the ecological function score directly. For instance, as a result of the reach scoring, Reach 217 within Roche Harbor scores high for physical functions yet it has a current designation that splits part of the reach between Rural Residential and Urban. The area currently designated as Urban contains primarily if not entirely residential uses and thus may fit within the Rural Residential designation more appropriately. The existing high physical process functions would also be supported by a change in designation that may offer more protection of those key functions.

In addition to ecological function scores, the inventory provides key pieces of information which are also helpful in deriving appropriate environment designations. These include land use, land ownership, shoreline type, and shoreline modifications to name a few. These data sources are helpful in understanding the current, potential, or anticipated development occurring within a given reach. This, along with information on the physical landscape (i.e. it is helpful to understand where rocky shorelines, feeder bluffs, pocket esturaries, etc., occur along the shoreline) can be helpful in deciding where a shoreline is more appropriately designated Rural Residential instead of Conservancy and vice-versa.

The inventory also provides detailed information for local planners, land owners, and other interested parties, regarding potential conflicts or areas of concern. For example, the information provided in Table 12 (Marine Shoreline Armoring by Shore Type) summarizes the amount of armoring within each management area as a percent of total shoreline, but also provides a similar breakdown by individual shore type. Through this information, the inventory provides information that suggests where armoring is most prevalent in the County (by percentage of shoreline, North Coast Eastsound has the highest value of 25 percent) but also identifies the type of shoreline in which it is most prevalent. By percentage, North Coast Eastsound armoring is most prevalent along feeder bluffs (74 percent). As such, considerations may be made to improve protection of feeder bluffs and minimize the future likelihood of new armoring while also exploring mechanisms to incentivize changes to existing armoring to reduce impacts to sediment delivery and transport (see management recommendations within Chapter 8).

2.5 GIS Methods

In developing this report, GIS was employed for two primary purposes. The first purpose was to assemble, in accordance with WAC 173-26-201(3)(c), a map inventory of a wide range of features relevant to planning for the County's shorelines. The complete map inventory can be seen in Appendix A: Map Folio. The key datasets used to develop the inventory maps can be seen in Appendix D: Key Data Sources for Shoreline Inventory Maps.

The second purpose was to assist with the analysis of shoreline conditions. GIS was used to analyze shoreline conditions at county-wide, management area and reach scales. The foremost use of GIS in the analysis of shoreline conditions was in developing the reach-scale ecological function scores presented in Chapter 4. Specific information detailing how GIS was used in

developing the ecological functions scores can be reviewed in Appendix E: GIS Methods for Ecological Function Scoring.

Notably, GIS data used in the development of this report were limited, as directed by the SMP Guidelines (WAC 173-26-201(3)(c)), to those that were "relevant and reasonably available." The Guidelines state that "adequate scientific information and methodology necessary for development of a master program should be available" (WAC 173-26-201(2)(a)); moreover, the SMP Handbook says that "existing data and information will likely be adequate but new information may need to be compiled from existing data" (Ecology. 2011c.). Consistent with this guidance, in developing this report, GIS efforts primarily consisted of working with existing data, despite their limitations. Creating new data to address the limitations of existing data or to fill known data gaps listed in Chapter 7 was beyond the scope of this report.

The GIS analysis of shoreline conditions was performed using typical GIS operations on common GIS software. Typical GIS operations performed include buffering, clipping, and intersecting. GIS work was mainly performed on computer with ArcGIS Desktop 9.3 equipped with XTools Pro. Additionally, Spatial Analyst was used in a limited number of operations.

The limited number of new datasets that were created as part of the development of this report includes the following:

- Shoreline jurisdiction
- Management areas
- Reaches

Shoreline jurisdiction was created in accordance with Ecology guidance to portray the approximate area of the County subject to the Shoreline Management Act. The management areas and reaches datasets, both derived from the shoreline jurisdiction dataset, were created according to the methods described in Section 2.2 of this report.

3.0 Ecosystem Profile

3.1 Regional Overview

The County is 621 square miles in size, but only 175 square miles (or about 112,000 acres) of that is land (U.S. Census Bureau 2011). There are approximately 464 miles of marine and lacustrine shoreline[1]. It is bounded to the south by the Strait of Juan de Fuca, to the west by Haro Strait, to the north by the Strait of Georgia, and to the east by Rosario Strait. There are many freshwater lakes in the County, but with only 12 larger than 20 acres: Spencer, Horseshoe, Hummel, Mountain, Cascade, Martin, Briggs (aka Roche Harbor), Sportsman, Zylstra, Dream, Woods, and Trout. There are no large streams.

3.1.1 Major Shoreline Description

The marine shoreline within the County is extremely diverse. The County is an archipelago, as defined by the U.S. Geological Survey (U.S. Geological Survey 2011a). Shorelines vary from low-bank, sandy to gravelly shorelines common in areas of thick glacial sediment to nearly vertical bedrock cliffs (such as on Blakely Island and portions of Orcas and San Juan Island). Due to the presence of bedrock on many of the shorelines, riparian vegetation is stunted along shorelines with large amounts of deep crustal rocks. However, along shorelines with marine sedimentary bedrock, vegetation can be lush. Where sediment is rich, vegetation is thick and typical of Puget Sound (dense with coniferous vegetation completely down to the ordinary high water mark), except where it has been cleared.

Development along the shoreline is also diverse, with portions of the shoreline intensely developed and armored (such as in Eastsound or Friday Harbor) and other portions entirely undeveloped (as found in many County Parks, San Juan County Land Bank Preserves (Land Bank) or areas set aside in conservation easements). However, most development is low-density and rural in character. A common development pattern along the County's marine shorelines is development on a pocket beach that is inset into a larger bedrock bowl.

There are limited areas of lacustrine shorelines in the County, along twelve lakes. Like the marine shorelines, the lakes in the County are extremely diverse from a physical perspective. Some are set in bedrock (such as Mountain Lake on Orcas), while others are features remaining from deglaciation (like Hummel Lake on Lopez). Development is similar to the marine shorelines – low-density and primarily rural in character, particularly in comparison to other lakes typical of the Puget Lowland.

[1] As noted in Section 1.2, the County has a total of approximately 481 miles of shoreline in unincorporated parts of the County (i.e. excludes the Town of Friday Harbor). However, for the purposes of the analysis of shoreline functions (see Chapter 3), islets of 0.5 acres or less (both marine and freshwater) were excluded. Therefore, the amount of shoreline analyzed in this report totals approximately 464 miles (439 miles of marine and 25 miles or freshwater).

3.2 Key Physical Controls

3.2.1 Climate

The climate of the County is maritime and characterized by cool dry summers and moderately wet winters (Orr et al. 2002, Klinger et al. 2006). From nearly 120 years of observations, the National Weather Service gage at Olga reports that temperature has averaged 57.1°F over that time period, with an all-time record high of 93°F measured in July 2009 and a record low of -8°F in January 1950 (Western Regional Climate Center 2010). Annual precipitation at Olga has varied between 15 and 38 inches, with an average of 29 inches. Only 6.7 inches of snow falls on average each year at Olga, one of the snowier places in the County (Western Regional Climate Center 2010). Spatially, precipitation varies significantly throughout the County, with Mount Constitution being by far the wettest area, receiving more than 48 inches of rain on average per year (Orr et al. 2002). Southern areas on San Juan Island and Lopez Island are the driest areas, averaging less than 20 inches per year in the vicinity of American Camp (Klinger et al . 2006, San Juan County 2000). The variation in rainfall is indicative of geographic differences, which can create microclimates of more or less precipitation depending on position in the landscape – commonly referred to as the "rain shadow" effect.

Climate Change

There are a number of recent reports in the scientific literature concerning climate change and its impact on the Pacific Northwest. Climate change has been shown to increase stream temperatures (particularly in the summertime: Mantua et al. 2010), compromise habitat restoration success (Battin et al. 2007), change the hydrology of stream basins (Elsner et al. 2010), increase wave energy (Allan and Komar 2006) and increase sea level (Canning 2005; Mote et al. 2008). While some of the climatic responses discussed in these works are expected to be negligible in San Juan County (i.e., the reduction in snowmelt: Elsner et al. 2010), others, such as increased stream temperatures are likely to have significant effects (Mantua et al. 2010). Alterations to basin hydrology cited by most of these works are dependent on changes to the gradual transition from spring snowmelt to fall runoff typical of Cascadian rivers (Elsner et al. 2010). However, snowmelt is a small contributor to seasonal stream flow in San Juan County (Western Regional Climate Center 2010), so these effects are likely to be inconsequential.

It is uncertain what influence climate change will have on local precipitation patterns, as this is a current data gap. However, there are several oceanographic changes, which will affect some areas of the County significantly. Changes in wave action are discussed in the next section on waves and currents and sea level rise is discussed separately below.

Sea level change is produced by the combined effects of global sea level rise and local factors, such as vertical land deformation (e.g., tectonic movements) as well as seasonal water surface elevation changes due to atmospheric circulation effects (Mote et al. 2008). In the case of San Juan County, there is net tectonic uplift (Verdonck 2006), which reduces the overall effect of global sea level (Canning 2005; Mote et al. 2008), which should be factored into any assessment of sea level rise (U.S. Army Corps of Engineers 2009). This explains the relatively modest sea level rise observed at Friday Harbor in the twentieth century (1.13 mm/year: NOAA 2011). It is important also to couch these changes in terms of interannual sea level variability associated with

El Niño. Mojfeld (1992) has shown that during El Niño years the average water level can be up to 1 foot higher than in ordinary winters. It is unclear whether and if so, how this particular effect will change in the future.

Locally other effects may play a role. For instance, heightened wave setup, a physical process by which wave energy raises the mean level of the sea, can over time increase extreme wave heights and thus average sea level during storm events in areas where swell is present (swell is the result of large waves produced in the open ocean). Because these effects are dependent on large open-ocean-derived waves, sea levels would only likely increase where swell is typically present (such as in the Strait of Juan de Fuca management area.

The NOAA Sea Level Rise and Coastal Flooding Impacts Viewer (http://csc.noaa.gov/digitalcoast/tools/slrviewer) provides a visual interactive on-line tool which helps to identify potential areas of inundation due to rising sea level. This information will be helpful in future evaluations of potential sea level change scenarios throughout the San Juan Islands as new development or redevelopment proposals come forward. Any evaluations of sea level change should be based on the best available science related to San Juan County, and identify shoreline areas that are especially vulnerable to sea level change, noting where landward migration of the shore would be both beneficial to the nearshore environment and feasible with existing land uses while at the same time identifying areas of potential conflict with existing land uses where protection may be necessary.

One of the main effects from any net rise in sea level in San Juan County would be an increase in the frequency of marine flood events and subsequent storm-related damage that may affect shoreline developments. Such a change would also affect high tide levels and could increase shoreline erosion rates along beaches and bluffs (Shipman 2009). Increases in erosion rates coupled with more frequent flooding would likely increase pressure to further armor shorelines. Such armoring may directly impact the nearshore environment by cutting off sediment sources and exacerbating erosion rates (Herrera and The Watershed Company 2011a). As noted by Shipman (2009), the response to any potential sea level rise and corresponding damage to property will likely be to favor rebuilding rather than relocating, and protecting rather than allowing shorelines to retreat. In planning to address potential sea level change, the County should prepare to allow appropriate engineering solutions that minimize impacts, while also avoiding hazardous situations along currently undeveloped shorelines by requiring placement of development in non-hazardous areas.

3.2.2 Topography and Bathymetry

The County is defined by the San Juan Archipelago. Topography is complex and diverse, and about every kind of landform is found somewhere in the County. Steep bedrock shorelines are common on portions of nearly every island. The bedrock is also diverse, varying from ultramafic igneous rock, to marine sedimentary rocks and glacial hardpan. The diversity in the lithology of the land creates innumerable landforms, including rare features such as tombolos and a large number of pocket beaches, which are rare elsewhere on Puget Sound shores. Landslides, as compared to similar areas in western Washington, are rare. Where recent glacially-derived sediment is abundant (such as Lopez), beaches often take the form of mixed (coarse, poorly

sorted) sediment beaches typical of Puget Sound (Finlayson 2006). Even a classic wave cut shelf exists on the southwest shoreline of Lopez because of the high wave energy in this locale.

The bathymetry surrounding the County is also diverse. The defining channels of the archipelago (Haro Strait, Strait of Juan de Fuca, and Rosario Strait) are deep, often exceeding 300 feet in places. Despite the depths along the boundaries of the County, there are numerous shoals and hundreds of islets scattered within the County limits. There are also broad flats, like Lopez Sound, that are only a few tens of feet deep. The shoreline itself exhibits this variability, with shallow marshes and mudflats occurring in areas of relative protection from waves and currents (such as Mud Bay on Lopez) to nearly vertical precipices on the north side of Orcas.

3.2.3 Geology

The geology of the County can be separated into bedrock and surficial (sedimentary) components, as has been common practice in geologic mapping (Pessl et al. 1989, Whetten et al. 1988). Consequently, the geology discussion provided below is organized by bedrock geology and sedimentary geology.

Bedrock Geology

The rocks of the San Juan Islands are structurally related to rocks found in the northwest Cascades, west of the Straight Creek fault (Brown et al. 2007) but have been given their own stratigraphic names such as the Fidalgo Complex, Constitution Formation, Turtleback Complex, and Orcas Chert, to name a few. The San Juan Islands consist of a series of terranes that were accreted to the North American continent approximately 150 million years ago during the late Jurassic Period and then assembled into a series of overlapping thrust sheets 84 to 100 million years ago during the late Cretaceous Period (Brandon et al. 1988). These thrust sheets include early Paleozoic granites and volcanic rocks, late Paleozoic to Jurassic chert and limestone, a clastic sequence of Jurassic sandstone, mudstone and pillow basalts, and early Cretaceous marine sediments (Brandon et al. 1988). Most units in the San Juan Island sequence show evidence of high-pressure, low-temperature metamorphism that occurred during the late Cretaceous thrusting (Brown et al. 2007).

Repeated glaciations during the last ice age shaped the bedrock and developed the rugged landscape of the islands. During the early to middle Pleistocene Epoch, climatic changes caused the continental ice sheet to move south from British Columbia and over the San Juan archipelago (Russell 1975). The region was scoured by a blanket of ice as much as one mile thick that carved out marine channels. As the glaciers advanced from north to south, they created numerous bays and waterways including San Juan Channel, West Sound, East Sound, and Lopez Sound. Higher elevations of bedrock were carved, scraped, and rounded. When the glaciers began melting, the resulting sediment was left behind, blanketing low-lying areas with unconsolidated glacial deposits of clay, silt, sand, gravel, and boulders.

Paleo-sea level record is also much more complicated in San Juan County than elsewhere in Puget Sound (Dethier et al. 1996). Following the collapse of the Puget Lobe, there was a period of time when the ice sheet was near or covered the County, but marine exchange had been restored to most of Puget Sound. This period is called the Everson Interstade. The proximity of

the ice sheet to the County suppressed the land surface, yielding local sea levels as much as 300 feet higher than today (Dethier et al. 1996). During this time, some of the islands of San Juan County consisted of two or more islands, which were bridged together with glacial till deposited by the advancing ice that filled inter-island waterways (e.g., the bridging of Orcas Island at Eastsound [Russell 1975]).

The bedrock geology of the San Juan Islands described above is important for understanding the physical controls on the occurrence and distribution of the County's sensitive habitats and priority species. The nature of the underlying bedrock geology is also important for understanding the spatial variability in groundwater yield from the bedrock aquifers used by the majority of private wells.

Sedimentary Geology

In the County, glacial and interglacial deposits are relatively thin compared to other areas in Puget Sound, where this type of deposition may be several thousand feet thick. Contour maps of sediment thickness generated from county well logs show most of the San Juans to have less than 20 feet of sediment cover, with some areas thicker than 300 feet on Lopez, Waldron, and Decatur islands (Dethier et al. 1996; USGS 2002). This thickness, compared to the Quaternary sediment layers in other parts of the Puget Lowland, is miniscule, and reflects the role that the bedrock elevations played in the glacial history of the islands. Glacial sediment distribution in the County varies greatly, with large pockets scattered throughout low-lying areas and little or no sediment found elsewhere. The two largest accumulations of sediment are located on Lopez and Orcas islands, where some sections extend below sea level.

Another aspect to the sedimentary geology of the County are those shoreline features generated since sea level stabilized approximately 6,000 years ago (Finlayson 2006). The shore types found in the County include spits and barriers, tombolos, sub-estuaries, bluffs, rocky platforms, plunging rocky shores, pocket beaches, and eroding bluffs (MacLennan et al. 2010). Many of these shoreline features are also expressed above modern sea level, owing to features placed during the Everson Interstade, as they are in other portions of northern Puget Sound (Kovanen and Slaymaker 2004).

Relative to much of Puget Sound, most of the San Juan County coastline is composed of exposed bedrock; however, a considerable portion of the coast is also composed of unconsolidated sediment and functions as feeder bluffs for beach substrate. Regardless, bluff recession rates are fairly low at most sites, and episodic landslides have been noted as rare in San Juan County (MacLennan et al. 2010). Most of the beaches throughout the County are composed of sand and gravel derived from the erosion of coastal "feeder" bluffs (MacLennan et al. 2010). Sediment size is a function of both the type of sediment eroding from coastal bluffs and the wave energy at the given area. The morphology and composition of these beaches are influenced by sediment input, wave climate, and shore orientation (MacLennan et al. 2010).

Wave climate is dictated by the open water distance over which winds blow unobstructed (fetch) and the orientation of the shoreline relative to the incoming waves. Low wave energy beaches are composed of poorly sorted sediment with a relatively narrow backshore and intermittent

vegetation. Higher wave energy beaches contain areas with well-sorted sediment, often dominated by cobbles (MacLennan et al. 2010). Beaches serve to partially buffer against further bluff erosion, particularly if they include nearshore vegetation or woody debris to attenuate wave energy (Herrera 2007a). The integrity of a coastal bluff is directly linked to the relative "health" of its beach below as well as the beaches located down-drift within a given drift cell. Drift cells and important feeder bluffs in the County have recently been delineated by MacLennan et al. (2010).

In general, the sedimentary geology of the San Juan Islands described above is important for understanding the formation and characteristics of the County's physical controls on nearshore habitat.

3.2.4 Soils

The soil types present in San Juan County reflect the diversity in the climate, geology and topography of the County. In fact, there are more than 50 soil series mapped in the county. In light of diversity, it is worthwhile to characterize general trends in soil types as they relate to the topographic and geologic setting of the region. All of the soil types present in San Juan County can be aggregated into five generalized map units; soils in the valleys of glacial drift plains; soils on glacial drift plains; soils on hills of glacial drift plains; soils on glacial drift plains and hills; and soils formed on hills and mountains (NRCS 2006). The following paragraphs summarizing the soil characteristics of these five map units are condensed descriptions of those provided in NRCS (2006).

Soils in the valleys of glacial drift plains comprise slightly less than 20 percent of the land area in San Juan County. The dominant soil series in these areas are Coveland, Deadmanbay, and Bazal. All three of these soils are formed from a parent material of glacial drift over dense glaciomarine deposits. Coveland and Deadmanbay share similar depth and drainage characteristics; both being somewhat poorly drained with a dense, restrictive layer at 40 to 60 inches below the surface. The Bazal soil series is poorly drained and has a shallower restrictive layer between 20 to 40 inches below the surface. All three of these soils have very shallow, seasonal high water tables ranging between 0 and 9 inches below the surface.

Soils on glacial drift plains comprise about 20 percent of the land area in San Juan County. The dominant series in these areas are Mitchellbay, Whidbey, and Roche. The parent material of these soils is glacial drift, glacial outwash and dense glaciomarine deposits. These soils are slightly better drained than those formed in the valleys with drainage classes of somewhat poorly drained, and moderately well drained, and moderately well drained, for Michellbay Whidbey and Roche respectively. All three series have a depth to a restrictive layer between 20 and 40 inches below the surface. The Mitchellbay series has the shallowest seasonal high water table of the three series at 6 to 15 inches. Whidbey and Roche are substantially deeper with seasonal high water depths of 34 to 39 inches and 15 to 23 inches respectively.

Soils on hills of glacial drift plains comprise about 7 percent of the land area in San Juan County. The dominant series in these areas are, Everett Taxadjunct, Indianaola and San Juan. The parent material for these soils is somewhat varied. Everett Taxadjunct and Indianola are formed on

glacial outwash, whereas San Juan is formed on eolian sand over glacial outwash. The sandy texture of these soils causes them to be somewhat excessively drained. These soils are the deepest in the county with no restrictive features within 60 inches from the surface. All three soils, Everett, Taxadjunct, and Indianola have a depth to seasonal high water table of greater than 72 inches.

Soils on glacial drift plains and hills represent about 9 percent of the land area in San Juan County. The dominant series in these areas are Roche, Rock Outcrop and Killebrew. Roche and Killebrew series are formed on glacial drift over glaciomarine sediment deposits. The Rock outcrop is metasedimentary. Roche series is moderately well drained and Killebrew is somewhat poorly drained. Both soils are somewhat shallow with a depth of 20-40 inches to a restrictive layer. Depth to the seasonal high water table for Roche and Killebrew series are 15 to 23 inches and 5 to 9 inches, respectively.

Soils on Hills and mountains comprise about 45 percent of the land area of San Juan County. The dominant soil types in these areas are Cady, Rock Outcrop, and Doebay. Both Cady and Doebay series are formed on glacial drift material mixed with colluvium derived from metasedimentary rock. Cady and Doebay soils are well drained. Cady is a very shallow soil with a depth of only 10 to 20 inches to lithic bedrock. Doebay is a slightly deeper soil with a depth of 20 to 40 inches to lithic bedrock. The seasonal high water table for both Cady and Doebay soils is more than 72 inches from the surface.

The native vegetation supported by these soils is typical of the northwestern Puget Sound region and consists of Western red cedar (*Thuja plicata*), Douglas-fir (*Pseudotsuga menziesii*), grand fir (*Abies grandis*), lodgepole pine (*Pinus contorta*), red alder (*Alnus rubra*), common snowberry (*Symphoricarpos albus*), trailing blackberry (*Rubus ursinus*), red elderberry (*Sambucus racemosa*), salmonberry (*Rubus parviflorus*), stinging nettle (*Urtica dioica*), salal (*Gaultheria shallon*), swordfern (*Polystichum munitum*), and licorice fern (*Polypodium glycyrrhiza*).

Limiting factors for vegetation growth are soil depth, excessive drainage or excessive wetness. As described above, many of the soils have a lithic contact within 10 to 40 inches of the soil surface. This restrictive layer can pose problems for deeply rooting plants, and also perch water potentially resulting in saturated conditions for extended time periods. The deeper soils, particularly those formed from glacial outwash, such as the Everett Taxadjunct or Indianola, are somewhat excessively drained potentially resulting in limited water availability during precipitation free periods. Lastly, many of the soils present in San Juan county have seasonally high water tables; in particular, soils in the valleys of glacial drift plains and soils on drift plains and hills (0 to 9 inches and 5 to 23 inches respectively). Seasonally high water extending into the root zone can limit or prohibit the growth of terrestrial plants.

3.3 Key Processes Related To Shoreline Ecosystem Functions

3.3.1 Processes Affecting Marine Shorelines

General Circulation Patterns

Oceanographic circulation in the County is diverse. The County exists within the larger oceanographic setting of the eastern Strait of Juan de Fuca and the southern Strait of Georgia. The overall landscape was defined by earlier glaciation and subglacial erosion (see Geology section for details). Boulder moraines deposited by glaciers formed sills that divide the region into three submarine basins: the western Strait of Juan de Fuca, stretching from the Pacific Ocean in the west to the Victoria-Green Point Sill in the east; the eastern Strait of Juan de Fuca and Haro Strait, reaching from the Victoria-Green Point Sill to the Boundary Pass Sill; and the Strait of Georgia, extending northward from the Boundary Pass Sill. The Victoria-Green-Point Sill has a minimum depth of about 55 meters; the Boundary Pass Sill is somewhat deeper, with a minimum depth of about 150 meters (Masson and Cummings 2000; Klinger et al. 2006). The sills influence circulation within and between the three basins through hydraulic control on the flows over the sills. The interior waters are connected to the coastal ocean via the western Strait of Juan de Fuca.

Flow throughout the County's shorelines is characterized by estuarine circulation driven primarily by discharge from the Fraser River and the Strait of Georgia through Rosario Strait, Haro Strait and a series of smaller passages to the Strait of Juan de Fuca (Masson and Cummings 2000). Discharge from the Skagit River drainage and Puget Sound provide secondary influences to the system. The period of maximum discharge from the Fraser River occurs in May and June, with minimal discharge from December through March (Klinger et al. 2006). The long-term average near-surface flow through the region is seaward, with an estimated speed of 0.12 knots through Juan de Fuca Strait (Pashinski and Charnell 1979; Klinger et al. 2006), producing about 8.8 million cubic feet per second of flow on average (Labrecque et al. 1994; Thomson et al. 2007). The seaward flow of surface water is opposed by a landward flow of oceanic water at depth, some of which is mixed with surface water as it passes over the relatively shallow sills that separate the basins.

Locally, flow is strongly modulated by mixed semi-diurnal tides that create swift tidal currents that reach speeds of several knots. Intense tidal flows cause vigorous vertical mixing, especially at constrictions, both lateral and vertical. Tidal motions tend to dominate circulation over periods of less than 10 hours; other large-scale estuarine processes dominate on longer time scales (Masson and Cummings 2000).

Wind Waves

Waves are the dominant mode of sediment transport alongshore for most of the County's marine shorelines (Finlayson 2006). It is likely that in areas where tidal currents are in excess of one knot, tides may play a secondary role, if those areas are also protected from swell (Curtiss et al. 2009), which is true for all management areas except the Strait of Juan de Fuca management area. The County is unusual in that the source of the waves changes depending on the geographic position and aspect of the shoreline in question. For most of the County (all management areas except the Strait of Juan de Fuca management area), waves are generated exclusively by local

winds, just as they generally are within the confines of Puget Sound (Finlayson 2006). As discussed before, locally wind-generated waves are limited by fetch, the distance over which the wind blows unobstructed. For most shorelines, particularly those within the center of the County, fetch is very restricted, meaning that the waves that sculpt the shoreline are small (generally less than 3 feet). Short-fetch waves also have short periods (the time interval between wave heights). The short-period waves are steep and can generate significant local shear stress (the physical process that strongly influences sediment transport), but these waves do not penetrate far down into the water column. This is important, because any human-induced alteration of a shoreline's wave characteristics could potentially affect the way sediment is transported along the shoreline.

The Strait of Juan de Fuca management area is dominated by swell, which as previously stated, is the result of large waves produced in the open ocean. Because these waves form in the largest storms and fetch is effectively unlimited, the height and the period of these waves are large. Observed evidence of waves on the southwest side of Lopez Island at Agate Beach indicates that waves in excess of 6 feet are common during storms (Herrera 2009a). Swell has numerous impacts to the physical processes relevant to the shoreline; the most pronounced being the development of a surf zone. When wave height is large and the wave period is long, waves come under the influence of the seabed far from the shoreline (typically hundreds of feet from where the water surface meets the shoreline). This causes them to break far from the shoreline. Short-period, fetch-limited waves generally do not break until within a few feet from the beach, making the beaches dominated by swash (the rushing back and forth of water at the point where the water surface meets the beach: Finlayson 2006). The presence of a surf zone changes the overall geomorphology of the beach and the associated ecological communities. For example, surf typically precludes the presence of most aquatic vegetation (while favoring energy tolerant species such as *Fucus*) because of the energetic environment within the surf zone. Sediment transport is also very intense within the surf zone, providing another natural stressor on the life that can inhabit that zone, as it is a highly abrasive environment.

Bluff Erosion and Landslides

Steep slopes exist throughout the County, overlain with varying types and depths of sediment and soils. Bedrock outcrops are also common (Maps 17A-C, Appendix A). When water accumulates in shallow surficial soils underlain by impermeable bedrock, the steep slopes become vulnerable to landslides (as described above). The number and state of landslide activity areas within the County are shown in Table 6. More unusual block failures are possible in the bedrock areas of the County, but these events are extremely rare.

Landslides are an important part of the nearshore ecosystem in locations where glacial sediment is thick (such as at northern Lopez Island). This sediment provides the substrate necessary for forage fish spawning, and macroalgae and eelgrass establishment. Where shoreline infrastructure prevents sediment from being recruited (such as in areas where there are bulkheads or other slope-protection structures), there is not sufficient sediment to compensate for the loss of sediment offshore to maintain the historical shoreline. Consequently, the downdrift beaches coarsen and denude (Herrera 2005).

Table 6. Landslide Activity Area Acreage within Each Management Area.

Location	Landslide Activity Areas (Number)[1]		
	Steep Slope	Unstable Slopes	Documented Slide Areas
Blakely	87	34	0
Decatur	67	19	12
Doe Bay	99	0	0
Eastsound	21	5	1
Fisherman Bay	2	54	0
Friday Harbor	3	6	0
Mud Bay	45	3	1
North Coast Eastsound	5	0	0
Olga	58	10	0
Roche Harbor	31	0	0
San Juan Channel	16	1	0
Shaw	21	0	0
Spencer Spit	23	32	2
Strait of Juan de Fuca	23	18	0
Stuart	58	6	0
Turtleback	70	2	0
Waldron	173	25	0
Westsound	15	0	0
Private Lakes	0	0	0
Public Lakes	0	0	0
Total	**817**	**214**	**16**

[1] Derived from shoreline slope stability data from the Washington Department of Ecology (2004).

Marine Floods

Like any coastal area, the County is prone to anomalous marine flood (high water) events. These events generally occur as a result of local and/or regional low atmospheric pressure (Mojfeld 1992). As described in Mojfeld (1992) and as occurred most recently in January 2010, these events typically occur during spring tides near the winter solstice when El Niño conditions in the Pacific Ocean are strong. The nearest source of long-term reliable marine water level is the 111-year record from Friday Harbor (NOAA 2011). The highest water level ever recorded in Friday Harbor on December 16, 1982, was approximately 11 feet above mean lower-low water (MLLW). Importantly, though these extreme events are being influenced by sea level change, the variability associated with atmospheric pressure is much larger than the magnitude of sea level rise. For instance, 6 of the 10 highest water levels observed in Friday Harbor occurred before 1990 (NOAA 2011).

Marine floods provide an important mechanism for delivery of sediment and marine detritus to backshore areas, where they are present and still intact. Where the shoreline is bulkheaded or otherwise artificially armored, these backshore communities cannot exist through exclusion (for

example if the backshore has been filled) and/or through water, sediment and detritus being prevented from entering these areas.

Earthquakes and Liquefaction

Three primary types of earthquakes could affect the County: 1) the Cascadia subduction zone, 2) deep crustal, and 3) upper (or shallow) crustal earthquakes (Williams et al. 2005). A small deep crustal earthquake event even occurred during the course of this shoreline inventory and characterization (Seattle Times 2011). All three types of earthquakes have the potential to produce strong ground motions in the County. The Cascadia subduction zone and upper crustal earthquakes can also produce tsunamis, although only tsunamis originating from shallow crustal earthquakes have the potential to inflict serious damage to the County. For a complete discussion of tsunamis, see the next section.

DNR has developed a map of liquefaction in the County (DNR 2011) that is provided in Appendix A, Map 18. Consistent with other areas in the state, liquefaction is generally most pronounced in unconsolidated sandy to silty areas. Because these areas are somewhat rarer in the County than in the Puget Lowland, liquefaction is generally less of a threat in San Juan County.

Tsunamis

One of the most significant natural hazards to the County shoreline areas is tsunamis. Tsunami deposits have been found throughout the Salish Sea, including Discovery Bay (Williams et al. 2005). The most well documented upper-crustal-sourced tsunami in western Washington was from a well-known slip in the Seattle Fault approximately 1,100 years ago (Hagstrum et al. 2004; Bourgeois and Johnson 2001). While it is unlikely that event affected the County in a significant way, tsunamis from other upper-crustal-earthquake sources are possible. The threat from a slip along the Cascadia Subduction Zone is also significant and has been documented to produce large tsunamis in shallow embayments within the Strait of Juan de Fuca (Williams et al. 2005). Despite the lack of information about the size of these events in the County, it is known that a tsunami generated by a slip along the Cascadia Subduction Zone would inflict the most damage to areas currently under the influence of swell, such as the Strait of Juan de Fuca management area, and less so in other protected areas. The threat of Pacific-basin-wide tsunamis from large earthquakes around the Pacific Rim to the County is small, owing to small sills in the Strait of Juan de Fuca. These sills break long period waves like tsunamis resulting in inundation less than that of the more common marine flooding described above.

As described by Williams et al. (2005), a tsunami produced by a slip on the Southern Whidbey Island Fault is the greatest threat to the County's shorelines, in particular to the Strait of Juan de Fuca management area, which is extremely close (within a few miles of) the fault. Very little is known about the recurrence interval of slips on the Southern Whidbey Island Fault (Johnson et al. 1996, Williams et al. 2005), so quantitative assessments of the probability of damage from these events is not possible without further research. However, it is suspected that since there has been no recorded slip on the fault system in historical times, there is a possibility that significant stress has accumulated there (Johnson et al. 1996).

Large landslides within the County could also produce a tsunami hazard. While even more unpredictable than seismic-induced tsunamis, landslides have been known to cause tsunamis in the past within Puget Sound (e.g., the 1894 Tacoma tsunami: Pierce County 2004; Shipman 2001). This mode of tsunami production has also been associated with the Fraser River delta (Mosher 2009), which would affect the north side of the County. In addition to delta-front-landslide tsunamis, like the 1894 Tacoma tsunami, large-scale (bedrock) block landslides are possible in the County. They have produced the largest tsunamis ever observed (such as the Lituya Bay slide in Alaska), although their effects are usually highly localized (Mader 1999; Parsons and Nittrouer 2004). While a probability of an event like this is extremely small, the threat to shorelines would be vast, if such event were to occur.

Water Quality

Over the past 15 years, three major ambient water quality monitoring efforts have been conducted in San Juan County. In addition, Ecology has conducted water quality, marine sediment and aquatic species tissue sampling within the County (Ecology 2011d). Pertinent discussions of water quality are provided within individual management area sections later in this report. In general, the primary water quality issues in the County appear to be related to low dissolved oxygen, high fecal coliform bacteria counts, and to a lesser degree elevated turbidity and nutrients. Sources of these constituents of concern are likely derived primarily from agricultural practices, residential development, and natural upwelling of nutrients in the nearshore.

A water quality study completed by Western Washington Universities Huxley College of the Environment identified several areas with impaired or marginal water quality when compared to State standards (Wiseman et al. 2000). The study consisted of monthly sampling during 1999 in fresh and marine waters. Samples were analyzed for temperature dissolved oxygen (DO), conductivity, pH, turbidity, total phosphorus, ammonia, nitrate/nitrite, and fecal coliform bacteria.

The San Juan County Watershed Management Action Plan and Characterization Report (SJC 2000) summarized water quality data collected from 1997 to 1998 on a bimonthly basis. Samples were analyzed for fecal coliform bacteria, pH, temperature, and total suspended solids (TSS). Typical water quality issues found from this study were high fecal coliform and high TSS.

More recently, the San Juan County Conservation District with a grant from Ecology conducted a volunteer-based monitoring program from March 2002 to December 2005 (SJCD 2005). The study consisted of data collection on an approximate 4- to 6-week interval from 24 sampling locations (marine and freshwater). Samples were analyzed for temperature, pH, dissolved oxygen, turbidity, and fecal coliform. Some waters test samples were found to have low DO, high turbidity, and high fecal coliforms.

It should be noted that none of these sampling programs included targeted sampling during storm events. Due to the fact that the majority of surface water constituents of concern are elevated in storm flow relative to base flow (Ahearn et al 2004; Herrera 2009b), it is likely that the

monitoring that has been conducted in San Juan County to date has underestimated average annual pollutant concentrations.

Analyses and maps delineating how groundwater and surface waters flow from the land to various shoreline segments in San Juan County prepared by Pacific Groundwater Group (2011) provide a useful tool for evaluating freshwater resources and contaminant pathways in the county. In addition, they provide an increased understanding of the linkages between upland areas and shoreline processes.

3.3.2 Processes Affecting Lacustrine Shorelines

As mentioned earlier in this document, lakes in the County are extremely diverse. Some of the lakes are natural features formed due to the collection of runoff and groundwater in natural depressions (e.g., Horseshoe Lake and Hummel Lake). Other lakes are formed by small dams (e.g., Trout Lake and Roche Harbor Lake), while still others are natural lakes that have been controlled by dams at their outlet (e.g., Cascade Lake, Mountain Lake, and Spencer Lake). With the possible exception of Mountain Lake, most of the lakes are small enough that a true littoral zone does not exist. The result is that overhanging riparian vegetation plays a key role in maintaining the habitat quality of these lakes. Many of the lakes are deep given their size and therefore could be stratified during portions of the year.

None of the lakes are intensely developed when compared to typical lakes in western Washington, although there is recreational development adjacent to a number of lakes such as Cascade Lake. However, most have some rural development around them and a few (such as Hummel Lake) have roads around their periphery, which has a detrimental impact on the quality and quantity of riparian vegetation, a key control on shoreline habitat. Two of the lake basins are protected permanently as a part of Moran State Park, while still others are protected because they are drinking water reservoirs.

3.4 Land Use and Land Cover

3.4.1 Land Use Patterns and SMA Use Preferences

This section reviews current and planned land use in shoreline jurisdiction to provide a basis to establish a compatible use pattern over the 20-year planning period of the SMP and to identify current or planned preferred uses in shoreline jurisdiction that should be protected or promoted to meet SMA goals for water-oriented uses, shoreline access, and ecological protection. The SMA promotes the following use preferences (RCW 90.58.020) for shorelines of statewide significance in the stated order, which in San Juan County include marine waters, including "those areas of Puget Sound and the Strait of Juan de Fuca and adjacent salt waters north to the Canadian line and lying seaward from the line of extreme low tide" (RCW 90.58.030):

1. Recognize and protect the statewide interest over local interest

2. Preserve the natural character of the shoreline

3. Result in long term over short term benefit

4. Protect the resources and ecology of the shoreline

5. Increase public access to publicly owned areas of the shorelines

6. Increase recreational opportunities for the public in the shoreline

7. Provide for any other element as defined in RCW 90.58.100 deemed appropriate or necessary

3.4.2 Current Land Use Patterns

Existing land use provides a baseline for types of land use and land cover found within shoreline jurisdiction. Existing land use data for the area covered by San Juan County shoreline jurisdiction was obtained from the San Juan County Assessor's data[2], which was overlaid on the GIS inventory maps for current land use (Map 5, Appendix A), land ownership patterns, and aerial images on Google Earth.

The predominant shoreline land use pattern across all shoreline jurisdictions in San Juan County is low-density residential and natural preserves (including parks and various types of conservation areas or other protected lands). Relatively more urban and intense development is found in the County's Urban Growth Areas (UGAs) (Friday Harbor, Eastsound, and Lopez Village), and various smaller Activity Centers where areas of more intensive rural development occur. These more intensive uses are found on the larger islands that are served by the State ferry system.

According to Ecology's SMP Guidelines (173-26-020 WAC), "water-oriented use means a use that is water-dependent, water-related, or water-enjoyment, or a combination of such uses." The Shoreline Management Act promotes uses that are "unique to or dependent upon use of the state's shoreline" as well as "ports, shoreline recreational uses including but not limited to parks, marinas, piers, and other improvements facilitating public access to shorelines of the state, industrial and commercial developments, which are particularly dependent on their location on or use of the shorelines of the state and other development that will provide an opportunity for substantial numbers of the people to enjoy the shorelines of the state." (RCW 90.58.020)

Definitions and examples of water-oriented uses are included in Table 7 below.

[2] As noted in subsequent sections of the report, the Assessor's data was used to initially describe existing land uses. However, the percentages for the "Undeveloped Land" category listed in this and in other subsequent sections include lands that are in protective holdings such as the Nature Conservancy and the San Juan Preservation Trust. Therefore, not all of the land in the Assessor's "Undeveloped Land" category should be considered developable. Please see Chapter 5 of this report for a detailed assessment of the development potential along San Juan County's shorelines.

Table 7. Water-Oriented Uses Definitions and Examples.

Water-Oriented Use Definitions	Water-Oriented Use Examples
"Water-dependent use" means a use or portion of a use that cannot exist in a location that is not adjacent to the water and which is dependent on the water by reason of the intrinsic nature of its operations. (WAC 173-26-020(36))	Examples of water-dependent uses may include ship cargo terminal loading areas, ferry and passenger terminals, barge loading facilities, ship building and dry docking, marinas, aquaculture, float plane facilities and sewer outfalls.
"Water-related use" means a use or portion of a use which is not intrinsically dependent on a waterfront location but whose economic viability is dependent upon a waterfront location because: (a) The use has a functional requirement for a waterfront location such as the arrival or shipment of materials by water or the need for large quantities of water; or (b) The use provides a necessary service supportive of the water-dependent uses and the proximity of the use to its customers makes its services less expensive and/or more convenient. (WAC 173-26-020 (40))	Examples of water-related uses may include warehousing of goods transported by water, seafood processing plants, hydroelectric generating plants, gravel storage when transported by barge, oil refineries where transport is by tanker, log storage, and potentially agriculture.
"Water-enjoyment use" means a recreational use or other use that facilitates public access to the shoreline as a primary characteristic of the use; or a use that provides for recreational use or aesthetic enjoyment of the shoreline for a substantial number of people as a general characteristic of the use and which through location, design, and operation ensures the public's ability to enjoy the physical and aesthetic qualities of the shoreline. In order to qualify as a water-enjoyment use, the use must be open to the general public and the shoreline-oriented space within the project must be devoted to the specific aspects of the use that fosters shoreline enjoyment. (WAC 173-26-020 (37))	Primary water-enjoyment uses may include, but are not limited to, parks, piers and other improvements facilitating public access to the shorelines of the state; and general water-enjoyment uses may include, but are not limited to restaurants, museums, aquariums, scientific/ecological reserves, and resorts/hotels.

Based on a review of County Assessor records, the current use categories that were considered most likely to meet the definition of water-oriented uses were selected as follows:

- Hotels/Motels
- Marine Craft Transportation
- Open Space
- Parks
- Cultural, Entertainment, and Recreational Activities
- Resorts and Camps
- Retail Trade-Eating/Drinking
- Aquaculture

In the rural portions of the County, much of the potential water-oriented uses are parks, open space, and cultural, entertainment, and recreational activities. Marine Craft Transportation, such as Deer Harbor Boatworks and Islands Marine Center, also appears as a common water-oriented

use including marine cargo and passenger transportation facilities, barge landing, marine railways, and marinas.

More urban examples of water-oriented uses, including hotels/motels and eating/drinking establishments, are found in the urban growth areas, activity centers, and master plan resorts.

3.4.3 Comprehensive Plan Land Use Patterns

San Juan County adopted its current Comprehensive Plan on December 20, 1998, and periodically updated it through April 2010. The Comprehensive Plan is guided by a vision and land use concept for arrangement of existing and Comprehensive Plan land uses that protects critical areas and property rights while accommodating future growth.

The land use concept of the San Juan County Comprehensive Plan shows how the County should grow and develop while protecting its quality of life and natural environment and equitably sharing the public and private costs and benefits of growth. The land use concept establishes the overall direction and guidance for the location of future growth including residential, commercial, and industrial growth in the County while protecting public health and safety and private property rights, and preserving the rural character and unique island atmosphere of the County. The land use concept further identifies the location of Comprehensive Plan land uses and intensities, distinguishing between growth areas for urban levels of development, activity centers, and other area of more intensive rural development, rural areas, and resource lands. Emphasis for future growth is placed in areas where adequate public facilities can be provided in an efficient manner. There are specific use environment overlays that apply in shoreline jurisdiction. San Juan County includes its shoreline designations on the same map as its Comprehensive Plan land use designations. This facilitates a review of use environment overlays in the County's shoreline jurisdiction, as well as applicable zoning districts.

The Comprehensive Plan does this, in part, through establishing land use designations that are applied to property throughout the County that describe the types of uses that can occur on these properties. The various land use districts and a general description of their purpose are outlined below to provide context for future land discussion by management area.

Urban Growth Areas

San Juan County has three unincorporated Urban Growth Areas where urban level residential, general commercial and general industrial uses, facilities, and services should be located. These include:

- Friday Harbor Urban Growth Area (Friday Harbor management area)
- Eastsound Urban Growth Area (Eastsound and North Coast Eastsound management areas)
- Lopez Village Urban Growth Area (Fisherman Bay management area)

Each of these urban growth areas is located in part within shoreline jurisdiction.

Activity Centers

The Comprehensive Plan also recognizes existing centers of activity that offer diverse employment opportunities, a variety of residential densities and housing types, general commercial, general industrial, institutional, recreational, and community uses in a concentrated development pattern. The following activity centers are found within shoreline jurisdiction:

- **Lopez Marine Center LAMIRD** provides a limited variety of residential options, and some intensive uses and services. It is expected to become part of the Lopez Village UGA over time.

- **Village Activity Centers:** These provide a limited variety of residential densities, and are pedestrian-oriented with a compact village core. They provide some intensive uses and services (including community sewage treatment facilities and community water systems), but are not capable of an appropriate urban-level development or expansion at this time. They are only appropriate for infill.

    - Orcas Village is a Village Activity Center found in the West Sound management area.

- **Hamlet Activity Centers**: These are residential areas that have some non-rural densities, and have small commercial centers that provide goods and services to surrounding rural and resource land uses. Hamlets are served by community water systems and may have community sewage treatment facilities, but have only rural governmental services. Hamlet Activity Centers include the following (listed with associated shoreline management area):

    - Olga – Olga
    - Deer Harbor – West Sound
    - Doe Bay – Doe Bay
    - West Sound – West Sound

- **Residential Activity Centers** are residential areas that have existing development patterns more dense than one unit per 5 acres, some portion of which is served by non-rural levels of capital facilities or services. Residential Activity Centers include the following (listed with associated shoreline management area):

    - North Roche Harbor – Roche Harbor
    - North Rosario Area – Olga

- **Master Planned Resorts** are self-contained and fully integrated planned unit developments, in a setting of significant natural amenities, with a primary focus on destination resort facilities consisting of short-term visitor accommodations associated with a range of developed on-site indoor or outdoor recreational facilities. They may contain other residential uses and commercial activities within their boundaries, but only if these uses are integrated into and support the on-site recreation nature of the resort. Master Planned Resorts may be within other activity centers. Master Planned Resorts include the following (listed with associated shoreline management area):

  - Roche Harbor Resort – Roche Harbor
  - Rosario Resort – Olga
  - West Beach Resort – Turtleback

*Note: **Island Centers** are another type of existing center of activity. However, there are currently no Island Centers in shoreline jurisdiction.*

Rural Lands

Rural lands are intended to retain the agricultural, pastoral, forested, and natural landscape qualities of the islands while providing people with choices of living environments at lower densities or use intensities than those in Activity Centers. Rural lands also include the Special Districts, which are discussed further below. The goal for each rural land designation is listed below:

Rural General Use: To provide flexibility for a variety of small-scale, low-impact uses to locate on rural lands.

Rural General designations are applied in areas where there is an existing mix of residential development, scattered single-family residences, small farms, forestry activities, resource-based commercial and industrial uses, cottage enterprises, rural commercial and rural industrial uses. This designation is not common in shoreline jurisdiction. However, there are small areas found in multiple management areas where this designation is applied. One example is at the Lopez Island State Ferry Terminal in the Spencer Spit management area.

Rural Farm-Forest: To provide for rural living opportunities which are compatible with small-scale farming and forestry activities.

The Rural Farm-Forest designation is applied to areas where predominant land use is farming and forestry mixed with residential development, and parcels are generally 5 or more acres in size. This land use designation is applied many places within shoreline jurisdiction across multiple management areas.

Rural Residential: To protect the predominantly residential character of some rural areas and provide for a variety of residential living opportunities at rural densities.

The Rural Residential designation is applied to areas where there are existing small acreage platted areas generally with private covenants and restrictions, and some exclusively residential developments are expected to continue to occur. Parcels in this designation are generally 2-5 acres in size, and may also include areas with lots less than two acres in size. This land use designation is applied many places within shoreline jurisdiction across multiple management areas.

Rural Industrial: To provide areas for rural oriented industrial uses that are not generally compatible with activity center land uses, which compliment rural character and development, and which can be served by rural governmental services.

The Rural Industrial designation is applied to land with existing or historical commitment to rural industrial uses and with direct access to public roadways classified as minor or major arterials. This land use designation is applied to few parcels within shoreline jurisdiction, but occurs in multiple management areas.

Rural Commercial: To provide areas for rural oriented commercial uses which compliment rural character and development, and which can be served by rural governmental services.

The Rural Commercial designation is applied to land with existing or historical commitment to rural commercial uses and with direct access to public roadways classified as minor or major arterials. This land use designation is applied to few parcels within shoreline jurisdiction, but occurs in multiple management areas.

Resource Lands: To recognize and protect the physical conditions and characteristics of agricultural and forest resource lands which are conducive to the use of such lands for long-term commercial production. Resource lands are further subdivided into:

> **Agricultural Resource Lands:** To ensure the conservation of agricultural resource lands of long-term commercial significance for existing and future generations, and protect these lands from interference by adjacent uses which may affect the continued use of these lands for production of food and agricultural products.
>
> Agricultural Resource Lands are found mostly on the larger, State-ferry served islands in the County. This designation is found in the Strait of Juan de Fuca management area on San Juan and Lopez islands, and small portions of the Friday Harbor, Mud Bay, Private Lakes, and West Sound management areas.
>
> **Forest Resource Lands:** To protect and conserve forest lands of long-term commercial significance for sustainable forest productivity and provide for uses that are compatible with forestry activities while maintaining water quality, water quantity, and fish and wildlife habitat.
>
> Forest Resource Lands are found mostly on the larger islands in the County. This designation is found in large areas of the Blakely Island, Turtleback, Olga, and Doe Bay management areas, as well as smaller portions of Private Lakes, Mud Bay, and Shaw Island management areas.

Special Districts

The following special districts are Comprehensive Plan land use designations applied for conservation of areas with unique or valuable natural features that warrant specific recognition and protective measures to ensure their existing character is maintained. Although these districts have the same name as shoreline use environments, they are Comprehensive Plan land use districts applied to both areas within the County's shoreline jurisdiction, as well as upland areas outside of the County's shoreline jurisdiction.

Conservancy: To protect, conserve, and manage existing natural conditions, resources, and valuable historic, scenic, educational, or scientific research areas for the benefit of existing and future generations without precluding compatible human uses.

Conservancy lands are applied to areas possessing valuable natural features or resources that will tolerate only minimal disturbance of the existing terrestrial or freshwater environments; or to areas possessing scenic, historical, or recreational qualities of considerable local, regional, state, or national significance that would be adversely affected by extensive modification or intensive use. This designation is applied to significant portions of all management areas. Uninhabited smaller islands within San Juan County commonly carry a Conservancy or a Natural land use designation.

Natural: To preserve indigenous plant and animal species and ecosystems in a natural state for the benefit of existing and future generations.

Natural lands are applied to only to those areas that are characterized by the presence of intact indigenous ecosystems or rare or unusual indigenous plant or animal species which are relatively intolerant of human use. This designation is applied to significant portions of all management areas. Uninhabited smaller islands within San Juan County commonly carry a Conservancy or a Natural land use designation.

Shoreline Use Environments

San Juan County applies existing shoreline use environments to areas covered by the County's current SMP. Environment designations sometimes have similar names as the land use designations, but they refer to separate regulations. For example, natural and conservancy designations have been used for both land use and shoreline designations. Notably, they do not have same regulatory implications even though the same names for designations have been used. As described above, the County applies shoreline jurisdictions on a combined land use district and Shoreline Master Program map. Existing use designations are classified as follows per the current SMP:

Urban Environment

Purpose: The purpose of the Urban Environment is to ensure optimum use of shorelines within areas characterized by medium and high-density residential, commercial, industrial, and institutional uses by permitting continued intensive activities and managing development so that it enhances and maintains shorelines for a multiplicity of urban types of uses. The Urban

environment is particularly suitable for those areas already developed intensively with mixed uses. These areas may or may not be adjacent to an activity center.

Designation Criteria: Shoreline areas to be designated "Urban" should meet one or more of the following criteria:

1. Areas characterized by intense land use, including recreational, residential, commercial, industrial, and institutional development, and port activities;

2. Areas designated for the expansion of urban uses in the Land Use Element;

3. Areas which do not fall under a. or b., above, but which do not present major biological or physical limitations for urban development and which can provide the necessary capital facilities, utilities, and access required to accommodate such development; or

4. Areas that are suitable for non-residential uses or that can be made compatible with residential areas.

Rural Environment

Purpose: The Rural Environment is intended for residential development and other mixed-use forms of development such as marinas, restaurants, resorts, and rural commercial and industrial activities. The Rural Environment should be used where roads, utilities, and public services can be or are provided to serve a mix of uses on the shoreline. The Rural Environment is an area capable of accommodating residential and mixed-use development, but which is not suitable or desirable for a more restrictive rural designation.

Designation Criteria: Shoreline areas to be designated Rural should meet one or more of the following criteria:

1. Areas presently containing medium density residential development mixed with nonresidential uses;

2. Areas designated for rural residential or non-residential uses in the Land Use Element;

3. Areas which do not fall under criteria a. or b., above, but which do not present major biological or physical limitations for medium density residential development and which can provide the necessary capital facilities, utilities, and access required to accommodate such development;

4. Areas which are suitable for non-residential uses or that can be made compatible with residential areas; or

5. Areas that would make desirable transition zones between Urban and Rural Farm-Forest, or between Urban and Conservancy environments.

Rural Residential Environment

Purpose: The Rural Residential Environment is intended primarily for residential shoreline development only. This designation should be used where residential covenants and restrictions are in effect and where roads, utilities, and public services can be or are provided. The Rural Residential Environment is an area where extensive medium density residential development already exists, but which is not suitable or desirable for mixed-use development.

Designation Criteria: Shoreline areas to be designated Rural Residential should meet one or more of the following criteria:

1. Areas presently containing considerable medium density residential development with few, if any, non-residential uses;

2. Areas designated for the continuation of residential development on existing parcels of medium residential density in the Land Use Element; or

3. Areas which do not fall under criteria a. or b., above, but which do not present major biological or physical limitations for residential development and which can provide the necessary rural services (capital facilities, utilities, and access) required to accommodate such development.

Rural Farm-Forest Environment

Purpose: The purpose of the Rural Farm-Forest Environment is to protect agricultural and timber lands and to maintain and enhance the rural low density character of the County's shoreline while providing protection from expansion of mixed use and urban types of land uses. Open spaces and opportunities for recreational and other uses compatible with agricultural and forestry activities should be maintained. Development related to the commercial fishing industry and aquaculture would be permitted. Other forms of development that are not contrary to the purpose of the Rural Farm-Forest Environment would be permitted only under certain circumstances.

Designation Criteria: Areas to be designated Rural Farm-Forest should meet one or more of the following criteria:

1. Areas dominated by agricultural, forestry, or recreational uses;

2. Areas possessing a high capacity to support agricultural and forestry uses and compatible forms of development;

3. Areas modified from their natural vegetative cover and surface drainage patterns but generally possessing low density development;

4. Areas where residential development is or should be low density because of biological or physical limitations, utility capabilities, access problems, and/or potential incompatibility with other uses;

5. Areas of undeveloped land not appropriate for Natural or Conservancy Environment designations and not planned for significant mixed-use development;

6. Areas which form buffer zones between Urban, Rural, or Rural Residential areas and Natural or Conservancy areas; or

7. Areas possessing valuable sand, gravel, and mineral deposits.

Conservancy Environment

Purpose: The purpose of the Conservancy designation is to protect, conserve, and manage existing natural resources and systems and/or valuable historic, educational, or scientific research areas without precluding compatible human uses. It is the most suitable designation for shoreline areas that possess a specific resource or value which can be protected without excluding or severely restricting all other uses, and for areas where primarily non-consumptive uses of the physical and biological resources are preferred. It should be applied to those areas that would most benefit the public if their existing character is maintained, but which are also able to tolerate limited or carefully planned development or resource use.

Designation Criteria: Areas to be designated Conservancy should meet one or more of the following criteria:

1. Areas possessing valuable natural resources or features, the use of which precludes activities or uses except those which would not degrade the area to be conserved;

2. Areas possessing valuable natural resources which will tolerate only minimal disturbance of the existing terrestrial or marine/freshwater environments;

3. Areas containing resources which lend themselves to management on a sustained-yield basis;

4. Areas possessing scenic or recreational qualities of considerable local, regional, or statewide significance which would be adversely affected by extensive modification or use; or

5. Areas that are free of extensive development and can serve as needed open space if their present character is maintained.

Natural Environment

Purpose: The purpose of the Natural Environment is to preserve rare or valuable natural resource systems by regulating uses that are likely to degrade or alter such resources. The primary determinant for designating an area as a Natural Environment is the presence of some rare natural resource considered valuable in its natural or original condition and which is relatively intolerant to human use.

Designation Criteria: Areas to be designated Natural should meet one or more of the following criteria:

1. General:

   (1) Areas where human influence and development are minimal;

   (2) Areas which have been degraded but which are capable of easily being restored to a natural condition or are capable of natural regeneration if left undisturbed;

   (3) Areas having a high scenic value in their natural states;

   (4) Areas having a high value in their natural states for low intensity recreational use;

   (5) Class I accretion beaches;

   (6) Salt marshes, bogs, and swamps;

2. Wildlife Habitats:

   (1) Areas used by rare, diminished, or endangered species (as identified in the federal/state list of threatened and endangered species) from which they obtain food, water, cover, and/or protection;

   (2) Areas providing a seasonal haven for concentrations of aquatic or terrestrial animals; e.g., migration routes, breeding or spawning sites, etc.;

   (3) Unusual and/or residual wildlife habitats remaining within developed areas;

3. Areas of Scientific Value:

   (1) Areas regarded as representing the county's basic ecosystem or geologic types and valuable for scientific research and/or monitoring,

including established research and/or collection areas, or areas identified by the Director of the University of Washington Friday Harbor Laboratories;

(2) Areas which deviate from the ecological or geological norms, but which are of particular scientific interest;

(3) Areas which best represent undisturbed natural conditions;

(4) Areas which contain rare and/or scientifically important features; or

4. Areas that Serve to Maintain Ecological Balances.

Aquatic Environment

Purpose: The purpose of the Aquatic Environment is to protect the quality and quantity of the water, to preserve the water surfaces and foreshores for shoreline dependent uses, such as navigation, commercial fishing, recreation, water-dependent industry, marinas and aquaculture, and to preserve the Aquatic area's natural features and resources. The Aquatic Environment consists of all water bodies under the jurisdiction of the SMA and within the boundaries of San Juan County. It includes the water surface together with the underlying lands and the water column, including but not limited to bays, straits, harbors, coves, estuaries, tidelands, and lakes.

Designation Criteria: Areas to be designated Aquatic are as follows:

1. All marine waters, including estuarine channels and wetlands, seaward of the line of ordinary high tide except where those waters between the ordinary high water mark and extreme low tide have been assigned a different environmental designation;

2. All lakes subject to this Master Program, below the ordinary high water mark;

3. All wetlands (as defined in WAC 173–22) associated with waters described in criteria a. and b., above.

Subarea Environments

The following subarea shoreline environments are in addition to the applicable subarea plans:

Eastsound Environments

Purpose: The purpose of the Eastsound Shoreline Environments is to ensure use and development of Eastsound shorelines in a manner consistent with the goals, general policies, land use districts and regulations of the Eastsound Subarea Plan and with the specific character and resources of the shorelines within its boundaries.

Designation Criteria: The following environment designations apply as described below:

Eastsound Urban: that portion of the shoreline located on East Sound and within the Village Commercial District boundaries established in the Eastsound Subarea Plan. Uses in the Eastsound Urban shoreline should be consistent with management policies for the Urban Environment. However, because few water-dependent or water-related uses are appropriate in this location, to be consistent with the policy of the Act the shoreline adjoining the commercial center of Eastsound should be used in ways that enhance opportunities for the public use and enjoyment of this shoreline.

Eastsound Marina District: that portion of the shoreline located on Georgia Strait and the marina waterway located within the Marina District boundaries established in the Eastsound Subarea Plan.

1. Uses in the Eastsound Marina District shoreline should be consistent with the management policies for the Urban Environment.

2. Public physical and visual access to the shoreline should be planned for and provided wherever appropriate. Uses which are not water-dependent or water-related, except single-family residential, should include appropriate public access to the shoreline. Otherwise, allowable uses shall not be required to grant public access as a condition of any permit approval.

Eastsound Conservancy District: that portion of the shoreline located along Crescent Beach at Ship Bay and that portion of the shoreline located along the northwest corner of Fishing Bay, as these boundaries are established in, the Eastsound Subarea Plan.

1. Uses in the Eastsound Conservancy District shoreline should be consistent with the management policies for the Conservancy Environment.

2. Public physical and visual access to the shoreline should be planned for and provided wherever appropriate. Uses that are not water-dependent or water-related, except single-family residential uses, should include appropriate public access to the shoreline.

Eastsound Natural District: that portion of the shoreline located at Madrona Point and within the Eastsound Natural District boundaries established in the Eastsound Subarea Plan.

Uses in the Eastsound Natural District shoreline should be consistent with the management policies for the Natural Environment.

Eastsound Residential: that portion of the shoreline located on East Sound (Fishing and Fish Bays), North Beach, and Terrill Beach within the boundaries established in the Eastsound Subarea Plan, and not included within any of the above shoreline environments.

Uses in the Eastsound Residential shoreline should be consistent with the management policies for the adjoining upland land use districts.

Shaw Environments

Purpose: The purpose of Shaw Shoreline Environments is to ensure use and development of the Shaw Island shorelines in a manner consistent with the goals, general policies, land use districts and regulations of the Shaw Island Subarea Plan.

Designation Criteria and Management Policies: The following environment designation criteria and management policies apply as described below. See the Unified Development Code for regulations specific to Shaw environments.

1. Shaw Rural: Same as Rural

2. Shaw Rural Farm Forest: Same as Rural Farm Forest

3. Shaw Conservancy: Same as Conservancy

4. Shaw Natural: Same as Natural

Waldron Subarea

While there are no shoreline environments specific to the Waldron Island subarea planning area, the Waldron Island Limited Development District Subarea Plan does include policies and regulations that apply to land use and development on the shorelines.

Marine Habitat Management Area Environment

Purpose: The purpose of the Marine Habitat management area environment is to preserve and restore critical marine habitat areas and may be applied as an overlay to another shoreline environment designation. It is designed to be applied to specific water bodies only in concert with designation of the associated watershed as provided for in the Land Use Element of the Comprehensive Plan.

Designation Criteria: Areas to be designated a Marine Habitat management area should meet at least three of the following criteria:

1. Areas currently designated Aquatic, Conservancy or Natural by this Master Program;

2. Areas supporting recreational and/or commercial shellfish growing;

3. Areas representing enclosed embayments or having limited tidal flushing and therefore more sensitive to sedimentation and nonpoint pollution sources than open waters;

4. Marine spawning and nursery areas; and

5. Areas particularly vulnerable to probable, cumulative adverse impacts of the forms of human use and development along and in the water that may otherwise occur in accordance with this Master Program.

Marine Protected Area Environment

Purpose: The purpose of the Marine Protected Area environment is to preserve and restore critical marine habitat areas and may be applied as an overlay to another shoreline environment designation. It is designed to be applied to specific aquatic, intertidal and/or terrestrial shoreline areas.

Designation Criteria: Areas to be designated a Marine Protected Area should meet at least two of the following criteria:

1. Areas currently designated Aquatic, Conservancy or Natural by this Master Program;

2. Spawning and nursery areas for invertebrates, fish, marine mammals, and/or seabirds;

3. Areas that have been identified as capable of contributing significantly to the long-term health of the marine ecosystem if appropriately managed to sustain or restore living marine resources;

4. Areas particularly vulnerable to probable, cumulative adverse impacts of the forms of human use and development along and in the water that may otherwise occur in accordance with this Master Program; and

5. Areas supporting recreational and/or commercial shellfish growing where they clearly support ecosystem health.

3.5 Historic and Cultural Resources

The islands of San Juan County have been inhabited for more than 9,000 years, first by Northern Straits Salish including the Lummi, Samish, Saanich, and Songhees. The Northern Straits Salish created cedar plank longhouses for shelter during winter periods, and during warmer periods fished, hunted, and maintained shellfish beds as well as upland gardens. They also created artificial reefs and stretched nets across them to capture salmon, a unique form of reef netting, not used elsewhere in the world. (Oldham 2005)

In the 1700s, Spanish and British expeditions explored the islands. Spanish Captain Francisco Eliza mapped the San Juan Islands in 1791 and 1792 naming channels and islands, and many names are still in use today. British Captain George Vancouver also briefly explored the islands in 1792 (Oldham 2005).

Eventually, the British and the United States agreed to joint occupation in 1818, and Spain laid no claim. However, neither the Spanish, English, or Americans who staked claims showed interest in settling the islands, and the 1846 Treaty of Oregon between the United States and Great Britain did not address the San Juan Islands when it otherwise resolved the countries' competing boundary claims. The Hudson Bay Company, in 1850, established the first non-Indian presence on the San Juan Islands at Eagle Cove. By 1853, the islands were claimed as U.S. possessions in the newly created Washington Territory. The lack of clarity over which country owned the islands led to the Pig War (Oldham 2005; National Park Service 2011).

In the mid-1800s Great Britain and the United States settled ownership of the island through arbitration, and this accord is recognized in the San Juan Island National Historical Park, which has preserved American and British Camps (National Park Service 2011).

In 1870, the population of the County was 554 persons (San Juan County 2010). Friday Harbor was incorporated in 1909; it is the only incorporated town in San Juan County. The port at Friday Harbor as well as ports at Roche Harbor (also located on San Juan Island) and Richardson on the southern end of Lopez grew rapidly in the late 1800s and early 1900s as island industry and commerce expanded. Due to the abundant salmon catches, large canneries developed at Friday Harbor and Richardson, and smaller ones elsewhere. Ship building businesses also flourished. Forest practices supplied wood for ship building and produce crates, and sawmills also were established at ports and elsewhere. The Mosquito Fleet transported citizens and goods back and forth to the mainland; the first car ferry was established in the 1920s (Oldham 2005).

Another flourishing business revolved around tourism and travel, particularly on Orcas Island. The first hotels opened in the 1880s. Also established were youth summer camps and beach cabin resorts in the 1920s and 1930s (Oldham 2005). In addition to tourism and travel, the islands have become popular to build second homes.

The 2005-2009 American Community Survey shows a current population of 15,295 and 11,228 housing units, 7,357 or 65.5 percent, which are occupied, reflecting a large number of second homes. Most homes were built between 1970 and 2000 (American Community Survey 2005-2009). While much growth has occurred, historic properties have been recognized on the Washington State Register, and many are located along the shoreline given the County's maritime heritage (see Table 8).A County Comprehensive Plan Goal states the County's aspirations to protect cultural resources: "To protect, preserve, and enhance the rich history and cultural resources of San Juan County; more particularly its significant places, traditions, artifacts, stories, family histories, and other important historical and archaeological items" (San Juan County 2010).

Due to the wealth of cultural resources, the State of Washington Department of Archaeology and Historic Preservation require cultural resources assessments when development or activities are proposed that may affect archaeological or historic resources.

Table 8. Sites and Structures on the Washington State Heritage Register.

Register Status	Location and Site (Year Established on Register)
WHR	Deer Harbor; Deer Harbor Community Club; 4319 Deer Harbor Road (1/26/2001)
WHR/NR	Doe Bay; Doe Bay General Store and Post Office; End of County Road (5/8/1986)
WHR/NR	Eastsound; Emmanuel Episcopal Church; 242 Main Street (12/12/1994)
WHR	Eastsound; West Sound Community Hall; Deer Harbor Road, 1/8 Mile East from Intersection With Crow Valley Road (9/24/1999)
WHR/NR	Eastsound VICINITY; Crow Valley School; Crow Valley Road (8/27/1987)
WH-BARN	Eastsound VICINITY; Jorgensen, James, Barn; 343 Buckhorn Road (11/2/2007)
WH-BARN	Eastsound VICINITY; Nordstrom Barn; 285 Nordstrom's Land (11/2/2007)
WHR/NR	Eastsound VICINITY; Patos Island Light Station; North of Eastsound on Patos Island (10/21/1977)
WHR	Friday Harbor; Odd Fellows Hall; 62 First Street North (8/22/1980)
WHR/NR	Friday Harbor; San Juan County Courthouse; 350 Court Street West (4/12/1984)
WH-BARN	Friday Harbor VICINITY; Barn; 326 Barnswallow Way (1/25/2008)
WHR	Friday Harbor VICINITY; Brann Cabin; 50 San Juan Park Drive, San Juan County Park (6/15/2007)
WHR	Friday Harbor VICINITY; Emmanuel Church; 311 Madden Lane (7/30/1971)
WH-BARN	Friday Harbor VICINITY; Lawson Barn; 2097 West Valley Road (1/25/2008)
NHL	Friday Harbor VICINITY; San Juan Island National Historic Site; Between Haro Strait and San Juan Channel (10/15/1966)
WHR/NR	Friday Harbor VICINITY; San Juan Island, Lime Kiln Light Station; West of Friday Harbor on Cr 1 (12/15/1978)
WHR/NR	Friday Harbor VICINITY; San Juan Lime Company / Cowell's; 1567 West Side Road North (3/6/2007)
WH-BARN	Friday Harbor VICINITY; Sweeney, John, Barn; 2602 San Juan Valley Road (1/25/2008)
WH-BARN	Friday Harbor VICINITY; Valley View Barn; 3006 San Juan Valley Road (1/25/2008)
WH-BARN	Lopez Island; Barn; 1005 Richardson Road (1/25/2008)
WH-BARN	Lopez Island; Higgins, Owen, Barn; 294 Vista Road (11/2/2007)
WHR	Lopez Island; Oscar Weeks Water Tower; 35 Tower Road (10/14/2003)
WHR/NR	Lopez Island; Port Stanley School; Port Stanley Road (12/9/1994)
WHR	Olga; Strawberry Barreling Plant; 11 Point Lawrence Road (10/8/2004)
WHR/NR	Orcas Island; Alderbrook Farmhouse; Point Lawrence Road, Doe Bay Vicinity (11/21/1985)
WHR/NR	Orcas Island; Orcas Hotel; Orcas (8/24/1982)
WHR/NR	Orcas Island; Rosario; South of Eastsound on Orcas Island (11/2/1978)
WHR	Orcas Island; Stone Tower on Mt. Constitution; Moran State Park, SE of Eastsound (5/31/1974)
REMOVED	Richardson; Richardson General Store and Warehouse; Richardson Road (11/9/1990)
WHR	Richardson VICINITY; Graham, Thomas and Hattie, House; 1790 Mud Bay Road (1/28/2005)

Register Status	Location and Site (Year Established on Register)
WHR/NR	San Juan Island; Roche Harbor; Northern San Juan Island (8/29/1977)
WH-BARN	Shaw Island; Biendl, John, Barn; Ben Nevis Road (11/2/2007)
WHR/NR	Shaw Island; Little Red Schoolhouse; Corner of Hoffman Cove and Neck Point Cove Road (6/19/1973)
WHR/NR	Shaw Island; Tharald Homestead; Hoffman Cove Road (1/17/2002)
WHR/DOE	Stuart Island; Turn Point Lighthouse Keepers' Quarters; Western end of Lighthouse Rd (8/22/1978)
WHR/NR	Waldron Island; Krumdiack Homestead; North Coast, Between Fishery Point and Point Hammond (4/29/1993)

Legend:
DOE = Determination of Eligibility-National Register
NHL = National Historic Landmark
REMOVED = Removed from Listing
WH-BARN = WA Heritage Barn Register
WH-BARN/WHR = WA Heritage Barn Register and WHR
WH-BARN/WHR/NR = WA Heritage Barn Register, WHR, and NR
WHR = Washington Heritage Register
WHR/DOE = WHR and Det of Eligibility to NR
WHR/NR = WHR and National Register
Source: Washington State Department of Archaeology and Historic Preservation 2009

3.6 Existing and Potential Public Access

Public access means "the ability of the general public to reach, touch, and enjoy the water's edge, to travel on the waters of the state, and to view the water and the shoreline from adjacent locations" (WAC 173-26-221(4)(a)). Public access may be provided on public properties or along with development that creates a demand for public access. Providing public access helps fulfill the public trust doctrine that holds "that the waters of the state are a public resource owned by and available to all citizens equally for the purposes of navigation, conducting commerce, fishing, recreation and similar uses." At the same time the public trust doctrine "does not allow the public to trespass over privately owned uplands to access the tidelands." This section addresses existing public access opportunities as well as future public access opportunities.

Information about San Juan County public access was obtained from County GIS data, the San Juan County Comprehensive Plan, the current San Juan County Parks, Trails, and Natural Areas Plan: 2011-2016 (The Trust for Public Land et al. 2010) and other sources. San Juan County owns and maintains a variety of parks, trails and natural areas, most of which are concentrated on San Juan, Orcas, Lopez, and Shaw islands (Table 9).

Table 9: Shoreline Parks, Open Space, and Trails.

Management Area	Shoreline Jurisdiction (acres)	Length (miles)	Dedicated Parks and Open Space (acres)	Marine Access Parks (acres)	Trails and Paths (linear feet)
Blakely	312.42	13.87	74.51		
Decatur	413.17	19.63	58.66		
Doe Bay	449.19	23.44	105.74		
Eastsound	400.53	17.53	29.34	2.38	2490
Fisherman Bay	338.63	13.96	58.80	50.39	6424
Friday Harbor	493.64	24.21	82.79	51.23	4777
Mud Bay	596.70	28.39	59.35	26.70	4390
North Coast Eastsound	153.02	4.40		0.99	
Olga	328.28	15.04	20.81	18.93	2324
Public Lakes	179.04	7.61	169.19		30781
Roche Harbor	850.37	33.74	75.93	41.26	5612
Private Lakes	728.58	17.76	242.99		8050
San Juan Channel	298.16	13.16	68.33	2.01	496
Shaw	758.59	38.17	168.63	39.40	
Spencer Spit	345.46	12.74	40.75	20.93	1640
Strait of Juan de Fuca	1067.39	57.70	230.89	181.40	19952
Stuart	748.00	35.99	92.87		8349
Turtleback	338.27	15.52	96.95		8385
Waldron	852.22	45.64	534.56		83883
Westsound	526.66	25.48	51.66	1.92	1255

In addition to parks and trails, San Juan County has a variety of marine access facilities such as docks, boat ramps, campgrounds and road ends (Table 10).

Table 10. Public Access Facilities.

Management Area	Total Facilities	Campgrounds	Docks	Boat Launch	Leased Float	Ramp	Road Ends
Blakely							
Decatur	1					1	
Doe Bay							2
Eastsound	1		1				0
Fisherman Bay	4	1	1		1	1	2
Friday Harbor	2	1				1	5
Mud Bay	4		2			2	3
North Coast Eastsound							4
Olga	4	1	2			1	5
Public Lakes	1	1		2			
Roche Harbor	2	1			1		2
Private Lakes							
San Juan Channel							
Shaw	2	1				1	3
Spencer Spit	1	1					2
Strait of Juan de Fuca	4	1	1			2	3
Stuart	2	1	1	2		1	
Turtleback	1	1					2
Waldron	1	2	1	2			
West Sound	4		3		1		

The State Department of Parks website indicates additional campgrounds are located at the following:

- Matia Island
- Clark Island
- Blind Island
- James Island
- Griffin Bay State Park

The San Juan County Comprehensive Plan does not contain a separate parks and recreation element. Instead, policies related to parks and open spaces are incorporated in the Land Use Element. The following goals and policies from the Land Use Element of the Comprehensive Plan are most relevant to the Shoreline Master Program update:

Goals:

- To provide for recreational opportunities to meet the needs and interests of County residents while ensuring that recreational uses are compatible with the natural limitations of each specific site and surrounding uses (Goal 2.2.E)
- To protect and conserve open space and scenic resources (Goal 2.2.I)
- To provide safe and convenient access to public lands and facilities without causing significant negative impacts on the quality of life or property of island residents, or adversely affecting fragile natural features (Goal 2.2.J)
- To protect those significant open spaces and vistas which substantially contribute to the rural character of the County (Goal 2.5.C)

Policies:

- Public agencies should acquire or otherwise assure access to publicly owned lands and facilities. Such access should not adversely affect the public resource or adjacent properties.
- Public access areas should be clearly and appropriately marked.
- Greenways or buffer zones should be provided within public access areas to protect adjacent private property.

A variety of departments and entities provide parks, trails, and natural areas throughout San Juan County. Those providers include San Juan County Parks Department, San Juan County Land Bank (land bank), and the Town of Friday Harbor as well as a mix of other providers such as school districts, local recreation districts, Chambers of Commerce, etc. In addition to County providers, State and Federal agencies also own and maintain parks and natural spaces in San Juan County (Table 11).

In 2010, the Trust for Public Lands, San Juan County Land Trust and San Juan County Parks Department collaborated on a Parks, Trails and Natural Areas Plan: 2011-2016 (abbreviated "Parks Plan" for the purposes of this report) which established a shared vision, goals, strategies, and a 6-year action plan for acquiring, developing, and renovating parks, trails, and natural areas in the county. Findings and recommendations from the Parks Plan are referenced throughout this document where relevant to the discussion of existing and potential public access. The most relevant over-arching goals of the Parks Plan related to public access include:

- Provide a quality, diversified parks, trails and natural areas system that offers a wide range of active and passive recreation experiences and conserves and respects natural resources and island character

- Acquire high-priority lands that preserve open spaces, improve access to water, conserve natural resources, maintain island character, and improve and expand recreational opportunities for the public to enjoy

Large government land holdings and the quantity of shorelines make opportunities for public access to parks, trails and natural areas are relatively abundant in San Juan County. However, existing public access sites fall short of demand. During the peak tourist season, the County's population increases by approximately 60 percent and can overwhelm the capacity of existing facilities. Fewer than 25 percent of community survey respondents from Lopez, Orcas, and Shaw islands described current conditions as providing "enough" access (The Trust for Public Land et al. 2010). Respondents to a community survey identified the need for more trails, more shoreline access and better maintenance of existing facilities.

Table 11. Parks and Open Space Ownership within the Shoreline Jurisdiction.

Agency	Parks, Recreation and Open Space Ownership (acres)	Facility Examples
Federal		
Bureau of Land Management	130.75	San Juan Islands National Historic Park and other land holdings
National Parks	147.94	San Juan Islands National Historic Park and other land holdings
Other Federal	258.11	
State		
Department of Natural Resources	472.23	Upright Head Reserve and others
Department of Fish and Wildlife	2.50	
Parks Department	384.89	Lime Kiln Point State Park, Moran State Park, Spencer Spit State Park and others
County/Local		
Land Bank	240.89	Dead Man Bay Preserve, Hummel Lake Preserve, Judd Cove Preserve, Lime Kiln Preserve, The Spit, Tombolo, Waterfront Park and others
Parks Department	78.39	Agate Beach County Park, Channel Vista Shore Access, Blackie Brady Park, East Olga Park Shore Access, Mud May Beach Odlin Park, Shark Reef Sanctuary, and others
Other County	14.24	Access off Port Stanley Road, Fish Creek Shore Access, Gravel Pit property, Obstruction Pass Marine Facility, Viewpoint Park, and others
Town of Friday Harbor	61.57	
Other		
Seattle Pacific University	101.56	
University of Washington	190.44	
The Nature Conservancy	84.69	

3.7 Marine Shoreline Types

San Juan County shorelines are remarkably diverse. Several studies have attempted to characterize the shoreline into shore types (Shipman 2008, MacLennan et al. 2010, Beamer and Fresh 2012, as examples). Many of these characterizations have interrelated shore types, as Appendix A of Beamer and Fresh (2012) illustrates. To summarize these data and to be as consistent as possible with other data used in this characterization (e.g., the juvenile fish presence data obtained by Beamer and Fresh [2012]), the Beamer and Fresh (2012) shore types are supplemented by feeder bluffs and pocket beaches, two key shore types outside of their characterization that are of particular importance in the County. Figure 2 below is provided by Shipman (2008) to depict various shore types described below. Table 12 provides a summary of the shore types and the levels of armoring in each. As can be seen in the table, shore types are preferentially armored (e.g., barrier beaches are armored more than rocky shorelines). For each management area, shore types which are either predominantly armored more than others (by percentage) within the same management area or represent the highest amount (in linear length) of armored shoreline are highlighted in the table.

Below, each shore type is described qualitatively, along with general attributes of that shore type in the County, including armoring. Comments with regard to armoring below typically relate to the relative amount of armoring in each shore type as compared to shorelines as a whole (i.e., the percentage of armoring in that shore type compared to the Countywide armoring percentage). For a full discussion of armoring, see the Marine Shoreline Alterations section below.

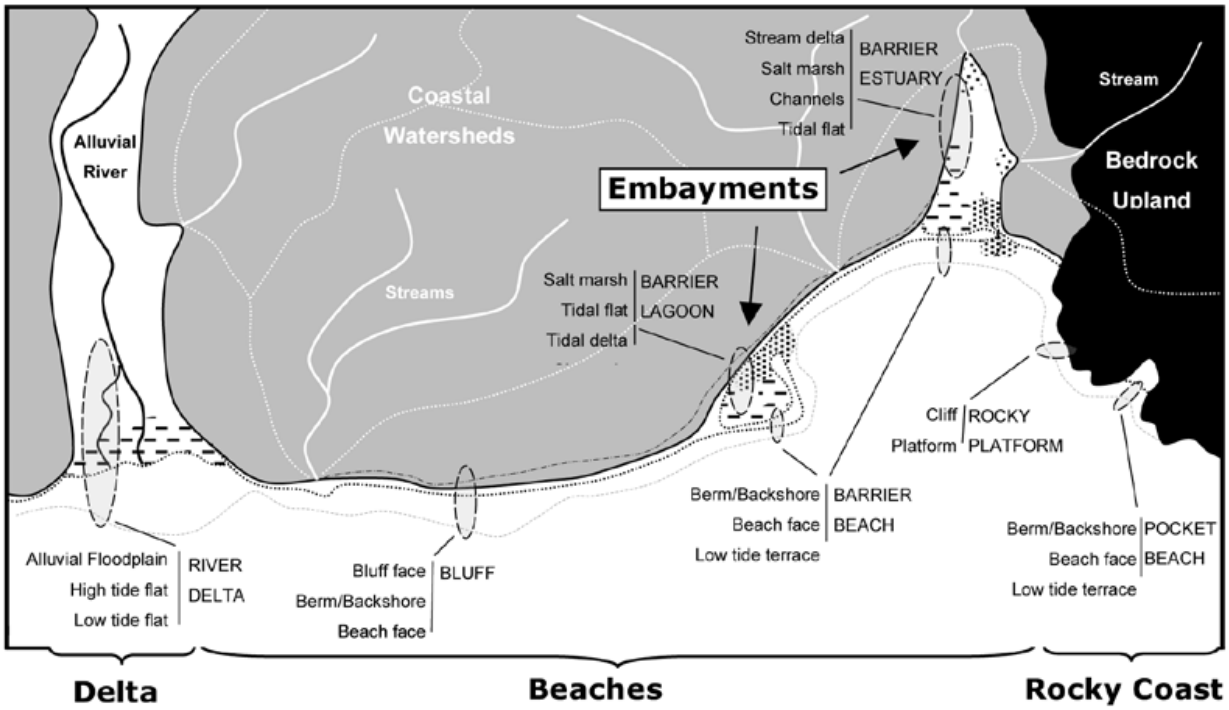


Figure 2. Coastal landforms typical of Puget Sound (Shipman 2008).

Barrier beaches – Barrier beaches are typified by a beach berm backed (landward of) a flat low backshore. Barrier beaches can be depositional or erosional, but are more typically a region of active transport between erosional and depositional areas. Their occurrence is sporadic throughout the County because they require a transport corridor, which is rare in bedrock-dominated areas. Where they occur, barrier beaches are armored more frequently than shorelines as a whole, possibly because as transport corridors they are prone to variability (erosion) over time. Figure 3 provides an example of a barrier beach along Spencer Spit on Lopez Island.

Photo courtesy of WA Department of Ecology

Figure 3. Barrier beach along Spencer Spit, Lopez Island

Bluff backed beach – Bluff backed beaches are those shorelines were a beach exists at the base of a sediment-rich bluff. Bluff backed beaches can occur in front of feeder bluffs, but not necessarily. Bluff backed beaches are most often found in areas with copious amounts of glacial sediment, like Lopez Island. Bluff backed beaches are armored by approximately the same amount as shorelines as a whole, with a few prominent exceptions such as the North Coast Eastsound Management Area and on Shaw Island, where armoring is more extensive. Figure 4 provides examples of bluff backed beaches along Decatur and Waldron Islands.

