

**TOWN OF COUPEVILLE  
SHORELINE MASTER PROGRAM  
GRANT NO. G0400107**



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**SHORELINE MASTER PROGRAM – PHASE 1  
SHORELINE ANALYSIS REPORT  
TASK 4  
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# TOWN OF COUPEVILLE

## SHORELINE MASTER PROGRAM

### SHORELINE ANALYSIS REPORT

## I. INTRODUCTION

### ***A. Background and Purpose***

The State of Washington's Shoreline Management Act (SMA, RCW 90.58) requires local jurisdictions to update existing shoreline plans and regulations. In July 2003, the Town of Coupeville entered into a grant agreement with the Washington Department of Ecology (Ecology) to acquire funding assistance for the update of the Town's Shoreline Master Program (SMP). The source of funds provided by Ecology are Coastal Zone Management 306 funds, through the National Oceanographic and Atmospheric Administration (NOAA). The grant partially funds Phase 1 of a two-phase approach. The first phase consists of gathering and analyzing information related to shoreline management, and providing recommendations to inform and guide the second phase, the development of planning policies and development regulations to manage shoreline development within the Town.

This report satisfies Task 4 of the grant agreement by presenting information on the primary driving processes that influence the physical and biological elements of the shoreline within the Town's jurisdiction. The report provides an analysis of existing information, identifies data gaps, and presents findings and recommendations to support and inform the Town's development of shoreline planning policies and regulations.

The purpose of this report is in part to provide information to help answer several important questions, including:

- Where is development likely to occur?
- What will be the likely impacts of future development?
- Where are opportunities for public access to the shoreline, and where can these opportunities be enhanced?
- Where can water-oriented uses be most appropriately located?

A glance at the maps accompanying this report will quickly reveal that potential development opportunities along Coupeville's shorelines are limited. The location of future development has been largely pre-determined by physical limitations and existing development within Coupeville's urban core and residential neighborhoods. While few questions regarding location remain unanswered, future development regulations will need to address primarily the nature, scale, and intensity of development.

Areas of restoration potential are less apparent, and planning for future restoration efforts will benefit from the careful evaluation of the existing biological and geological processes and conditions along Coupeville's shoreline as discussed in Section II, *Ecosystem Processes and Shoreline Function*, prepared by Coastal Geologic Services, Inc. (CGS), June 2004. The remainder of this report was prepared by Island Environmental and Technical Services (IETS), September, 2004.

### ***B. Physical Setting***

The Town of Coupeville lies on the south side of Penn Cove on central Whidbey Island, in northern Puget Sound (Map 7), within sections 33, 34, and 35, T32N R1E, and Sections 3

and 4, T31N, R1E, W.M. Town limits along the shoreline run from approximately 700' west of Vine Road on the west side of the town to about 1500' west of Long Point on the east side of town. There are approximately 2.46 linear miles of marine shoreline along Penn Cove within the Town.

The nearshore at both the eastern and western ends of the Coupeville study area is characterized by steep, high bluffs, while the central portion of the study area consists of moderate height bluffs (30 - 50 ft) or low bank waterfront, with several scattered accretionary beaches. No significant sources of freshwater are found within the study area, though several small freshwater seeps and one spring were identified on the beach (CGS field observation). The beaches of Coupeville are classified by the DNR Shorezone database (DNR 2001) as mixed gravel/sand estuarine beaches.

The climate of the central Whidbey Island area is relatively mild and drier than surrounding northern Puget Lowlands communities, owing to the moderating affects of the surrounding marine waters and the positioning within the rain shadow cast by the Olympic Mountains. Rainfall in Coupeville generally ranges between 18 to 25 inches per year, compared with over 30 inches per year on south Whidbey Island (WSU 2004). Average temperatures range from winter lows in the mid-30s to summer averages in the low 70s, with the frost-free season beginning in mid-April and first frost occurring around late October. The relatively scarce precipitation and high infiltration rate in many areas of the town have left little opportunities for significant surface water features to develop. There are no distinct natural drainage channels, ponds, wetlands, or other notable freshwater features within the Coupeville shoreline area.