Photos courtesy of WA Department of Ecology

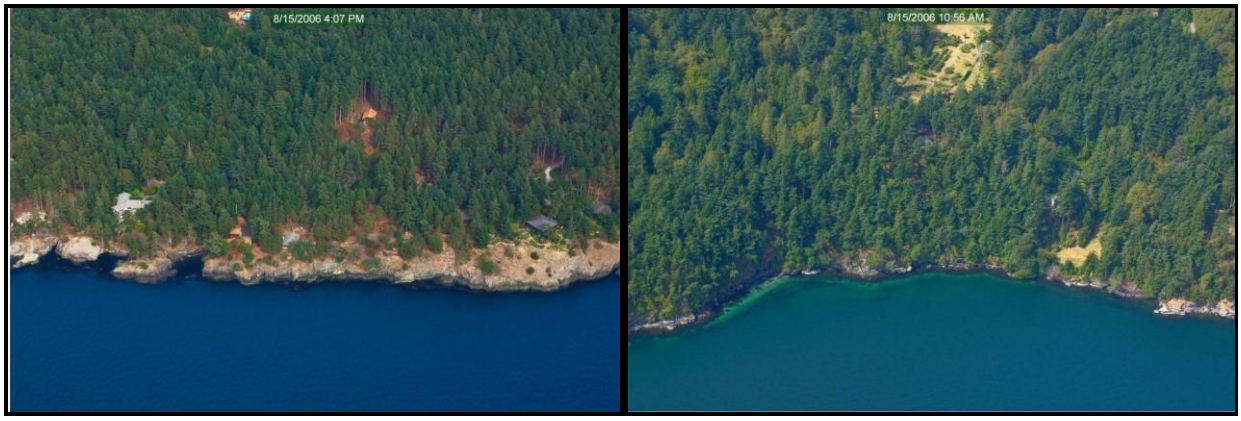
Figure 4. Bluff backed beaches along Decatur and Waldron Islands

Pocket estuary like – This generic category refers to shorelines that are typically protected embayments that have a source of freshwater and marshes associated with them. This shore type is distributed throughout the County, though a few areas lack them entirely. Pocket estuary shorelines are armored more often than shorelines as a whole, typically because they are often developed as low-lying areas with easy access to the ocean. Figure 5 provides an example of a pocket estuary like shoreline with a barrier beach along Third Beach on San Juan Island.

Photo courtesy of WA Department of Ecology

Figure 5. Pocket estuary like shoreline along Third Beach, San Juan Island

Rocky shoreline – Rocky shorelines are a broad category of shorelines referring to all of those shorelines that are dominated (from a physical process perspective) by solid bedrock. Rocky shorelines are by far the most common type of shoreline in the County. Rocky shorelines are armored less often than the shoreline as a whole. However, some rocky shorelines are armored. Figure 6 provides examples of rocky shorelines along San Juan and Orcas Islands.



Photos courtesy of WA Department of Ecology

Figure 6. Rocky shorelines along San Juan and Orcas Islands

Feeder bluff – A feeder bluff is an eroding bluff that supplies a significant portion of the sediment transported downdrift from it along the shoreline. Typically feeder bluffs in San Juan County are comprised of glacially derived sediments, and are most common on Lopez Island. Feeder bluffs are armored approximately the same amount as shorelines as a whole, with a few prominent exceptions such as the North Coast Eastsound Management Area, where armoring is more extensive. Figure 7 provides an example of a feeder bluff along Waldron Island.

Photo: MacLennan et al. (2010)

Figure 7. Feeder bluff along Waldron Island

Pocket beach - A pocket beach is a small beach that is contained between two bedrock headlands that exhibits little to no net longshore transport (Shipman 2008). Transport can be significant in a cross-shore sense. Pocket beaches are typically found in association with rocky shorelines, though not exclusively. They are armored slightly more frequently than shorelines as a whole. Figure 8 provides examples of pocket beaches along Waldron and Blakely Islands.

Photos courtesy of WA Department of Ecology

Figure 8. Pocket beaches along Waldron and Blakely Islands

Table 12. Marine Shoreline Armoring by Shore Type.

		Beamer and Fresh Shore Types[1]				PIAT Project Shore Types[2]	
		Barrier Beach	Bluff Backed Beach	Pocket Estuary Like	Rocky Shoreline	Feeder Bluff	Pocket Beach
BLAKELY ISLAND MANAGEMENT AREA 13.87 mi[3] 1% armored	Length (mi) of shore type[4] (% of mgmt area)[5]	.55 (4%)	5.59 (42%)	.48 (4%)	6.09 (45%)	1.45 (11%)	.72 (5%)
	Length (ft) of coincident armoring (% of shore type)	514 (18%)	215 (<1%)	2,416 (96%)	254 (<1%)	28 (<1%)	305 (8%)
DECATUR ISLAND MANAGEMENT AREA 19.63 mi[3] 3% armored	Length (mi) of shore type[4] (% of mgmt area)[5]	1.59 (9%)	4.65 (25%)	.56 (3%)	10.32 (56%)	2.37 (13%)	1.33 (7%)
	Length (ft) of coincident armoring (% of shore type)	1,724 (21%)	1,076 (4%)	0 (0%)	159 (<1%)	100 (<1%)	41 (<1%)

		Beamer and Fresh Shore Types[1]				PIAT Project Shore Types[2]	
		Barrier Beach	**Bluff Backed Beach**	**Pocket Estuary Like**	**Rocky Shoreline**	**Feeder Bluff**	**Pocket Beach**
DOE BAY MANAGEMENT AREA 23.44 mi[3] 1% armored	**Length (mi) of shore type[4]**	0	2.31	.06	13.67	.74	4.29
	(% of mgmt area)[5]	(0%)	(11%)	(<1%)	(67%)	(4%)	(21%)
	Length (ft) of coincident armoring	0	96	0	596	0	1,038
	(% of shore type)	(0%)	(<1%)	(0%)	(<1%)	(0%)	(5%)
EAST SOUND MANAGEMENT AREA 17.53 mi[3] 3% armored	**Length (mi) of shore type[4]**	.44	2.76	.00	10.51	1.22	2.36
	(% of mgmt area)[5]	(3%)	(17%)	(<1%)	(65%)	(8%)	(15%)
	Length (ft) of coincident armoring	653	548	0	487	101	1,580
	(% of shore type)	(28%)	(4%)	(0%)	(<1%)	(2%)	(13%)
FISHERMAN BAY MANAGEMENT AREA 13.96 mi[3] 20% armored	**Length (mi) of shore type[4]**	3.01	8.28	3.13	0.51	2.92	.03
	(% of mgmt area)[5]	(20%)	(55%)	(21%)	(3%)	(19%)	(<1%)
	Length (ft) of coincident armoring	4,378	9,589	1,346	257	764	0
	(% of shore type)	(28%)	(22%)	(8%)	(10%)	(5%)	(0%)
FRIDAY HARBOR MANAGEMENT AREA 24.21 mi[3] 7% armored	**Length (mi) of shore type[4]**	1.76	4.67	1.09	11.55	1.32	2.75
	(% of mgmt area)[5]	(8%)	(21%)	(5%)	(52%)	(6%)	(12%)
	Length (ft) of coincident armoring	103	1,334	260	3,029	128	3,010
	(% of shore type)	(1%)	(5%)	(5%)	(5%)	(2%)	(21%)

		Beamer and Fresh Shore Types[1]				PIAT Project Shore Types[2]	
		Barrier Beach	**Bluff Backed Beach**	**Pocket Estuary Like**	**Rocky Shoreline**	**Feeder Bluff**	**Pocket Beach**
MUD BAY MANAGEMENT AREA 28.39 mi[3] 4% armored	**Length (mi) of shore type[4]**	1.21	3.73	2.17	16.16	1.89	3.82
	(% of mgmt area)[5]	(4%)	(14%)	(8%)	(60%)	(7%)	(14%)
	Length (ft) of coincident armoring	2,212	1,738	134	1,445	368	1,025
	(% of shore type)	(35%)	(9%)	(1%)	(2%)	(4%)	(5%)
NORTH COAST EASTSOUND MANAGEMENT AREA 4.40 mi[3] 25% armored	**Length (mi) of shore type[4]**	.63	2.02	.24	.65	.44	.36
	(% of mgmt area)[5]	(14%)	(47%)	(5%)	(15%)	(10%)	(8%)
	Length (ft) of coincident armoring	269	4,288	0	1,147	1,698	184
	(% of shore type)	(8%)	(40%)	(0%)	(33%)	(74%)	(10%)
OLGA MANAGEMENT AREA 15.04 mi[3] 5% armored	**Length (mi) of shore type[4]**	.05	4.55	.14	7.58	.31	1.29
	(% of mgmt area)[5]	(<1%)	(33%)	(1%)	(55%)	(2%)	(9%)
	Length (ft) of coincident armoring	0	3,294	127	1,005	0	1,714
	(% of shore type)	(0%)	(14%)	(17%)	(3%)	(0%)	(25%)
ROCHE HARBOR MANAGEMENT AREA 33.74 mi[3] 6% armored	**Length (mi) of shore type[4]**	1.12	9.37	3.76	14.66	1.18	3.97
	(% of mgmt area)[5]	(3%)	(28%)	(11%)	(44%)	(4%)	(12%)
	Length (ft) of coincident armoring	0	5,961	710	1,794	246	2,046
	(% of shore type)	(0%)	(12%)	(4%)	(2%)	(4%)	(10%)

		Beamer and Fresh Shore Types[1]				PIAT Project Shore Types[2]	
		Barrier Beach	**Bluff Backed Beach**	**Pocket Estuary Like**	**Rocky Shoreline**	**Feeder Bluff**	**Pocket Beach**
SAN JUAN CHANNEL MANAGEMENT AREA 13.16 mi[3] 2% armored	**Length (mi) of shore type[4]**	0	0	.22	9.59	0	2.35
	(% of mgmt area)[5]	(0%)	(0%)	(2%)	(79%)	(0%)	(19%)
	Length (ft) of coincident armoring	0	0	0	612	0	944
	(% of shore type)	(0%)	(0%)	(0%)	(1%)	(0%)	(8%)
SHAW MANAGEMENT AREA 38.17 mi[3] 4% armored	**Length (mi) of shore type[4]**	.49	2.48	1.34	25.58	.52	6.43
	(% of mgmt area)[5]	(1%)	(7%)	(4%)	(71%)	(1%)	(18%)
	Length (ft) of coincident armoring	651	4,105	571	871	236	3,663
	(% of shore type)	(25%)	(31%)	(8%)	(<1%)	(9%)	(11%)
SPENCER SPIT MANAGEMENT AREA 12.74 mi[3] 8% armored	**Length (mi) of shore type[4]**	1.90	4.34	1.00	5.80	2.50	.24
	(% of mgmt area)[5]	(14%)	(33%)	(8%)	(44%)	(19%)	(2%)
	Length (ft) of coincident armoring	1,788	4,755	0	667	611	215
	(% of shore type)	(18%)	(21%)	(0%)	(2%)	(5%)	(17%)
STRAIT OF JUAN DE FUCA MANAGEMENT AREA 57.70 mi[3] 2% armored	**Length (mi) of shore type[4]**	0	4.12	1.23	36.22	1.69	7.91
	(% of mgmt area)[5]	(0%)	(8%)	(2%)	(74%)	(3%)	(16%)
	Length (ft) of coincident armoring	0	1,175	157	368	29	4,493
	(% of shore type)	(0%)	(5%)	(2%)	(<1%)	(<1%)	(11%)

		Beamer and Fresh Shore Types[1]				PIAT Project Shore Types[2]	
		Barrier Beach	**Bluff Backed Beach**	**Pocket Estuary Like**	**Rocky Shoreline**	**Feeder Bluff**	**Pocket Beach**
STUART ISLAND MANAGEMENT AREA 35.99 mi[3] <1% armored	**Length (mi) of shore type[4]**	.29	2.76	.27	27.67	.59	2.62
	(% of mgmt area)[5]	(<1%)	(8%)	(<1%)	(82%)	(2%)	(8%)
	Length (ft) of coincident armoring	80	208	22	931	0	522
	(% of shore type)	(5%)	(1%)	(2%)	(<1%)	(0%)	(4%)
TURTLEBACK MANAGEMENT AREA 15.52 mi[3] 4% armored	**Length (mi) of shore type[4]**	0	3.88	0.15	8.73	.69	1.67
	(% of mgmt area)[5]	(0%)	(27%)	(1%)	(61%)	(5%)	(12%)
	Length (ft) of coincident armoring	0	2,386	316	99	92	263
	(% of shore type)	(0%)	(12%)	(39%)	(<1%)	(3%)	(3%)
WALDRON MANAGEMENT AREA 45.64 mi[3] <1% armored	**Length (mi) of shore type[4]**	.55	7.01	0	30.18	1.96	2.85
	(% of mgmt area)[5]	(1%)	(17%)	(0%)	(74%)	(5%)	(7%)
	Length (ft) of coincident armoring	0	633	0	653	0	421
	(% of shore type)	(0%)	(2%)	(0%)	(<1%)	(0%)	(3%)
WEST SOUND MANAGEMENT AREA 25.48 mi[3] 7% armored	**Length (mi) of shore type[4]**	.11	3.85	2.07	14.62	.79	3.13
	(% of mgmt area)[5]	(<1%)	(16%)	(9%)	(62%)	(3%)	(13%)
	Length (ft) of coincident armoring	350	3,539	638	2,015	355	3,182
	(% of shore type)	(60%)	(17%)	(6%)	(3%)	(9%)	(19%)

[1] Shore types from Beamer and Fresh (2012). Shorelines which have been altered and thereby not classified by Beamer and Fresh (2012) as one of these shore types are not reported.

[2] Shore types from the Pulling It All Together project (PIAT 2012).
[3] Islets of 0.5 acres or less excluded from calculation.
[4] Length includes all Beamer and Fresh (2012) or PIAT (2012) shore type data within management unit.
[5] Percentage of total length of all Beamer and Fresh (2012) or PIAT shore type data located within management unit.

3.8 Marine Shoreline Alterations

Marine shoreline alterations typically include overwater structures such as piers and boathouses, shoreline armoring, flow control structures such as dams and tide gates and stormwater outfalls. Other types of shoreline modifications found in San Juan County include groins, marine railways, boat ramps, and residential development that affect nearshore and riparian vegetation. These alterations and their common impacts are discussed in the following sections. Additional information on common threats to priority habitats and species that are related to shoreline development can be found in the literature review document *Best Available Science for Marine Fish and Wildlife Habitat Conservation Areas* (Herrera and The Watershed Company 2011).

3.8.1 Overwater Structures

Overwater structures in the County include bridges, buildings, large floats, piers or docks (see Figure 9) and an assortment of unusual features such as fill placed on a dock. There are a total of 655 structures per the available GIS inventory. Of the 655 structures, there are 6 bridges, 10 buildings, 51 floats, 544 piers/docks, and 44 unusual structures (Table 13).

Friends of the San Juans (2009)

Figure 9. Examples of Overwater Structures in San Juan County.

These structures have an impact on the nearshore environment and the habitat and the species that use these habitats. Their impacts to the nearshore are detailed in Herrera and The Watershed Company (2011), but some examples are discussed here.

Estuarine and shallow marine nearshore habitats provide passage for fish and shellfish, larvae, and are important sources of prey resource production, refugia, and spawning substrates for the region's Pacific salmon, groundfish, and forage fish. Overwater structures can pose alterations to key controlling factors, such as light, wave energy and substrate regimes, that determine the

habitat characteristics that support these critical functions (Nightingale and Simenstad 2001). The literature also reflects that fish migrating along the shoreline have consistently shown behavioral responses upon encountering docks. These responses include pausing, school dispersal, and migration directional changes (Nightingale and Simenstad 2001). Alarming declines in plant and animal populations in Washington's inland marine waters highlight the need to identify and avoid stressors to the region's marine resources (West 1997). Fish populations suffering from significant anthropogenic stresses include Pacific salmon, Pacific herring, Pacific cod, walleye pollock, Pacific hake, and three species of demersal rockfish (West 1997) many of which use the rich nearshore/estuarine habitat along the County. At some point in their juvenile rearing stage, each of the above-named species, and the forage fish that support them, rely on nearshore vegetated, gravel, or mudflat habitats to meet critical rearing needs. This reliance upon nearshore habitat for important rearing needs combined with the natural geomorphologic limitations in habitat extent and the proximity of these habitats to human transportation corridors magnifies the importance of protecting these habitats from further loss and degradation (Norris 1991).

Table 13. Summary of Overwater Structures within Each Management Area.

Management Area	Bridges	Buildings	Floats	Pier/Dock	Other	Total
Blakely	0	0	1	7	2	10
Decatur	0	0	1	33	3	37
Doe Bay	0	0	0	5	1	6
Eastsound	0	1	2	19	0	22
Fisherman Bay	0	2	2	20	7	31
Friday Harbor	0	2	8	69	3	82
Mud Bay	1	1	0	17	6	25
North Coast Eastsound	0	0	0	4	0	4
Olga	1	0	2	22	1	26
Roche Harbor	0	0	3	150	4	157
San Juan Channel	0	0	1	13	0	14
Shaw	0	1	7	45	2	55
Spencer Spit	0	1	1	17	6	25
Strait of Juan de Fuca	2	0	0	12	3	17
Stuart	0	0	10	20	1	31
Turtleback	0	0	0	10	0	10
Waldron	0	0	0	5	0	5
Westsound	2	2	13	76	5	98
Private Lakes	NDA	NDA	NDA	NDA	NDA	14*
Public Lakes	NDA	NDA	NDA	NDA	NDA	9*
Total	**6**	**10**	**51**	**544**	**44**	**678**

NDA = No data available.

*Total number of overwater structures determined from an examination of recent aerial photographs.

Source: Shoreline overwater structures data from WA Department of Natural Resources (2007)

3.8.2 Shoreline Armoring

Shoreline armoring occurs throughout the shorelines of the County (Table 14), even in some areas that are mapped as bedrock. In total, just under 4 percent of the marine shoreline in the County is armored in some way. Numerous documents have suggested a link between armoring (particularly by bulkheads) accelerated beach erosion and the loss of nearshore habitat of adjacent shorelines (Mulvihill et al. 1980; Thom and Shreffler 1994; MacDonald et al. 1994; Sobocinski 2003; Williams and Thom 2001; Brennan and Culverwell 2004; Herrera and The Watershed Company 2011). Of these documents, Thom and Shreffler (1994) summarize biological impacts due to armoring; MacDonald et al. (1994) discuss impacts of shoreline armoring on geological processes and physical features, and Williams and Thom (2001) compiles and describes direct impacts, indirect permanent effects, and cumulative effects resulting from shoreline armoring. The possible direct effects of shoreline armoring include the following:

- **Encroachment.** Encroachment involves the placement of armoring or other structures on the upper or lower beach. If armoring is originally constructed seaward of the upper limit of the beach below extreme high water, it immediately narrows the beach causing a habitat loss. Fill and encroachment can sometimes be identified from current or historical photographs, or by the lack of wrack in front of it. Active encroachment and placement of fill in intertidal lands is primarily historical in nature because fill of intertidal lands is now prohibited by a series of local, state and federal regulations.

- **Active erosion.** Active erosion is a mechanism by which armoring, particularly bulkheading, accelerates beach erosion by reflecting wave energy and amplifying edge waves. This in turn increases sediment suspension and subsequently the rate of sediment transport offshore. When active erosion is present, the beach loss in front of armoring is greater than background or the natural erosion rate and therefore the beach is lowered, as in Figure 10.

Table 14. Armored Shoreline Totals Within Each Management Area.

Management Area	Total Shoreline Length (feet)	Total Armored Shoreline Length (feet)	Percentage Armored
Blakely	73,215	878	1.20
Decatur	103,625	2,946	2.84
Doe Bay	123,772	1,740	1.41
Eastsound	92,573	3,147	3.40
Fisherman Bay	73,685	14,440	19.60
Friday Harbor	127,845	8,434	6.60
Mud Bay	149,919	6,277	4.19
North Coast Eastsound	23,249	5,818	25.02
Olga	79,431	3,892	4.90
Roche Harbor	178,174	10,257	5.76
San Juan Channel	69,498	1,594	2.29
Shaw	201,546	8,872	4.40
Spencer Spit	67,270	5,592	8.31
Strait of Juan de Fuca	304,647	6,014	1.97
Stuart	190,029	1,459	0.77
Turtleback	81,953	3,014	3.68
Waldron	240,977	1,899	0.79
Westsound	134,521	8,969	6.67
Private Lakes	93,772	NDA	NDA
Public Lakes	40,181	NDA	NDA
Total	2,449,887	95,242	3.89

NDA = No data available

Source: Shoreline armoring data from the Friends of the San Juans (2009)

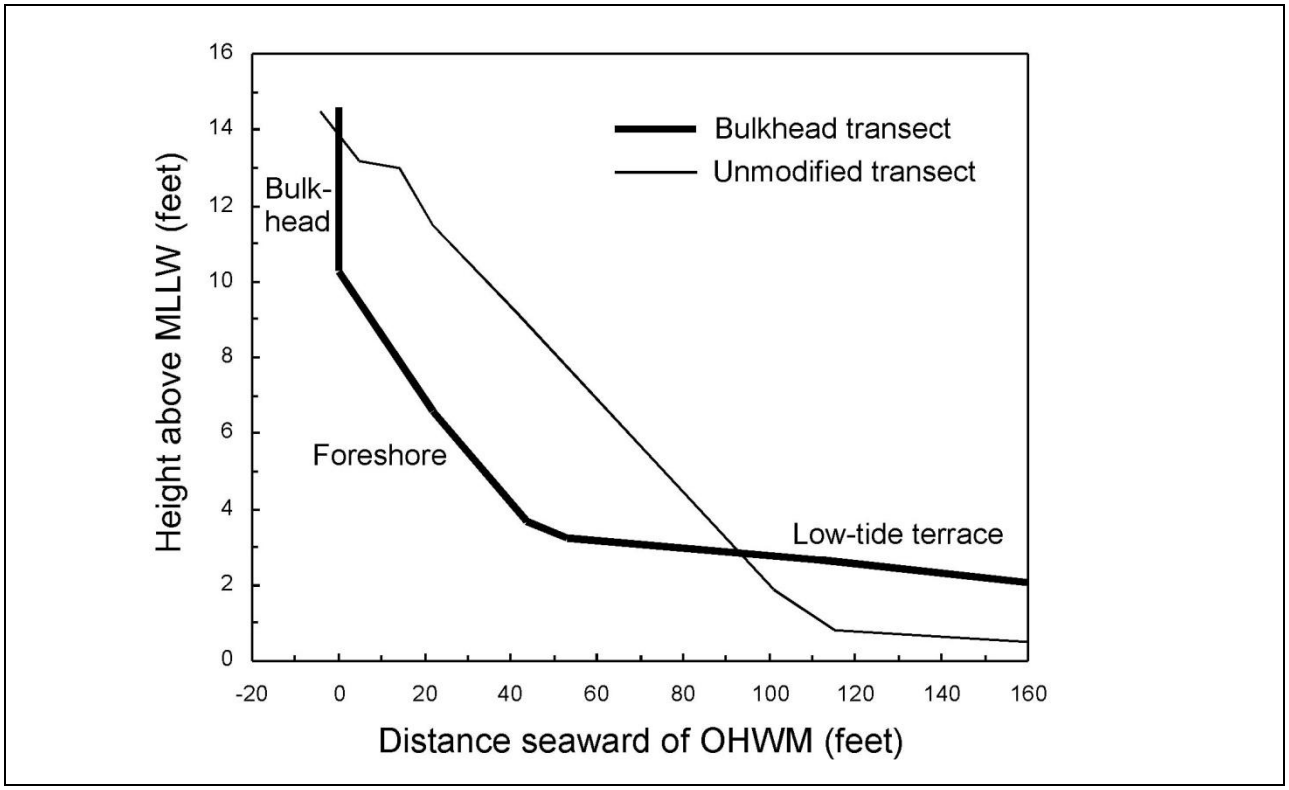


Figure 10. Comparison of Beach Profiles from Whidbey Island (Herrera 2009c).

In addition to these direct effects of bulkheads, there are several indirect effects that often occur. They are:

- **Passive erosion.** Passive erosion describes the fact that, if armoring is constructed and stabilizes a shoreline undergoing natural retreat (erosion), the armoring precludes the formation of new upper beach habitat. Initial construction of armoring structure leaves the upper beach intact, but over time natural erosion removes beach substrate in front of the structure and eventually the upper beach is lost. The loss of sediment causes the loss of the upper beach, as shown in Figure 10.

- **Sediment impoundment**. Sediment impoundment describes the possibility that armoring cuts off the upland supply of sediment to a beach, leading to beach loss. As a bluff erodes, it feeds sediment into the littoral cell. If armoring stops this erosion from occurring, a corresponding quantity of sediment would be missing from the littoral cell. This normally affects the down-drift beaches, by affecting the overall littoral supply, rather than the beach directly in front of the bulkhead.

- **Shoreline simplification.** Armoring, particularly a bulkhead, can reduce the physical complexity of the upper beach, such as the loss of wood debris accumulations in the upper beach. The shoreline is effectively shortened with considerable edge habitat lost. Armoring can also be associated with a significant loss of overhanging shoreline vegetation and wood debris accumulations, thereby reducing shade and the physical complexity of the upper beach.

Not all of the bulkheads in the County are placed low enough to incur all of the effects described above, particularly if the bulkheads are placed on exclusively bedrock shorelines. However, there are many bulkheads that have been constructed well seaward of MHHW. For those bulkheads, the net result of these effects is to eliminate the upper beach and the wrack commonly associated with it. Because upper beach areas are critical for forage fish spawning, the loss of these areas represents a significant impact to the productivity of the County's nearshore. Also lost is the quality of the migratory pathway for juvenile salmon, which is crucial to the recovery of both Puget Sound and Strait of Georgia (Fraser) salmonid stocks. There are also numerous effects that occur in association with bulkhead construction, such as deforestation, invasive species infestation, and fill. These effects again have numerous compounding impacts on nearshore wildlife including the loss of riparian cover, loss of macroinvertebrates, loss of large woody debris to adjacent shorelines, concentration of runoff, etc.

3.8.3 Flow-Control Structures

Flow-control structures that affect shorelines in the County take two broad forms: dams and tide gates. There are many dams throughout the county and several of the lakes are formed by small dams, as discussed in detail in the Processes Affecting Lacustrine Shorelines section of this report. Dams have numerous physical impacts, not the least of which is that they often serve as fish barriers. In addition to fish passage, they alter the hydrology of the streams that they are placed, depending on how they are managed. They also inhibit the transport of sediment (particularly coarse sediment), which can cause erosion to downstream areas. Upstream they impound water and cause the deposition of fine sediments, which may adversely affect habitat.

Tide gates are placed to allow for agriculture (the growing of salt intolerant vegetation) and reduce marine flooding in salt marshes adjacent to marine waters. There are three tide gates in the County, all of which are on Lopez (Maps 8C, Appendix A). Like dams, they often serve as fish barriers, although new designs, such as side-hinged gates and self-regulating gates that remain open a greater amount of time (and lessen velocities when open) can reduce or eliminate fish passage issues. Regardless of whether of whether they are fish barriers, tide gates disrupt natural geomorphic and hydrographic processes and can lead to water quality problems due to the restriction of tidal exchange.

3.8.4 Stormwater Outfalls

There are at least 84 stormwater outfalls that discharge untreated stormwater from the County into nearshore waters. Outfalls are summarized based on the number of cross culverts, storm drain outfalls, and tidegates found in the San Juan County (2008) datasets titled Culverts (for

cross culverts and storm drain outfalls) and Catch Basins (for tidegates). Nearly all of the outfalls are on the ferried islands (Orcas, Lopez, San Juan, and Shaw). Stormwater from developed environments typically contain heavy metals (zinc and copper), nutrients (nitrogen), and bacterial contamination (fecal coliform bacteria) (Herrera and The Watershed Company 2011b). These constituents of concern can have detrimental effects on aquatic species such as forage fish and salmonids, can result in the closure of shellfish beds, and can affect the health of people that consume food harvested from these waters.

3.8.5 Other Shoreline Modifications

The physical diversity of the County does not end with natural features. Numerous structures that do not fit neatly into common modification types are common. These modifications include groins, jetties, marine railways (i.e., boat rails), mooring buoys, boat ramps, marinas, and even a nearshore hot tub (Whitman 2011). The impacts of these modifications are highly site- and modification-specific. The impacts can vary from having very little impact on the surrounding landscape to extremely detrimental, in the case of large, dredged marinas. Similarly, mooring buoys have been noted for their potential impact to substrate and aquatic vegetation conditions from dragging anchor lines. However, new anchoring techniques are being utilized which limit substrate disturbance (e.g. line floats, screw anchors, etc.). Table 15 provides the number of these modifications in each management area.

Table 15. Other Shoreline Modification Totals Within Each Management Area.

Reach Name	Groins	Marine Railways	Boat Ramps	Break-waters	Jetties	Marinas	Buoys	Floats	Pilings
Blakely	0	1	3	0	0	1	25	0	28
Decatur	1	1	3	0	1	3	165	2	92
Doe Bay	0	1	3	1	0	0	59	0	2
Eastsound	1	3	1	0	0	0	59	1	6
Fisherman Bay	5	1	3	0	0	5	164	6	40
Friday Harbor	3	1	6	0	0	4	75	2	19
Mud Bay	4	5	5	1	1	0	96	1	12
North Coast Eastsound	1	1	2	1	0	1	30	1	0
Olga	1	1	4	0	0	2	126	2	21
Roche Harbor	5	20	8	0	0	4	207	3	41
San Juan Channel	0	0	2	0	0	0	40	0	0
Shaw	4	6	8	0	0	3	127	16	33
Spencer Spit	3	3	3	0	0	1	93	2	10
Strait of Juan de Fuca	1	2	4	1	0	2	59	1	38
Stuart	1	2	5	0	0	2	132	15	23
Turtleback	0	4	1	1	0	0	59	3	36
Waldron	0	1	2	0	0	0	151	0	17
West Sound	0	1	7	1	0	8	122	15	7
Private Lakes	NDA	NDA	NDA	NDA	NDA	NDA	NDA	NDA	NDA
Public Lakes	NDA	NDA	NDA	NDA	NDA	NDA	NDA	NDA	NDA

Reach Name	Groins	Marine Railways	Boat Ramps	Break-waters	Jetties	Marinas	Buoys	Floats	Pilings
Total	30	54	70	6	2	36	1789	70	425

NDA = No data available.
Source: Shoreline modification data from the Friends of the San Juans (2009)

3.9 Lacustrine Shoreline Alterations

The lakes in the County are relatively unaltered compared to similar lakes in the Puget Lowland. A few of the lakes have small marina infrastructure on them, but these are not recorded in the County's GIS database. However, the most common alteration is the placement of roads, sometimes with armoring, next to the lakeshore. This occurs on Hummel Lake, Dream Lake, Sportsman Lake, Cascade Lake, and Martins Lake. In addition to the geomorphic disruption a road can cause, the road can also preclude shoreline vegetation. It can also affect hydrologic flows as they are concentrated through a culvert rather a natural channel. As mentioned before, several of the lakes are reservoirs (e.g., Briggs Lake, Trout Lake), meaning that they are a result (or partially a result) of the dams that made them. Most of these are used for drinking water supply and are therefore relatively undeveloped, despite their constructed origin.

3.10 Nearshore Key Habitats and Species Usage

The supratidal, intertidal, and subtidal zones of the nearshore that extend throughout the county's marine shoreline areas provide unique conditions to support many species that are dependent on the nearshore environment. Nearshore habitat is important to numerous sensitive, threatened and endangered species, many with cultural and commercial importance. Supporting habitat for salmon and other species includes kelp forests and eelgrass beds that extend throughout the County, and vegetated nearshore riparian areas. The diverse shoreline types present throughout the County are often suitable habitat for a variety of birds, forage fish, invertebrates, and vegetation; many are key sensitive species, but also form the habitat structure and food base to support upper trophic level species of birds, salmon, and marine mammals. Other San Juan County wildlife that dependent on shoreline habitat include river otter, mink, deer, fox, and raccoon. Freshwater nearshore areas, including many streams and 12 significant lakes provide additional structure and function to support foraging, breeding, and refuge opportunities for key species. Additional information regarding key nearshore species, and their occurrence and use of habitats in San Juan County, can be found in the literature review document *Best Available Science for Marine Fish and Wildlife Habitat Conservation Areas* (Herrera and The Watershed Company 2011).

3.10.1 Tidal and Freshwater Wetlands

Most of the tidal and freshwater wetlands in Washington have been altered by changes including channelization, dredging, diking, filling of wetlands and tidal areas, and degraded water quality. The alteration and loss of tidal and freshwater wetland habitat by factors such as urbanization, agriculture, forestry and water resource development has been extensive throughout the Puget

Sound region. In 2000, it was estimated that 39 percent of Puget Sound coastal wetlands and 70 percent of emergent wetlands have been lost (Ecology 2000).

In San Juan County, the nearshore includes many tidal wetlands classified as pocket estuaries that offer juvenile salmon refuge from predation and increased food resources. In the County, many of these pocket estuaries are protected by barrier beaches. These pocket estuaries have the potential to be impacted by loss of sediment supply, which causes erosion of the barrier beach and ultimately compromise their ability to function properly (Megan Dethier, personal communication, October 2011). Surveys also suggest considerable nearshore use of pocket estuaries by lingcod, greenling, surf smelt; and pink, Chinook, coho and chum salmon (Beamer et al. 2008; Beamer and Fresh 2012).

Table 16 provides the estimated area of tidal and freshwater wetland habitat identified by Adamus and EarthDesign (2010) for San Juan County found within the shoreline jurisdiction for each management area.

Table 16. Tidal and Freshwater wetlands within Shoreline Jurisdiction of Management Areas.

Management Area	Tidal Wetland (acres)	Freshwater Wetland (acres)
Blakely	0	2.2
Decatur	13.4	6.1
Doe Bay	0	0
East Sound	0.3	32.4
Fisherman Bay	41.4	23.1
Friday Harbor	23.6	15.0
Mud Bay	29.7	22.2
North Coast Eastsound	1.7	58.9
Olga	0.9	5.6
Roche Harbor	51.3	100.0
San Juan Channel	0	9.8
Shaw	2.1	3.1
Spencer Spit	6.0	64.8
Strait of Juan de Fuca	2.6	46.2
Stuart	1.3	7.0
Turtleback	0	7.2
Waldron	0	22.3
Westsound	1.9	5.5
Private Lakes	0	349.1
Public Lakes	0	0.9

Source: Adamus and Earth Design (2010)

Habitat modifications resulting from development tend to reduce the overall amount of habitat, and reduces the general productivity of tidal and freshwater wetlands, which limits overall utility of these areas for birds and aquatic organisms rearing, cover, foraging, and migration. Some of the important functions affected (Adamus 2006) include:

- **Providing Habitat**: Tidal and freshwater wetlands create a rich nursery environment for aquatic and terrestrial species. Tens of thousands of birds, mammals, fish, and other wildlife species rely on tidal and freshwater wetland habitats to live, feed, and reproduce.

- **Primary Production**: Acre for acre, estuaries and freshwater wetlands are among the most biologically productive ecosystems on earth.

- **Erosion and Flood Control**: Tidal and freshwater wetlands serve as buffers, protecting shorelines from erosion and flooding.

- **Pollutant Filter**: Tidal and freshwater wetlands filter pollutants, and improve water quality.

Tidal wetlands occur throughout the county, primarily in the Roche Harbor, Fisherman Bay, Mud Bay, and Friday Harbor management areas. Freshwater wetlands are most prevalent in the Rural Lakes management area.

Wetlands are protected and their development is regulated on federal, state, and local levels. However, wetland habitat may be threatened by historic and continued development if protection, mitigation, and restoration do not adequately ensure no net loss of important functions. Even development of non-regulated adjacent lands can adversely affect wetlands and influence their functional quality. For example, in tidal embayments with little circulation, where the less-dense fresh water floats on top of the seawater, increasing stormwater flows increase the thickness of the freshwater layer, enhances stratification, and potentially reduces the oxygen in deeper areas. Estuaries and wetlands are particularly sensitive to changes in the timing and volume of freshwater discharges since plant community composition is determined by sedimentation, water level, flood tolerance, and salinity gradients. Where shoreline wetlands filter incoming runoff, increased and more frequent flows may not allow water to infiltrate, and may cause wetlands to export rather than trap nutrients (Lee et al. 2006). Also, ground and vegetation disturbance that may occur during the development of adjacent land areas, typically create conditions for invasive non-native plant growth that can spread into wetlands and their buffers.

3.10.2 Streams and Nearshore Riparian Areas

Most streams in San Juan County are small and many do not support anadromous or resident salmonids (presence and habitat use in streams is described further in the section on Fish and Fish Habitat in this report). Many streams in the San Juans no longer support anadromous fish spawning, rearing, or migration because of extensive anthropogenic modification of stream hydrology and geomorphology (dams, perched culverts, water withdrawal, channelization, and

sedimentation as examples). In many cases, withdrawals for potable water and irrigation exceed the minimum instream flows needed to support anadromous fish. In addition to improving hydrologic and geomorphologic stream conditions, the restoration of anadromous fish use of San Juan Island streams would likely require establishing minimum instream flow reservations in suitable habitat.

Often streams in San Juan County are also impacted by heavy sediment loading resulting from unpaved roads, lack of buffers, and poor riparian management, including unrestricted livestock access to stream corridors. During summer, some streams dry out and become choked with invasive vegetation including reed canarygrass, particularly in agricultural areas. The numerous dams and ponds inhibit instream flow, particularly during May to December.

Stream mouths are important habitat within the marine shoreline, bringing fresh water, food sources, and nutrients to the marine environment. Anadromous fish feed and take cover at these locations; areas that also allow fish to make the physiological transition from freshwater to saltwater.

The value of the San Juan Islands for salmon lies mainly in the diverse nearshore habitats. All twenty-two populations of Puget Sound Chinook salmon (as well as chum, pink, sockeye and coho salmon, use San Juan County's nearshore waters for feeding and migration as they move from inland freshwaters to the Pacific ocean (SSPS 2007; Wyllie-Echeverria 2008a; Wyllie-Echeverria and Barsh 2007; Beamer and Fresh 2012)). Typically cited nearshore habitat requirements of juvenile salmonids include (Simenstad 2000):

- Shallow-water, typically low-gradient habitats with fine, unconsolidated substrates
- The presence of aquatic vegetation, emergent marsh vegetation, and shrub/scrub or forested riparian vegetation
- Areas of low current and wave energy
- Concentrations of small, non-evasive invertebrates

Muddy deltas at stream mouths are one of several important nearshore habitats used by juvenile salmon in San Juan County (Wyllie-Echeverria and Barsh 2007). Nearshore riparian vegetation is also important to salmon and forage fish. For example, juvenile chum and coho salmon abundance is associated with terrestrial vegetation dominated by western red cedar and mosses characteristic of mature coastal forests (Romanuk and Levings 2006). In addition, terrestrial insects using riparian vegetation have recently been shown to be a large component of the diet of juvenile salmonids (Romanuk and Levings 2010). Sobocinski (2003) documented the importance of insect communities and benthic organisms that are either directly or indirectly associated with riparian vegetation. These lower trophic organisms serve as the basis of the food web for sensitive fish species that use the upper nearshore environment (Romanuk and Levings 2010;

Williams and Thom 2001). In addition, some fish and invertebrates feed directly on vegetative detritus (Brennan and Fresh 2004).

Although not consistently occurring across all shorelines, San Juan County includes areas that contain each of the habitat requirements listed above. For example, San Juan County beaches are mainly comprised of unconsolidated gravel and sand with variable compositions depending on position and wave energy. While parts of the county are exposed to high-energy waves from the Strait of Georgia and the Strait of Juan de Fuca, other portions are more sheltered and are characteristic of low wave energy conditions.

Nearshore riparian areas provide functions and important habitat for forage fish, birds, and other species in addition to salmon. Nearshore riparian areas provide functions that can affect the suitability of habitat for species including shellfish and marine mammals due to influences on water quality and food availability. Fish, birds, shellfish, and marine mammals are each discussed in corresponding sections of this report.

3.10.3 **Eelgrass and Kelp**

Intertidal and subtidal substrates along the shoreline support eelgrass including native (*Zostera marina*) and introduced (*Zosteria japonica*) species, and at least 17 species of kelp. Native eelgrass and kelp beds are a critical element of the nearshore zone because they form an important habitat for many sensitive species including salmon, forage fish, crab, and shrimp. Eelgrass provides both physical structure and trophic support for the biological community; it forms habitat that provides shelter and food. Eelgrass is nursery habitat for many sensitive species including salmon, and is an important spawning substrate for Pacific herring (Bostrom et al. 2006; Murphy et al. 2000; Mumford 2007; Penttila 2007).

Eelgrass and kelp are also carbon fixers, making them important to nearshore primary production. They provide a direct source of food for other species, contribute nutrients as they break down during senescence, and provide a substrate that provides the base of the food chain for other culturally and economically important species. The meadows provide refuge from current and wave energy, protect juvenile salmon from predation, and attract organisms that are important food sources for many species of fish, shellfish, and nearshore birds.

Eelgrass

Eelgrass commonly grows in low to moderately high-energy intertidal and shallow subtidal areas having a muddy or sandy substrate. Typically, eelgrass beds form near MLLW and extend to depths from about 6.5 feet (2 meters) above MLLW to 30 feet (9 meters) below MLLW. Eelgrass beds occur throughout the nearshore zone of San Juan County's shorelines (Washington Coastal Atlas 2010), usually as patches or narrow bands near the shore, or as solid meadows in the subtidal zone (Nelson and Waaland 1997). Eelgrass is found along roughly 20 percent of San Juan County Shoreline (SSPS 2007). However, the San Juan Archipelago has been experiencing declines in native eelgrass. Significant losses occurred in Westcott-Garrison Bays between 2000 and 2004 (Pentilla 2007; SSPS 2007), and between 1995 and 2004 there has been a steady decline in the abundance of eelgrass in the San Juan Archipelago. During this time, approximately 82 acres of eelgrass were lost from within 11 small embayments (Dowty et al. 2005; PSAT 2007).

Kelp

Kelps prefer high-energy environments with rocky substrate in lower intertidal or subtidal zones where currents renew available nutrients and prevent sediment from covering the plants. Most kelps occur in the shallow subtidal zone from MLLW to about 65 feet (20 meters) below MLLW (Mumford 2007).

Kelp forests are comprised of both floating and non-floating or understory species and both types occur in a patchy distribution throughout the subtidal zone of San Juan County's shorelines (Washington Coastal Atlas 2010). Floating kelp, otherwise known as bull kelp (N*ereocystis leutkeana*), occur along approximately 31 percent of the county's shoreline, while understory kelps (such as *Laminaria complanata*, *Costaria costata*. *Saccharina subsimplex*, and *Agarum fimbriatum*) occur along 63 percent (Mumford 2007). Of the 23 kelp species known to occur in Puget Sound (Mumford 2007), at least 17 have been observed in San Juan County, and were collected from subtidal sites at Cantilever Point, Reed Rock, Friday Harbor, Point George, Shady Cove, McConnell Island, and Burrows Bay (Garbary et al. 1999).

Kelps drive primary ecosystem productivity, and provide important habitat for many commercial and sports fish, invertebrates as well as marine mammals (Dayton 1985, Duggins et al. 1989, Steneck et al. 2002). Growth rates of benthic suspension feeders have been found to increase in the presence of organic detritus originating from kelps (Duggins et al. 1989) indicating the important role of kelps in the marine food chain.

Understory kelps moderate fluid transport near bottom sediments and provide physical structure that captures sediments and suspended particulates for transport to the seabed (Eckman et al. 1989). Kelp in general has been shown to dampen wave energy, which affects beach formation in terms of grain size and sediment accumulation.

Kelp habitat is also used by many fish species. Murphy et al. (2000) found greater densities of seven species of salmonids in habitat with kelp than without in Southeast Alaska. Research by WDFW found that juvenile salmon and surf smelt preferentially used kelp bed habitats (Shaffer 2003). Simenstad et al. (1979) found Chinook, coho, and chum salmon utilizing kelp beds in the Strait of Juan de Fuca. In addition, a similar study by Dean et al. (2000) found sculpin and rockfish primarily associated with kelps.

3.10.4 Shellfish Resources

San Juan County marine shorelines and waters provide habitat for numerous shellfish species including Pinto (or Northern) abalone (*Haliotis kamtschatkana*), sea urchins (*Strongylocentrotus* spp.), crab, shrimp, and various clam species. In general, shellfish depend on specific sediment compositions (such as grain size, amount of different grain and gravel sizes, and organic content). For example, shellfish such as littleneck clam (*Protothaca staminea*) and butter clam (*Saxidomus gigantea*) prefer sediment mixed with gravel and cobble (Dethier 2006).

Pinto Abalone

Pinto abalone occurs in San Juan County, although they are critically rare. Current population abundance of the species is not well known, and overharvest is thought to be a significant problem for this species (NMFS 2007; West 1997. Populations along the west coast of the United States and Canada have experienced dramatic declines in the last few decades (NMFS 2007; PSRF 2010). The only part of the inside waters of Washington where they are currently found is the San Juan Islands and the Strait of Juan de Fuca (Dethier 2006). Pinto abalone live in shallow subtidal rocky areas with moderate to high wave energies. They typically occur in the low intertidal zone in kelp beds along well-exposed coasts, and in depths up to 35 feet (10.7 meters) (PSAT 2007).

Sea Urchin

WDFW data indicate sea urchin distribution throughout much of San Juan County's shoreline, and their distribution is likely associated with the availability of rocky substrates (Dethier 2006). Sea urchins are herbivores that live in shallow to deep waters on rocky substrates, especially in the northern inside waters and the more exposed waters of the state (Dethier 2006). Sea urchins are critical agents of subtidal community structure in rocky areas due to their intensive grazing of young and adult seaweeds. They also support an important roe fishery in San Juan County.

Dungeness Crab

There is limited published information on the distribution and habitat use of Dungeness crab (*Cancer magister*) in San Juan County relative to other areas in the region. However, presence is well documented throughout the County, and intertidal and shallow subtidal areas along the shoreline provide suitable habitat for Dungeness crab. Dungeness crab distribution has been documented in Lopez Sound, Roche Harbor, False Bay, most of West Sound, East Sound (Buck Bay and Ship Bay), Reid Harbor, Cowlitz Bay, and surrounding Sucia Island. Juveniles are closely associated with cover in the intertidal that can consist of bivalve shells, eelgrass (*Zostera* spp.), gravel-sand substrates, and/or macroalgae (Thayer and Phillips 1977; Dinnel et al. 1986a; Dinnel et al. 1986b; as cited in Fisher and Velasquez 2008). These forms of cover provide juveniles a refuge from birds, fish, and many other predators (Eggleston and Armstrong 1995). Juveniles progressively move to deeper water as they grow (Fisher and Velasquez 2008). Intertidal habitats are critical for juvenile feeding as those areas can have prey densities higher than subtidal habitats (Fisher and Velasquez 2008).

Pandalid Shrimp

Pandalid shrimp (pandalidae), including several species such as humpy shrimp (*Pandalus goniurus*), are an arthropod that is considered a state priority species for recreational, commercial, and tribal importance, and for having vulnerable aggregations that are susceptible to population decline (WDFW 2008). Pandalid shrimp live mostly in the subtidal zone as adults (NMFS 2010a), but can occupy depths ranging from intertidal tide pools to more than 1,300 meters (Cadrin et al. 2004). They are usually over muddy substrate (ADFG 2010), but can occupy a range of habitats and substrates ranging from rocky to sand or mud (Cadrin et al. 2004).

Clams and Oysters

San Juan County shorelines provide relatively isolated patches of habitat for numerous oyster and clam species. This includes non-native Pacific oyster (*Crassostrea gigas*); various clams including native littleneck clam (*Protothaca staminea*), introduced manila clam (*Venerupis philippinarum*), varnish clam (*Nuttalia obscurata*), butter clam (*Saxidomus gigantea*), and geoduck clams, and mussels. Clams and oyster beds are documented in Westcott Bay and Ship Bay. Clam distribution also includes Griffin Bay, Mud Bay, and Lopez Sound in the general vicinity of Spencer Spit, and subtidal populations in isolated patches throughout the county's shorelines.

Shellfish growing areas in San Juan County include those at Buck Bay, East Sound, Hunter Bay, MacKaye Harbor, Mud Bay, Shoal Bay, Upright Channel, and Westcott Bay. Recreational shellfishing opportunities occur throughout much of San Juan County shorelines along public clam and oyster beaches (WDFW 2010e).

Commercial geoduck clam (*Panopea abrupta*) fisheries are not designated in San Juan County (WDFW 2010d). However, geoduck distribution is patchy throughout the Salish Sea. Commonly found in subtidal areas, geoduck can also occur in low intertidal zones. In San Juan County, it is likely precluded from most intertidal areas due to unsuitable habitat conditions, however small isolated patches of suitable habitat have been documented by WDFW.

3.10.5 **Fish and Fish Habitat**

Salmonid

All species of salmonids that occur in the northwest occur in the nearshore and adjacent waters of San Juan County. San Juan County shorelines and marine waters are an important habitat to Chinook salmon (*Oncorhynchous tshawytscha*) but large numbers of chum (*O. keta*), pink (*O. gorbuscha*), sockeye (*O. nerka*) and coho salmon (*O. kisutch*) are also found in the nearshore from early spring through late summer (Kerwin 2002; Beamer et al. 2008; Beamer and Fresh 2012). Steelhead (*O. mykiss*) and coastal cutthroat trout (*O. clarki clarki*) are also known to occur in the marine waters around the San Juan Islands (Kerwin 2002), and bull trout (*Salvelinus confluentus*) may also be present in the nearshore waters of the County (WDFW 2010c). Anadromous fish distribution in freshwater systems includes chum, coho, and kokanee salmon, and rainbow and coastal cutthroat trout. Table 17 summarizes the ESA listing status of each salmonid species and associated critical habitat designations.

Table 17. State and Federal Listing Status of Priority Salmonid Species Occurring in San Juan County.

Species	Washington State Status	Federal Status
Bull Trout/ Dolly Varden	Candidate	Threatened
Chinook Salmon	Candidate	Threatened
Chum Salmon	Candidate	Threatened
Coastal Res./ Searun Cutthroat	Not listed	Species of Concern
Coho	Candidate	Species of Concern

Species	Washington State Status	Federal Status
Kokanee	Not listed	Not listed
Pink Salmon	Not listed	Not listed
Rainbow Trout	Not listed	Not listed
Sockeye Salmon	Candidate	Not listed
Steelhead	Candidate	Threatened

All salmonid species are important based on WDFW listing status as priority species. Although there are no known natural Chinook spawning areas in the islands, all 22 populations of Puget Sound Chinook salmon use San Juan County's nearshore and marine waters for feeding and migration, making these areas an essential part of salmon recovery in Puget Sound (SSPS 2007). The nearshore zone also provides valuable direct or indirect habitat functions for other salmon species known to move through the marine waters during their outmigration from the many rivers and streams that enter the Strait of Georgia and Puget Sound.

In San Juan County, nearshore habitats important to salmonid species include kelp forests and eelgrass meadows, forage fish spawning areas, estuaries and intertidal wetlands (SSPS 2007) and nearshore riparian areas including stream mouths (Wyllie-Echeverria and Barsh 2007). Each of these key habitats is discussed in corresponding sections of this report.

Juvenile salmon move along the shallows of nearshore habitat and may be found throughout the year depending on species, stock, and life history stage. During their ocean phase, steelhead are generally found within 10 and 25 miles of the shore (Wydoski and Whitney 2003). Chinook salmon are highly dependent on estuarine habitats to complete their life history, and the timing of migration to saltwater is highly variable for this species. Juvenile chum salmon migrate quickly to saltwater as small fry and are therefore highly dependent on the nearshore environment. The recent study by Beamer and Fresh (2012) found juvenile salmonid use throughout the County shorelines, in a variety of shoreline types.

While quantitative studies remain limited, recent surveys (Wyllie-Echeverria and Barsh 2007; Beamer et al. 2008) in combination with historical and anecdotal reports (Barsh and Murphy 2007; Wyllie-Echeverria 2008a, 2008b) describe salmonid use of multiple estuarine and freshwater habitats in San Juan County. Surveys verified the presence of Chinook, chum, pink, and coho salmon at different times of the year utilizing the intertidal beaches in San Juan County, including those over course sediment (Barsh and Wyllie-Echeverria 2006; Wyllie-Echeverria and Barsh 2007). The largest numbers of salmon in 2006 were found along the beaches of Waldron Island and President Channel, the beaches of south Lopez, and the rocky shorelines of north San Juan (Barsh and Murphy 2007).

Surveys suggest considerable nearshore use of pocket beaches and bluff backed beaches by Chinook, coho and chum salmon (Beamer et al. 2008). Recent statistical modeling has shown that every mile of nearshore habitat could be used by juvenile salmonids (Beamer and Fresh 2012).

In nearshore waters of Puget Sound (Brennan et al. 2009), terrestrial insects have been shown to be a large component of the diet of juvenile salmonids (Romanuk and Levings 2010) and typically include insects such as midges and ants that swarm in late summer (personal communication with Russel Barsh, Kwiáht, December 29, 2010); comprising part of the coastal food web of particular importance to Chinook and coho (Johnson and Schindler 2009). Juvenile chum and coho salmon abundance is also associated with marine waters having shorelines with terrestrial vegetation dominated by western red cedar (*Thuja plicata*) and mosses characteristic of mature coastal forests (Romanuk and Levings 2006). In addition, juvenile use of coarser, higher energy beaches distinguishes the San Juan Islands from most of Puget Sound, where smolts tend to congregate in much more protected delta environments and pocket estuaries (Barsh and Murphy 2007). Coastal cutthroat trout have also been shown to extensively use nearshore areas in the County (Beamer and Fresh 2012).

Southern Pacific Eulachon

Southern DPS Pacific eulachon (*Thaleichthys pacificus*) are a small anadromous fish that use estuarine, marine, and stream habitat in the Salish Sea. On March 18, 2010, NMFS announced the listing of Pacific eulachon as a threatened species effective on May 17, 2010 (75 FR 13012). The southern DPS includes populations spawning in rivers south of the Nass River in British Columbia, Canada, to the Mad River in California including the major production area or core population of eulachon associated with the Fraser River (74 FR 10857). Critical habitat has not yet been designated but will be considered by NMFS in the future (75 FR 13012).

Details of their movement and habitat requirements in saltwater are largely unknown but surveys have shown concentrations off Vancouver Island (Willson et al. 2006) and occurrences in the Strait of Georgia (personal communication with Dan Penttila, WDFW biologist, May 7, 2010). Migrations from saltwater to streams for spawning typically peaks between April and May in the Fraser River (NMFS 2010b).

Available information indicates that eulachon may occur in along San Juan County shorelines and marine waters because larvae and juveniles become widely distributed by marine currents (74 FR 10857) The County shoreline is within an area that would be considered a migration route for eulachon juvenile out-migrants and adults returning to natal streams such as the Fraser River to spawn.

Forage Fish

Forage fish species play a critical role in the functioning of nearshore marine ecosystems in Washington State. The San Juan County shoreline provides known spawning and rearing habitat for important forage fish including Pacific herring (*Clupea pallasi*), Pacific sand lance (*Ammodytes hexapterus*), and surf smelt (*Hypomesus pretiosus*). In general, forage fish require specific substrate types (Pentilla 2007), clean water with low suspended sediment levels (Levings and Jamieson 2001; Morgan and Levings 1989), and suitable spawning and refuge habitat such as eelgrass beds.

Several studies in the San Juan Islands have documented the potential and actual use of nearshore marine habitats by forage fish (Penttila 1999, 2001; Wyllie-Echeverria and Barsh

2007; Friends of the San Juans 2004a,b,c). In San Juan County, roughly 80 miles of potential forage fish spawning beaches, and approximately 13 miles of documented spawning beaches, have been identified by WDFW and Friends of the San Juans (Friends of the San Juans 2004a; SSPS 2007).

Priority forage fish spawning regions were identified by Friends of the San Juans (2004b) in consultation with WDFW. The regions share the following characteristics:

- Spawn activity of multiple species of forage fish documented in region
- Multiple spawning sites documented in close proximity
- Spawn activity documented in multiple seasons
- Spawn activity documented in region by historic WDFW surveys (1989-1999) and by the San Juan County Forage Fish Spawning Habitat Assessment Project (2000-2003)

The four priority forage fish nearshore habitat regions identified for San Juan County include:

- Mud/Hunter Bay Region, Lopez Island
- West Sound and Blind Bay Region, Orcas and Shaw islands
- MacKaye Harbor Region, Lopez Island
- Greater Westcott Bay Region, San Juan Island

Pacific Herring

Two spawning stocks of Pacific herring are identified in San Juan County. One occurs in the Westcott Bay/Roche Harbor region (Northwest San Juan Island stock), and the second occurs in the eastern region of the county including Mud and Hunter bays on Lopez Island, West Sound and East Sound on Orcas Island, and Blind Bay on Shaw Island (Interior San Juan Island stock) (Penttila 1999; Stick and Lindquist 2009).

WDFW describes the Northwest San Juan Island stock as "disappearance", meaning it can no longer be found in its formerly consistently utilized spawning ground (Stick and Lindquist 2009). The Interior San Juan Island stock is considered "depressed", meaning recent abundance is well below the long-term mean, but not so low to expect recruitment failure (Stick and Lindquist 2009). The presence of Pacific herring has also been documented around stream mouths and marine beaches on Orcas, Shaw, and Waldron islands (Barsh and Wyllie-Echeverria 2006; Wyllie-Echeverria and Barsh 2007).

Pacific herring use the nearshore environment for all of their life-history stages. Herring primarily use eelgrass and marine algal turf as a spawning substrate but may also use middle intertidal boulder/cobble rock surfaces with little or no macroalgae (Penttila 2007). In San Juan County, spawning generally occurs on eelgrass or a fibrous red alga known as *Gracilariopsis* (Penttila 1999). Beamer and Fresh (2012) found juvenile herring to have the highest probability of presence for pocket beaches.

Surf Smelt and Sand Lance

Like Pacific herring, surf smelt use nearshore habitat for all of their life-history stages. The spawning habitat of this species resembles that of surf smelt; they typically spawn in the upper third of the intertidal zone, in sand-sized substrate (Penttila 2007). As a result, these two species often use the same beaches and co-occurrence of eggs is common during winter when spawning seasons overlap. Depositional shore forms such as beaches at the far ends of drift cells and sandy spits support sand lance spawning.

Moulton (2000) identified potential spawning habitat for surf smelt and sand lance on 24 islands in the area, with Lopez Island having the greatest potential habitat areas, followed by San Juan and Orcas Island. The presence of Pacific herring, surf smelt, and Pacific sand lance have also been documented around stream mouths and marine beaches on Orcas, Shaw, and Waldron islands (Barsh and Wyllie-Echeverria 2006; Wyllie-Echeverria and Barsh 2007). Currently, surf smelt spawning has been documented at 59 sites in San Juan County, while Pacific sand lance spawning has been documented at eight beaches (Friends of the San Juans 2004a; SSPS 2007).

Eelgrass is also important habitat for surf smelt and other forage fish species as it provides refuge (Penttila 2007). The protection and enhancement of physical processes and conditions that support and maintain this habitat are important considerations for shoreline management. As with other species that depend on specific substrate types in the nearshore environment, the recruitment and transport of substrate along the shoreline strongly influence the quality and quantity of available spawning habitat. These processes influence the distribution of spawning substrate, as well as submerged aquatic vegetation used by herring and other species. Beamer and Fresh (2012) found surf smelt to have the highest probability of presence for barrier beaches while sand lance probabilities were more varied across management units and shoreline type.

Rock fish

Rock sole (*Lepidopsetta bilineata*) are a species of flat fish preferring sand and mud bottom substrates generally in waters less than 120 feet deep (JRB Associates 1984). Spawning has been documented primarily in the extreme south of Puget Sound (Lowery 2012) and is much rarer, although present. in the San Juan Islands. They spawn in the intertidal and subtidal zones between mid-winter and summer (NMFS 2012). In the Puget Sound region including the San Juan Islands, their specific spawning habitats and substrates are uncertain. However, eggs have been observed in forage fish spawning beach surveys in Puget Sound, often where piers or pilings are present. Their spawning areas may not overlap with forage fish. The eggs are non self-adhesive (Lowery 2012) and may mix and settle into intertidal areas that are used by forage fish for spawning. Rock sole larvae develop in the upper water column of shallow waters where they consume small zooplankton. Adults feed on benthic invertebrates in deeper waters where spawning may also occur (Horton 1989).

Other Fish

The presence of habitat features such as eelgrass beds and suitable substrates that support prey resources is indicative of the importance of the shoreline for salmon as well as groundfish and other species. Along with anadromous salmon that depend on the nearshore environment for rearing and migration, over 200 species of fish have been identified in the Puget Sound region

(Gelfenbaum et al. 2006). Commercial marine fish species include Pacific hake (*Merluccius productus*), Pacific cod (*Gadus macrocephalus*), walleye pollock (*Theragra chalcogramma*), spiny dogfish (*Squalus acanthias*), lingcod (*Ophiodon elongatus*), English sole (*Pleuronectes vetulus*), and various rockfish species (*Sebastes* spp.). Nineteen species of rockfish have been observed in the San Juan Archipelago (Wyllie-Echeverria and Sato 2005). Of these, three species are federally listed under the ESA, including Boccacio (*Sebastis paucispinis*), canary rockfish (*S. pinniger*), and yelloweye rockfish (*S. ruberrimus*) (75 FR 22276).

Habitat features within the nearshore zone likely provide direct or indirect benefit to numerous marine species. For example, although typically occurring at depths (more than 40 meters) that are greater than the nearshore environment, Pacific hake depend on species including Pacific herring, smelt, crabs, and shrimp for food. Areas containing kelp and eelgrass beds, and providing adequate substrate and habitat structure for species in the nearshore, contribute to the long term success and viability of other species such as Pacific hake. Similarly, kelp and eelgrass habitats support rockfish species, particularly during their larval and juvenile stages. Hence, kelp and eelgrass habitats are essential for the survival of these species. In general, rockfish species rely on shallow surface waters (including those containing kelp and eelgrass) and distribution by currents; and then are associated with deeper rocky habitats as they mature (Wyllie-Echeverria and Sato 2005).

3.10.6 Priority Habitats and Species

The priority habitats and species (PHS) (WDFW 2010c) within the County occur along forested bluffs, beaches, intertidal, subtidal, and marine waters, and throughout the nearshore waters. Inland lakes and freshwater streams, and associated wetlands and uplands, also contain priority habitats for wildlife and provide water quality maintenance, and flood control functions. These habitats are crucial for a variety of mammals (including marine mammals), birds, and fish. San Juan County has significant tracts of undeveloped shoreline with cliffs, mature second-growth forest, shrub, and prairie habitats that, if protected, will continue to provide significant and unique habitats that are now rare in the Puget Sound. *The Best Available Science for Marine Fish and Wildlife Habitat Conservation Areas* (Chapter 3) (Herrera and The Watershed Company 2011) provides detailed information on the County's priority habitats and species, both upland and marine. In addition, management recommendations and limiting factors for priority habitats and species can be found on WDFW's web site: http://wdfw.wa.gov/conservation/phs/mgmt_recommendations/.

Appendix B summarizes the priority species and habitats known to occur in San Juan County. These include species that are also protected at the state and federal level and is not an exhaustive list of species that may occur within the study area. Fish and shellfish species are discussed under the Fish and Fish Habitat and Shellfish Resources sections of this report. The remaining species on the list: mammals, birds, amphibians, and insects are briefly discussed below if they are highly reliant on shoreline areas or have a significant presence in the shoreline areas of San Juan County. Species that do not occur in the shoreline habitat are not discussed further.

3.10.7 Marine Mammals

Priority marine mammals that are likely to occur in, or rely on, shoreline habitats in San Juan County include the Southern Resident population of killer whale, grey whale, humpback whale, Steller sea lion, sea otter, and harbor seal. Each is described in the following sections.

Southern Resident Killer Whale

The Southern Resident DPS of killer whales (*Orcinus orca*) was listed as endangered on February 16, 2005 (70 FR 69903). Critical habitat was designated for this species on November 29, 2006 (71 FR 69054). The Southern Resident population consists of three pods that numbered 87 whales in 2007 (NMFS 2008a).

The Whale Museum in Friday Harbor keeps a database of verified sightings by location quadrants or "quads." Sightings may be of individual or multiple whales. Frequent sightings occur in the San Juan Islands (Orca Network 2010a), and in 2009 the population using Puget Sound and the waters of the San Juan Islands included 85 individual whales (PSP 2010).

The San Juan County shoreline lies within ESA-designated critical habitat for the Southern Resident killer whale. There are three specific areas designated as critical habitat. In addition to Haro Straight and the waters around San Juan Island, the other Summer Core Areas are in the Strait of Juan de Fuca and Puget Sound. Areas with water less than 20 feet deep relative to the extreme high water mark are not included in the critical habitat designation (71 FR 69054), a demarcation that excludes some of the nearshore elements of the county's shorelines.

Gray Whale

The Eastern North Pacific population of gray whales was delisted from endangered status under the ESA in 1994 but is still considered "sensitive". National Marine Fisheries Service (NMFS) completed a status review in 1999 (Rugh et al. 1999) and retained the unlisted status of the population based on population trends (NMFS 2010c). In October 2010, NMFS was petitioned to conduct a status review of the Eastern North Pacific population to determine whether to list the population as "depleted" under the Marine Mammal Protection Act (75 FR 68756). This petition is currently under review.

Gray whales travel annually between feeding grounds in Alaska and breeding grounds in Mexico. They migrate north along the Pacific coast typically between mid-February and May, and return to their breeding grounds in the fall (NMFS 2010c). Summer feeding grounds are primarily located offshore of Northern Alaska and the Bering Sea but there are indications that the gray whale population may be expanding its summer range in search of alternative feeding grounds. Gray whales are increasingly sighted in the inland waters of Washington and British Columbia, usually during their migration north in the spring (Orca Network 2010b). Although gray whale occurrences may be rare, they pass through San Juan County marine waters during their migration and foraging forays into the inland waters.

Humpback Whale

Humpback whales were listed as endangered on June 2, 1970 (35 FR 8491). Critical habitat has not been designated for this species. Humpback whales migrate to Alaska during the summer to feed. The Washington coast is a corridor for their annual migration north to feeding grounds and south to breeding grounds (Osborne et al. 1988).

Although rare in the inside waters of Washington and British Columbia, humpback whales have been sighted with increasing frequency in recent years (Falcone et al. 2005). Since 2001, sightings of humpback whales reported through the Orca Network have increased annually. Thirteen unique individuals were identified in inside waters of Washington and British Columbia in 2003 and 2004, of which one was a juvenile identified in the San Juan Islands (Falcone et al. 2005). Due to their migration pattern, humpback whales are most likely to occur in San Juan County waters in late spring and early summer but have also been sighted in other seasons.

Steller Sea Lion

Steller sea lion (*Eumetopias jubatus*) was listed as threatened on April 10, 1990 (62 FR 30772). Critical habitat was designated for Steller sea lions on March 23, 1999 (64 FR 14051); however, all designated critical habitat lies outside Washington State. Although federally designated critical habitat areas are all located outside San Juan County, habitat that is considered "essential to the conservation of the Stellar sea lion" includes the "physical and biological habitat features that support reproduction, foraging, rest, and refuge" (58 FR 45269).

In the fall, winter, and spring months an estimated 800 to 1,000 Stellar sea lions move through the Strait of Juan de Fuca and Strait of Georgia to feed on Pacific hake and dense herring stocks that spawn in British Columbia (PSAT 2007). Haul-outs and rookeries tend to be preferentially located on exposed rocky shoreline, wave-cut platforms, ledges, or rocky reefs (NMFS 2010b). In San Juan County Whale Rock, Bird Rocks, Peapod Rocks, Spieden Island, and Sucia Island provide haul-out sites for relatively small numbers (PSAT 2007). Steller sea lions have also been observed hauled out on rock reefs associated with outer islands, for example, the reefs at the east-northeast end of Patos Island. Although these sites are not considered "major haul-outs" which have been designated as critical habitat, these haul-out sites provide Stellar sea lions with opportunities for rest, foraging, and refuge.

Sea Otter

Abundance of sea otters (*Enhydra lutris*) has increased overall since 1989, with an estimated population of over 800 sea otters (PSAT 2007) that occur in large groups (50 to 100 individuals) along the Olympic Peninsula coastline and western Strait of Juan de Fuca. The population range is thought to extend from Kalaloch to the western Strait of Juan de Fuca. Although dispersion from this "core range" is rare, distribution shifts have been noted (Lance et al. 2004), and sea otters have been sighted in the eastern Strait of Juan de Fuca, San Juan Islands near Cattle Point, and within southern Puget Sound (Lance et al. 2004). Systematic surveys have not been conducted in the inland waters of Washington.

Throughout their range, sea otters use a variety of shallow coastal habitats. Sea otters are mostly associated with rocky substrates supporting kelp beds, but they also frequent soft-sediment areas where kelp is absent (Lance et al. 2004). Although sea otter occurrences in San Juan County are rare, the presence of suitable habitat and foraging opportunities indicate that the county's shorelines may be an important area for sea otters.

Harbor Seals

Harbor seals (*Phoca vitulina richardsi*) are the most abundant marine mammal in Puget Sound. Although curious, they are shy animals and prefer quiet, unpopulated areas.

Seals haul-out on protected beaches, spits, bars, rocks and log rafts to bask in the sun and sleep. Harbor seals often haul-out at low tide to digest food, rest, give birth, or nurse young. Pupping occurs in June and July along the Strait of Juan de Fuca and the San Juan Islands. Documented haul-out sites are located throughout San Juan County, generally on small islands and rocks near Stuart and Spieden islands, Henry Island, along the San Juan Channel, the Sucia archipelago, and the exposed southern shoreline of Lopez Island.

3.10.8 Birds

Many species of sea birds, raptors, and waterfowl use the forested bluffs, beach, nearshore, intertidal, estuarine wetlands, freshwater streams and lakes, and deeper marine waters within and surrounding the County. Birds use these habitats for cover, perching, foraging, feeding, and nesting.

Many shorebirds travel thousands of miles a year, flying between South America and Alaska or Canada. During the spring and late summer, migrating shorebirds are usually seen resting and feeding on Salish Sea beaches. The Puget Sound Nearshore Partnership (PSNP) has identified three signature nearshore shorebird species: surf scoter (*Melanitta perspicillata*), black oystercatcher (*Haematopus bachmani*), and dunlin (*Calidris alpina*). Surf scoters and dunlins spend much of the nonbreeding period in the Salish Sea region and migrate to boreal or Arctic areas to breed; the black oystercatcher is essentially a permanent resident. All of these species use the nearshore habitat along the County shorelines. Other than use of agricultural fields by dunlins, all three species are associated with the marine environment.

Bald eagles, great blue herons, or peregrine falcons may perch on trees on shoreline bluffs or large woody debris in estuaries and feed in the marine waters along the County shoreline. Bird species commonly associated with shorelines and listed by federal or state agencies as endangered, threatened, or sensitive and which occur regularly in San Juan County include marbled murrelet, bald eagle, and peregrine falcon. Each of these species is discussed in the following sections.

Other bird species, and breeding or non-breeding concentrations, are also considered priority species. Although they are not listed as endangered, threatened, or sensitive, these important species are considered protected under state and local regulations. Common loon, for example, is frequently observed in San Juan county marine waters where they feed on forage fish, an important food source. Other protected species of birds that use the shoreline include great blue

heron, purple martin, concentrations of cormorants and terns, waterfowl, and cavity nesting ducks.

Marbled Murrelet

The marbled murrelet was Federally listed as threatened under the Endangered Species Act in Washington, Oregon and California on September 28, 1992 (57 FR 45328). Critical habitat was established for these birds on September 12, 2006, and covers the entire marine shoreline along the San Juan County and the other marine shorelines throughout Puget Sound. Critical habitat was proposed to be revised in 2008, but no ruling has yet occurred. A recovery plan for Washington, Oregon and California populations is in effect (USFWS 1997).

Adults commonly fly between the nest and sheltered marine waters where they feed on forage fish and small marine invertebrates. No nests are confirmed in the County. However survey efforts have been limited, and suitable habitat conditions (including mature forests and food availability) suggest potential nesting. Also, marbled murrelet adults and young have been observed along the shoreline during the breeding season.

The habitat along the County shoreline is excellent for providing prey species for marbled murrelet and other seabirds. Marbled murrelets feed on herring, Pacific sand lance, and smelts, all of which occur within the intertidal and nearshore habitat along the County shoreline. The Seattle Audubon Society indicates areas of concentration along the south shore of Lopez Island and Obstruction and Peavine Passes between Orcas and Blakely islands.

Bald Eagle

Bald eagles are commonly associated with marine or lake shorelines where they often attracted by the presence of live or dead fish and other prey items. They nest in tall trees (generally greater than 85 feet in height) usually within 0.25 miles of shorelines. While the bald eagle was delisted from a federal ESA status of Threatened in 2008, it is still protected under the Bald Eagle Management Act, and is a state Sensitive species that requires protection. Nest sites were identified throughout San Juan County shorelines.

Peregrine Falcon

Similarly, peregrine falcon is a state listed sensitive species. At least 20 pairs of birds are known to regularly nest in the County. Individuals from other areas commonly forage along the county's shorelines. Although they use a wide variety of open habitats, peregrine falcons are similar to bald eagles in that they are associated with marine and lake shorelines where waterfowl concentrate or nesting seabird colonies are present and provide foraging opportunities.

3.10.9 Federally Listed Species

The San Juan County shoreline and associated estuaries and wetlands provide excellent habitat for marine mammals, shorebirds, seabirds, raptors, and other waterfowl. Endangered and threatened mammals and bird species are addressed under the Marine Mammals and Birds sections of this report. Listed fish species are addressed under the Fish and Fish Habitat section.

3.11 Predicted Juvenile Fish Presence Based on Shoreline Type

Knowledge of fish use in the marine waters of San Juan County is limited by the lack of available datasets that cover the entire County. As discussed in Section 3.10.5 numerous authors have reported on fish use of the County, however published Countywide datasets only cover fish use of streams within the islands (WDFW 2010b). Reliance on documented observations in published studies is helpful, but does not provide an adequate picture of the role of marine shorelines in sustaining the County's fisheries.

It is well known that the San Juan Islands offer diverse nearshore habitats that serve as nursery grounds to migrating juvenile salmonids from other watersheds (Kerwin 2002). There are few spawning streams in the County and most salmon using San Juan County shorelines originate from outside the County. Nevertheless, the islands are an important refuge and resting area for salmon migrating to and from other areas, such as the Fraser, Skagit, and Samish rivers.

In addition, as mentioned previously, the San Juans are a source of forage fish, which provides a food source to sub-adult and adult salmon on return migrations (Kerwin 2002). Forage fish found within or expected in the nearshore marine habitats of the County include Pacific herring, surf smelt, and Pacific sand lance. There are also numerous known herring spawning areas and documented surf smelt and sand lance spawning beaches. The identification of species and habitats for fish are ongoing, and fisheries resources continue to be researched in the San Juans to fill data gaps that are critical to successful fisheries recovery efforts.

A key data gap is a better understanding of fish use of the County's shorelines. The attributes of preferred shoreline types can be an important limiting factor in the recovery of populations (Mortensen et al. 2000). In an effort to better understand what fish preferences are for shoreline habitat types, Beamer and Fresh (2012) performed 1,375 beach seine sets at 82 different sites throughout the San Juan Islands over a two-year period in 2008 and 2009. Then, Beamer and Fresh (2012) used the beach seine data to develop a model that would predict juvenile fish use of County shorelines. The beach seine sites were selected to represent different regions within the San Juans and different geomorphic shoreline types. Heavily modified shorelines where shoreline type could not be determined were not included as beach seine sites. The results of the beach seines are the basis for predicting juvenile fish presence based on shoreline type; thus indicating preferred habitats. All fish species included in the model were juvenile, unmarked (therefore assumed to be wild) and included Chinook salmon, chum salmon, pink salmon, herring, sand lance, surf smelt, lingcod, and greenling (Hexigramids).

Table 18 provides the length of shoreline type for each management area and the probability of juvenile fish presence associated with that shoreline type for juvenile Chinook, chum, and pink salmon; lingcod and greenling; and the forage fish surf smelt, sand lance, and herring. Note that the reach extents included within each management area defined for this inventory and characterization report do not always match the reach extents used by Beamer and Fresh (2012). Consequently, there are differences between results for similar areas reported in Beamer and Fresh (2012) and those in Table 16 that are attributable to differences in reach boundary extents. For example, Beamer and Fresh report Chinook presence probability for the Waldron Island-

President Channel area as 25 percent for rocky shoreline. However, for the Waldron Management Area as defined for this report, Chinook salmon has a presence probability on rocky shoreline of 23 percent. In most cases, the differences are minor, but it is important to understand the reason (i.e., differences in reach boundary extents).

Table 18. Probability of Juvenile Fish Presence by Shoreline Type.

			Beamer and Fresh Shoreline Type[1]				
			Barrier Beach	Bluff Backed Beach	Pocket Beach	Pocket Estuary Like	Rocky Shoreline
BLAKELY ISLAND MANAGEMENT AREA	**Length (mi) of shoreline type[2] (% of mgmt area)[3]**		.55 (4%)	5.59 (42%)	.74 (5%)	.48 (4%)	6.09 (45%)
	Juvenile Fish Presence Probability	Chinook	13%	18%	61%	5%	20%
		Chum	22%	43%	94%	19%	62%
		Pink	38%	55%	81%	23%	74%
		Lingcod and Greenling	56%	64%	95%	30%	79%
		Surf Smelt	42%	22%	33%	20%	8%
		Sand Lance	25%	30%	59%	3%	50%
		Herring	13%	20%	46%	8%	24%
DECATUR ISLAND MANAGEMENT AREA	**Length (mi) of shoreline type[2] (% of mgmt area)[3]**		1.59 (9%)	4.65 (25%)	1.32 (7%)	.56 (3%)	10.32 (56%)
	Juvenile Fish Presence Probability	Chinook	19%	28%	33%	14%	14%
		Chum	28%	57%	61%	35%	49%
		Pink	44%	67%	58%	35%	62%
		Lingcod and Greenling	63%	73%	76%	39%	70%
		Surf Smelt	47%	26%	26%	26%	7%
		Sand Lance	33%	42%	35%	7%	37%
		Herring	15%	24%	34%	12%	21%
DOE BAY MANAGEMENT AREA	**Length (mi) of shoreline type[2] (% of mgmt area)[3]**		0 (0%)	2.31 (11%)	4.27 (21%)	.06 (<1%)	13.67 (67%)
	Juvenile Fish Presence Probability	Chinook	NA	19%	31%	10%	13%
		Chum	NA	66%	96%	45%	75%
		Pink	NA	51%	55%	28%	57%
		Lingcod and Greenling	NA	80%	96%	45%	87%
		Surf Smelt	NA	7%	7%	7%	2%
		Sand Lance	NA	33%	40%	7%	42%
		Herring	NA	24%	42%	13%	25%

			Beamer and Fresh Shoreline Type[1]				
			Barrier Beach	Bluff Backed Beach	Pocket Beach	Pocket Estuary Like	Rocky Shoreline
EAST SOUND MANAGEMENT AREA	**Length (mi) of shoreline type[2] (% of mgmt area)[3]**		.44 (3%)	2.76 (17%)	2.36 (15%)	.00 (<1%)	10.51 (65%)
	Juvenile Fish Presence Probability	Chinook	14%	19%	29%	4%	11%
		Chum	18%	36%	49%	26%	38%
		Pink	27%	40%	44%	30%	46%
		Lingcod and Greenling	55%	63%	73%	36%	66%
		Surf Smelt	18%	10%	12%	16%	4%
		Sand Lance	11%	14%	16%	4%	17%
		Herring	8%	13%	20%	5%	12%
FISHERMAN BAY MANAGEMENT AREA	**Length (mi) of shoreline type[2] (% of mgmt area)[3]**		3.01 (20%)	8.28 (55%)	.03 (<1%)	3.13 (21%)	0.51 (3%)
	Juvenile Fish Presence Probability	Chinook	5%	7%	10%	3%	5%
		Chum	19%	37%	48%	23%	40%
		Pink	35%	53%	52%	27%	58%
		Lingcod and Greenling	70%	79%	96%	45%	78%
		Surf Smelt	40%	21%	26%	23%	6%
		Sand Lance	28%	32%	40%	7%	32%
		Herring	8%	12%	19%	6%	11%
FRIDAY HARBOR MANAGEMENT AREA	**Length (mi) of shoreline type[2,4] (% of mgmt area)[3]**		1.76 (8%)	4.67 (21%)	2.96 (13%)	1.09 (5%)	11.55 (52%)
	Juvenile Fish Presence Probability	Chinook	5%	8%	14%	4%	5%
		Chum	18%	40%	58%	25%	43%
		Pink	35%	52%	57%	28%	58%
		Lingcod and Greenling	73%	80%	96%	45%	87%
		Surf Smelt	42%	20%	22%	22%	6%
		Sand Lance	30%	34%	35%	6%	38%
		Herring	8%	10%	14%	5%	10%

			Beamer and Fresh Shoreline Type[1]				
			Barrier Beach	Bluff Backed Beach	Pocket Beach	Pocket Estuary Like	Rocky Shoreline
MUD BAY MANAGEMENT AREA	**Length (mi) of shoreline type[2] (% of mgmt area)[3]**		1.21 (4%)	3.73 (14%)	3.77 (14%)	2.17 (8%)	16.16 (60%)
	Juvenile Fish Presence Probability	Chinook	13%	20%	20%	5%	8%
		Chum	21%	44%	67%	19%	51%
		Pink	37%	56%	67%	23%	69%
		Lingcod and Greenling	56%	65%	62%	30%	55%
		Surf Smelt	42%	23%	25%	20%	7%
		Sand Lance	24%	31%	22%	3%	21%
		Herring	13%	21%	28%	8%	16%
NORTH COAST EASTSOUND MANAGEMENT AREA	**Length (mi) of shoreline type[2,5] (% of mgmt area)[3]**		.63 (14%)	2.02 (47%)	.20 (5%)	.24 (5%)	.65 (15%)
	Juvenile Fish Presence Probability	Chinook	24%	28%	38%	10%	17%
		Chum	36%	72%	96%	45%	75%
		Pink	50%	65%	61%	28%	66%
		Lingcod and Greenling	73%	83%	96%	45%	88%
		Surf Smelt	30%	12%	11%	7%	3%
		Sand Lance	42%	45%	44%	7%	48%
		Herring	23%	31%	46%	13%	29%
OLGA MANAGEMENT AREA	**Length (mi) of shoreline type[2] (% of mgmt area)[3]**		.05 (<1%)	4.55 (33%)	1.43 (10%)	.14 (1%)	7.58 (55%)
	Juvenile Fish Presence Probability	Chinook	14%	20%	34%	10%	12%
		Chum	18%	40%	53%	23%	39%
		Pink	27%	43%	45%	21%	46%
		Lingcod and Greenling	55%	65%	74%	34%	66%
		Surf Smelt	18%	11%	14%	10%	4%
		Sand Lance	11%	17%	20%	3%	19%
		Herring	8%	14%	24%	7%	14%

			Beamer and Fresh Shoreline Type[1]				
			Barrier Beach	Bluff Backed Beach	Pocket Beach	Pocket Estuary Like	Rocky Shoreline
ROCHE HARBOR MANAGEMENT AREA	**Length (mi) of shoreline type[2,6] (% of mgmt area)[3]**		1.12 (3%)	9.37 (28%)	3.83 (12%)	3.76 (11%)	14.66 (44%)
	Juvenile Fish Presence Probability	Chinook	12%	17%	28%	8%	11%
		Chum	21%	42%	54%	25%	42%
		Pink	12%	19%	15%	8%	16%
		Lingcod and Greenling	50%	58%	65%	30%	59%
		Surf Smelt	31%	16%	19%	18%	5%
		Sand Lance	15%	19%	20%	3%	21%
		Herring	10%	16%	27%	9%	16%
SAN JUAN CHANNEL MANAGEMENT AREA	**Length (mi) of shoreline type[2] (% of mgmt area)[3]**		0 (0%)	0 (0%)	2.37 (19%)	.22 (2%)	9.59 (79%)
	Juvenile Fish Presence Probability	Chinook	NA	NA	23%	7%	9%
		Chum	NA	NA	85%	40%	67%
		Pink	NA	NA	72%	37%	75%
		Lingcod and Greenling	NA	NA	96%	45%	88%
		Surf Smelt	NA	NA	10%	9%	3%
		Sand Lance	NA	NA	20%	3%	21%
		Herring	NA	NA	0%	0%	0%
SHAW MANAGEMENT AREA	**Length (mi) of shoreline type[2,7] (% of mgmt area)[3]**		.49 (1%)	2.48 (7%)	5.88 (16%)	1.34 (4%)	25.58 (71%)
	Juvenile Fish Presence Probability	Chinook	6%	9%	18%	5%	7%
		Chum	21%	41%	70%	27%	54%
		Pink	39%	57%	65%	31%	68%
		Lingcod and Greenling	56%	64%	82%	37%	74%
		Surf Smelt	31%	17%	15%	16%	4%
		Sand Lance	15%	19%	18%	4%	19%
		Herring	7%	11%	10%	5%	7%

			Beamer and Fresh Shoreline Type[1]				
			Barrier Beach	Bluff Backed Beach	Pocket Beach	Pocket Estuary Like	Rocky Shoreline
SPENCER SPIT MANAGEMENT AREA	**Length (mi) of shoreline type[2] (% of mgmt area)[3]**		1.90 (14%)	4.34 (33%)	.25 (2%)	1.00 (8%)	5.80 (44%)
	Juvenile Fish Presence Probability	Chinook	7%	10%	16%	5%	6%
		Chum	15%	30%	40%	19%	33%
		Pink	30%	44%	45%	23%	49%
		Lingcod and Greenling	48%	56%	64%	30%	60%
		Surf Smelt	36%	19%	22%	20%	6%
		Sand Lance	15%	19%	20%	3%	21%
		Herring	10%	16%	26%	8%	15%
STRAIT OF JUAN DE FUCA MANAGEMENT AREA	**Length (mi) of shoreline type[2] (% of mgmt area)[3]**		0 0%	4.12 8%	7.62 15%	1.23 2%	36.22 74%
	Juvenile Fish Presence Probability	Chinook	NA	17%	21%	7%	9%
		Chum	NA	48%	75%	31%	56%
		Pink	NA	40%	64%	22%	60%
		Lingcod and Greenling	NA	28%	51%	26%	46%
		Surf Smelt	NA	7%	21%	17%	5%
		Sand Lance	NA	28%	20%	3%	22%
		Herring	NA	7%	23%	8%	13%
STUART ISLAND MANAGEMENT AREA	**Length (mi) of shoreline type[2] (% of mgmt area)[3]**		.29 (<1%)	2.76 (8%)	2.60 (8%)	.27 (<1%)	27.67 (82%)
	Juvenile Fish Presence Probability	Chinook	15%	21%	35%	11%	14%
		Chum	30%	59%	78%	37%	61%
		Pink	35%	51%	52%	27%	55%
		Lingcod and Greenling	54%	61%	71%	33%	64%
		Surf Smelt	33%	17%	20%	18%	6%
		Sand Lance	25%	31%	33%	6%	35%
		Herring	13%	20%	33%	11%	20%

			Beamer and Fresh Shoreline Type[1]				
			Barrier Beach	Bluff Backed Beach	Pocket Beach	Pocket Estuary Like	Rocky Shoreline
TURTLEBACK MANAGEMENT AREA	**Length (mi) of shoreline type[2] (% of mgmt area)[3]**		0 (0%)	3.88 (27%)	1.66 (11%)	0.15 (1%)	8.73 (61%)
	Juvenile Fish Presence Probability	Chinook	NA	39%	42%	19%	17%
		Chum	NA	72%	90%	45%	71%
		Pink	NA	80%	76%	42%	80%
		Lingcod and Greenling	NA	83%	96%	45%	88%
		Surf Smelt	NA	19%	16%	20%	5%
		Sand Lance	NA	56%	39%	10%	42%
		Herring	NA	39%	30%	20%	19%
WALDRON MANAGEMENT AREA	**Length (mi) of shoreline type[2] (% of mgmt area)[3]**		.55 (1%)	7.01 (17%)	2.92 (7%)	0 (0%)	30.18 (74%)
	Juvenile Fish Presence Probability	Chinook	27%	39%	59%	NA	23%
		Chum	36%	72%	96%	NA	75%
		Pink	55%	80%	79%	NA	82%
		Lingcod and Greenling	73%	83%	96%	NA	88%
		Surf Smelt	36%	19%	20%	NA	6%
		Sand Lance	45%	56%	58%	NA	60%
		Herring	25%	39%	60%	NA	36%
WEST SOUND MANAGEMENT AREA	**Length (mi) of shoreline type[2] (% of mgmt area)[3]**		.11 (<1%)	3.85 (16%)	3.04 (13%)	2.07 (9%)	14.62 (62%)
	Juvenile Fish Presence Probability	Chinook	6%	6%	10%	3%	4%
		Chum	21%	41%	55%	26%	44%
		Pink	39%	57%	58%	30%	62%
		Lingcod and Greenling	58%	51%	58%	28%	55%
		Surf Smelt	30%	21%	24%	21%	7%
		Sand Lance	17%	10%	11%	2%	12%
		Herring	7%	15%	25%	8%	14%

[1] Shoreline types from Beamer and Fresh (2012).
[2] Length reflects all Beamer and Fresh (2012) shore type data located within management unit.
[3] Percentage of total length of all Beamer and Fresh (2012) data located within management unit.

[4] The Friday Harbor Management Area also includes a limited amount (0.38 mile) of shorelines classified as "modified" by Beamer and Fresh (2012). Beamer and Fresh (2012) did not estimate juvenile fish presence probability for these shorelines.
[5] The North Coast Eastsound Management Area also includes a limited amount (0.60 mile) of shorelines classified as "modified" by Beamer and Fresh (2012). Beamer and Fresh (2012) did not estimate juvenile fish presence probability for these shorelines.
[6] This Roche Harbor Management Area also includes a limited amount (0.27 mile) of shorelines classified as "modified" by Beamer and Fresh (2012). Beamer and Fresh (2012) did not estimate juvenile fish presence probability for these shorelines.
[7] This Shaw Island Management Area also includes a limited amount (0.04 mile) of shorelines classified as "modified" by Beamer and Fresh (2012). Beamer and Fresh (2012) did not estimate juvenile fish presence probability for these shorelines.

The table indicates that pocket beaches score high as habitat for all the juvenile fish species examined in the study and within all of the management areas. Pocket beaches followed by bluff backed beaches are most preferred by Chinook and chum salmon, in all management areas. Habitat preferences of pink salmon are more varied across management areas and also include rocky shores. Lingcod and greenling have similar preferences to Chinook and chum and prefer pocket beaches, flowed by bluff backed beaches and rocky shores. When present in the management area, surf smelt are most frequently found near barrier beaches and least likely near rock shores. Sand lance are more variable in habitat preferences with similar presence at pocket beaches, bluff backed beaches, rocky shorelines and, less frequently, at pocket estuary habitats. Herring are most likely to be present near pocket beaches, followed by bluff backed beaches and rocky shores; least often at barrier beaches and pocket estuaries. In general pocket estuaries were found used by all species where present but varied by species and management area.

Beamer and Fresh (2012) also examined fish abundance, timing of presence, and fish size. These factors are not covered in this report.

3.12 Lakes

The County contains 12 lakes (Table 19) that were identified by the County in their Comprehensive Land Use Plan (San Juan County 2011), and that meet the acreage criteria for shoreline management. These lakes are important for wildlife habitat but also provide functions for water quality management. The lakes range in size from nearly 200 acres (Mountain Lake) to those that just meet the 20-acre requirement (e.g., Dream Lake). Some of these lakes, such as Sportsman Lake and Hummel Lake also have potential associated wetlands. Lakes in San Juan County include those designated as protected (Mountain Lake and Cascade Lake), and 10 additional lakes that are designated as rural residential (Table 19).

The largest lakes in the county, Mountain and Cascade Lakes, are on Orcas Island. In addition to providing habitat for wildlife, many of the county's lakes are used for domestic water supplies irrigation, fishing, and recreation. Due to their large size and connection to streams, Mountain and Cascade Lakes support fish species including coastal cutthroat trout, rainbow trout (in Cascade Lake), and kokanee populations. Sportsman Lake and Zylstra Lake on San Juan Island also have rainbow trout populations, as do Horseshoe and Spencer Lakes (Blakely Island) and

Hummel Lake (Lopez Island). Zylstra Lake, including waters originating from Trout Lake, feeds into False Bay Creek, which supports coho salmon (WDFW 2010b).

Trout, Briggs, Cascade, and Mountain Lakes supply domestic water for many of the residential areas in the county including the towns of Friday Harbor and Roche Harbor, Rosario, Olga, and Doe Bay. Therefore, protection of water quality is important in these lakes. Due to the high quality condition of these lakes and their associated wetlands, these lakes provide important functions within the watershed. They are located near the top of the watershed and can provide important flood control and water quality maintenance functions to their surrounding and downstream waters. These areas, including their streams, wetlands, and uplands also provide diverse and unique habitat conditions not found in other regions of the state, thus protection of these areas is important.

Table 19. Lake Sizes and Their Shoreline Management Areas.

Island/Lake	Acreage	Shoreline Management Area [a]
Blakely Island		
Horseshoe Lake	84	PR
Spencer Lake	64	PR
Lopez Island		
Hummel Lake	36	PR
Orcas Island		
Cascade Lake	172	P
Martin Lake (Diamond Lake)	22	PR
Mountain Lake	198	P
San Juan Island		
Briggs Lake (Roche Harbor Lake)	29	PR
Dream Lake	23	PR
Sportsman Lake	66	PR
Trout Lake	54	PR [b]
Woods Reservoir	29	PR
Zylstra Lake	48	PR

[a] P = Public Lakes Shoreline Management Area,
PR = Private Lakes Shoreline Management Area

[b] Although Trout Lake is publicly owned, it has been included in the Private Lakes Shoreline Management Area because the lake is functionally private (public access is controlled).

4.0 Discussion of San Juan County Management Areas

The following sections discuss conditions and characteristics of each shoreline area with respect to nearshore physical processes, the presence of streams and wetlands, geologic hazards, habitats and species use, marine riparian habitat, nearshore and estuarine habitats, water quality, marine sediments and fish tissue samples if available, and shoreline use patterns including land use, shoreline modifications and existing and potential public access. A reach assessment for each management area is provided, and identification of general restoration opportunities. A more comprehensive restoration plan for the County will be prepared as a separate document.

Table 20 provides a summary of conditions found within each management area. It shows the shoreline length, percent of shoreline armoring, vegetation types, land use, number of overwater structures, types of geologic hazards present and number of mapped streams found within each management area. The table indicates there is a wide range of conditions reflecting development types such as armoring and overwater structures as well as differences in types of geologic hazards present and mapped streams. All of the management areas have priority species present.

The list of species provided in Table 20 is from existing County databases at the time of the preparation of this document (2011/2012). Ongoing data collection efforts are continuing and have documented use of many areas within the County by protected species. For instance, while WDFW databases do not show Chinook salmon, a federally listed species, as present within San Juan County, it is known that juvenile Chinook, could be present in any of the management areas in the County although they are predicted to favor pocket beaches and bluff-back beaches (Beamer and Fresh 2012).

The discussions of critical and priority habitat and species, including salmonids rely primarily on available (WDFW 2010c) data on species presence that are included in the map folio (Appendix A). To avoid cumbersome redundancy throughout the sections, these are not cited in each case. However, where other sources are referenced, citations are provided.

The reach assessment for each management area used the shoreline inventory to specifically evaluate the physical and biological conditions of individual shoreline segments. These data were then analyzed and summarized for each management area in terms of the percent of the highest score possible for physical functions and habitat functions (see Figure 11). The percent of possible score was used to compare management area conditions because the possible score depends on the number of reaches, which vary by management area. While a fully functioning shoreline from a physical perspective is possible, and even likely for an ecologically rich reach, owing to the diverse needs of the different priority species it is not possible for a reach to be scored perfectly for habitat conditions. Figure 11 reflects this condition, as scores for physical conditions are much higher relative to scores for habitat conditions.

Table 20. Summary Table for Each Management Area.

Management Area	Length (miles)	Shoreline Armoring [1] (%)	Total Overwater Structures[2]	Geologic hazards	Species and Habitats Present	Streams[3]
Blakely	13.9	1.2	10	Landslides, Landslide tsunamis	Surf smelt spawning, eelgrass, kelp, seal haul-outs, numerous birds and shellfish	1
Decatur	19.6	2.8	37	Landslides, Liquefaction, Landslide Tsunamis	Surf smelt spawning, eelgrass, kelp, seal haul-outs, numerous birds and shellfish	0
Doe Bay	23.4	1.4	6	Tsunamis	Surf smelt spawning, eelgrass, kelp, seal haul-outs, raptors and shellfish	14
East Sound	17.5	3.4	22	Landslides, Landslide Tsunamis	Sand lance and herring spawning, eelgrass, seal haul-outs, cutthroat trout, several birds and shellfish	16
Fisherman Bay	14.0	19.6	31	Liquefaction, Landslides, Landslide Tsunamis	Eelgrass, kelp, numerous birds and shellfish	0
Friday Harbor	24.2	6.6	82	Liquefaction, Landslides, Landslide Tsunamis	Surf smelt and sand lance spawning, eelgrass, kelp, seal haul-outs, raptors and shellfish	10
Mud Bay	28.4	4.2	25	Liquefaction, Landslides, Landslide Tsunamis	Surf smelt and herring spawning, eelgrass, kelp, seal haul-outs, numerous birds and shellfish	1
North Coast Eastsound	4.4	25.0	4	Liquefaction, Tsunamis, Landslides	Eelgrass, kelp, bald eagle and shellfish	4
Olga	15.0	4.9	26	Landslides, Landslide Tsunamis	Surf smelt spawning, eelgrass, kelp, seal haul-outs, various salmonids, numerous birds and shellfish	9
Roche Harbor	33.7	5.8	157	Tsunamis, Liquefaction	Surf smelt and herring spawning, eelgrass, kelp, seal haul-outs, numerous birds and shellfish	11
San Juan Channel	13.2	2.3	14	Tsunamis, Landslides	Eelgrass, kelp, seal haul-outs, various salmonids, bald eagle and numerous species of shellfish	11

Management Area	Length (miles)	Shoreline Armoring [1] (%)	Total Overwater Structures[2]	Geologic hazards	Species and Habitats Present	Streams[3]
Shaw	38.2	4.4	55	Liquefaction, Landslide Tsunamis	Surf smelt and herring spawning, eelgrass, kelp, seal haul-outs, numerous birds and shellfish	3
Spencer Spit	12.7	8.3	25	Landslides, Liquefaction, Landslide Tsunamis	Sand lance, herring and surf smelt spawning, eelgrass, kelp, big brown bats, numerous birds and shellfish	3
Strait of Juan de Fuca	57.7	2.0	17	Liquefaction, Tsunamis, Landslides	Sand lance, surf smelt, and rocksole spawning, eelgrass, kelp, seal haul-outs, coho	13
Stuart	36.0	0.8	31	Landslides, Tsunamis, Liquefaction	Surf smelt spawning, eelgrass, kelp, seal haul-outs, numerous birds and shellfish	0
Turtleback	15.5	3.7	10	Landslides, Tsunamis	Surf smelt spawning, eelgrass, kelp, seal haul-outs, raptors, and shellfish	7
Waldron	45.6	0.8	5	Tsunamis, Landslides, Liquefaction	Surf smelt spawning, eelgrass, kelp, seal haul-outs, numerous birds and shellfish	0
Westsound	25.5	6.7	98	Landslide Tsunamis	Sand lance, herring and surf smelt spawning, eelgrass, kelp, various salmonids, numerous birds and shellfish	9
Public Lakes	7.6	NDA	NDA	None	Various salmonids and bald eagle	NDA
Private Lakes	17.8	NDA	NDA	None	Various salmonids, numerous species of birds, and California myotis	NDA

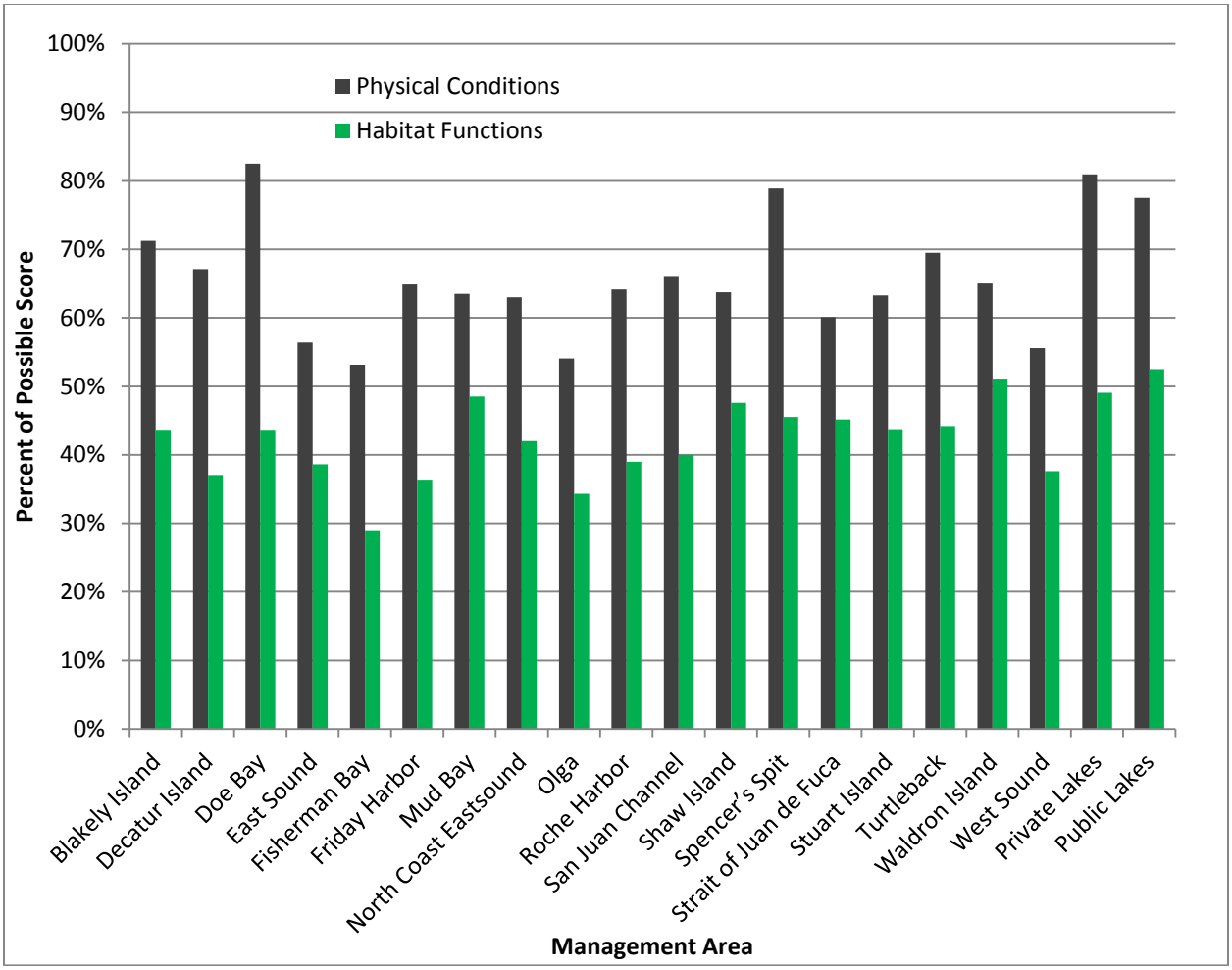
NDA = No data available

[1] Shoreline armoring data from the Friends of the San Juans (2009)

[2] Overwater structures data from WA Department of Natural Resources (2007)

[3] Based on watercourse layer provided by DOE (2000).

Figure 11 shows the highest scoring marine management areas, for physical conditions are Doe Bay followed by Spencer Spit; Blakely Island and Turtleback also score comparatively high. Both the Private lakes and Public Lakes management areas score high for physical conditions and for habitat functions. The lowest ranking management areas for physical conditions are Fisherman Bay and Olga management areas. Overall, physical conditions in the majority of management areas score above 60 percent with only four out of the 20 scoring less than 60 percent of the possible score. This suggests that, although there are reaches with substantial shoreline modifications, comparatively, the County as a whole provides important intact physical conditions to support nearshore and marine functions.


100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Physical Conditions
Habitat Functions
Percent of Possible Score
Blakely Island
Decatur Island
Doe Bay
East Sound
Fisherman Bay
Friday Harbor
Mud Bay
North Coast Eastsound
Olga
Roche Harbor
San Juan Channel
Shaw Island
Spencer's Spit
Strait of Juan de Fuca
Stuart Island
Turtleback
Waldron Island
West Sound
Private Lakes
Public Lakes
Management Area

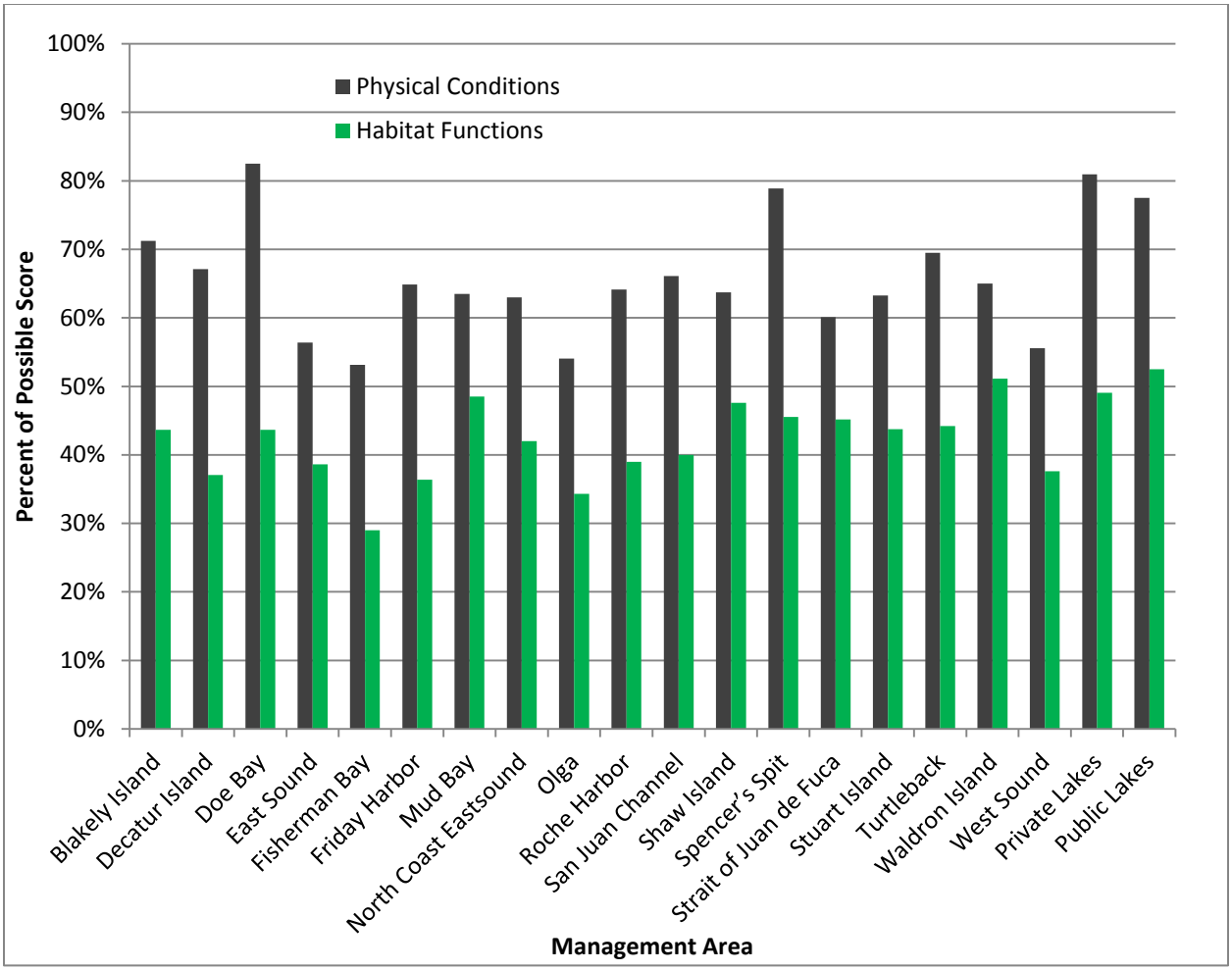


Figure 11. Summary of Physical Conditions and Habitat Functions Found Within Each Management Area (percent of possible score).

The highest scoring marine habitat conditions were found in the Waldron (51 percent), Mud Bay (49 percent), and Shaw Island (48 percent) management areas. It is important to remind the reader that some of the WDFW PHS data sets used are based upon very few observations. Consequently, low species presence or habitat scores could be an artifact of the number of observations. This likely means that presence and habitat for some species is underreported and habitat functions for many management areas may, in reality, be higher than shown in the assessment, especially in more remote areas and uninhabited islands. See *Section 2.4 Method Used to Inventory and Characterize Management Areas* for additional information on this important data limitation. The figure also indicates that more developed reaches (such as parts of the Fisherman Bay and Olga management areas) generally have lower reach scores for habitat conditions than less developed areas (such as the Waldron Island and Mud Bay management areas).

Private and public lakes were 49 percent and 53 percent of the total possible score respectively for freshwater systems. For freshwater shorelines, Public Lakes scored slightly higher than Private Lakes for habitat conditions due primarily to the higher number of documented salmonid species in the Public Lakes management area. Here again, WDFW data set limitations for PHS species may have resulted in overall lower habitat function scores for the lake management areas.

There is a moderate statistical correlation between scores for physical conditions and habitat conditions amongst all the management areas ($r = 0.61$). This is likely less strong than it might be because certain habitat condition features such as presence of associated wetlands, haul-out habitat, and presence of some WDFW PHS species are not directly related to the criteria used to score shoreline physical conditions.

Individual reach scores that comprise the summarized rankings in Figure 11 are found in the Reach Analysis sections of the management areas discussions below. Within each individual marine reach, 40 is the highest possible score for physical conditions, and 50 is the highest for habitat functions. For marine shorelines, a total reach score for physical conditions that is 24 (60 percent of possible) or higher indicates the reach is functioning within the range of higher performing reaches, while a score less than 24 suggests that there are impaired areas within the reach. For marine habitat conditions, reach scores nearing 50 are virtually impossible because of the wide variation in priority species requirements. In general, scores less than 20 (40 percent of possible) represent the lowest third of marine reach habitat scores and may indicate there are significant limitations on habitat functions within the reach.

For freshwater reaches, 20 is the highest score for both physical conditions and for habitat functions (total scores are lower because fewer criteria are included in the scoring than for the marine functional assessment). Both the Private and Public Lakes management areas score well above 60 percent for physical conditions and both score relatively high for habitat conditions.

For the individual management area discussions, marine management areas are organized alphabetically followed by the lake management areas (locations and boundaries are shown in Figure 1).

4.1 Blakely Island Management Area

The Blakely Island management area consists primarily of Blakely Island and encompasses just under 14 miles of shoreline. Two small named, but uninhabited, islands also occur in the management area. Blakely Island itself is largely uninhabited with concentrated development at the north and south end of the island. There is an airport at the north end of the island, which extends into the shoreline management zone at its south end. There are no major ferry terminals in the management area.

Table 21 is a summary of the reach assessment for the Blakely Island management area. The table is in two parts, one covering general physical conditions, the other addressing those conditions directly related to habitat functions. The following discussions cover both the

conditions scored in the reach assessment (Tables 21 A and B) and management area results from the ecosystem-wide characterization.

4.1.1 Physical and Biological Characterization

Nearshore Physical Processes

The geology of Blakely Island is relatively simple by comparison to the rest of the County. Most of the island is comprised of a large ophiolite (the Fidalgo ophiolite). This mineral-rich unit severely limits the production of soil and vegetation. The shoreline in these areas is also extremely steep, with limited portions of the shoreline being nearly vertical. However, the composition of the rock (i.e., an ophiolite) restricts the formation of pocket beaches, even in natural embayments like Thatcher Bay. At the north end of the island there is a relatively high, inclined glacial drift terrace that is developed with an airport (the primary means of access to the island). The glacial drift has been eroded over time and produced modest beaches that surround the terrace. A geological map of the island is provided in Map 15C in Appendix A.

Four of the six reaches comprising Blakely Island contain feeder bluffs and two reaches contain pocket beaches. Most (four) of Blakely Island's drift cells are located adjacent to the glacial drift terrace on the north side of the island (Map 13C, Appendix A). Two of these converge at an accretionary shoreform at the west end of the terrace. The other two form a tombolo at the northern tip of the island. There are also two small, convergent drift cells within Thatcher Bay and a divergence zone on the southeast side of the island.

Wave energy is low to moderate along the management area shorelines due to protection of adjacent islands in nearly direction. Tidal currents are significant (in excess of 2 knots) near Peavine Pass in the north and Thatcher Pass in the south and along the east side of the island. The west side of the island is much more quiescent (Canadian Hydrographic Service 2010). Thatcher Pass is also the main ferry route into the County and therefore sees significant vessel activity and wakes.

The Blakely Island shoreline remains relatively undisturbed in most reaches. Natural current patterns are intact but there is some armoring in reaches 90 through 94 that can affect wave and current attenuation. All reaches have some shoreline vegetation removed but vegetation within the entire shoreline district is relatively dense.

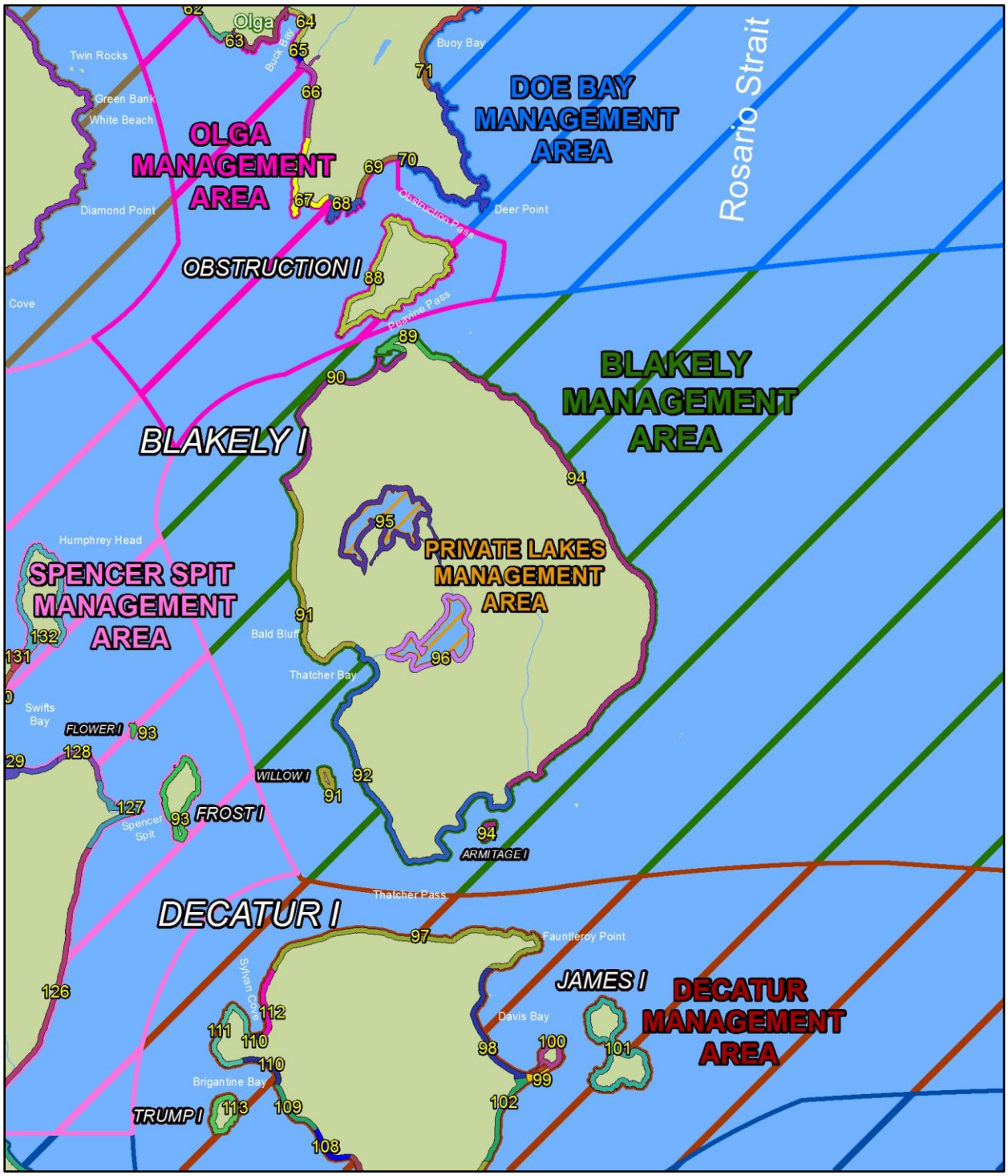


Figure 12. Blakely Island Management Area.

Geologic Hazards

Much of the shoreline in the management area is extremely steep. As such, there is a potential for landsliding around the entire island, but documented landslides are rare. The nature of the landsliding on much of Blakely Island is quite different due to the composition of the bedrock.

Landsliding, where it occurs, is associated with chemical weathering and faulting of the rock. This mode of landsliding results in toppling and small rockslides. The drift terrace at the north end of the island is also susceptible to more traditional slumping, particularly at the southwest end.

Because of the presence of bedrock, most of the management area is not susceptible to liquefaction. There is active faulting on the northwest end of the island, but this area is uninhabited. There is a moderate liquefaction threat to the drift terrace, particularly to marsh areas that surround it. The only significant tsunami risk is from landslide-induced tsunamis originating from surrounding islands (primarily from heavily-faulted portions of Orcas Island).

Streams and Associated Wetlands

There is a single unnamed stream on Blakely Island. The stream drains from Horseshoe Lake into Spencer Lake. From Spencer Lake, the stream discharges into Thatcher Bay at a former mill site. Small potential associated wetlands are present around Horseshoe Lake.

Critical or Priority Habitat and Species Use

The Blakely Island management area does not generally provide suitable habitat for clams or crabs with some exceptions, due to the steep shorelines. However, except for the waters southwest of the island, the area likely provides suitable habitat for pandalid shrimp. Marine mammals and seabirds may use the small islands and rocks in the southern portion of the management area. Bald eagles have also been observed along the forested shoreline of Blakely Island, where significant trees likely provide nesting opportunities. Habitat with a high potential for marbled murrelet nesting has been identified along the western shoreline from Peavine Pass to the southern shoreline of Thatcher Bay (SJC 2009). Most of the island contains habitat suitable for rockfish, with the possible exception of the area adjacent to the glacial drift terrace in the north and Thatcher Bay. Blakely Island nearshore areas are characterized by narrow strips of eelgrass, as well as both floating and understory kelps off most of its shoreline. The lack of documented haul outs and spawning habitat limited the management area's scores for habitat functions.

Marine Riparian, Nearshore, and Estuarine Habitats

Estuarine habitat is found in all reaches of Blakely Island although the areas are small, with the exception of reach 90, and therefore scored on the low end of the scale. Thatcher Bay on the western shoreline provides estuarine habitat that may be an important rearing area for salmonids due to the influence of freshwater from upstream Horseshoe and Spencer Lakes, and the presence of pocket beaches. Thatcher Bay also contains known surf smelt spawning habitat. The forested riparian zone is intact overall.

Water Quality, Sediment, and/or Tissue Sample Results

Although data have been collected northwest of Blakely Island near Obstruction Island (Ecology 2011d), no systematic analysis has been done with these data. As such, water quality is largely unknown in this management area but likely, the area has relatively high water quality given the extent of development in most reaches.

4.1.2 Shoreline Use Patterns[3]

Existing Land and Shoreline Use

Land Use

The Blakely Island management area consists of marine shorelines on Blakely Island (excluding Blakely Island's lakes large enough qualify as shorelines, which are treated under Private Lakes below) and the smaller Armitage and Willow islands.

Current land uses in the Blakely Island management area are as follows:

- Residential – 26 percent
- Trade – 1 percent
- Services – 10 percent
- Cultural, Entertainment, Recreation – 4 percent
- Undeveloped Land[4] – 60 percent

Blakely Island has a mixture of resource, residential and vacant land uses with some smaller areas of government, undeveloped – conservation easements, trade, and unclassified existing land uses. The northwestern portion of Blakely Island, along Peavine Pass, is the most developed portion of the island and is mostly characterized by existing residential uses. There is one parcel classified as trade, which consists of a general store at the island's marina. The eastern portion of Blakely Island is mostly resource land uses with some small areas of vacant land separating the resource land from the residential land described above, and government land in the central east portion of the island where Washington State Department of Natural Resources owns property. The southeastern portion of Blakely Island is mostly vacant with some interspersed residential uses. The southern tip of Blakely Island, along Thatcher Pass, is vacant, while the pattern of vacant with some residential interspersed continues on the southwestern side of the island to Thatcher Bay. Thatcher Bay consists of a mixture of cultural/recreation, unclassified, resource, and vacant lands – conservation easement uses. North of Thatcher Bay the western side of Blakely Island is predominantly resource with a small area of vacant land separating the resource from the residential land first described in this section on the north. The smaller Armitage Island is entirely cultural/recreation, while Willow Island is entirely undeveloped Federal land.

Additional shoreline land use includes several DNR utility line easements and an existing log booming and storage lease in Thatcher Bay. The majority of tidelands in this Management Area are publicly owned and managed by DNR (state-owned aquatic lands).

[3] Note: Folio maps call out an existing land use category called "cultural, entertainment, and recreational." For purposes of this narrative, this category is described as cultural/recreation since most of these properties are parks and similar recreation uses.

[4] The percentages for the "Undeveloped Land" category listed here and in other subsequent sections describing land use in the various management areas were derived from County assessor's data. Not all of the land in the "Undeveloped Land" category should be considered developable. Please see Chapter 5 of this report for a detailed assessment of the development potential along San Juan County's shorelines.

Water-dependent uses in the Blakely Island management area include the Blakely Island Marina at the northern end of Blakely Island, a marine railway on the southern side of Blakely Island, and private and community docks and piers along areas with existing residential development on the northern and southern ends of Blakely Island, and one pier on Armitage Island.

Land Use Designations

Comprehensive Plan land use designations on Blakely Island are largely Forest Resource, corresponding to the shoreline jurisdiction classified as resource and conservation uses. The northern portion of the island characterized by residential uses is largely designated Rural Residential, while a small number of shoreline parcels near the marina, including the general store, are designated Rural General. The Washington State Department of Natural Resources (DNR) parcel on the central east portion of Blakely Island is designated Conservancy, while the areas of Blakely Island south of the Forest Resource designation are designated as Rural Farm Forest with a small area of Conservancy located on the south portion of the Thatcher Bay in the area with the existing cultural/recreation use. The smaller Armitage Island is designated Conservancy, and Willow Island is designated Natural.

Shoreline Environment Designations

The majority of Blakely Island, including all of the Forest Resource designated shoreline described above is designated with a Conservancy shoreline environment. The developed northern portion of Blakely Island is in Rural Residential shoreline environment except for the portion surrounding the Blakely Island Marina, which is designated with a rural shoreline environment. The other exceptions to the largely Conservancy-designated Blakely Island, include small areas of Rural Residential at the north end of Thatcher Bay and on portions of the south end of Blakely Island characterized by low-density development, and a Natural environment designation covering the Washington DNR parcel on the east-central part of the island. Armitage Island is designated with a Conservancy environment, and Willow Island is designated with a Natural shoreline environment designation.

Shoreline Modifications

Only slightly over 1 percent of shorelines in the Blakely Island management area are armored. The armoring is interspersed throughout the island on several pocket beaches, some of which have been previously mapped as being bedrock.

There are only seven docks and piers in the management area, one of lowest number in the County's management areas. However, there is a single large marina at the north end of Blakely Island. There is also a minor amount of fill associated with former mill site and hydropower plant in Thatcher Bay. The management area has fewer mooring buoys (25) than any other management area in the County. They are primarily clustered at the north and south ends of Blakely Island.

Existing and Potential Public Access Areas

The Blakely Island management area contains approximately 900 acres of land owned by Seattle Pacific University and used as a wilderness environmental research campus. This management

area has approximately 312 acres within shoreline jurisdiction. However, there are no public access opportunities on Blakely Island and the island is not served by ferry. The island is accessed from outside via private ferry and boats at the private marina at the northern tip of the island.

Neither the Parks Plan nor the Land Use Element of the Comprehensive Plan include recommended actions specific to expanding or enhancing public access in the Blakely Island management area.

4.1.3 Restoration Opportunities

A former mill site in Thatcher Bay has been the subject of active restoration for several years. The primary aspect of this work is to remove thick deposits of fine-grained wood waste. This work is currently underway. However, there is other infrastructure associated with the mill site and past industrial activities that could be removed and build upon the restoration actions already been undertaken.

In addition to the work at Thatcher Bay, it may be possible to restore the tombolo that defines the northern tip of Blakely Island. Currently there is a marina adjacent to a large open meadow, with associated shoreline that is armored (bulkheaded). It is clear from an analysis of historical maps that there has been significant land alteration and fill, even though this does not appear in the County database. Prior to development there was a marsh complex (U.S. Coast and Geodetic Survey 1889a) in this area. Restoring marsh conditions to this area would have significant benefits to fish and shorebird species.

Table 21A. Blakely Island Management Area Reach Assessment – Physical Conditions.

Reach	Natural Sediment Transport Patterns	Shoreline Sediment Input Alterations - Feeder Bluffs	Shoreline Sediment Input Alterations - Pocket Beaches	Shoreline Sediment Input Alterations - Barrier Beaches	Natural Current Patterns	Wave & Current Attenuation	Nutrient and Toxics Removal	Shade	Total
93	5	NP	NP	NP	5	5	5	3	23
89	5	NP	NP	5	5	5	5	4	29
90	5	4	NP	3	5	4	5	3	29
91	5	5	NP	NP	5	4	5	4	28
92	5	5	3	NP	5	4	5	3	30
94	5	5	5	NP	5	4	5	3	32
Median	5.00	5.00	4.00	4.00	5.00	4.00	5.00	3.00	29.00
Average	5.00	4.75	4.00	4.00	5.00	4.33	5.00	3.33	28.50
Percent of Highest Possible Score	100%	95%	80%	80%	100%	87%	100%	67%	71%

NP = Not Present

Table 21B. Blakely Island Management Area Reach Assessment – Habitat Conditions.

Reach	Vegetation Coverage	Estuary Habitat	Birds	Haul-out Habitat	Eelgrass	Floating Kelp	Understory Kelp	Spawning Habitat[1]	Herring Spawning Habitat	Shellfish	Total
93	5	1	1	0	5	0	5	0	0	4	21
89	5	1	1	0	5	5	5	0	0	3	20
90	5	5	1	0	5	5	5	0	0	3	24
91	5	1	0	5	5	5	5	3	0	2	26
92	5	1	4	0	5	0	5	3	0	2	20
94	5	3	0	0	5	5	5	0	0	2	20
Median	5.00	1.00	1.00	0.00	5.00	5.00	5.00	0.00	0.00	2.50	20.50
Average	5.00	2.00	1.17	0.83	5.00	3.33	5.00	1.00	0.00	2.67	21.83
Percent of Highest Possible Score	100%	40%	23%	17%	100%	67%	100%	20%	0%	53%	44%

[1] Includes priority spawning habitat for sand lance, surf smelt, and rock sole.

4.2 Decatur Island Management Area

The Decatur Island management area includes all of Decatur Island and a collection of smaller islands that form a mini-archipelago bounded by Rosario Strait to the east, Thatcher Pass to the north and Lopez Sound to the south and west. The Decatur Island management area has three large secondary islands: James Island, which is a Washington State Park; Center Island and Trump Island, both of which are in private ownership and inhabited. The island does not have major (WSDOT) ferry terminal, but does have many smaller industrial marine terminals.

Table 22 is a summary of the reach assessment for the Decatur Island management area. The table is in two parts, one covering general physical conditions, the other addressing those conditions directly related to habitat functions. The following discussions cover both the conditions scored in the reach assessment (Tables 22A and B) and management area results from the ecosystem-wide characterization. In general, the shoreline reaches of Decatur score high for physical conditions with the exception of reach 107 at Reads Bay. Habitat conditions in reaches 102 and 103 at White Cliffs, and 106 through 109 on Reads Bay score low. This is because most of these areas lack haul-out habitat, floating kelp, and priority fish spawning habitat.

4.2.1 Physical and Biological Characterization

Nearshore Physical Processes

The Decatur Island management area is extremely diverse from a geologic perspective, even by County standards. At the south end of the island, including Rim Island, metal-rich bedrock is common and sediment is rare. The central portion of Decatur Island, where most development has occurred, consists of glacial sediments. Here beaches are common, with the glacial sediment spread by waves to more rocky areas in the north and south. The northern portion of the island is bedrock, but primarily different in composition (less mineral-rich) than the bedrock in the south.

Drift on Decatur is dominated by the two large tombolos that define Decatur Head and the isthmus at Reads Bay. At Reads Bay, drift is convergent at the head of the bay. North of the bay there is area of divergence (with significant feeder bluffs) that feed the bay and areas further north. Likewise there is a large feeder bluff complex at White Cliffs that feed both of the large tombolos. Some of these feeder bluffs have been armored. A small drift cell occurs in Davis Bay and feeds the other side of the tombolo at Decatur Head. There is also a short unidirectional drift cell on the southeast side of Center Island.

Most of the management area is relatively protected from waves. Only the White Cliffs portion of Decatur Island (and the south end of James Island) is exposed, and then only to locally produced waves in Rosario Strait. Tidal currents are generally modest on the west side of management area (e.g., less than 1 knot: Canadian Hydrographic Service 2010), with the exception of near Lopez Pass and Thatcher Pass. The east side of the island is regularly exposed to significant tidal currents in excess of 2 knots (Canadian Hydrographic Service 2010). These areas also have increased vessel traffic (particularly Thatcher Pass, which has significant ferry traffic).

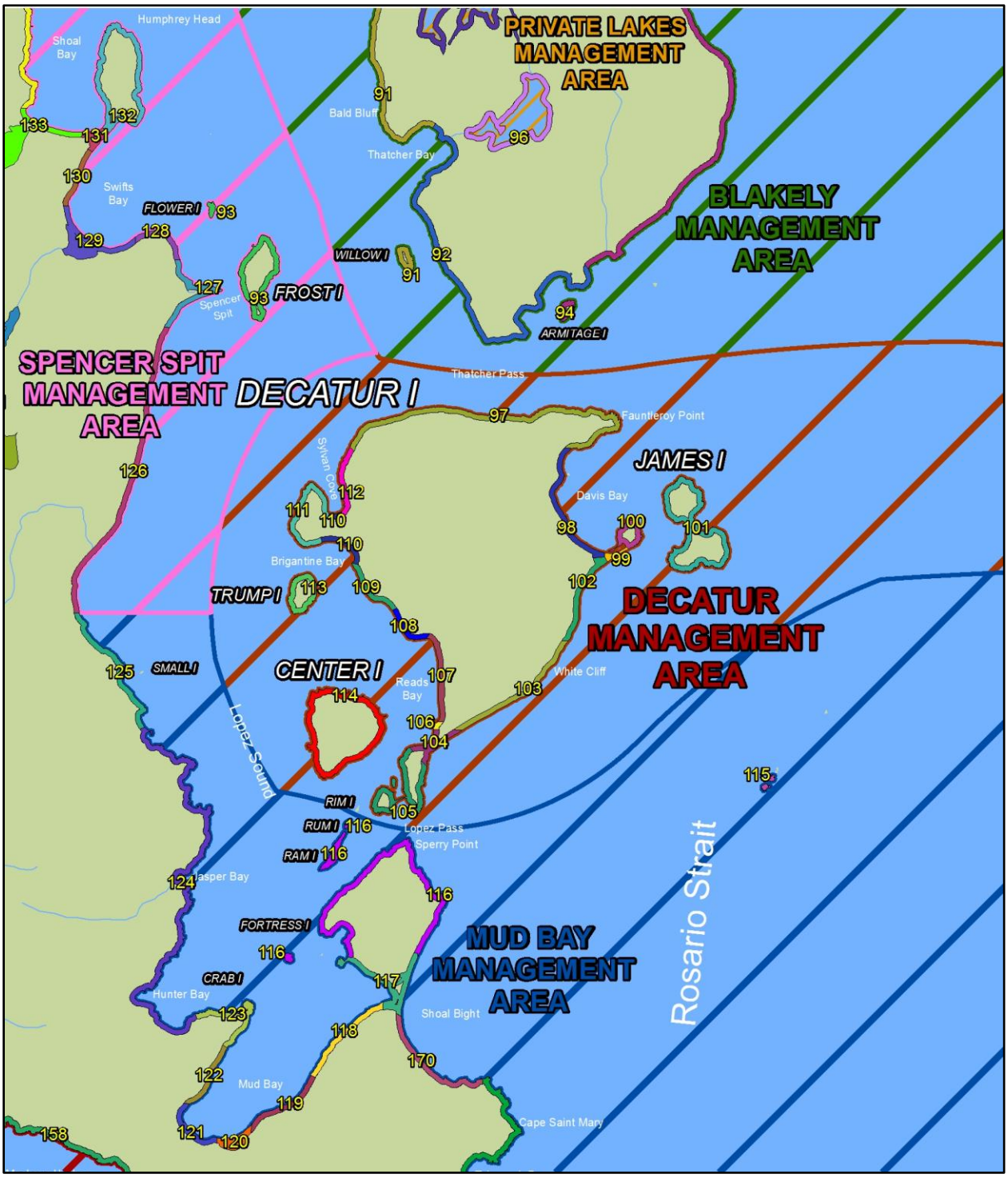


Figure 13. Decatur Island Management Area.

Geologic Hazards

The most significant geologic hazard in the management area is landsliding along White Cliffs. In aggregate, this area has the most unstable shoreline in the County. These bluffs, comprised primarily of a glacial-sediment sequence common in Puget Sound, have been mapped as active landslide areas. These bluffs offer one of the best examples of "feeder bluffs" in the County. These landslide areas serve an important function of maintain sediment supply to the tombolos at either side of the island.

Other geologic hazards are minor in comparison. Liquefaction susceptibility is low to moderate in areas where sediment exists. The tsunami threat is also low to moderate because of the protection provided by Lopez Island from the Strait of Juan de Fuca, where most of the tsunamis would arrive from. Like most of the rest of the County, there is a risk from landslide-induced tsunamis generated from surrounding islands.

Streams and Associated Wetlands

There are no mapped streams or lakes in this management area. The two primary shoreline-associated wetlands are formed in the tombolos that define Decatur Head and the isthmus on Reads Bay. The wetland complex adjacent to Reads Bay has been extensively ditched, though it is not currently in the County ditch database.

Critical or Priority Habitat and Species Use

There is one documented forage fish spawning beach in the management area along a pocket beach at the southern end of Reads Bay (reaches 106 and 107). The area of Reads Bay, and waters extending from the southern end of Decatur Island to Center Island and Trump Island contains documented crab and shrimp habitat. Pandalid shrimp habitat extends throughout Lopez Sound. Bald eagles and other important bird species are known to use forested habitat throughout the management area, including forested shorelines of Decatur Island and James Island. Although marbled murrelet nesting has not been documented in San Juan County, potential nesting habitat has been identified along the northern shorelines of Decatur Island (SJC 2009). The rocky north shoreline contains habitat suitable for rockfish, in addition to areas around James and Center Island. Eelgrass extends primarily along the eastern and southern shorelines of Decatur Island, but is also present in isolated location along the northern shoreline, Brigantine Bay and small coves of James Island. Kelp is also documented around James Island and few isolated areas of Decatur Island (such as Fauntleroy Point), but is generally limited in the management area. Floating kelp is less common in this management area and documented only sporadically along Thatcher Pass, James Island, Lopez Pass and Brigantine Bay. Understory kelp is documented in virtually all the management area reaches except reaches 107 and 108 within Reads Bay. No herring spawning habitat is documented in the management area; however, reaches 104 and 106 in the southern part of Reads Bay have priority spawning habitat for other fish species. Shellfish are documented to be present in all the management area reaches.

Marine Riparian, Nearshore, & Estuarine Habitats

Estuarine habitat occurs in Davis Bay and Sylvan Cove. The vast majority of the Decatur Island management area has intact well-developed riparian vegetation along the shore. Some estuarine

habitat is present in nearly every reach within the management area although the areas are generally less than two acres. Vegetation within the shoreline jurisdiction is generally dense, although most of the reaches have had some vegetation removed from the nearshore.

Water Quality, Sediment, and/or Tissue Sample Results

Ambient water quality monitoring has been conducted in Lopez Sound by the Department of Ecology that showed periodic exceedances of temperature and dissolved oxygen water quality criteria; these exceedances were attributed to natural upwelling of low dissolved oxygen marine water and were not influenced by anthropogenic activities (Ecology 2011e). One sediment sample was also collected between Center Island and Lopez Island that exceeded the Sediment Management Standards SQS bioassay criterion; sediment in this area is classified as Category 2 "Sediments of Concern" (Ecology 2011e).

4.2.2 Shoreline Use Patterns

Existing Land and Shoreline Use

Land Use

The Decatur Island management area includes Decatur Island along with the smaller Center, James, Rim, and Trump islands. The shoreline jurisdiction on Decatur Island is primarily characterized by vacant and residential existing land uses, with some smaller areas classified in the cultural/recreation existing land use. Overall existing land uses in the Decatur Island management area include:

- Residential – 37 percent
- Cultural, Entertainment, Recreation – 28 percent
- Undeveloped Land – 35 percent

The north and western side of Decatur, from Brigantine Bay to Thatcher Pass is mostly vacant. Residential and vacant parcels are interspersed between Thatcher Pass and Fauntleroy Point. The eastern side of Decatur Island is largely developed in large lot residential development with a small amount of vacant land interspersed. Decatur Head, an eastern promontory at the south side of Davis Bay on the central eastern portion of Decatur Island is classified as a cultural, entertainment and recreation land use. South of Decatur Head, existing land uses continue in a pattern of mostly residential with some vacant land uses until the southern promontory of Decatur Island, which is classified in the cultural/recreation land use category. Existing land use on the west side of Decatur Island, along Reads Bay to Brigantine Bay, is mostly residential with some areas of vacant interspersed, particularly near Brigantine Bay.

Additional shoreline use includes several DNR utility line easements. There are also privately owned Oyster Tracts in Reads Bay. The tidelands are a mix of state-owned aquatic lands and private ownership.

Of the other islands in this management area, Center Island's shoreline jurisdiction is largely developed as residential with small areas of undeveloped open space tracts (classified under the Open Space Taxation Act) and in cultural/recreation use. James Island is a state park with some

campsites and trails predominantly in the center part of the island. The remainder of James Island is undeveloped natural area. Trump Island is undeveloped land classified under the Open Space Taxation Act.

Water-dependent uses in the Decatur Island management area include the Decatur Head public marine facility, the pier at James Island State Park, as well as private and community piers and docks found on Decatur, Center, and Trump islands, and a marine railway on Center Island. Water-enjoyment uses include James Island State Park.

Land Use Designations

Comprehensive Plan land use designations in the Decatur Island management area offer a range of uses, most of which correspond to existing land uses described above. The majority of the Decatur Island shoreline jurisdiction is designated Rural General. The exceptions to this rule are that the southern promontory of Decatur Island is designated Natural, a small area on the southwestern shoreline jurisdiction along Reads Bay is designated Rural Industrial, and there are two areas designated Rural Residential: one of which is on the northern side of Reads Bay, and the other surrounds a peninsula on the western side of Decatur Island between Brigantine Bay and Sylvan Cove. The Rural Industrial designated parcel contains a boat dock and storage for multiple boats.

Shoreline Environment Designations

In terms of the other islands in this management area, Center Island's shoreline jurisdiction is almost entirely designated Rural Residential, with the exception of the cultural/recreation parcel on the west side of the island which is designated Conservancy. James Island, as a state park, is designated Conservancy and Trump Island is designated Natural.

The majority of Decatur Island is in the Conservancy shoreline environment designation, with Rural Farm-Forest environment applied along most of Reads Bay and the southern portion of Davis Bay. A very small part of the Decatur shoreline at the south end of Reads Bay is designated in the Urban environment (parcel mentioned above with Rural Industrial land use designation). Of the smaller islands in this management area, Center Island has Rural Farm-Forest shoreline environment, James Island has a Conservancy shoreline environment designation, and Trump Island is mostly Natural with a small area of Conservancy.

Shoreline Modifications

The Decatur Island management area has armoring along 2.8 percent of its shorelines. Most of the armoring occurs on shoreline that possesses glacial sediment, with the exception of armoring of Center Island, which is mapped as being entirely bedrock. If the percentage of armoring would be expressed in terms of the glacial sediment areas only, the percentage of armoring would be larger.

There are more mooring buoys (165) in the Decatur Island management area than any other management area in the County. Nearly all of the mooring buoys are located in Davis Bay and Reads Bay. The management area also has more pilings (92) than any other management area.

There are also 37 overwater structures, which are mostly docks and piers. In addition to the docks and piers there are three boat ramps, a groin, a jetty and two marinas. There is a minor amount of fill associated with residences on the tombolo of Decatur Head.

Existing and Potential Public Access Areas

Decatur Head boat ramp, located on Decatur Island provides public shoreline access. The Decatur Island management area also includes James Island, a 113-acre marine camping and moorage park owned by Washington State Parks Department. The moorage park is open year round for camping and day use and includes over 12,000 feet of saltwater shoreline on Rosario Strait. Portions of the island are closed to public access due to their designation as a natural Forest Area; however, the island does contain approximately 1.5 miles of hiking trails. James Island State Park offers western views of the San Juan Islands from a high bluff along the loop trail (Washington State Parks and Recreation Commission, 2010 James Island).

Neither the Parks Plan nor the Land Use Element of the Comprehensive Plan include recommended actions specific to expanding or enhancing public access in the Decatur Island management area. GIS data indicates that this management area lacks trails within its shoreline. Shoreline public access opportunities for trails, boat launches or docks exist on preserve lands and land owned by community or homeowners groups (e.g., Decatur Community Association).

4.2.3 Restoration Opportunities

The wetland complex along Reads Bay is an excellent opportunity for restoration. Wetland complexes of its size and connection to marine waters are rare in the County, despite their ecological value (see Beamer et al. [2003, 2005] for discussion on ecological value of similar wetland complexes). The wetland complex is large and undeveloped, but it has been extensively ditched (though it is not currently recorded in County data). Ditches can simplify the landscape and can lead to trapping of ESA-protected fish species. The ditches could be removed and natural connection to marine waters restored. There may also be the opportunity to remove some of the unused mooring buoys and pilings from Reads Bay and consolidate the use of the remaining ones.

Table 22A. Decatur Island Management Area Reach Assessment – Physical Conditions.

Reach	Natural Sediment Transport Patterns	Shoreline Sediment Input Alterations - Feeder Bluffs	Shoreline Sediment Input Alterations - Pocket Beaches	Shoreline Sediment Input Alterations - Barrier Beaches	Natural Current Patterns	Wave & Current Attenuation	Nutrient and Toxics Removal	Shade	Total
97	5	5	5	NP	5	5	5	4	34
98	5	4	NP	5	5	4	5	3	31
99	5	NP	NP	5	5	5	5	0	25
100	5	NP	NP	5	5	5	5	2	27
101	5	NP	5	NP	5	5	5	4	29
102	5	5	NP	5	5	5	5	2	32
103	5	4	NP	NP	5	4	5	2	25
104	5	5	NP	4	5	4	5	3	31
105	5	NP	5	NP	5	5	3	3	26
106	5	NP	NP	5	5	4	3	2	24
107	5	NP	NP	2	5	3	3	1	19
108	5	5	NP	NP	5	4	3	2	24
109	5	5	NP	NP	5	4	3	3	25
110	5	NP	5	NP	5	5	5	3	28
111	5	NP	5	NP	5	5	5	3	28
112	5	NP	5	NP	5	5	5	4	29
113	5	NP	5	NP	5	5	5	3	28
114	1	4	4	NP	5	4	3	4	25
115	5	NP	NP	NP	5	5	5	0	20
Median	5.00	5.00	5.00	5.00	5.00	5.00	5.00	3.00	27.00
Average	4.79	4.63	4.88	4.43	5.00	4.53	4.37	2.53	26.84
Percent of Highest Possible Score	96%	93%	98%	89%	100%	91%	87%	51%	67%

NP = Not Present

Table 22B. Decatur Island Management Area Reach Assessment – Habitat Conditions.

Reach	Vegetation Coverage	Estuary Habitat	Birds	Haul-out Habitat	Eelgrass	Floating Kelp	Understory Kelp	Spawning Habitat[1]	Herring Spawning Habitat	Shellfish	Total
97	5	1	0	0	5	5	5	0	0	2	23
98	5	4	1	0	5	0	5	0	0	1	21
99	5	1	1	0	5	0	5	0	0	2	19
100	5	1	2	0	5	0	5	0	0	2	20
101	5	1	0	0	5	5	5	0	0	2	23
102	5	1	0	0	0	0	5	0	0	2	13
103	5	1	2	0	0	0	5	0	0	2	15
104	5	2	2	0	5	0	5	3	0	4	26
105	5	1	0	0	5	5	5	0	0	4	25
106	5	0	0	0	0	0	5	3	0	4	17
107	5	2	0	0	0	0	0	0	0	3	10
108	4	0	0	0	0	0	0	0	0	3	7
109	5	0	1	0	5	0	5	0	0	3	19
110	5	1	0	0	5	0	5	0	0	3	19
111	5	1	0	0	0	5	5	0	0	2	18
112	5	0	1	0	0	5	5	0	0	2	18
113	5	1	1	0	0	5	0	0	0	3	15
114	5	3	0	0	5	5	5	0	0	4	27
115	5	0	0	5	0	5	0	0	0	2	17
Median	5.00	1.00	0.00	0.00	5.00	0.00	5.00	0.00	0.00	2.00	19.00
Average	4.95	1.11	0.58	0.26	2.63	2.11	3.95	0.32	0.00	2.63	18.53
Percent of Highest Possible Score	99%	22%	12%	5%	53%	42%	79%	6%	0%	53%	37%

[1] Includes priority spawning habitat for sand lance, surf smelt, and rock sole.

4.3 Doe Bay Management Area

The Doe Bay management area covers over 23 miles of shoreline along the sparsely populated east end of Orcas Island. The management area has two distinct geographic areas; the northern shore that is extremely steep and largely uninhabited and the southern shoreline that is less steep (though steeper than most places) and sparsely populated. The management area includes an uninhabited mini-archipelago of islands northeast of Orcas Island including Barnes Island, Clark Island, Lone Tree Island, and the Sisters. The Peapod Rocks and Doe Island southeast of Orcas Island are also included in this management area. There are no major transportation related uses in this management area.

Table 23 is a summary of the reach assessment for the Doe Bay management area. The table is in two parts, one covering general physical conditions, the other addressing those conditions directly related to habitat functions. The following discussions cover both the conditions scored in the reach assessment (Tables 23A and B) and management area results from the ecosystem-wide characterization. The Doe Bay management area is the highest scoring for physical habitat primarily because each of its reaches has intact feeder bluffs and few shoreline modifications to interrupt sediment transport, natural current patterns or affect wave attenuation. Habitat functions are lower than might be expected due to few documented priority bird species, and no documented fish spawning habitat.

4.3.1 Physical and Biological Characterization

Nearshore Physical Processes

The geology of the Doe Bay management area is both complex and simple. With the exception of thin layers of glacial drift its southern shoreline; nearly the entire management area is comprised of extremely old (greater than 200 million years old) oceanic bedrock. Because this bedrock has been uplifted several miles, the area has a number of mapped faults (Lapen 2000), many of which are likely relict from the uplift. As a result, locally there can be large variations of the strength and make-up of the bedrock, but the presence of near-surface bedrock dominates the geomorphology of the shoreline everywhere. There are no mapped drift cells in this management area.

Wave energy is fairly large, but locally sourced. The exposure of the north shore is significant as there is open exposure to the Strait of Georgia, while the southern shore has exposure to the south via Rosario Strait. Tidal currents are intense offshore (often exceeding 2.5 knots: Canadian Hydrographic Service 2010), particularly near Point Lawrence, where Rosario Strait makes a sharp turn from the Puget Lowland to the Strait of Georgia.

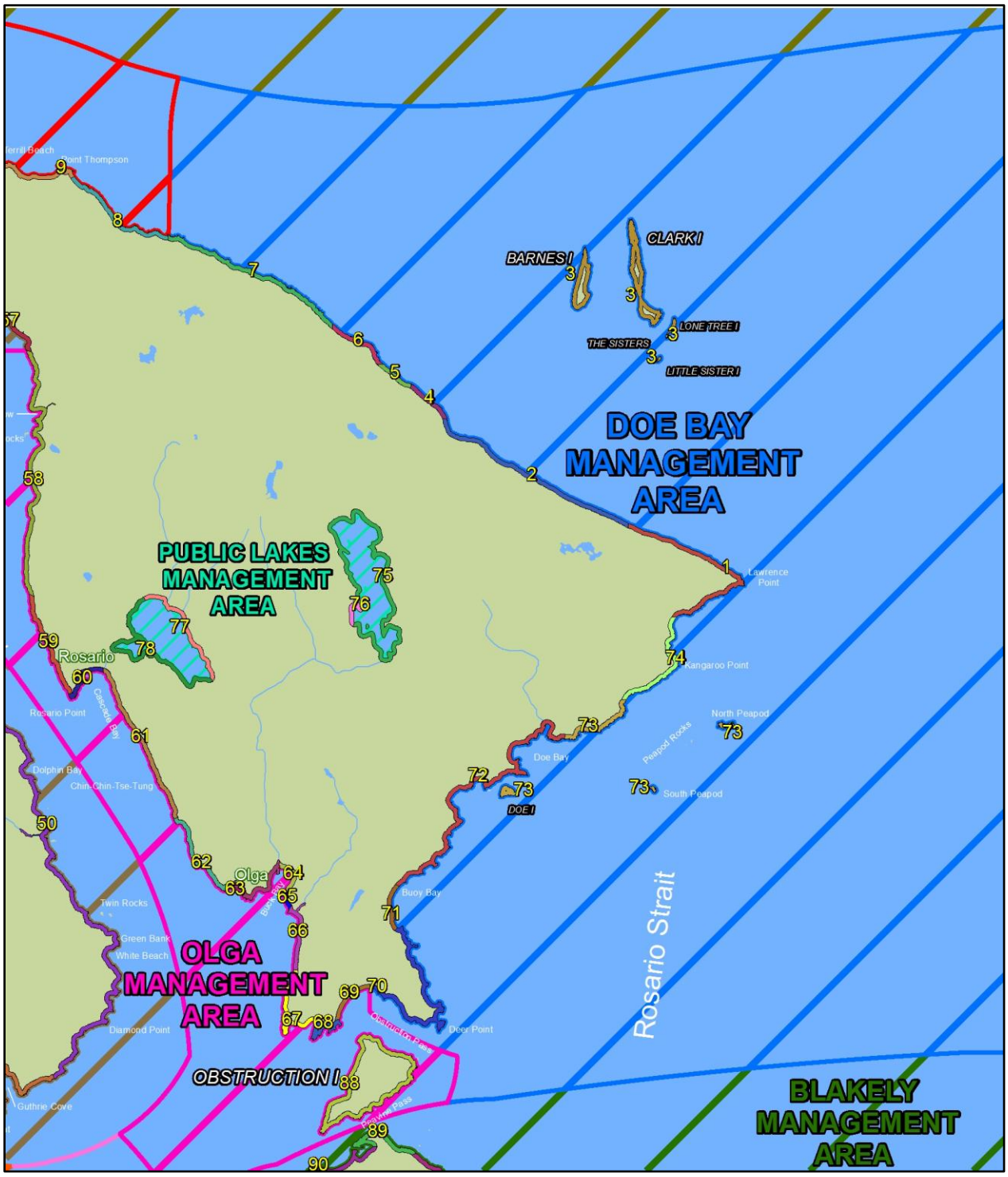


Figure 14. Doe Bay Management Area.

Geologic Hazards

Despite having some of the steepest shorelines in the County, there are no mapped recent slides or unstable slopes in the Doe Bay management area. This has to do with the significant age of the rocks that comprise the management area. The old age of the rocks and the lack of sediment draping those rocks mean that only deep bedrock failures would occur on the island, which are generally rare to non-existent. If a landslide or earthquake were to occur in the management area it would occur catastrophically and would likely be very large. The presence of competent bedrock also precludes liquefaction (DNR 2011).

The tsunami risk is moderate in this management area. Most of the risk is a result of tsunamis generated in the Strait of Georgia, such as the Fraser delta (Mosher 2009), but there is some level of protection afforded by the Sucia mini-archipelago and other nearby land masses. These tsunamis would primarily affect the north shore only. Tsunamis from the Strait of Juan de Fuca are also a threat, but they would also likely be attenuated owing to the complexity of the islands in between the management area and the probable sources. These tsunamis would most likely affect only the south shore. Habitat with a high potential for marbled murrelet nesting has been identified along the northern shoreline Orcas Island within the Doe Bay management area (SJC 2009).

Streams and Associated Wetlands

There are 12 mapped, non-fish-bearing small streams in the management area (Wild Fish Conservancy 2011). In addition there are two fish-bearing streams. One drains to Doe Bay, with an extensive ditch network in its headwaters. The other is less altered and drains to embayment between Point Lawrence and Kangaroo Point. Nearshore wetlands are rare, particularly on the steep north shore of the management area.

Critical or Priority Habitat and Species Use

The rocky north shoreline contains habitat suitable for rockfish. An area long this shoreline near Point Lawrence has been designated as a voluntary no-take bottom fish recovery area. Pandalid shrimp likely use subtidal habitat off the northern shoreline of Orcas Island. The southern shoreline and smaller islands within this management area provide suitable habitat for sea urchins, Seabird and marine mammal haul-outs are common among the small islands. Eelgrass has a patchy distribution along a narrow band that is close to the southern shoreline. Understory kelp and floating kelp are found in virtually all the management areas. At least one shellfish species is documented in each reach. No forage or other priority fish spawning habitat is documented in the management area.

Marine Riparian, Nearshore, and Estuarine Habitats

Estuarine habitat, though generally less than two acres per reach is found within all reaches in the Management area, with the exception of reach 4. Relatively undisturbed forest cover along the shoreline provides habitat for bald eagles, which occur frequently near Deer point, between Doe Bay and Point Lawrence, and along the northern shoreline of Orcas Island. A narrow band of aspen dominated forest community, commonly associated with areas further inland, extends

along some portions of the northern shoreline (north of Eagle Lake to Point Lawrence) and contributes to habitat diversity in the marine riparian zone.

Water Quality, Sediment, and/or Tissue Sample Results

In general, water quality is largely unknown in this management area. However, water quality data have been collected from a stream that discharges to Doe Bay. On these data sets elevated levels of fecal coliform bacteria, low dissolved oxygen concentrations, and elevated nutrient levels were observed (Wiseman et al. 2000; SJCD 2005); however, no waters within the management area are on Ecology's 303d list.

4.3.2 Shoreline Use Patterns

Existing Land and Shoreline Use

Land Use

The Doe Bay management area extends from the north side of Obstruction Pass on Orcas Island, up the southeast side of Orcas Island to Point Lawrence, and then northwest on the north side of the island to a point east of Point Thompson east of the community of Eastsound. The Doe Bay management area also includes smaller islands on the east side of Orcas Island, including Barnes, Clark, Lone Tree, The Sisters, Little Sister, and Doe islands, as well as the Peapod Rocks.

Overall existing land use in the Doe Bay management area includes:

- Residential – 54 percent
- Cultural, Entertainment, Recreation – 28 percent
- Undeveloped Land – 18 percent

From Obstruction Pass north to Point Lawrence, the majority of existing land uses are residential with vacant land interspersed along with small amounts of cultural/recreation, the latter of which is located at Doe Bay. Doe Island itself is cultural/recreation. Point Lawrence itself, and the land to the southwest, is cultural/recreation. The northeastern side of Orcas Island is predominantly characterized by residential land uses, with vacant land interspersed. Traveling northwest from Point Lawrence, the existing land use pattern begins with cultural/recreation and vacant uses with a small amount of residential. Moran State Park and other nearby recreational lands provide an area entirely within the cultural/recreation land use category. Further northwest, the existing land use pattern changes to largely residential land uses with vacant land uses interspersed to the eastern end of North Coast Eastsound management area. The Peapods consist of conservation areas. Barnes Island is residential, Clark Island is cultural/recreation use, and Lone Tree Island and the Sisters are undeveloped Federal land.

Additional shoreline use includes several DNR utility line easements. There are also privately owned Oyster Tracts between Obstruction Pass and Pt. Lawrence. The majority of tidelands are state-owned aquatic lands

Water-dependent uses in this management area consist of private and community docks, piers, and a marine railway. Most of these facilities are found on the southern part of the management

area between Obstruction Pass and Point Lawrence, and on the smaller islands of Doe and Barnes. Doe Island is one of the Washington State Parks' Marine Parks, providing water enjoyment use as well. Clark Island, another Washington State Marine Park, also provides water enjoyment use. Doe Bay Resort provides a restaurant, boat rental, and lodging; and Moran State Park's freshwater shorelines also provide additional water enjoyment uses in this management area.

Land Use Designations

The Comprehensive Plan land use designations applied in the Doe Bay management area begin with Rural Farm Forest in the northwestern end of the management area. Further southeast, land designation transitions to Rural Residential, followed by Conservancy and Forest Resource. The portion of Moran State Park within this management area is designated Conservancy. Land southeast of Moran State Park to Point Lawrence is mostly Forest Resource with some Natural land mixed in. Point Lawrence itself is Natural and land to the southwest is Conservancy and Rural Farm Forest. The area around Kangaroo Point is designated Rural Residential, and then Forest Resource further to the southwest. The Doe Bay area is designated an Activity Center with Rural Farm Forest on either side of the bay. Further to the southwest, land is designated Rural Residential to Buoy Bay, where designations change briefly to Forest Resource and then to Rural Farm Forest to Obstruction Pass. Doe Island and two of the three Peapods are designated Conservancy, while the North Peapod is designated Natural. Barnes and Clark islands are designated Conservancy and the remaining smaller islands are designated Natural.

Shoreline Environment Designations

Shoreline environment designations in this management area are predominantly Rural Farm-Forest with Conservancy making up the second largest shoreline environment, followed by small areas of Rural, Rural Residential, and Natural environments. Rural Farm-Forest environment designation characterizes the shoreline jurisdiction from Obstruction Pass to Doe Bay Resort. Doe Bay Resort, in Doe Bay, has a shoreline environment of Rural. Northeast of Doe Bay Resort, the shoreline environment designation changes to Rural Farm-Forest environment to an area southwest of Kangaroo Point. Here the shoreline environment is Rural Residential, changing to Conservancy north of Kangaroo Point. Point Lawrence itself is designated a Natural shoreline environment designation. Northwest of Point Lawrence, the shoreline designation is Rural Farm-Forest until Moran State Park, at which point the shoreline environment changes to Conservancy for the remainder of this management area's Orcas Island jurisdiction. The smaller islands in the management area included Clark Island and Doe Island are Conservancy. Barnes Island is a mix of Natural and Conservancy. The remainder of the smaller islands in this management area have Natural environment designations.

Shoreline Modifications

Approximately 1.4 percent of the management area is armored. Most of the armoring occurs on the pocket beaches that are common on the south shore. The bedrock that dominates the north shore of the management area is not armored anywhere. If the percentage of armoring was evaluated based on pocket beach area only, the percentage of armoring would be significantly higher. There are only six docks and piers, a small number for the relatively long shoreline in

this management area, but these are also concentrated along small pocket beaches on the south shore. In addition to the docks and piers there are three boat ramps and marine railway, all on the south shore. Moorings are scattered throughout the small embayments along the south shore. There is also a breakwater that protects a beach on private islet in one of these areas.

Existing and Potential Public Access Areas

The Doe Bay management area, along the east end of Orcas Island has over 23 miles of shorelines. The Doe Bay management area also contains the Bluebells Springs conservation easement. This 66-acre property and conservation easement protects a stretch of approximately 1,800 feet of scenic shoreline by reducing the total development potential of the property from 13 lots to 5 lots and reducing the number of potential shoreline lots from 8 to 2.

Existing Facilities

- Doe Bay Road End. Located on the southeast shore of Orcas Island, this road end provides public access to the shoreline near Doe Bay Resort. The area is high bank, but access to the beach is possible. There are picnic tables, a viewing bench and a parking area shared by resort visitors and the public.

- Sea Acres Road: This road end, on the eastern edge of Orcas and North of Kangaroo Point, terminates on the side of private property with a steep cliff to rocks and the water.

- Clark/Barnes Islands and Doe Island. Doe Island has a campground and dock.

Existing Facilities with Potential for Improvement

Currently no trails or pathways exist in this management area to provide shoreline public access.

In addition to general goals related to acquiring high-priority lands that enhance public access; providing a quality parks system; developing trails that meet the recreation and transportation needs of the community; securing funding for the development and maintenance of facilities; and engaging the communities in planning and stewardship of the parks system, the Parks Plan 6-year action plan specifically calls for:

- Refining and pursuing opportunities to improve public shoreline access on Orcas Island

- Holding a biennial forum of park and recreation service providers on Orcas and San Juan islands to foster partnerships and collaboration to improve the provision of services and programs

GIS data indicates no campgrounds, docks, ramps or floats in this management area. Limited physical access exists on the north side of the management area due to steep slopes.

4.3.3 Restoration Opportunities

They are relatively limited restoration opportunities because most of the shoreline in its predevelopment state. The north shore (half of the management area) has essentially no development that interferes with natural shoreline processes. Development is sparse on the south shore and rarely is close to the shoreline. Despite the lack of nearshore development, bulkheading is quite intense given that most of the shoreline is bedrock. Bulkheading to protect infrastructure is not necessary in most cases where it has been used. In many instances, the bulkhead merely protects a large lawn. In these instances, there is an opportunity to remove these bulkheads and restore predevelopment nearshore processes.

Table 23A. Doe Bay Management Area Reach Assessment – Physical Conditions.

Reach	Natural Sediment Transport Patterns	Shoreline Sediment Input Alterations - Feeder Bluffs	Shoreline Sediment Input Alterations - Pocket Beaches	Shoreline Sediment Input Alterations - Barrier Beaches	Natural Current Patterns	Wave & Current Attenuation	Nutrient and Toxics Removal	Shade	Total
1	5	5	NP	5	5	5	5	4	34
2	5	5	NP	4	5	4	5	5	33
3	5	5	5	5	5	4	5	4	38
4	5	5	NP	NP	5	5	5	4	29
5	5	5	NP	5	5	5	5	4	34
6	5	5	NP	5	5	5	5	4	34
7	5	5	5	5	5	4	5	4	38
70	5	3	5	4	3	4	5	3	32
71	5	5	NP	3	5	4	5	2	29
72	5	5	NP	4	5	4	5	3	31
73	5	5	NP	5	5	5	5	3	33
74	5	5	NP	4	5	4	5	3	31
Median	5.00	5.00	5.00	5.00	5.00	4.00	5.00	4.00	33.00
Average	5.00	4.83	5.00	4.45	4.83	4.42	5.00	3.58	33.00
Percent of Highest Possible Score	100%	97%	100%	89%	97%	88%	100%	72%	83%

NP = Not Present

Table 23B. Doe Bay Management Area Reach Assessment – Habitat Conditions.

Reach	Vegetation Coverage	Estuary Habitat	Birds	Haul-out Habitat	Eelgrass	Floating Kelp	Understory Kelp	Spawning Habitat[1]	Herring Spawning Habitat	Shellfish	Total
1	5	2	2	0	5	5	5	0	0	2	26
2	5	1	0	0	0	5	5	0	0	1	17
3	5	4	0	5	5	5	5	0	0	2	31
4	5	0	0	0	0	5	5	0	0	1	16
5	5	1	0	0	0	5	5	0	0	1	17
6	5	1	0	0	0	5	5	0	0	1	17
7	5	2	0	0	0	5	5	0	0	1	18
70	5	2	0	0	5	5	5	0	0	2	24
71	5	2	0	0	5	0	5	0	0	2	19
72	5	2	1	0	5	5	5	0	0	2	25
73	5	1	1	5	5	5	5	0	0	2	29
74	5	1	0	0	5	5	5	0	0	2	23
Median	5.00	1.50	0.00	0.00	5.00	5.00	5.00	0.00	0.00	2.00	21.00
Average	5.00	1.58	0.33	0.83	2.92	4.58	5.00	0.00	0.00	1.58	21.83
Percent of Highest Possible Score	100%	32%	7%	17%	58%	92%	100%	0%	0%	32%	44%

[1] Includes priority spawning habitat for sand lance, surf smelt, and rock sole.

4.4 East Sound Management Area

The East Sound management area extends from Grindstone Harbor to the east end of Ship Bay. This management area includes the main waterfront of the town of Eastsound. It also includes Indian Island and number of similar small, uninhabited rocky islets less than a few hundred feet offshore of the mainland throughout East Sound. There are no major transportation related uses in this management area.

Table 24 is a summary of the reach assessment for the East Sound management area. The table is in two parts, one covering general physical conditions, the other addressing those conditions directly related to habitat functions. The following discussions cover both the conditions scored in the reach assessment (Tables 24A and B) and management area results from the ecosystem-wide characterization. The East Sound management area includes important feeder bluffs (reaches 51 and 52). There are also a number of pocket beaches in the management area. About half of the reaches have shoreline modifications that can affect natural current patterns. The East Sound management area is among the lower scoring for habitat functions primarily due to a lack of documented priority bird species, haul-out habitat, and floating kelp.

4.4.1 Physical and Biological Characterization

Nearshore Physical Processes

The geology is reasonably complex and similar to other areas on the south side of Orcas Island. Bedrock, generally of marine origin, is at or near the surface for much of the management area, particularly in southern portions. The glacial sediments deposited near the town of Eastsound are similar to the North Coast Eastsound management area, although bedrock is much closer to the surface and exposed in places.

There are three drift cells in this management. The largest and most active is the drift cell (and feeder bluffs) that feed Crescent Beach. There are also drift cells that feed barrier beaches in Judd Cove and in the Eastsound Shores area.

Wave energy is generally modest and derived entirely from local wind-waves, though these can be significant near the village of Eastsound owing to the significant southern fetch there. Tidal currents are also modest (generally less than 1 knot).

Geologic Hazards

The risk of geologic hazards is low in the management area. While there are faults that dissect East Sound, they are largely relic from the uplift of Orcas Island. The only unstable bluff in the management area is the bluff on the east side of Ship Bay. This area, comprised primarily of glacial drift, has documented recent slides. Tsunami risk is insignificant (aside from local landslide-generated tsunamis), as is liquefaction (except the Crescent Beach marsh).

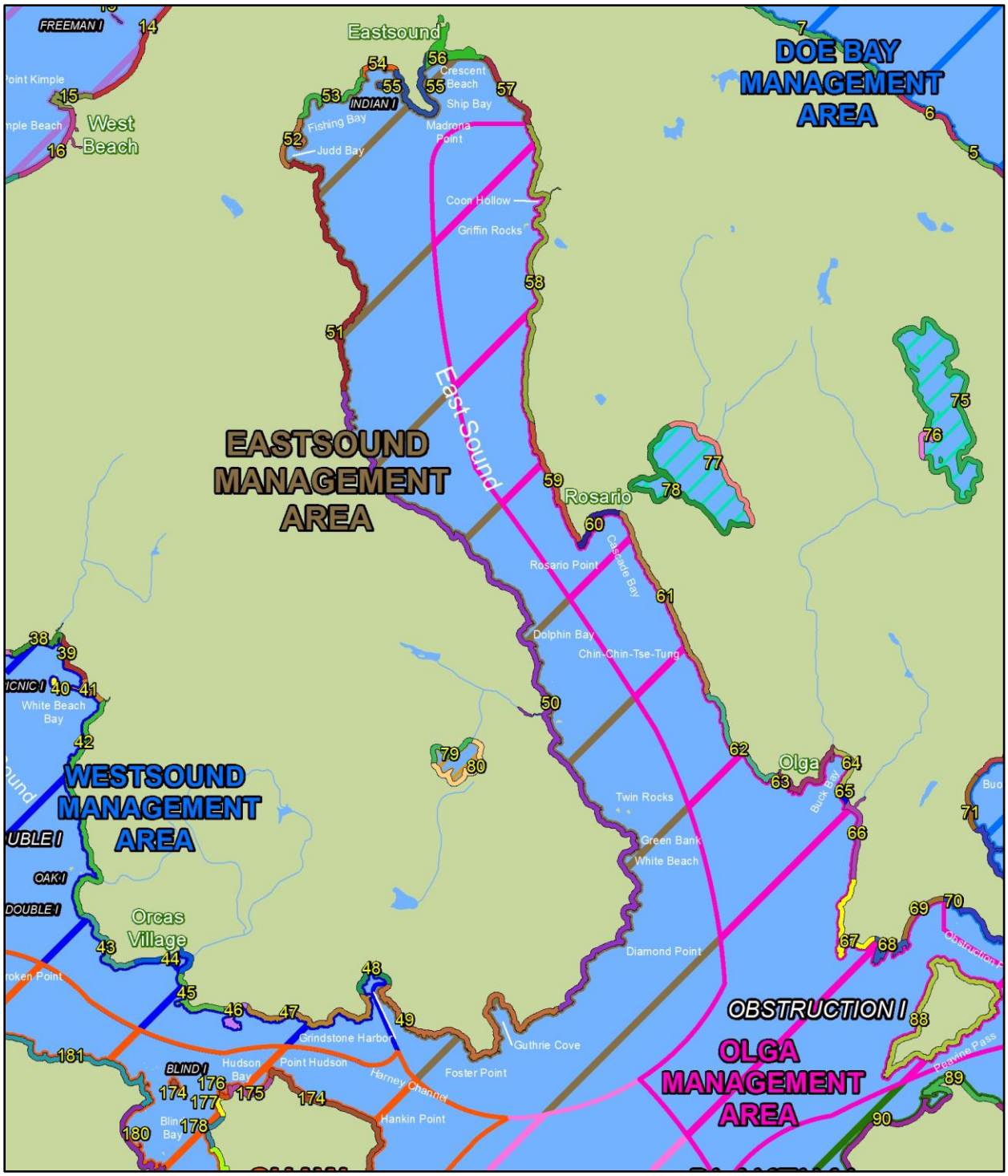


Figure 15. East Sound Management Area.

Streams and Associated Wetlands

Similar to the West Sound management area, there are a number of small streams within the management area. These include a stream in Grindstone Harbor (in addition to the stream that divides the West Sound and East Sound management areas), the stream outlet of Martins Lake and a stream in Gutherie Cove, and stream that drains to Judd Cove. The large stream that feeds Grindstone Harbor and the stream that drains to Judd Cove both have been documented to sustain fish.