### **C. Shoreline Jurisdiction**

The SMA establishes a local government's shoreline jurisdiction as extending 200' landward of the ordinary high water mark (OHWM), along with any associated wetlands. As there are no wetlands associated with the shoreline within the Town limits, shoreline jurisdiction is limited to that area within 200' of the OHWM, as depicted on Map 4.

## **II. ECOSYSTEM PROCESSES AND SHORELINE FUNCTION**

### **A. Overview**

The shorelines within the town of Coupeville encompasses 2.46 linear miles. Under Coupeville's existing shoreline management master plan, approximately 7010 ft is designated as Shoreline Residential (54%), 3760 ft Urban (29%), and 2200 ft Rural (17%).

Coupeville beaches represent a commonly occurring beach characteristic found in the Northern Puget Sound, as having two distinct foreshore components: a high-tide beach and a low-tide terrace (Johannessen 1993). The high-tide beach consists of a relatively steep beachface with coarse sediment and an abrupt break in slope at its waterward extent. Sand in a mixed sand and gravel beach is winnowed from the high-tide beach by waves (Chu 1985) and deposited on the low-tide terrace. Extending seaward from the break in slope, the low-tide terrace typically consists of a gently sloping accumulation of poorly sorted fine grained sediment (Komar 1976, Keuler 1979, Johannessen 1993). The beaches are supplied with sediment from eroding bluff and alongshore transport (CGS *in prep*, DNR 2001, Keuler 1988).

#### ***Shoreline Composition***

Puget Sound beach composition is dependant upon three main influences; wave energy, sediment sources, and relative position of the beach with in a littoral cell. Wave energy is controlled by fetch; the open water over which winds blow without any interference from

land. Within the Coupeville study area fetch is limited to 6 miles from the northeast, and 2.4 miles from the west-northwest (measured from center of study area). Segment exposure was classified by DNR's Shorezone inventory as "semi-protected and protected", based on calculations, however, following field observations, all segments were reclassified as "protected" (DNR 2001).

Wave action gradually erodes beaches and the toe of coastal bluffs, leading to landslides. These coastal bluffs are the primary source of sediment for most Puget Sound beaches, including the Coupeville study area (Keuler 1988, Downing 1983). Bluff composition and wave energy influence the composition of beach sediment. Waves can sort coarse and fine sediment and large waves can move cobbles that small waves cannot. Beaches supplied by the erosion of coarse gravel bluffs will differ in composition from those fed by the erosion of sandy material. The exposed strata of the eroding bluffs in the study area are largely composed of sand, gravel, and silt (CGS field observation, DNR 2001, DOE 1979). These same materials dominate sediment found on the beaches, with the exception of silt (and clay), that is winnowed from the beachface and deposited in deep water. A detailed description of the geology found in the study areas is included in the segment descriptions.

In addition to the previously mentioned influences (waves, sediment sources and position within littoral cell), tidal range also affects beaches over time. Rosen (1977) demonstrated that the coastal erosion rate decreases with increasing tidal range. This is due to the focusing of wave energy at a narrow vertical band with small tidal range in comparison to the dissipation of wave energy over a large vertical band with a greater tidal range. The tidal range in the study area is 7.8 ft (2.38 m) or meso-tidal (6.5 - 13.5 ft; 2 - 4 m range). A moderate tidal range means that erosion will be primarily focused within the 7.8 ft (2.38 m) of the beach profile exposed to tidal waters (excluding storm conditions). It is important to keep in mind however, the majority of coastal erosion in the region occurs when high wind events coincide with high tides and act directly on the backshore and bluffs (Downing 1983). The majority of coastal landsliding occurs during and following high precipitation periods in the winter (Tubbs 1974, Shipman 2001).

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

The shore of Coupeville contains one net shore-drift cell and a very broad zone of drift divergence (6,000 ft) (Keuler 1988). Sediment is transported eastward from the divergent zone to the cell's terminus; the accretionary cusped foreland (spit) of Long Point. Sediment sources west of the Coupeville wharf include toe erosion and slowly eroding bluffs (shallow landslides and slumps). DNR's Shorezone inventory has classified this western portion of the study area as erosive (2001). The Coastal Zone Atlas of Washington identified this eroding bluff section of shoreline as unstable with some areas of recent slide activity (DOE 1979). The area of instability with recent landslide activity directly falls within historic landslide deposits (QIs). The remaining bluffs in the drift cell have Vashon till as the upper unit.