In addition to the stream mouths there are two lagoon/wetland systems at the head of East Sound on the Eastsound waterfront. One of these areas has been largely filled and highly modified (the wetland called the Eastsound Swale) associated with Fishing Bay and the heart of the Eastsound commercial district: U.S. Coast and Geodetic Survey 1889c), while the other wetland complex associated with Crescent Beach is largely intact, although this complex is also affected by the construct of Crescent Beach Road.

Critical or Priority Habitat and Species Use

Ship Bay contains suitable habitat for various clam and crab species; all reaches within this management area have at least one documented shellfish species. The small stream entering East Sound from Martin Lake to the west supports coastal cutthroat trout. Crescent Beach is a known forage fish spawning beach (reaches 55 through 57) with documented herring spawing ranging beyond to reaches 53-57. Additional herring spawning is documented in reach 50. Nearshore waters along the shoreline from Judd Cove to Coon Hollow (reaches 52 through 57) are critical habitat for Pacific herring spawning as well as portions of reach 50 further to the south. The rocky western shoreline of East Sound contains habitat suitable for rockfish. The management area does not contain habitat that would be suitable for floating kelp species such as bull kelp that require well circulated water and rock substrates; however, understory kelp is reported intermittently present from Judd Cove to Crescent Beach (reaches 49 through 51, 55 and 57). Documented eelgrass is present in a patchy distribution from Grindstone Harbor to Fishing Bay. Herring spawning habitat is found in all but two reaches within the management area.

Marine Riparian, Nearshore, and Estuarine Habitats

Estuarine habitat is patchy throughout the management area. However, these patchy areas of nearshore wetland and freshwater influences contribute to riparian habitat diversity and the high biological productivity of East Sound. Such areas could provide suitable rearing areas for salmon smolts potentially entering the area.

Water Quality, Sediment, and/or Tissue Sample Results

Several water quality problems have been documented in the East Sound management area. The primary water quality problem is low dissolved oxygen concentrations; the East Sound was 303(d) listed for dissolved oxygen in 2008 (Ecology 2011e). Although the East Sound is located in an area with physical characteristics or circulation patterns that may increase its susceptibility to anthropogenic effects relative to other parts of the Puget Sound, the Department of Ecology's staff determined that the dissolved oxygen concentrations observed at this location may reflect human influences and warrants further examination (Ecology 2011e). The East Sound is listed as

Category 2 "Waters of Concern" due to a small fraction of the pH samples that did not meet water quality criteria (Ecology 2011e). The East Sound, however, did meet water quality criteria for temperature and ammonia-nitrogen (Ecology 2011e).

Streams discharging to the East Sound have also been documented with water quality problems, including high fecal coliform bacteria concentrations, low dissolved oxygen concentrations, and high conductivity (Wiseman et al. 2000; SJCD 2005).

One sediment sample collected from East Sound exceeded the Sediment Management Standards SQS bioassay criterion; sediment in this area is listed as a Category 2 "Sediments of Concern" (Ecology 2011e).

4.4.2 Shoreline Use Patterns

Existing Land and Shoreline Use

Land Use

The East Sound management area extends from Grindstone Harbor to the eastern edge of Ship Bay. Shoreline jurisdiction in this management area is predominantly residential.

Overall existing land use in the East Sound management area includes:

- Residential – 62 percent
- Trade – 1 percent
- Cultural, Entertainment, Recreation – 10 percent
- Undeveloped Land – 26 percent

The area between Grindstone Harbor and Guthrie Cove is mostly residential with some unclassified, cultural/recreation, and vacant land interspersed. The area east of Guthrie Cove is developed with rural residential uses. Beyond this development, existing land uses include a mix of larger lot residential, conservation, vacant, resource, unclassified, and cultural/recreation uses. Residential becomes a more predominant use, particularly north of Dolphin Bay. A large parcel of cultural/recreation land use (Indralaya, a retreat center) exists south of Judd Cove. San Juan County Land Bank's preservation land is located to the north of this recreational use. Judd Cove itself is largely residential, but with one manufacturing use located among the existing residences. More dense residential uses exist further north and east in the Eastsound UGA, particularly between Fishing Bay and Madrona Point. The area just west of Madrona Point also includes a mix of existing uses consisting of service, trade, and cultural/recreation uses. Madrona Point itself is a cultural/recreation use owned by the Lummi Nation. East of Madrona Point, in Ship Bay, the existing uses along the marine shoreline consist of a small amount of residential, cultural/recreation uses, and Crescent Beach area where a wetland extends shoreline jurisdiction inland. The Crescent Beach area also includes a DNR lease for an aquaculture operation. The east side of Ship Bay is characterized by suburban intensity residential development and a single trade land use. There are also privately owned Oyster Tracts in the East Sound Area.

Additional shoreline use includes a DNR utility line easement. The tidelands are a mix of state-owned aquatic lands and private ownership.

Water-dependent uses in this management area include docks, piers and marine railways, most of which are private or community-owned. A public marine facility is located in the Eastsound area on Madrona Point. Water enjoyment uses consist of several hotel/lodging facilities, particularly close to and within Eastsound, and other retail trade-eating/drinking establishments in Eastsound UGA. Another water enjoyment use is the Eastsound Waterfront County Park, located west of Madrona Point.

Land Use Designations

Comprehensive Plan land use designations in this management area consist of Rural Farm Forest from Grindstone Harbor to Guthrie Cove. The east side of Guthrie Cove provides a small area of Rural Residential where an existing residential development exists. From Guthrie Cove to the north side of Fishing Bay on the west side of Eastsound UGA, land in shoreline jurisdiction is designated Rural Farm Forest.

Eastsound is the largest community on Orcas Island, serving as the focal point of existing and future growth on Orcas Island. Between Fishing Bay and the east end of Ship Bay, a number of different future land designations exist reflecting the more urban and suburban character of Eastsound. These designations include Eastsound Rural Residential, a variety of Eastsound Residential districts ranging from 2 dwelling units per acre to 12 dwelling units per acre, Rural Commercial, Eastsound Natural (Madrona Point and Indian Island), and Eastsound Rural.

Shoreline Environment Designations

Shoreline environment designations are Rural Farm-Forest from Grindstone Harbor to a point south of Dolphin Bay. From there the shoreline use environment designations alternate between Conservancy and Rural Farm-Forest until the Eastsound UGA. The Eastsound UGA has a variety of specific shoreline use designations for this more intensely developed area. Eastsound Residential is applied from the western part of the UGA to the east side of Eastsound Waterfront County Park. From there to the western edge of Madrona Point, the designation is Eastsound Urban, reflecting the urban character of this segment of shoreline jurisdiction in the heart of Eastsound. The northern part of Madrona Point is Eastsound Residential on both sides of the point, with a Natural designation applied to both Indian Island and the south side of Madrona Point. East of Madrona Point is a Conservancy designation followed by additional Eastsound Residential to the eastern edge of the management area.

Shoreline Modifications

Approximately 3.3 percent of the management area is armored, near the average percentage for the County. The armoring is strongly correlated to pocket beaches and areas of glacial sediment. Considering much of the management area is bedrock, if the percentage of armoring would be expressed in terms of pocket beach area only, the percentage of armoring would be significantly larger. There is modest number of overwater structures (22) in the management area, most of which are docks and piers and are concentrated in the village of Eastsound, and other protected

embayments near the village. There is only one boat ramp and three marine railways. There are no marinas. Most of the mooring buoys are clustered in the small protective embayments in the southwestern corner of the management area.

Existing and Potential Public Access Areas

Existing Facilities

The Eastsound management area contains over 17.5 miles of shoreline and has several opportunities for public access, including the Eastsound Waterfront Park and Madrona Dock, Crescent Beach, and Judd Cove Natural Area Preserves, and nearly 2,500 feet of trails and paths.

Crescent Beach Drive runs parallel to the shoreline offering public access to Crescent Beach. Crescent Beach is a Natural Area Preserve of over 100 acres and more than 2,000 feet of waterfront, together with space for walking trails and off-road parking. Judd Cove Preserve is located in a secluded, well-protected inlet with scenic value and habitat for shorebirds, waterfowl and marine life. Public access has been enhanced by improved trailhead parking.

Existing Facilities with Potential for Improvement

Eastsound Madrona Dock, a 150-foot fixed dock with a 40-foot seasonal floating dock, offers opportunities for improved public access to the adjacent beach as well as parking and signage improvements. The Parks Plan recommends installation of an interpretive panel/kiosk and bench. Madrona Point is owned by the Lummi Nation where public access is prohibited. This management area lacks campgrounds or boat launching facilities.

4.4.3 Restoration Opportunities

The village of Eastsound was one of the first places in the County to be settled. Because early development was often made without regard to environmental consequences, most of the restoration opportunities lie close to the village. Crescent Beach just east of the village center is backed by a largely intact and protected wetland complex. However, there are a couple of residential structures and Crescent Beach Drive that separate and disconnect this wetland complex from East Sound. Restoring predevelopment-level nearshore processes to this area by reconnecting the wetland to East Sound in a more natural way would provide enormous habitat improvements and would restore the wetland's historical estuarine features.

Table 24A. East Sound Management Area Reach Assessment – Physical Conditions.

Reach	Natural Sediment Transport Patterns	Shoreline Sediment Input Alterations - Feeder Bluffs	Shoreline Sediment Input Alterations - Pocket Beaches	Shoreline Sediment Input Alterations - Barrier Beaches	Natural Current Patterns	Wave & Current Attenuation	Nutrient and Toxics Removal	Shade	Total
49	5	NP	4	NP	5	4	5	3	26
50	3	NP	4	NP	5	4	2	4	22
51	5	5	5	NP	5	5	2	4	31
52	5	5	5	NP	5	4	2	4	30
53	5	NP	5	NP	3	4	2	3	22
54	5	NP	0	NP	0	2	2	2	11
55	5	NP	3	5	3	4	2	3	25
56	5	NP	NP	3	3	3	2	0	16
57	5	4	NP	NP	3	4	2	2	20
Median	5.00	5.00	4.00	4.00	3.00	4.00	2.00	3.00	22.00
Average	4.78	4.67	3.71	4.00	3.56	3.78	2.33	2.78	22.56
Percent of Highest Possible Score	96%	93%	74%	80%	71%	76%	47%	56%	56%

NP = Not Present

Table 24B. East Sound Management Area Reach Assessment – Habitat Conditions.

Reach	Vegetation Coverage	Estuary Habitat	Birds	Haul-out Habitat	Eelgrass	Floating Kelp	Understory Kelp	Spawning Habitat[1]	Herring Spawning Habitat	Shellfish	Total
49	5	1	1	0	5	0	5	0	0	2	14
50	5	5	2	5	5	0	5	0	5	2	29
51	5	2	0	0	5	0	5	0	0	1	13
52	5	0	0	0	5	0	0	0	5	1	11
53	4	1	2	0	5	0	0	0	5	1	14
54	3	1	0	0	0	0	0	0	5	1	7
55	5	2	0	0	5	0	5	3	5	3	23
56	5	0	0	0	0	0	0	3	5	3	11
57	4	1	0	0	0	0	5	3	5	3	17
Median	5.00	1.00	0.00	0.00	5.00	0.00	5.00	0.00	5.00	2.00	14.00
Average	4.56	1.44	0.56	0.56	3.33	0.00	2.78	1.00	3.89	1.89	15.44
Percent of Highest Possible Score	91%	29%	11%	11%	67%	0%	56%	20%	78%	38%	39%

[1] Includes priority spawning habitat for sand lance, surf smelt, and rock sole.

4.5 Fisherman Bay Management Area

Fisherman Bay management area extends from the transition of sediment to bedrock at Kings Point in the south to Odlin County Park in the north. It includes Fisherman Bay, which borders Lopez Village. There are no major transportation related uses in this management area.

Table 25 is a summary of the reach assessment for the Fisherman Bay management area. The table is in two parts, one covering general physical conditions, the other addressing those conditions directly related to habitat functions. The following discussions cover both the conditions scored in the reach assessment (Tables 25A and B) and management area results from the ecosystem-wide characterization. The Fisherman Bay management area is the lowest scoring for both physical structure and for habitat functions. Physical conditions are scored low because there are generally fewer pocket beaches and where there are feeder bluffs or barrier beaches, they are often modified. There are also a number of outfalls, reaches in areas listed on Ecology's 303d list of waters of concern, and much of the shoreline vegetation has been modified affecting nearshore shade. From a habitat perspective, the management area is generally lacking in both understory and floating kelp as well as priority fish spawning habitat.

4.5.1 Physical and Biological Characterization

Nearshore Physical Processes

The management area is comprised entirely of glacial sediment rather than bedrock, and is therefore more similar to Puget Sound than the rest of the County from a physical process perspective. The glacial sediments that comprise the management area also possess the same sequence of bedding as in Puget Sound, with the possible exception that glacial drift is much more common in the management area. The result is a series of drift cells. The largest drift cell extends from the southern limit of the management area to the tip of the spit that protects Fisherman Bay. The drift cell on the outer beach of the spit is an important salmon migration corridor. A set of divergent drift cells define the shoreline between Fisherman Bay and Flat Point. Another set of divergent drift cells are present between Flat Point and Odlin County Park. Sediment transport within Fisherman Bay is minimal, but complex.

Wave energy is also typical of Puget Sound. Significant fetch is present to the south for the southern half of the management area, but the shoreline is oriented nearly parallel to southerly winds giving rise to significant alongshore transport. Tidal currents are significant, but not large (i.e., generally less than 1 knot), increasing to the south (Canadian Hydrographic Service 2010).

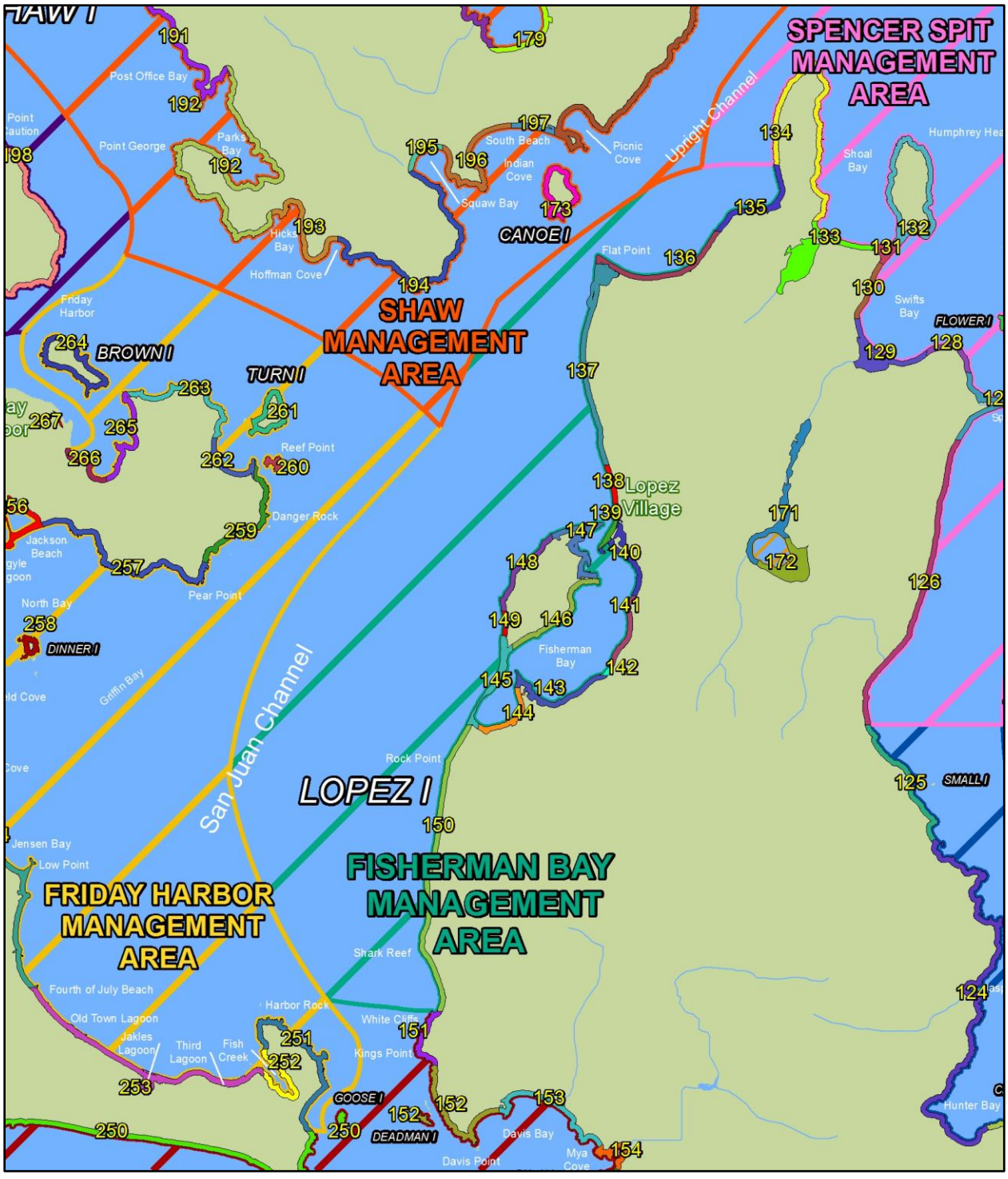


Figure 16. Fisherman Bay Management Area.

Geologic Hazards

The most significant geologic hazard in the management area is landsliding from two feeder bluff complexes north and south of Fisherman Bay. There is also a feeder bluff complex in between Flat Point and Odlin County Park that could be unstable. Liquefaction risk is variable. Liquefaction risk is moderate to high around the fringes of the Fisherman Bay and the wetland complex at Flat Point. It is also moderate along the shoreline at the southern end of the management area, but low to non-existent elsewhere. The management area lacks the surficial, relict (and active) tectonism common in the rest of the County. There is also a minimal tsunami risk, coming only from local landslide-generated tsunamis.

Streams and Associated Wetlands

Wetlands and fringing salt marshes are extensive along the margins of Fisherman Bay. The northern portion of the stream network that drains to the bay is ditched. There is also a wetland complex at Flat Point. There may have been also been a wetland complex in present-day Odlin County Park, which is now ditched. There are no mapped streams in the management area.

Critical or Priority Habitat and Species Use

Clam habitat is somewhat limited. Conditions are most suitable for sea urchin along the shorelines south of Fisherman Bay, and potentially suitable for geoduck clams off the outer shoreline of the peninsula that forms Fisherman Bay. Pacific herring and other forage fish spawning has not been documented in the management area, but a large portion of the management area has suitable habitat for forage fish spawning, and two sites (near Fisherman Bay Spit and Odlin Park) may have potential, indicated by one-egg counts during surveys (Friends of the San Juans 2004b). Two eggs must be counted for protection under the Washington Administrative Code. The shoreline vegetation is comprised partly by a narrow band of eelgrass that appears continuous from the northern extent of the management area near Odlin Park to White Cliffs at the southern extent. Floating kelp is limited in extent to the west side of Fisherman Bay spit and from Rock Point to White Cliffs (reaches 148 and 150). Understory kelp is documented at Flat Point (reach 136) and the tip of Fisherman Bay spit (reach 47). Bald eagles have been observed along the shoreline from the Fisherman Bay Spit to White Cliffs at the southern extent of the management area, likely in part due to significant trees on high bluffs that provide perching and nesting opportunities.

Marine Riparian, Nearshore, and Estuarine Habitats

Fisherman Bay contains estuarine habitat in all but two reaches. The shoreline generally lacks significant pocket beaches that would support fish rearing and migration. However, the extensive eelgrass, beach wrack, and a relatively unbroken forested shoreline jurisdiction likely contribute to suitable habitat conditions for important species and their prey.

Water Quality, Sediment, and/or Tissue Sample Results

Water quality samples collected from the south end of Fisherman Bay lagoon exhibited low fecal coliform bacteria concentrations (SJC 2000). Fisherman Bay is also classified as Category 2 "Waters of Concern" due to periodic low dissolved oxygen concentrations (Ecology 2011e). The

water quality of several ditches and outfalls that discharge to Fisherman Bay have also been monitored; elevated fecal coliform bacteria and low dissolved oxygen concentrations were documented in several studies (SJC 2000; Wiseman et al. 2000; SJCD 2005).

Sediment samples have also been collected from Fisherman Bay that exceeded Sediment Management Standards CSL chemistry criteria for 1,2,4-Trichlorobenzene, 1,2-Dichlorobenzene, and Hexachlorobenzene; sediment in this area is classified as Category 2 "Sediments of Concern" (Ecology 2011e).

4.5.2 Shoreline Use Patterns

Existing Land and Shoreline Use

Land Use

The Fisherman Bay management area extends from Kings Point on the southwest side of Lopez Island to the northern tip of Lopez Island. Overall existing land use in the Fisherman Bay management area includes:

- Residential – 74 percent
- Trade – 1 percent
- Services – 1 percent
- Cultural, Entertainment, Recreation – 8 percent
- Undeveloped Land – 16 percent

Existing land uses between King Point and Rock Point consist largely of large lot residential uses. From Rock Point to the north side of Lopez Village, including both sides of Fisherman Bay, the area is characterized by smaller lot residential development with a wider mix of existing land uses located near Lopez Village. The east side of Fisherman Bay south of Lopez Village includes three trade, one government/education, and one manufacturing land use. There is a large conservation parcel at the entrance to Fisherman Bay at the south end of Lopez Village. Lopez Village itself includes a small number of trade land uses, such as restaurants and retail establishments in amongst the small lot residential development that characterizes this part of Lopez Island. The remainder of this management area, north to Flat Point, is characterized by residential development with one large resource parcel located near Flat Point. Between Flat Point and the end of the management area at the northern tip of Lopez Island the area is predominantly residential with two large cultural/recreation parcels interspersed. Fisherman Bay is an important transportation hub for Lopez Island residents, visitors, and commercial business. In addition to private boats, it is served by seaplanes.

Additional shoreline use includes several DNR utility line easements. The tidelands are a mix of state-owned aquatic lands and private ownership.

Water-dependent uses in this management area include marinas in and near Lopez Village, and docks, piers, and marine railways, most of which are private. Among these, a public marine facility exists at Odlin Park in the northern part of the management area. Water enjoyment uses include eating and retail establishments in Lopez Village, hotel/lodging in and near Lopez Village, and Odlin Park. The Fisherman Bay spit supports annual reef netting operations.

Land Use Designations

The Comprehensive Plan land use designation from Kings Point north to Fisherman Bay is Rural Farm Forest. A small area in the southeast portion of Fisherman Bay is designated Rural Residential where an existing small lot residential development exists. At the northern entrance to Fisherman Bay, Lopez Village Urban Growth Area and Lopez Village Growth Reserve Area are found on the eastern shore. These areas are characterized by more intense urban/suburban development patterns with smaller lots than found in most other places in the County, with the exception of Eastsound and Friday Harbor. They also have a wider mix of uses concentrated in a small area. North of Lopez Village to the end of the management area at the northern tip of Lopez Island, the majority of shoreline jurisdiction area is designated Rural Farm Forest reflecting generally larger lot residential development. There are two exceptions that are designated Conservancy where Washington State DNR and San Juan County Park property exist.

Shoreline Environment Designations

The southern part of the management area to the entrance to Fisherman Bay is characterized by a Conservancy use environment. The west side of Fisherman Bay is in the Residential Rural-Farm shoreline environment, with the southern portion in Rural Residential. The eastern side of Fisherman Bay is characterized by alternating areas of Rural and Urban shoreline environments, with Conservancy applied on the eastern entrance to Fisherman Bay. Further north, a Rural Residential/Conservancy split environment is applied to the area near Lopez Village north of the entrance to Fisherman Bay. Conservancy is applied to the shoreline environment further north to the east side of Flat Point, with an area of Rural Farm-Forest east of that. Odlin Park at the northern end of the management area is designated Conservancy.

Shoreline Modifications

Nearly 20 percent of the management area is armored, much higher than the average percentage for the County and more than many rural areas of Puget Sound (USGS 2010). Because this management area is comprised entirely of glacial sediments, the true percentage of armoring is reflected appropriately here. This percentage is probably comparable to the actual percentage of armoring of pocket beach shorelines elsewhere in the County.

Fisherman Bay is a great natural harbor and, as a result, the management area has the largest number of mooring buoys (164) anywhere in the County, aside from the Decatur Island management area, which has only one more. Nearly all of these mooring buoys are in the bay. There are also four marinas in the bay. Fill is also common along the fringes of the bay. The remainder of the management area is less developed and reflects conditions typical of rural portions of the County. However, there are five groins in this management area, more than anywhere else in the County. It is likely that this is because the sediment-rich shorelines and large drift cells make groin placement much more effective than elsewhere in the County where sediment supply and transport is much more confined.

Existing and Potential Public Access Areas

Fisherman Bay management area has nearly 14 miles of shorelines and over 6,400 feet of trails and paths.

Existing Facilities

- Fisherman Bay Preserve. This preserve area has three unique features: the spit, the tombolo and Weeks Wetland. The sandy spit marks the entrance to Fisherman Bay. The tombolo is a connection between the islands and acts as a buffer between San Juan Channel and Fisherman Bay. The 24-acre Weeks Wetland is a unique saltwater wetland with a trail and observation deck. All of the property in the Fisherman Bay preserves provides habitat for wildlife.

- Lopez Village Road end provides a public staircase to the beach and has associated parking.

- Weeks Point Road end is located in Lopez Village and provides access to the water and views of the entrance to Fisherman Bay. Amenities at this developed road end include: parking for six cars, a picnic table, a launching area for hand-carried boats, and appropriate signage differentiating between the public access and adjacent private properties.

- The shoreline has 6,424 feet of trails, primarily located at the tombolo and the spit area.

Existing Facilities with Potential for Improvement

This management area contains public access opportunities in the form of parks, trails, natural area preserves, and road ends including, but not limited to:

- Odlin County Park is a roughly 80-acre regional park that includes a campground, picnic areas, boat launch, dock, ball fields, and a sandy beach. The Parks Plan recommends exploring expansion opportunities, renovating the park in accordance with the 2006 Master Plan, and installing directional and way finding signage.

- Otis Perkins Day Park provides views of Griffin Bay as well as bird and wildlife viewing opportunities. The park contains approximately 220 feet of gravel beach and an unpaved parking area that can accommodate ten cars. The park also has one picnic table and a portable toilet. The Park Plan recommendations include updating the park sign and installing a portable toilet with an enclosure or concrete pad.

4.5.3 Restoration Opportunities

Fisherman Bay has numerous impairments to nearshore functions. These include ditched (concentrated) upland freshwater sources to the bay, fill, armoring and bulkheading, overwater structures and a very large number of mooring buoys and pilings, some of which are likely not in current use. Because this all occurs within a confined area and a considerable amount of land is collectively held, a feasibility study could be undertaken to identify opportunities to improve this potentially great natural resource.

In addition to work at Fisherman Bay, Odlin County Park could also be a target for restoration. Historic maps indicate that the meadow area and parking lot in the center of the park were once a sloping marsh (U.S. Coast and Geodetic Survey 1889d). Restoration of this area would increase shorebird populations in the area and provide rearing habitat for migrating salmonids.

Table 25A. Fisherman Bay Management Area Reach Assessment – Physical Conditions.

Reach	Natural Sediment Transport Patterns	Shoreline Sediment Input Alterations - Feeder Bluffs	Shoreline Sediment Input Alterations - Pocket Beaches	Shoreline Sediment Input Alterations - Barrier Beaches	Natural Current Patterns	Wave & Current Attenuation	Nutrient and Toxics Removal	Shade	Total
135	3	5	NP	NP	2	4	5	4	23
136	5	3	NP	5	5	4	5	4	31
137	5	4	NP	5	5	4	5	3	31
138	5	3	NP	NP	5	2	5	3	23
139	5	NP	NP	5	2	2	3	1	18
140	5	NP	NP	5	5	4	3	1	23
141	5	NP	NP	NP	0	2	3	2	12
142	5	NP	NP	NP	5	2	3	4	19
143	3	NP	NP	4	0	3	3	2	15
144	5	NP	NP	NP	1	4	3	3	16
145	5	NP	NP	1	3	3	3	1	16
146	1	0	NP	3	3	3	3	1	14
147	5	NP	5	5	5	4	3	1	28
148	5	NP	NP	NP	5	5	5	3	23
149	5	NP	NP	NP	5	4	5	0	19
150	3	4	NP	5	5	4	5	3	29
Median	5.00	3.50	5.00	5.00	5.00	4.00	3.00	2.50	21.00
Average	4.38	3.17	5.00	4.22	3.50	3.38	3.88	2.25	21.25
Percent of Highest Possible Score	88%	63%	100%	84%	70%	68%	78%	45%	53%

NP = Not Present

Table 25B. Fisherman Bay Management Area Reach Assessment – Habitat Conditions.

Reach	Vegetation Coverage	Estuary Habitat	Birds	Haul-out Habitat	Eelgrass	Floating Kelp	Understory Kelp	Spawning Habitat[1]	Herring Spawning Habitat	Shellfish	Total
135	5	1	1	0	5	0	0	0	0	2	14
136	5	1	0	0	5	0	5	0	0	1	17
137	5	3	0	0	5	0	0	0	0	1	14
138	4	1	1	0	0	0	0	0	0	1	7
139	4	1	0	0	5	0	0	0	0	1	11
140	5	5	1	0	5	0	0	0	0	1	17
141	4	0	0	0	5	0	0	0	0	1	10
142	4	1	0	0	5	0	0	0	0	1	11
143	5	3	0	0	5	0	0	0	0	1	14
144	5	2	0	0	0	0	0	0	0	1	8
145	5	5	1	0	5	0	0	0	0	3	19
146	4	1	0	0	5	0	0	0	0	1	11
147	5	5	0	0	5	0	5	0	0	2	22
148	5	1	0	0	5	5	0	0	0	2	18
149	5	0	0	0	5	0	0	0	0	2	12
150	5	3	2	0	5	5	5	0	0	2	27
Median	5.00	1.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00	1.00	14.00
Average	4.69	2.06	0.38	0.00	4.38	0.63	1.67	0.00	0.00	1.44	14.50
Percent of Highest Possible Score	94%	41%	8%	0%	88%	13%	33%	0%	0%	29%	29%

[1] Includes priority spawning habitat for sand lance, surf smelt, and rock sole.

4.6 Friday Harbor Management Area

The Friday Harbor management area includes unincorporated portions of Friday Harbor and Griffin Bay on San Juan Island, extending southwards to Cattle Point. The management area includes Brown Island, Turn Island, and Dinner Island, as well as several small uninhabited islets, primarily around Reef Point. There are no major transportation related uses in this management area.

Table 26 is a summary of the reach assessment for the Friday Harbor management area. The table is in two parts, one covering general physical conditions, the other addressing those conditions directly related to habitat functions. The following discussions cover both the conditions scored in the reach assessment (Tables 26A and B) and management area results from the ecosystem-wide characterization. Physical conditions score about 65 percent of the possible score primarily due to the large number of modifications of the shoreline including outfalls and shoreline armoring. Habitat functions also score relatively low primarily from reduced vegetation cover in some reaches, and few reaches with haul-out habitat, floating kelp and priority fish spawning habitat. There is a general trend in the reach assessment, with those reaches closest to the Town of Friday Harbor (in particular, reach 266) scoring lowest. Those reaches closer to Cattle Point score much higher, and are more typical of other sparsely developed areas of the County.

4.6.1 Physical and Biological Characterization

Nearshore Physical Processes

The geology of the Friday Harbor management area is diverse. While metal-rich bedrock is common in some areas (i.e., the two primary promontories: Cattle Point and Reef Point), there are thick layers of glacial outwash and drift in the isthmuses that connect these points of land to the rest of San Juan Island. The presence of glacial sediments provides the nearshore with sediment in places and gives rise to lagoons and tombolos, which are common in this management area, particularly on the isthmuses.

Several drift cells have been mapped in this management area. The largest drift cell provides sediment to a series of barrier lagoons on the isthmus associated with Cattle Point. Drift is from east to west. There is a second smaller drift cell that originates from the same short, but significant, feeder bluff that terminates in the bedrock of Cattle Point. In addition Cattle Point also has a drift cell near Goose Island. There are a series of small drift cells associated with pocket beaches between Turn Point and Argyle Lagoon. Brown and Turn Island also have small drift cells on the southern shoreline.

Some of the largest tidal currents in the County are encountered through the San Juan Channel as it passes between Lopez and San Juan islands. Currents in excess of 2.5 knots are common in this area (Canadian Hydrographic Service 2010). The remainder of the management area has lesser currents and the two primary embayments are relatively quiescent. Wave energy is modest as most of the area has limited fetch due to the proximity of other islands.

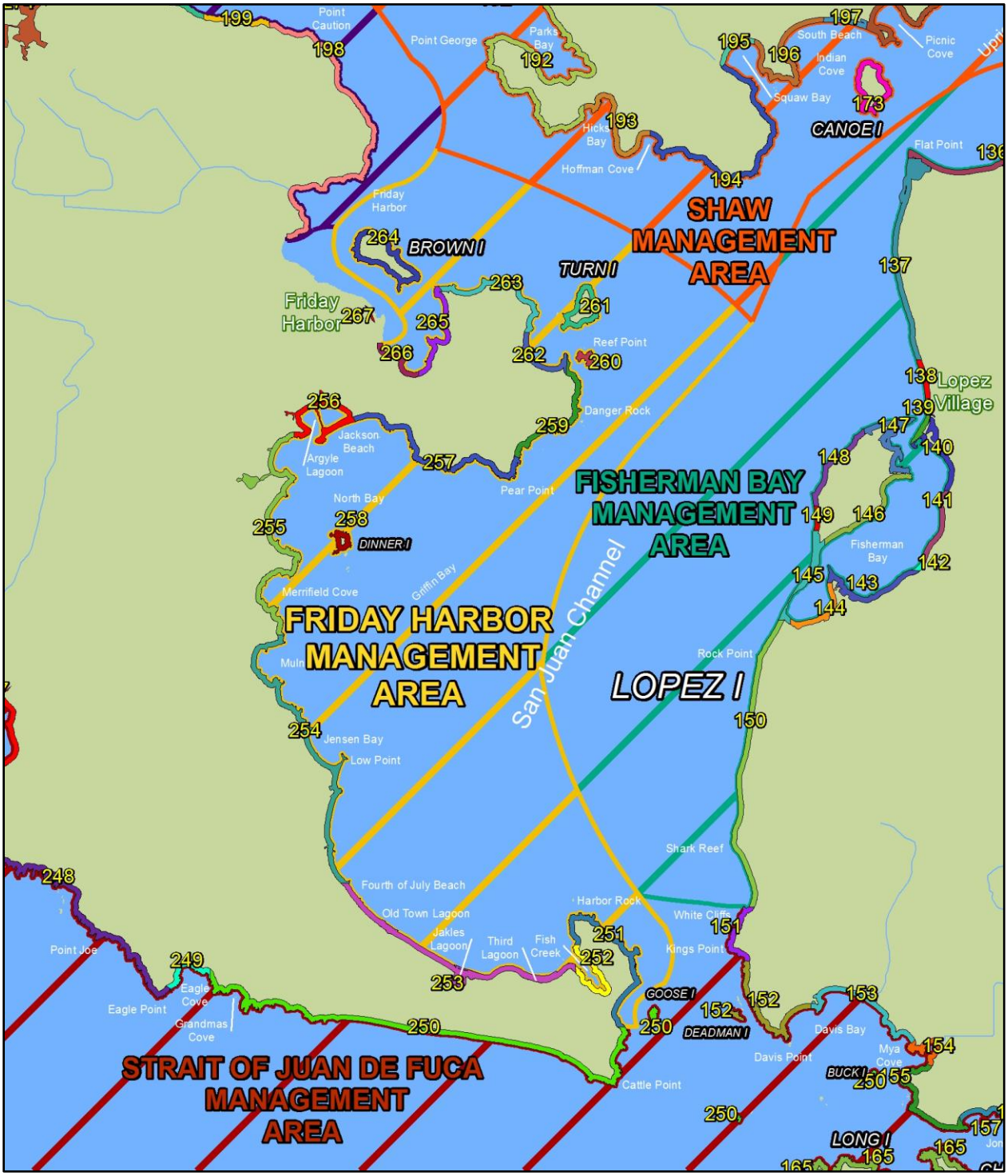


Figure 17. Friday Harbor Management Area.

Geologic Hazards

The geologic hazards are relatively modest in comparison to other portions of the County. Liquefaction is possible near the lagoons in glacial outwash within the San Juan Island National Historic Park, but is unlikely elsewhere in the management area due to the presence of competent bedrock. The glacial outwash in the Park is also subject to landsliding, and represents the only significant landslide threat in the management area. Tsunamis are unlikely and would likely only be a result of landslide-generated tsunamis generated on other adjacent islands.

Streams and Associated Wetlands

There are 10 very small streams in this management area. None of them are currently fish bearing. These streams have numerous culverts in the shoreline management zone, particularly in the northern portion of the management area, indicating significant modifications have occurred. There are several natural lagoons at the south end of Griffin Bay. These are largely intact features. Also included in this management area is Argyle Lagoon, which is adjacent to a large gravel pit. It is uncertain to what extent it is a natural feature since the T-sheet for this area shows existing development (U.S. Coast and Geodetic Survey 1897b).

Critical or Priority Habitat and Species Use

Griffin Bay contains pandalid shrimp habitat, as well as some nearshore areas suitable for clam species (in the vicinity of barrier beaches at Jakles Lagoon and Fish Creek) including geoduck (North Bay). Beaches near Argyle Lagoon, Jackson Beach, and Jensen Bay provide spawning habitat for forage fish including sand lance and surf smelt. Juvenile Chinook, chum, and pink salmon have been documented in Griffin Bay nearshore areas (Wyllie-Echeverria and Barsh 2007). Small islands including Dinner Island and Harbor Rock provide habitat for seabirds. The shoreline also provides habitat for bald eagles, although use by this species may be limited compared to other management areas due to current development or relative lack of suitable trees. The rocky headlands and islets common throughout the management area contain habitat suitable for rockfish. Eelgrass is documented in all but one reach of this management area and understory kelp is found in all. Floating kelp is patchier in its distribution overall but clustered near Danger Rock, Reef Point and Turn Island (reaches 259 through 263). Up to three species of shellfish are found within every reach. Priority fish spawning habitat is documented in Jensen Bay, Argyle Lagoon and Pear Point (reaches 2564, 256 and 257).

Marine Riparian, Nearshore, and Estuarine Habitats

Estuarine habitat is present within all reaches but generally two acres or less within each reach. The northern portions of the management area including North Bay, Merrifield Cove, and Mulno Cove shorelines are relatively developed compared to other locations, resulting in relatively disturbed terrestrial riparian vegetation. Thus significant forested areas are generally lacking from these areas, but are prominent along the San Juan Island National Historic Park shoreline.

Water Quality, Sediment, and/or Tissue Sample Results

Several water quality problems have been documented in the Friday Harbor management area. The primary water quality problems include low dissolved oxygen and elevated fecal coliform

bacteria concentrations; Friday Harbor was 303(d) listed for dissolved oxygen in 2008 and was also 303(d) listed for fecal coliform bacteria in 1996 and 1998 (Ecology 2011e). Friday Harbor is currently classified as a Category 2 "Waters of Concern" for fecal coliform bacteria (Ecology 2011e). In contrast, water quality results from two sample locations at Friday Harbor exhibited low levels of fecal coliform bacteria concentrations (Wiseman et al. 2000). Several other water quality studies have evaluated the water quality of streams discharging to Friday Harbor with mixed results; Wiseman et al. (2000) and SJCD (2000) showed elevated levels of fecal coliform bacteria concentrations while no water quality problems were reported in SJCD (2005).

Sediment in Friday Harbor exceeded Sediment Management Standards CSL chemistry criteria for 1,2,4-Trichlorobenzene, 1,2-Dichlorobenzene, 1,4-Dichlorobenzene, and Hexachlorobutadiene; sediment in this area is classified as Category 2 "Sediments of Concern" (Ecology 2011e).

4.6.2 Shoreline Use Patterns

Existing Land and Shoreline Use

Land Use

The Friday Harbor management area extends from north of Cattle Point to the southern limits of the Town of Friday Harbor on San Juan Island. It also includes the nearby smaller islands of Dinner, Brown, and Turn islands. Overall existing land use in the Friday Harbor management area includes:

- Residential – 70 percent
- Services – 2 percent
- Cultural, Entertainment, Recreation – 18 percent
- Undeveloped Land – 10 percent

Existing land uses are almost entirely small lot residential between the southern end of the management area near Cattle Point, to Fish Creek east of the American Camp, the exceptions being two vacant lots and an undeveloped conservation easement. The area between Fish Creek and Fourth of July Beach is in cultural/recreation use (National Park Service – American Camp). Between Fourth of July Beach and approximately Merrifield Cove existing land use patterns in shoreline jurisdiction consist of larger lot residential, vacant, cultural/recreation, and small amounts of unclassified land uses. Between Merrifield Cove and Argyle Lagoon, the area becomes more intensely residential with smaller lot development. Two government/education land uses exist in between Argyle Lagoon and Pear Point, along with some cultural/recreation land uses. Jackson Beach to the southern Friday Harbor town limits consists mostly of residential land uses with a small amount of conservation, vacant, and cultural/recreation uses mixed in. Brown and Dinner islands are residential, and Turn Island is a cultural/recreation use.

Additional shoreline uses includes several DNR utility line easements, at least one desalination system and a barge landing. The tidelands are a mix of state-owned aquatic lands and private ownership.

Water-dependent uses include docks, piers, and marine railways, most of which are private or community facilities. Water enjoyment uses in this management area include the American Camp National Park, Jackson Beach Park, and the marine state park campground at Turn Island.

Land Use Designations

The Comprehensive Plan land use designation from the beginning of the management area north of Cattle Point to the eastern edge of American Camp, west of Fish Creek, is designated Rural Residential. American Camp itself is largely designated Conservancy to reflect the national park status of this area; however, there are also small areas designated as Natural in places, such as Jackles Lagoon. North of American Camp's Fourth of July Beach to Mulno Cove, shoreline jurisdiction is mostly in Rural Farm Forest with a small area of Agricultural Resource and Conservancy in the south part. The existing residential area between the north end of Mulno Cove and the south side of North Bay is designated Rural Residential. Further north, land use designations transition to Rural Farm Forest until Argyle Lagoon, where it changes to Rural Residential to the south Friday Harbor town limits in the town's UGA. The area within the Town of Friday Harbor's UGA and just south of it provide for more intensity of development than found in most of the remainder of the County, with the exception of Eastsound and Lopez Village. There is one Rural Industrial parcel south of the town limits separated by two larger lot residential parcels designated Rural Residential. Of the smaller islands, Brown Island, near Friday Harbor, is entirely designated Rural Residential, while Dinner and Turn islands are designated Natural.

Shoreline Environment Designations

The southern part of this management area is in Rural Residential shoreline environment, reflecting the developed state of the management area east of American Camp. The American Camp portion of the San Juan Island National Park includes both Conservancy and Natural environments along its shoreline jurisdiction in this management area. The shoreline environment designation is mostly Rural Farm-Forest north to the south side of Merrifield Cove, with the exception of a small area of Natural environment designation at Low Point, and a Rural Residential environment designation at Jensen Bay. Further north, Merrifield Cove is Rural Residential, and a split designation of Natural and Rural Residential occurs further to the north followed by more Rural Residential. Beyond that, the shoreline environment is Rural Farm-Forest until approximately Argyle Avenue. Shoreline designations at the Argyle Lagoon and Jackson Beach areas are a mix of Rural Residential, Conservancy, Natural, and Rural Farm-Forest. From the east end of Jackson Beach to the outskirts of Friday Harbor, shoreline environment designations alternate between Conservancy and Rural Residential. The shoreline environment designation becomes Urban at the south end of Friday Harbor near Black Street to the end of the management area. Brown Island is Rural Residential, Dinner Island is a combination of Conservancy and Natural, and Turn Island is Natural. Remaining smaller islands are either Conservancy, Natural or a combination of the two.

Shoreline Modifications

Approximately 6.6 percent of the management area is armored, much higher than the average percentage for the County. Armoring is primarily located in areas of glacial sediment. For

example, the entire shoreline of a pocket beach near Reef Point is armored. While bedrock outcrops are not as common in this management area as others, if the percentage of armoring would be expressed in terms of pocket beach area only, the percentage of armoring would be significantly larger. There are relatively large number of dock and piers (69) and other overwater structures (13). These features increase in prevalence as the Town of Friday Harbor is approached. There are also six boat ramps and four marinas. Mooring buoys are the only structure relatively rare in the management area, but there are 75 of them, mostly located in and around Friday Harbor.

Existing and Potential Public Access Areas

Existing Facilities

The Friday Harbor management area has approximately 24.2 miles of shorelines, roughly 3,500 feet of trails, and the following public access opportunities:

- Carter Beach Road end leads to a grassy area with low bank that provides a good launching point for kayaks headed to Turn Island.
- Mill Street ends at shoreline a little south of the Jackson Beach boat ramp. It offers shoreline public access before it turns to connect with Wilks Way.
- Third Lagoon Preserve is adjacent to American Camp National Historic Park and Cattle Point Natural Resources Conservation Area. The site contains a rare saltwater lagoon.
- Jackson Beach boat ramp provides public access and launching facilities.
- People are allowed to land, hike, and camp on parts of Turn Island (Washington State Parks and Recreation Commission 2011).

Existing Facilities with Potential for Improvement

- Halsey Road end stops 150 feet from high bank waterfront. The area has potential for development as a view point looking across Griffin Bay to San Juan Channel.
- Jensen Bay Road end provides a beautiful view of Griffin Bay and a trail down the medium bank waterfront to the beach. However, once at the beach, public access is limited by signs on both sides of the road end identifying the adjoining beach and tidelands as private and prohibit trespassing.
- Cameron Bay Road stops short of the water but the site provides a nice view of bird nesting on one of the small outer islands. There is also a picnic site accessible on foot.

- Turn Point County Park – also identified as a road end in public works documents – is located at the end of Turn Point Road, before it turns into Pear Point Road. The park includes parking, a walking trail and benches at a low-bank viewpoint. Beach access is available for launching hand-carry boats. The Parks Plan identifies future improvements such as Americans with Disability Act (ADA) accessibility, entry and way finding signage, and installation of a portable toilet.

- Mulno Cove Farm Conservation Easement contains 500 feet of Griffin Bay shoreline and reduces development potential from 16 lots to 5 lots and precludes development along the shoreline.

Public access and trail facilities are recommended in the Parks Plan. Generally, this management area provides significant public access opportunities. The expansion, maintenance, and further development of these opportunities will achieve the goals of the Comprehensive Plan and the Parks Plan.

4.6.3 Restoration Opportunities

The largest and most obvious restoration opportunity in the Friday Harbor management area is the restoration of Argyle Lagoon, which is owned by the University of Washington and is set aside as marine preserve administered by WDFW, along with the adjacent LaFarge gravel pit. The lagoon is a natural feature, as it is present in historic maps predating most development (U.S. Coast and Geodetic Survey 1897b). However, there has been significant alteration to the area near the gravel pit and associated marina. Restoration of the marsh shown in the T-sheet should expand fish and bird use of the site and provide a good opportunity to showcase the nearshore environment to residents and visitors of Friday Harbor.

Table 26A. Friday Harbor Management Area Reach Assessment – Physical Conditions

Reach	Natural Sediment Transport Patterns	Shoreline Sediment Input Alterations - Feeder Bluffs	Shoreline Sediment Input Alterations - Pocket Beaches	Shoreline Sediment Input Alterations - Barrier Beaches	Natural Current Patterns	Wave & Current Attenuation	Nutrient and Toxics Removal	Shade	Total
251	5	5	3	NP	5	4	5	3	30
252	5	NP	1	NP	5	4	5	3	23
253	5	5	NP	5	5	4	5	3	32
254	5	5	3	5	5	4	5	2	34
255	3	4	4	NP	0	4	5	3	23
256	5	NP	NP	4	3	4	5	1	22
257	5	NP	5	NP	3	4	5	2	24
258	5	NP	5	NP	5	5	5	2	27
259	5	NP	1	NP	3	4	5	3	21
260	5	NP	5	NP	5	5	5	2	27
261	5	5	NP	NP	5	5	5	3	28
262	5	5	0	NP	5	2	5	2	24
263	5	5	2	NP	3	4	5	4	28
264	3	4	5	NP	5	4	5	4	30
265	3	NP	1	NP	5	4	5	4	22
266	5	NP	NP	NP	5	4	5	1	20
Median	5.00	5.00	3.00	5.00	5.00	4.00	5.00	3.00	25.50
Average	4.63	4.75	2.92	4.67	4.19	4.06	5.00	2.63	25.94
Percent of Highest Possible Score	93%	95%	58%	93%	84%	81%	100%	53%	65%

NP = Not Present

Table 26B. Friday Harbor Management Area Reach Assessment – Habitat Conditions.

Reach	Vegetation Coverage	Estuary Habitat	Birds	Haul-out Habitat	Eelgrass	Floating Kelp	Understory Kelp	Spawning Habitat[1]	Herring Spawning Habitat	Shellfish	Total
251	5	1	0	0	5	5	5	0	0	3	19
252	5	2	0	0	5	0	5	0	0	3	15
253	5	5	0	0	5	0	5	0	0	3	18
254	3	4	2	5	5	0	5	3	0	2	26
255	3	3	0	0	5	0	5	0	0	3	16
256	2	1	0	0	5	0	5	5	0	2	18
257	3	1	0	5	5	5	5	3	0	2	26
258	5	1	1	0	5	0	5	0	0	2	14
259	4	2	0	5	5	5	5	0	0	2	24
260	5	3	0	5	5	5	5	0	0	2	25
261	5	2	1	0	5	5	5	0	0	2	20
262	4	2	0	0	5	5	5	0	0	2	19
263	5	2	0	0	5	5	5	0	0	2	19
264	5	1	0	0	5	0	5	0	0	1	12
265	4	1	1	0	5	0	5	0	0	1	13
266	3	1	0	0	0	0	5	0	0	1	7
Median	5.00	2.00	0.00	0.00	5.00	0.00	5.00	0.00	0.00	2.00	18.50
Average	4.13	2.00	0.31	1.25	4.69	2.19	5.00	0.69	0.00	2.06	18.19
Percent of Highest Possible Score	83%	40%	6%	25%	94%	44%	100%	14%	0%	41%	36%

[1] Includes priority spawning habitat for sand lance, surf smelt, and rock sole.

4.7 Mud Bay Management Area

The Mud Bay management area is defined by the southeastern end of Lopez Island that is comprised of bedrock (Figure 18). It extends from the transition from sediment bedrock at the south end of Lopez Sound around numerous promontories and Mud Bay to Aleck Bay on the south end of the island. The management area includes Boulder Island and Castle Island and numerous small bedrock islets in Mud Bay. There are no major transportation related uses in this management area.

Table 27 is a summary of the reach assessment for the Mud Bay management area. The table is in two parts, one covering general physical conditions, the other addressing those conditions directly related to habitat functions. The following discussions cover both the conditions scored in the reach assessment (Tables 27A and B) and management area results from the ecosystem-wide characterization. Mud Bay management area is among the higher scoring management areas for both physical conditions and habitat functions. This is because the shoreline in general has fewer modifications and there are a significant number of pocket beaches. From the habitat perspective, there are many reaches with multiple shellfish species and priority fish spawning sites, and a high percentage of vegetation coverage in the shoreline jurisdiction.

4.7.1 Physical and Biological Characterization

Nearshore Physical Processes

The Mud Bay management area is extremely diverse, even by County standards. The shoreline varies from sediment-rich shorelines, similar to Puget Sound (such as at the southeast end of Mud Bay) to steep, plunging bedrock shorelines comprised entirely of basalt. Much of the shoreline is a mix of these shoreline types, where pocket beaches are common. Where sediment exists, primarily in Mud Bay, there are several drift cells, two of which converge at the head of Mud Bay and the large tombolo that connects Skull Island and Sperry Point to Lopez Island.

The physical forcing on the shorelines of the Mud Bay management area varies dramatically. Promontories along the southern shoreline of Lopez Island (Point Colville, Castle Island) are extremely exposed to high wave and tidal energy and are more similar to the Strait of Juan de Fuca management area than any other area in the County. The embayments along the southern and southeastern shoreline (Aleck Bay, Hughes Bay, and McArdle Bay, Watmough Bay and Shoal Bight) are also extremely diverse with respect to wave energy depending on the aspect of the shoreline of interest, with those shorelines facing south and west having the most energy. Tidal energy is much lower than near promontories. Mud Bay itself is one of the quiescent areas within the County, both with respect to waves and tides.

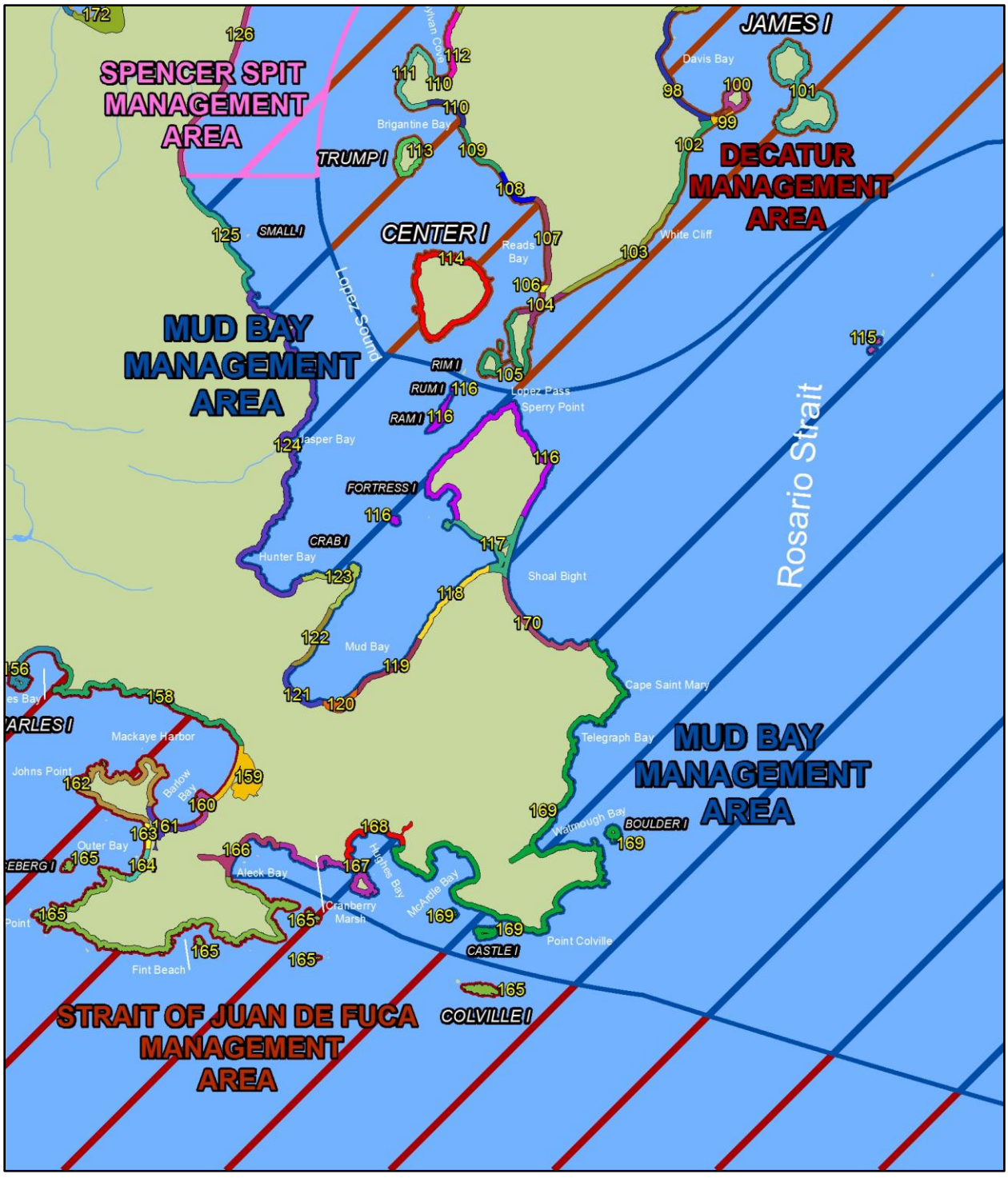


Figure 18. Mud Bay Management Area.

Geologic Hazards

There is also a large diversity of geologic hazards. The southern shoreline is exposed to some of the same kind of tsunami risks as the Strait of Juan de Fuca management area (i.e., tsunamis from the Northeast Pacific and from the Strait of Juan de Fuca). However, protected areas in the northern portion of the management area are mostly sheltered from them. Landsliding could occur across the management area everywhere glacial sediments are found on the shoreline, but the only area that sees consistent bluff retreat and failure is along the south shoreline of Mud Bay. Even here, erosion and bluff retreat is slow because of relatively quiescent wave and tidal conditions. Liquefaction risk is relatively high in the marshes, but low to non-existent elsewhere.

Streams and Associated Wetlands

There are several large marsh complexes in this management area. The two largest are associated the head of Mud Bay and the large tombolo associated with Skull Island and Sperry Point. Other smaller marsh complexes occur at the head of Watmough Bay and Aleck Bay, and Hunter Bay, and a small inlet on Skull Island. The smaller marsh complexes are relatively intact, while the two larger marshes are developed at their periphery with a relatively small amount of hydrologic alteration. There is only one mapped stream in the management area. It is unnamed and discharges to Jasper Bay.

Critical or Priority Habitat and Species Use

Documented forage fish spawning extends along the bluff backed beaches of Hunter Bay and Mud Bay, an area identified as one of four priority forage fish spawning habitats in the County (Friends of the San Juans 2004a). Pacific herring spawning habitat is also present in much of this management area from Jasper Bay to Sperry Point (reaches 117 through 124). Mud Bay shoreline provides habitat for clams and crab, while suitable crab habitat extends north to Jasper Bay and the general area of Hunter Bay. The Mud-Hunter Bay area also supports seabirds and shorebirds, which are also common near Boulder Island and Castle Island off the outer shoreline of Lopez Island. The rocky promontories and islets throughout the management area contains habitat suitable for rockfish. Eelgrass is found in a patchy distribution throughout the management area. Floating kelps are less common and only documented in reaches 116, 124, 167, and 169. Understory kelps are common and documented throughout Mud Bay, Sperry Peninsula and Shoal Bight (reaches 116 through 118, and 122 through 170).

Marine Riparian, Nearshore, and Estuarine Habitats

Estuarine habitats occur in all reaches but two within the management area. These areas also support eelgrass colonies. The outer shoreline is forested but steep and rocky. This provides suitable habitat for a variety of birds, but potentially likely limits the suitability for many juvenile fish that rely on shallow nearshore areas. Vegetation coverage is high in the shoreline jurisdiction of all reaches.

Water Quality, Sediment, and/or Tissue Sample Results

Elevated fecal coliform bacteria concentrations were observed in water quality samples collected from tidal areas of Mud Bay (SJCD 2005). Water quality samples collected from a stream that

discharges to Jasper Bay exhibited elevated fecal coliform bacteria concentrations, occasionally low dissolved oxygen concentrations, and occasionally high nutrient concentrations (Wiseman et al. 2000). High fecal coliform bacteria concentrations were also observed in a streams discharging to Mud and Hunter Bays (SJC 2000; SJCD 2005).

One sediment sample was also collected between Center Island and Lopez Island that exceeded the Sediment Management Standards SQS bioassay criterion; sediment in this area is classified as Category 2 "Sediments of Concern" (Ecology 2011e).

4.7.2 Shoreline Use Patterns

Existing Land and Shoreline Use

Land Use

The Mud Bay management area extends from the mid-point of the east side of Lopez Island south to Aleck Bay, and includes the smaller Ram, Fortress, Boulder, and Castle islands. Overall existing land use in the Spencer Spit management area includes:

- Residential – 63 percent
- Services – 2 percent
- Undeveloped Land – 34 percent

Existing land uses from the mid-point of the eastern side of Lopez Island south to Hunter Bay consist predominantly of large-lot residential development interspersed with large parcels of unclassified and conservation uses. From the south side of Hunter Bay to the east side of Mud Bay, this management area is characterized by more intense, smaller lot residential development. The northeastern corner of Mud Bay to the peninsula to Sperry Point consists of large lot residential uses with some vacant interspersed. The peninsula with Sperry Point is mostly held in conservation easement, with some large lot residential development on the western side. South on Shoal Bight to Cape Saint Mary, existing land uses include a mix of small and large lot residential and vacant parcels, with a government/education land use on Cape Saint Mary itself. South of Cape Saint Mary, most of the shoreline jurisdiction to Point Colville is vacant with smaller amounts of residential, conservation, and unclassified uses. Point Colville to the east side of McArdle Bay consists of government/education and conservation uses on large lots. The shoreline jurisdiction between McArdle Bay and the end of the management area at Aleck Bay is predominantly residential, with a mix of large and small lots, and includes areas in conservation, and vacant land uses. Boulder, Castle, and Fortress islands are all undeveloped or vacant Federal lands. Ram Island is an unclassified existing land use.

Additional shoreline uses includes several DNR utility line easements, at least one desalination system and an aquaculture operation. The tidelands are a mix of state-owned aquatic lands and private ownership.

Water-dependent uses in this management area consist of a number of piers, docks, and marine railways, many of which are privately owned. One public marine facility is identified at Hunter Bay.

Land Use Designations

The northern portion of this management area has a small area designated Rural Residential reflecting an area currently developed in small lot residential. South of this area, the management area's shoreline jurisdiction is designated Rural Farm Forest south through Mud Bay. This area includes areas with both large lot and small lot residential development. The Sperry Point peninsula is designated Forest Resource. South of this location, from Shoal Bight to Cape Saint Mary is a mix of Rural Farm Forest and Rural Residential. Cape Saint Mary to the north side of Watmough Bay is designated Forest Resource. The south side of Watmough Bay to the south side of McArdle Bay is designated a combination of Rural Farm Forest, Conservancy, and Natural designations. The remainder of the management area between McArdle Bay and Aleck Bay is predominantly Rural Farm Forest with smaller area of Agricultural Resource and Forest Resource.

Crab, Fortress, and Castle islands are designated Natural. Ram Island is designated Conservancy.

Shoreline Environment Designations

Shoreline environment designations are predominantly Rural Farm-Forest south to Hunter Bay, with the exception of one small area designated Conservancy. From Hunter Bay to the east side of Mud Bay, existing shoreline designations alternate from Rural Residential to Conservancy, back to Rural Residential, and then to Rural Farm-Forest. Both sides of the neck of the peninsula leading to Sperry Point are designated Conservancy, while the peninsula itself is designated Rural Farm-Forest. A Rural Farm-Forest shoreline designation continues south from Shoal Bight to Telegraph Bay. The shoreline environment from this point to the end of this management area is mostly Conservancy with small area of Natural at Point Colville.

Shoreline Modifications

Approximately 4.1 percent of the management area is armored, higher than the average percentage for the County. This management area has a significant amount of glacial sediments, so this likely explains the greater than average amount of armoring, since most of the armoring is correlated with sediment-rich regions. In particular, the tombolo associated with Skull Island and Sperry Point has significant length of armoring and fill associated with the access roadway. Fill occurs in other areas as well. Like Spencer Spit management area, there are a moderate number of overwater structures (25), but here they are scattered throughout the management area. There are four groins, a significant number for the County. There are also a relatively moderate number of mooring buoys (96) and pilings (12). Mooring buoys are clustered in Hunter Bay near Crab Island, Shoal Bay and in the middle of Mud Bay.

Existing and Potential Public Access Areas

The Mud Bay management area has over 28 miles of shorelines and 4,300 feet of trails and paths.

Existing Facilities with Potential for Improvement

- Cole Conservation Easement is a 245-acre property with 52 acres of woodland waterfront on Aleck Bay, including more than 1,500 feet of rocky shoreline and a protected beach.

- Helwig Conservation Easement is a 10.7-acre property that also provides protected shoreline on Aleck Bay. The easement provides guidance and restrictions to minimize scenic impacts of development on this site.

- Watmough Bay Preserve, together with past and planned donations and easements property in the vicinity, protects the character of the bay and the significant ecological features of the area while maintaining public access.

- Hunter Bay Dock and one dock near Roslyn Road end. The facility is the primary dock used by residents of Decatur and Center Islands. A reinforced concrete ramp is located to the east of the dock. The ramp serves both recreational and light commercial needs.

- Sperry Street Road end is a short walk from Sperry Road and provides view of the mud flats and Lopez Island.

Public access opportunities in this management area include the following parks, easements, preserves, and road ends:

- Blackie Brady Park is a pocket park on a cove with a secluded beach. The park has a picnic table, a wooden staircase and a gravel turnaround. Opportunities for improvement include directional signage and repair of storm damage on wooden steps.

- Mud Bay Beach is a day use park primarily used for clam digging, crabbing and dinghy access. Opportunities for improvement include the development of amenities, parking, signage and a turnaround.

- Roslyn Road end is an undeveloped easement to Mud Bay. The site is currently unmarked and has limited area for turnaround.

The management area has 4,390 feet of trails in parks and conservation areas. To enhance public access in this management area, the County should explore the recommendations in the Parks Plan for improvements to Blackie Brady Park and conduct general review and analysis of feasible improvements to undeveloped road ends.

4.7.3 Restoration Opportunities

The tombolo associated with Skull and Sperry Point is an excellent target for restoration. Development is relatively sparse, but sizeable areas have been armored and filled. An investigation could be undertaken to maintain access to Skull Island, while restoring predevelopment-level natural processes and improving existing habitat. The Mud Bay Dock Road could also be relocated away from the shoreline.

Table 27A. Mud Bay Area Reach Assessment – Physical Conditions.

Reach	Natural Sediment Transport Patterns	Shoreline Sediment Input Alterations - Feeder Bluffs	Shoreline Sediment Input Alterations - Pocket Beaches	Shoreline Sediment Input Alterations - Barrier Beaches	Natural Current Patterns	Wave & Current Attenuation	Nutrient and Toxics Removal	Shade	Total
116	5	5	5	5	5	5	3	3	36
117	5	NP	3	2	5	3	3	1	22
118	0	3	NP	4	5	4	3	4	23
119	5	4	NP	NP	3	4	3	4	23
120	5	NP	NP	4	5	4	3	2	23
121	5	NP	NP	NP	5	4	3	3	20
122	5	4	NP	NP	5	4	3	3	24
123	3	4	3	NP	5	4	3	4	26
124	5	NP	4	NP	5	4	3	4	25
125	3	5	4	NP	5	4	3	4	28
166	5	NP	4	NP	5	4	5	2	25
167	5	NP	4	NP	5	4	5	3	26
168	5	NP	4	NP	3	4	5	3	24
169	5	NP	4	NP	3	4	5	3	24
170	5	4	5	NP	5	4	5	4	32
Median	5.00	4.00	4.00	4.00	5.00	4.00	3.00	3.00	24.00
Average	4.40	4.14	4.00	3.75	4.60	4.00	3.67	3.13	25.40
Percent of Highest Possible Score	88%	83%	80%	75%	92%	80%	73%	63%	64%

NP = Not Present

Table 27B. Mud Bay Area Reach Assessment – Habitat Conditions.

Reach	Vegetation Coverage	Estuary Habitat	Birds	Haul-out Habitat	Eelgrass	Floating Kelp	Understory Kelp	Spawning Habitat[1]	Herring Spawning Habitat	Shellfish	Total
116	5	2	0	5	5	5	5	0	0	4	31
117	5	5	1	0	5	0	5	0	5	4	30
118	5	1	2	0	5	0	5	3	5	3	29
119	5	1	0	0	5	0	0	3	5	3	22
120	5	5	3	0	5	0	0	3	5	3	29
121	5	4	0	0	0	0	0	0	5	2	16
122	5	1	0	0	5	0	5	0	5	3	24
123	5	1	0	5	5	0	5	3	5	2	31
124	5	2	0	0	5	5	5	3	5	3	33
125	5	2	3	0	5	0	5	0	0	3	23
166	5	0	0	0	5	0	5	0	0	2	17
167	5	1	0	0	0	5	5	0	0	2	18
168	4	0	1	0	5	0	5	0	0	2	17
169	5	1	0	5	5	5	5	0	0	2	28
170	5	2	1	0	0	0	5	0	0	3	16
Median	5.00	1.00	0.00	0.00	5.00	0.00	5.00	0.00	5.00	3.00	24.00
Average	4.93	1.87	0.73	1.00	4.00	1.33	4.00	1.00	2.67	2.73	24.27
Percent of Highest Possible Score	99%	37%	15%	20%	80%	27%	80%	20%	53%	55%	49%

[1] Includes priority spawning habitat for sand lance, surf smelt, and rock sole.

4.8 North Coast Eastsound Management Area

The North Coast Eastsound Management Area is the smallest management area in the County. It is a little more than four miles of highly developed shoreline in between the two other large, sparsely developed management areas on the north shore of Orcas Island and within and adjacent to the town of Eastsound.

Table 28 is a summary of the reach assessment for the North Coast Eastsound management area. The table is in two parts, one covering general physical conditions, the other addressing those conditions directly related to habitat functions. The following discussions cover both the conditions scored in the reach assessment (Tables 28A and B) and management area results from the ecosystem-wide characterization. The North Coast Eastsound Management area is characterized by generally intact sediment transport patterns but some reaches are impacted by outfalls and shoreline armoring, thus affecting current patterns and wave and current attenuation. While vegetation coverage is high in the shoreline jurisdiction, nearshore vegetation coverage is modified in most reaches. The management area lacks haul-out habitat as well as spawning habitat for priority fish species.

4.8.1 Physical and Biological Characterization

Nearshore Physical Processes

The geology of the management area is dominated by glacial outwash, with small bedrock outcrops near some of the promontories (e.g., Point Thompson). In this sense, this management area is much more like Puget Sound than the rest of the County (and especially neighboring management areas). The presence of outwash provides sediment for several beaches, including North Beach and Terrill Beach. The presence of sediment gives rise to barrier beach that defines several estuarine wetlands and lagoons, which were common prior to development (U.S. Coast and Geodetic Survey 1888b).

Three relatively long drift cells have been delineated in this management area. Two of these converge near the center of the management area, while the third begins at the east end of the management area and transports sediment to near Point Thompson.

Wave energy is significant, but locally sourced, primarily from winds associated with the outflow of the Fraser River valley and the Strait of Juan de Fuca (Finlayson 2006). Tidal currents can be significant (on the order of 1 knot), but not as large those associated with other areas of the County. Generally the management area is a place of convergence and divergence of flow around Orcas Island (Canadian Hydrographic Service 2010).

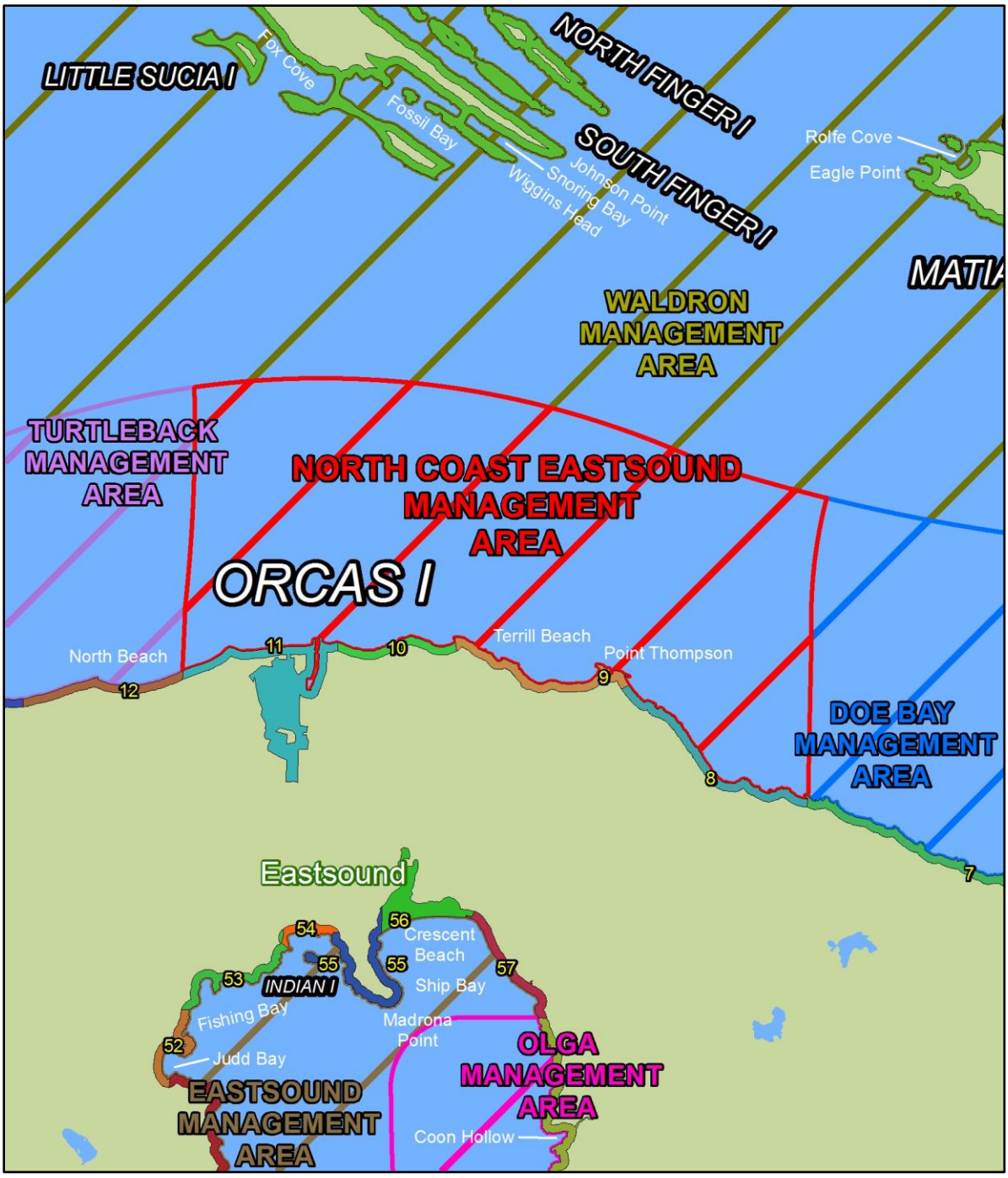


Figure 19. North Coast Eastsound Management Area.

Geologic Hazards

The geologic hazards to this management area are numerous. In fact, this is probably the most geologically hazardous intensely developed area in the County. The presence of sediment, and potentially fill, near the airport is one of the few populated areas in the County that has been mapped as highly susceptible to liquefaction. Areas on the periphery of the management area (at the east and west ends) have a much lower risk of liquefaction. Increasing the risk and wholesale instability of the glacial sediment is a fault that has been mapped through the outwash prism that defines the management area (Lapen 2000). This fault may be relict from the uplift of the entire island, but a risk remains that it could be reactivated, particularly if it is stressed by other seismicity in the area.

Tsunami risk is similar to the north shore of the Doe Bay management area. The primary risk is from tsunamis originating on the Fraser delta and other upper crustal faults that dissect the Strait of Georgia. As everywhere in the County, there is a risk of landslide-generated tsunamis from adjacent land masses (e.g., Gulf Islands, etc.).

Small landsliding is possible just east of the airport and near Rossel Lane at the east end of the management area. In addition to this continuous, but minor slumping and erosion, large portions of the outwash prism could also be mobilized catastrophically.

Streams and Associated Wetlands

There are four mapped streams in the management area. None of these streams are fish bearing. These streams are often associated with ditches and culverts, indicating that they may be a result of human activities. The nearshore freshwater runoff network is disturbed in many areas and sometimes piped and thus concentrated.

There are several nearshore marshes in the management area, which are unusual in the County. In particular a large marsh complex exists at the southeast end of Terrill Beach. This area meets the definition of pocket estuary (Beamer et al. 2003, 2005), a key habitat type for juvenile salmonids. There may have been a similar, but smaller and more subtle, feature just west of the airport and Brandt's Landing. This area is now extensively ditched and developed, with the exception of the large wetland just west of the airport.

Critical or Priority Habitat and Species Use

The shoreline habitat supports clams, shrimp, and urchins. Eelgrass is documented near Point Thompson and along North Beach and may support the success of these species in juvenile stages. Floating kelp beds are documented in reaches 8, 9, and 10; and understory kelp is reported in all reaches accept the North Beach area (reach 12). Pocket beaches, including those along North Beach and those occurring intermittently from Terrill Beach to the eastern extent of the management area, provide an important habitat type commonly used by juvenile Chinook salmon. Chinook, as well as other salmonid species are likely to occur in this area that is along an important migration route into President Channel. The rocky headlands common in the management area are suitable habitat for rockfish. There is no documented priority fish spawning habitat in the management area,

Marine Riparian, Nearshore, and Estuarine Habitats

Estuarine habitat exists primarily in association with Terrill Beach marsh but is present in all reaches in the management area. Based on aerial imagery the shoreline vegetation in general has experienced a higher level of disturbance relative to many other management areas. Wetlands in close proximity to the marine shoreline contribute to habitat diversity in the marine riparian zone and may be important areas for water quality management. However, their use by bird species may be impacted by current human disturbances in the general vicinity.

Water Quality, Sediment, and/or Tissue Sample Results

Although data have been collected near the area (Ecology 2011e), the water quality is largely unknown in this management area.

4.8.2 Shoreline Use Patterns

Existing Land and Shoreline Use

Land Use

From the eastern edge of the North Coast Eastsound management area to the Brandt's Landing private marina, existing land uses consist entirely of residential uses on small lots. The Brandt's Landing Marina is a cultural/recreation use. The associated wetland and inlet in this management area is in an area largely made up of transportation/utility use with some residential, vacant, and cultural/recreation uses. This includes the Orcas Island airport. West of the Brandt's Landing Marina, the marine shoreline is characterized as mostly small lot residential with some smaller areas of cultural/recreation uses interspersed.

Overall existing land use in the North Coast Eastsound management area includes:

- Residential – 80 percent
- Transportation, Communication, Utility – 3 percent
- Cultural, Entertainment, Recreation – 14 percent
- Undeveloped Land – 3 percent

Additional shqreline uses include at least two DNR authorized outfalls, one a sanitary sewer outfall and the other a stormwater outfall. The tidelands are a mix of state-owned aquatic lands and private ownership.

Water-dependent uses in this management area consist of the Brandt's Landing Marina and a few private or community docks and piers located east of the Brandt's Landing. Boat charter businesses at the Brandt's Landing Marina are also water-dependent uses. Water enjoyment uses in shoreline jurisdiction in this management area consist of various lodging accommodations, such as bed and breakfasts and cottage rentals.

Land Use Designations

East of Terrill Beach Road, the land designation is Rural Residential reflecting the larger lot residential development in this area on the edge of the Eastsound urban area. Comprehensive Plan land use designations between Terrill Beach Road and North Beach consist of Eastsound

Rural Residential, and a variety of Eastsound Residential land use districts reflecting the more dense residential development that exists in this area. The inlet in which the Brandt's Landing Marina is located in this area is designated Natural with some small areas of Rural Commercial mixed in. The associated wetland to the south is mostly contained on property that is designated for Eastsound Airport District, along with portions on some of the surrounding Service Park and Eastsound Residential districts.

Shoreline Environment Designations

The shoreline environment designation on the eastern part of the management area to Terrill Beach Road is Rural Residential. Between Terrill Beach Road and the western end of the management area, the shoreline environment designation is Eastsound Residential, with one exception. The shoreline designation surrounding the Brandt's Landing Marina is Eastsound Marina.

Shoreline Modifications

The North Coast Eastsound management area is the most heavily armored management area in the County. Over 25 percent of the shoreline is armored. This is nearly the overall Puget Sound average of 27 percent (USGS 2010). The high degree of armoring is likely reflective of the relatively high energy and easily erodible glacial drift that is common in this management area. However, even areas that are mapped as bedrock possess armoring. The high energy deters the placement of docks, piers, and mooring buoys. Only four docks and piers are present in this heavily developed area. Thirty mooring buoys are scattered throughout the management area, but there are less them here than anywhere else in the County, except in Blakely Island. There is also a pair of jetties that protect the inlet to Brandt's Landing.

Existing and Potential Public Access Areas

The North Coast Eastsound management area has roughly 4.4 miles of shoreline. There are four road ends that provide public access opportunities in this management area:

- North Beach Road end offers a view to Sucia Island and is adjacent to public tidelands. The road end is currently developed with paved parking for ten cars and a bench. However, there are no other amenities.
- Blanchard Road end extends to the water, but steep topography currently precludes public access to the shoreline.
- Buckhorn Road end provides a view of the water and has potential access to medium bank shoreline.
- Terrill Beach Road end is a narrow, undeveloped access that has the potential for medium bank water access to a beautiful beach area.

Currently no trails or pathways exist in this management area to provide shoreline public access. Formalizing access opportunities at the road ends discussed above would be in keeping with the Parks Plan goals.

4.8.3 Restoration Opportunities

The Terrill Beach marsh pocket estuary should be a focal point of restoration in this management area. Pocket estuaries are key habitat elements in the life history of (threatened) Chinook salmon (Beamer et al. 2003, 2005) and they are extremely rare in the County, mostly because of the unusual geology of the islands. Therefore, protection and restoration of these marshes should be a high priority County-wide. While the lowermost portions of the marsh is largely intact, riparian vegetation and the transition to the upland vegetation is largely missing. The uppermost portions of the stream channels that feed the marsh have also been heavily altered by human activities. Anecdotal accounts also suggest that there are opportunistic alterations to the connection of the marsh with the Strait (such as restoring beach dunes after large storm events to re-disconnect the pocket estuary). There are also hydrologic disruptions to the upland hydrologic connection extending to Mt Baker Road and beyond.

In addition to the Terrill Beach marsh, the large wetland west of the airport could also be improved. Removal of ditches in the contiguous wetland west of the airport could improve the hydrology, and thereby the ecological functions of the wetland.

Table 28A. North Coast Eastsound management area Reach Assessment – Physical Conditions.

Reach	Natural Sediment Transport Patterns	Shoreline Sediment Input Alterations - Feeder Bluffs	Shoreline Sediment Input Alterations - Pocket Beaches	Shoreline Sediment Input Alterations - Barrier Beaches	Natural Current Patterns	Wave & Current Attenuation	Nutrient and Toxics Removal	Shade	Total
8	5	5	NP	NP	5	4	5	3	27
9	3	NP	3	5	5	4	5	3	28
10	5	0	NP	3	2	2	5	4	21
11	5	NP	NP	5	2	4	5	1	22
12	5	5	NP	NP	5	5	5	3	28
Median	5.00	5.00	3.00	5.00	5.00	4.00	5.00	3.00	27.00
Average	4.60	3.33	3.00	4.33	3.80	3.80	5.00	2.80	25.20
Percent of Highest Possible Score	92%	67%	60%	87%	76%	76%	100%	56%	63%

NP = Not Present

Table 28B. North Coast Eastsound Management Area Reach Assessment – Habitat Conditions.

Reach	Vegetation Coverage	Estuary Habitat	Birds	Haul-out Habitat	Eelgrass	Floating Kelp	Understory Kelp	Spawning Habitat[1]	Herring Spawning Habitat	Shellfish	Total
8	5	5	0	0	0	5	5	0	0	1	21
9	5	5	1	0	5	5	5	0	0	2	28
10	5	3	0	0	0	5	5	0	0	3	21
11	3	3	0	0	5	0	5	0	0	2	18
12	5	4	1	0	5	0	0	0	0	2	17
Median	5.00	4.00	0.00	0.00	5.00	5.00	5.00	0.00	0.00	2.00	26.00
Average	4.60	4.00	0.40	0.00	3.00	3.00	4.00	0.00	0.00	2.00	21.00
Percent of Highest Possible Score	92%	80%	8%	0%	60%	60%	80%	0%	0%	40%	42%

[1] Includes priority spawning habitat for sand lance, surf smelt, and rock sole.

4.9 Olga Management Area

The Olga management area covers most all of the east shore of East Sound from Ship Bay to Obstruction Pass. The management area includes the town of Olga and Rosario and is dominated by low-density residential development. The management area also includes Obstruction Island, which is sparsely developed. There are no major transportation related uses in this management area, but the Rosario marina is often used by Kenmore Air as seaplane terminal.

Table 29 is a summary of the reach assessment for the Olga management area. The table is in two parts, one covering general physical conditions, the other addressing those conditions directly related to habitat functions. The following discussions cover both the conditions scored in the reach assessment (Tables 29A and B) and management area results from the ecosystem-wide characterization. The Olga management area is one of the lower scoring both for physical conditions and for habitat functions. It scores low for physical conditions because it generally lacks feeder bluffs, pocket beaches and barrier beaches, many reaches have impaired water quality, and reduced shoreline shading. Estuary habitat is lacking compared to many other management areas as well as floating kelp and priority fish spawning habitat.

4.9.1 Physical and Biological Characterization

Nearshore Physical Processes

The geology of the Olga management area is similar to the rest of the southern shoreline of Orcas Island, with portions comprised of metal-rich oceanic crust and basalt (such as near Entrance Mountain) interspersed with more sandstone and a thin veneer of glacial sediments in topographic troughs (such as found near the town of Olga). The geologic diversity leads to a number of different shoreforms depending on the local lithology. Sediments are generally confined to local pockets.

The Olga management area has three drift cells on the Orcas Island mainland. These are relatively long drift cells, all of which terminate in Rosario Bay, Buck Bay and the center of Obstruction Pass. Obstruction Island also has a divergence with two short drift cells emanating from it on the northwest side of the island. There is another small drift cell on the northeast side of the island.

Wave energy is relatively modest, and entirely locally sourced. Wave energy increases towards the head of East Sound due to the long southern fetch. Tidal currents are generally slow by County standards, with the exception of the flows through Obstruction Pass and Peavine Pass.

Glenwood Springs Chinook salmon hatchery is located within this management area. It uses freshwater springs and ponds and nearshore stream habitat support Chinook salmon releases and returns.

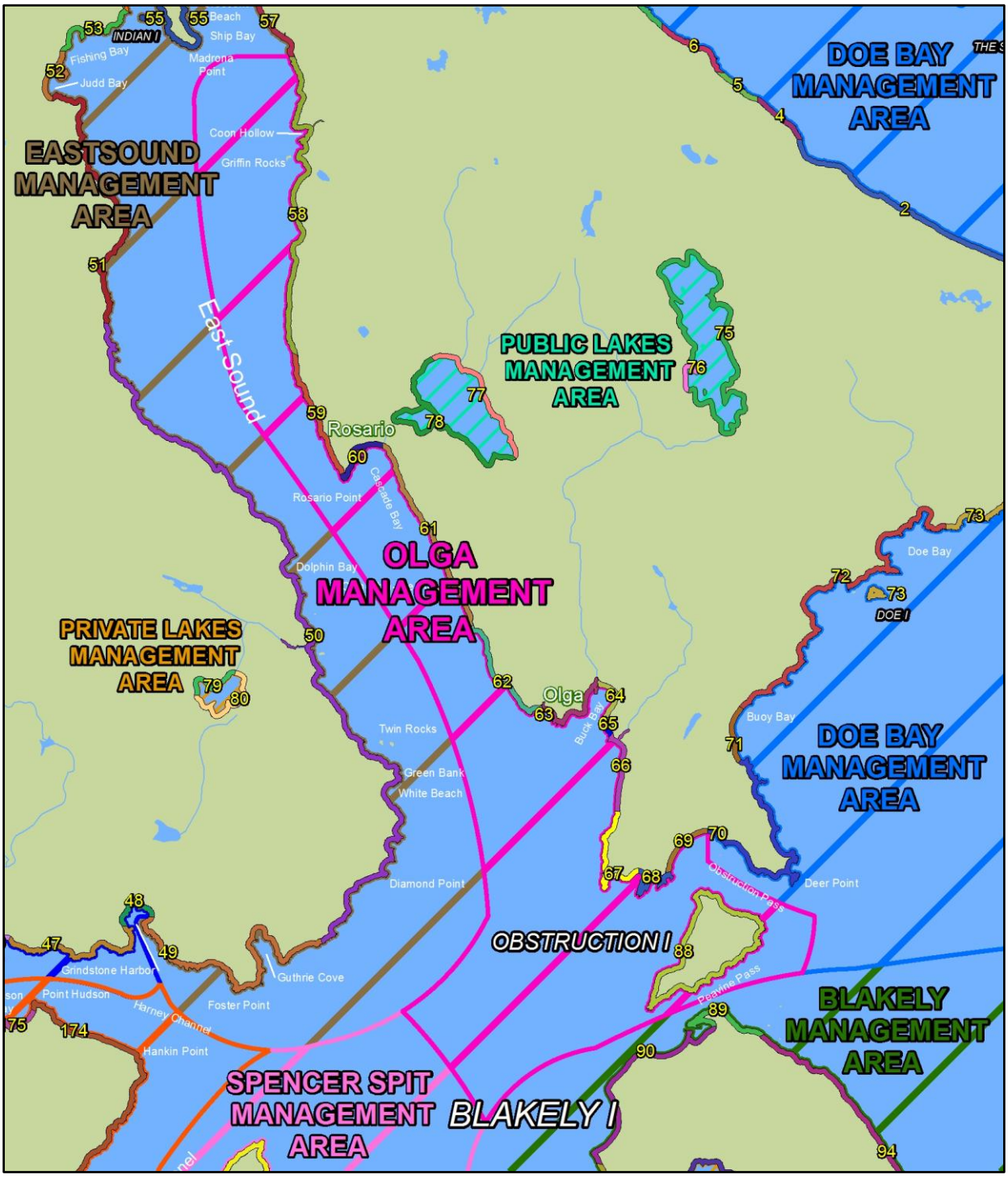


Figure 20. Olga Management Area.

Geologic Hazards

Like the rest of southern Orcas Island, the Olga management area is riddled with faults, which are likely not active. The relatively competent bedrock means that very few areas are potentially unstable, even though slopes can be incredibly steep. The only area of documented bluff instability is just south of Buck Bay, where a thin veneer of glacial drift covers a steep bedrock slope. Instability occurs at the contact between the drift and the bedrock. Tsunami risk is minor due only to landslide-induced tsunamis and liquefaction is also insignificant.

Streams and Associated Wetlands

The Olga management area is home to Cascade Creek, the largest (by volumetric flow rate) stream in the County. Cascade Creek outlets in two locations; one is at Cascade Lake, a large, jurisdictional lake within Moran State Park that is controlled by a dam and discharges to Cascade Bay in Rosario. The mainstem of Cascade Creek discharges just east of the town of Olga into Buck Bay. The stream is habitat for many species of anadromous fish.

In addition to Cascade Creek, there are eight other small streams (Wild Fish Conservancy 2011). One of the largest of these streams drains the northeast side of Olga to East Sound. Two of the other streams are partially ditched. One is located near Griffin Rocks and the other drains to Obstruction Pass.

The largest wetlands (both historic and existing) are located surrounding Buck Bay, associated with Cascade Creek and the large stream that drains northeast Olga mentioned above. Wetland complexes also exist in association with the ditched streams mentioned above.

Critical or Priority Habitat and Species Use

Shorelines near Coon Hollow and Griffin Rocks provide important crab habitat. Coho and chum salmon have also been documented in the lower reach of the stream entering East Sound near Griffin Rocks, and in Cascade Creek entering Buck Bay from Cascade Lake. Cascade Creek also supports coastal cutthroat trout. Documented forage fish spawning is limited to a small pocket beach adjacent to the town of Olga. Pacific herring spawning habitat is present on the east side of East Sound in reach 58. Eelgrass presence is limited in the management area with documented presence only near Coon Hollow, Buck Bay, and in a patchy distribution along the Obstruction Pass shoreline. There are limited documented observations of floating kelp in this management area however understory kelp is documented in all but Buck Bay (reach 64). Bald eagles have been observed using shoreline habitat between the Town of Olga and Obstruction Pass. The rocky headlands common in the management area are suitable habitat for rockfish.

Marine Riparian, Nearshore, and Estuarine Habitats

Estuarine habitat is sparse, patchy, and comprised of small areas (generally 1 acre or less). Shoreline vegetation is patchy in coverage and some reaches offer very little shade to the nearshore. In general, however, vegetation cover in the entire shoreline jurisdiction is relatively continuous, but breaks occur near developed areas that are concentrated near pocket beaches.

Water Quality, Sediment, and/or Tissue Sample Results

In general, the water quality in the Olga management area is good with the exception of elevated fecal coliform bacteria concentrations. Water quality monitoring conducted at Cascade Bay exhibited high concentrations of fecal coliform bacteria (Wiseman et al. 2000). Wiseman et al. (2000), however, noted that there were unusually low levels of nutrients (i.e., nitrate/nitrite and soluble reactive phosphorus). Elevated fecal coliform bacteria concentrations were also observed at the mouth of Cascade Creek, which discharges into Buck Bay (Wiseman et al. 2000). Other streams that discharge to the Olga management area also exhibited elevated fecal coliform bacteria and total suspended solids concentrations (SJC 2000).

One sediment sample collected from Cascade Bay exceeded the Sediment Management Standards SQS bioassay criterion; sediment in this area is listed as Category 2 "Sediments of Concern" (Ecology 2011e).

4.9.2 Shoreline Use Patterns

Existing Land and Shoreline Use

Land Use

The Olga management area extends from the east side of Ship Bay to the north side of Obstruction Pass. Overall existing land use in the Olga management area includes:

- Residential – 75 percent
- Cultural, Entertainment, Recreation – 10 percent
- Undeveloped Land – 14 percent

Existing land uses in the Olga management area south to Rosario Point consists of large lot residential development with a few unclassified and vacant lots. The land around Rosario Point is characterized by more intense residential development along with the cultural/recreation use of the Rosario Resort itself, a water-oriented use located at Rosario Point and along Cascade Bay. Continuing south to Olga, residential lots become larger, and residential uses are interspersed with conservation land uses. Some large conservation parcels are located west of Olga Hamlet. Olga itself provides more intense residential development on both sides of Buck Bay, with one trade land use, and an undeveloped lot in the Open Space Taxation program in this area. Between Buck Bay and Obstruction Pass, the remainder of the shoreline jurisdiction in this management area is largely large lot residential with the notable exception of a Washington State Park property (cultural/recreation use), and a small number of vacant, unclassified, and cultural/recreation lots in the area.

Additional shoreline uses include a DNR authorized wastewater outfall (Rosario), at least one desalination system (Obstruction Is.) and at least one utility easement. Tidelands are a mix of state-owned aquatic lands and private ownership.

Water-dependent uses in this management area include marinas, docks, piers, and marine railways, including the public marine facility at Obstruction Pass on the eastern edge of the management area. Also included in this category is the marina at Rosario Resort. Water

enjoyment uses include Rosario Resort, other hotel/lodging uses in the management area, and the state park property at the southeast corner of East Sound.

Land Use Designations

In terms of future land use designation, the area immediately south and east of Ship Bay is designated Rural Farm Forest. Traveling south, approaching Rosario Point land designations change to a pattern of Master Planned Resort at Rosario Point with small amounts of Rural Residential on both sides of the Master Planned Resort area. Beyond that, land designations become Forest Resource and Rural Farm Forest before reaching Olga, which is designated Olga Hamlet on the west side of Buck Bay. Buck Bay itself is designated Rural Farm Forest. Further to the south, land designation becomes Forest Resource, Conservancy at Lime Kiln Point State Park, and Rural Farm Forest beyond that to the edge of the management area at Obstruction Pass.

Shoreline Environment Designations

Shoreline environment designations consist of Rural Residential south to Coon Hollow, where the designation changes to Rural Farm-Forest south to Rosario Resort. The northern and southern edges of Rosario Resort are designated Rural Residential, while the most developed portion of Rosario Resort along the north side of Cascade Bay is designated Rural. South of Rosario Resort's Rural Residential environment, the shoreline environment changes to Conservancy until the western edge of the Olga Activity Center. Most of Olga itself is designated Rural, except for that which borders Buck Bay, which is designated Conservancy. South of Buck Bay, the shoreline environment changes to Rural Farm Forest south to the state park. The East Sound side of the state park is designated with a Conservancy environment, while the Obstruction Pass side is designated Rural Farm-Forest. Beyond that shoreline use designation changes to Rural on the north side of Obstruction Pass east to the end of the management area.

Shoreline Modifications

Approximately 4.9 percent of the management area is armored, much higher than the average percentage for the County. While the armoring is preferentially located in areas of glacial sediment, there are many revetments along shorelines mapped as containing bedrock. There are a relatively large number of mooring buoys (126), which are clustered near the villages of Rosario and Olga, and in Obstruction Pass. In addition to four boat ramps scattered throughout the management area, there is also a large marina and seaport at Rosario.

Existing and Potential Public Access Areas

Existing Facilities

The Olga management area has over 15 miles of shorelines with a variety of public access opportunities, including approximately 2,300 feet of trails and paths and the following conservation easements, docks and road ends:

- Obstruction Pass campground was transferred from DNR to Washington State Parks in 2002. The campground offers 11 primitive, walk-in campsites as well as parking and 3 boat moorings. The area also offers trails in shoreline jurisdiction.

- Buck Bay Conservation Easement is a relatively small site but has a significant impact on the aesthetics of Buck Bay and the views from Pt. Lawrence Road in Olga. The site has 343 feet of high bank waterfront.
- Golithan Preserve Conservation Easement preserves 143 feet of forested shoreline on the east side of Buck Bay. This preserve maintains the view of the forested point from Pt. Lawrence Road in Olga.
- Obstruction Pass Dock is adjacent to Lieber Haven Resort and provides parking for 5 trailers and 11 cars, a 130-foot pier, 45-foot floating dock, and a boat ramp. The drive-on pier is connected to the concrete float via a 36‟ gangway. West of the dock and float is the ramp. The ramp is constructed of concrete logs. The facility provides primary commercial and community linkage to Blakely and Obstruction Islands. All gasoline and propane currently delivered to Orcas is offloaded at this ramp.
- First Street Road end extends to the water; the site contains a public stairway and trail to a small pocket beach.
- East Olga Park shore access and the unopened Grays Avenue right-of-way provide additional public access opportunities.

Existing Facilities with Potential for Improvement

- Barnacle Lane Road end stops 100 feet before the water's edge. The site provides a good view of Obstruction Island but does not have a turnaround or parking.
- Mukosa Lane road end is a 10-foot public access easement to the rocky beach. Opportunities for expanding this access are limited due to the width of the easement and the proximity to the neighboring house.

There is approximately 2,324 feet of trail in this management area, predominantly located in the Obstruction Pass campground area. Potential opportunities exist to expand or formalize some of the public access points in this management area. However, physical conditions at some of the sites may limit the potential for expanding access.

4.9.3 Restoration Opportunities

Cascade Creek is one of the only creeks in the County with documented salmonid use, yet it has numerous physical impairments. Until recently, Point Lawrence Road constricted the channel significantly at the mouth and the road prism blocked what were likely deltaic marshes prior to development (significant development was apparent even in the historic T-sheet: U.S. Coast and Geodetic Survey 1889a). The County has replaced this road section with a bridge, which should substantially improve habitat conditions at the mouth of Cascade Creek. There are also opportunities at the mouth of the two unnamed, unmapped streams (i.e., the ditch on Barnacle Lane and the stream near Griffin Rocks) to restore the mouths of these streams to more closely simulate predevelopment conditions.

Table 29A. Olga Management Area Reach Assessment – Physical Conditions.

Reach	Natural Sediment Transport Patterns	Shoreline Sediment Input Alterations - Feeder Bluffs	Shoreline Sediment Input Alterations - Pocket Beaches	Shoreline Sediment Input Alterations - Barrier Beaches	Natural Current Patterns	Wave & Current Attenuation	Nutrient and Toxics Removal	Shade	Total
58	5	NP	3	NP	0	4	2	4	18
59	5	NP	5	NP	5	5	2	3	25
60	5	NP	0	NP	5	5	3	1	19
61	3	NP	NP	NP	5	4	3	4	19
62	5	NP	3	NP	5	4	2	3	22
63	5	NP	0	NP	2	4	2	3	16
64	5	NP	NP	NP	0	4	2	2	13
65	5	NP	NP	NP	3	4	2	4	18
66	5	5	NP	5	5	4	0	4	28
67	5	5	5	NP	5	5	2	5	32
68	5	NP	3	NP	5	4	5	3	25
69	5	NP	NP	NP	1	3	5	1	15
88	5	5	3	NP	5	4	5	4	31
Median	5.00	5.00	3.00	5.00	5.00	4.00	2.00	3.00	19.00
Average	4.85	5.00	2.75	5.00	3.54	4.15	2.69	3.15	21.62
Percent of Highest Possible Score	97%	100%	55%	100%	71%	83%	54%	63%	54%

NP = Not Present

Table 29B. Olga Management Area Reach Assessment – Habitat Conditions.

Reach	Vegetation Coverage	Estuary Habitat	Birds	Haul-out Habitat	Eelgrass	Floating Kelp	Understory Kelp	Spawning Habitat[1]	Herring Spawning Habitat	Shellfish	Total
58	5	1	1	0	5	0	5	0	5	3	25
59	4	0	0	5	0	0	5	0	0	1	15
60	3	0	0	0	0	0	5	0	0	1	9
61	5	0	1	0	0	0	5	0	0	1	12
62	5	0	0	0	0	0	5	0	0	3	13
63	4	2	3	0	5	0	5	3	0	3	25
64	4	0	0	0	0	0	0	0	0	2	6
65	5	0	1	0	5	0	5	0	0	2	18
66	5	1	0	0	5	0	5	0	0	2	18
67	5	0	0	0	5	0	5	0	0	3	18
68	5	0	1	0	5	5	5	0	0	3	24
69	3	1	0	0	5	0	5	0	0	2	16
88	5	1	0	0	5	5	5	0	0	3	24
Median	5.00	0.00	0.00	0.00	5.00	0.00	5.00	0.00	0.00	2.00	18.00
Average	4.46	0.46	0.54	0.38	3.08	0.77	4.62	0.23	0.38	2.23	17.15
Percent of Highest Possible Score	89%	9%	11%	8%	62%	15%	92%	5%	8%	45%	34%

[1] Includes priority spawning habitat for sand lance, surf smelt, and rock sole.

4.10 Roche Harbor Management Area

The Roche Harbor management area includes the shoreline between Davison Head (including the point) and Mitchell Bay. While the total spatial extent of the management area is somewhat limited, the shoreline is extremely convoluted, including many large bays (Westcott, Mitchell, Garrison, Open, etc.) and promontories (Bell Point, White Point, Bazalgette Point, etc.), making the total shoreline length longer than most other management areas. The management area also includes many islands (Henry Island, Posey Island, Guss Island, Pearl Island, Pole Island, Barren Island, etc.) that are separated from the San Juan Island mainland and other islands by narrow passages. There are no major transportation related uses in this management area, although Roche Harbor marina is used by seaplanes and vessels.

Table 30 is a summary of the reach assessment for the Roche Harbor management area. The table is in two parts, one covering general physical conditions, the other addressing those conditions directly related to habitat functions. The following discussions cover both the conditions scored in the reach assessment (Tables 30A and B) and management area results from the ecosystem-wide characterization. The Roche Harbor management area contains a number of poorly scoring reaches for both physical conditions as well as habitat functions along with a number of high scoring reaches such as on Henry Island, White Point, and Davison Head. It also includes some of the lowest scoring reaches for habitat among all management areas primarily in and adjacent to Roche Harbor itself and within Mitchell Bay. Westcott Bay also scores relatively low on physical conditions, and habitat functions follow suit.

4.10.1 Physical and Biological Characterization

Nearshore Physical Processes

The geology of the management area is essentially a mix of bedrock blocks separated by small passages filled with glacial sediments. The bedrock lithology varies from oceanic crust (i.e., iron-rich basalt) to marine sedimentary rock. The interspersed glacial sediments create numerous pocket beaches and harbors that are sedimentologically distinct from one another. Tombolos are also common.

There are 28 mapped drift cells in this management area. Many are only a few hundred feet long. They are most prevalent in the bays at the isthmuses associated the various tombolos in the management area.

Tidal flows are extremely large (in excess of 2.5 knots) on the western periphery of the management area for areas that abut Haro Strait (Canadian Hydrographic Service 2010). However, within the confines of Roche Harbor, tidal energy is much smaller. Wave energy follows a similar pattern, with significant wave energy occurring on Kellett Bluff on Henry Island (with lesser amounts of swell), but protected areas (such as Roche Harbor) see almost no wave energy. Wave energy can also be significant for exposed north aspect shorelines in the northern reaches of the management area (although much less than Kellett Bluff).

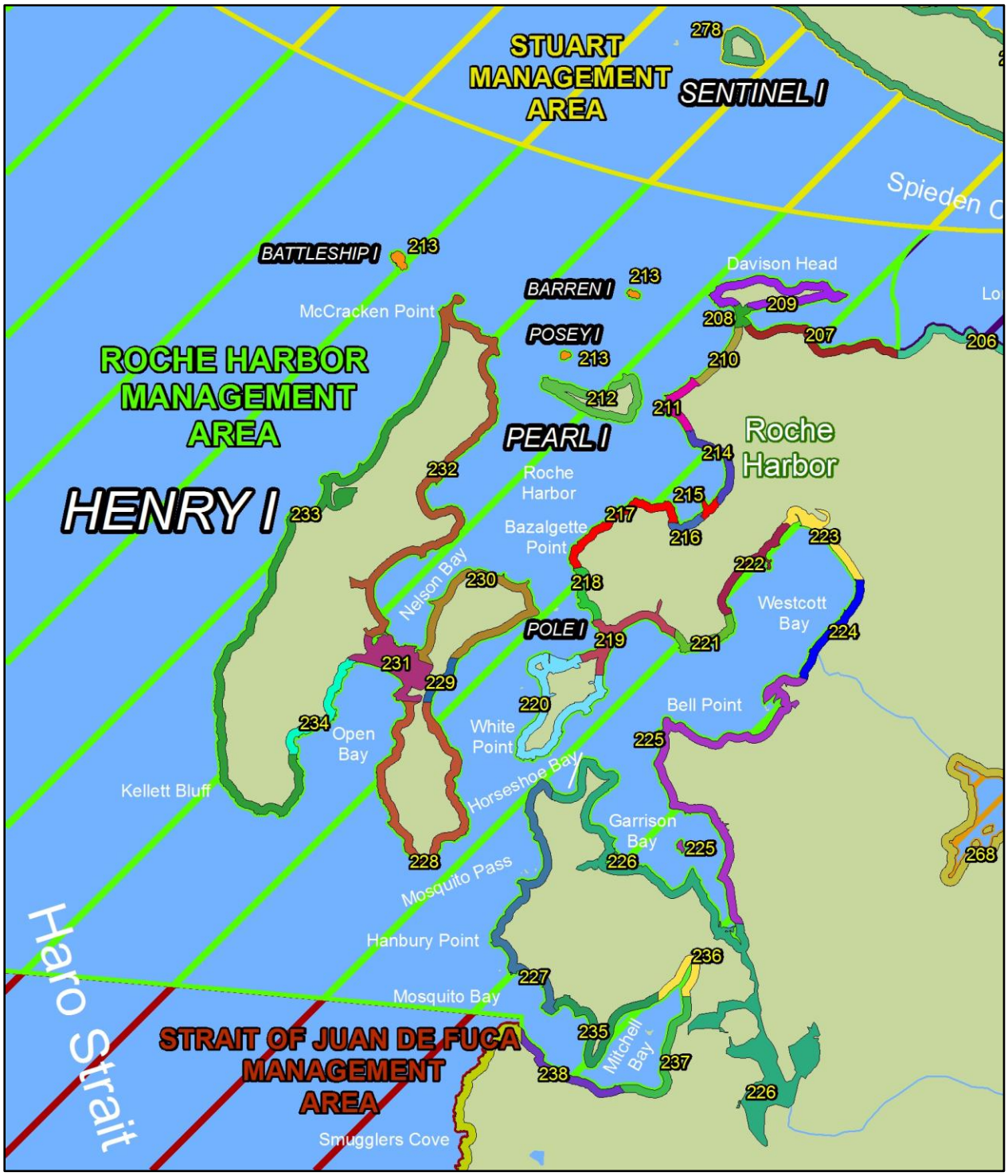


Figure 21. Roche Harbor Management Area.

Geologic Hazards

The southern end of the management is bounded by the Rosario Thrust Fault, a fault associated with the uplift of the entire island. While is possible that this fault, as well as splays of it, could be reactivated at any time, it is more likely that they are relict features. The liquefaction threat is non-existent with the exception of a moderate threat in the salt marshes and other fine-grained embayments. Landsliding has also not been noted in this management area.

The tsunami threat is highly variable throughout the management area. The southern side of Henry Island is susceptible to all tsunamis originating in or passing through the Strait of Juan de Fuca, including a tsunami triggered by a slip of the Southern Whidbey Island Fault; however, this area is largely unpopulated.

Streams and Associated Wetlands

Salt marshes are common in the management area. Significant intact salt marshes occur between Nelson Bay and Open Bay on Henry Island, between Mitchell and Garrison Bay on San Juan Island, the head of Garrison Bay and the base of Davison Head. The marsh between the bays on Henry Island is one of the largest intact marsh complexes in the County. There are also numerous other smaller salt marshes that fringe the larger bays, but these are often altered.

There are fish bearing streams in the management area. One, Doe Creek, drains Roche Harbor Lake, and discharges to Westcott Bay while the other stream, Garrison Creek, drains to the head of Garrison Bay. There are seven other streams that are very small and not fish bearing, although one (that drains to Westcott Bay) could be if a barrier was removed.

Critical or Priority Habitat and Species Use

The Roche Harbor Management area provides important spawning habitat for Pacific herring through Wescott Bay, Garrison Bay, and Mosquito Pass (reaches 217, and 219 through 228). Westcott and Garrison Bays are priority fish spawning areas (Friends of the San Juans 2004a). The area between Westcott and Garrison Bay around bell point, Horseshoe Bay, and small pocket beaches to the south are documented forage fish spawning beaches. This area is also important clam and Dungeness crab habitat. Crab habitat extends into Roche harbor as well; and deeper waters surrounding the western and northern shorelines within the management area provide suitable habitat for sea urchins. Westcott Bay also contains oyster beds, distinguishing this area from many of the nearshore areas throughout the County.

Eelgrass distribution is relatively extensive throughout these nearshore areas. However, significant losses have occurred in recent years, specifically in Westcott and Garrison Bays. Although the precise relationships are uncertain, the disappearing Pacific herring stock in this region (Stick and Lindquist 2009) may be related to the reduction of eelgrass beds or changing water quality conditions. Both floating kelp and understory kelp have a patchy distribution throughout the management area.

The shorelines and associated waters between Roche Harbor and Mosquito Pass provide seal haul-outs, and likely provide foraging opportunities for this and other mammals as well as sea

birds. The western coast of Henry Island and other forested areas provide suitable habitat for bald eagles, peregrine falcons and other important species. In combination, the complexity of shoreline habitats within the management area provide opportunities for a diverse range of priority species, and likely provide unique rearing and foraging opportunities for many important species. The rocky headlands common in the management area are suitable habitat for rockfish.

Marine Riparian, Nearshore, and Estuarine Habitats

Estuarine habitat is present in almost all reaches although the majority have less than one acre. The inside waters between Henry Island and San Juan Island, including Open Bay, and extending from Davison Head, south to Mosquito Bay contain important estuarine habitats. Shoreline vegetation is less dense overall than in many management areas but vegetation coverage within the entire shoreline jurisdiction is relatively intact.

Water Quality, Sediment, and/or Tissue Sample Results

Water quality samples have been collected from Garrison Bay that exhibited low fecal coliform bacteria and nutrient concentrations (Wiseman et al. 2000). In addition, Wiseman et al. (2000) also collected water quality samples from two streams that discharge to Roche Harbor; both of which were identified as possessing good water quality. However, water quality samples were also collected from a stream that discharges to Garrison Bay where elevated fecal coliform bacteria, low dissolved oxygen concentrations, and high temperatures were observed (Wiseman et al. 2000). High fecal coliform bacteria and TSS concentrations have also been documented in several streams and ditches discharging to Westcott Bay (SJC 2000; SJCD 2005).

Sediment sampled from the Roche Harbor exceeded the Sediment Management Standards SQS bioassay criterion and the Sediment Management Standards CSL chemistry criterion for 1,2,4-Trichlorobenzene; sediment in this area was classified as Category 2 "Sediments of Concern" (Ecology 2011e).

Development activities including logging, agriculture, and residential development have been noted as potential or likely sources of impacts to water quality. This is due to altered filtration capacity, altered stormwater runoff, and elevated nutrients and biocides (Klinger et al. 2006). These water quality impacts may indirectly affect the growth and distribution of eelgrass.

4.10.2 Shoreline Use Patterns

Existing Land and Shoreline Use

Land Use

The Roche Harbor management area extends from the south side of Spieden Channel east of Davison Head to the south side of Mosquito Bay on San Juan Island and includes the smaller Henry, Pole (a very small, rocky island located in Mosquito Pass), Pearl, Posey, Barren, and Battleship islands.

Overall existing land use in the Roche Harbor management area includes:

- Residential – 69 percent

- Cultural, Entertainment, Recreation – 11 percent
- Undeveloped Land – 19 percent

The area around Davison Head and Roche Harbor is characterized by more intense, smaller lot residential development. The cultural/recreation land uses associated with Roche Harbor exist on the east side of Roche Harbor, surrounded by residential development. Farther south, White Point and Westcott Bay are mostly residential with small amounts of vacant, conservation, and commonly held vacant property located at the north end of Westcott Bay. The southern part of Westcott Bay, including Bell Point and the east side of Garrison Bay consists of a small amount of resource and a larger cultural/recreation property. The south side of Garrison Bay to the south side of Mosquito Bay is almost completely residential with small areas of cultural/recreation uses. The San Juan Preservation Trust holds the 21 acre Mosquito Pass Preserve and a joint conservation easement between the Land Bank and the San Juan Preservation Trust holds another 21 acres along Henry Isthmus.

Battleship, Barren, Posey, and Pole islands are cultural/recreational uses. Pearl Island is completely residential. The north end of the western portion of Henry Island, and most of the eastern portion, are characterized by residential development. The south end of the western portion of Henry Island is largely vacant, with some cultural/recreational, resource, and conservation land uses. The eastern portion of Henry Island, in addition to residential development, also includes some conservation and cultural/recreational uses, and a few vacant parcels.

Additional shoreline uses include a DNR authorized sanitary sewer outfall (Roche Harbor), multiple desalination systems, multiple utility easements, an aquaculture operation and a barge landing. There are also privately owned Oyster Tracts in Westcott Bay. The tidelands are a mix of state-owned aquatic lands and private ownership.

Water-dependent uses in this management area consist mostly of marinas, piers, docks, and marine railways. The major water-dependent use is the public marine facility at Roche Harbor. Water enjoyment uses consist of the Roche Harbor Resort, and the English Camp part of the San Juan National Park among others.

Land Use Designations

Comprehensive Plan land use from the beginning of the management area near Davison Head to the north side of Roche Harbor is Rural Residential. Roche Harbor itself is designated Master Planned Resort Comprehensive Plan land designation, a water-oriented use. The peninsula containing Bazalgette and White Points is predominantly designated Rural Residential reflecting the small lot residential development occurring near Roche Harbor. This designation continues on the west side of Westcott Bay, but changes to Master Planned Resort where the Roche Harbor resort abuts the northern end of Westcott Bay. The east side of Westcott Bay is Rural Farm Residential to the National Park property at English Camp near Bell Point, where the Comprehensive Plan land use designation changes to Conservancy. From there, the majority of the shoreline to the north side of Mitchell Bay is Rural Residential with a small area of Rural

Farm Forest designation interspersed. The east and south side of Mitchell Bay is designated Rural Farm Forest reflecting larger lot residential development.

Battleship, Barren, Posey, and Pole islands are designated Natural. Pearl Island is designated Rural Residential reflecting the existing residential development there. The majority of the western portion of Henry Island is designated Rural Farm Forest, except for the federal property at the south end, which is designated Natural. The eastern portion of Henry Island is mostly designated Rural Residential, with a small amount of Rural Farm Forest.

Shoreline Environment Designations

This management area starts with a predominantly Rural Residential shoreline designated area on either side of Roche Harbor. The inner portion of Roche Harbor itself is designated with an Urban shoreline environment. From Bazalgette Point to both sides of White Point shoreline environment designation is mostly Conservancy with smaller areas of Natural. The majority of Westcott Bay is in a split shoreline environment of Rural Residential/Conservancy, except at the northern end of the Bay, which is split between Conservancy/Natural. The English Camp unit of the San Juan National Park provides a Conservancy environment to the south side of Garrison Bay. From there to the end of the management area, shoreline environment designations alternate between Rural Residential and Rural Residential/Conservancy, with small amounts of Conservancy applied to the southeast corner of Mitchell Bay.

Shoreline Modifications

Approximately 5.7 percent of the management area is armored, much higher than the average percentage for the County, especially since this includes the large amount of undeveloped bedrock shoreline on Henry Island. Armoring is preferentially located in areas of glacial sediment and highly concentrated in a few embayments, but there are also revetments on shorelines mapped as bedrock.

The convoluted shorelines of this management area make ideal harboring space. As a result, the Roche Harbor management area has by far the largest number of overwater structures (157, including 150 docks and piers) anywhere in the County (in excess of 50 percent more than the second management area, West Sound). This is compounded by Roche Harbor marina, which is one of the largest marinas in the County and comparable in overwater area to Friday Harbor Marina. In terms of overwater area, about one-third of overwater area in the County outside of the Town of Friday Harbor limits is located here. There are also more mooring buoys (207) and boat ramps (eight) than anywhere else in the County. Exacerbating this development is its concentration in the embayments on the San Juan Island mainland. The south and west side of Henry Island is largely absent of overwater structures and other shoreline modifications. In addition, Westcott Bay Sea Farms is located within this management area and extensively uses shoreline and marine areas for growing oysters, clams, and mussels.

Existing and Potential Public Access Areas

Roche Harbor management area has approximately 33.75 miles of shorelines and over 5,600 feet trails and paths. There are two road ends that provide public access in this management area.

Armadale Road ends A and B both end several hundred yards before the water's edge. While currently undeveloped, both road ends have the potential for two parking spaces and a walking path to the water.

In addition to the road ends discussed above, the English Camp portion of San Juan Island National Historic Park is also located within the Roche Harbor management area. There is one campground on Posey Island. No other camping facilities or docks exist in this management area.

The County currently leases float space from Roche Harbor Resort, namely the first two finger piers, A1 and A2 on dock A. It is a short-term lease renewed at the first of each year and includes parking for vehicles permitted annually by Public Works.

4.10.3 Restoration Opportunities

Nearshore habitat such as protected areas that maintain the conditions suitable for eelgrass growth and forage fish spawning are becoming impaired throughout the management area. These habitats have a high potential for adverse impacts from development. Identifying the specific sources of elevated TSS in Westcott Bay, and implementation of actions to reduce TSS, represent potential restoration opportunities due to the ecological significance of Westcott Bay as a historically prominent forage fish spawning area

Garrison Creek is also a target for restoration. A significant impediment to restoration of anadromous fish habitat in Garrison Creek is lack of instream flow, caused by upstream impoundments and water withdrawal. The stream has also been deforested and ditched along its periphery. A restoration feasibility analysis is underway. Ideally restoration will address in-stream flow limitations and support spawning and rearing habitat for all life stages of cutthroat, coho, and chum. Juvenile and sub-adult Chinook would also benefit from improved water quality in the nearshore (Habitat Work Schedule 2011).

In addition to improvement of water quality, improvements can be made in the large number of overwater structures and shoreline armoring present in this management area. The large number of private landowners in a relatively small area provides the opportunity for outreach education about the best available science concerning the maintenance of docks, piers, bulkheads and other shoreline infrastructure.

Table 30A. Roche Harbor Management Area Reach Assessment – Physical Conditions.

Reach	Natural Sediment Transport Patterns	Shoreline Sediment Input Alterations - Feeder Bluffs	Shoreline Sediment Input Alterations - Pocket Beaches	Shoreline Sediment Input Alterations - Barrier Beaches	Natural Current Patterns	Wave & Current Attenuation	Nutrient and Toxics Removal	Shade	Total
207	5	5	4	NP	5	4	5	5	33
208	5	5	NP	5	5	5	3	3	31
209	5	5	4	5	5	4	3	4	35
210	5	5	NP	NP	5	2	3	4	24
211	5	NP	3	NP	5	4	3	4	24
212	5	NP	4	NP	5	4	3	3	24
213	5	NP	5	NP	5	5	3	0	23
214	5	NP	5	NP	5	5	3	2	25
215	5	NP	NP	NP	5	5	3	2	20
216	5	NP	5	NP	5	4	3	2	24
217	5	NP	4	NP	5	4	3	4	25
218	5	NP	3	NP	3	4	3	4	22
219	0	5	4	5	2	4	3	3	26
220	5	5	3	5	5	4	3	3	33
221	5	NP	NP	NP	5	5	3	2	20
222	5	3	NP	NP	3	4	3	3	21
223	5	NP	NP	NP	5	4	3	1	18
224	5	5	NP	NP	3	3	0	3	19
225	5	2	5	5	5	4	3	4	33
226	5	NP	4	NP	2	4	3	4	22
227	5	NP	1	NP	5	4	3	4	22
228	5	NP	5	5	5	5	3	3	31

229	5	5	NP	5	5	5	3	2	30
230	5	4	NP	5	5	4	3	4	30
231	5	NP	5	5	5	5	3	1	29
232	5	NP	4	5	5	4	3	3	29
233	5	5	5	NP	5	5	5	4	34
234	5	NP	5	NP	5	5	3	4	27
235	3	NP	2	NP	3	4	3	3	18
236	5	NP	NP	NP	5	5	3	3	21
237	5	5	NP	NP	5	4	3	5	27
238	5	NP	NP	NP	5	4	3	4	21
Median	5.00	5.00	4.00	5.00	5.00	4.00	3.00	3.00	24.50
Average	4.78	4.54	4.00	5.00	4.56	4.25	3.03	3.13	25.66
Percent of Highest Possible Score	96%	91%	80%	100%	91%	85%	61%	63%	64%

NP = Not Present

Table 30B. Roche Harbor Management Area Reach Assessment – Habitat Conditions.

Reach	Vegetation Coverage	Estuary Habitat	Birds	Haul-out Habitat	Eelgrass	Floating Kelp	Understory Kelp	Spawning Habitat[1]	Herring Spawning Habitat	Shellfish	Total
207	5	1	3	0	5	0	5	0	0	2	21
208	5	0	0	0	0	0	0	0	0	2	7
209	5	1	0	0	5	5	5	0	0	2	23
210	5	1	0	0	0	0	0	0	0	2	8
211	4	1	0	0	5	0	5	0	0	2	17
212	5	2	2	0	5	0	5	0	0	3	22
213	5	2	0	5	5	5	5	0	0	2	29
214	4	1	0	0	5	0	5	0	0	1	16
215	4	1	0	0	0	0	0	0	0	1	6
216	5	1	0	0	0	0	0	0	0	1	7
217	5	1	0	0	5	0	5	0	5	3	24
218	5	0	0	0	5	0	5	0	0	3	18
219	3	0	0	0	5	0	0	0	5	4	17
220	4	2	3	5	5	5	5	0	5	3	37
221	4	0	0	0	0	0	0	0	5	4	13
222	4	1	1	0	0	0	0	0	5	3	14
223	4	4	0	0	0	0	0	0	5	2	15
224	5	2	0	0	0	0	0	0	5	4	16
225	5	1	0	0	5	0	0	3	5	4	23
226	5	5	0	0	5	0	5	3	5	3	31
227	5	1	0	5	5	5	5	3	5	3	37
228	5	3	0	5	5	5	5	0	5	4	37
229	5	2	0	0	0	0	5	0	0	2	14
230	5	3	0	0	5	5	5	0	0	3	26
231	5	5	0	0	5	0	5	0	0	1	21
232	5	5	1	5	5	5	5	0	0	3	34

233	5	1	0	0	5	5	5	0	0	2	23
234	5	1	0	0	5	5	5	0	0	2	23
235	5	3	0	0	0	0	0	0	0	1	9
236	5	2	0	0	0	0	0	0	0	1	8
237	5	1	0	0	0	0	0	0	0	1	7
238	5	2	0	0	5	0	5	3	0	1	21
Median	5.00	1.00	0.00	0.00	5.00	0.00	2.50	0.00	0.00	2.00	19.50
Average	4.72	1.75	0.31	0.78	3.13	1.41	2.50	0.38	1.72	2.34	19.50
Percent of Highest Possible Score	94%	35%	6%	16%	63%	28%	50%	8%	34%	47%	39%

[1] Includes priority spawning habitat for sand lance, surf smelt, and rock sole.

4.11 San Juan Channel Management Area

The San Juan Channel management area extends from Friday Harbor in the south to just east of Davison Head on northeast side of San Juan Island, along the south edge of San Juan Channel. The management area also includes O'Neal Island. There are no major transportation related uses in this management area.

Table 31 is a summary of the reach assessment for the San Juan Channel management area. The table is in two parts, one covering general physical conditions, the other addressing those conditions directly related to habitat functions. The following discussions cover both the conditions scored in the reach assessment (Tables 31A and B) and management area results from the ecosystem-wide characterization. This management area scores high for maintaining natural sediment and current patterns as well as wave and current attenuation. Most reaches have high water quality and shoreline shading is relatively intact, This management area largely lacks floating kelp, haul-out habitat, and spawning habitat for priority fish species.

4.11.1 Physical and Biological Characterization

Nearshore Physical Processes

The geology of this management is relatively uniform and consists of altered marine sedimentary bedrock. Most of the shoreline is steep with very little sediment in transport alongshore. The presence of sediment does increase to the north where thin deposits do intersect the shoreline in a few places. There are no mapped drift cells in this management area.

Tidal currents in the middle of San Juan Channel are well in excess of 1 knot at times. Tidal flows in the embayments of the management area are much less. Wave energy is very small inside Friday Harbor and generally increases as one moves north in the management area. The north shore of San Juan has fairly significant waves as there is indirect exposure to the Strait of Georgia.

Geologic Hazards

Landsliding is possible in many locations throughout the management area due to the large slopes present, but the resistant nature of the bedrock dictates that failures are rare and local. The tsunami threat is small for the most of the shoreline that has an easterly aspect, while the northern end of the management (that faces north) could experience some effects from a tsunami generated anywhere in the Strait of Georgia, including tsunamis generated from a Fraser River delta collapse. Liquefaction is non-existent.

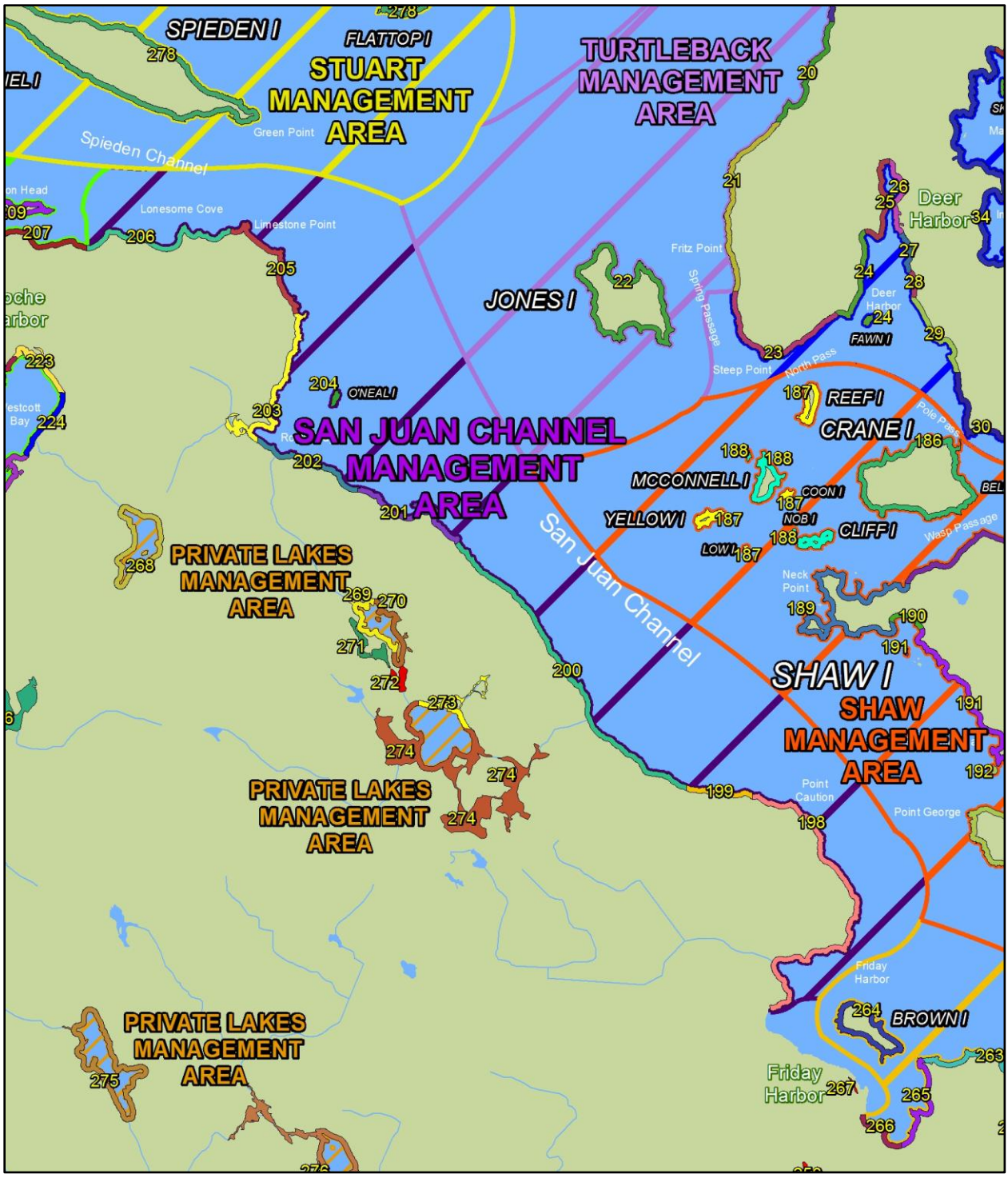


Figure 22. San Juan Channel Management Area.

Streams and Associated Wetlands

There are many mapped streams in this management area. Salmon Creek drains Beaverton Valley north and west of the Town of Friday Harbor. It empties into Friday Harbor at the Friday Harbor Laboratories owned by the University of Washington. Another stream serves as an outlet for Sportsman Lake, a jurisdictional lake in the middle of the management. Neva Lake also has an outlet that drains to the southern side of Rocky Bay. There is a small mapped, unnamed stream that drains to the head of Rocky Bay. There are five other small ephemeral streams in the management area. There are very few shoreline wetlands in the management area. Only one is mapped at the head of Rocky Bay.

Critical or Priority Habitat and Species Use

The shoreline generally lacks shallow nearshore habitat and beach formations that would support a variety of clam and forage fish species, however all reaches have at least two documented shellfish species, and the nearshore habitat is suitable for urchins along the entire shoreline, and for pandalid shrimp in the vicinity of Rocky Bay and O'Neal Island. Floating kelp is present off Point Caution (reaches 198 and 199) as well as Limestone Point and Lonesome Cove (reaches 205 and 206). Understory kelp and eelgrass are documented in all reaches except for O'Neal Island. No spawning habitat for priority fish species is reported for any of the reaches.

Chinook salmon, as well as high densities of chum and pink salmon are known to use the Lonesome Cove shoreline off of Spieden Channel (Wyllie-Echeverria and Barsh 2007), and are likely present along other reaches in the management area as well. This general area, at the convergence of Spieden, President, and San Juan Channels, is known to have relatively high juvenile salmon densities in the nearshore areas compared to other nearshore locations sampled in the County (Wyllie-Echeverria and Barsh 2007). Higher densities indicate that it is a key migration route for juvenile salmon or that nearshore areas are more heavily used due to a variety of potential geographic and environmental conditions. While the entire County is likely very important for salmonids, nearshore areas in this region may therefore have even more significance for juvenile salmon migration and success compared to other regions in County.

Otherwise significant small island habitats used by mammals and sea bird colonies are generally lacking from the management area. Bald eagle perches and potential nesting areas are present along the majority of the shoreline. Nearly the entire shoreline in this management area is suitable habitat for rockfish.

Marine Riparian, Nearshore, and Estuarine Habitats

Estuarine habitat is reported in all reaches except two but areas are small (less than 2 acres in all reaches). The shoreline is primarily forested, but steep and rocky. Vegetation coverage is dense throughout the shoreline jurisdiction and there is good vegetation coverage in the immediate shoreline area of most all the reaches.

Water Quality, Sediment, and/or Tissue Sample Results

Although data have been collected near the management area (Ecology 2011e), the water quality within this management area is unknown.

4.11.2 Shoreline Use Patterns

Existing Land and Shoreline Use

Land Use

The San Juan Channel management area extends from the northern Friday Harbor city limits to the south side of Spieden Channel on San Juan Island, and also includes the smaller O'Neal Island.

Overall existing land use in the San Juan Channel management area includes:

- Residential – 61 percent
- Services – 25 percent
- Cultural, Entertainment, Recreation – 2 percent
- Undeveloped Land – 12 percent

North of Friday Harbor is a large government/education property, called Friday Harbor Laboratories, owned by the University of Washington that extends to the north side of Point Caution. Existing land uses in the remainder of the management area are mostly residential with smaller lots and more intense residential development located at the southern and northern edges of the management area. A small number of conservation, vacant, cultural/recreation, and trade land uses are interspersed along the remainder of the management area. O'Neal Island is also residential.

Additional shoreline uses include a DNR authorized water intake system at UW Friday Harbor Labs and a desalination system. The majority of tidelands are state-owned aquatic lands.

Water-dependent uses in this management area include docks, piers, and marine railways, many of which are private. Another water-dependent use is the University of Washington's Friday Harbor Laboratories Biological Preserve marine research located north of Friday Harbor city limits. Hotel/lodging such as bed and breakfast establishments mixed in with existing residential development provides for water enjoyment uses.

Land Use Designations

The University of Washington Laboratories property is designated Natural and Conservancy (Conservancy at the developed portion of the site). West of the University of Washington property at Point Caution is an area designated Rural Residential characterized by small lot residential development. Further west and north, Comprehensive Plan land use designations change to Rural Farm Forest to Rocky Bay, with the exception of a small area of Residential Rural southeast of Rocky Bay. Future land designations change to Rural Residential between north side of Rocky Bay and Limestone Point. West of Limestone Point to the end of the management area, Comprehensive Plan land use designation is Rural Farm Forest, reflecting the larger lot residential development in this area. O'Neal Island is designated Natural and Conservancy.

Shoreline Environment Designations

The University of Washington Laboratories property north of Friday Harbor carries Natural and Conservancy shoreline environment designations. Conservancy is applied at the developed portion of the University of Washington Laboratories property. North and west of the University of Washington Laboratories property to Rocky Bay, this management area is predominantly in Conservancy shoreline environment, with small areas of Rural Residential or Rural Residential/Conservancy split designations found in areas characterized by more intense existing residential development. North of Rocky Bay, Rural Residential becomes the common shoreline environment, with small areas of Conservancy applied in places, such as Reuben Tarte County Park. This pattern continues to the end of the management area.

Shoreline Modifications

San Juan Channel is only 2.2 percent armored; one of the lowest values of armoring on the major islands. This is largely attributable to the steep bedrock shorelines, which preclude nearshore development and eliminate the need for erosion protection. The lack of nearshore development limits the number of dock and piers (13). There are only 2 boat ramps and 40 mooring buoys, some of the lowest values anywhere on the three major islands. There are also no unusual modifications, such as groins and jetties.

Existing and Potential Public Access Areas

Existing Facilities

The San Juan Channel management area has just over 13 miles of shorelines and just under 500 feet of trails and paths mainly in the Rueben Park area. Reuben Tarte Day Park is located in this management area and features two small beaches on either side of a rocky peninsula and views across Rocky Bay to Jones, Yellow and Orcas islands.

Existing Facilities with Potential for Improvement

University of Washington owns approximately 475 acres area north of Friday Harbor. Although the University Road has access to shoreline, it may not be publicly accessible.

The Parks Plan includes the following recommendations for improving public access at Rueben Tarte Day Park:

- Upgrade (gravel or pave) lower parking area and turn around
- Upgrade/pave ADA parking stall and connection to portable toilet
- Replace existing portable toilet with ADA accessible unit
- Install interpretive signage
- Replace deteriorating benches

4.11.4 Restoration Opportunities

The relatively small amount of shoreline development in the management area, both past and present, limits restoration opportunities because most of the shoreline in its predevelopment state. However, conservation can be a focus here since the development pressure in this management area is more intense than elsewhere because of its proximity to Friday Harbor.

Table 31A. San Juan Channel Management Area Reach Assessment – Physical Conditions.

Reach	Natural Sediment Transport Patterns	Shoreline Sediment Input Alterations - Feeder Bluffs	Shoreline Sediment Input Alterations - Pocket Beaches	Shoreline Sediment Input Alterations - Barrier Beaches	Natural Current Patterns	Wave & Current Attenuation	Nutrient and Toxics Removal	Shade	Total
198	5	NP	2	NP	5	4	5	4	25
199	5	NP	NP	NP	5	5	5	5	25
200	5	NP	5	NP	5	4	5	5	29
201	5	NP	5	NP	5	4	5	4	28
202	5	NP	5	NP	5	5	5	5	30
203	5	NP	4	NP	5	4	5	4	27
204	5	NP	NP	NP	5	5	5	3	23
205	5	NP	3	NP	3	4	5	4	24
206	5	NP	4	NP	5	4	5	4	27
Median	5.00		4.00		5.00	4.00	5.00	4.00	27.00
Average	5.00		4.00		4.78	4.33	5.00	4.22	26.44
Percent of Highest Possible Score	100%	0%	80%	0%	96%	87%	100%	84%	66%

NP = Not Present

Table 31B. San Juan Channel Management Area Reach Assessment – Habitat Conditions.

Reach	Vegetation Coverage	Estuary Habitat	Birds	Haul-out Habitat	Eelgrass	Floating Kelp	Understory Kelp	Spawning Habitat[1]	Herring Spawning Habitat	Shellfish	Total
198	5	1	0	0	5	5	5	0	0	2	23
199	5	0	0	0	5	5	5	0	0	2	22
200	5	1	1	0	5	0	5	0	0	2	19
201	5	1	0	0	5	0	5	0	0	3	19
202	5	1	0	0	5	0	5	0	0	3	19
203	5	2	0	0	5	0	5	0	0	3	20
204	4	0	0	5	0	0	0	0	0	2	11
205	5	1	0	0	5	5	5	0	0	2	23
206	5	2	0	0	5	5	5	0	0	2	24
Median	5.00	1.00	0.00	0.00	5.00	0.00	5.00	0.00	0.00	2.00	20.00
Average	4.89	1.00	0.11	0.56	4.44	2.22	4.44	0.00	0.00	2.33	20.00
Percent of Highest Possible Score	98%	20%	2%	11%	89%	44%	89%	0%	0%	47%	40%

[1] Includes priority spawning habitat for sand lance, surf smelt, and rock sole.

4.12 Shaw Island Management Area

The Shaw Island management area includes all of Shaw Island and a collection of smaller islands that form a mini-archipelago bounded by San Juan, Upright and Harney Channels, West Sound and Deer Harbor. The largest of the secondary islands is Crane Island, which is inhabited. Other inhabited islands include: Coon Island, Bell Island, Cliff Island, and McConnell Island. The primary (WSDOT) ferry terminal for Shaw Island is at the east end of the mouth of Blind Bay.

Table 32 is a summary of the reach assessment for the Shaw Island management area. The table is in two parts, one covering general physical conditions, the other addressing those conditions directly related to habitat functions. The following discussions cover both the conditions scored in the reach assessment (Tables 32A and B) and management area results from the ecosystem-wide characterization. The reaches within the Shaw Island management area are diverse. Some are lower than the rest of the County (generally those with development), while others are highly functioning. Blind Bay (179) is the most physically impaired; reach 174 is one of the highest scoring reaches in the county for habitat conditions.

4.12.1 Physical and Biological Characterization

Nearshore Physical Processes

Shaw Island is comprised primarily marine sedimentary rock. While still bedrock, the marine sedimentary rock that comprises Shaw Island is much more erodible than its igneous counterparts on the major islands in the County. The marine sedimentary rock is also interbedded with layers of varying strength causing the shoreline to have numerous small pockets due to past erosion of the shoreline. As a result, pocket beaches and tombolos are extremely common on Shaw Island. The pocket beaches are primarily derived from eroded bedrock. This compartmentalization of the shoreline means that sediment supply impacts to the shoreline are localized, but pronounced.

There are five small drift cells mapped in this management area. Two are isolated drift cells, which essentially are associated with large pocket beaches. One occurs along South Beach with significant feeder bluffs at the west end, while the other small drift cell is associated with the west side isthmus that connects Broken Point to the Shaw Island mainland. The other three drift cells occur in Blind Bay. One isolated cell occurs in the northwest end of the bay and terminates at a bedrock outcropping. The other two converge, as occurs in a classic pocket beach, at the head of Blind Bay.

Figure 23. Shaw Island Management Area.

Most of the island is relatively protected from wave energy by other islands (because the wave energy is reduced by short fetches), with the possible exception of the south end of Shaw Island from Hoffman Cove to Picnic Point. Tidal flows are significant near local topographic constrictions (i.e., passes), such as Pole Pass, and in San Juan Channel, but tidal flows are generally less than flows within the major channels that ring the other islands. Even in San Juan Channel, currents rarely exceed 2 knots (Canadian Hydrographic Service 2010). It is likely that vessel wakes play a secondary role in sediment transport on the beaches near the ferry terminal and heavily used narrow passes.

Geologic Hazards

The sedimentary rock on Shaw Island has the potential to be unstable due to sliding along bedding contacts or where it is mantled with a thin veneer of glacial drift (such as at the west end of Indian Cover), particularly in the wet season. Despite these areas of potential instability, most landsliding on Shaw Island shorelines is muted and slow by comparison to other Western Washington shorelines. Because of the proximity of bedrock throughout much of the island liquefaction is insignificant with the exception of low lying area of glacial between Indian Cove and Blind Bay. The Shaw Island management area is relatively protected from tsunamis generated outside of the San Juan archipelago. The primary risk of tsunami in this management area comes from large landslides on the other major San Juan Islands.

Streams and Associated Wetlands

Due to their lithology, Shaw Island and surrounding islands in the management area are relatively permeable and therefore lack significant perennial streams. Wetlands are also rare. There are three small unnamed drainage basins on Shaw Island. The largest is an unnamed ephemeral stream that drains to Squaw Bay, while the other two discharge to Blind Bay and to the embayment on the west side of Broken Point. One small (unmapped) stream on Neck Point is dammed near the limits of the shoreline management area (close to within 200 feet of the marine ordinary high water mark). There are no jurisdictional lakes on Shaw Island.

Critical or Priority Habitat and Species Use

Although there are no salmon bearing streams on Shaw Island, nearshore areas provide suitable habitat for juvenile salmon and forage fish. Eelgrass beds occur in a patchy distribution throughout most of the reaches, and provide habitat for fish, including suitable spawning habitat for Pacific herring in Blind Bay and just east of there (reaches 174, and 177 through 181). Blind Bay is a priority fish spawning habitat area for forage fish (Friends of the San Juans 2004a). Surf smelt spawning habitat is present along the bluff backed beach of Blind Bay and in a patchy distribution along Shaw Island's northern shoreline between Broken Point and Point Hudson. Both floating kelp and understory kelp have a patchy distribution throughout the management area. Juvenile Chinook, chum, and pink salmon presence have been documented in nearshore areas of Parks Bay and Hicks Cove (Wyllie-Echeverria and Barsh 2007), and are likely present throughout other nearshore areas. The rocky headlands common in the management area are suitable habitat for rockfish.

Blind Bay, Indian Cove, and Squaw Bay are important habitat for Dungeness crab. Shellfish species are documented in virtually all reaches. Small islands in the San Juan Channel, such as Yellow Island, Cliff Island, Low Island, and others along the western shoreline of Shaw Island are known harbor seal haul-out sites. These areas, as well as McConnell Island also provide suitable habitat for seabird colonies, and other birds commonly associated with shorelines.

Marine Riparian, Nearshore, and Estuarine Habitats

Estuarine habitat occurs in several embayments characterized by bluff backed and pocket beach shoreforms. Estuarine habitat is present in Blind Bay, Parks Bay, and Indian Cove, and there are a number of smaller pocket estuaries along the San Juan Channel shoreline. Forested areas, primarily along the eastern and southern shorelines of Shaw Island provide suitable habitat for bald eagles, and are used by bald eagles for nesting and perching. Vegetation coverage is dense within the shoreline jurisdiction although shade to the nearshore is somewhat compromised in a number of reaches.

Water Quality, Sediment, and/or Tissue Sample Results

Although data have been collected in the area (Ecology 2011d), no systematic analysis has been done with this data. As such, water quality is largely unknown in this management area.

4.12.2 Shoreline Use Patterns

Existing Land and Shoreline Use

Land Use

The Shaw Island management area mostly contains residential land uses, with areas of government and educational, vacant, and conservation parcels also found within shoreline jurisdiction. Current land uses in the Shaw Island management area are as follows:

- Residential – 52 percent
- Services – 16 percent
- Cultural, Entertainment, Recreation – 3 percent
- Undeveloped Land – 29 percent

Shaw Island, the largest island within the Shaw Island management area, has its western and northern shoreline dominated by existing residential uses, with small amounts of conservation, resource, and vacant land. The Shaw Island Ferry Terminal at the northeast corner of Blind Bay includes the existing marine facility use of the ferry terminal, as well as the Shaw General Store, the only trade use in shoreline jurisdiction. The southwestern shoreline between Parks Bay and Squaw Bay is largely in conservation, including properties owned by the University of Washington for conservation purposes, along with some vacant and residential enclaves near Hicks Bay. East of Squaw Bay, the Shaw Island shoreline jurisdiction includes a mix of County parks, residential development, conservation land, and small amounts of vacant land. The most intense residential development in this area occurs along South Beach and Picnic Cove. Between Picnic Cove and Point Hudson, the shoreline jurisdiction is largely undeveloped (vacant and conservation) with very little residential development. The point west of Squaw Bay supports an annual reef net fishery.

Other islands within the Shaw Island management area include Canoe, Crane, Bell, Cliff, Reef, McConnell, and Yellow islands, along with a number of smaller islands interspersed among them. Most of these islands are either characterized by residential development or are vacant. The largest of these islands, Crane Island, has a shoreline entirely in residential land use. Similarly, Cliff, Bell, and Coon islands are also characterized by residential uses. Canoe Island is a private island owned by an educational institution with an on-site camp facility and limited shoreline development. McConnell Island has a mix of residential and vacant land uses, while Yellow, Reef, and the smaller islands are vacant or have low levels of residential development on them.

Additional shoreline uses include multiple DNR utility easements and at least one desalination system. The tidelands are a mix of state-owned aquatic lands and private ownership with the majority being state-owned aquatic lands.

Primary water-dependent uses in the Shaw Island management area consist of the Washington State Ferry Terminal at the northeast corner of Blind Bay and the associated Shaw General Store, and the public marine facility Shaw Island Park at Indian Cove in the southeastern portion of Shaw Island. Other water dependent uses consist of barge landing locations and community and private docks located along developed shorelines on Shaw and as well as private marine railways, and community and private docks on Shaw, Crane, Bell, Cliff, Coon, Canoe, and smaller inhabited islands. Water enjoyment uses include Shaw Island County Park on Indian Cove, and an education camp on Canoe Island.

Land Use Designations

The County's Comprehensive Plan land use designations in this management area generally corresponds with existing land use patterns. Rural Residential designations dominate the shoreline between the western side of Blind Bay on the northern side of Shaw Island and Parks Bay and western side of Shaw Island. Rural Residential is also applied on the Crane Island shoreline jurisdiction. Natural, Conservancy, and Rural Farm Forest designations predominate on the southern side of Shaw Island with a small enclave of Rural Residential along South Beach to Picnic Cove. Rural Farm Forest and Forest Resource designations dominate the eastern side of the Shaw Island. Canoe, Cliff, McConnell, and Reef islands are all designated as Conservancy, while Yellow Island is designated Natural.

Shoreline Environment Designations

The Rural Farm-Forest shoreline environment is the predominant shoreline environment applied to Shaw Island. Rural Farm-Forest is applied to all but a few areas between Blind Bay on the north side and Parks Bay on the west side of Shaw Island. Exceptions include four short areas of Conservancy on Neck Point. The peninsula that includes Point George, one of the University of Washington conservation properties, is designated with the Natural environment. A small area between Hicks Bay and Hoffman Cove is in the Rural Farm-Forest environment, while another University of Washington conservation property located between Hoffman Cove and Squaw Bay is mostly designated Natural with areas of Rural Farm-Forest and Conservancy environment mixed in on the west side of Squaw Bay. A split designation of Conservancy and Natural environments is applied to the north side of Squaw Bay, while the San Juan County Park

property between the east side of Squaw Bay and South Beach is designated Conservancy. The residential development east of the County Park and the remainder of the less developed east side of Shaw Island to Point Hudson is designated Rural Farm-Forest environment. The area between Point Hudson and the State Ferry Terminal on the northeast corner of Blind Bay includes both Rural and Rural Farm-Forest environments. Of the smaller islands in this management area, Crane Island's shoreline carries a Rural Farm-Forest environment designation, while the remainder of the smaller islands are either Conservancy, Natural, or a combination of the two environments.

Shoreline Modifications

Approximately 4.4 percent of the management area is armored. Most of the armoring occurs on the pocket beaches that fringe Shaw Island. The bedrock outcrops are rarely armored, although this does occur near the transition to sandier areas. If the percentage of armoring would be expressed in terms of pocket beach area only, the percentage of armoring would be significantly higher. There are 55 overwater structures, a vast majority of which are docks and piers. In addition to the docks and piers, there are four groins and eight boat ramps, more than any other management area except the Roche Harbor management area (which also has eight). Most of the mooring buoys are located in Blind Bay. There is also some amount of fill at the Ferry Terminal.

Existing and Potential Public Access Areas

The Shaw Island management area has approximately 759 acres of shoreline jurisdiction. Shaw Island County Park is the most significant public access facility in this management area. The park is approximately 60 acres and includes a campground with 11 primitive campsites, the Indian Cove boat ramp for small vessels, and a day use area. The San Juan County Parks Plan recommends renovating the park per the 2008 Master Plan (The Trust for Public Land et al. 2010).

In addition to the developed county/regional park, there are a few road ends managed by the Public Works Department that provide shoreline access or the potential for access:

Existing Facilities

- Blind Bay Road: This road end is located on the north side of the island and provides 20 feet of right-of-way on the rocks south of the Washington State Ferries dock.

- Indian Cove Ramp: The ramp is located within Indian Cove County Park at the end of Shaw Park Road. Since it is located on a very flat, shallow beach, the wooden ramp can only be used at high tide to launch small recreational boats. Commercial landing craft can often only access it 2 or 3 times per year.

- Shaw Landing Dock: The small dock and stairway is located adjacent and to the southwest of the state ferry loading area. There is currently no float and no beach access from the facility

Existing Facilities with Potential for Improvement

- Hoffman Cove Road: This road end is located at the entrance to the University of Washington property on the south end of Shaw Island. This is a popular spot for local residents to enjoy bird watching, beach combing and hiking but there are no provisions for parking.

- Neck Point Cove Road: this undeveloped road end on the northwestern end of the island provides access to a beach area and tidelands in a small bay that is used for small boat launching and landings. No parking is available.

Currently there are only a limited amount of trails or pathways in this management area, specifically located within the County Park. The University of Washington is a large land owner in the Shaw Island management area. The Parks Plan calls for working with the University of Washington to explore public access opportunities on Shaw Island.

4.12.3 Restoration Opportunities

Localized development including road construction and deforestation may have historical and ongoing (current) impacts on water quality and beach formation. Where development like this has occurred in close proximity to Blind Bay, impacts likely affect forage fish habitat. Because Blind Bay is an important forage fish spawning area, re-establishment of vegetative and beach structure along the shoreline via the removal or relocation of roadways may be a restoration opportunity to improve forage fish habitat.

Bordering the Washington State Ferry landing on Shaw Island is a cove with a private/community dock. This privately owned cove is populated by a thick eelgrass bed, feeding great blue herons, mergansers, and river otters. The beach is flanked by rocky outcrops with a steep (10-foot high) backshore. A creosote-timber bulkhead was installed on the adjacent property to prevent erosion from ferry wakes and storm waves (Habitat Work Schedule 2011). Because there are no structures protected by the bulkhead and the creosote continues to pollute the cove, removing the bulkhead is a restoration opportunity.

Table 32A. Shaw Island Management Area Reach Assessment – Physical Conditions.

Reach	Natural Sediment Transport Patterns	Shoreline Sediment Input Alterations - Feeder Bluffs	Shoreline Sediment Input Alterations - Pocket Beaches	Shoreline Sediment Input Alterations - Barrier Beaches	Natural Current Patterns	Wave & Current Attenuation	Nutrient and Toxics Removal	Shade	Total
173	5	NP	5	NP	5	4	5	4	28
174	5	NP	4	5	5	4	5	4	32
175	5	NP	2	NP	5	4	5	4	25
176	5	NP	5	NP	3	5	5	3	26
177	5	NP	5	NP	3	5	5	4	27
178	5	5	0	NP	3	3	5	3	24
179	1	2	NP	NP	0	2	5	2	12
180	5	5	5	NP	3	4	5	2	29
181	5	5	4	NP	5	4	5	5	33
182	5	NP	0	2	3	2	5	3	20
183	5	0	2	NP	5	4	5	4	25
184	1	NP	4	NP	5	4	5	4	23
185	5	NP	NP	NP	5	5	5	3	23
186	5	NP	4	NP	5	4	5	4	27
187	5	NP	4	NP	5	4	5	3	26
188	5	NP	4	NP	5	4	5	4	27
189	5	NP	2	NP	2	4	5	4	22
190	5	NP	5	NP	5	5	5	3	28
191	5	NP	3	NP	5	4	5	4	26
192	5	NP	4	NP	5	4	5	4	27
193	5	NP	4	NP	5	4	5	2	25

194	5	NP	5	NP	5	4	5	2	26
195	5	NP	2	NP	1	4	5	1	18
196	5	5	5	5	3	5	5	3	36
197	5	NP	NP	3	5	4	5	0	22
Median	5.00	5.00	4.00	4.00	5.00	4.00	5.00	3.00	26.00
Average	4.68	3.67	3.55	3.75	4.04	4.00	5.00	3.16	25.48
Percent of Highest Possible Score	94%	73%	71%	75%	81%	80%	100%	63%	64%

NP = Not Present

Table 32B. Shaw Island Management Area Reach Assessment – Habitat Conditions.

Reach	Vegetation Coverage	Estuary Habitat	Birds	Haul-out Habitat	Eelgrass	Floating Kelp	Understory Kelp	Spawning Habitat[1]	Herring Spawning Habitat	Shellfish	Total
173	5	1	1	0	5	5	5	0	0	3	25
174	5	1	0	5	5	5	5	3	5	3	37
175	5	1	0	0	5	0	5	3	0	0	19
176	5	0	0	0	0	0	5	0	0	0	10
177	5	0	0	0	5	0	5	0	5	1	21
178	5	1	0	0	5	0	5	0	5	2	23
179	5	4	1	0	5	0	5	3	5	2	30
180	4	5	1	0	5	0	5	3	5	2	30
181	5	1	1	0	5	5	5	3	5	3	33
182	5	1	2	0	5	0	5	0	0	1	19
183	5	1	0	0	5	0	5	0	0	2	18
184	5	1	2	0	5	5	5	0	0	2	25
185	5	0	1	5	0	5	0	0	0	2	18
186	5	3	0	0	5	5	5	0	0	2	25
187	5	1	3	5	5	5	5	0	0	4	33
188	5	1	0	5	5	5	5	0	0	3	29
189	5	3	0	5	5	5	5	3	0	2	33
190	5	1	0	0	0	0	5	0	0	1	12
191	5	1	1	5	5	5	5	0	0	1	28
192	5	1	0	5	5	5	5	0	0	2	28
193	5	0	5	5	5	5	5	0	0	2	32
194	5	2	0	0	5	5	5	0	0	3	25
195	5	4	0	0	0	0	0	0	0	2	11
196	5	1	1	0	5	0	5	0	0	3	20
197	4	0	0	0	0	0	5	0	0	2	11

Median	5.00	1.00	0.00	0.00	5.00	5.00	5.00	0.00	0.00	2.00	25.00
Average	4.92	1.40	0.76	1.60	4.00	2.60	4.60	0.72	1.20	2.00	23.80
Percent of Highest Possible Score	98%	28%	15%	32%	80%	52%	92%	14%	24%	40%	48%

[1] Includes priority spawning habitat for sand lance, surf smelt, and rock sole.

4.13 Spencer Spit Management Area

Spencer Spit management area includes all of Upright Head, Humphrey Head, Frost Island, Flower Island, and the shorelines in between. It also includes the entire drift cell that supplies the south side of Spencer Spit. The southern extent of the management area is defined by the transition from sediment to bedrock in Lopez Sound. The primary ferry terminal for Lopez Island is near the tip of Upright Head.

Table 33 is a summary of the reach assessment for the Spencer Spit management area. The table is in two parts, one covering general physical conditions, the other addressing those conditions directly related to habitat functions. The following discussions cover both the conditions scored in the reach assessment (Tables 33A and B) and management area results from the ecosystem-wide characterization. Spencer Spit management area is one of the highest scoring for physical conditions particularly near Spencer Spit itself. Upright Head (reach 134) is by far the best performing reach for providing habitat within the management area, despite containing the island's main ferry terminal.

4.13.1 Physical and Biological Characterization

Nearshore Physical Processes

The geology of the Spencer Spit management area is typified by sediment-rich shorelines interspersed with bedrock outcroppings. Upright Head, Humphrey Head, Frost Island, and Flower Island are all bedrock outcrops. There is a tombolo associated with Humphrey Head and an incomplete tombolo associated with Frost Island (Spencer Spit). Like all tombolos, sediment transport is convergent at the base of these features.

Tidal currents are generally weaker than in any other management area (much less than 1 knot: Canadian Hydrographic Service 2010). Wave energy is also weaker than most other management areas. Both tidal and wave energy increases from south to north.

Geologic Hazards

Much of the shoreline that is comprised of sediment in this management is to some degree unstable. Extensive feeder bluffs exist to the south of Spencer Spit, though there is generally a lack of active sliding, probably a result of the relatively lack of wave energy. The other major feeder bluff, located at the promontory that separates Swift Bay from Spencer Spit is more active, but still less active than White Cliffs on Decatur Island. Liquefaction risk is generally low to non-existent, except in the marshes where it is moderate to high. Like the Fisherman Bay management area, the surficial, relict (and active) tectonism common in the rest of the County is not present in the Spencer Spit management area. Tsunami risk is limited to landslide-induced tsunamis generated from the west side of Blakely and Decatur islands.

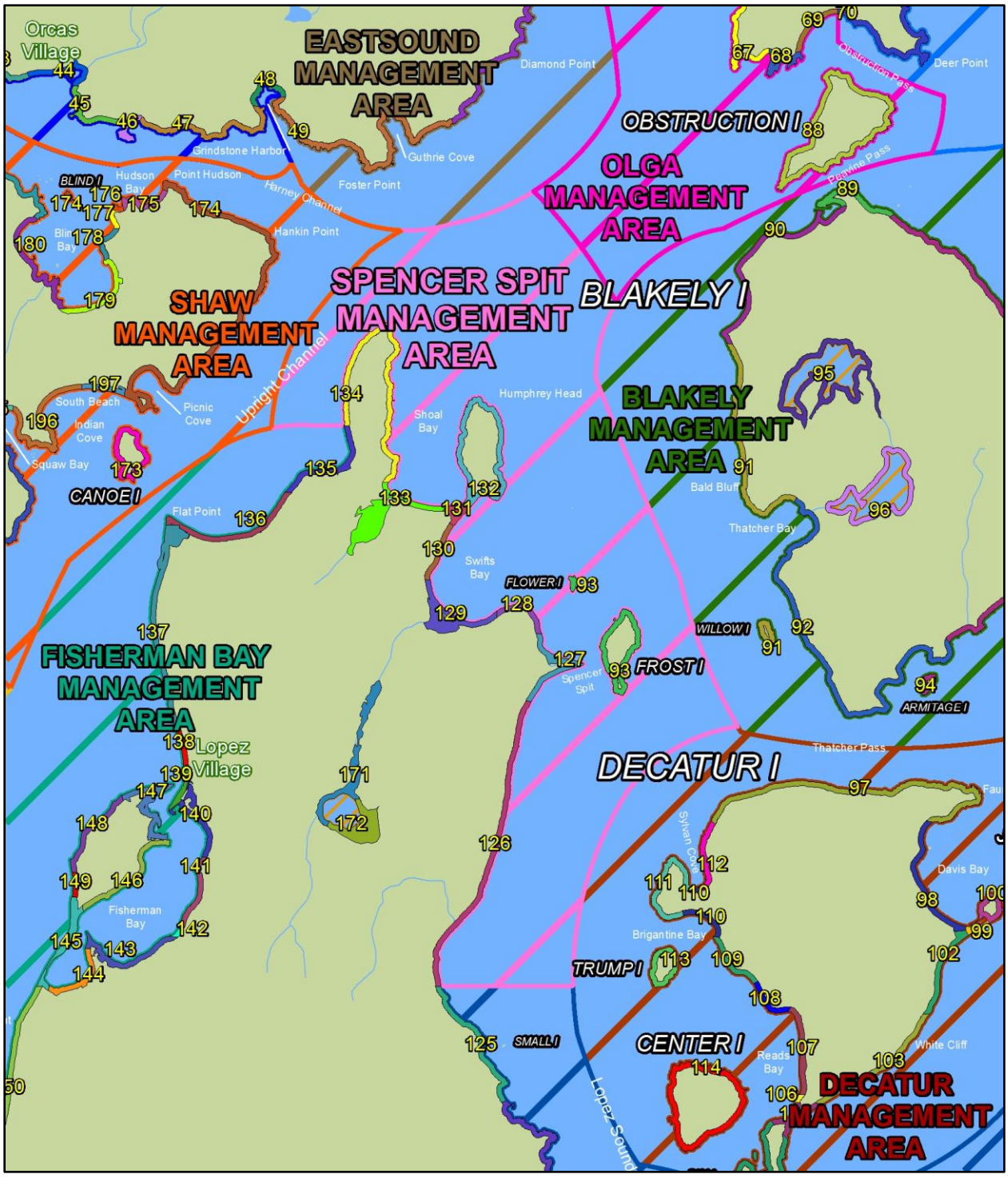


Figure 24. Spencer Spit Management Area.

Streams and Associated Wetlands

There are several large salt marsh complexes in this management area. There are marshes associated with the two tombolos (the tombolo at Humphrey Head and Spencer Spit) and also a large marsh complex at Port Stanley. These marshes vary in terms of alteration with Spencer Spit being largely intact, while the marsh at Port Stanley is ditched and ringed by road fill. There are three mapped streams in the management area, the largest of which drains to the marsh and tide gate at Port Stanley. This stream also serves as the outlet for jurisdictional Hummel Lake. The other two streams are much smaller and have both been altered to some extent.

Critical or Priority Habitat and Species Use

Spencer Spit management area contains a relatively contiguous habitat important for Dungeness crabs, and for a variety of clam species from Spencer Spit and south along bluff backed beaches. The entire area is also likely important for pandalid shrimp. Eelgrass is documented throughout most of the management area shorelines. Floating kelp is only documented near Upright Head but understory kelp are found in all management area reaches.

The unique habitats of Shoal Bay and near Upright Head provide beach and intertidal habitat for priority fish spawning. Pacific herring spawning habitat is also present in Shoal Bay and near Upright Head (reaches 131 through 134), along with extensive habitat for a variety of clams and other shellfish. Outside of Shoal Bay, a large area that includes portions of this, and three management areas (Blakely Island, Olga, and Eastsound) is documented as an important Pacific herring adult holding area, the only such area identified within San Juan County. The two rocky headlands (Upright and Humphrey) that form Shoal Bay are also suitable habitat for rockfish. Haul-out habitat is not documented in the management area.

Habitat in this management area is likely important for numerous priority species including salmon and birds that rely on crab and clams as prey species. Bald eagles, peregrine falcons and seabird colonies have all been observed in the northern areas surrounding Shoal Bay and Spencer Spit.

Marine Riparian, Nearshore, and Estuarine Habitats

Portions of Shoal Bay and Swifts Bay contain estuarine habitat, and eelgrass that is important to numerous priority species. Lagoons at Spencer Spit, and in Shoal Bay and Swifts Bay, have valuable riparian habitat that provides transitional areas between upland and marine areas that benefits numerous birds, fish, and other species. Aerial photos indicate that riparian vegetation has been substantially disturbed along segments of shoreline in Swifts and Shoal Bays, however, forest cover remains intact throughout much of the management area shorelines. Preserved conditions are most evident around Spencer Spit State Park.

Water Quality, Sediment, and/or Tissue Sample Results

Ambient water quality monitoring conducted by the Department of Ecology showed periodic exceedances of temperature and dissolved oxygen criteria in Lopez Sound; these exceedances were attributed to natural upwelling of low dissolved oxygen marine water and were not determined to be influenced by anthropogenic activities (Ecology 2011e). Water quality

monitoring has also been conducted on streams that discharge to Shoal and Swifts Bays; elevated fecal coliform bacteria concentrations, low dissolved oxygen concentrations, and high nutrient levels were observed (SJC 2000; Wiseman et al. 2000; SJCD 2005).

4.13.2 Shoreline Use Patterns

Existing Land and Shoreline Use

Land Use

The Spencer Spit management area extends from the northern peninsula on Lopez Island to approximately the mid-point on the east side of the island, and includes the smaller Frost Island.

Overall existing land use in the Spencer Spit management area includes:

- Residential – 72 percent
- Transportation, Communications – 1 percent
- Trade – 2 percent
- Cultural, Entertainment, Recreation – 10 percent
- Undeveloped Land – 14 percent

The northern peninsula is largely residential with a small amount of vacant property. The shoreline jurisdiction in Shoal Bay is characterized by small lot residential development with several small cultural/recreation uses, and a large trade parcel located on the southwest side of Humphrey Head. From Humphrey Head to Spencer Spit is a largely residential area with small lot residential development characterizing this area. Spencer Spit, a state park, is classified as a cultural/recreation use. Between Spencer Spit and the south end of the management area is a largely large lot residential area with some vacant and unclassified parcels interspersed. Frost Island is characterized by residential development.

Frost Island is residential, while Flower Island is undeveloped Federal land that is part of the San Juan National Wilderness Area.

Additional shoreline uses include a DNR utility easement and an aquaculture operation (Shoal Bay). The tidelands are a mix of state-owned aquatic lands and private ownership.

Water-dependent uses in this management area include the State Ferry Terminal at the northern tip of Lopez Island, Spencer Marina, as well as several piers, docks, and marine railways, many of which are private. Water enjoyment uses include Spencer Spit State Park.

Land Use Designations

Comprehensive Plan land use on the northern peninsula of Lopez Island is generally Rural Farm Forest with the exception of the area surrounding the state ferry dock, which is designated Rural General. Rural Farm Forest designation extends down the western side of Shoal Bay south of the ferry terminal. The south side of Shoal Bay is designated Rural Residential reflecting smaller lot residential development in this area. Both sides of the peninsula to Humphrey Head are designated Rural Farm Forest while the majority of Humphrey Head is designated Rural

Residential. Swifts Bay, south of Humphrey Head to Spencer Spit State Park is designated Rural Farm Forest. The state park itself is designated Conservancy. The remainder of the management area south of Spencer Spit State Park is designated Rural Farm Forest.

Frost Island is designated Rural Residential and Flower Island is designated Natural.

Shoreline Environment Designations

The northern part of this management area is predominantly Rural Residential with a small area of Conservancy applied around the State Ferry Terminal. Shorelines on both sides of the neck to Humphrey Head are designated Conservancy, while Humphrey Head itself is mostly Rural Residential with a small area of Rural. South of Humphrey Head, shoreline environment is designated as Rural Residential to the north side of Spencer Spit, where the designation changes to Conservancy for the remainder of the Lopez Island part of this management area. The smaller Frost Island is designated Conservancy, while Flower Island is designated Natural.

Shoreline Modifications

About 8.3 percent of the management area is armored, much higher than the average percentage for the County. This management area is comprised predominantly of glacial sediments, so this alone likely explains the relative prevalence of armoring, despite the reduced wave energy here. There are a moderate number of overwater structures (25), but many of these are located at Spencer's Landing in Shoal Bay, which also has series of breakwaters associated with it. This makes the rest of the shoreline relatively undisturbed for a major island (aside from the Ferry Terminal at the northern tip of Upright Head). There are also a relatively moderate number of mooring buoys (93) and pilings (10). Like the overwater structures, these are concentrated in Shoal Bay. Port Stanley and the mouth of the stream that drains Hummel Lake are significantly altered and likely possess fill in places.

Existing and Potential Public Access Areas

The Spencer Spit management area has roughly 12.75 miles of shorelines with a variety of public access opportunities, including approximately 1,600 feet of trails and paths and the following parks, preserves, and road ends:

- Spencer Spit State Park is a 138-acre marine and camping park with a reputation for excellent crabbing and clamming. It is one of the few state parks in the San Juan Islands that is accessible by automobile.
- Upright Head Preserve is a 26-acre property adjacent to the Lopez ferry landing. The preserve protects this property, which is highly visible from the water, from development of the 13-lot subdivision for which infrastructure has already been developed.
- Shipley Shores Road ends (A and B) are located on Swifts Bay, approximately 1/4 mile apart. Road end B has public access signs but no parking. Road end A needs public access signs as well as other amenities.

- Port Stanley Road end is also located on Swifts Bay. This site provides access to the water and has public access signs maintained by the County.

4.13.3 Restoration Opportunities

One of the largest opportunities for habitat improvement in the County is the restoration of the stream and wetland complex at Port Stanley. The recently removed tide gate on this stream had restricted fish access to remaining portions of the salt marsh in this area[5]. Roads also confine and divide the habitat in this area. Restoration of this stream, similar to what has already occurred at Shoal Bay, would improve water quality and provide rearing habitat for migrating salmonid that currently does not exist.

[5] Current mapping provided on map 7 still depicts a tide gate at this location.

Table 33A. Spencer Spit Management Area Reach Assessment – Physical Conditions.