Net shore-drift extends east from the Coupeville wharf a distance of 1.82 miles to its terminus just west at Long Point. Erosive features are scattered throughout the drift cell including active feeder bluffs, contributing bluffs, low bank failures (slumping) and toe erosion (CGS field observations, CGS in prep). The Coastal Zone Atlas of Washington

(DOE 1979) identified an approximately 3000 ft section of bluff instability extending west from the eastern edge of the study area (Map 2). This section of shoreline consists of a narrow foreshore with very high bluffs (approximately 100 - 200 ft). Active slides, slumps, and a freshwater spring are found within this section of shoreline (CGS in prep). These bluffs are composed of undifferentiated Pleistocene sediments and a small section of Everson gravel. Continuing west to Lovejoy Point the bluff stability rises to intermediate stability, however these bluffs are located further inland and are not as likely to be actively contributing sediment to the beach. Composed of sand and gravel beach deposits (DOE 1979), this section of shore is an accretion shoreform. It is easily characterized as accretionary due to the extensive low elevation backshore area and sand flat. Historic map T-2011, from 1888, shows the presence of marsh vegetation in a coastal wetland, the majority of which has been filled for development.

### *Marine Water Quality*

Local marine water quality has been a concern in Penn Cove over the last decade. The Coupeville stormwater/sewage treatment outfall has been listed on the Washington State Department of Ecology's 303-d list twice in the recent past (1996 and 1998). In 1996, the outfall was listed due to excess counts of fecal coliforms, and in 1998 due to depleted levels of dissolved oxygen. Water quality problems are also likely related to sources outside of the Town, including untreated stormwater, non-point pollution, and the Penn Cove Water District's sewer outfall across the cove from the Town.

The site occupied by the Coupeville Wastewater Treatment Plant was for many years the location of a shipbuilding firm and lumber mill operated by the Lovejoy family. Some years following the closure of this operation, the Town purchased the land to construct a facility to provide primary treatment of sewage. In the 1980s, the plant and operations were expanded to provide secondary treatment. The 1999 Wastewater Treatment Facilities Plan reported that while the plant continued to function within its State discharge permit, it was reaching design capacity for both solids loading and flow. Improvements (Phase I) were made to the facility to increase flow capacity in 2001. Further proposed (Phase II) improvements are scheduled for 2004 to increase the organic loading (BOD) capacity. In 1995, the town of Coupeville successfully acquired grant funding for a portion of the aforementioned projects and a 0% loan through the Department of Ecology to reduce the number of raw sewage overflows into Penn Cove from its wastewater treatment facility by 25%.

Large portions of the Coupeville shores are currently closed to shellfish harvesting due to its proximity to the Penn Cove Water and Sewer District's sewage treatment plant outfall, across the cove from the Town. East of the study area and just west of Lovejoy Point shellfish harvesting is permitted, however there is a harvest advisory (Washington State Department of Health 2004).

Four outfalls are present within the Coupeville study area. The eastern-most outfall is for storm water diverted through drainpipes down the high gradient eroding bluff. The second and more central outfall is found at the Coupeville sewage/storm water treatment facility. Two small outfalls are located on either side of the Coupeville wharf. Neither outfall appears to be substantially interrupting the natural physical processes taking place in surrounding area.

### *Marine Habitat*

As previously mentioned the Coupeville shoreline consists of mixed gravel and sand estuarine beaches with bluffs of variable height, or less frequently, vegetated backshores. There is not a significant source of freshwater or salmonid-bearing stream within or near the study area, nor is there any fringing marsh habitat (WDFW, 2004).

There is a long regional oral history of forage fish spawning in the study area (WDFW 1999). Washington Department of Fish and Wildlife (WDFW) reported that surf smelt

(*Hypomesus pretiosus*) spawn in the upper foreshore throughout the study area during both winter and summer spawning. Pacific sand lance (*Ammodytes hexapterus*) also utilize small sections of beach for spawning habitat (WDFW 2004, Island County Marine Resource Committee (IS-MRC) 2004).

Priority Habitat Species data was acquired from WDFW for the Coupeville shoreline. Two bald eagle (*Haliaeetus leucocephalus*) nests were observed in the eastern portion of the study area, though much of the study area falls within the Coupeville or Long Point Bald Eagle Territories (WDFW 2004). This encompasses 72% of the linear shoreline within the study area.