Reach	Natural Sediment Transport Patterns	Shoreline Sediment Input Alterations - Feeder Bluffs	Shoreline Sediment Input Alterations - Pocket Beaches	Shoreline Sediment Input Alterations - Barrier Beaches	Natural Current Patterns	Wave & Current Attenuation	Nutrient and Toxics Removal	Shade	Total
126	3	4	NP	NP	5	4	1	3	20
127	5	5	NP	5	5	5	5	1	31
128	5	5	NP	NP	5	5	5	4	29
129	3	5	NP	4	0	4	3	2	21
130	5	0	NP	0	3	2	5	4	19
131	5	NP	NP	2	5	2	5	2	21
132	3	3	1	3	5	4	5	3	27
133	5	4	NP	0	1	3	5	3	21
134	5	NP	3	NP	3	4	5	4	24
Median	5.00	4.00	2.00	2.50	5.00	4.00	5.00	3.00	21.00
Average	4.33	3.71	2.00	2.33	3.56	3.67	4.33	2.89	23.67
Percent of Highest Possible Score	87%	74%	40%	47%	71%	73%	87%	58%	79%

NP = Not Present

Table 33B. Spencer Spit Management Area Reach Assessment – Habitat Conditions.

Reach	Vegetation Coverage	Estuary Habitat	Birds	Haul-out Habitat	Eelgrass	Floating Kelp	Understory Kelp	Spawning Habitat[1]	Herring Spawning Habitat	Shellfish	Total
126	5	2	1	0	5	0	5	0	0	4	22
127	5	3	0	0	5	0	5	3	0	4	25
128	5	1	0	0	0	0	5	0	0	4	15
129	5	2	1	0	5	0	5	0	0	2	20
130	5	1	1	0	5	0	5	0	0	3	20
131	4	0	0	0	5	0	5	0	5	3	22
132	5	1	0	0	5	0	5	0	5	3	24
133	3	1	0	0	5	0	5	3	5	1	23
134	5	3	0	0	5	5	5	3	5	3	34
Median	5.00	1.00	0.00	0.00	5.00	0.00	5.00	0.00	0.00	3.00	22.00
Average	4.67	1.56	0.33	0.00	4.44	0.56	5.00	1.00	2.22	3.00	22.78
Percent of Highest Possible Score	93%	31%	7%	0%	89%	11%	100%	20%	44%	60%	46%

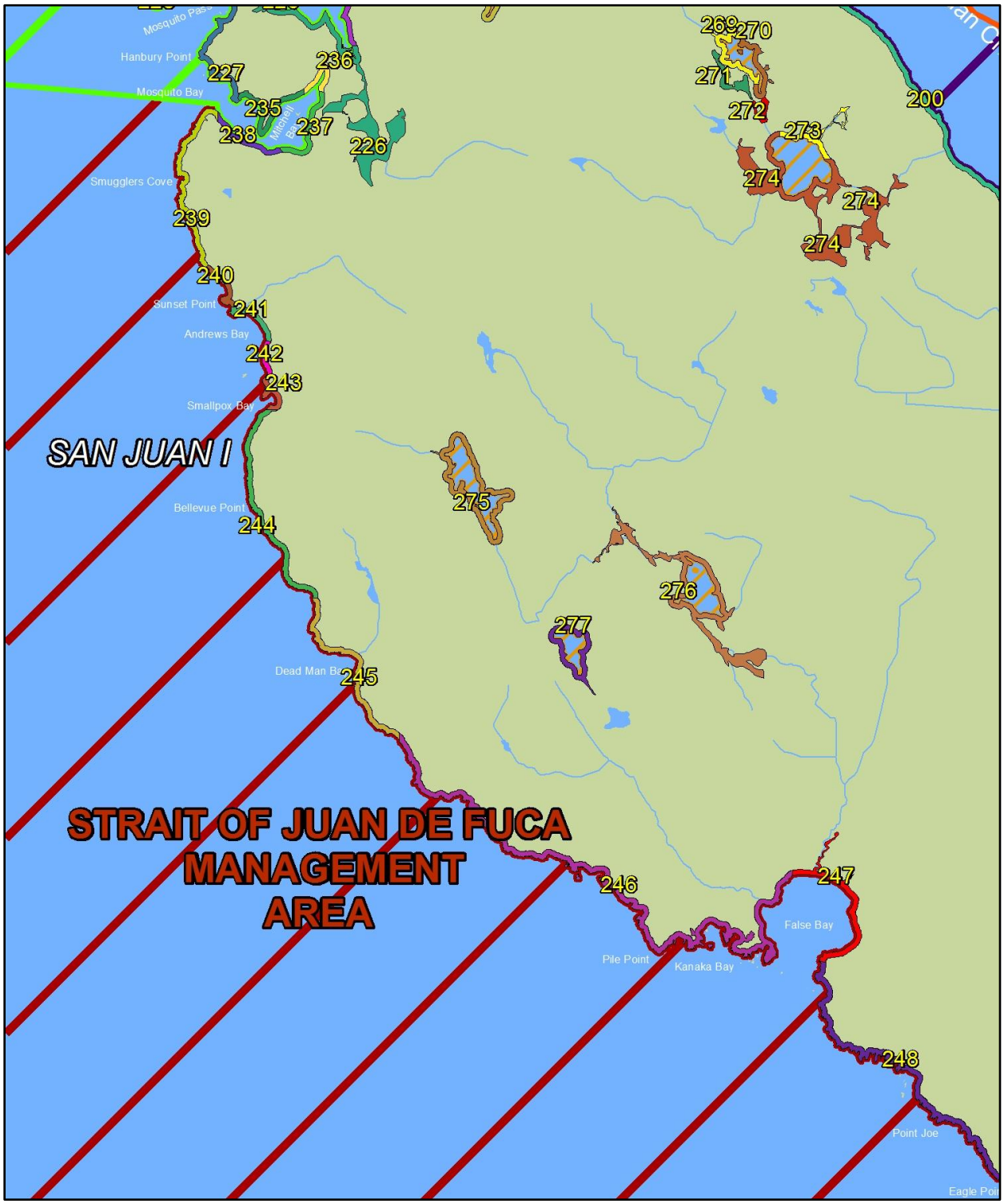
[1] Includes priority spawning habitat for sand lance, surf smelt, and rock sole.

4.14 Strait of Juan de Fuca Management Area

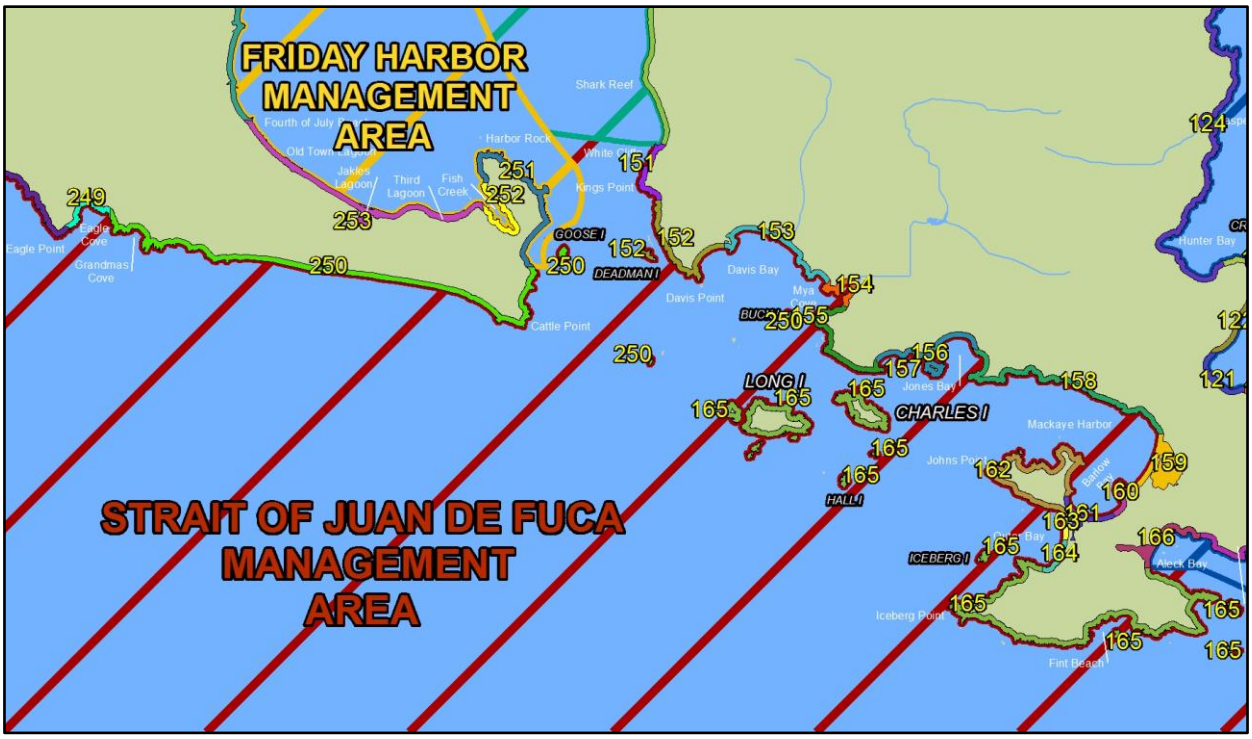
The Strait of Juan de Fuca management area is by far the largest management area in the County. It has over 57 miles of shoreline along the Strait of Juan de Fuca, primarily on southwest portion of Lopez Island and the southern shore of San Juan Island. It includes many rocky islets close to the San Juan and Lopez Island mainland, the largest of which are Charles Island and Long Island. It is bounded in the northwest by those shorelines that are protected by the Saanich Peninsula. To the southeast it is roughly divided where the shorelines become relatively protected by swell at the southeast end of Lopez Island. The management area is truncated on the southeast end of San Juan Island at Cattle Point, and it ends at the limit of bedrock on Lopez's western shore. There are no major transportation related uses in this management area, although MacKaye Harbor Road does run adjacent to the shoreline for more than a mile on southwestern Lopez Island.

Table 34 is a summary of the reach assessment for the Strait of Juan de Fuca management area. The table is in two parts, one covering general physical conditions, the other addressing those conditions directly related to habitat functions. The following discussions cover both the conditions scored in the reach assessment (Tables 34A and B) and management area results from the ecosystem-wide characterization. This management area is formed by the intense physical environment (frequent high wave energy), which may also preclude the kinds of activities that impair shorelines elsewhere in the County. Thus it is relatively free of structures that would impair sediment transport but there are outfalls and shoreline armoring that affect current patterns and wave and current attenuation. Habitat functions are highly variable within this management area.

Figure 25. Strait of Juan de Fuca Management Area.



Straight of Juan de Fuca Management Area – Detail 1



Straight of Juan de Fuca Management Area – Detail 2

4.14.1 Physical and Biological Characterization

Nearshore Physical Processes

The geology of the west shore of San Juan Island is dominated by bedrock, with numerous pocket beaches, where the bedrock is capable of producing beach sediment or where glacial sediments are present. The management area is heavily faulted, but unlike southern Orcas Island, where most faulting is likely relict from past geologic activity, it is unclear whether or not the faults along the Strait of Juan de Fuca management area are active. The southwestern end of Lopez Island is also heavily faulted, but possesses much more glacial drift than on San Juan Island. The glacial drift forms several large pocket beaches (e.g., Agate Beach) that are isolated from one another and which have formed tombolos in many places throughout the management area. Because of the relatively high energy and isolated sediment sources, the beaches in the management area do not fit neatly to standard conceptions of drift cells. Transport is influenced much more by cross-shore processes, nearshore circulation and the interaction of surf with swash typical of exposed coastal settings (Komar 1996). As a result, these shorelines have a tendency to be sandier and shallowly sloped than shorelines elsewhere in Puget Sound (Finlayson 2006).

Given the size of the management area, there are only three mapped drift cells. Two of these cells converge at the head of False Bay, along another separate long drift cell in the National Park near Cattle Point on San Juan Island. There are no mapped drift cells in this management area on Lopez Island.

The wave environment in this management area is fundamentally different than in the rest of the County. This management area is exposed to swell (waves originating from the Northeast Pacific Ocean, which makes it much more like the outer coast of Washington than Puget Sound and the rest of the County, which is relatively protected from these waves. Because swell has much a larger height and period than locally sourced wind-waves, a surf zone, albeit small, can be formed in places (e.g., Agate Beach: Herrera [2009a]). Tidal currents are extremely intense (greater than 2.5 knots) in places in the management area, but they are particularly strong along the southern shore of San Juan Island and the promontories of southern Lopez Island.

Geologic Hazards

The Strait of Juan de Fuca management area is by far the most geologically hazardous area in the County. The risk is so significant (and unique) to this management area, it is recommended that the County assemble a plan to address these risks. The principal risk is that the management area is only a few miles from the Southern Whidbey Island Fault, which has been documented to have generated large earthquakes in the recent geologic past (Johnson et al. 1996; Williams et al. 2005). In addition to the destruction possible from the earthquake, a slip of this fault would likely produce a large tsunami (many feet in height) and destroy of much of the infrastructure that sits only slightly above MHHW in the management area. A slip of the Devils Mountain Fault would induce similar damage to the south shore of Lopez Island, but its effects would likely be much more localized. There are several smaller faults that have also been mapped throughout the management area (Whetten et al. 1988; Schasse 2003) that could slip along with the Southern Whidbey Island or Devils Mountain Fault, or move independently due to loading from other ambient seismicity.

In addition to tsunamis generated locally, there is a significant risk of a large tsunami generated by a slip of the Cascadia Subduction Zone. While most of the rest of the County would see moderate-sized waves that would be scattered by the rest of the archipelago, the Strait of Juan de Fuca management area would likely see significant wave heights (again, on the order of many feet). It is nearly certain that the tsunamis that generated sand deposits observed in Discovery Bay from the slips of the Cascadia Subduction Zone (Williams et al. 2005), similarly affected this management area, which has many regions that are generally less protected from tsunamis than Discovery Bay. In fact, water level variability, experienced in some places in this management area from the 2011 Japan tsunami, was likely similar to what was observed in Neah Bay (i.e., in excess of 2 feet: NOAA 2011). And, as everywhere in the County, there is a slight risk of landslide-generated tsunami. In this case, this landslide could originate anywhere on the northern shore of the Olympia Peninsula between the Elwha River delta to Admiralty Inlet, or from the Saanich Peninsula on Vancouver island.

In addition to seismic and tsunami risks, there are also landslide and liquefaction risks, but these are minor in comparison. Liquefaction is possible in the marshes associated with False Bay and MacKaye Harbor and in the glacial sediments near Cattle Point. Landslides are possible in many of the pocket beach settings throughout the management area. Landslides have been documented in the glacial sediments near Cattle Point.

Streams and Associated Wetlands

There are many large streams in this management area. Two of the largest streams discharge to False Bay. The largest stream, False Bay Creek, is extensively ditched in its lowest reaches. In addition, instream flows in False Bay Creek are affected by water withdrawals from Trout Lake, and by impoundments and water withdrawals by adjacent landowners. Impaired instream flows exacerbate water quality issues in False Bay Creek. Aside from these two large streams, there are seven other small streams that drain from San Juan Island in this management area. There are also three small ditched streams that discharge to MacKaye Harbor and Barlow Bay. All of these streams are controlled with tide gates.

In addition to the streams, there are two large, heavily altered, marsh complexes. False Bay is fringed by land that has been ditched and drained. While some wetland areas remain, it was likely a much larger marsh prior to development. At MacKaye Harbor, a large interconnected marsh in glacial drift that connected Aleck Bay, Outer Bay, and MacKaye Harbor has been ditched, drained, and filled. Intact marsh sections remain, but the system is largely fragmented and much smaller than what was present prior to development.

Critical or Priority Habitat and Species Use

Documented priority fish spawning areas in this management area are in False Bay near the mouth of False Bay Creek, where sand lance spawning has been documented, and north of Cattle Point at the entrance to San Juan Channel. There are also several documented priority fish spawning beaches between MacKaye Harbor and Outer Bay on Lopez Island. MacKaye Harbor also contains the only documented rock sole spawning beach in San Juan County, making this a unique area (although not yet documented, rock sole spawning also likely occurs at other County beaches). Pacific herring spawning habitat is documented near Smuggler's Cove on San Juan Island (reach 239). The rocky headlands common in this management area are also suitable habitat for rockfish.

Shellfish are documented in every reach and False Bay provides conditions suitable for Dungeness crab. Eelgrass is found in virtually all reaches as is floating kelp and understory kelp. in fact, the outer (western) coast of San Juan Island is mostly characterized by kelp forests. Eelgrass distribution is mostly limited to areas at the entrance of False Bay (a documented priority wetland), the shoreline from Eagle Cove to Cattle Point, and the vicinity of Sunset Point and Andrews Bay. Small isolated patches also occur in areas along the shoreline between Andrews Bay and False Bay, and in small embayments of Lopez Island.

Haul-out habitat is found at Kanaka Bay and near Cattle Point on San Juan, and near Davis Point and Iceberg Point on Lopez Island. The small islands and rocks along the southern shoreline of Lopez Island provide significant habitat for seabirds, likely due in part to the presence of fish and the foraging opportunities they provide for birds and other species. Seabirds are common among the small islands and rocks near David Bay and MacKaye Harbor off Lopez Island, as well as isolated locations along the western shoreline of San Juan Island. Bald eagles are also attracted to these areas. Along the San Juan Island shoreline, bald eagles are likely to use habitat associated with plunging rock shorelines near Dead Man Bay and pocket beaches around False Bay.

Marine Riparian, Nearshore, and Estuarine Habitats

Estuarine habitat is somewhat patchy throughout the management area but is generally present in Davis Bay, MacKaye Harbor, and Outer Bay of Lopez Island. Shoreline vegetation coverage is generally poor throughout the management area but most reaches have fairly intact vegetation coverage in the shoreline jurisdiction.

Water Quality, Sediment, and/or Tissue Sample Results

Ambient water quality monitoring conducted by the Department of Ecology (2011e) showed regular exceedances of dissolved oxygen criteria in the Strait of Juan de Fuca management area. These exceedances were attributed to natural upwelling of low dissolved oxygen marine water and to anthropogenic activities. One water sample was collected from False Bay lagoon, which exhibited elevated fecal coliform bacteria concentrations and elevated water temperatures (SJC 2000). In addition, water quality data have been collected at False Bay Creek near its confluence with False Bay; chronically high fecal coliform bacteria concentrations, high temperatures, chronically low dissolved oxygen concentrations, high nutrients, and high turbidity were observed (Wiseman et al. 2000). Additional water quality studies have shown elevated fecal coliform bacteria concentrations, high temperatures, and high turbidity in False Bay Creek (SJC 2000; SJCD 2005). Water quality samples were also collected from two streams at Lopez Island that discharge to Davis Bay and Mya Cove, both of which contained high fecal coliform bacteria and low dissolved oxygen concentrations (Wiseman et al. 2000).

One sediment sample was also collected from MacKaye Harbor that exceeded the Sediment Management Standards SQS bioassay criterion; sediment in this area is classified as Category 2 "Sediments of Concern" (Ecology 2011e).

4.14.2 Shoreline Use Patterns

Existing Land and Shoreline Use

Land Use

The Strait of Juan de Fuca management area extends from the south side of Mitchell Bay to Cattle Point on San Juan Island, and then extends from Kings Point to Aleck Bay on Lopez Island. This management area also includes the smaller islands of Goose, Deadman, Buick, Long, Charles, Hall, and Iceberg.

Overall existing land use in the Strait of Juan de Fuca management area includes:

- Residential – 58 percent
- Services – 8 percent
- Cultural, Entertainment, Recreation – 13 percent
- Undeveloped Land – 22 percent

Existing land uses on the San Juan Island portion of the management area are predominantly residential to Deadman Bay, with the exceptions of cultural/recreation land uses at Smallpox and Deadman Bay (County and State parks), and a resource use at Deadman Bay as well. Between Deadman Bay and Pile Point is another predominantly residential area with some large vacant

lots mixed in. The area around Pile Point and the west side of False Bay includes some large conservation properties with a small residential area located on the southwest corner of False Bay. The remainder of False Bay includes residential, resource, government/education, and vacant land uses. Approximately 200 acres of tidelands and uplands within False Bay are owned by the University of Washington Friday Harbor Laboratories and managed as part of the False Bay Marine Preserve. The southeast side of False Bay is owned by the Mar Vista Resort. Between False Bay and Point Joe is an area with a large amount of cultural/recreation, resource, and conservation uses. Between Point Joe and Eagle Cover is a largely residential area with some conservation and cultural/recreation uses mixed in. Residential lots are larger near Point Joe, and relatively smaller for the designated Residential Rural Farm land use district near Eagle Cove. East of Eagle Cover to Cattle Point, the majority of the shoreline jurisdiction is cultural/recreation, with a government/education land use at Cattle Point.

Kings Point south to Davis Point on Lopez Island consists of residential, government/education, and conservation land uses. Most of the area between David Bay and Jones Bay consists of smaller lot residential development, with some large vacant and resource parcels mixed in. MacKaye Harbor to Outer Bay continues a pattern of largely residential land uses with small amount of vacant, conservation, and cultural/recreation uses mixed in. A wetland at the east side of MacKaye Harbor that could extend the shoreline jurisdiction in this location exists in a largely developed residential area. A large government/education land use extends from the south side of Outer Bay to the west side of Fint Beach. Existing uses between Fint Beach and Aleck Bay consist of conservation and unclassified uses, while the south side of Aleck Bay is residential.

Goose, Long, and Charles islands are residential. Buck, Hall, Iceberg, and Deadman islands are undeveloped Federal land.

Tidelands are a mix of state-owned aquatic lands and private ownership with the majority being state-owned aquatic lands.

Water-dependent uses in this management area consist of marinas, docks, piers, and marine railways, many of which are private. Two public marine facilities exist in this management area: one at Smallpox Bay on San Juan Island, and one at MacKaye Harbor on Lopez Island. Another water-dependent use is lighthouses. In this management area, these are located at Lime Kiln State Park and Cattle Point on San Juan Island. Water enjoyment uses consist of Lime Kiln State Park, American Camp unit of the San Juan National Park (south side), and County Parks, and several hotel/lodging facilities, such as bed and breakfasts that are mixed in with existing residential development in places along this management area.

Land Use Designations

Comprehensive Plan land use designations from the beginning of this management area on the south side of Mosquito Bay to Smallpox Bay are Rural Residential. Smallpox Bay itself is designated Conservancy (County Park). Between Smallpox Bay and Kanaka Bay, land use designations include a mix of Rural Residential in areas with smaller lot residential development, Rural Farm Forest and Conservancy (including Lime Kiln State Park) in areas with larger lot residential and/or state park, conservation, or resource lands. There is a small area between

Kanaka Bay and the west side of False Bay designated Rural Residential with small lot residential development. The remaining shoreline jurisdiction in False Bay is mostly Rural Farm Forest with some Natural and Agricultural Resource on the north side of the bay. Between False Bay and American Camp National Park land, Comprehensive Plan land use designations include a mix of Rural Farm Forest, Agricultural Resource, and Residential Rural (at Eagle Cove). The American Camp National Park shoreline jurisdiction is designated Conservancy and this designation extends to the end of this management area on San Juan Island.

Comprehensive Plan land use designations from Kings Point to Davis Bay are Rural Farm Forest with one large lot designated Natural where a San Juan County Park exists. Davis Bay from Davis Point to Mya Cove is made up of Rural Farm Forest and Agricultural Resource Comprehensive Plan land use designations. The south side of Mya Cove is designated Rural Residential and extends part way to Jones Bay before changing to Rural Farm Forest. The north side of Jones Bay also includes a small area of Agricultural Resource designation. Jones Bay to the north side of MacKaye Harbor is Rural Farm Forest. The smaller lot residential areas on the north and east sides of MacKaye Harbor are Rural Residential, as is the Johns Point peninsula on the south. The remainder of MacKaye Harbor is designated Rural Farm Forest. The remainder of this management area between south side of Jones Point peninsula and Aleck Bay includes a mixture of Rural Farm Forest, Conservation, and Natural designations. The Federal property at Iceberg Point is designated Natural.

Goose, Deadman, Buck, Iceberg, and some of the smaller islets near Long Island are designated Natural, while Long and Charles islands are designated Conservancy.

Shoreline Environment Designations

This management area starts on the south side of Mosquito Bay on San Juan Island where a small area of Conservancy/Natural environment is applied. The shoreline south of here to Smallpox Bay is Rural Residential. Smallpox Bay itself is designated Rural, and south of it, the shoreline environment designation changes to Conservancy until Lime Kiln State Park. Lime Kiln is characterized by Conservancy/Natural, Conservancy, and Natural shoreline environments. South of the park to about Pile Point, shoreline environment designations alternate between Conservancy/Natural, Conservancy, Residential Rural, and Conservancy again. Shoreline environment designations from Pile Point to Point Joe are generally Rural Farm-Forest or Rural Farm-Forest/Natural. Exceptions to this rule include Rural Residential in a small developed area between Kanaka Bay and False Bay, and a Natural-designated area on the north side of False Bay. Point Joe to Eagle Point is designated Conservancy/Natural, and Eagle Cove is designated Rural Residential. The remainder of the management area on San Juan Island consists of Conservancy and Natural designated areas along government-owned shoreline. The Lopez Island portion of this management area is predominantly designated with a Conservancy environment designation with the following exceptions. The Shark Reef Sanctuary County Park and the area around Iceberg Point area designated Natural, a small area on the north side of Davis Bay is designated Rural Residential, areas on both sides of Jones Bay are designated Rural Residential with two very small areas designated Urban and Rural west of Jones Bay, and areas of Residential Farm-Forest at MacKaye Harbor and Outer Bay.

Shoreline Modifications

Only 1.9 percent of the Strait of Juan de Fuca management area has been armored. Armoring is heavily concentrated in a few locales: False Bay, Outer Bay (Agate Beach), and MacKaye Harbor. The armoring in MacKaye Harbor and Agate Beach is primarily associated with roadways. There are also relatively few overwater structures (17) given the size of the management area. It is likely that this is because of the large expense of engineering structures capable (structurally) of sustaining large forces, in light of the more energetic wave environment. Mooring buoys are also rare (only 59), considering the size of the management area. However, there are two marine railways, four boat ramps, a marina, a groin and two breakwater/jetties.

Existing and Potential Public Access Areas

The Strait of Juan de Fuca management area has over 57 miles of shorelines.

Existing Facilities

- Deadman Bay Preserve provides access to 1,600 feet of shoreline south of Limekiln Point State Park as well as views across Puget Sound to Vancouver Island and the Olympic Mountains.

- Hunt Conservation Easement protects shoreline at Cattle Pass, which is visible from griffin Bay and the south shore of Lopez Island. This property has many unique characteristics that make it suitable for unique plants and a variety of animals.

- Johnson Conservation Easement property abuts Iceberg Point and protects 660 feet of shoreline on Outer Bay.

- Limekiln Preserve and Westside Preserve property abuts Deadman Bay and Limekiln Point State Park. This property has ecological, scenic and public access values.

- MacKaye Harbor dock includes a boat ramp, small dock head, and 60-foot floating dinghy dock as well as the associated parking areas for the facilities.

- Richardson Street ends at an old fuel dock with storage tanks. The road end provides a view of MacKay Harbor.

Existing Facilities with Potential for Improvement

A wide variety of public access opportunities, including nearly 20,000 feet of trails and paths and the following parks, preserves, and road ends:

- San Juan County Park is a 12-acre park on Smallpox Bay. The park and campground are popular with kayakers and other boaters. There is a concrete ramp, parking, flush toilets and day use picnic amenities. Parks

Plan contains several recommendations related to opportunities for improvement at this park, including: development of a master plan; preservation activities for the historic cabin on site; installation of dumpster; renovation of shelter; acquisition of adjacent land; and renovation of office and residence. The Plan also recommends implementing an environmental education program to take advantage of high visitor use.

- Agate Beach County Park is a 4-acre day use park with nearly 600 feet of wide, gravely beach. The Parks Plan recommends the following improvements for this park: develop site master plan; add culvert or bridge over southern trail entrance; replace toilet; upgrade parking; replace staircase and signs; install ADA accessible picnic tables and associated pathway.
- Eagle Cove County Park is another day use park that provides water access via a 250-yard walking trail as well as parking for 6 cars. The Parks Plan includes the following recommendations for this park: install entry and way finding signage; install stairs leading to beach; improve beach access.
- Shark Reef Sanctuary is a 40-acre site previously owned by DNR, but transferred to the County in 2005. The site contains a trail through the forest to a bluff with views of a large seal rookery. Currently, the site does not provide ADA access. The Parks Plan recommends the following: replace toilets for ADA compliance; conduct trail and shoreline restoration; and install interpretive signs.
- False Bay Road end provides access via an unimproved path to the University of Washington Biological Preserve and False Bay Tidelands.

This management area has a diverse supply of public access options. Continued investment in the maintenance and enhancement of the existing access sites will implement the goals and policies of the Comprehensive Plan as well as the goals, strategies and action items in the Parks Plan.

4.14.3 Restoration Opportunities

Because of the intensity of physical processes along the shoreline, there are not many restoration opportunities. However, most of the shoreline modifications are concentrated in a few places and these can be improved. Conceptual engineering design has been completed to replace the large riprap bulkhead at Agate Beach Road with nourishment and engineered large wood debris. In addition, restoration of the marsh complex at the head of False Bay and the mouth of False Bay Creek would have significant habitat benefits. Currently False Bay Creek is ditched and the water quality of the bay is severely impaired providing additional restoration opportunities that would benefit habitat conditions. A series of interrelated restoration actions have also been proposed and analyzed for MacKaye Harbor (Coastal Geologic Services 2009).

Table 34A. Strait of Juan de Fuca Management Area Reach Assessment – Physical Conditions.

Reach	Natural Sediment Transport Patterns	Shoreline Sediment Input Alterations - Feeder Bluffs	Shoreline Sediment Input Alterations - Pocket Beaches	Shoreline Sediment Input Alterations - Barrier Beaches	Natural Current Patterns	Wave & Current Attenuation	Nutrient and Toxics Removal	Shade	Total
151	5	5	5	NP	5	5	5	4	34
152	5	NP	5	NP	5	5	5	1	26
153	5	NP	4	NP	5	4	5	2	25
154	5	NP	5	NP	5	4	5	3	27
155	5	NP	5	NP	5	5	5	3	28
156	5	NP	3	NP	5	4	5	2	24
157	5	NP	NP	NP	5	5	5	0	20
158	3	NP	1	NP	3	4	3	3	17
159	5	NP	5	NP	1	4	3	1	19
160	5	NP	4	NP	5	4	3	4	25
161	5	NP	0	NP	0	2	3	1	11
162	5	NP	4	NP	5	4	3	3	24
163	5	NP	1	NP	3	3	5	0	17
164	5	NP	1	NP	2	3	5	3	19
165	5	NP	4	NP	5	4	5	2	25
239	5	NP	3	NP	5	4	5	4	26
240	5	NP	3	NP	3	4	5	3	23
241	5	NP	5	NP	5	4	5	2	26
242	5	NP	5	NP	5	5	5	4	29
243	5	NP	3	NP	2	4	5	4	23
244	5	NP	5	NP	5	5	5	4	29
245	5	NP	5	NP	2	5	5	3	25
246	5	5	4	NP	5	4	5	2	30

247	5	4	NP	NP	2	4	0	2	17
248	5	NP	5	NP	5	5	5	1	26
249	5	NP	5	NP	5	5	5	0	25
250	5	5	5	NP	3	5	5	1	29
Median	5.00	5.00	4.00		5.00	4.00	5.00	2.00	25.00
Average	4.93	4.75	3.80		3.93	4.22	4.44	2.30	24.04
Percent of Highest Possible Score	99%	95%	76%	0%	79%	84%	89%	46%	60%

NP = Not Present

Table 34B. Strait of Juan de Fuca Management Area Reach Assessment – Habitat Conditions.

Reach	Vegetation Coverage	Estuary Habitat	Birds	Haul-out Habitat	Eelgrass	Floating Kelp	Understory Kelp	Spawning Habitat[1]	Herring Spawning Habitat	Shellfish	Total
151	5	0	2	0	5	5	5	0	0	2	24
152	5	1	0	5	5	5	5	0	0	2	28
153	5	2	0	0	5	5	5	0	0	2	24
154	5	3	1	0	5	0	0	0	0	2	16
155	5	0	0	0	5	5	5	0	0	2	22
156	4	0	0	0	5	0	5	0	0	2	16
157	5	0	1	0	5	0	5	0	0	2	18
158	5	0	1	0	5	5	5	3	0	2	26
159	4	0	0	0	0	0	5	5	0	2	16
160	4	1	2	0	5	0	0	5	0	2	19
161	4	0	1	0	5	0	0	5	0	2	17
162	5	1	0	0	5	5	5	3	0	2	26
163	5	0	0	0	0	0	0	3	0	2	10
164	5	2	0	0	0	0	5	3	0	2	17
165	5	5	0	5	5	5	5	0	0	3	33
239	5	1	3	0	5	5	5	0	5	2	31
240	4	0	0	0	5	5	5	0	0	3	22
241	4	0	1	0	5	5	5	0	0	2	22
242	5	0	1	0	5	5	5	0	0	2	23
243	4	0	1	0	5	5	5	0	0	2	22
244	5	0	0	0	5	5	5	0	0	2	22
245	4	0	3	0	5	5	5	0	0	2	24
246	5	2	0	5	5	5	5	0	0	4	31
247	4	3	0	0	5	0	5	3	0	3	23
248	3	3	0	5	5	5	5	0	0	3	29

249	1	0	0	0	5	5	5	0	0	2	18
250	3	1	0	5	5	5	5	5	0	2	31
Median	5.00	0.00	0.00	0.00	5.00	5.00	5.00	0.00	0.00	2.00	22.00
Average	4.37	0.93	0.63	0.93	4.44	3.33	4.26	1.30	0.19	2.22	22.59
Percent of Highest Possible Score	87%	19%	13%	19%	89%	67%	85%	26%	4%	44%	45%

[1] Includes priority spawning habitat for sand lance, surf smelt, and rock sole.

4.15 Stuart Island Management Area

The Stuart Island management area includes all of Stuart Island and a collection of smaller islands that form a mini-archipelago bounded by Haro Strait to the west and north and Spieden Island to the south. The Stuart Island management area could be thought of as extension of the Gulf Islands, as they have more similarity to them in terms of lithology, climate and physical environment. Spieden Island, Johns Island, and Satellite Island are the three largest islands aside from Stuart Island in this management area. Only Johns Island has permanent year-round residents. There are numerous smaller, named islands in this management area, but they are largely uninhabited. The airport on Stuart island is on former marshland that encroaches on the shoreline both in Prevost Harbor and Johns Pass.

Table 35 is a summary of the reach assessment for the Stuart Island management area. The table is in two parts, one covering general physical conditions, the other addressing those conditions directly related to habitat functions. The following discussions cover both the conditions scored in the reach assessment (Tables 35A and B) and management area results from the ecosystem-wide characterization. Many reaches in this management area are undeveloped and these are generally high functioning both physically and for providing habitat. A number of reaches are short and thus one or two developments can substantially affect their score.

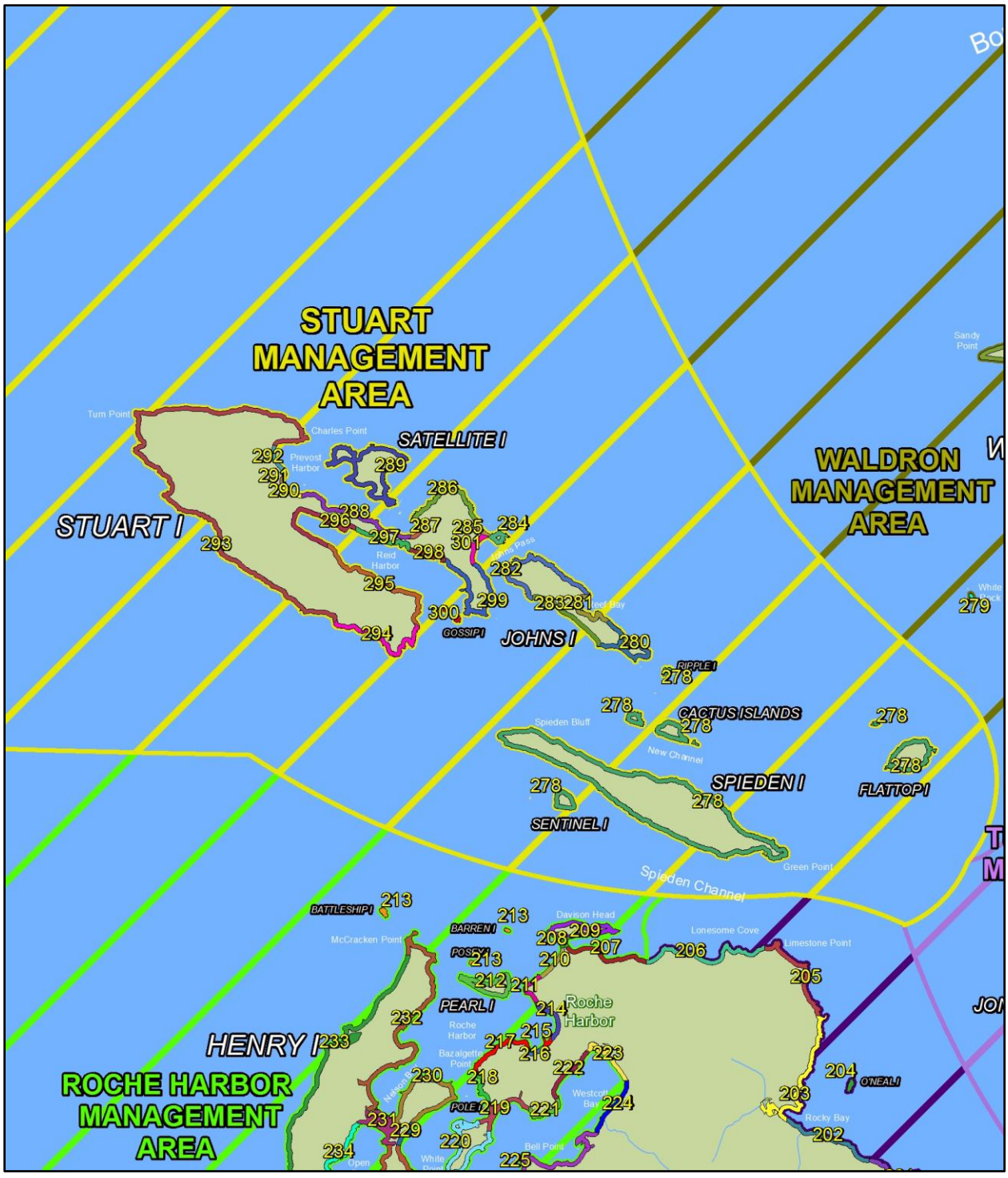


Figure 26. Stuart Island Management Area.

4.15.1 Physical and Biological Characterization

Nearshore Physical Processes

Stuart Island and the small islands are comprised primarily of marine sedimentary rock. This rock is somewhat more lithified (hard, resistant to erosion) than elsewhere (such as found on Shaw Island). As result the shoreline can be bare and steep in places. Bedrock walls dominate the western end of Stuart Island near a sharp turn in Haro Strait. Beaches, where they occur, are largely pocket beaches on the north sides of the islands, where wave energy is less than on the more exposed, less developed southern side of the island. The beach material is eroded bedrock.

The mapped drift cells in the Stuart Island management area are mostly converging drift cells associated with the heads of the major embayments (including Reid Harbor, Prevost Harbor, and Johns Pass). There is also a drift along the south shore of Johns Island.

Wave energy is relatively significant throughout the management area owing to the presence of Haro Strait. However, the management area is largely protected from swell (by the Saanich Peninsula in British Columbia and by San Juan Island to the southeast), so the waves are primarily locally sourced. The management area is exposed to significant tidal energy and it is not uncommon for currents in excess of 2.5 knots to occur along any one of the more exposed shorelines in the management area (Canadian Hydrographic Service 2010). Vessel wakes are also significant because Haro Strait surrounds the management area and is the main shipping channel for Vancouver and the Strait of Georgia.

Geologic Hazards

While steep slopes are common, there are no mapped landslides in this management area, principally because the bedrock that defines these steep slopes is very competent. Liquefaction is only an issue in flat wetland areas where sediment has accumulated, particularly near the airport. While it is possible that tsunamis originating from the Strait of Juan de Fuca and the open ocean could reach Stuart Island, it is likely that they would be greatly diminished owing to the protection of surrounding land. Even tsunamis from the Strait of Georgia would be diminished from protection by the Gulf Islands. The most significant tsunami threat is from large failures on the large islands that surround the management area.

Streams and Associated Wetlands

There are no mapped streams or lakes in this management area. Wetlands, where they exist are confined to steep valleys in the bedrock that define the islands. They are generally not associated with marine shorelines, except for where they are separated from marine waters by a pocket beach. The tombolo on the Stuart Island mainland at Johns Pass appears to have an associated marsh complex that has been extensively ditched (based on aerial photographic interpretation, although neither the wetland nor the ditch appears in County data.

Critical or Priority Habitat and Species Use

Bedrock walls that form the cliffs and bluffs are a priority habitat in this management area. Diverse conditions allow for a mixture of eelgrass habitat (throughout Prevost Harbor, parts of Reid Harbor, and across shorelines of Stuart and Johns islands), as well as floating kelp that

occur around Spieden, Sentinel, and Cactus islands, and intermittently around all of the main islands. Understory kelp is fairly continuous in this management area and found within all reaches. The only documented priority fish spawning area is located near the outlet to Reid Harbor. Shellfish are documented in every reach, with many having three or four species present. Haul-out habitat is documented on Spieden Island, the south shore of Prevost Harbor, and near John's Pass.

These habitats provide opportunities for nesting and foraging by bald eagles, peregrine falcons, black oystercatchers, and seabird colonies that are common throughout the area. These species also use the smaller islands in the southeast portion of the management area, such as Sentinel Island, Cactus Islands, and Flattop Island, where harbor seal haul-outs are also common. Relatively small patches of substrate throughout the area provide suitable habitat for subtidal clams, while the larger estuarine-like habitat in Reid Harbor likely supports Dungeness crab and clams. Most of this management area has suitable habitat for rockfish, with exception of some of the marshy embayments.

Marine Riparian, Nearshore, and Estuarine Habitats

Estuarine habitat is patchy in distribution, and includes areas of Reid Harbor, Prevost Harbor, and small pockets near Johns Pass, and the northern shoreline of Johns Island. Although the uplands within the shoreline jurisdiction are generally well vegetated and largely undisturbed, the shoreline in many reaches has significant areas lacking vegetation suitable for shading the nearshore.

Water Quality, Sediment, and/or Tissue Sample Results

In general, water quality is largely unknown in this management area. One sediment sample was collected in Prevost Harbor that exceeded the Sediment Management Standards SQS bioassay criterion; sediment in this area is listed as a Category 2 "Sediments of Concern" (Ecology 2011e).

4.15.2 Shoreline Use Patterns

Existing Land and Shoreline Use

Land Use

The Stuart Island management area includes Stuart, Spieden, Satellite, Johns, Cactus, and Flattop islands with several smaller islands interspersed. Stuart Island, the largest in this management area, is characterized by a mix of resource, residential, vacant, and cultural/recreation land uses. The northwestern portion of Stuart Island is dominated by a mix of resource, cultural/recreation, and vacant land uses, while residential land uses dominate the remainder of the island's shoreline jurisdiction. Stuart Island State Park with locations on Prevost/Reid Harbors, and at Turn Point makes up the cultural/recreation existing land use on Stuart Island. There are also two airstrips on Stuart Island. Of the other islands in this management area, only Johns and the westernmost of the two Cactus Islands also have residential land uses in shoreline jurisdiction. The remainder of the islands in this management area are in recreation or conservation land uses.

Overall, current land uses in the Stuart Island management area are as follows:

- Residential – 28 percent
- Cultural, Entertainment, Recreation – 24 percent
- Undeveloped Land – 48 percent

Additional shoreline uses include a DNR utility easement. The majority of tidelands are state-owned aquatic lands.

Water-oriented uses in this management area consist of water-dependent marine facilities, including public marine facilities at Prevost and Reid harbors associated with Stuart Island State Park, private and community docks on the east side of Stuart Island, Johns Island, the Cactus Islands, and Spieden Island. Another water-dependent use is the lighthouse facility at Turn Point on Stuart Island. Water enjoyment uses consist of Stuart Island State Park, and Satellite Island, which is used by a YMCA camp organization. The point southwest of Reid Harbor annually supports a reef net fishery.

Land Use Designations

Similar to other management areas, Comprehensive Plan land use districts generally reflect existing land use patterns. The eastern portion of Stuart Island is designated Rural Residential, while the middle portion of Stuart Island, including nearby Satellite Island, is designated Conservancy, and the western portion of the island is designated Rural Farm Forest (with the exception of the western edge of Stuart Island, which is designated Natural). The small islands to the southeast of Stuart Island, such as Gossip Island, are designated Natural. The western portion of Johns Island is designated Rural Farm Forest, reflecting the larger lot residential and conservation land uses that exist in that part of the island, and the eastern portion of Johns Island is designated Rural Residential, reflecting its existing developed residential character. Of the remaining islands in the Stuart Island management area, Spieden Island is designated Conservancy, while the remainder of the smaller islands are designated Natural.

Shoreline Environment Designations

The majority of Stuart Island is in the Conservancy environment with smaller amounts of Rural Farm-Forest and Natural shoreline environment designations. The Natural environment designation is applied to Turn Point, part of the Stuart Island State Park owned by the Bureau of Land Management (BLM). Rural Farm-Forest environment designation is applied on both sides of Reid Harbor outside of the Stuart Island State Park land, and in a small are on the western side of Prevost Harbor. Johns Island also has multiple shoreline environments applied to it. The western portion of Johns Island is designated Conservancy, A small portion of the shoreline on the north side of the island west of Reef Bay is designated Natural, the mostly developed middle portion of Johns Island is designated Rural Farm-Forest, and the east side of the island is in Conservancy. Of the smaller island, Satellite and Spieden islands are designated Conservancy environment, and the remainder are designated Natural.

Shoreline Modifications

The Stuart Island management area is the least armored management area in the County when expressed as a percentage total shoreline. Less than 1 percent of the management area is

armored. However, most of the armoring occurs on the pocket beaches that fringe Stuart Island. The bedrock outcrops are extremely common and rarely armored, although this does occasionally occur near the transition to sandier areas. If the percentage of armoring would be expressed in terms of pocket beach area only, the percentage of armoring would be significantly larger.

There are 31 overwater structures, which are mostly docks, piers and floats. In addition to the docks and piers, there are five boat ramps, a groin and two marinas. The average footprint of these overwater structures is larger than most other management areas. Most of the mooring buoys are in Reid Harbor and in between Satellite Island and Stuart Island at the southeast end of Prevost Harbor.

Existing and Potential Public Access Areas

Stuart Island management area has approximately 748 acres of shoreline jurisdiction. Public access in the Stuart Island management area is limited to the boat ramp at the west end of Reid Harbor and Stuart Dock located in Prevost Harbor. Stuart Island State Park is part of the Cascadia Marine Trail and offers camping and moorage at Reed and Prevost harbors (Washington State Parks and Recreation Commission 2010). Turn Point lighthouse is located on federally owned land at the northwest edge of the management area. Portions of Stuart Island shoreline are owned by the Washington State Parks Parks and Recreation Commission and some of the smaller islands (such as Flattop and Sentinel) are USFWS National Wildlife Preserves and contribute to shoreline views and aesthetics for the area. Currently trail boat launch and campground facilities exist in shoreline jurisdiction.

Neither the San Juan County Parks, Trails, and Natural Areas Plan nor the Land Use Element of the Comprehensive Plan include recommended actions specific to expanding or enhancing public access in the Stuart Island management area.

4.15.3 Restoration Opportunities

The management area has large undeveloped areas, making restoration opportunities sparse. However, the tombolo at Johns Pass on the Stuart Island mainland has a former marsh complex that has been heavily disturbed by ditch installation and possibly fill. Because development is sparse and is not constraining this area, it should be possible to restore natural function to these marshes.

Table 35A. Stuart Island Management Area Reach Assessment – Physical Conditions.

Reach	Natural Sediment Transport Patterns	Shoreline Sediment Input Alterations - Feeder Bluffs	Shoreline Sediment Input Alterations - Pocket Beaches	Shoreline Sediment Input Alterations - Barrier Beaches	Natural Current Patterns	Wave & Current Attenuation	Nutrient and Toxics Removal	Shade	Total
278	5	NP	5	NP	5	5	5	3	28
280	5	NP	5	NP	5	5	5	2	27
281	5	NP	4	NP	5	4	5	3	26
282	5	NP	5	NP	5	5	5	3	28
283	3	5	NP	NP	5	4	5	2	24
284	5	NP	5	NP	5	4	5	3	27
285	5	NP	2	NP	5	3	5	2	22
286	5	NP	5	NP	5	5	3	4	27
287	5	5	NP	NP	5	4	3	3	25
288	5	5	NP	NP	5	5	3	5	28
289	5	NP	5	NP	5	5	3	3	26
290	5	5	NP	NP	5	4	3	2	24
291	5	NP	NP	NP	5	5	3	5	23
292	5	5	NP	NP	5	4	3	3	25
293	5	NP	5	NP	5	4	3	3	25
294	5	NP	5	NP	5	5	5	2	27
295	5	NP	5	NP	5	5	5	5	30
296	5	NP	NP	NP	5	5	5	4	24
297	5	NP	NP	NP	5	5	5	2	22
298	5	NP	0	NP	5	4	5	1	20
299	5	NP	3	5	5	4	5	3	30

300	5	NP	NP	NP	5	5	5	0	20
301	5	NP	NP	4	5	4	5	1	24
Median	5.00	5.00	5.00	4.50	5.00	5.00	5.00	3.00	25.00
Average	4.91	5.00	4.15	4.50	5.00	4.48	4.30	2.78	25.30
Percent of Highest Possible Score	98%	100%	83%	90%	100%	90%	86%	56%	63%

NP = Not Present

Table 35B. Stuart Island Management Area Reach Assessment – Habitat Conditions.

Reach	Vegetation Coverage	Estuary Habitat	Birds	Haul-out Habitat	Eelgrass	Floating Kelp	Understory Kelp	Spawning Habitat[1]	Herring Spawning Habitat	Shellfish	Total
278	5	4	0	5	5	5	5	0	0	3	32
280	5	0	0	0	5	5	5	0	0	3	23
281	5	1	1	0	5	5	5	0	0	1	23
282	5	3	1	0	5	5	5	0	0	2	26
283	4	0	1	0	5	5	5	0	0	3	23
284	5	1	0	0	5	5	5	0	0	2	23
285	5	1	0	0	0	0	5	0	0	1	12
286	5	2	1	0	5	5	5	0	0	1	24
287	5	1	0	0	0	0	5	0	0	1	12
288	5	2	0	0	5	5	5	0	0	1	23
289	5	3	0	5	5	5	5	0	0	2	30
290	5	2	0	0	0	0	5	0	0	1	13
291	5	1	0	0	5	5	5	0	0	1	22
292	5	1	0	0	5	5	5	0	0	1	22
293	5	1	0	0	5	5	5	0	0	3	24
294	4	0	0	0	5	5	5	0	0	2	21
295	5	1	0	0	5	5	5	0	0	3	24
296	5	1	0	0	0	0	5	0	0	3	14
297	5	0	3	0	0	5	5	0	0	2	20
298	5	0	0	0	5	5	5	0	0	2	22
299	5	2	0	5	5	5	5	3	0	3	33
300	5	1	1	0	5	0	5	0	0	4	21
301	5	1	0	0	0	0	5	3	0	2	16
Median	5.00	1.00	0.00	0.00	5.00	5.00	5.00	0.00	0.00	2.00	23.00
Average	4.91	1.26	0.35	0.65	3.70	3.70	5.00	0.26	0.00	2.04	21.87

Percent of Highest Possible Score	98%	25%	7%	13%	74%	74%	100%	5%	0%	41%	44%

[1] Includes priority spawning habitat for sand lance, surf smelt, and rock sole.

4.16 Turtleback Management Area

The Turtleback management area covers over 15 miles of shoreline along the sparsely populated northwest end of Orcas Island. The management area extends from the northeastern outskirts of Eastsound to just north of Steep Point. The management area includes Jones Island and Freeman Island, which are uninhabited state parks. It is bounded to the west by President Channel. There are no major transportation related uses in this management area.

Table 36 is a summary of the reach assessment for the Turtleback management area. The table is in two parts, one covering general physical conditions, the other addressing those conditions directly related to habitat functions. The following discussions cover both the conditions scored in the reach assessment (Tables 36A and B) and management area results from the ecosystem-wide characterization. There is little variability between the reach scores for physical conditions in the Turtleback management area. All score well score compared to the rest of the County. Scores for habitat functions are more variable due to variability in presence of estuary habitat, haul-out habitat and understory kelp.

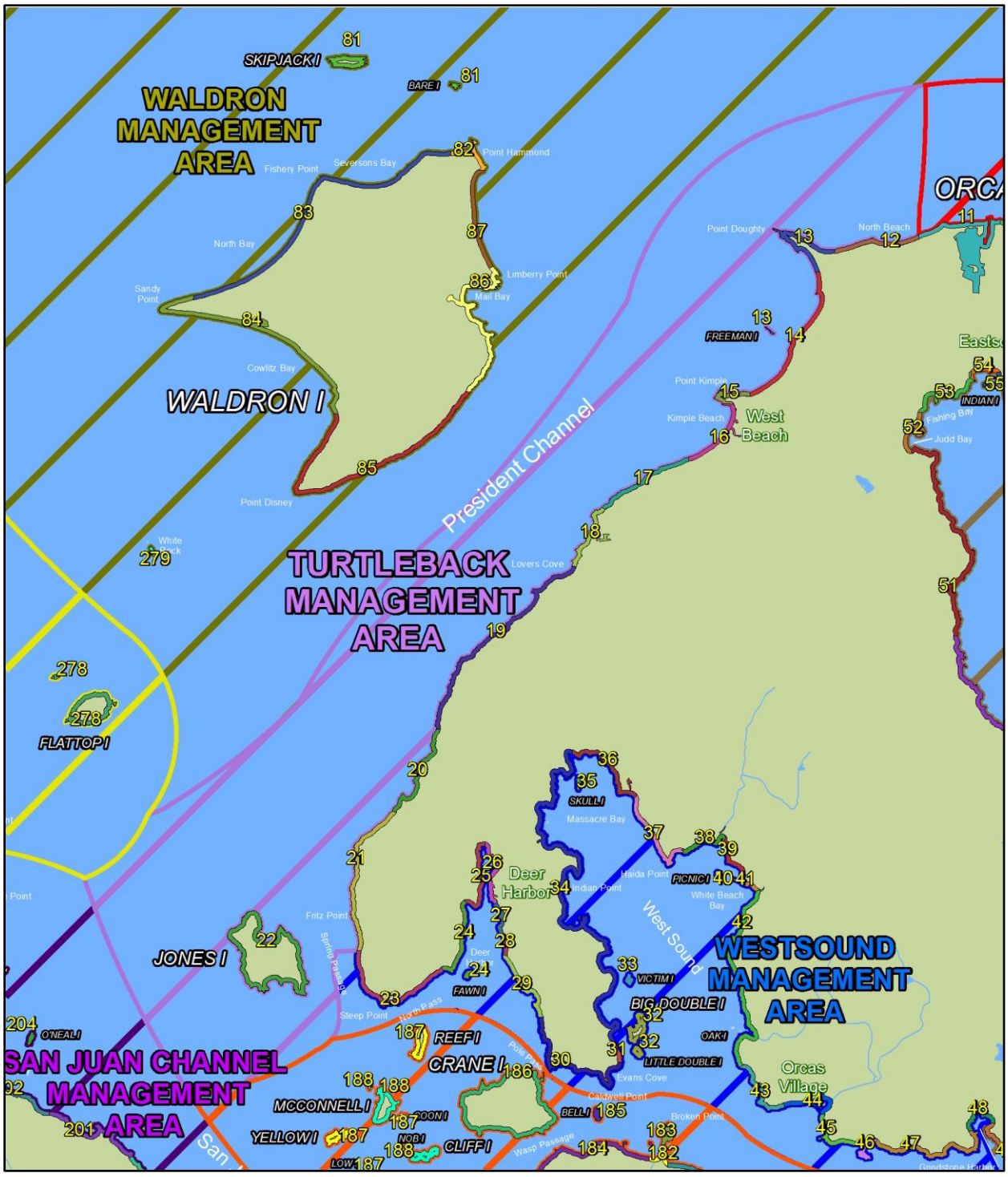


Figure 27. Turtleback Management Area.

4.16.1 Physical and Biological Characterization

Nearshore Physical Processes

The management area exhibits a transition from glacial outwash sediments typical of Eastsound area to purely bedrock shoreline on the west side of Turtleback Mountain. The transition in the north begins as a series of pocket beaches, which diminish in size until they disappear into the west slope of Turtleback Mountain at West Beach. Turtleback Mountain, including Orcas Knob, is comprised of extremely ancient (more than 500 million years old) oceanic crust, with some minor components of gabbro (rocks from the mantle). The mineralogy of these rocks is complex, unusual and metallic, limiting vegetative growth to the point where natural rocky areas persist in some areas.

There are three long drift cells in the northern portion of the management area. One is the remnant of the drift cell also included in the North Coast Eastsound management area. The other two have opposite orientation and constitute West Beach (in the south, with northward drift) and another embayment to the north (with southward drift).

Wave energy also varies from north to south. Northern areas, particularly those east of Point Doughty, have significant wave energy from the Strait of Georgia. Areas further south are in the lee of the rest of the Orcas Island and have much more modest waves. Tidal currents are variable, but significant (in excess of 2 knots at times), in President Channel.

Geologic Hazards

The Turtleback management area is riddled with faults (Lapen 2000). Most of these are likely relict faults from the uplift of Turtleback Mountain and surrounding areas, but they could be reactivated as zones of weakness in the presence of other ambient seismicity. Landsliding does occur near the west end of West Beach and just east of Point Doughty. The tsunami risk in the management area decays similar to the wave energy from north to south. The principal source of tsunamis in the management area would be those originating from the Strait of Georgia and the Fraser River delta (Mosher 2009). Liquefaction is negligible, particularly the further from Eastsound.

Streams and Associated Wetlands

There are seven small streams and very few wetlands in this management area. Ditches are extensive in the pocket beach areas of the north, where the few nearshore wetlands in the management area exist currently and historically. The largest stream discharges at West Beach, through a culvert. Further south, wetlands are local and small and runoff is more or less unconfined due to the lack of upland development.

Critical or Priority Habitat and Species Use

The mostly rocky shoreline provides suitable conditions for sea urchin throughout the management area. Shellfish are documented within every reach. One instance of priority fish spawning habitat is documented between Point Doughty and Point Kimple. Eelgrass is present in all but one reach. Understory kelp is present in all reaches. Floating kelp is more patchy in its

distribution and is present near the outer extents of Points Doughty and Kimple and occurs sporadically along the rocky portion of shoreline farther south (reaches 13, 15, 17, 18, 19, 21, and 22). No priority fish spawning habitat is documented in this management area.

This management area is along an important migration route for juvenile salmon as indicated by high densities in nearshore areas around President Channel (Beamer et al. 2008, Wyllie-Echeverria and Barsh 2007). Steep forested habitat suitable for bald eagles and having a high potential to be suitable for marbled murrelet nesting occurs along the shoreline in the general vicinity of Lovers Cove (SJC 2009). Most of this management area is also suitable habitat for rockfish.

Marine Riparian, Nearshore, and Estuarine Habitats

Estuarine habitat is patchy and, where present, is small in size (less than 2 acres per reach). However, there are a number of pocket beach formations and associated nearshore wetlands, primarily along the northern half of the management area's shoreline, that provide a key habitat type for Chinook and other salmon during their outmigration. Unique forest communities comprised of aspen stands occur along much of the rocky southern portion of the shoreline, an area that also contains significant rocky cliffs, and is commonly used by bald eagles. Shoreline shade and vegetation coverage within the shoreline jurisdiction are generally intact.

Water Quality, Sediment, and/or Tissue Sample Results

Although data have been collected near the area (Ecology 2011e), the water quality is largely unknown in this management area.

4.16.2 Shoreline Use Patterns

Existing Land and Shoreline Use

Land Use

The Turtleback management area includes the area along the north and west side of Orcas Island from North Beach to Point Doughty and follows along President Channel to approximately Fritz Point. This management area also includes Freeman and Jones islands.

Overall existing land use in the Turtleback management area includes:

- Residential – 46 percent
- Cultural, Entertainment, Recreation – 13 percent
- Undeveloped Land – 42 percent

Existing land uses between North Beach and Point Doughty include cultural/recreation, residential, and vacant land uses. This pattern of existing land uses continues south to Point Kimple with the addition of a small number of parcels in conservation easement in that area. South of Point Kimple is a largely residential area with some cultural/recreation uses. Further south, residential, unclassified, vacant, and conservation easement areas are located within shoreline jurisdiction. The southernmost portion of this management area is a largely residential

area with few other existing use types extending to Fritz Point. Jones Island is natural marine state park land use.

Tidelands are a mix of state-owned aquatic lands and private ownership.

Water-dependent uses in this management area consist of a small number of private docks and piers, including those associated with Camp Orkila and West Beach Resort. A public dock on Jones Island State Park is also a water-dependent use. Water enjoyment uses include Camp Orkila, West Beach Resort, Jones Island State Park, and a small number of other lodging establishments such as bed and breakfasts along developed portions of the Orcas Island portion of this management area.

Land Use Designations

In terms of Comprehensive Plan land uses, from North Beach to Kimple Beach most of the shoreline jurisdiction in this management area is designated Rural Farm Forest. Exceptions include the Washington State DNR-owned parcel at Point Doughty, which is designated Natural, and a small area of Activity Center at Kimple Beach. Further south, the land designation transitions to Forest Resource. One large parcel is designated Conservancy, providing a transition to an area exclusively designated Rural Farm Forest extending south to Fitz Point. Jones Island is designated Natural.

Shoreline Environment Designations

Shoreline environment designations in this management area are a mix of Rural, Conservancy, Rural Farm-Forest, and Natural. The North Beach portion of this management area is designated Rural with one large parcel designated Conservancy east of the Washington DNR property at Point Doughty. Point Doughty itself is designated with a Natural shoreline environment. A few properties south of Point Doughty are Conservancy, followed by another Rural-designated area that extends to Conservancy-designated Point Kimple. The Kimple Beach area south of Kimple Point, including the West Beach Resort is designated Rural. South of there, the shoreline environment changes to Conservancy following the Forest Resource and Conservancy land use designated lands in this area. The remainder of this management area to Fitz Point is designated with Rural Farm-Forest shoreline environment. Jones Island is designated with a Natural Shoreline environment.

Shoreline Modifications

The Turtleback management area has 3.7 percent of its shoreline armored. Nearly all of the armoring occurs on the large pocket beaches that are present in the northern portion of the management area. The bedrock outcrops that abut Turtleback Mountain are not armored, and only a few small pocket beaches are armored in the southern portion of the management area. If the percentage of armoring would be expressed in terms of pocket beach area only, the percentage of armoring would be significantly larger. There are only 10 docks and piers, but they are on average quite large in comparison to others in the County. Moorings are scattered throughout the management area, but are concentrated near West Beach. There are also a large number of pilings (36 in total in the management area) concentrated at West Beach.

Existing and Potential Public Access Areas

Existing Facilities

Public access opportunities in the 15.5 miles of shoreline within the Turtleback management area include a campground on Jones Island and the following road ends:

- Cormorant Bay Road End is accessed by an unpaved road. The road end has a steep bank that makes beach access difficult. However, there is a small turn-around and enough space to park three cars.

- Enchanted Forest Road end overlooks the President Channel. The road ends at beach level and currently serves as a viewpoint and a good location for launching kayaks. Additional development potential – for parking, turn-around, etc. – is low due to space limitations and environmental constraints from a nearby creek.

Existing Facilities with Potential for Improvement

Currently minimal trails or pathways exist in this management area to provide shoreline public access. Due to topography and other physical restrictions, expanding access opportunities at the road ends discussed above would likely prove difficult.

4.16.3 Restoration Opportunities

There is a relatively small amount of shoreline development due to the steep slopes common in the central and southern portions of the management area. Despite the lack of nearshore development, bulkheading is quite intense given that most of the shoreline is bedrock. In some cases, though not all, the bulkheads merely protect a large lawn.

Also the stream mouth on West Beach has a culvert extremely near the shoreline. This has locally modified transport of freshwater and sediment and potentially restricted fish use further upstream. Because these resources are rare in the County, particularly on Orcas Island, removal or replacement is an opportunity for restoration.

Table 36A. Turtleback Management Area Reach Assessment – Physical Conditions.

Reach	Natural Sediment Transport Patterns	Shoreline Sediment Input Alterations - Feeder Bluffs	Shoreline Sediment Input Alterations - Pocket Beaches	Shoreline Sediment Input Alterations - Barrier Beaches	Natural Current Patterns	Wave & Current Attenuation	Nutrient and Toxics Removal	Shade	Total
13	5	5	5	NP	5	5	5	3	33
14	5	3	NP	NP	5	4	5	4	26
15	5	NP	5	NP	5	5	5	4	29
16	5	4	0	NP	3	4	5	4	25
17	5	5	NP	NP	5	5	5	4	29
18	5	NP	5	NP	5	5	5	4	29
19	5	NP	5	NP	5	4	5	4	28
20	5	NP	2	NP	3	4	5	5	24
21	5	NP	4	NP	3	4	5	5	26
22	5	NP	5	NP	5	5	5	4	29
Median	5.00	4.50	5.00		5.00	4.50	5.00	4.00	28.50
Average	5.00	4.25	3.88		4.40	4.50	5.00	4.10	27.80
Percent of Highest Possible Score	100%	85%	78%	0%	88%	90%	100%	82%	70%

NP = Not Present

Table 36B. Turtleback Management Area Reach Assessment – Habitat Conditions.

Reach	Vegetation Coverage	Estuary Habitat	Birds	Haul-out Habitat	Eelgrass	Floating Kelp	Understory Kelp	Spawning Habitat[1]	Herring Spawning Habitat	Shellfish	Total
13	5	1	0	5	5	5	5	0	0	2	28
14	5	2	1	0	5	0	0	3	0	2	18
15	5	1	0	0	5	5	5	0	0	2	23
16	5	0	2	0	0	0	5	0	0	2	14
17	5	0	0	0	5	5	5	0	0	2	22
18	5	1	0	0	5	5	5	0	0	2	23
19	5	2	0	0	5	5	5	0	0	2	24
20	5	0	0	0	5	0	5	0	0	2	17
21	5	0	0	0	5	5	5	0	0	3	23
22	5	1	0	5	5	5	5	0	0	3	29
Median	5.00	1.00	0.00	0.00	5.00	5.00	5.00	0.00	0.00	2.00	23.00
Average	5.00	0.80	0.30	1.00	4.50	3.50	4.50	0.30	0.00	2.20	22.10
Percent of Highest Possible Score	100%	16%	6%	20%	90%	70%	90%	6%	0%	44%	44%

[1] Includes priority spawning habitat for sand lance, surf smelt, and rock sole.

4.17 Waldron Island Management Area

The Waldron Island management area includes Waldron Island, the Sucia archipelago (as defined by the Sucia Islands, Patos Island, Matia Island, and Puffin Island) and assorted small outcroppings north of Orcas Island. Like the Stuart Island management area, the physical environment of the Waldron Island management area has more in common with the Gulf Islands than the rest of the County. With the exception of a few (typically isolated and seasonal) residences scattered on the outer islands, the only development in the management area is on Waldron Island. There are no major transportation related uses in this management area. There is a community dock at the south end of Cowlitz Bay, which serves local vessel traffic.

Table 37 is a summary of the reach assessment for the Waldron Island management area. The table is in two parts, one covering general physical conditions, the other addressing those conditions directly related to habitat functions. The following discussions cover both the conditions scored in the reach assessment (Tables 37A and B) and management area results from the ecosystem-wide characterization. The Waldron Island management area has intact sediment transport current patterns and wave and current attenuation. Very little of the management area is armored. Habitat scores are generally high with the exception of the reach between Limberry Point and Point Hammond.

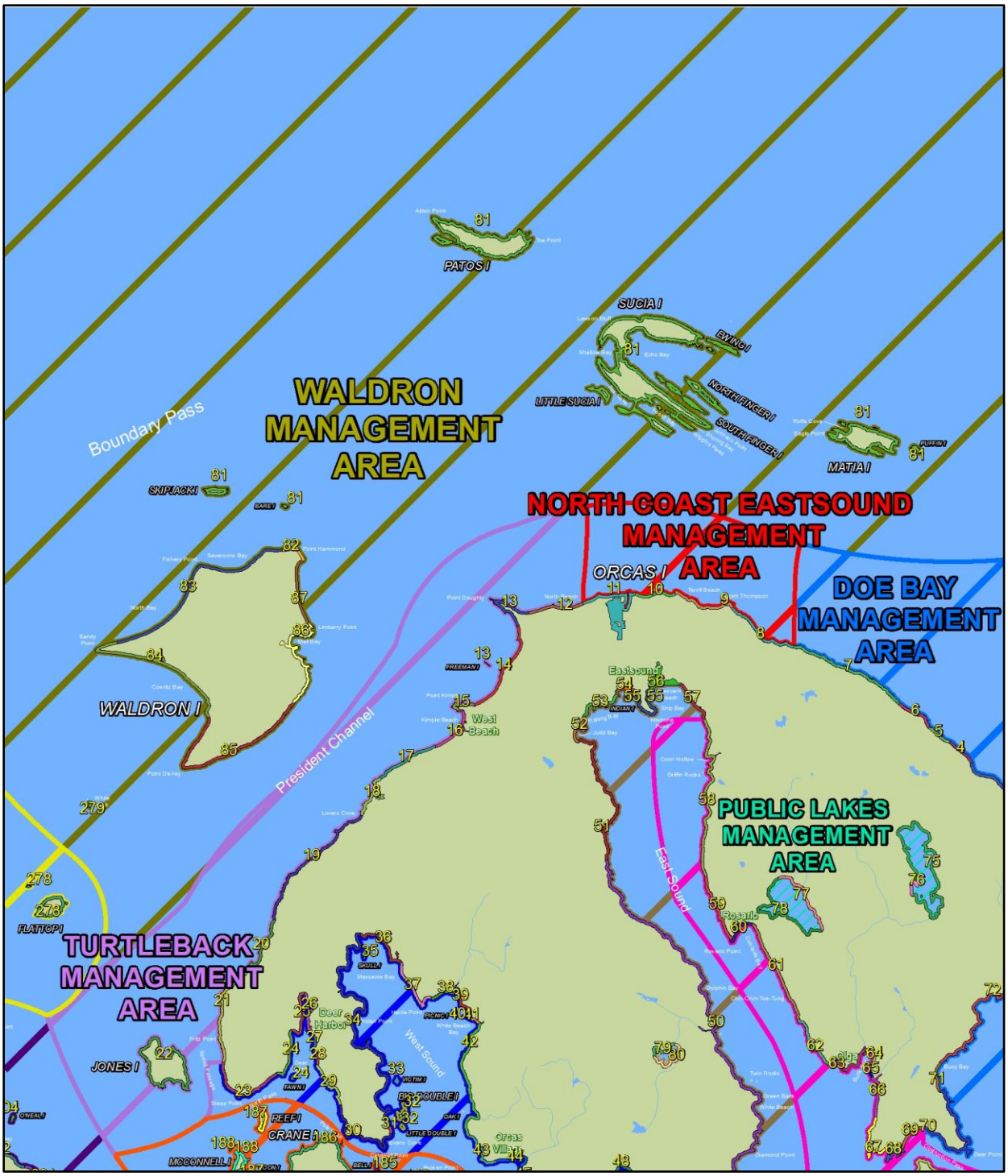


Figure 28. Waldron Island Management Area.

4.17.1 Physical and Biological Characterization

Nearshore Physical Processes

Like the Gulf Islands, the Waldron Island management area is comprised primarily of a mix of deformed marine and continental sedimentary bedrock. This makes for steep, but stable, shorelines in the many places where this is found. In addition to the bedrock outcroppings, a large glacial drift terrace defines the northern two-thirds of Waldron Island. In this area, the shoreline has sufficient sediment to form a bluffs and beaches, typical of Puget Sound.

There are four major drift cells in this management area. Two of these converge at Sandy Point. The other two diverge at feeder bluff just south of Point Hammond.

Wave energy in the management area is higher than normal in the County at large, although the area is protected from swell. This is a result of large fetches in nearly all directions. Tidal energy is also large. It is not uncommon for currents to exceed 2.5 knots at various locations at various times (Canadian Hydrographic Service 2010). Wave energy from vessel traffic is insignificant because of the high ambient energy and open marine waters setting around the islands.

Geologic Hazards

The tsunami threat in the Waldron management area is likely greater than any management area in the County, with the exception of the Strait of Juan de Fuca management area. The threat is somewhat different from most of the rest of the County, in that the tsunamis of interest would originate in the Strait of Georgia. In particular, considerable work has been done in Canada to address the threat of delta-front-landslide tsunamis on the Fraser River delta (Mosher 2009). However, there are numerous large faults that transverse the basin that could also generate a tsunami. Finally, the management area is susceptible to landslide-generated tsunamis from the surrounding Gulf Islands, the British Columbia mainland, and the heavily faulted northern shoreline of Orcas Island.

Because of the presence of bedrock throughout much of the management area, liquefaction is only an issue on the drift terrace. Landslides are thought to occur along the bluffs at the edge of the drift terrace that defines the northern two-thirds of Waldron Island; however, these bluffs are mature and the slopes are only marginally unstable; no active sliding has been reported.

Streams and Associated Wetlands

There are no mapped streams or lakes in this management area. There are several large wetland complexes adjacent to the shoreline in Cowlitz Bay (Appendix A). They are typically (naturally) separated from marine waters by a beach berm, and are therefore classified as lagoons, which are relatively rare in the Salish Sea. These types of lagoons are used extensively by shorebirds. Because of the high ecological value of these wetlands, they have been largely protected from future development by The Nature Conservancy.

Critical or Priority Habitat and Species Use

Nearshore areas in Cowlitz Bay and Mail Bay of Waldron Island, as well as the bays and coves surrounding the Sucia archipelago contain important habitats for Dungeness crab and sea

urchins. Other waters surrounding the islands provide habitat for sea urchins and pandalid shrimp. Subtidal clam habitat is documented near Point Hammond along Waldron Island's northern shoreline. Most of the reaches have two or more shellfish species present. Eelgrass is found in all reaches including within Cowlitz Bay, North Bay, and Mail Bay of Waldron Island, as well as the bays and coves surrounding the Sucia archipelago. The rocky shoreline along President Channel and portions of Sucia are characterized by kelp; both floating and understory. Documented priority fish spawning habitat is found in Cowlitz Bay and the south shore of Point Disney.

Juvenile salmonids use many of the nearshore areas surrounding Waldron Island including Cowlitz Bay and Severson Bay where Chinook, coho, and high densities of pink and chum salmon have been recorded (Wyllie-Echeverria and Barsh 2007). This management area is along an important migration route for juvenile salmon as indicated by high densities in nearshore areas around President Channel (Beamer et al. 2008; Wyllie-Echeverria and Barsh 2007). Bald eagles are common along the shorelines of Waldron and Sucia islands. Smaller island including Skipjack Island and the Sucia archipelago provide suitable habitat for seabirds, and marine mammals, and are used by harbor seals and sea lions as haul-out sites. Black oystercatchers are commonly observed. Most of this management area is also suitable habitat for rockfish, with the possible exception of the west end of Waldron Island.

Marine Riparian, Nearshore, and Estuarine Habitats

Estuarine habitats are present in Cowlitz Bay and Mail Bay of Waldron Island, and portions of the Sucia archipelago. Marine riparian vegetation on the bluffs and back beaches is relatively intact overall on Waldron Island and throughout this management area, and provides habitat for bald eagles and peregrine falcons. A unique characteristic of the southern shoreline of Waldron Island is the presence of aspen stands from Point Disney to Mail Bay.

Water Quality, Sediment, and/or Tissue Sample Results

Ambient water quality monitoring has been conducted by the Department of Ecology north of Patos Island; fecal coliform bacteria, dissolved oxygen, and ammonia-nitrogen all met water quality criteria (Ecology 2011e). This location is currently classified as Category 2 "Waters of Concern" due to a small fraction of pH samples that did not meet water quality criteria (Ecology 2011e).

One sediment sample was collected at Cowlitz Bay that exceeded the Sediment Management Standards SQS bioassay criterion (Ecology 2011e). One sediment sample was collected next to North Finger Island that also exceeded the Sediment Management Standards SQS bioassay criterion (Ecology 2011e). Sediment in both areas is classified as Category 2 "Sediments of Concern".

4.17.2 Shoreline Use Patterns

Existing Land and Shoreline Use

Land Use

The Waldron management area consists of Waldron Island with the smaller Bare and Skipjack islands associated nearby. This management area also includes Patos, Sucia, Little Sucia, Ewing, North Finger, South Finger, Matia, and Puffin islands further to the northeast.

Overall existing land use in the Waldron management area includes:

- Residential – 20 percent
- Cultural, Entertainment, Recreation – 35 percent
- Undeveloped Land – 45 percent

Waldron Island's shoreline jurisdiction is a mixture of residential and undeveloped (vacant and conservation) land uses. Existing land uses on the northern side of Waldron Island from Fishery Point east consist of residential, with some smaller areas classified as conservation (Open Space Taxation Act or conservation easement), and one resource parcel along Seversons Bay. East of Severson Bay is a large unclassified parcel. Point Hammond on Waldron Island's northeast corner is surrounded by vacant conservation easement land use. South of the conservation parcels, the eastern side of Waldron Island is developed in residential uses until Limberry Point, which is vacant. From Mail Bay south, the eastern side of Waldron is characterized by a mix of residential and vacant land. The southern portion of Waldron Island surrounding Point Disney is vacant land owned by the San Juan Preservation Trust. Cowlitz Bay on the southwestern portion of Waldron Island to Sandy Point contains residential uses to the west, but also contains several large parcels owned by the Nature Conservancy. Sandy Point itself is a resource land use. From Sandy Point to Fishery Point along North Bay, is a largely residential area with some small amounts of vacant land, including a large undeveloped parcel in the Open Space Taxation program. Skipjack and Bare islands to the north of Waldron are both undeveloped Federal islands that are part of the Federal San Juan Wilderness managed by U.S. Fish and Wildlife Service.

In the island group farther north, also included in this management area, Patos, Matia, and Puffin islands are undeveloped Federal islands. Matia and Puffin islands are part of the Federal San Juan Wilderness. However, Matia has a small marine campground administered through Washington State Parks. Patos, owned by BLM, also has a lighthouse and a small Washington State Park-administered marine campground. Sucia, Little Sucia, and Ewing islands are a Washington State Park property, one of the park system's marine parks only accessible by private boat (cultural/recreation use). South Finger Island and another small island south of Sucia Island are both residential, while North Finger Island is vacant.

Tidelands are a mix of state-owned aquatic lands and private ownership with the majority being state-owned aquatic lands.

Water-dependent uses in this management area consist of two docks on Waldron Island (a public access dock on Cowlitz Bay, and a private dock on Mail Bay), a public dock in Fossil Bay on

Sucia Island, public access landing areas on Patos and Matia islands, and private docks on North and South Finger islands. Another important water-dependent use is the Patos Island lighthouse on Alden Point. Water enjoyment uses include state park facilities at Matia, Patos, and Sucia islands.

Land Use Designations

In terms of Comprehensive Plan land use designations, the shoreline jurisdiction on Waldron Island are largely designated Rural Farm Forest. A small area near Point Hammond, and a larger area on the south side of Waldron Island near Point Disney are designated Conservancy and Natural. The central portion of Cowlitz Bay on the western side of Waldron Island is designated Natural as well. Skipjack and Bare islands are both designated Natural.

Patos Island is designated a combination of Conservancy and Natural. Sucia, Ewing, North Finger, South Finger, and Matia islands are all mostly designated Conservancy with small amounts of Natural on their shorelines. Little Sucia and Puffin islands are both designated Natural.

Shoreline Environment Designations

Shoreline use environments on Waldron Island are a mix of Conservancy and Natural with smaller areas of Rural Farm-Forest mixed in. A Natural environment designation is applied from the east side of Seversons Bay to south of Point Hammond. A split Conservancy and Natural environment designation is applied to the shoreline jurisdiction further south side of Mail Bay, with the exception of a smaller area of Rural Farm-Forest located in this area north of Limberry Point. South from Mail Bay to the southern tip of Waldron Island at Point Disney and further north to the south side of Cowlitz Bay is Natural environment shoreline designation. The portion of Cowlitz Bay characterized by low-density development and including the public access dock is designated Rural Farm-Forest. The remainder of the west side of Waldron Island is in Natural environment designation to the west side of Seversons Bay with the exception of a small area with a split designation of Conservancy/Natural on the north side of Cowlitz Bay, and a small area of Rural Farm-Forest on North Bay. The south side of Seversons Bay itself is designated Rural Farm-Forest shoreline environment. Of the remaining smaller islands in this management area, Northern and Southern Finger islands are designated with the Conservancy environment. Sucia Island has a mix of Conservancy and Natural shoreline environments along this state park's shoreline. The remaining small islands are designated with a Natural shoreline environment.

Shoreline Modifications

The Waldron Island management area is less armored per shoreline mile than any other management area in the County. Less than 1 percent of its shorelines are armored. This is biased somewhat by the large amount of undeveloped shoreline in the Sucia Archipelago. Most of the armoring that does exist occurs at the primary boat landings on Waldron Island and Sucia Island. There are only five docks and piers, two boat ramps, and one marine railway. These are concentrated near the primary boat landings. There are a large number of mooring buoys (151), almost as many as much more developed areas in the County (such as North Coast Eastsound

and Fisherman Bay on Lopez). They are scattered throughout the islands, but they are also clustered next to the primary boat landings. There are also 17 pilings – a considerable number given the general lack of development in the management area.

Existing and Potential Public Access Areas

The Waldron Island management area has approximately 45 miles of shorelines, and approximately 852 acres of area. The Waldron Dock on west side of Waldron Island in Cowlitz Bay offers public shoreline access opportunity. The facility consists of a pier with a turning apron leading to a gangway down to a float, also described as a hammerhead dock. There is no parking on the road. The area south of the dock has road access and is popularly used as a ramp for boat launching and small launch landing. While there is no structure formally built as a boat ramp, the site is hard packed and serves the needs of the island for delivery of essential supplies and materials. Approximately 184 acres of land in this management area is under conservation easement (The Trust for Public Land et al. 2010. Table 3.6). This management area contains campground and boat launches. Approximately 535 acres of total shore land is dedicated for open space and preservation. This includes most of Sucia Island and Patos Island and portion of Waldron Island. Neither the Parks Plan nor the Land Use Element of the Comprehensive Plan recommended specific actions to expand or enhance public access in the Waldron Island management area.

4.17.3 Restoration Opportunities

The small amount of development in the management area, both past and present, limits restoration opportunities because most of the shoreline is already in a relatively pristine state. What little development there is often is properly set back from the shoreline. However, conservation could be used to add to the large reserves that already exist. Also there may be opportunities to remove some of the large number of mooring buoys and pilings that are no longer being used.

Table 37A. Waldron Island Management Area Reach Assessment – Physical Conditions.

Reach	Natural Sediment Transport Patterns	Shoreline Sediment Input Alterations - Feeder Bluffs	Shoreline Sediment Input Alterations - Pocket Beaches	Shoreline Sediment Input Alterations - Barrier Beaches	Natural Current Patterns	Wave & Current Attenuation	Nutrient and Toxics Removal	Shade	Total
81	5	NP	4	NP	5	4	3	3	24
82	5	5	NP	NP	5	5	5	3	28
83	5	5	NP	NP	5	4	5	3	27
84	5	5	NP	5	5	4	3	2	29
85	5	NP	NP	NP	5	5	3	2	20
86	5	NP	4	NP	5	4	5	3	26
87	5	5	NP	NP	5	5	5	3	28
279	5	NP	NP	NP	5	5	5	0	20
Median	5.00	5.00	4.00	5.00	5.00	4.00	5.00	3.00	27.00
Average	5.00	5.00	4.00	5.00	5.00	4.43	4.14	2.71	26.00
Percent of Highest Possible Score	100%	50%	80%	100%	100%	89%	83%	54%	65%

NP = Not Present

Table 37B. Waldron Island Management Area Reach Assessment – Habitat Conditions.

Reach	Vegetation Coverage	Estuary Habitat	Birds	Haul-out Habitat	Eelgrass	Floating Kelp	Understory Kelp	Spawning Habitat[1]	Herring Spawning Habitat	Shellfish	Total
81	5	5	0	5	5	5	5	0	0	4	34
82	5	1	0	0	5	5	5	0	0	3	24
83	5	5	0	0	5	0	5	0	0	2	22
84	5	1	1	0	5	5	5	3	0	4	29
85	5	0	2	0	5	5	5	3	0	3	28
86	5	2	0	0	5	5	5	0	0	2	24
87	5	1	0	0	5	0	5	0	0	2	18
279	4	0	0	5	0	5	0	0	0	1	15
Median	5.00	1.00	0.00	0.00	5.00	5.00	5.00	0.00	0.00	3.00	24.00
Average	5.00	2.14	0.43	0.71	5.00	3.57	4.38	0.86	0.00	2.86	25.57
Percent of Highest Possible Score	100%	43%	9%	14%	100%	71%	83%	17%	0%	57%	51%

[1] Includes priority spawning habitat for sand lance, surf smelt, and rock sole.

4.18 West Sound Management Area

The West Sound management area extends from just west of Steep Point to Grindstone Harbor. The shoreline is extremely complex and long (more than 25 miles in extent) and includes all of West Sound and Deer Harbor. The management area also includes numerous islets within West Sound and Deer Harbor, including Fawn Island, Big Double Island, Little Double Island, Picnic Island, Skull Rock, Victim Island, and Oak Island. Some of these islands are inhabited. The area is bordered to the south by a network of passages, dominated by Harney Channel in the east. The primary (WSDOT) ferry terminal for Orcas Island is located in Orcas Village. There is also a large bridge across the mouth of the Deer Harbor estuary near the village of Deer Harbor.

Table 38 is a summary of the reach assessment for the West Sound management area. The table is in two parts, one covering general physical conditions, the other addressing those conditions directly related to habitat functions. The following discussions cover both the conditions scored in the reach assessment (Tables 38A and B) and management area results from the ecosystem-wide characterization. There is wide variability among both physical and habitat conditions within the reaches in this management area, and overall, generally lower than the rest of the County. Although sediment transport is generally intact, current patterns and wave and current attenuation are generally more impaired. Some reaches have significant disturbance to shoreline vegetation, which affects shading of the nearshore. The wide variation in the presence of different habitat types generally lowers scores for habitat functions.

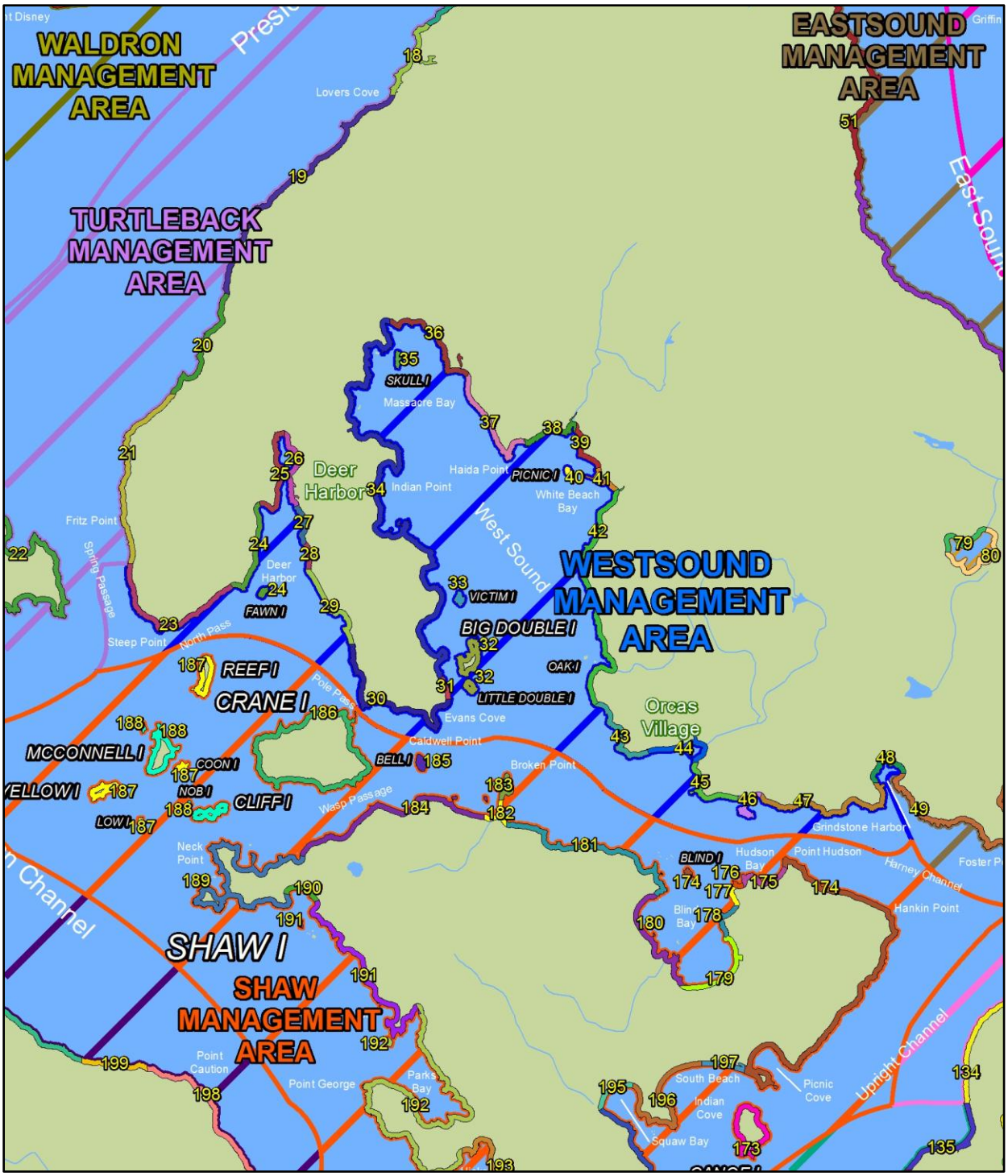


Figure 29. West Sound Management Area.

4.18.1 Physical and Biological Characterization

Nearshore Physical Processes

The West Sound management area is geologically complex, even by County standards. It reflects the transition of deep crustal rocks typical of Turtleback Mountain to the marine sedimentary rocks of Shaw Island. It also has geologically recent glacial sediments scattered throughout the management area in topographic depressions (such as Deer Harbor). The complexity results in a wide variety of shore types from steep bedrock shorelines in the west to low-gradient estuarine embayments, like Deer Harbor.

There are several mapped drift cells in the management area, most of which are associated with converging drift cells within embayments and at tombolos. Converging drift cells occur at a tombolo in Harney Channel and in White Fish Bay. There are also isolated drift cells on the east side of Deer Harbor, in Massacre Bay, and just east of Orcas Village.

The wave energy in the West Sound management area is relatively low. Waves are derived exclusively from local winds blowing through the embayments that define the management area. Currents are also generally small by comparison to the rest of the County, with the strongest currents found near topographic constrictions, such as Harney Channel and Pole Pass.

Geologic Hazards

West Sound is probably the least geologically hazardous management area in the County. While there are several east-west-oriented faults that dissect the management area, they are likely relict from earlier tectonic activity. Slopes are highly variable, but where steep slopes occur, the lithology is such that slope stability is generally not an issue. Areas with glacial sediment have slopes that are generally mild by County standards. There are no areas of active landsliding. Tsunami risk is insignificant (aside from local landslide-generated tsunamis), as is liquefaction.

Streams and Associated Wetlands

There are nine small, mostly ephemeral, streams that drain to the east side of West Sound. In addition to these streams, there are number of other smaller ephemeral streams that generally drain to embayments throughout the management area. The most notable of these smaller tributary streams drains to Deer Harbor and forms a somewhat large pocket estuary there. Similar but smaller features occur near the community of West Sound, an embayment about two-thirds of mile north of Pole Pass, just west of Orcas Island, and in Grindstone Harbor. An incomplete tombolo at Double Cove also has a marsh associated with it, but this is the extent of estuarine marshes in this management area.

Critical or Priority Habitat and Species Use

West Sound is a high priority fish spawning habitat area for forage fish (Friends of the San Juans 2004a). Forage fish spawning beach habitat is documented in six small pocket beaches throughout West Sound, from Evans Cove to White Beach Bay. Much of the nearshore area, primarily in Massacre Bay but extending from Pole Pass in the south to White Beach Bay in the northern portion of the management area, is also critical Pacific herring spawning habitat (reaches 30 through 41). Eelgrass is found in all but two reaches within the management area.

Both floating kelp (in reaches 24, 30, 32, 34, 42, 43, 45 through 47) and understory kelp (in reaches 23, 30 through 34, 37, 38, 42 through 45 and 47) occur sporadically throughout Deer Harbor all the way east as far as Grindstone Harbor. Shellfish are documented in all reaches. Waters within Deer Harbor are likely used by sea urchins. Haul-out habitat is not reported in any reach.

Crow Valley Creek, the stream entering White Beach Bay, is used by coho and chum salmon, and coastal cutthroat trout. Nearshore habitat near White Beach may be important transitional areas for coho and chum salmon. Sea birds may feed on forage fish and are commonly observed among the many small islands near the shorelines of West Sound and Deer Harbor. These areas also provide important habitat for crab. Bald eagles have been observed along the forested rocky cliffs along the western shoreline of West Sound. The rocky headlands common in this management area are also suitable habitat for rockfish.

Marine Riparian, Nearshore, and Estuarine Habitats

Estuarine habitat is much more sporadic in extent than other management areas but is found in generally small areas of reaches predominantly in West Sound and Deer Harbor. There is considerable variation in the level of disturbance to shoreline vegetation throughout the management area affecting shading of the nearshore marine environment. Conditions range from undisturbed forest with overhanging vegetation, to landscaped lawns abutting many of the pocket beaches. In general, vegetation coverage within the shoreline jurisdiction is contiguous and dense.

Water Quality, Sediment, and/or Tissue Sample Results

Water quality samples collected from Deer Harbor and West Sound exhibited low levels of fecal coliform bacteria in addition to dissolved oxygen and pH levels that met water quality criteria (Wiseman et al. 2000). Water quality data were also collected from several streams that discharge to the West Sound management area. Elevated levels of fecal coliform bacteria, low dissolved oxygen, and high TSS concentrations were observed in a stream that drains Crow Valley (Wiseman et al. 2000). Similar results were observed in other water quality studies that studied locations in the West Sound management area (SJC 2000; SJCD 2005).

Sediment samples have also been collected in Deer Harbor and West Sound that exceeded the Sediment Management Standards SQS bioassay criterion (Ecology 2011e). In addition, sediment samples from West Sound also exceeded Sediment Management Standards CSL chemistry criteria for 1,2,4-Trichlorobenzene, 1,2-Dichlorobenzene, 1,4-Dichlorobenzene, Hexachlorobenzene, and Hexachlorobutadiene. Sediment in these areas is classified as Category 2 "Sediments of Concern" (Ecology 2011e).

4.18.2 Shoreline Use Patterns

Existing Land and Shoreline Use

Land Use

West Sound management area extends from Fritz Point to Grindstone Harbor on Orcas Island. It also includes the small islands near the Orcas Island shore: Fawn, Little Double, Big Double, Victim, Skull, Picnic, and Oak islands.

Overall existing land use in the West Sound management area includes:

- Residential – 78 percent
- Cultural, Entertainment, Recreation – 6 percent
- Undeveloped Land – 16 percent

Existing land uses adjacent in shoreline jurisdiction from Fritz Point to Deer Harbor are predominantly residential with a small amount of vacant land interspersed. The inner portion of Deer Harbor is characterized by resource use but is in a land bank conservation easement, while the southern part of Deer Harbor is mostly residential with a service (boatworks) and two cultural/ recreation uses (boat marinas). The marina on the east side of Deer Harbor has a shop on it, and the U.S. Post Office is located in the upland portion of the shoreline jurisdiction. The predominantly residential existing land use continues south to Evans Cove. From there, the existing land use pattern changes to include an even mix of conservation, residential, vacant, cultural/recreation, and unclassified uses north to Indian Point. From Indian Point to Haida Point, the shores of Massacre Bay are characterized by large lot residential, with some small amounts of resource, vacant, and cultural/recreation uses. South and east of Haida Point to Orcas Village, the shoreline jurisdiction is predominantly residential with two cultural/recreation uses (marinas) and small areas of vacant uses. There is one existing trade land use (an inn) on the north side of White Beach Bay, east of Haida Point in the West Sound Activity Center. At Orcas Village, the shoreline jurisdiction includes a handful of trade (a store and hotel), cultural/recreation uses (State Ferry Terminal and associated facilities), and one government use (U.S. Post Office). The area between Orcas Village and Grindstone Harbor is predominantly residential with small amounts of vacant and cultural/recreation uses.

Of the small islands within this management area, Fawn, Big Double, Little Double, and Picnic islands are residential, and Oak, Skull, and Victim islands are undeveloped Federal lands.

Additional shoreline uses include multiple DNR utility easements, two desalination systems, a sanitary sewer outfall, a non-water dependent overwater structure (private residence) and a bridge easement. The tidelands are a mix of state-owned aquatic lands and private ownership.

Water-dependent uses in this management area consist of several public marine facilities, including Deer Harbor, Westsound (Boddington), and Orcas Landing (including the Washington State Ferry terminal). This category also includes a large number of private and community docks, piers, and marine railways, and the boatworks at Deer Harbor. Water enjoyment uses include several hotels/inns and bed and breakfast establishments, particularly in and near Deer

Harbor, West Sound, and Orcas Village. Other water enjoyment areas include Washington State marine parks at Skull and Victim islands.

Land Use Designations

In terms of Comprehensive Plan land use designations, most of the area between Fritz Point and Deer Harbor is designated Rural Farm Forest, with a Rural Residential designation corresponding to a predominantly developed area on both side of Steep Point. Most of Deer Harbor is designated Deer Harbor Hamlet Residential, with smaller areas of the shoreline jurisdiction here designated Deer Harbor Hamlet Commercial, Deer Harbor Hamlet Industrial, and Deer Harbor Hamlet Park. The variety of Comprehensive Plan land use designations here represents the higher intensity activity center of the Deer Harbor Hamlet. Between Deer Harbor and Orcas Village, the majority of the shoreline jurisdiction is designated Rural Farm Forest, with large parts of this area, particularly on the west side of West Sound being designated Forest Resource. The shoreline jurisdiction in Orcas Village itself is designated Activity Center. East of Orcas Village to Grindstone Harbor, the shoreline jurisdiction is designated Rural Farm Forest.

Fawn, Big Double, and Little Double islands are designated Conservancy, and Oak, Skull, and Victim islands are designated Natural.

Shoreline Environment Designations

This management area has a mix of shoreline environments applied, reflecting more varied land uses than most of the other management areas. From south of Fritz Point to the southwest corner of Deer Harbor, Rural Residential shoreline environment is applied. Further north, to the edge of the Deer Harbor Activity Center, the shoreline environment designation is Conservancy. With some exceptions the Deer Harbor Activity Center's shoreline environment is Rural. Exceptions include Conservancy applied to the northern or inner Deer Harbor area, which is surrounded by land bank property, and the Deer Harbor Marina on the eastern shore with its store and upland Post Office, which is designated Urban. Rural Residential is applied to the next several parcels south of the Deer Harbor Activity Center. Beyond that, the shoreline is designated Rural Farm-Forest until the West Sound Activity Center. The West Sound Activity Center south to White Beach Bay is designated Rural. Beyond that is an area designated Rural Farm-Forest until reaching Orcas Village. Orcas Village Activity Center is designated Rural except around the Washington State Ferry Terminal and the nearby marina, which are designated Urban, reflecting the more developed and built-up character of Orcas Village. The remainder of the management area to Grindstone Harbor is predominately Rural Farm-Forest with small areas of Rural Residential and Conservancy applied in this area.

Fawn, Big Double, and Little Double islands are designated Conservancy, and Oak, Skull, and Victim islands are designated Natural.

Shoreline Modifications

Approximately 6.7 percent of the management area is armored, a relatively high percentage for the County, particularly given the amount of bedrock shoreline in the area. While the armoring is preferentially located in areas of glacial sediment, there are many revetments along shorelines

mapped as containing bedrock. There are 98 overwater structures in the management area, which is second only to Fisherman Bay in terms of number. Most of these structures are docks and piers (76), but there are a large number of overwater buildings and bridges. In addition to the docks and piers, there are seven boat ramps and five marinas, more than any other management area except the Fisherman Bay (which also has five). There are also a large number of mooring buoys (122), which are clustered near the villages of Deer Harbor, West Sound, and Orcas Village.

Existing and Potential Public Access Areas

The Westsound management area contains over 25 miles of shoreline and several active and passive shoreline access opportunities, including:

Existing Facilities

- Westsound Dock – also referred to as Boddington's Dock. This facility includes a 165-foot pier attached to two 45-foot floating docks and is available for day use.

- Orcas Village Tidelands is a conservation easement that protects eelgrass beds and marine habitat adjacent to the Orcas ferry landing.

- Orcas Landing is a relatively recent acquisition by the Public Works department. This public marine facility contains a drive-on pier with a small building. To the east, a small float is reserved for the Sheriff's boat. To the east, three floats provide mooring for up to 4 hours. A gangway on each side of the pier provides access to the floats. There is little public parking available at the site. Adjacent to the pier are four spaces – 2 ADA, one for the sheriff and one for the County. On the northern elevated boundary are seven reserved parking spaces..

- Deer Harbor Preserve is a 2-acre land bank property with 650 feet of low-bank shoreline, associated tidelands, a walking path, and views to the Wasp islands. Deer Harbor road provides access to shoreline.

- The Land Bank owns shoreline public access in Massacre Bay linking West Sound and the Turtleback Mt. Preserve.

Existing Facilities with Potential for Improvement

- Clapp Conservation Easement is a 160-acre property on which the development potential has been reduced from 58 to 16 units; the number of shoreline lots cannot exceed 5. This protects the visual access and aesthetics of an important stretch of shoreline in the Westsound management area. The easement currently does not allow shoreline public access. Opportunity can be explored to provide shoreline public access.

- Deer Harbor Marina Float: Public Works leases float space from Deer Harbor Marina in a 25 year lease. Mooring is by permit only. The facility serves the private and commercial needs of outer island residents, primarily those from Waldron Island. There is a 1000 lb. capacity loading crane, owned and maintained by Public Works. Currently, there is no dedicated parking that goes with the public mooring. Generally, parking at Deer Harbor is a problem, especially during the summer months. Acquisition of a suitable parking facility is an on-going challenge that has not been resolved.

A trail in this management area connects with the Deer Harbor Loop Trail. The public access opportunities available in the Westsound management area are generally consistent with the goals and policies of the Comprehensive Plan and Parks Plan.

4.18.3 Restoration Opportunities

There are numerous opportunities to restore freshwater streams discharging to the nearshore environment throughout the management area; however, probably the most significant opportunity is related to the artificial constriction at the Channel Road Bridge in Deer Harbor. Deer Harbor is a large, classic pocket estuary, which is relatively rare in the County. The bridge also clearly restricts tidal and freshwater exchange. Opening the constriction will reinitiate predevelopment-level physical processes expanding habitat opportunities for both fish and shorebirds. Because of this opportunity, engineering plans have been prepared by others to perform this restoration activity, but funding has not yet been secured to complete the project.

Table 38A. West Sound Management Area Reach Assessment – Physical Conditions.

Reach	Natural Sediment Transport Patterns	Shoreline Sediment Input Alterations - Feeder Bluffs	Shoreline Sediment Input Alterations - Pocket Beaches	Shoreline Sediment Input Alterations - Barrier Beaches	Natural Current Patterns	Wave & Current Attenuation	Nutrient and Toxics Removal	Shade	Total
23	5	NP	4	NP	5	4	5	4	27
24	5	NP	5	NP	5	5	3	4	27
25	5	NP	NP	NP	3	4	3	3	18
26	5	NP	NP	NP	5	4	3	1	18
27	5	NP	NP	NP	2	4	3	1	15
28	5	2	NP	NP	3	3	3	5	21
29	5	4	NP	NP	3	4	3	3	22
30	5	NP	2	NP	3	4	5	4	23
31	5	NP	NP	NP	5	5	3	5	23
32	5	NP	5	NP	5	5	3	4	27
33	5	NP	NP	NP	5	5	3	3	21
34	5	NP	3	NP	3	4	3	4	22
35	5	NP	NP	NP	5	5	3	0	18
36	5	NP	NP	NP	1	4	3	3	16
37	5	NP	4	NP	0	4	3	3	19
38	5	5	NP	NP	0	4	3	2	19
39	5	NP	0	NP	2	3	3	3	16
40	5	NP	NP	NP	5	5	3	0	18
41	5	NP	0	NP	5	2	3	3	18
42	5	NP	3	NP	3	4	3	5	23
43	5	NP	5	NP	5	5	5	3	28
44	5	5	NP	NP	0	4	5	3	22

45	5	5	5	NP	5	5	5	3	33
46	5	5	NP	2	5	4	5	4	30
47	5	NP	5	NP	5	5	5	3	28
48	5	NP	3	NP	5	4	5	4	26
Median	5.00	5.00	5.00	2.00	5.00	4.00	3.00	3.00	22.00
Average	5.00	4.33	3.38	2.00	3.58	4.19	3.62	3.08	22.23
Percent of Highest Possible Score	100%	87%	68%	40%	72%	84%	72%	62%	56%

NP = Not Present

Table 38B. West Sound Management Area Reach Assessment – Habitat Conditions.

Reach	Vegetation Coverage	Estuary Habitat	Birds	Haul-out Habitat	Eelgrass	Floating Kelp	Understory Kelp	Spawning Habitat[1]	Herring Spawning Habitat	Shellfish	Total
23	5	0	0	0	5	0	5	0	0	4	19
24	5	0	1	0	5	5	0	0	0	3	19
25	5	2	0	0	5	0	0	0	0	2	14
26	5	3	0	0	5	0	0	0	0	2	15
27	4	2	0	0	5	0	0	0	0	2	13
28	4	0	0	0	5	0	0	0	0	2	11
29	4	0	0	0	5	0	0	0	0	2	11
30	5	0	0	0	5	5	5	3	5	3	31
31	5	1	0	0	5	0	5	0	5	1	22
32	5	1	1	0	5	5	5	0	5	2	29
33	5	0	1	0	0	0	5	0	5	1	17
34	5	4	0	0	5	5	5	3	5	1	33
35	5	0	5	0	0	0	0	0	5	1	16
36	4	0	0	0	5	0	0	0	5	1	15
37	4	1	0	0	5	0	5	0	5	1	21
38	4	1	1	0	0	0	5	3	5	1	20
39	5	1	0	0	5	0	0	0	5	1	17
40	5	1	0	0	5	0	0	0	5	1	17
41	4	1	0	0	5	0	0	0	5	1	16
42	5	1	0	0	5	5	5	0	0	2	23
43	4	0	0	0	5	5	5	3	0	1	23
44	3	0	0	0	5	0	5	3	0	1	17
45	5	0	1	0	5	5	5	0	0	1	22
46	5	0	0	0	5	5	0	0	0	1	16
47	5	1	0	0	5	5	5	0	0	1	22

48	5	0	0	0	5	0	0	0	0	0	10
Median	5.00	0.50	0.00	0.00	5.00	0.00	5.00	0.00	0.00	1.00	17.00
Average	4.62	0.77	0.38	0.00	4.42	1.73	2.50	0.58	2.31	1.50	18.81
Percent of Highest Possible Score	92%	15%	8%	0%	88%	35%	50%	12%	46%	30%	38%

[1] Includes priority spawning habitat for sand lance, surf smelt, and rock sole.

4.19 Private Lakes Management Area

The Private Lakes management area includes all of the privately held lakes in the County that are greater than 20 acres in size. This includes: Sportsman Lake, Horseshoe Lake, Spencer Lake, Zylstra Lake, Roche Harbor Lake (aka Briggs Pond), Hummel Lake, Martins Lake, Woods Lake, and Dream Lake. The Private Lakes management area also includes Trout Lake, even though it is publicly owned by the Town of Friday Harbor (for use as a water-supply reservoir), because the lake is functionally private (public access is controlled). Per DNR, Trout Lake has state-owned shorelands and bedlands. There are no major transportation related uses in this management area, although several lakes have adjacent roads.

Table 39 is a summary of the reach assessment for the Private Lakes management area. The table is in two parts, one covering general physical conditions, the other addressing those conditions directly related to habitat functions. The following discussions cover both the conditions scored in the reach assessment (Tables 39A and B) and management area results from the ecosystem-wide characterization. In general, the private lakes score similar to their public counterparts with the highest scoring reaches typically undeveloped lake reaches. Reaches with a road generally score lower because of significant alterations to the physical environment from road construction and maintenance (for example, the placement of rock, disconnection of shoreline sediment sources) and lack of riparian vegetation. Other private lakes (such as Zylstra Lake and Woods Lake) have been affected primarily by logging and recreational development.

4.19.1 Physical and Biological Characterization

Geologic Hazards

There are no known geologic hazards to the Private Lakes.

Drainage Basins, Tributary Streams, and Associated Wetlands

The drainage basins are diverse among the Private Lakes. Some of the lakes have stream tributaries (such as Spencer Lake and Trout Lake), while others have none (like Horseshoe Lake). There are several reservoirs (Trout Lake, Roche Harbor Lake, Dream Lake, Woods Lake and Martins Lake). These lakes are natural; however, the dams that regulate their discharge also affect sediment transport processes within the lakes. Many of the lakes have associated wetlands. Most have no or a relatively low level of adjacent development. The Trout Lake drainage basin is protected from future development to protect this water-supply reservoir for the Town of Friday Harbor.

Critical or Priority Habitat and Species Use

Many Private Lakes provide habitat to support planted rainbow trout populations. These include Sportsman Lake and Zylstra Lake on San Juan Island, Horseshoe, and Spencer lakes (Blakely Island) and Hummel Lake (Lopez Island). WDFW also plants triploid trout in Hummel Lake. Fish occurrence in Trout Lake is unknown. However, the water from this lake eventually drains into False Bay Creek, which has high potential to provide habitat for native populations of salmon.

Zylstra Lake contributes water to False Bay Creek, and is an important source of minimum flows during drier seasons to support habitat conditions for coho fry that may be present at times. Private lakes, which in general are not heavily developed, also provide suitable habitat for bird species that are associated with freshwater habitats. This includes bald eagles, which have been observed near Zylstra, Spencer, and Horseshoe Lakes and likely use habitat along the forested shorelines of other lakes. Both shoreline vegetation providing nearshore shade, and vegetation coverage within the shoreline jurisdiction score high in all reaches.

Water Quality, Sediment, and/or Tissue Sample Results

There is no known publically available water quality data for the private lakes with the exception of Trout Lake, which is a water supply source for the Town of Friday Harbor. Trout Lake water has routinely met drinking water standards with the exception of total Trihalomethanes (THMs), which are a byproduct of the chlorination process (Town of Friday Harbor 2011). No fish tissue data are available for Trout Lake.

4.19.2 Shoreline Use Patterns

Existing Land and Shoreline Use

Land Use

Overall existing land use in the Private Lakes management area includes:

- Residential – 18 percent
- Services – 17 percent
- Cultural, Entertainment, Recreation – 4 percent
- Undeveloped Land – 61 percent

Roche Harbor Lake's shoreline jurisdiction on San Juan Island is entirely resource land uses. Neva Lake has a mix of land uses, including residential, cultural/recreation, trade, and vacant. There is a private resort (Lakedale) on the shores of this lake, providing for a wider mix of existing land uses. Sportsman Lake is largely residential with small amounts of vacant and cultural/recreation land uses. Egg Lake, a wetland area associated with Sportsman Lake, is largely vacant with some large lot residential land uses on the edges of the lake's shoreline jurisdiction. Other wetlands associated with Sportsman Lake, found south and southeast of the lake are in areas with vacant lands predominating, as well as some large lot residential development. Zylstra Lake shoreline is almost entirely in resource land use. Associated wetlands to the north, including Margos Lake, include a mix of residential, vacant, and conservation land uses. While Zylstra Lake's southern associated wetlands are mostly in resource land, Woods Lake is in an area with large lot residential development and a small amount of resource and vacant land uses interspersed. Trout Lake is completely surrounded by government/education land use as the Town of Friday Harbor's municipal water supply.

Martins Lake on Orcas Island is completely surrounded by resource land uses.

Lopez Island's Hummel Lake shoreline jurisdiction is predominantly in resource use with cultural/recreation and vacant parcels making up the second largest amount of existing land use.

There are also a handful of residential land uses on this lake's shoreline. The stream and associated wetland that travel north from Hummel Lake are flanked with existing resource land use near the lake with large lot residential uses more predominant at the northern end of this shoreline jurisdiction.

Blakely Island's Horseshoe Lake is entirely surrounded by existing resource land uses. While Spencer Lake is largely made up of resource land use, it also includes a large lot residential use on its northern shore, and a government/education use on the southern shore.

Some of the larger lakes, such as Horseshoe Lake on Blakely Island, have water-dependent uses, such as private piers or docks. In terms of water-related uses, dams exist at Briggs, Neva, Dream, and Trout lakes on San Juan Island. Dams also exist on Martin Lake on Orcas Island and Spencer Lake on Blakely Island. Water enjoyment uses, such as hotels/lodging and associated eating establishments are found adjacent to Neva and Dream Lakes, which are in a more developed area than other San Juan Island lakes with shoreline jurisdiction.

Land Use Designations

Roche Harbor Lake's shoreline jurisdiction is designated Rural Farm Forest. Comprehensive Plan land uses in Neva Lake's shoreline include Rural General on the south side, and Rural Farm Forest on the remaining shorelines. Dream Lake, Egg Lake, and Sportsman Lake are surrounded by Rural Farm Forest designations. Zylstra Lake's shoreline is designated Agricultural Resource, while associated wetlands extending to Margos Lake include both Agricultural Resource and Rural Farm Forest designations. Woods Lake is completely surrounded by Rural Farm Forest designation. Trout Lake's shorelines are designated Town of Friday Harbor as it is the Town's municipal water supply source.

Martins Lake's shorelines on Orcas Island are designated Forest Resource. Comprehensive Plan land use designations on Hummel Lake are predominantly Rural Farm Forest with the exception of the northeast side and the associated wetland extending to the north, which are both in the Agricultural Resource designation. Both Horseshoe Lake and Spencer Lake on Blakely Island are designated Forest Resource.

Shoreline Environment Designations

Of the lakes with shoreline jurisdiction on San Juan Island, Roche Harbor Lake, Zylstra Lake, and the Sportsman Lake group that includes Neva, Dream, and Egg lakes are in the Rural Farm-Forest shoreline environment. Trout Lake is in the Natural shoreline environment.

Martins Lake on Orcas Island and Hummel Lake on Lopez Island are designated Rural Farm Forest shoreline designation. Spencer Lake on Blakely Island is also in the Rural Farm Forest shoreline designation, and Horseshoe Lake, also on Blakely Island, is in the Conservancy shoreline designation.

Shoreline Modifications

No official County database exists for the shoreline modifications to lakes. Several of the Private Lakes (Sportsman, Hummel, Dream, Martin's, and Spencer lakes) have roads along their

shorelines. All of the lakes have at least one overwater structure within them, with the exception of Martins Lake, Woods Lake and Zylstra Lake. Spencer Lake has four overwater structures. Trout Lake is a reservoir and therefore has a dam at its outlet.

Existing and Potential Public Access Areas

The Private Lakes management area has roughly 17.7 miles of freshwater shorelines. There are over 8,000 feet of trails in this management area. On San Juan Island, Roche Harbor Lake has trails within the shoreline. Trout Lake also has trails, but public access to Trout Lake is controlled. There is a locked gate on the road to the lake. There are no sanctioned recreational opportunities allowed in the Trout Lake watershed (Town of Friday Harbor Water System Plan 2003). On Lopez Island, Hummel Lake Preserve offers public access and trails within the shoreline.

4.19.3 Restoration Opportunities

Several of the private lakes (Sportsman, Hummel, Dream, Martin's, and Spencer lakes) have roads along their shorelines. In most cases, areas adjacent to the roadway have been cleared, eliminating all riparian woody vegetation. In a few locations (e.g., Hummel and Dream lakes), fill has also been placed, altering the shoreline geomorphology. Removing the fill would have the largest habitat benefits, replacing lost shoreline habitat, but it would require costly relocation of the roadway. Revegetation, while not as beneficial as fill removal, would restore lost riparian habitat and would be relatively straightforward to implement considering that it could be done in the road right of way, which is typically under County control.

Table 39A. Private Lakes Management Area Reach Assessment – Physical Conditions.

Reach	Shoreline Modifications	Natural Current Patterns	Toxics Nutrient and Toxics Removal	Shade	Total
79	5	3	5	4	17
80	5	5	5	5	20
95	5	5	0	5	15
96	5	5	5	5	20
171	3	1	5	2	11
172	5	5	5	5	20
268	5	5	3	5	18
269	4	5	5	5	19
270	3	1	5	4	13
271	5	5	5	4	19
272	4	3	5	4	16
273	3	1	5	3	12
274	5	0	5	4	14
275	3	5	5	5	18
276	5	1	0	3	9
277	3	5	5	5	18
Median	5.00	5.00	5.00	4.50	17.50
Average	4.25	3.44	4.25	4.25	16.19
Percent of Highest Possible Score	85%	69%	85%	85%	81%

Table 39B. Private Lakes Management Area Reach Assessment – Habitat Conditions.

Reach	Vegetation Coverage	Wetland Habitat	Birds	Salmonids	Total
79	5	0	0	0	5
80	5	1	1	0	7
95	5	4	0	3	12
96	5	0	0	0	5
171	5	5	0	3	13
172	5	5	5	0	15
268	5	1	0	0	6
269	5	1	0	0	6
270	4	4	2	0	10
271	4	5	5	0	14
272	5	5	1	0	11
273	4	5	0	3	12
274	5	5	0	3	13
275	5	1	0	0	6
276	4	5	1	5	15
277	5	2	0	0	7
Median	5.00	4.00	0.00	0.00	10.50
Average	4.75	3.13	1.00	1.13	9.81
Percent of Highest Possible Score	95%	63%	20%	23%	49%

4.20 Public Lakes Management Area

The Public Lakes management area includes Cascade Lake and Mountain Lake on Orcas Island. Cascade Lake and Mountain Lake are a part of Moran State Park (a small portion of Cascade Lake is in private ownership). There are no major transportation related uses in this management area, although Cascade Lake has a road adjacent to a significant length of its shoreline.

Table 40 is a summary of the reach assessment for the Public Lakes management area. The table is in two parts, one covering general physical conditions, the other addressing those conditions directly related to habitat functions. The following discussions cover both the conditions scored in the reach assessment (Tables 40A and B) and management area results from the ecosystem-wide characterization. The Public Lake management area scores very high for physical conditions as well as habitat functions. Although there are shoreline modifications and disruptions to natural current patterns on a number of reaches, in general the extent of undeveloped shore and adjacent uplands provides high quality habitat. Where there are lower scores, they are principally a result of the recreational infrastructure associated with the public lakes. Cascade Lake scores particularly low because the shoreline is heavily modified to provide recreational uses and public access to the shore in Moran State Park. By comparison, Mountain Lake scores much higher as there is much less development-related infrastructure.

4.20.1 Physical and Biological Characterization

Geologic Hazards

There are no known geologic hazards to the Public Lakes management area.

Drainage Basins, Tributary Streams and Associated Wetlands

Mountain Lake does not have a mapped stream source but does have seasonal tributary streams. At least two small streams (one a tributary from Cascade Creek) drain to Cascade Lake. The public lakes drainage basins are mostly protected from future development because they are in parks. There are no documented wetlands surrounding Cascade Lake; however, Cascade Lake has an associated lagoon. Small fringing wetlands do occur around Mountain Lake. The public lakes have dams and, for each, the dam construction and operation largely determines sediment input and discharge.

Critical or Priority Habitat and Species Use

Mountain Lake and Cascade Lake each support cutthroat trout and kokanee populations. Cascade Lake contains rainbow trout, and both lakes are also planted with sterile triploid trout to increase recreational fishing opportunities. These lakes are generally undeveloped and likely provide suitable habitat for numerous bird species that are associated with freshwater environments although only one reach has a reported sighting of a priority species, the common loon. The common loon, a state sensitive species is attracted to relatively undisturbed forest lakes that are greater than 50 acres in size, and that have deep inlets or bays, good water quality, food sources, and nesting sites. Mountain and Cascade lakes provide typical conditions to support this species. Likely many other bird species are attracted to these conditions.

Water Quality, Sediment, and/or Tissue Sample Results

Fish tissue data have been collected from Mountain and Cascade Lakes. Mountain Lake was 303(d) listed in 2008 for elevated levels of PCBs in fish tissue samples (kokanee salmon) (Ecology 2011e). In contrast, fish tissue samples (including largemouth bass, rainbow trout, and kokanee salmon) collected from Cascade Lake met all associated fish tissue criteria (Ecology 2011e).

4.20.2 Shoreline Use Patterns

Existing Land and Shoreline Use

Land Use

Both Cascade and Mountain lakes are completely within Moran State Park. Existing land uses around Mountain Lake consist of the cultural/recreation use of the state park, including campsites near the lake. Cascade Lake has similar land uses along most of its shoreline jurisdiction as Mountain Lake, but also includes a boat rental facility not present at Mountain Lake. In addition, the Cascade Lake lagoon includes some large vacant parcels and a handful of cultural/recreation uses on the far western end of the lake.

Overall existing land use in the Public Lakes management area includes:

- Cultural, Entertainment, Recreation – 90 percent
- Undeveloped Land – 10 percent

The boat rental facility and docks at Cascade Lake are considered a water-dependent use. Moran State Park and the campground and hiking trails surrounding both lakes in this management area are considered water enjoyment uses.

Cascade Lake and Mountain Lake on Orcas Island have state-owned shorelands and bedlands that management authority appears to have been provided to the Washington State Parks and Recreation Commission by Commissioner Order in 1932.

Land Use Designations

The portions of the two lakes found within Moran State Park are designated Conservancy, reflecting their status within a state park. The Cascade Lake Lagoon is surrounded by Rural Residential land designation on the north and south, and by Master Plan Resort on the far west where it touches Rosario Resort.

Shoreline Environment Designations

Both Public Lakes are in the Conservancy shoreline environment.

Shoreline Modifications

No official County database exists for shoreline modifications to lakes. However, an analysis of aerial photographs indicates that there are four overwater structures in Cascade Lake and a boat ramp and dock at Mountain Lake. Cascade Lake has a road along its shoreline for more than one-

third of a mile. Mountain Lake also has road beside it, but only for a limited distance. Cascade and Mountain Lakes (both natural lakes) are dammed.

Existing and Potential Public Access Areas

This management area has over 30,000 feet of trails and paths; the Moran State Park campground has a dock and boating facilities. Both Cascade and Mountain Lakes have trails around the shoreline. Mountain and Cascade Lakes each have a boat launch. Cascade Lake has some campsites in shoreline jurisdiction.

4.20.3 Restoration Opportunities

Because these lakes are relatively undeveloped and high quality in both human and ecological perspectives, restoration opportunities are limited. However, Cascade Lake, like some of the Private Lakes, does have a road along a portion of its shoreline, some of which is on fill. The riparian zone in this area is sparsely vegetated. Moving the road would be difficult due to the adjacent steep slopes, but improving vegetation cover in the riparian corridor may be possible.

For the undisturbed portions of these lakes it is likely that protection and conservation measures that sustain continuity across terrestrial and aquatic habitats will be important for species and for protecting the long term water quality. Conservation of vegetated buffers and corridors between the lakes and other habitats should be a priority for future management. Further investigation should be undertaken to determine the origin of PCBs to Mountain Lake kokanee salmon.

Table 40A. Public Lakes Management Area Reach Assessment – Physical Conditions.

Reach	Shoreline Modifications	Wave attenuation	Toxics removal	Shade	Total
75	5	5	0	5	15
76	4	4	0	5	13
77	3	3	5	4	15
78	4	5	5	5	19
Median	4.00	4.50	2.50	5.00	15.00
Average	4.00	4.25	2.50	4.75	15.50
Percent of Highest Possible Score	80%	85%	50%	95%	78%

Table 40B. Public Lakes Management Area Reach Assessment – Habitat Conditions.

Reach	Vegetation Coverage	Wetland Habitat	Birds	Salmonids	Total
75	5	1	0	5	11
76	5	0	0	5	10
77	4	0	1	5	10
78	5	1	0	5	11
Median	5.00	0.50	0.00	5.00	10.50
Average	4.75	0.50	0.25	5.00	10.50
Percent of Highest Possible Score	95%	10%	5%	100%	53%

5.0 Use Analysis

This section presents a use analysis, identifying current and projected shoreline use patterns, as well as estimating future demand for shoreline space, consistent with SMP guidelines. The use analysis includes a shoreline land capacity analysis that estimates total amount of potential future residential, commercial, and industrial development in the shoreline jurisdiction based upon an assessment of buildable lands and zoning designations applied to the shoreline jurisdiction. In addition, use analysis also includes an assessment, based in part on an assessment of existing and planned land uses, of potential future land use conflicts, projected shoreline preferred uses, and potential uses needed based upon economic needs of the community.

5.1 Shoreline Land Capacity Analysis – Methods

The purpose of the shoreline land capacity analysis is to gauge the potential level of development that may occur in the future along shorelines given adopted Comprehensive Plan land use designations. The information is intended to provide an understanding of the future level of intensity that may occur given current plans and regulations.

San Juan County's land use plans contained in the County's Comprehensive Plan give a more specific picture of likely future activities on the shorelines than the present SMP, which allows more uses/activities in each of the shoreline environments compared to the County's Comprehensive Plan land use designations.

The method to determine shoreline land capacity is summarized below. A more detailed matrix of assumptions is included in Appendix C.

- **Determine shoreline boundaries.** The analysis includes parcels within or intersecting the shoreline jurisdiction, which is 200 feet, measured horizontally from the ordinary high water mark. The parcel was included whether the entire parcel was within shoreline jurisdiction, or just a part of the parcel was included in shoreline jurisdiction. However, if a parcel was only within an associated wetland, then it was not included in the land capacity analysis.
- **Determine Development Potential.** The analysis estimates developable acres by future land use category. Developable acres include: 1) vacant land that can be subdivided (vacant land includes those lands with no buildings but also includes land with buildings that have little to no value per the assessor's record); 2) vacant land on parcels too small to be subdivided but with a potential legal right to develop; 3) partially used (e.g., single-family properties containing one home but the land can be further subdivided; or 4) underutilized (land value exceeds building value on multifamily, commercial, or industrial properties). Constraints such as wetlands, streams, and their buffers, as well as any land preserved for

habitat protection or land conservation were deducted from gross acres. Other deductions were made for government or public ownership properties, and private and public access roads and development infrastructure. Market factor reductions, which account for land that may not be available (e.g., owners does not wish to develop), are also included. Densities are applied to the net buildable acres for residential development to estimate total future dwellings.

- Due to specific residential development patterns in San Juan County, a factor based upon the U.S. Census data and the San Juan County Housing Needs Assessment (Personal communication with Colin Maycock, Senior Planner, San Juan County on April 2011) was applied to estimate the number of the dwellings calculated above which are second homes and/or guest lodging.
- Because the vast majority of undeveloped and/or partially developed shoreline is residential, the County Planning staff was able to provide an assessment of potential commercial and industrial development and redevelopment in shoreline jurisdiction by reviewing parcel-specific data.

The statistical results exclude the following lands:

- Lands specifically identified as "public" on the San Juan County Comprehensive Plan. Lands identified as "public" or "government" on existing land use maps were excluded from statistical analysis of additional residences and commercial/industrial development potential. However, since public uses may result in shoreline development of structures or facilities, designated public acres are described in each subsection where applicable.
- Lands designated for conservation whether publicly or privately owned were excluded from the statistics since the likelihood is that these conservation easements or ownership (e.g., Nature Conservancy) mean that future development or redevelopment on these lands is unlikely.

It is important to note that this analysis is intended to give an overall picture of the potential for development along shorelines, but is not an exact predictor of which parcels may develop or redevelop. In addition, the analysis does not provide a "rate" of development.

5.2 Shoreline Land Capacity Analysis – Results By Management area

The results of the shoreline jurisdiction land capacity analysis divided by management area are summarized in Table 41 below. A summary discussion of the land capacity results by management area follows Table 41.

Table 41. Estimated Residential Land Capacity – Parcels Within or Touching Shoreline Jurisdiction.

Management Area	Shoreline Length (Miles)	Number of Parcels Within Shoreline Jurisdiction	Vacant Parcels[1]		Protected Lands Parcels (approximate)		Parcels with Nonconforming Structures[2]		Potential New SFRs[3] in Vacant and Partially Used Land	Potential New SFRs in Lots Unable to Subdivide	Potential New Multi-Family Dwelling Units	Total Dwelling Units
			#	% of Total #	#	% of Total #	#	% of Total #				
Blakely	13.9	138	59	43%	9	7%	8	6%	62	38	0	100
Decatur	19.6	265	78	29%	5	2%	38	14%	128	66	0	194
Doe Bay	23.4	265	115	43%	8	3%	22	8%	31	90	0	121
East Sound	17.5	279	121	43%	20	7%	37	13%	120	67	66	253
Fisherman Bay	14.0	350	112	32%	14	4%	30	9%	42	86	0	128
Friday Harbor	24.2	450	122	27%	15	3%	109	24%	48	101	0	149
Mud Bay	28.4	323	145	45%	20	6%	25	8%	46	111	0	157
North Coast Eastsound	4.4	162	47	29%	0	0%	17	10%	3	43	0	46
Olga	15.0	328	116	35%	5	2%	34	10%	54	96	0	150
Private Lakes	17.8	103	64	62%	21	20%	4	4%	56	35	0	91
Public Lakes	7.6	12	6	50%	4	33%	1	8%	10	0	0	10
Roche Harbor	33.7	719	222	31%	11	2%	137	19%	121	198	0	319
San Juan Channel	13.2	228	62	27%	3	1%	54	24%	39	54	0	93
Shaw	38.2	323	129	40%	21	7%	67	21%	151	87	0	238
Spencer Spit	12.7	291	88	30%	16	5%	28	10%	3	74	0	77
Strait of Juan de Fuca	57.7	547	209	38%	34	6%	25	5%	73	154	0	227
Stuart	36.0	260	134	52%	9	3%	29	11%	158	99	0	257
Turtleback	15.5	122	43	35%	5	4%	30	25%	105	34	0	139
Waldron	45.6	149	68	46%	15	10%	12	8%	61	48	0	109
West Sound	25.5	383	119	31%	18	5%	65	17%	108	41	84	233
TOTAL	**464.0**	**5,697**	**2,059**	**36%**	**253**	**4%**	**772**	**14%**	**1,419**	**1,522**	**150**	**3,091**

[1] Assessed building value of less than $10,000.
[2] Presence of building within 50 feet of shoreline, which are non-conforming under the existing SMP.
[3] Single-family residence.

Overall, the land capacity analysis shows that the vast majority of development capacity within the County's shoreline jurisdiction is residential development. Another large portion of the County's shorelines were excluded from the land capacity analysis because it is held in public ownership and/or protected through conservation easements or other measures. A small fraction of the County's shoreline capacity is available for commercial development that could include water-enjoyment uses such as restaurants. Although a small amount of the County's shoreline jurisdiction is in industrial uses, there is no measureable industrial land capacity in the County shoreline jurisdiction. Much of the existing potential industrial capacity is taken up by essential industrial uses, such as boat repair facilities, which in some cases represent the only location for this type of development on the island on which the use is located. Because there is so little commercial and industrial land capacity in the County, County staff assisted in providing a qualitative assessment of parcels that have commercial or industrial development potential.

A review of Table 41 shows the disproportionate amount of residential development in shoreline jurisdiction that can be attributed to development of existing lots too small to subdivide under the San Juan County Code (SJCC). Almost half of the single-family residential development capacity occurs on these lots. In addition, Table 41 also shows the very low capacity for multifamily development in the San Juan County shoreline jurisdiction.

Although Table 41 indicates a potential residential land capacity of 3,091 dwelling units, County permit data for waterfront residential development in the years 2000-2009 indicates that permit activity averaged approximately 57 per year during this period. Applying the average permit data indicates that the residential land capacity could last 50 years or more into the future. Based upon 2010 U.S. Census data and the San Juan County Planning Department's analysis of housing needs, approximately 40 percent of the overall housing capacity, or approximately 1,236 dwelling units of the 3,091 dwelling unit total would be second homes or guest housing.

5.2.1 Blakely Island

The Blakely Island management area includes 138 parcels. Of these parcels, 43 percent are vacant and approximately 7 percent are protected from development by public or conservation group ownership, conservation easements, or similar reasons. Six percent of parcels include at least one non-conforming structure.

The Blakely Island management area's shoreline is designated for rural uses with a combination of residential, resource, and conservation uses. County land use districts in this management area include Forest Resource, Residential Rural, Rural Farm Forest, and Conservancy. The most intense uses of property would come from Rural Residential land uses at the northern portion of the management area. Approximately 62 percent of the approximately 100 new dwelling units that could occur in this management area would result from plat activity. Although large portions of Blakely Island are in Forest Resource land use that could allow nonresidential resource-based uses, much of the island is also owned by institutions and/or held in conservation easements. Therefore, there is no measurable commercial or industrial development capacity in this management area.

Although existing zoning allows some limited opportunity for non-priority uses in the shoreline jurisdiction, future use conflicts in this management area are highly unlikely. Use conflicts are particularly unlikely when accounting for the County's existing shoreline regulations, which would inhibit non-priority shoreline uses. This management area includes area for shoreline residential and associated water-dependent uses of associated docks and piers. Residential use of shorelines is a preferred use. However, the associated water-dependent uses such as piers and docks are not necessarily a preferred use but rather an allowed use. There is little or no area in the management area dedicated to water-oriented or shoreline preferred commercial and industrial uses in this management area.

5.2.2 Decatur Island

The Decatur Island management area includes 265 parcels. Of these parcels, 29 percent are vacant and approximately 2 percent are protected from development by public or conservation group ownership, conservation easements, or similar reasons. Fourteen percent of parcels include at least one non-conforming structure.

The Decatur Island shoreline is entirely designated for rural land uses. San Juan County land use districts along the shoreline in this management area include Rural Residential, Rural General, Rural Industrial, Conservancy, and Natural. Based on these designations, the most intense use of property appears to be with Rural General and Rural Residential designated lands found on most of the Decatur Island and Center Island shorelines. The majority of new residential development capacity in shoreline jurisdiction exists in these two designations. Although approximately one-third of the residential development capacity in this management area occurs on lots too small to be subdivided under the SJCC, some larger subdivision opportunities exist in this management area, particularly on Decatur Island. Although a small amount of Rural Industrial land exists in shoreline jurisdiction on Decatur Island, there is no measurable additional commercial or industrial development capacity in this management area.

Existing zoning allows some opportunity for non-priority uses in the shoreline jurisdiction, particularly in the Rural General and Rural Industrial land use designations found on Decatur Island in this management area. These zones allow a wide variety of uses, providing potential for future use conflicts. However, when considering existing shoreline regulations that the County applies in this management area, it appears that future use conflicts would be unlikely. This management area includes area for shoreline uses of residential and associated water-dependent uses, such as associated docks and piers and water-enjoyment uses associated with recreation at state parks and other public lands within this management area. A small amount of Rural Industrial land on the south side of Decatur Island allows industrial priority uses within the shoreline jurisdiction, though the area is currently developed with little or no additional development capacity.

5.2.3 Doe Bay

The Doe Bay management area includes 265 parcels. Of these parcels, 43 percent are vacant and approximately 3 percent are protected from development by public or conservation group

ownership, conservation easements, or similar reasons. Eight percent of parcels include at least one non-conforming structure.

The Doe Bay management area is designated for rural uses and has one rural Activity Center, Doe Bay, in its boundaries. County land use districts in this management area include Rural Residential, Rural Farm Forest, Forest Resources, Activity Center, Conservancy, and Natural. Although the Doe Bay Activity Center allows for higher intensity land uses than the other land use districts, there is little residential development capacity in that part of shoreline jurisdiction since much of that area is built out. Most of the residential development capacity in this management area comes from pre-existing lots that are too small for subdivision in the Rural Residential and Rural Farm Forest land use districts. There is no measureable commercial or industrial development capacity in this management area.

Although existing zoning allows some limited opportunity for non-priority uses in the shoreline jurisdiction, particularly in the small area designated as Activity Center, where a wider variety of uses are allowed, future use conflicts in this management area are unlikely. Use conflicts are particularly unlikely when accounting for the County's existing shoreline regulations, which would inhibit non-priority shoreline uses. This management area includes area for shoreline uses of residential and associated water-dependent uses of associated docks and piers. There is also area dedicated to water enjoyment recreation uses. There is little or no area in the management area dedicated to water-oriented or shoreline preferred commercial and industrial uses in this management area.

5.2.4 East Sound

The East Sound management area includes 279 parcels. Of these parcels, 43 percent are vacant and approximately 7 percent are protected from development by public or conservation group ownership, conservation easements, or similar reasons. Thirteen percent of parcels include at least one non-conforming structure.

The East Sound management area includes the south side of the Eastsound Urban Growth Area as well as significant rural areas on the west side of East Sound. County land use districts in this management area consist of Rural Farm Forest, Rural Residential, Eastsound Rural Residential, Eastsound Residential 2/acre, Eastsound Natural, Village Commercial, Village Residential, and Eastsound Rural. Approximately half of the residential development capacity in this management area comes from development and redevelopment of single-family land that can be subdivided, approximately one-quarter of residential capacity comes from development of single-family housing on pre-existing lots too small to subdivide, and one-quarter comes from multifamily development on vacant and partially used land. This management area is only one of two in the County with multifamily development capacity in shoreline jurisdiction. According to County Planning staff estimates, there are four partially developed parcels zoned Village Commercial in this management area that present the possibility for commercial redevelopment (Maycock, Colin. Personal communication, April 29, 2011). The area for potential commercial redevelopment in this management area amounts to approximately 0.89 acres. According to County Planning staff, there are no active land use applications for commercial development in

this management area. However, potential commercial redevelopment could include a wide variety of land uses based upon uses allowed in the Village Commercial land use designation.

Although the wide variety of land uses allowed in the Village Commercial zone provides a greater potential for future use conflicts, the existing shoreline use designations applied within the management area would minimize the likelihood of use conflicts. This management area includes area for shoreline uses of residential and associated water-dependent uses of associated docks, piers, and marina. Although a portion of this management area would allow for water-oriented commercial uses – such as water-enjoyment restaurants or lodging, much of this area is already developed and there is little opportunity for redevelopment. There is no area in the management area dedicated to shoreline preferred industrial uses.

5.2.5 Fisherman Bay

The Fisherman Bay management area includes 350 parcels. Of these parcels, 32 percent are vacant and approximately 4 percent are protected from development by public or conservation group ownership, conservation easements, or similar reasons. Nine percent of parcels include at least one non-conforming structure.

The Fisherman Bay management area includes the Lopez Village Urban Growth Area, but is predominantly made up of rural land use districts. Land use districts in this management area include Rural Farm Forest, Rural Residential, Lopez Village Urban Growth Area, Lopez Village Urban Growth Reserve, Marine Center LAMIRD, and Conservancy. The most intense land use development in this management area would come from the Lopez Village Urban Growth Area. However, the portion of the management area in this land use district is mostly built-out, and only a small percentage of residential land capacity is estimated to result from development there. Approximately 67 percent of residential land capacity in this management area is estimated to come from vacant pre-existing lots too small to be subdivided, most of which are located within the Rural Farm Forest land use district in this management area. In addition, the Marine Center LAMIRD, which contains the Lopez Islander Resort property and marina, is identified as partially used/redevelopable. According to County Planning staff, the approximately 13 acres of this designation in the Fisherman Bay management area could redevelop with commercial uses and/or a combination of residential and commercial uses (Maycock, Colin. Personal communication, April 29, 2011).

Although the wide variety of land uses allowed in the Lopez Village Urban Center and the Marine Center LAMIRD land use designations provides a greater potential for future use conflicts, the existing shoreline use designations applied within the management area would minimize the likelihood of use conflicts.

5.2.6 Friday Harbor

The Friday Harbor management area includes 450 parcels. Of these parcels, 27 percent are vacant and approximately 3 percent are protected from development by public or conservation group ownership, conservation easements, or similar reasons. Twenty-four percent of parcels include at least one non-conforming structure.

The Friday Harbor management area includes rural uses, including rural uses on the outskirts of the Town of Friday Harbor. Land use districts in this management area include Rural Farm Forest, Rural Residential, Rural Industrial, and Conservancy. The most intense land use development in this management area would come from the Rural Residential land use district and the small amount of Rural Industrial. Approximately 68 percent of the residential development capacity in this management area is estimated to come from pre-existing lots too small to be subdivided, most of which are located within the Rural Residential land use district. Although this management area is on the outskirts of the Town of Friday Harbor, there is no urban growth area within shoreline jurisdiction, and there is no measureable commercial or industrial land development capacity estimated in the management area.

Although existing zoning allows some limited opportunity for non-priority uses in the shoreline jurisdiction, future use conflicts in this management area are unlikely, particularly when accounting for the County's existing shoreline regulations, which would inhibit non-priority shoreline uses. The zoning designation with the highest likelihood of allowing a non-priority use would be the Rural Industrial zone. However, the small amount of Rural Industrial zone in this management area is occupied by an essential boat repair yard, which is unlikely to redevelop (Maycock, Colin. Personal communication, April 29, 2011). This management area includes area for shoreline uses of residential and associated water-dependent uses of associated docks, piers, and marina. In addition, space is dedicated to water-enjoyment public recreation uses in this area as well. There is little or no area in the management area dedicated to water-oriented or shoreline preferred commercial uses in this management area.

5.2.7 Mud Bay

The Mud Bay management area includes 323 parcels. Of these parcels, 45 percent are vacant and approximately 6 percent are protected from development by public or conservation group ownership, conservation easements, or similar reasons. Eight percent of parcels include at least one non-conforming structure.

The Mud Bay management area is entirely made up of rural uses. Land use districts in this management area include Rural Farm Forest, Rural Residential, Forest Resource, Conservancy, and Natural. The most intense land use development in this management area would come from the Rural Residential land use district. However, the portion of the management area in this designation is largely built out. The majority of residential development capacity in this management area comes from the Rural Farm Forest land use district. Approximately 71 percent of the residential development capacity would occur on pre-existing lots too small to subdivide. There is no measureable commercial or industrial land development capacity estimated in this management area.

Although existing zoning allows some limited opportunity for non-priority uses in the shoreline jurisdiction, future use conflicts in this management area are unlikely, particularly when accounting for the County's existing shoreline regulations, which would inhibit non-priority shoreline uses. This management area includes large areas for shoreline residential uses which may also be accompanied by associated water-dependent uses such as docks, piers, and marina. In addition, space is dedicated to water-enjoyment public recreation uses in this management

area as well. There is little or no area in the management area dedicated to water-oriented or shoreline preferred commercial or industrial uses.

5.2.8 North Coast Eastsound

The North Coast Eastsound management area includes 162 parcels. Of these parcels, 29 percent are vacant and none are protected from development by public or conservation group ownership, conservation easements, or similar reasons. Ten percent of parcels include at least one non-conforming structure.

The North Coast Eastsound management area includes portions of the County's Eastsound Urban Growth Area as well as some rural areas on the fringe of that urban growth area located on Orcas Island. This management area includes Rural Residential, Eastsound Rural Residential, Eastsound Residential 1/acre, Eastsound 4/acre P, Eastsound Marina, and Service and Light Industrial land use districts, Although this management area is largely urban with higher intensity land use districts than most of the other management areas, much of the existing shoreline is already developed. Most of the residential development capacity in this management area comes from development on pre-existing lots that are too small for subdivision (approximately 43 of 46 potential dwelling units). Although there is land in this management area dedicated to commercial development, there is little or no redevelopment potential in this management area (Maycock, Colin. Personal communication, April 29, 2011).

Although existing zoning allows some limited opportunity for non-priority uses in the shoreline jurisdiction, future use conflicts in this management area are unlikely, particularly when accounting for the County's existing shoreline regulations, which would inhibit non-priority shoreline uses. When not considering County shoreline regulations, the zones within this management area allow a wider variety of land uses and intensities than found in other management areas. This management area includes large areas for shoreline residential uses which may also be accompanied by associated water-dependent uses such as docks, piers, and marina. As described above, although there is area dedicated to commercial uses in this management area that could allow shoreline preferred non-residential uses, there is little or no commercial land capacity in this area.

5.2.9 Olga

The Olga management area includes 328 parcels. Of these parcels, 35 percent are vacant and approximately 2 percent are protected from development by public or conservation group ownership, conservation easements, or similar reasons. Ten percent of parcels include at least one non-conforming structure.

The Olga management area is in rural uses with one Hamlet (Olga) and one Master Planned Resort (Rosario) providing areas with more intense rural development. Other land use districts in this management area include Rural Farm Forest, Rural Residential, Forest Resource, and Conservancy. The majority of residential development capacity in this management area comes from development on pre-existing lots too small to be subdivided. Several Master Plan Resort parcels at Rosario Resort were identified as partially used/redevelopable in the land capacity

analysis. County Planning Staff indicated that although some commercial redevelopment could occur as a result of the future redevelopment in the Master Planned Resort land use designation, it would require a new Planned Unit Development (PUD) or an amendment to the existing PUD. The Olga Store also is identified as a potential commercial redevelopment site. However, based on County staff input this parcel is also unlikely to redevelop (Maycock, Colin. Personal communication, April 29, 2011).

Although existing zoning allows some limited opportunity for non-priority uses in the shoreline jurisdiction, future use conflicts in this management area are unlikely, particularly when accounting for the County's existing shoreline regulations, which would inhibit non-priority shoreline uses. The Master Planned Resort and the Olga Hamlet land use designations provide the greatest opportunity for future use conflicts based upon variety of uses allowed when not accounting for the County's shoreline jurisdiction. This management area includes large areas for shoreline residential uses which may also be accompanied by associated water-dependent uses such as docks, piers, and marina. In addition, space is dedicated to water-enjoyment public recreation uses in this management area as well. There is limited area dedicated to water-oriented or shoreline preferred commercial uses, and no area dedicated to industrial uses in this management area.

5.2.10 Private Lakes

The Private Lakes management area includes 103 parcels. Of these parcels, 62 percent are vacant and approximately 20 percent are protected from development by public or conservation group ownership, conservation easements, or similar reasons. Four percent of parcels include at least one non-conforming structure.

The Private Lakes management area is completely in rural land use districts on four of the County's islands. Land use districts in this management area include Rural Farm Forest, Agricultural Resource, and Forest Resources. The most intense land use development in this management area would come from the Rural Farm Forest land use district located on the shores of Sportsman, and Dream Lakes on San Juan Island, and Hummel Lake on Lopez Island. The majority of residential development capacity in this management area comes from development and redevelopment occurring in the Rural Farm Forest land use district. About 38 percent of this development occurs on pre-existing lots too small to subdivide. There is no measureable commercial or industrial land development capacity estimated in this management area.

Although existing zoning allows some limited opportunity for non-priority uses in the shoreline jurisdiction, future use conflicts in this management area are unlikely, particularly when accounting for the County's existing shoreline regulations, which would inhibit non-priority shoreline uses. This management area includes large areas for shoreline residential uses which may also be accompanied by associated water-dependent uses such as docks and piers. There is little or no area in the management area dedicated to water-oriented or shoreline preferred commercial or industrial uses.

5.2.11 Public Lakes

The Public Lakes management area includes 12 parcels. Of these parcels, 50 percent are vacant and approximately 33 percent are protected from development by public or conservation group ownership, conservation easements, or similar reasons. Eight percent of parcels include at least one non-conforming structure.

The Public Lakes management area is almost entirely within Moran State Park, which is within the County's Conservancy land use district. However, a small portion of the management area includes Rural Residential and Master Planned Resort (Rosario Resort) land use districts. Because of the amount of area already protected in state park, this management area has the lowest residential development capacity of all management areas in the County. Approximately 10 dwelling units are estimated to occur through redevelopment of underutilized parcels on the west side of Cascade Lake.

There is little or no opportunity for future use conflicts in this management area. The shoreline jurisdiction in Moran State Park offers water enjoyment recreation use opportunities. There is a limited area available for preferred residential use in this management area and no opportunity for industrial preferred uses in this management area.

5.2.12 Roche Harbor

The Roche Harbor management area includes 719 parcels. Of these parcels, 31 percent are vacant and approximately 2 percent are protected from development by public or conservation group ownership, conservation easements, or similar reasons. Nineteen percent of parcels include at least one non-conforming structure.

The Roche Harbor management area is predominantly made up of rural uses, as well as the Roche Harbor Master Planned Resort. Other land use districts in this management area include Rural Farm Forest, Rural Residential, and Conservancy, and Natural. The most intense land use development in this management area would come from the Master Planned Resort land use district. However, the portion of the management area in Master Planned Resort is mostly built-out, and only a small percentage of residential land capacity is estimated to result from development in that land use district. As with many other management areas, the majority (more than 60 percent) of residential land capacity in this management area is estimated to come from vacant pre-existing lots too small to be subdivided, most of which are located within the Rural Residential land use district. There is no measureable commercial or industrial land development capacity estimated in the management area.

Although existing zoning allows some limited opportunity for non-priority uses in the shoreline jurisdiction, future use conflicts in this management area are unlikely, particularly when accounting for the County's existing shoreline regulations, which would inhibit non-priority shoreline uses. The land use designation offering the greatest opportunity for potential future use conflicts is the Master Planned Resort at Roche Harbor. This land use designation allows a wider variety of land uses than others within this management area. This management area includes large areas for shoreline residential uses which may also be accompanied by associated water-

dependent uses such as docks, piers, and marina. In addition, space is dedicated to water-enjoyment public recreation uses in this management area as well. There is little or no area in the management area dedicated to water-oriented or shoreline preferred commercial or industrial uses.

5.2.13 San Juan Channel

The San Juan Channel management area includes 228 parcels. Of these parcels, 27 percent are vacant and approximately 1 percent are protected from development by public or conservation group ownership, conservation easements, or similar reasons. Twenty-four percent of parcels include at least one non-conforming structure.

The San Juan Channel management area is made up of rural uses and a large government/ institutional use on the northern outskirts of the Town of Friday Harbor. Land use districts in this management area include Rural Farm Forest, Rural Residential, and Conservancy, and Natural. The most intense land use development in this management area would come from the Rural Residential land use district. Although there is little vacant land available for subdivision, more than half of residential land capacity in this management area is estimated to come from vacant pre-existing lots too small to be subdivided, most of which are located within the Rural Residential and Rural Farm Forest land use districts. Most of the remainder of residential development capacity comes from redevelopment on underutilized parcels. The outskirts of the Town of Friday Harbor in this management area are made up of a government facility (University of Washington research facility), which could result in some non-residential shoreline development. However, there is otherwise no measureable commercial or industrial land development capacity estimated in the management area.

Although existing zoning allows some limited opportunity for non-priority uses in the shoreline jurisdiction, future use conflicts in this management area are unlikely, particularly when accounting for the County's existing shoreline regulations, which would inhibit non-priority shoreline uses. This management area includes large areas for shoreline residential uses which may also be accompanied by associated water-dependent uses such as docks, piers, and marina. In addition, space is dedicated to water-enjoyment public recreation uses in this management area as well. There is little or no area in the management area dedicated to water-oriented or shoreline preferred commercial or industrial uses.

5.2.14 Shaw Island

The Shaw Island management area includes 323 parcels. Of these parcels, 40 percent are vacant and approximately 7 percent are protected from development by public or conservation group ownership, conservation easements, or similar reasons. Twenty-one percent of parcels include at least one non-conforming structure.

The Shaw Island management area is entirely designated for rural land uses. San Juan County land use districts along the shoreline include Rural Residential, Rural Farm Forest, Forest Resource, Conservancy, and Natural. Based on these designations, the most intense use of property appears to be within Rural Residential-designated lands found mostly on the north and

west shorelines of Shaw Island and throughout Crane Island. The majority of new residential development capacity in shoreline jurisdiction exists in Rural Residential areas on Shaw and Crane islands, with the Rural Farm Forest land use district on Shaw Island accommodating the second largest amount of residential development capacity. Approximately 36 percent of the residential development capacity in this management area occurs on lots too small to be subdivided under the SJCC. Most of these lots are found in the Rural Residential land use district. There is no measurable commercial or industrial development capacity in this management area. There are small amounts of existing commercial development, and government or other institutional owned properties in shoreline jurisdiction could result in some non-residential development. However, there is little potential for non-residential development in this management area.

Although existing zoning allows some limited opportunity for non-priority uses in the shoreline jurisdiction, future use conflicts in this management area are unlikely, particularly when accounting for the County's existing shoreline regulations, which would inhibit non-priority shoreline uses. This management area includes large areas for shoreline residential uses which may also be accompanied by associated water-dependent uses such as docks, piers, and marina. The management area also includes an area for the priority use of a ferry terminal at the north end of Shaw Island. In addition, space is dedicated to water-enjoyment public recreation uses in this management area as well. There is little or no area in the management area dedicated to water-oriented or shoreline preferred commercial or industrial uses.

5.2.15 Spencer Spit

The Spencer Spit management area includes 291 parcels. Of these parcels, 30 percent are vacant and approximately 5 percent are protected from development by public or conservation group ownership, conservation easements, or similar reasons. Ten percent of parcels include at least one non-conforming structure.

The Spencer Spit management area is entirely made up of rural uses. Land use districts in this management area include Rural Farm Forest, Rural Residential, Rural General, and Conservancy, and Natural. The most intense land use development in this management area would come from the Rural General land use district applied near the State ferry terminal. However, the portion of the management area in Rural General is largely built-out with only a fraction of residential land capacity estimated to result from development in that land use district. This management area has the largest percentage of its residential development capacity resulting from development on vacant pre-existing lots too small to be subdivided. Approximately 96 percent residential development capacity comes from this category of land. Although non-residential uses could occur in the Rural General land use district, there is no measureable commercial or industrial land development capacity estimated in the management area.

Although existing zoning allows some limited opportunity for non-priority uses in the shoreline jurisdiction, future use conflicts in this management area are unlikely, particularly when accounting for the County's existing shoreline regulations, which would inhibit non-priority shoreline uses. This management area includes large areas for shoreline residential uses which

may also be accompanied by associated water-dependent uses such as docks, piers, and marina. The management area also includes an area for the priority use of a ferry terminal at the north end of Lopez Island. In addition, space is dedicated to water-enjoyment public recreation uses in this management area as well. There is little or no area in the management area dedicated to water-oriented or shoreline preferred commercial or industrial uses.

5.2.16 Strait of Juan de Fuca

The Strait of Juan de Fuca management area includes 547 parcels. Of these parcels, 38 percent are vacant and approximately 6 percent are protected from development by public or conservation group ownership, conservation easements, or similar reasons. Five percent of parcels include at least one non-conforming structure.

The Strait of Juan de Fuca management area is completely in rural land use districts. Land use districts in this management area include Rural Farm Forest, Rural Residential, Agricultural Resource, Conservancy, and Natural. The most intense land use development in this management area would come from the Rural Residential. The majority of residential development capacity in this management area comes from Rural Residential and Rural Farm Forest land use districts, and approximately 68 percent of the overall residential development capacity in this management area would occur on pre-existing lots too small to subdivide. There is no measureable commercial or industrial land development capacity estimated in this management area.

Although existing zoning allows some limited opportunity for non-priority uses in the shoreline jurisdiction, future use conflicts in this management area are unlikely, particularly when accounting for the County's existing shoreline regulations, which would inhibit non-priority shoreline uses. This management area includes large areas for shoreline residential uses which may also be accompanied by associated water-dependent uses such as docks, piers, and marina. In addition, space is dedicated to water-enjoyment public recreation uses in this management area as well. There is little or no area in the management area dedicated to water-oriented or shoreline preferred commercial or industrial uses.

5.2.17 Stuart Island

The Stuart Island management area includes 260 parcels. Of these parcels, 52 percent are vacant and approximately 3 percent are protected from development by public or conservation group ownership, conservation easements, or similar reasons. Eleven percent of parcels include at least one non-conforming structure.

The Stuart Island management area is entirely designated for rural land uses. San Juan County land use districts along the shoreline in this management area include Rural Residential, Rural Farm Forest, Conservancy, and Natural. Based on these designations, the most intense use of property appears to be with Rural Residential-designated lands found mostly on the eastern portion of Stuart Island and the eastern portion of Johns Island. The majority of new residential development capacity in shoreline jurisdiction exists in Rural Residential areas on Stuart and Johns Islands, with Rural Farm Forest on Stuart and Johns islands making up the second largest

amount of residential development capacity. Although subdivision development opportunities exist in this management area, approximately 39 percent of the residential development capacity in this management area occurs on lots too small to be subdivided under the SJCC, most of which are found in the Rural Residential and Rural Farm Forest land use districts. There is no measurable commercial or industrial development capacity in this management area.

Although existing zoning allows some limited opportunity for non-priority uses in the shoreline jurisdiction, future use conflicts in this management area are unlikely, particularly when accounting for the County's existing shoreline regulations, which would inhibit non-priority shoreline uses. This management area includes large areas for shoreline residential uses which may also be accompanied by associated water-dependent uses such as docks, piers, and marina. In addition, space is dedicated to water-enjoyment public recreation uses in this management area. There is little or no area in the management area dedicated to water-oriented or shoreline preferred commercial or industrial uses.

5.2.18 Turtleback

The Turtleback management area includes 122 parcels. Of these parcels, 25 percent are vacant and approximately 4 percent are protected from development by public or conservation group ownership, conservation easements, or similar reasons. Twenty-five percent of parcels include at least one non-conforming structure.

The Turtleback management area is designated for rural uses with one master planned resort at West Beach. The master planned resort provides the most intensive development pattern in this management area but is considered fully developed in shoreline jurisdiction. Other land use districts in this management area include Rural Farm Forest, Forest Resource, Conservancy, and Natural. There is relatively little vacant land that can be subdivided in this management area's shoreline jurisdiction. However, redevelopment on Rural Farm Forest-designated land provides the greatest amount of residential development capacity in this management area. There is no measureable commercial or industrial development capacity in this management area.

Although existing zoning allows some limited opportunity for non-priority uses in the shoreline jurisdiction, future use conflicts in this management area are unlikely, particularly when accounting for the County's existing shoreline regulations, which would inhibit non-priority shoreline uses. The land use designation allowing the greatest variety of land uses and holding the greatest potential for future use conflicts is the Master Planned Resort. This management area includes large areas for shoreline residential uses which may also be accompanied by associated water-dependent uses such as docks, piers, and marina. In addition, space is dedicated to water-enjoyment public recreation uses in this management area. There is little or no area in the management area dedicated to water-oriented or shoreline preferred commercial or industrial uses.

5.2.19 Waldron Island

The Waldron Island management area includes 149 parcels. Of these parcels, 46 percent are vacant and approximately 10 percent are protected from development by public or conservation

group ownership, conservation easements, or similar reasons. Eight percent of parcels include at least one non-conforming structure.

The Waldron Island management area is designated for rural uses, with land held in conservation or other park designations making up a large portion of the vacant property in this management area. Land use districts in this management area consist of Rural Farm Forest, Conservancy, and Natural. Most residential development capacity in this management area is located in the Residential Farm Forest land use district. Almost 50 percent of potential residential development capacity comes from pre-existing lots too small for subdivision. There is very little development capacity on islands other than Waldron Island in this management area. Most of the northern management area in and around Patos, Sucia, and Matos islands is owned by the government or otherwise held for conservation purposes. There is no measureable commercial or industrial development capacity in this management area.

Although existing zoning allows some limited opportunity for non-priority uses in the shoreline jurisdiction, future use conflicts in this management area are unlikely, particularly when accounting for the County's existing shoreline regulations, which would inhibit non-priority shoreline uses. This management area includes large areas for shoreline residential uses which may also be accompanied by associated water-dependent uses such as docks, piers, and marina, particularly on Waldron Island. In addition, the smaller islands in this management area provide large areas dedicated to water-enjoyment public recreation uses in this management area. There is little or no area in the management area dedicated to water-oriented or shoreline preferred commercial or industrial uses.

5.2.20 West Sound

The West Sound management area includes 383 parcels. Of these parcels, 31 percent are vacant and approximately 5 percent are protected from development by public or conservation group ownership, conservation easements, or similar reasons. Seventeen percent of parcels include at least one non-conforming structure.

The West Sound management area includes the Hamlet of Deer Harbor and two activity centers: Westsound, and Orcas Village. Land use districts in this management area include Rural Residential, Rural Farm Forest, Forest Resource, Conservancy, Natural, Deer Harbor Hamlet Residential, Deer Harbor Hamlet Commercial, and Activity Center. The most intense development in this management area could occur in the Deer Harbor Hamlet Residential and Activity Center land use districts. Most of the residential development capacity in this management area comes from vacant and partially used lots that can be developed in the Deer Harbor Hamlet Residential land use district, including the largest amount of multifamily development capacity in the County's shoreline jurisdiction. The only vacant commercial parcel in the County is found within the Orcas Village Activity Center in this management area. This vacant parcel, located east of the state ferry terminal, would only provide a small amount of commercial development due to the size of the parcel and the built-up environment surrounding it (Maycock, Colin. Personal communication, April 29, 2011).

Although existing zoning allows some limited opportunity for non-priority uses in the shoreline jurisdiction, future use conflicts in this management area are unlikely, particularly when accounting for the County's existing shoreline regulations, which would inhibit non-priority shoreline uses. The land use designations allowing the widest variety of uses, and thus providing the greatest opportunity for future use conflicts includes various Deer Harbor Hamlet land use designations and the Activity Center land use designation. This management area includes large areas for shoreline residential uses which may also be accompanied by associated water-dependent uses such as docks, piers, and marina. The management area also includes an area for the priority use of a ferry terminal at the Orcas Village Activity Center. In addition, space is dedicated to water-enjoyment public recreation uses in this management area as well. There are small areas dedicated to commercial and industrial development in this management area. The management area includes the only identified vacant commercial parcel in the County's shoreline jurisdiction in the Orcas Village Activity Center. However, there is little additional capacity for commercial development and none identified for preferred industrial uses in this management area.

6.0 Public Access Analysis

6.1 Parks and Recreation Plans

Existing and potential public shoreline access has been discussed in the context of management areas throughout this document. However, several of the goals, strategies and actions identified in the Parks Plan are broader in scope than a particular management area.

The following action items and strategies have the most potential for improving shoreline public access in San Juan County:

- Protect lands valuable for shoreline access, views, and habitat. Protect high-priority lands – including high-habitat-value lands – using a variety of methods such as purchase of development rights or donation.

- Develop new and improve existing water access opportunities. Develop road ends as water access points where feasible. Enhance water access opportunities on existing public lands. Invest in signage and basic infrastructure at public access sites.

- Provide for all users. Plan for meeting disability access standards in upgrades and future development.

- Provide connectivity between sites and facilities. Identify and prioritize priority trail projects. Acquire the land and provide the resources required to implement those projects.

- Coordinate to maximize impact of resources. Improve coordination between federal, state and local agencies and organizations with land protection and park open/space interests to identify common opportunities and leverage resources. Identify resource-sharing opportunities to improve service and delivery.

- Adequately fund development and maintenance efforts. Provide adequate funding for acquisitions and maintenance by passing real estate excise tax, maintaining current levels of county funding, and regularly assessing fee structures to ensure revenue generation.

- Educate and inform public of access opportunities. Develop trail map. Implement environmental education programs at high use parks. Inform pubic of project progress updates, events, and volunteer opportunities.

- Public Private Partnership. Work with private and public landowners to protect high-priority lands using a variety of tools such as land or development right purchase, exchange, and private donation.

6.2 Potential Gaps and Opportunities

The public access analysis relies on GIS data, existing technical reports such as the current San Juan County Comprehensive Plan, Parks Plan (The Trust for Public Land et al. 2010), and other available information from existing community organizations.

San Juan County's 2030 vision for parks, trails and natural areas is to have an "interconnected integrated system of paths, trails, and natural areas that provides easy access to the water and natural areas." The Parks Plan identifies shoreline access as one of the highest priority needs. Key community needs are: trails, land protection, water access and stewardship and maintenance.

The San Juan County Land Bank and other local preservation groups such as San Juan Preservation Trust are actively working towards land conservation for protecting sensitive habitat.

Several citizen-driven trail groups have been active on the ferry-served islands (San Juan, Shaw, Lopez, and Orcas). The Parks Plan maps (Maps 7A-C, Appendix A) propose priority corridors providing connections to popular sites within the islands. Most of these will offer shoreline access. The proposed trails properties are owned by public and private entities. Implementation of these trails would largely depend on how public properties such as utility corridors are utilized in coordination with existing shoreline public access. Working with private property owners has been identified in the Parks Plan as a key to implementing the proposed trails (The Trust for Public Land et al. 2010, pg xiv).

A survey conducted for the Parks Plan reveals that residents feel there is a greater need of improvement for water or marine access opportunities. Fewer than 25 percent of survey respondents from Lopez, Orcas, and Shaw believe there is "enough" access. Beach and tideland access was identified as the most desired among other types of water access. Orcas Island has the lowest percentage of publicly accessible shoreline with only 1.5 miles (2 percent) of the island's 70 total miles of shoreline defined as publicly accessible; these areas are concentrated around Eastsound, Obstruction Pass, and Deer Harbor. Orcas and Lopez have the most boat ramps and docks; however, Orcas Island has only one public boat ramp while Shaw Island has no public docks and San Juan Island only has public docks within the Town of Friday Harbor, although several private docks within Roche Harbor do provide semi-public access. While shoreline access road ends currently provide some level of public access to the water, half of them need to be surveyed to delineate ownership boundaries, and many need to be enhanced to accommodate parking and provide more controlled public access.

The Parks Plan assesses water access needs in terms of distribution of public access in residential concentrations. Approximately 30 percent of residents live within 1 mile of a shoreline access

road end, while 24 percent live within a mile of publicly accessible shoreline. Water access on Orcas Island is most limited, with only 17 percent of residential dwellings located within one mile of publicly accessible shoreline. Access to public boat ramps and docks is most limited, with no public docks on San Juan (outside of the Port of Friday Harbor facilities and the semi-public facility in Roche Harbor) or Shaw and 66 percent of residents living more than 3 miles from public boat ramps on all of the islands (with more than 90 percent of residents on Orcas Island) (The Trust for Public Land et al. 2010, pg 45). This clearly identifies a strong need for public access in the County's shoreline. Shoreline public access opportunities vary depending on land ownership, topography and land development patterns. Based on these factors, the Parks Plan Map maps (Maps 7A-C, Appendix A) show opportunity areas for shoreline public access. Most of the opportunity areas for water access are in Eastsound, Westsound, San Juan Channel, North Coast Eastsound, and Mud Bay management areas. Opportunities to improve shoreline access also include interisland transport of goods.

From expanding shoreline access through road ends and shoreline parks to acquiring new waterfront lands, County Parks, Land Bank and Public Works can all play a role in improving access to the shoreline. There is also opportunity to work with other public agencies such as the Bureau of Land Management and Washington Department of Natural Resources to improve access to existing public lands on the shore (The Trust for Public Land et al. 2010, pg 51). Expanding funding options for parks, trails, and natural areas and continuing to improve stewardship and maintenance of existing facilities also need to be explored.

6.2.1 Management Areas

Based on shoreline public access need and existing shoreline public access, this section describes opportunities for improving public access in each management area. Opportunities include marine and lake access in terms of trails, road ends, docks, floats, visual access, potential acquisition of easements, and land trust activities.

Blakely Island Management Area

The Parks Plan and the County's Comprehensive Plan do not indicate any expansion of public access in this area. Although most of the island contains protected lands, there is no shoreline public access such as public docks, marina or trails. There is need for marine access and trail connection within shoreline. Physical shoreline access opportunity exists at lower elevations on the northern and southern sides. Protected lands can offer trail connection and shoreline vistas from higher elevations.

Decatur Island Management Area

The Parks Plan and the County's Comprehensive Plan do not indicate any expansion of public access in this area. The management area contains natural forest. James Island offers views of the San Juan Islands from the high bluff along the loop trail that should be protected. Limited physical shoreline public access opportunity exists on the north side of Decatur Island and the southern tip of the Island under the San Juan Preservation Trust ownership due to topography. Opportunity exists for visual shoreline access on the preserve lands at higher elevations and physical shoreline access on land owned by community or homeowners groups and via road ends

and easements. Limited parking is available within the County ROW that provides potential access to the concrete log ramp located at the end of Decatur Head Drive North.

Doe Bay Management Area

Views from the high bank viewpoint areas near Doe Bay Resort should continue to be protected. Access easements or other opportunities could be considered to improve public shoreline access, especially on the low bank areas. Opportunity to provide facilities such as campgrounds, docks, ramps or floats can be explored on the eastern side of the management area in the preserve land near Point Lawrence. Due to steep slopes, visual access will be more appropriate on the northern part of the management area. The road ends on the southeast side of the Orcas Island can be further explored to provide trail connections, docks, ramps or floats facilities.

Eastsound Management Area

Opportunities exist for public access improvements through expansion of open space protection and road ends. The Parks Plan suggests development of more trails at Judd Cove. Opportunities exist near road ends that need detailed survey. This can also offer other facilities such as ramps.

Fisherman Bay Management Area

Opportunities for improving public shoreline access in this management area are generally addressed by the recommendations in the Parks Plan. Most opportunities consist of park improvements such as expansion and renovation opportunities in Odlin County Park with additional directional and wayfinding signage. There is no parking specifically dedicated to the marine facilities. All parking is a part of the County Park complex. Opportunities also exist in the improvement of the Otis Perkins Day Park with signage and additional park facilities.

All of the property in the Fisherman Bay Preserve provides habitat for wildlife. This offers opportunities to preserve and maintain the character and ecological functions in this area.

Direct physical shoreline access may be difficult in many shoreline areas in the management area because of the high bank. However, opportunities exist for visual access and some physical access through road ends.

Friday Harbor Management Area

Generally, this management area provides significant public access opportunities.

- Halsey Road end stops 150 feet from high bank waterfront. The area has potential for development as a view point looking across Griffin Bay to San Juan Channel.

- Jensen Bay Road end provides view of Griffin Bay and a trail down the medium bank waterfront to the beach. Public access can be improved in this area by working with adjacent property owners as currently there are

signs on both sides of the road end identify the adjoining beach and tidelands as private and prohibit trespassing.

- Cameron Bay Road stops short of the water but the site provides view of bird nesting on one of the small outer islands. Opportunity exists to improve this road end with picnic site accessible on foot and connection with water.

- The Parks Plan identifies improvements for Turn Point County Park. This includes American with Disability Act (ADA) accessibility, entry and way finding signage, and installation of a portable toilet.

The expansion, maintenance, and further development of these opportunities will achieve the goals of the Comprehensive Plan and the Parks Plan.

Mud Bay Management Area

Opportunities exist to improve Blackie Brady Park and Roslyn Road end, an undeveloped easement to Mud Bay. These are:

- Improvement in Blackie Brady with directional signage and repair of storm damage on wooden steps.

- Mud Bay Beach is a day use park primarily used for clam digging, crabbing and dinghy access. Opportunities for improvement include the development of amenities, parking, signage and a turnaround.

- Roslyn Road end is an undeveloped easement to Mud Bay. The site is currently unmarked and has limited area for turnaround. These can be improved with proper way finding signage and turnaround area.

Limited opportunities exist for physical access due to high banks. Watmough Bay Preserve's public access could be maintained while preserving the significant ecological features.

North Coast Eastsound Management Area

Access can be improved in existing road ends at North Beach Road by adding public amenities, such as benches and picnicking facilities. Buckhorn Road end provides a view of the water and has opportunity to improve the shoreline access by signage, benches, and site amenities. Terrill Beach Road end is a narrow, undeveloped access that has the potential for medium bank water access to a beautiful beach area. New public access opportunities can be created via access easements and connection with trails.

Olga Management Area

Potential opportunities exist to expand or formalize some of the public access points in this management area. However, physical conditions at some of the sites may limit the potential for expanding access. For example, Mukosa Lane road end offers public access to the rocky beach. However, opportunities for expanding this access are limited due to the width of the easement and the proximity to the neighboring house. Barnacle Lane road end provides a good view of Obstruction Island. Opportunities exist to preserve this view and add turnaround or parking. The Parks Plan recommends adding wayfinding signage and renovation of the beach staircase at East Olga Park.

Private Lakes Management Area

Opportunities exist to improve access to lakes on San Juan Island. In particular, shoreline public access and recreational uses at Trout Lake, where public access is currently restricted by the Town of Friday Harbor, could be explored. On Lopez Island, Hummel Lake Preserve should be maintained to preserve its character. On Blakely Island, physical access to Horseshoe and Spencer Lakes shorelines is difficult due to high banks. The Parks Plan's priority trails corridor maps (Maps 7C, Appendix A) suggest connecting the lakes with trails.

Public Lakes Management Area

This management area is well preserved under Moran State Park boundaries. Adequate trail connections exist in Mountain Lake and Cascade Lake shorelines. Opportunities exist for additional water-access amenities such as ramps, floats, docks, as well as campground facilities.

Roche Harbor Management Area

The San Juan Island Trails Committee has been successfully working with private property owners in opening up trail facilities for public access, such as trails in Roche Harbor. Opportunities exist for road end improvements and additional public access in land conservation areas. For example, Henry Island has preserved land on the west and south sides. The high bluff area can offer viewing opportunities with lookout improvements. Armadale Road ends A and B both end several hundred yards before the water's edge. While currently undeveloped, both road ends have the potential for shoreline public access improvement and two parking spaces and a walking path to the water.

San Juan Channel Management Area

Opportunities exist to improve public access at Rueben Tarte Day Park as follows:

- Upgrade (gravel or pave) lower parking area and turn around
- Upgrade/pave ADA parking stall and connection to portable toilet
- Replace existing portable toilet with ADA accessible unit, install interpretive signage and replace deteriorating benches

Shaw Island Management Area

Currently there are only a limited amount of trails or pathways in this management area, specifically located within the County Park. This management area is 36 percent in public ownership, but only 5 percent is actually accessible since the University of Washington provides very limited public access. Opportunities need to be explored to offer more public access in the University of Washington's property. Other opportunities include:

- Improvement of Hoffman Cove Road and with Neck Point Cove Road ends with parking facilities
- Add trails and pathways in shoreline jurisdiction
- At the Shaw Landing dock, there is currently no float and no beach access from the facility.

Spencer Spit Management Area

Limited new opportunities exist for physical access due to high banks. Opportunities consist of view protection on high-bank areas and trails connecting Hummel Lake to Spencer Spit State Park. Other improvement opportunities include:

- Shipley Shores Road ends (A and B) improvement near Swifts Bay. Improve parking on Road end B and public access signs on Road end A. Both can be improved with other amenities such as benches.

Strait of Juan de Fuca Management Area

This area has a diverse supply of public access options. These should be maintained and adequately funded for further improvement. Improvement opportunities in this management area are as follows:

- San Juan County Park improvement. Parks Plan contains several recommendations related to opportunities for improvement at this park, including: development of a master plan; preservation activities for the historic cabin on site; installation of dumpster; renovation of shelter; acquisition of adjacent land; and renovation of office and residence. The Plan also recommends implementing an environmental education program to take advantage of high visitor use.
- Agate Beach County Park improvement. The Parks Plan recommends the following improvements for this park: develop site master plan; add culvert or bridge over southern trail entrance; replace toilet; upgrade parking; replace staircase and signs; install ADA accessible picnic tables and associated pathway.

- Eagle Cove County Park. The Parks Plan recommends installing entry and way finding signage; installing stairs leading to beach; improving beach access.

- Shark Reef Sanctuary improvement. The Parks Plan recommends the following: replace toilets for ADA compliance; conduct trail and shoreline restoration; and install interpretive signs.

- False Bay Road end improvement at University of Washington Biological Preserve and False Bay Tidelands.

Stuart Island Management Area

The Parks Plan and the County's Comprehensive Plan do not indicate any expansion of public access in this area. Limited opportunity exists for trail improvement in this management area.

Turtleback Management Area

Shoreline public access is difficult in this management area due to steep banks and other physical restrictions. Viewpoints should be protected at the Enchanted Forest Road end that overlooks President Channel. The area provides a good location for launching kayaks, but additional development potential is low in this area due to space limitations and environmental constraints from a nearby creek.

Waldron Island Management Area

The Parks Plan and the County's Comprehensive Plan do not indicate any expansion of public access in this area. There may be opportunities to expand trail access through conservation easements. The preserved land on the western low bank near Cowlitz Bay can offer additional shoreline access with amenities. The high bluff area on the south owned by the Nature Conservancy has opportunity to be improved with viewpoints.

West Sound Management Area

The Parks Plan indicates this management area as one of the Water Access Opportunity Areas (The Trust for Public Land et al. 2010. Map 4.6). Opportunities exist for continued efforts of the Land Bank to restore habitat functions in the Deer Harbor Preserve area.

Clapp Conservation Easement has opportunity to provide shoreline public access.

Currently, there is no dedicated parking that goes with the public mooring for the Deer Harbor Marina Float. The facility serves the private and commercial needs of outer island residents, primarily those from Waldron Island. Generally, parking at Deer Harbor is a problem, especially during the summer months. Acquisition of a suitable parking facility is an on-going challenge that needs resolved.

7.0 Data Gaps

7.1 Development of 1:24,000 Geologic Maps For Entire County

The County has generally poorly mapped geology. While there have been numerous geologic maps created covering parts of the County (Whetten et al. 1988; Pessl et al. 1989; Dethier et al. 1996; Lapen 2000; Schasse 2003), these have only focused on small portions of the County, and most of these were done several years ago. Updated geologic maps based on recent lidar data would assist in identifying areas of past modifications as well as future restoration opportunities.

7.2 Lakeshore Modifications

The lakes in the County are large, vegetatively diverse, and nearly all are in high quality condition and their protection is important. Therefore, the detailed information collected for marine shorelines, including armoring and overwater structures (existing DNR data for lake overwater structures is incomplete, including only structures on Cascade Lake), could be collected and added to the shoreline database for the lakes. This information can then be used to make informed decisions on protection and restoration opportunities along lacustrine shorelines.

7.3 Tidal Flow Data

The only reliable information for tidal current magnitude and direction within the County is provided by the Canadian government (Canadian Hydrographic Service 2010). The information is based upon numerical modeling of tidal flows. While this information was extremely useful in the production of this characterization, the purposes of modeling were to inform Canadian citizens and municipalities of flow in Canadian waters. The inclusion of the County in this effort is incidental. As the body of knowledge grows on the ecological processes, it will be imperative to understand the dynamics of the nearshore waters in greater detail than is resolved in the Canadian work and previous investigations made by others. Therefore it is recommended that observation data be sought that broadly characterizes tidal flow around the islands.

7.4 Climate Change

7.4.1 Weather

There has been an extensive amount written about expected weather related precipitation and hydrologic changes in the Olympic and Cascade mountains, and the Puget Lowland due to climate change. However, it is unclear the extent to which these predicted climate changes apply to the County. There is also no information addressing potential changes associated with the location and timing of the Olympic Mountain rain shadow, which dominates much of the County's weather.

7.4.2 Sea Level Rise and Ocean Acidification

Mote et al. (2008) completed a study that provided predictions of sea-level rise for Washington's Northwest Coast, Southern and Central Coasts, and Puget Sound. Predictions varied considerably between those three regions due to varying rates of vertical land movement (VLM). VLM is considered a basis for sea level rise predictions in Washington State. In the case of San Juan County, there is net tectonic uplift (Verdonck 2006), which reduces the overall effect of global sea level rise (Canning 2005, Mote et al. 2008). However, the rate and extent of VLM in the future is uncertain. Identification of sea level rise impacts on San Juan County needs continued study and remains a serious and significant data gap. Assessment tools, such as the NOAA Sea Level Rise and Coastal Flooding Impacts Viewer (NOAA 2012) are helpful in understanding the location of potential flooding and inundation areas, but the impacts of such an occurrence are speculation given the potential VLM. In addition, significant and pressing effects may be from changes in wave energy, storm surge potential, and threats to marine species from ocean acidification.

7.5 Water Quality Data For Certain Islands

Some of the islands, for instance Shaw Island, have little to no water quality data available for them. Considering these hard to reach places are likely to have a certain amount of development associated with them in the coming years, it would be prudent to develop baseline conditions upon which no net loss can be maintained.

7.6 Nearshore Wrack Data

In the County, there is significant diversity in terms of the shoreline to store and generate wrack (i.e., driftwood and other sea-borne organic detritus). Wrack has been shown to have an important ecological role in the health of nearshore ecosystems (Herrera and The Watershed Company 2011). However, there is no County database of the presence and amount of wrack on County shorelines. Being able to quantify this aspect of nearshore health would improve the shoreline characterization and nearshore inventory.

7.7 Tidegates

As noted by several sources, the County lacks detailed inventory information on tidegate locations. For instance, comments have noted that there are more tide gates along Lopez Island's MacKaye Harbor and Barlow Bay Roads than identified in this inventory for the entire county. This has not been field verified by the authors of this report, but given the lack of tidegate data, the assertion is likely accurate.

8.0 Shoreline Management Recommendations

The following are recommended actions for translating the inventory and characterization findings into draft SMP policies, regulations, environment designations, and restoration strategies for areas within shoreline jurisdiction. In addition to the following analysis-specific recommendations, the updated SMP should incorporate all other requirements of the Shoreline Management Act (RCW 90.58) and the Shoreline Master Program Guidelines (WAC 173-26).

8.1 Environment Designations

8.1.1 Background

As outlined in WAC 173-26-191(1)(d), "Shoreline management must address a wide range of physical conditions and development settings along shoreline areas. Effective shoreline management requires that the shoreline master program prescribe different sets of environmental protection measures, allowable use provisions, and development standards for each of these shoreline segments." In WAC 173-26-211(2)(a), the Guidelines further direct development and assignment of environment designations based on "existing use pattern, the biological and physical character of the shoreline, and the goals and aspirations of the community as expressed through comprehensive plans…" (Note: The methodology discussion in Section 8.1.3 below describes how the function analysis scores presented earlier may be considered in assigning preliminary designations).

Ecology Recommended Classification System

The Guidelines recommend the use of six basic environments: Natural, Rural Conservancy, Aquatic, High-intensity, Urban Conservancy, and Shoreline Residential. The purpose and designation criteria of these six environments are as follows:

Natural Environment

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

Designation Criteria: A "natural" environment designation should be assigned to shoreline areas if any of the following characteristics apply:

1. The shoreline is ecologically intact and therefore currently performing an important, irreplaceable function or ecosystem-wide process that would be damaged by human activity;

2. The shoreline is considered to represent ecosystems and geologic types that are of particular scientific and educational interest; or

3. The shoreline is unable to support new development or uses without significant adverse impacts to ecological functions or risk to human safety.

Rural Conservancy Environment

Purpose: The purpose of the "rural conservancy" environment is to protect ecological functions, conserve existing natural resources and valuable historic and cultural areas in order to provide for sustained resource use, achieve natural flood plain processes, and provide recreational opportunities. Examples of uses that are appropriate in a "rural conservancy" environment include low-impact outdoor recreation uses, timber harvesting on a sustained-yield basis, agricultural uses, aquaculture, low-intensity residential development and other natural resource-based low-intensity uses.

Designation Criteria: Assign a "rural conservancy" environment designation to shoreline areas outside incorporated municipalities and outside urban growth areas, as defined by RCW 36.70A.110, if any of the following characteristics apply:

1. The shoreline is currently supporting lesser-intensity resource-based uses, such as agriculture, forestry, or recreational uses, or is designated agricultural or forest lands pursuant to RCW 36.70A.170;

2. The shoreline is currently accommodating residential uses outside urban growth areas and incorporated cities or towns;

3. The shoreline is supporting human uses but subject to environmental limitations, such as properties that include or are adjacent to steep banks, feeder bluffs, or flood plains or other flood-prone areas;

4. The shoreline is of high recreational value or with unique historic or cultural resources; or

5. The shoreline has low-intensity water-dependent uses.

Aquatic Environment

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

Designation Criteria: Assign an "aquatic" environment designation to lands waterward of the ordinary high-water mark. Local governments may designate submerged and intertidal lands with shoreland designations (e.g., "high-intensity" or "rural conservancy") if the management policies and objectives for aquatic areas are met. In this case, the designation system used must provide regulations for managing submerged and intertidal lands that are clear and consistent

with the "aquatic" environment management policies in this chapter. Additionally, local governments may assign an "aquatic" environment designation to wetlands.

High-intensity Environment

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

Designation Criteria: Assign a "high-intensity" environment designation to shoreline areas within incorporated municipalities, urban growth areas, and industrial or commercial "limited areas of more intensive rural development," as described by RCW 36.70A.070, if they currently support high-intensity uses related to commerce, transportation or navigation; or are suitable and planned for high-intensity water-oriented uses.

Urban Conservancy Environment

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

Designation Criteria: Assign an "urban conservancy" environment designation to shoreline areas appropriate and planned for development that is compatible with maintaining or restoring of the ecological functions of the area, that are not generally suitable for water-dependent uses and that lie in incorporated municipalities, urban growth areas, or commercial or industrial "limited areas of more intensive rural development" if any of the following characteristics apply:

1. They are suitable for water-related or water-enjoyment uses;

2. They are open space, flood plain or other sensitive areas that should not be more intensively developed;

3. They have potential for ecological restoration;

4. They retain important ecological functions, even though partially developed; or

5. They have the potential for development that is compatible with ecological restoration.

Shoreline Residential Environment

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

Designation Criteria: Assign a "shoreline residential" environment designation to shoreline areas inside urban growth areas, as defined in RCW 36.70A.110, incorporated municipalities,

"rural areas of more intense development," or "master planned resorts," as described in RCW 36.70A.360, if they are predominantly single-family or multifamily residential development or are planned and platted for residential development.

8.1.2 Existing County Shoreline Designations

As discussed previously in Chapter 2, the current County SMP utilizes a system of seven primary environment designations: Urban, Rural, Rural Residential, Rural Farm-Forest, Conservancy, Natural, and Aquatic (note that these environment designations are generally listed in order of decreasing level of intensity and allowed uses). Photos illustrating County shorelines with these designations are shown in Figures 30 through 35 below. The County shoreline environment designations also include several designations specific to the Eastsound and Shaw subarea plans. Finally, the County has two shoreline environment designation overlays (Marine Habitat management area Environment, Marine Protected Area Environment) intended to "preserve and restore critical marine habitat areas."

Table 42 below illustrates how the County's existing seven primary shoreline designations relate to Ecology's recommended classification system. Each of the County's existing primary shoreline designations is paired with the most comparable Ecology designation. A brief comparison of the two designations is then provided. This comparison is intended to help illustrate whether the County's guidelines currently or could potentially comply with the Guidelines. Note that the Guidelines stipulate that "local governments may establish a different designation system or may retain their current environment designations, provided it is consistent with the purposes and policies" of WAC 173-26-211.

The shoreline environment designations for the Eastsound and Shaw subarea plans generally relate to one of the County's primary shoreline environment designations (though several of the subarea designations include their own unique provisions). Table 43, for each existing subarea shoreline designation, shows the related County shoreline designation and the comparable Ecology designation. See section 2.4 for a brief discussion on the review of existing environment designations and methodology related to potential redesignations.

Table 42. Comparison of Existing County Shoreline Designations and Ecology's Recommended Classification System.

Existing County Shoreline Designation	Summary of County Shoreline Designation Purpose and Criteria	Comparable Ecology Designation	Summary of Ecology Shoreline Designation Purpose and Criteria (WAC 173-26-211)	Comparison
Urban	Purpose: "…to ensure optimum use of shorelines within areas characterized by medium and high density residential, commercial, industrial, and institutional uses by permitting continued intensive activities and managing development so that it enhances and maintains shorelines for a multiplicity of urban types of uses." Criteria: "one or more of the following criteria…areas characterized by intense land use, including recreational, residential, commercial, industrial, and institutional development, and port activities; …areas designated for the expansion of urban uses..."	*High Intensity*	Purpose: "to provide for high-intensity water-oriented commercial, transportation, and industrial uses…" Criteria: "shoreline areas within incorporated municipalities, urban growth areas, and industrial or commercial 'limited areas of more intense rural development'…if they currently support high-intensity uses related to commerce, transportation or navigation; or are suitable and planned for high-intensity water-oriented uses."	Compared to Ecology's High Intensity designation, the County's Urban designation includes a broader scope of uses (e.g. residential and institutional). The County's Urban designation also includes less-intense uses (e.g. medium density residential).
Rural	Purpose: "…intended for residential development and other mixed use forms of development such as marinas, restaurants, resorts, and rural commercial and industrial activities." Criteria: "one or more of the following…areas presently containing medium density residential development mixed with nonresidential uses; …areas designated for rural residential or non-residential uses..."	*High Intensity*	Purpose: "to provide for high-intensity water-oriented commercial, transportation, and industrial uses…" Criteria: "shoreline areas within incorporated municipalities, urban growth areas, and industrial or commercial 'limited areas of more intense rural development'…if they currently support high-intensity uses related to commerce, transportation or navigation; or are suitable and planned for high-intensity water-oriented uses."	Compared to Ecology's High Intensity designation, the County's Rural designation includes a broader scope of uses (e.g. restaurants and resorts). The County's Rural designation also includes less-intense uses (e.g. medium density residential).
Rural Residential	Purpose: "…primarily for residential shoreline development only…but which is not suitable or desirable for mixed use development." Criteria: "…one or more of the following…areas presently containing considerable medium density residential development with few, if any, non-residential uses; …areas designated for the continuation of residential development on existing parcels of medium residential density…"	*Rural Conservancy*	Purpose: "…to protect ecological functions, conserve existing natural resources and valuable historic and cultural areas in order to provide for sustained resource use…and provide recreational opportunities. Examples of uses that are appropriate…include low-impact outdoor recreation uses, timber harvesting on a sustained-yield basis, agricultural uses, aquaculture, low-intensity residential development and other natural resource-based low-intensity uses." Criteria: "…if any of the following characteristics apply…currently supporting lesser-intensity resource-based uses, such as agriculture, forestry, or recreational uses, or is designated agricultural or forest lands…; …currently accommodating residential uses outside urban growth areas and incorporated cities or towns; …supporting human uses but subject to environmental limitations, such as properties that include or are adjacent to steep banks, feeder bluffs, or flood plains or other flood-prone areas; …high recreational value or with unique historic or cultural resources…; …has low-intensity water-dependent uses."	Compared to Ecology's Rural Conservancy designation, the County's Rural Residential designation has a narrower focus. Specifically, the County's Rural designation particularly fits with the Ecology Rural Conservancy criterion that the shoreline is "currently accommodating residential uses outside urban growth areas and incorporated cities or towns." Note that the County's Rural Residential designation also shares some commonalities with Ecology's Shoreline Residential designation. In short, both designations are primarily intended to accommodate residential development. However, because Ecology's Shoreline Residential designation is generally not intended for unincorporated areas, it was not used as the comparable Ecology designation in this table.

Table 42 (continued). Comparison of Existing County Shoreline Designations and Ecology's Recommended Classification System.

Existing County Shoreline Designation	Summary of County Shoreline Designation Purpose and Criteria	Comparable Ecology Designation	Summary of Ecology Shoreline Designation Purpose and Criteria (WAC 173-26-211)	Comparison
Rural Farm-Forest	Purpose: "…to protect agricultural and timber lands and to maintain and enhance the rural low density character…while providing protection from expansion of mixed use and urban types of land uses…Development related to the commercial fishing industry and aquaculture would be permitted." Criteria: "…one or more of the following…areas dominated by agricultural, forestry, or recreational uses; …areas possessing a high capacity to support agricultural and forestry uses…; …areas modified from their natural vegetative cover and surface drainage patterns but generally possessing low density development; …areas where residential development is or should be low density because of biological or physical limitations, utility capabilities, access problems, and/or potential incompatibility with other uses; …areas possessing valuable sand, gravel, and mineral deposits."	*Rural Conservancy*	Purpose: "…to protect ecological functions, conserve existing natural resources and valuable historic and cultural areas in order to provide for sustained resource use…and provide recreational opportunities. Examples of uses that are appropriate…include low-impact outdoor recreation uses, timber harvesting on a sustained-yield basis, agricultural uses, aquaculture, low-intensity residential development and other natural resource-based low-intensity uses." Criteria: "…if any of the following characteristics apply…currently supporting lesser-intensity resource-based uses, such as agriculture, forestry, or recreational uses, or is designated agricultural or forest lands…; …currently accommodating residential uses outside urban growth areas and incorporated cities or towns; …supporting human uses but subject to environmental limitations, such as properties that include or are adjacent to steep banks, feeder bluffs, or flood plains or other flood-prone areas; …high recreational value or with unique historic or cultural resources…; …has low-intensity water-dependent uses."	Compared to Ecology's Rural Conservancy designation, the County's Rural Farm-Forest designation has a narrower focus. Specifically, the County's Rural Farm-Forest designation particularly fits with the Ecology Rural Conservancy criterion that the shoreline is "currently supporting lesser-intensity resource-based uses, such as agriculture, forestry, or recreational uses, or is designated agricultural or forest lands."
Conservancy	Purpose: "…to protect, conserve, and manage existing natural resources and systems and/or valuable historic, educational, or scientific research areas without precluding compatible human uses. It is the most suitable designation for shoreline areas which possess a specific resource or value which can be protected without excluding or severely restricting all other uses, and for areas where primarily non-consumptive uses of the physical and biological resources are preferred." Criteria: "…one or more of the following…areas possessing valuable natural resources or features, the use of which precludes activities or uses except those which would not degrade the area to be conserved; …areas possessing valuable natural resources which will tolerate only minimal disturbance…; …areas containing resources which lend themselves to management on a sustained-yield basis; …areas possessing scenic or recreational qualities of considerable local, regional, or statewide significance which would be adversely affected by extensive modification or use."	*Rural Conservancy*	Purpose: "…to protect ecological functions, conserve existing natural resources and valuable historic and cultural areas in order to provide for sustained resource use…and provide recreational opportunities. Examples of uses that are appropriate…include low-impact outdoor recreation uses, timber harvesting on a sustained-yield basis, agricultural uses, aquaculture, low-intensity residential development and other natural resource-based low-intensity uses." Criteria: "…if any of the following characteristics apply…currently supporting lesser-intensity resource-based uses, such as agriculture, forestry, or recreational uses, or is designated agricultural or forest lands…; …currently accommodating residential uses outside urban growth areas and incorporated cities or towns; …supporting human uses but subject to environmental limitations, such as properties that include or are adjacent to steep banks, feeder bluffs, or flood plains or other flood-prone areas; …high recreational value or with unique historic or cultural resources…; …has low-intensity water-dependent uses."	Compared to Ecology's Rural Conservancy designation, the County's Conservancy designation has a narrower focus. Specifically, the County's Rural designation particularly fits with the Ecology Rural Conservancy criterion that the shoreline is "supporting human uses but subject to environmental limitations, such as properties that include or are adjacent to steep banks, feeder bluffs, or flood plains or other flood-prone areas."

Table 42 (continued). Comparison of Existing County Shoreline Designations and Ecology's Recommended Classification System.

Existing County Shoreline Designation	Summary of County Shoreline Designation Purpose and Criteria	Comparable Ecology Designation	Summary of Ecology Shoreline Designation Purpose and Criteria (WAC 173-26-211)	Comparison
Natural	Purpose: "…to preserve rare or valuable natural resource systems by regulating uses which are likely to degrade or alter such resources. The primary determinant…is the presence of some rare natural resource considered valuable in its natural or original condition and which is relatively intolerant to human use." Criteria: "One or more of the following…areas where human influence and development are minimal; …areas which have been degraded but which are capable of easily being restored to a natural condition or are capable of natural regeneration if left undisturbed; …areas used by rare, diminished, or endangered species…; areas providing a seasonal haven for concentrations of aquatic or terrestrial animals…; …Areas of Scientific Value…Areas which Serve to Maintain Ecological Balances …"	*Natural*	Purpose: "…to protect those shoreline areas that are relatively free of human influence or that include intact or minimally degraded shoreline functions intolerant of human use. These systems require that only very low intensity uses be allowed..." Criteria: "…if any of the following characteristics apply…shoreline is ecologically intact and therefore currently performing an important, irreplaceable function or ecosystem-wide process that would be damaged by human activity; …considered to represent ecosystems and geologic types that are of particular scientific and educational interest; …unable to support new development or uses without significant adverse impacts to ecological functions or risk to human safety."	The County's and Ecology's Natural designations are extremely similar.
Aquatic	Purpose: "…to protect the quality and quantity of the water, to preserve the water surfaces and foreshores for shoreline dependent uses…and to preserve the Aquatic area's natural features and resources." Criteria: "…all marine waters…seaward of the line of ordinary high tide…; …all lakes subject to this Master Program, below the ordinary high water mark; …all wetlands associated with waters described…*above*."	*Aquatic*	Purpose: "…to protect, restore, and manage the unique characteristics and resources of the areas waterward of the ordinary high-water mark." Criteria: "…lands waterward of the ordinary high-water mark…may assign…to wetlands."	The County's and Ecology's Aquatic designations are extremely similar.

Photo courtesy Department of Ecology

Figure 30. Example of Urban-Designated Shoreline – San Juan Island.

Photo courtesy Department of Ecology

Figure 31. Example of Rural-Designated Shoreline – Orcas Island.

Photo courtesy Department of Ecology

Figure 32. Example of Rural Residential-Designated Shoreline – San Juan Island.

Photo courtesy Department of Ecology

Figure 33. Example of Rural Farm-Forest Designated Shoreline – Shaw Island.

Photo courtesy Department of Ecology

Figure 34. Example of Conservancy-Designated Shoreline – Lopez Island.

Photo courtesy Department of Ecology

Figure 35. Example of Natural-Designated Shoreline – Blakely Island.

Table 43. Relationship of Existing County Subarea Plan Shoreline Designations to Ecology's Recommended Classification System.

Subarea Shoreline Designation	Related County Shoreline Designation	Comparable Ecology Designation
Eastsound Urban	Urban	High Intensity
Eastsound Marina District:	Urban	High Intensity
Eastsound Conservancy District	Conservancy	Rural Conservancy
Eastsound Natural District	Natural	Natural
Eastsound Residential	See note*	Shoreline Residential
Shaw Rural	Rural	High Intensity
Shaw Rural Farm Forest	Rural Farm Forest	Rural Conservancy
Shaw Conservancy	Conservancy	Rural Conservancy
Shaw Natural	Natural	Natural

*Existing SMP states that "uses in the Eastsound Residential shoreline should be consistent with the management policies for the adjoining upland use districts."

The Guidelines do not contain explicit provisions related to environment designation overlays, such as the County's current Marine Habitat Management and Marine Habitat Protected Area Environments. However, as stated above, the Guidelines state that "local governments may establish a different designation system or may retain their current environment designations, provided it is consistent with the purposes and policies" of WAC 173-26-211.

8.1.3 Methodology

It is difficult to describe a methodology for environment designation recommendations as there are very few firm "rules." In general, the Ecology Guidelines criteria will be used and further informed by the following GIS data:

- Current land use
- Planned land use
- Ownership
- Wetlands
- Floodplains
- Vegetation
- Impervious surface
- Ecological function scores (provided in Chapter 3 of this report)

While current and future land use and ownership provide basic context for a given segment of land, recommended environment designations do not always correlate strongly with those parameters. County parcels are often quite large and extend well beyond shoreline jurisdiction. For example, while the current land use may indicate a single-family residential use, the actual development may not be in shoreline jurisdiction and would therefore not have necessarily resulted in potential adverse impacts to shoreline condition. The vegetation and impervious surface data are better gauges of alteration in shoreline jurisdiction, as well as the ecological

function scores. For this reason, parcels that have a current or planned land use of residential (or other designation allowing alteration) may ultimately have a Conservancy or even Natural environment designation within shoreline jurisdiction. The parcel can still accommodate the use, perhaps even in shoreline jurisdiction, and satisfy the WAC requirements for consistency between the environment designations and the Comprehensive Plan (see WAC 173-26-211(3) for additional detail about consistency requirements). In areas with smaller parcel sizes, current land use will be more strongly correlated with level of alteration and the resulting environment designation because more often the entire parcel or a large portion of the parcel is in shoreline jurisdiction.

In general, Natural will be the recommended designation when impervious surface percentages are very low; when wetlands and/or floodplain percentages are high; when vegetation is primarily forest, scrub-shrub or various types of wetlands; and when the function score is high.

Rural Conservancy may generally be applied to County lands consistent with the Ecology criteria and when impervious surface percentages are low (often less than 10); when wetlands and floodplain percentages are low to moderate (absence of these does not indicate alteration or poor function); when vegetation is primarily forest, scrub-shrub or various types of wetlands; and when function scores are typically above average.

High-intensity will be limited to some areas of more intensive rural development and master planned resorts. Current land use, particularly in areas of more intensive rural development and master planned resorts, and a low function score correlate strongly with appropriate assignment of this designation.

The Shoreline Residential designation might be applied in portions of County areas of more intensive rural development and master planned resorts that are designated for residential use only. This designation is primarily driven by existing and planned land use, as outlined in the Ecology criteria above.

Similar to Shoreline Residential, Urban Conservancy might be applied in portions of areas of more intensive rural development and master planned resorts that are consistent with the Ecology criteria and when impervious surface percentages are low (often less than 10); when wetlands and floodplain percentages are low to moderate (absence of these does not indicate alteration or poor function); when vegetation is primarily forest, scrub-shrub or various types of wetlands; and when function scores are typically above average. For example, this designation might be applied to a park in the Eastsound subarea.

8.1.4 Recommendations

Based on the Background and Methodology outlined above, the following specific recommendations are provided for future development and assignment of environment designations in the County and its subareas:

- Consider utilizing the basic six-category environment designation scheme in the SMP Guidelines, applying designations appropriately to County lands.

- Consider whether additional environment designations would be appropriate to further delineate unique areas that might warrant designation-specific use or modification regulations, such as waterfront parks.

- Substantively utilize inventory and characterization findings, such as GIS information and/or function scores, in this report to inform assignment of environment designations, as outlined in Methodology.

8.2 General Policies and Regulations

8.2.1 Critical Areas

- Consider whether the County's critical areas regulations should be incorporated into the SMP by reference or through direct inclusion. Either method of inclusion may require modification of the County's critical areas regulations to meet SMA criteria (e.g. exceptions and exemptions).

- Consider the application of site-specific variable buffer widths along marine shorelines within environment designations as needed to ensure no net loss of ecological functions and as consistent with developed policies and regulations under the County's revised critical areas ordinance.

8.2.2 Flood Hazard Reduction

- Consistent with the WAC provisions in the Guidelines, provide maximum flexibility for developing and maintaining flood hazard reduction measures as needed to continue protection of existing developed areas.

- Consider whether statements regarding sea level change should be included in order to ensure that development is designed and located to avoid damage from sea level change within the lifetime of a structure (see discussion in section 3.2.1).

8.2.3 Public Access

- Recognize San Juan County's 2030 vision for parks, trails and natural areas as a shoreline public access plan (see section 6.2).

- Recognize future planning efforts by the San Juan County Land Bank to acquire additional shorelands, which may provide future public access. Consider corresponding changes which may be necessary to the

environment designations for such shorelands, ensuring consistency with Land Bank goals and policies.

8.2.4 Shoreline Vegetation Conservation

- Build on the existing protections provided in the County's critical areas regulations and current SMP, paying special attention to measures that will promote retention of shoreline vegetation and development of a well-functioning shoreline, which provides both physical and habitat processes.

- Ensure clear regulations for selective pruning of trees for safety and view protection as may be allowed per WAC 173-26-221(5)(c).

8.2.5 Water Quality, Stormwater, and Nonpoint Pollution

- Include policies and regulations that appropriately incorporate recommendations of the County's water quality-related studies, particularly as related to impaired parameters listed by Ecology (see Chapter 4 discussions for each managmenet area under *Water Quality, Sediment, and/or Tissue Sample Results*).

- Ensure that regulations allow for placement of any structures or facilities in shoreline jurisdiction for the purpose of improving water quality, as long as impacts are identified and mitigated, if necessary.

- Consider adding clarifying statements noting that the policies of the SMP are also policies of the County's comprehensive plan and that the policies also apply to activities outside shoreline jurisdiction that affect water quality within shoreline jurisdiction. However, the regulations apply only within shoreline jurisdiction.

- Consider policies which seek to improve water quality, quantity (the amount of water in a given system, with the objective of providing for ecological functions and human use), and flow characteristics in order to protect and restore ecological functions and ecosystem-wide processes of shorelines within Shoreline Management Act jurisdiction. Statements may refer to the implement Ecology's 2005 Storm Water Management Manual, for Western Washington.

8.3 Shoreline Modification Provisions

8.3.1 Shoreline Stabilization

- Ensure "replacement" and "repair" definitions and standards are consistent with WAC 173-26-231(3)(a). Repair activities should be defined to

include a replacement threshold so that applicants and staff will know when "replacement" requirements need to be met.

- Otherwise, fully implement the intent and principles of the WAC Guidelines. Reference appropriate exemptions found in the WAC related to "normal maintenance and repair" and "construction of the normal bulkhead common to single-family residences." These are not exemptions from the regulations, however; they are exemptions from a Shoreline Substantial Development Permit.

- Give preference to those types of shoreline modifications that have a lesser impact on ecological functions. Policies should promote "soft" over "hard" shoreline modification measures. Preference should also be given to those structures that exist and can be constructed entirely above MHHW. As seen in the shoreline armoring comparative tables by management area (Table 12), some areas have a higher percentage of armoring and likewise some shoreline types are more armored than others.

- Policies should also incorporate U.S. Army Corps of Engineers guidance regarding sea level rise (U.S. Army Corps of Engineers 2009).

- Incentives should be included in the SMP that would encourage modification of existing armoring, where feasible, to improve habitat while still maintaining any necessary site use and protection. Emphasis should be placed on providing incentives to key shoreline types such as feeder bluffs, pocket beaches, barrier beaches, etc.

8.3.2 Piers and Docks

- Consider not allowing new docks in areas with eelgrass, except for public docks and docks on non-ferry served islands when there is no alternate form of moorage.

- Provide clear "replacement" and "repair" definitions and standards. Repair activities should be defined to include a replacement threshold so that applicants and staff will know when "replacement" requirements need to be met.

- Assess dimensional and other standards for new piers and replacement/modified piers contained in the existing SMP and update as needed to provide clarity.

- Consider standards that address materials such as grated decking for dock and pier replacements/modifications that may be proposed in the future along the shoreline.

- Be consistent with Washington Department of Fish and Wildlife and U.S. Army Corps of Engineers design standards, and recognize special local issues or circumstances.

8.3.3 Fill

- Restoration fills should be encouraged, including improvements to shoreline habitats, material to anchor LWD placements, and as needed to implement shoreline restoration. Recommend not requiring Conditional Use Permit for restoration-related fills.

- Fills waterward of the OHWM to create developable land should be prohibited, and should only be allowed landward of OHWM if not inconsistent with the requirement to protect shoreline ecological functions and ecosystem-wide processes.

- The potential for upland fill proposals, rather than aquatic, may increase in the future if the sea level rise expectations are realized. Detailed regulations governing upland fills should be developed.

8.3.4 Breakwaters, Jetties, Groins and Weirs

- Consider prohibiting new breakwaters, jetties, groins, or weirs in the SMP except where they are essential to restoration or maintenance of existing water-dependent uses.

8.3.5 Dredging and Dredge Material Disposal

Except for purposes of shoreline restoration, flood hazard reduction, and maintenance of existing legal moorage and navigation, consider prohibiting these modifications.

8.3.6 Shoreline Habitat and Natural Systems Enhancement Projects

- The SMP should include incentives to encourage restoration projects, particularly in areas identified as having lower function. For example, allow modification of impervious surface coverage, density, height, or setback requirements when paired with significant restoration. Emphasize that certain fills, such as nearshore gravels or material to anchor logs, can be an important component of some restoration projects.

8.4 Shoreline Uses

8.4.1 Agriculture

- The County allows some agricultural uses in certain areas, and there may be some agricultural activities in the shoreline jurisdiction. Ensure

appropriate provisions for agricultural uses continue while also protecting critical areas from new agricultural development.

8.4.2 Aquaculture

- The County allows some aquaculture uses in certain shoreline areas. Ensure appropriate provisions for aquaculture uses continue.

8.4.3 Boating Facilities

- Public and private, commercial boating facilities are prevalent and an important part of the County's economy and culture. Regulations should be crafted that are consistent with the WAC, as well as accommodate any known plans for modifications of any of these facilities. Incentives should be used where appropriate to encourage site restoration.

8.4.4 Commercial Development

- Recognize commercial uses and consider incentives to attract water-oriented uses in appropriate locations along the shoreline.

8.4.5 Forest Practices

- Provide general policies and regulations for forest practices according to the WAC Guidelines.

8.4.6 Industry

- Include provisions for industrial uses while ensuring no net loss of shoreline ecological functions.

8.4.7 Mining

- Provide general policies and regulations for mining according to the WAC Guidelines.

8.4.8 Recreational Development

- Policies and regulations related to parks management should provide clear preferences for shoreline restoration consistent with public access needs and uses. Existing natural parks should be protected and enhanced.

- Include provisions for existing and potential recreational uses, including boating, scuba diving, kayaking, swimming, and fishing.

8.4.9 Residential Development

- Recognize current and planned shoreline residential uses with adequate provision of services and utilities as appropriate to allow for shoreline recreation and ecological protection.

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

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

- Consider adding statements which acknowledge the potential for sea level change. This may include assuring that new residential structures and associated facilities are located where shoreline modifications would not be necessary to protect such a structure within the life of the structure when accounting for potential sea level change.

8.4.10 Transportation and Parking

- Allow for maintenance and improvements to existing roads and parking areas and for necessary new roads and parking areas where other locations outside of shoreline jurisdiction are not feasible.

- Opportunities for armoring reduction may be available by removal or relocating some roads in shoreline jurisdiction.

8.4.11 Utilities

- Allow for utility maintenance and extension with criteria for location and vegetation restoration as appropriate.

8.5 Restoration Plan

A Restoration Plan document will be prepared as a later phase of the Shoreline Master Program update process, consistent with WAC 173-26-201(2)(f). The Shoreline Restoration Plan must address the following six subjects (WAC 173-26-201(2)(f)(i-vi)) and incorporated findings from this analysis report:

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

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

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

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

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

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

The Restoration Plan will "include goals, policies and actions for restoration of impaired shoreline ecological functions. These master program provisions should be designed to achieve overall improvements in shoreline ecological functions over time, when compared to the status upon adoption of the master program." The Restoration Plan will mesh potential projects identified in this report with additional projects, regional or local efforts, and programs of each jurisdiction, watershed groups, and environmental organizations that contribute or could potentially contribute to improved ecological functions of the shoreline.

9.0 References

Adamus, P. 2006. Wetlands of Island County, Washington Profile of characteristics, Functions, and Health. College of Oceanic and Atmospheric Sciences, Oregon State University. August 2006.

Adamus Resource Assessment, Inc. and EarthDesign, Inc. 2010. Characterization of Wetland and Nearshore Landscapes of San Juan County. Corvallis, OR. December 2010.

ADFG. 2010. Shrimp Fact Sheet. Alaska Department of Fish and Game. http://www.adfg.state.ak.us/pubs/notebook/shellfsh/shrimp.php (accessed November 17, 2010).

Ahearn, D.S., R.W. Sheibley, R.A. Dahlgren, and K.E. Keller. 2004. Temporal Dynamics of Stream Water Chemistry in the Last Free-Flowing River Draining the Western Sierra Nevada, California. *Journal of Hydrology* 295(1-4):47-63.

Allan, J. and P.D. Komar. 2006. Climate controls on U.S. West Coast erosion processes. *Journal of Coastal Research* 22(3):511-529.

American Community Survey. 2005-2009. San Juan County, Washington, Selected Social Characteristics in the United States: 2005-2009. 5-Year Estimates. Available: http://factfinder.census.gov/. Accessed: April 18, 2011.

Barsh, R. and M. Murphy. 2007. Origins of juvenile Chinook in San Juan County. KWIAHT Report to the San Juan County Marine Resources Committee. September 2007 (Revised).

Barsh, R. and T. Wyllie-Echeverria. 2006. Habitat and Fish Use of Stream Mouths and Beaches on Orcas, Shaw, and Waldron Islands, 2003-2004, Part I.

Battin, J., M.W. Wiley, M.H. Ruckelshaus, R.N. Palmer, E. Korb, K.K. Bartz, and H. Imaki. 2007. Projected impacts of climate change on salmon habitat restoration. Proceedings of the National Academy of Sciences of the United States of America 104(16):6720-6725.

Bavins, M., D. Couchman, and J. Beumer. 2000. Fisheries Guidelines for Fish Habitat Buffer Zones. Department of Primary Industries, Queensland, Fish Habitat Guideline FHG 003.

Beamer, E. and K. Fresh. 2012. (Draft) Juvenile Salmon and Forage Fish Presence and Abundance in Shoreline Habitats of the San Juan Islands, 2008-2009: Map Applications for Selected Fish Species. Skagit River Systems Cooperative and NOAA Fisheries for the Washington State Salmon Recovery Funding Board. April 2012.

Beamer, E., A. McBride, C. Greene, R. Henderson, G. Hood, K. Wolf, K. Larsen, C. Rice, and K. Fresh. 2005. Delta and Nearshore Restoration for the Recovery of Wild Skagit River Chinook Salmon: Linking Estuary Restoration to Wild Chinook Salmon Populations. Skagit Chinook Recovery Plan. LaConner, Washington, Skagit River System Cooperative: 93.

Beamer, E., A. McBride, R. Henderson, and K. Wolf. 2003. The importance of non-natal pocket estuaries in Skagit Bay to wild Chinook salmon: an emerging priority for restoration. Skagit River System Cooperative, La Conner, Washington. Available at: www.skagitcoop.org/.

Beamer, E., K.L. Fresh, R. Henderson, T. Wyllie-Echeverria. 2008. WRIA 2 Shoreline: Preliminary Habitat and Beach Seining Results.

Berry, H., J. Harper, T. Mumford, Jr.,B. Bookheim, A. Sewell, and L. Tamayo. 2001. Washington State Shorezone Inventory. Nearshore Habitat Program Washington State Department of Natural Resources, Olympia,WA.

Bostrom C, Jackson E, Simenstad C. 2006. Seagrass landscapes and their effects on associated fauna: a review. *Estuarine and Coastal Shelf Science* 68(3-4):383-403.

Bourgeois, J. and S.Y. Johnson. 2001. Geologic evidence of earthquakes at the Snohomish delta, Washington, in the past 1,200 years. *GSA Bulletin* 113:482-494.

Brandon, M.T., D.S. Cowan, and J.A. Vance. 1988. The Late Cretaceous San Juan thrust system, San Juan Islands, Washington. Geological Society of America Special Paper Number 221.

Brennan, J. and H. Culverwell. 2004. Marine Riparian: An Assessment of Riparian Functions in Marine Ecosystems. Unpublished draft.

Brown, E.H., B.A. Housen, and E.R. Schermer. 2007. Tectonic evolution of the San Juan Islands thrust system, Washington. Geological Society of America Field Guide Number 9.

Cadrin, S.X., J.A. Boutillier, and J.S. Idoine. 2004. A Hierarchal Approach to Determining Reference Points for Pandalid Shrimp. *Can. J. Fish. Aquat. Sci.* 61:1373-1391.

Canadian Hydrographic Service. 2010. Current Atlas Juan de Fuca to Strait of Georgia. Canadian Hydrographic Service, Pacific Region, Department of Fisheries and Oceans, Institute of Ocean Sciences, Sidney, British Columbia.

Canning, D.J. 2005. Sea Level Rise and Coastal Hazards in Washington State. Washington State Department of Ecology. Presented at: The Future Ain't What it Used to Be: Planning for Climate Disruption, 2005 Regional Climate Change Conference, Seattle, Washington. October 27, 2005.

Christensen, D. 2000. Protection of Riparian Ecosystems: A Review of Best Available Science. Jefferson County Environmental Health Division, Washington.

Coastal Geologic Services. 2009. MacKaye Harbor Community Shoreline Restoration Project—Restoration Plan: Final Report. Prepared for: Friends of the San Juans. March 2009.

Curtiss, G.M., P.D. Osborne, and A.R. Horner-Devine. 2009. Seasonal patterns of coarse sediment transport on a mixed sand and gravel beach due to vessel wakes, wind waves, and tidal currents. *Marine Geology* 259(1-4):73-85.

Dayton, P.K. 1985. Ecology of Kelp Communities. *Annual Review of Ecological Systems* 16: 215-45.

Dean, R.G. and R.A. Dalrmple. 2002. *Coastal Processes with Engineering Applications*. Cambridge, UK: Cambridge University Press.

Dean T.A,, L. Haldorson, D.R, Laura, S.C, Jewett and A. Blanchard. 2000. The distribution of nearshore fishes in kelp and eelgrass communities in Prince William Sound, Alaska: Associations with vegetation and physical habitat characteristics. Environmental Biology of Fishes 57:271-287.

Dethier, D.P., D.P. White, and C.M. Brookfield. 1996. Maps of the surficial geology and depth to bedrock of False Bay, Friday Harbor, Richardson, and Shaw Island 7.5-minute quadrangles, San Juan County, Washington. Washington Division of Geology and Earth Resources. Open File Report 96-7.

Dethier, M. 2006. Native Shellfish in Nearshore Ecosystems of Puget Sound. Puget Sound Nearshore Partnership Report No. 2006-04. Seattle District, U.S. Army Corps of Engineers, Seattle, Washington.

Dinnel, P.A., D.A. Armstrong, and R.O. McMillan. 1986a. Dungeness Crab, Cancer magister, distribution, recruitment, growth and habitat use in Lummi Bay, Washington. University of Washington, School of Fisheries Report Number FRI-UW-8612.

Dinnel, P.A., R.O. McMillan, D.A. Armstrong, T.C. Wainwright, A.J. Whiley, R. Burge, and R. Bumgarner. 1986b. Padilla Bay Dungeness Crab, Cancer magister, habitat study. National Estuarine Research Reserve Reprint Series Number 3.

DNR. 2011. Liquefaction map website. Obtained on website on March 15, 2011: ftp://ww4.dnr.wa.gov/geology/pubs/ofr04-20/ofr04-20_sanjuan_liq.pdf.

Dowty, P., Reeves, B., Berry, H., Wyllie-Echeverria, S., Mumford, T., Sewell, A., Milos, P., and R. Wright. 2005. Puget Sound submerged vegetation monitoring program 2003-2004 Monitoring Report. Washington Department of Natural Resources, Puget Sound Ambient Monitoring Program. Olympia, Washington.

Duggins, D.O., C.A. Simenstad and J.A. Estes. 1989. Magnification of secondary production by kelp detritus in coastal marine ecosystems. Science 245(4914):170-173.

Ecology 2011d. Environmental Information Management (EIM) Database. Obtained on website on April 4, 2011: http://apps.ecy.wa.gov/eimreporting/Downloads.htm.

Ecology 2011e. Water Quality Assessment for Washington (WQA). Obtained on website on April 18, 2011: http://apps.ecy.wa.gov/wqawa2008/viewer.htm.

Ecology. 2000. Washington State Department of Ecology Alternative Bank Protection Methods for Puget Sound Shorelines. Publication # 00-06-012.

Ecology. 2011a. Washington State Department of Ecology, Coastal Zone Atlas. Obtained on website on March 15, 2011: https://fortress.wa.gov/ecy/coastalatlas/viewer.htm.

Ecology. 2011b. Washington State Department of Ecology, WRIA 2 documents.

Ecology. 2011c. Washington State Department of Ecology, Shoreline Management Plan Handbook: Chapter 7: Shoreline Inventory and Characterization. Obtained on website on March 15, 2011: http://www.ecy.wa.gov/programs/sea/shorelines/smp/handbook/Chapter7.pdf.

Eggleston, D. and D.A. Armstrong. 1995. Larval supply, active substrate selection, and post-settlement survival as determinants of estuarine Dungeness crab recruitment. *Ecological Monographs* 65:193-216.

Eckman J.E, Duggins D.O, Sewell A.T. 1989. Ecology of understory kelp environments. Effects of kelps on flow and particle transport near the bottom. J. Exp. Mar. Biol. Ecol. 129:173-187.

Elsner, M.M., L. Cuo, N. Voisin, J.S. Deems, A.F. Hamlet, J.A. Vano, K.E.B. Mickelson, S-Y. Lee, D.P. Lettenmaier. 2010. Implications of 21st century climate change for the hydrology of Washington State. Climate Change doi:10.1007/s10584-010-9855-0.

Falcone, E., J. Calambokidis, G. Steiger, M. Malleson, J. Ford. 2005. Humpback whales in the Puget Sound/Georgia Strait Region. http://www.cascadiaresearch.org/Falconeetal2005humpbacks.pdf (accessed November 21, 2010).

Finlayson, D. 2006. The Geomorphology of Puget Sound Beaches. Oceanography. University of Washington, Seattle, Washington. PhD thesis.

Fisher, W., and D. Velasquez. 2008. Management Recommendations for Washington's Priority Habitat and Species: Dungeness Crab. Washington Department of Fish and Wildlife. Olympia, Washington. December, 2008.

Friends of the San Juans. 2004a. Documented Surf Smelt and Pacific Sand Lance Spawning Beaches In San Juan County With a Summary of Protection and Restoration Priorities for Forage Fish Habitat. Friends of the San Juans, Friday Harbor, Washington.

Friends of the San Juans. 2004b. Forage fish spawning habitat assessment and a summary of protection and restoration priorities for San Juan County Washington. Final Project Report. Friends of the San Juans, Friday Harbor, Washington.

Friends of the San Juans. 2004c. Exploratory Pacific herring spawning habitat surveys for San Juan County, Washington. Friends of the San Juans, Friday Harbor, Washington.

Friends of the San Juans. 2009. San Juan County Shoreline Modification Inventory, GIS Geo-referenced Database. Friends of the San Juans, Friday Harbor, Washington.

Garbary D.J., Kim K.Y., Klinger T. 1999. Red algae as hosts for endophytic kelp gametophytes. Source: *Marine Biology* 135(1):35-40. October 1999.

Gelfenbaum, G., T. Mumford, J. Brennan, H. Case, M. Dethier, K. Fresh, F. Goetz, M. van Heeswijk, T.M. Leschine, M. Logsdon, D. Myers, J. Newton, H. Shipman, C.A. Simenstad, C. Tanner, and D. Woodson. 2006. Coastal Habitats in Puget Sound: A research plan in support of the Puget Sound Nearshore Partnership. Puget Sound Nearshore Partnership Report No. 2006-1. Published by the U.S. Geological Survey, Seattle, Washington.

Habitat Work Schedule. 2011. Habitat Work Schedule. Obtained April 1, 2011, from website: http://hws.ekosystem.us.

Hagstrum, J.T., B.F. Atwater, and B.L. Sherrod. 2004. Paleomagnetic correlation of late Holocene earthquakes among estuaries in Washington and Oregon. *Geochemistry Geophysics Geosystems* 5(10):10.1029/2004GC000736.

Herrera and The Watershed Company. 2011a. Best Available Science for Marine Fish and Wildlife Habitat Conservation Areas. Chapter 3. Prepared for San Juan County Community Development and Planning Department. January 2011.

Herrera and The Watershed Company. 2011b. Best Available Science Stormwater Management Alternatives. Chapter 7. Prepared for San Juan County Community Development and Planning Department. January 2011.

Herrera. 2005. Marine shoreline sediment survey and assessment, Thurston County, Washington. Thurston Regional Planning Council, Olympia, Washington. Prepared by Herrera Environmental Consultants, Inc., Seattle, Washington.

Herrera. 2007a. Marinas and Shipping/Ferry Terminals White Paper. Washington Department of Fish & Wildlife, Olympia, Washington. Prepared by Herrera Environmental Consultants, Inc., Seattle, Washington.

Herrera. 2007b. Shoreline Modification White Paper. Washington Department of Fish & Wildlife, Olympia, Washington. Prepared by Herrera Environmental Consultants, Inc., Seattle, Washington.

Herrera. 2008. Mooring Buoys White Paper. Washington Department of Fish & Wildlife, Olympia, Washington. Prepared by Herrera Environmental Consultants, Inc., Seattle, Washington.

Herrera. 2009a. Conceptual shoreline armoring design: MacKaye Harbor Road MP 1.5 to 1.7. Prepared for: San Juan County Public Works Department.

Herrera. 2009b. Data Report: Portage Bay Shellfish Protection District Bacteria Monitoring Study. Prepared for Whatcom County Department of Public Works, by Herrera, Inc., Seattle, Washington.

Herrera. 2009c. Assessment and recommendations for habitat protection: Strawberry Point, Whidbey Island. Prepared for Island County Planning and Community Development Department. January 30, 2009.

Herrera. 2011. City of Bainbridge Island Addendum to the Summary of Science Report. Prepared for City of Bainbridge Island Planning and Community Development Department. January 26, 2011.

Horton H.F. 1989. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Pacific Northwest)–Dover and rock sole. U.S. Fish Wildl. Serv. Biol. Rep. 82(11.123). U.S. Army Corps of Engineers, TR EL-82-4. 17 pp.

Johnson, S.P. and D.E. Schindler. 2009. Trophic Ecology of Pacific Salmon (Oncorhynchus spp.) in the Ocean: A synthesis of stable isotope research. *Ecol. Res.* 24:855-863.Johnson, S.Y., C.J. Potter, J.M. Armentrout, J.J. Miller, C. Finn, and C.S. Weaver. 1996. The Southern Whidbey Island Fault: An Active Structure in the Puget Lowland, Washington. *Geological Society of America Bulletin* 108(3):334-354.

JRB Associates. 1984. Water Quality Dependant Uses in Puget Sound – Final Report. Prepared for U.S. Environmental Protection Agency, Washington D.C., by JRB Associates, Bellevue, Washington. March 30, 1984.

Kelsey, H.M., B. Sherrod, S.Y. Johnson, and S.V. Dadisman. 2004. Land-level changes from a late Holocene earthquake in the northern Puget Lowland, Washington. *Geology* 32:469-472.

Kerwin, J. 2002. Salmon and Steelhead Habitat Limiting Factors Report for the San Juan Islands (Water Resource Inventory Area 2). Washington Conservation Commission.

Klinger, T., D. Fluharty, K. Evans and C. Byron. 2006. Assessment of Coastal and Water Resources and Watershed Conditions at San Juan Island National Historical Park. U.S. Department of the Interior, Water Resources Division, Natural Resource Program Center. Technical Report NPS/NRWRD/NRTR-2006/360.

Kovanen, D.J. and O. Slaymaker. 2004. Relict Shorelines and Ice Flow Patterns of the Northern Puget Lowland from Lidar Data and Digital Terrain Modelling. Geografiska Annaler Series a-. *Physical Geography* 86A(4):385-400.

Labrecque, A.J.M., R.E. Thomson, M.W. Stacey, and J.R. Buckley. 1994. Residual currents in Juan de Fuca Strait. *Atmosphere-Ocean* 32(2):375-394.

Lance, M.M., S.A. Richardson and H.L. Allen. 2004. Washington state recovery plan for the sea otter. Washington Department of Fish and Wildlife, Olympia. December, 2004. 91 pp.

Lapen, T.J. 2000. Geologic Map of the Bellingham 1:100,000 Quadrangle, Washington. Prepared by Washington State Department of Natural Resources.

Lee, S.Y., R.J.K. Dunn, and R.A. Young. 2006. "Impact of Urbanization on Coastal Wetland Structure and Function," *Austral Ecology* 31.

Lemieux, J.P., Brennan, J.S., Farrell, M., Levings, C.D., and Myers, D. (Editors). 2004. Proceedings of the DFO/PSAT sponsored Marine Riparian Experts Workshop, Tsawwassen, BC, February 17-18, 2004. Can. Manuscr. Rep. Fish. Aquat. Sci. 2680: ix + 84 p.

Leschine, T.M. and A.W. Petersen. 2007. Valuing Puget Sound's Valued Ecosystem Components. Puget Sound Nearshore Partnership Report No. 2007-07. Published by Seattle District, U.S. Army Corps of Engineers, Seattle, Washington.

Levings, C.D. and G. Jamieson. 2001. Marine and estuarine riparian habitats and their role in coastal ecosystems, Pacific Region. Canadian Science Advisory Secretariat Research document 2001/109.

Lowery, D. Forage Fish Beach Survey Training (slide presentation). Washington Department of Fish and Wildlife, Habitat Program, Science Division. http://wdfw.wa.gov/conservation/research/projects/marine_beach_spawning/training/foragefish_beach_survey_training_presenter_notes.pdf (accessed October 22, 2012).

MacDonald, K., D. Simpson, B. Paulsen, J. Cox, and J. Gendron. 1994. Shoreline Armoring Effects on Physical Coastal Processes in Puget Sound, Washington. Coastal Erosion Management Studies, Volume 5. Washington Department of Ecology, Shorelands and Water Resources Program, Olympia, Washington.

MacLennan, A. and J. Johannessen. 2008. San Juan Initiative Protection Assessment Nearshore Case Study Area Characterization. Prepared for: The San Juan Initiative; The Puget Sound Partnership through The Surfrider Foundation.

MacLennan, A, J. Johannessen, and S. Williams. 2010. Draft Current Geomorphic Shoretype (Feeder Bluff) Mapping of San Juan County, WA – Phase 2. Prepared for: San Juan County Marine Resources Committee and the Northwest Straits Commission. Prepared by Coastal Geological Services, Bellingham, Washington. March 31, 2010.

Mader, C.L. 1999. Modeling the 1958 Lituya Bay mega-tsunami. *Science of Tsunami Hazards* 17:57-67.

Mantua, N., I. Tohver and A. Hamlet. 2010. Climate change impacts on streamflow extremes and summertime stream temperature and their possible consequences for freshwater salmon habitat in Washington State. *Climatic Change* 102:187–223.

Marine Resources Committee (MRC). (2011). Marine Stewardship Area Monitoring Plan and Strategy, San Juan County Marine Resources Committee (Draft). June 27, 2011

Masson, D. and P.F. Cummings. 2000. Fortnightly modulation of the estuarine circulation in Juan de Fuca Strait. Journal of Marine Research 58(3):439-463.

Miles, J.R., P.E. Russell, and D.A. Huntley. 2001. Field measurements of sediment dynamics in front of a seawall. Journal of Coastal Research 17(1):195-206.

Mojfeld, H.O. 1992. Subtidal sea level fluctuations in a large fjord system. *Journal of Geophysical Research* 97(C12):20,191-20,199.

Morang, A., M.C. Mohr, and C.M. Forgette. 2011. Longshore Sediment Movement and Supply along the US Shoreline of Lake Erie. *Journal of Coastal Research* 27(4):619-635.

Morgan, J.D. and C.D. Levings, 1989. Effects of Suspended Sediment on Eggs and Larvae of Lingcod, Pacific Herring, and Surf Smelt. *Canada Technical Report Fisheries Aquatic Science* 1729: 31 p., 1989.

Mortensen, D, A Wertheimer, S Taylor, and J Landingham. 2000. The relationship between early marine growth of pink salmon, *Oncorhynchus gorbuscha*, and marine water temperature, secondary production, and survival to adulthood. Fishery Bulletin 98:319-335.

Mosher, 2009. Submarine landslides and consequent tsunamis in Canada. *Geoscience Canada* 36(4):179-190.

Mote, P., A. Petersen, S. Reeder, H. Shipman, and L.W. Binder. 2008. Sea Level Rise in the Coastal Waters of Washington State. UW Climate Impacts Group and Washington State Department of Ecology. January 2008.

Murphy M.L., S.W, Johnson, D.J., and Csepp. 2000. A comparison of fish assemblages in eelgrass and adjacent subtidal habitats near Craig, Alaska. Alaska Fishery Research Bulletin 7:11-21.

Moulton, L.L. 2000. Distribution of Potential Surf Smelt and Pacific Sand Lance Spawning Habitat in San Juan County, San Juan County Forage Fish Project. Prepared by MJM Research, Lopez Island, Washington. July 2000.

Mulvihill, E.L., C.A. Francisco, J.B. Glad, K.B. Kaster, and R.E. Wilson. 1980. Biological Impacts of Minor Shoreline Structures on the Coastal Environment: State of the Art Review. FWS/OBS- 77/51, 2 vol. U.S. Fish and Wildlife Service, Biological Services Program.

Mumford, T.F. 2007. Kelp and Eelgrass in Puget Sound. Puget Sound Nearshore Partnership Report No. 2007-05. Published by Seattle District, U.S. Army Corps of Engineers, Seattle, Washington.

Murphy, M.L., S.W. Johnson, and D.J. Csepp. 2000. A comparison of fish assemblages in eelgrass and adjacent subtidal habitats near Craig, Alaska. *Alaska Fishery Research Bulletin* 7:11-21

National Park Service. 2011. San Juan Island National Historical Park: The Pig War. Available: http://www.nps.gov/sajh/historyculture/the-pig-war.htm. Accessed: April 18, 2011.

National Wildlife Federation. 2007. Sea-level Rise and Coastal Habitats in the Pacific Northwest: An Analysis for Puget Sound, Southwestern Washington, and Northwestern Oregon.

Nelson T.A. and J.R. Waaland. 1997. Seasonality of eelgrass, epiphyte, and grazer biomass and productivity in subtidal eelgrass meadows subjected to moderate tidal amplitude. *Aquatic Botany* 56(1):51-74. February 1997.

Nightingale, B. and C. Simenstad. 2001. Overwater structures: marine issues. White Paper submitted to Washington State Department of Fish and Wildlife, Washington State Department of Ecology, and Washington State Department of Transportation. University of Washington, Wetland Ecosystem Team, School of Aquatic and Fishery Sciences, Seattle, Washington.

NMFS. 2007. Pinto abalone (Haliotis kamtschatkana) fact sheet. National Marine Fisheries Service November 1, 2007. http://www.nmfs.noaa.gov/pr/pdfs/species/pintoabalone_detailed.pdf (accessed November 17, 2010).

NMFS. 2008a. National Marine Fisheries Service. 2008. Recovery Plan for Southern Resident Killer Whales (Orcinus orca). National Marine Fisheries Service, Northwest Region, Seattle, Washington.

NMFS. 2010a. Pandalid Shrimp Species, Pandalidae. National Marine Fisheries Service, Alaska Fisheries Science Center. http://www.afsc.noaa.gov/kodiak/photo/misshrimp.htm (accessed November 17, 2010).

NMFS. 2010b. Status Review Update for Eulachon in Washington, Oregon, and California. Prepared by the Eulachon Status Review Team. National Marine Fisheries Service. January 20, 2010.

NMFS. 2010c. Gray Whale (Eschrichtius robustus). National Marine Fisheries Service, Alaska Fisheries Science Center. http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/graywhale.htm (accessed November 17, 2010).NOAA. 2011. NOAA Tides and Currents website. http://tidesandcurrents.noaa.gov/geo.shtml?location=9449880 (accessed April 1, 2011).

NMFS. 2012. FBE Focal Species - Rock Sole. National Marine Fisheries Service, Alaska Fisheries Science Center. http://www.afsc.noaa.gov/race/behavioral/rocksole_fbe.htm (accessed October 22, 2012).

NOAA. 2012. Sea Level Rise and Coastal Flooding Impacts Viewer. NOAA Coastal Services Center. http://csc.noaa.gov/digitalcoast/tools/slrviewer (accessed October 8, 2012).

Norris, J.E. 1991. Habitat Associations of Juvenile Rockfishes from Inland Marine Waters of Washington State: An Annotated Bibliography and Review. Number 117, State of Washington Department of Fisheries, Seattle, Washington.

NRCS. 2006. Soil Survey of San Juan County Washington. U.S. Department of Agriculture Natural Resource Conservation Service. Obtained on website on March 25, 2010: http://soildatamart.nrcs.usda.gov/manuscripts/wa055/0/SanJuanWA.pdf.

Oldham, Kit. 2005. San Juan County -- Thumbnail History HistoryLink.org Essay 7505. Available: Historylink.org. Accessed: April 18, 2010. October 04, 2005.

Orca Network. 2010a. Orca Network sightings map. http://www.orcanetwork.org/sightings/map.html (accessed November 27, 2010).

Orca Network. 2010b. Gray Whales Eschrichtius robustus. http://www.orcanetwork.org/nathist/graywhales.html (accessed November 27, 2010).

Orr, L.A., H.H. Bauer, and J.A. Wayenberg. 2002. Estimates of ground-water recharge from precipitation to glacial-deposit and bedrock aquifers on Lopez, San Juan, Orcas, and Shaw Islands, San Juan County, Washington. U.S. Geological Survey Water Resources Investigation Report 02-4114. Accessed at: http://pubs.usgs.gov/wri/wri024114/.

Osborne, R., J. Calambokidis & E.M. Dorsey, 1988, A guide to marine mammals of Greater Puget Sound. Island Publishers, Anacortes, Washington. 191pp.

Pacific Groundwater Group. 2011. San Juan County Annual Groundwater Monitoring Report. Prepared for: San Juan County Department of Health and Community Services. June 2011.

Parsons, J.D. and C.A. Nittrouer. 2004. Extreme events transporting sediment across continental margins: The relative influence of climate and tectonics. In: The Sea, Vol. 13. eds. A.R. Robinson, J. McCarthy, and B.J. Rothschild.

Pashinski, D.J. and R.L. Charnell. 1979. Recovery record for surface drift cards released in the Puget Sound-Strait of Juan de Fuca system during calendar years 1976-1977. NOAA Technical Memorandum ERL PMEL-14.

Penttila, D. 2007. Marine Forage Fishes in Puget Sound. Puget Sound Nearshore Partnership Report No. 2007-03. Published by Seattle District, U.S. Army Corps of Engineers, Seattle, Washington.

Penttila, D.E. 1999. Documented spawning areas of the Pacific herring (Clupea), surf smelt (Hypomesus), and Pacific sand lance (Ammodytes) in San Juan County, Washington. Washington Dept. of Fish and Wildlife, Marine Resources Division. Manuscript Report. LaConner, Washington. 27p.

Penttila, D.E. 2001. Effects of Shading Upland Vegetation on Egg Survival for Summer-Spawning Surf Smelt on Upper Intertidal Beaches in Puget Sound. Washington Department of Fish and Wildlife, Marine Resources Division.

Pessl, F., D.P. Dethier, D.B. Booth, and J.P. Minard. 1989. Surficial Geologic Map of the Port Townsend 30- by 60-Minute Quadrangle, Puget Sound Region, Washington. Scale 1:100,000. Prepared by U.S. Geologic Survey.

Pierce County. 2004. Pierce County Natural Hazard Mitigation Plan. Obtained on August 4, 2010 from: http://www.co.pierce.wa.us/xml/abtus/ourorg/dem/EMDiv/MP/PC%20Cover-Table%20of%20Contents.pdf.

PSAT. 2007. 2007 Puget Sound Update: Ninth Report of the Puget Sound Assessment and Monitoring Program. Puget Sound Action Team, Office of the Governor Olympia, Washington.

PSP. 2010. 2009 State of the Sound Report. Puget Sound Partnership, Olympia, Washington. January 2010.

PSRF. Puget Sound Restoration Fund. http://www.restorationfund.org/projects-abalone.php (accessed November 17, 2010).

Pulling it All Together (PIAT). 2012. (Draft). Strategic Salmon Recovery Planning in San Juan County Washington: The Pulling It All Together (PIAT) Project. Report to the San Juan County Lead Entity for Salmon Recovery and the Washington State Salmon Recovery Funding Board. Friends of the San Juans. July 17, 2012. 61p.

Reid, G.K. 1961. *Ecology of inland waters and estuaries*. New York, Reinhold Publishing Corporation, 375 p.

Rice, C.A. 2006. Effects of shoreline modification on a northern Puget Sound beach: microclimate and embryo mortality in surf smelt. Estuaries and Coasts 29(1):63-71.

Roegner, G.C., E.W. Dawley, M. Russell, A. Whiting, and D.J. Teel. 2011. Juvenile salmonid use of reconnected tidal freshwater wetlands in Grays River, Lower Columbia River Basin. Transactions of the American Fisheries Society 139(4):1211-1232.

Romanuk T.N. and C.D. Levings. 2010. Reciprocal Subsidies and Food Web Pathways Leading to Chum Salmon Fry in a Temperate Marine-Terrestrial Ecotone. PLoS ONE 5(4): e10073. doi:10.1371/journal.pone.0010073

Romanuk, T.N. and C.D. Levings. 2006. Relationships between fish and supralittoral vegetation in nearshore marine habitats. *Aquatic Conserv: Mar. Freshw. Ecosyst.* 16:115–132.

Rugh, D. J., M. M. Muto, S. E. Moore, and D. P. DeMaster. 1999. Status Review of the Eastern North Pacific Stock of Gray Whales. National Oceanographic and Atmospheric Administration, National Marine Fisheries Service, Alaska Fisheries Science Center. Memorandum NMFS-AFSC-103. August 1999.

Russell, R.H. 1975. Geology and water resources of the San Juan Islands, San Juan County, Washington. Washington Department of Ecology Water Supply Bulletin No. 46.

San Juan County. 2010. San Juan County Comprehensive Plan. Last amended by Ordinance 18-2010. April 27, 2010.

San Juan County. 2011. San Juan County Community Development and Planning Department – Comprehensive Plan. Available at: http://www.co.san-juan.wa.us/planning/compplan.aspx.

Shaffer, A. 2003. Preferential use of Nearshore Kelp Habitats by Juvenile Salmon ad Forage Fish. Proceedings, Georgia Basin/Puget Sound Research Conference, Vancouver, BC.

Schasse, H.W. 2003. Geologic Map of the Washington Portion of the Port Angeles 1:100,000 Quadrangle. Prepared by Washington State Department of Natural Resources.

Seattle Times. 2011. 3.2 magnitude quake under San Juan Islands. http://seattletimes.nwsource.com/html/localnews/2014162531_apwasanjuanislandsquake.html (accessed February 9, 2011).

Sherrod, B.L., R.J. Blakely, C.S. Weaver, H.M. Kelsey, E. Barnett, L. Liberty, K.L. Meagher, and K. Pape. 2008. Finding concealed active faults: Extending the southern Whidbey Island fault across the Puget Lowland, Washington. *Journal of Geophysical Research* 112:B05313.

Shipman, H. 2001. The fall of Camano Head: A Snohomish account of a large landslide and tsunami in Possession Sound during the early 1800s. *TsuInfo Alert* 3(6):13-14.

Shipman, H. 2008. A Geomorphic Classification of Puget Sound Nearshore Landforms. Puget Sound Nearshore Partnership Report No. 2008-01. Published by the U.S. Army Corps of Engineers.

Shipman, H. 2009. The Response of the Salish Sea to Rising Sea Level: A Geomorphic Perspective, Puget Sound Georgia Basin Ecosystem Conference, February 8-11, 2009, Seattle, WA, 8pp.

Shipman, H. 2010. The geomorphic setting of Puget Sound: Implications for shoreline erosion and the impacts of erosion control structures. In: *Puget Sound Shorelines and the Impacts of Armoring: Proceedings of a State of the Science Workship, May 2009*. USGS Scientific Investigations Report 2010-5254. p. 19-33.

Simenstad, C.A. 2000. Commencement Bay aquatic ecosystem assessment: Ecosystem-scale restoration for juvenile salmon recovery. Prepared for City of Tacoma, Washington State Department of Natural Resources and the U.S. Environmental Protection Agency.Simenstad C.A,, M.S. Miller, C.F. Nyblade, K, Thornburgh, and L.J. Bledsoe. 1979. Food web relationships of northern Puget Sound and the Strait of Juan de Fuca: a synthesis of the available knowledge. EPA DOC Research Report EPS-600/7-79-259.

SJC. 2000. San Juan County Watershed Management Action Plan and Characterization Report. San Juan County Watershed Management Committee. August 24, 2000. < http://www.co.san-juan.wa.us/health/wtrshdpln/part2toc.html >.

SJC. 2009. Marbled Murrelet Habitat Map. June, 2009. http://www.sanjuanco.com/cdp/docs/CAO/MarbledMurrelet_v1.pdf (accessed May 3, 2011).

SJCD. 2005. San Juan Conservation District Monitoring: Final Report. Grant No: G020022, San Juan Conservation District, Friday Harbor, Washington.

Sobocinski, K.L. 2003. The Impact of Shoreline Armoring on Supratidal Beach Fauna of Central Puget Sound. M.S. thesis. University of Washington, Seattle, Washington. 83 pp.

SSPS. 2007. Puget Sound Salmon Recovery Plan. Shared Strategy for Puget Sound, Shared Strategy Development Committee. Plan adopted by the National Marine Fisheries Service January 19, 2007.

Stick, K.C. and A. Lindquist. 2009. 2008 Washington State Herring Stock Status Report. Washington Department of Fish and Wildlife. November 2009.

Steneck, R.S., M.H. Graham, B.J. Bourque, D. Corbett, J.M. Erlandson, J.A. Estes, M.J. Tegner, 2002. Kelp forest ecosystems: biodiversity, stability, resilience and future. Environmental Conservation 29(4):436-459.

Thayer, G. W., and R. C. Phillips. 1977. Importance of eelgrass beds in Puget Sound. *Marine Fisheries Review* 39:18-22.

The Trust for Public Land, CORE GIS, Conservation Technix, Inc. 2010. San Juan County Parks, Trails, and Natural Areas Plan 2011 – 2016. Prepared for San Juan County. December 2010.

The Watershed Company (TWC). 2011. Letter to Colin Maycock, San Juan County Community Planning and Development. January 3, 2011.

Thom, R.M. and D.K. Shreffler. 1994. Shoreline Armoring Effects on Coastal Ecology and Biological Resources in Puget Sound, Washington. Coastal Erosion Management Studies, Volume 7. Washington Department of Ecology, Shorelands and Environmental Assistance Program, Olympia, Washington.

Thomson, R.E., S.F. Mihaly, and E.A. Kulikov. 2007. Estuarine versus transient flow regimes in Juan de Fuca Strait. *Journal of Geophysical Research* 112(C09022):doi:10.1029/2006JC003925.

Town of Friday Harbor. 2011. Web site accessed December 28, 2011. http://www.fridayharbor.org/town%20documents/CCR/ccr2011b.pdf

U.S. Army Corps of Engineers. 2006. Coastal Engineering Manual. Document Number EM 1110-2-1100. U.S. Army Corps of Engineers.

U.S. Army Corps of Engineers. 2009. Water Resource Policies and Authorities Incorporating Sea-Level Change Considerations in Civil Works Programs. Circular Number EC 1165-2-211. U.S. Army Corps of Engineers.

U.S. Census Bureau. 2011. Factfinder website. .http://factfinder.census.gov/home/saff/main.html?_lang=en (accessed April 1, 2011).

U.S. Coast and Geodetic Survey. 1888a. Topography of, Gulf of Georgia, Washington Territory, North East Part of Orcas Island. Register No. 1869.

U.S. Coast and Geodetic Survey. 1888b. Topography of, Gulf of Georgia, Washington Territory, Patos, Sucia and Matia Islands. Register No. 1870.

U.S. Coast and Geodetic Survey. 1889a. Topography of Washington Sound, Washington, Thatcher Pass to Watmough Bight. Register No. 1952.

U.S. Coast and Geodetic Survey. 1889b. Topography of Washington Sound, Washington, Thatcher Pass to Watmough Bight. Register No. 1953.

U.S. Coast and Geodetic Survey. 1889c. Topography of Washington Sound, Part of Orcas Island. Register No. 1954.

U.S. Coast and Geodetic Survey. 1889d. Topography of Washington Sound, Washington, North End of Lopez Island. Register No. 1955.

U.S. Coast and Geodetic Survey. 1894a. Topography of Washington Sound, Washington, Orcas and Waldron Islands. Register No. 2192.

U.S. Coast and Geodetic Survey. 1894b. Topography of Washington Sound, Washington, Stuart, Spieden and Other Islands. Register No. 2193.

U.S. Coast and Geodetic Survey. 1894c. Topography of Washington Sound, Washington, San Juan and Henry Islands. Register No. 2194.

U.S. Coast and Geodetic Survey. 1895a. Topography of Washington Sound, Washington, Orcas, Shaw and Other Islands. Register No. 2229.

U.S. Coast and Geodetic Survey. 1895b. Topography of Washington Sound, Washington, Orcas, Shaw and San Juan Islands. Register No. 2230.

U.S. Coast and Geodetic Survey. 1895c. Topography of Washington Sound, Washington, Part of San Juan Island. Register No. 2231.

U.S. Coast and Geodetic Survey. 1897a. Topography of Washington Sound, Washington, Part of San Juan Island, Dead Mans Bay to Eagle Point. Register No. 2300.

U.S. Coast and Geodetic Survey. 1897b. Topography of Washington Sound, Washington, Part of San Juan Island, Dead Mans Bay to Eagle Point. Register No. 2301.

U.S. Coast and Geodetic Survey. 1897c. Topography of Washington Sound, Washington, Part of Lopez Island, Big Rock to Point Colville. Register No. 2302.

USFWS. 1997. Recovery Plan for the Marbled Murrelet (*Brachyramphus marmoratus*) in Washington, Oregon and California populations. Region 1, U.S. Fish and Wildlife Service, Portland, OR. 1997.

USGS. 2002. Estimates of Ground-Water Recharge from Precipitation to Glacial-Deposit and Bedrock Aquifers on Lopez, San Juan, Orcas, and Shaw Islands, San Juan County, Washington. U.S. Geological Survey (USGS) Water-Resources Investigations Report 02-4114.

USGS. 2010. Puget Sound Shorelines and the Impacts of Armoring: Proceedings of a State of the Science Workshop, May 2009. Scientific Investigations Report 2010–5254.

USGS. 2011a. Geographic Names Information System (GNIS). U.S. Geological Survey. Obtained from website on August 11, 2010: http://geonames.usgs.gov/pls/gnispublic/f?p=gnispq:3:8457832217162589::NO::P3_FID:151068.

USGS. 2011b. Microsoft Research Maps. U.S. Geological Survey. Obtained from website on April 4, 2011: http://msrmaps.com/.

Verdonck, D. 2006. Contemporary vertical crustal deformation in Cascadia. *Tectonophysics* 417:221-230.

Washington Coastal Atlas. 2010. https://fortress.wa.gov/ecy/coastalatlas/viewer.htm (accessed November 12, 2010).

Washington State Department of Archaeology and Historic Preservation. 2009. Listed Historic Places in Washington. Olympia, Washington. December 17, 2009. Available: http://www.dahp.wa.gov. Accessed: April 18, 2011.

Washington State Parks and Recreation Commission. 2010. James Island. Available: http://www.parks.wa.gov/parks/?selectedpark=James%20Island. Accessed April 18, 2011.

Washington State Parks and Recreation Commission. 2010. Stuart Island. Available: http://www.parks.wa.gov/parks/?selectedpark=Stuart%20Island. Accessed April 18, 2011.

Washington State Parks and Recreation Commission. 2011. Turn Island. Available: http://www.parks.wa.gov/parks/?selectedpark=Turn%20Island&subject=all. Accessed April 18, 2011).

WDFW. 2008. Priority habitat and species list summary sheet for Crustaceans (Crustacea). August 2008. http://www.wdfw.wa.gov/conservation/phs/list/2008/2008-sept_crustaceans.pdf (accessed November 20, 2010).

WDFW. 2010a. Washington Department of Fish and Wildlife, Aquatic Nuisance Species website. Obtained from website on August 11, 2010: http://wdfw.wa.gov/fish/ans/identify/html/index.php?species=nuttalia_obscurata#humanhealth.

WDFW. 2010b. Washington Department of Fish and Wildlife, Salmonscape digital maps of fish distribution. Obtained from website on August 11, 2010: http://wdfw.wa.gov/mapping/salmonscape/index.html.

WDFW. 2010c. Washington Department of Fish and Wildlife, Priority Habitats and Species Map.

WDFW. 2010d. Washington Department of Fish and Wildlife Commercial geoduck tracts map. Obtained from website on August 10, 2010: http://wdfw.wa.gov/fishing/shellfish/geoduck/

WDFW. 2010e. Recreational Shellfishing Public Clam and Oyster Beaches, Beach Map Area: San Juan Islands. http://wdfw.wa.gov/fishing/shellfish/beaches/search.php?searchby=MapArea&search=02&orderby=BeachName ASC (accessed November 17, 2010).

West, J.E. 1997. Protection and restoration of marine life in the inland waters of Washington State. Puget Sound/Georgia Basin Environmental Report Series: Number 6. Puget Sound Water Quality Action Team, Olympia, Washington. May 1997.

Western Regional Climate Center. 2010. Olga 2 SE, Washington (456096). http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?wa6096.

Whetten, J.T., P.I. Carroll, H.D. Grower, E.H. Brown, and F. Pessl. 1988. Bedrock Geologic Map of the Port Townsend 30- by 60-Minute Quadrangle, Puget Sound Region, Washington. Scale 1:100,000. Prepared by U.S. Geologic Survey.

Whitman, T. 2011. Shoreline Modification Results. From data to decision making: Using local inventories and natural resource data effectively workshop. Friday Harbor. April 18, 2011.

Wild Fish Conservancy. 2011. Puget Sound Water Type Assessment: 2005-2007. http://wildfishconservancy.org/maps (accessed April 20, 2011).

Williams, G. and R. Thom. 2001. Marine and Estuarine Shoreline Modification Issues. Prepared for Washington Department of Fish and Wildlife, Washington Department of Ecology, and Washington Department of Transportation, by Battelle Marine Sciences Laboratory, Pacific Northwest National Laboratory, Sequim, Washington.

Williams, H.F.L., I. Hutchinson, and A.R. Nelson. 2005. Multiple sources for late-Holocene tsunamis at Discovery Bay, Washington State, USA. *The Holocene* 15(1):60-73.

Willson, M.F., R.H. Armstrong, M.C. Hermans, and K. Koski. 2006. Eulachon: a review of biology and an annotated bibliography. Alaska Fisheries Science Center Processed Report 2006-12. Auke Bay Laboratory, Alaska Fish. Sci. Cent., NOAA, Natl. Mar, Fish. Serv., Juneau, Alaska.

Wisseman, C., R. Matthews, and J. Vandersypen. 2000. San Juan County Monitoring Project: Final Report, Institute for Watershed Studies, Huxley College of Environmental Studies, Western Washington University, Bellingham. Washington.

Wydoski, R.S., and R.R. Whitney. 2003. Inland Fishes of Washington, Second Edition. American Fisheries Society and University of Washington Press.

Wyllie-Echeverria, T. and M. Sato. 2005. Rockfish in San Juan County-Recommendations for Management and Research. Proceedings of the 2005 Puget Sound Georgia Basin Research Conference.

Wyllie-Echeverria, T. and R. Barsh. 2007. Fish Use of Nearshore Habitat in San Juan County, 2005-2006 Final Report. Report to Salmon Recovery Funding Board. July 2, 2007.

Wyllie-Echeverria. 2008a. Best Available Science for Salmon and Salmon Habitat in San Juan County – November 2008. Wyllie-Echeverria Associates. Report to San Juan County under agreement 08-CD.022. 2008.

Wyllie-Echeverria. 2008b. Map of salmon sampled from San Juan County (unpublished). Wyllie-Echeverria Associates.

Zhang, X, X. Liu, M. Zhang, R. Dahlgren, and M. Eitzel. 2010. A Review of Vegetated Buffers and a Meta-analysis of their Mitigation Efficacy in Reducing Nonpoint Source Pollution. *J. Environ. Qual.* 39:76-84.

APPENDIX A

Map Folio

APPENDIX B

Priority Habitats and Species

APPENDIX C

San Juan County Land Capacity Analysis Methodology

APPENDIX D

Key Data Sources for Shoreline Inventory Maps

APPENDIX E

GIS Methods for Ecological Function Scoring