Eelgrass beds (*Zostera* sp.) have been mapped in the study area several times. Jim Norris Marine Resource Consultants collected the most recent and presumably most accurate data, in 2000 – though his surveys did not cover the entire study area. His mapping showed eelgrass beds to be present intermittently throughout the study area. Norris observed patches and narrow continuous beds (excluding areas unsurveyed) of eelgrass at depths up to –4.6 ft (MLLW). DNR's Shorezone database observed patchy eelgrass contiguously throughout the study area in 1999 (2001).

Kelp beds were not observed during field visits nor found in existing data sources. Other marine algae were observed and found consistently in the intertidal throughout the study area. These algae include: sea lettuce (*Ulva* sp.), sea hair (*Enteromorpha* sp.), red algae (*Porphyra* sp.) and rockweed (*Fucus* sp.).

Shellfish are abundant throughout the study area (WDFW 2004, DNR 2001). Barnacles (*Balanus glandula*), blue mussels (*Mytilus trossulus*), heart cockles (*Clinocardium nuttallii*), hardshell clams (*Protothaca staminea*, *Tresus nuttallii*, *Saxidomus giganteus*) were observed throughout several if not all the shore reaches. Jim Norris Marine Resource Consultants mapped geoduck beds (*Panopea generosa*) in addition to eelgrass during his 2000 survey. At the time he mapped geoducks in small areas in the eastern portion of the study area and continuous beds west of the Coupeville Wharf. Additional marine invertebrates observed include starfish (*Pisaster brevispinus*) and green urchins (*Strongylocentrotus droebachiensis*), ghost shrimp (*Callinassa californiensis*) and blue mud shrimp (*Upogebia pugettensis*) (CGS field observation, WDFW 2004, DNR 2001).

Small patches of *Spartina anglica* were observed growing in the upper intertidal sediments in several areas of the Coupeville study area. These small patches should be dug up without delay as this aggressive invasive species rapidly dominates the intertidal areas and is known to impact eelgrass and shellfish beds. Consultation with the Island County Noxious Weed Board is recommended for successful eradication.

Development and shoreline modifications have reduced the overhanging northwest native riparian vegetation to only 55% of the linear shoreline (DNR 2001, CGS field observation). Non-native invasive species were frequently observed in more developed segments of shoreline and included English ivy (*Hedera helix*), Himalayan blackberry (*Rubus discolor*), and Scotch broom (*Cytisus scoparius*). Native vegetation observed in the upland areas along the Coupeville shoreline include common assemblages of northwest native trees and shrubs and area listed in the appendix of this report. Throughout most of the study area riparian areas are narrow and provide limited function as habitat. However, landslides in the eastern and western ends of the study area, where denser riparian areas are found, are likely to contribute large woody debris to the nearshore environment.

### ***Shoreline Development and Modification***

A substantial portion of the Coupeville shoreline has been modified from its original state. Shoreline modifications observed within the area include: over-water structures, riprap, bulkheading and filling. Approximately 33% of the linear shoreline has undergone such

modifications, excluding filling which is not easily observed (CGS *in prep*, CGS field observations, DNR 2001).

The most obvious of shoreline modifications are numerous over-water (over-bluff) structures located east of the north end of Alexander Street in Coupeville, including the Coupeville wharf. Continuous bulkheading and armoring can be found both east and west of the wharf. This section of shoreline is currently designated as Urban. Armoring and bulkheading were the most frequency observed shoreline alterations. Bulkheading and armoring is most prevalent within the section of shoreline that extends east from the Coupeville sewage facility and continues until just west of Lovejoy Point. The western-most modification is in the form of armoring, or riprap, which is essentially a wall of boulders. The eastern portion of this continuous modified shoreline is a bulkhead comprised entirely of toxic creosote wood. Several less significant sections of modified shoreline exist within the study area, which will be discussed in more detail in the segment descriptions section of this report.

## **B. Individual Segment Descriptions**

The study area was delineated into nine contiguous reaches of shoreline (Map 1). Segment breaks were consistent with those used by the Department of Natural Resources (DNR) in Washington State's Shorezone Inventory (2001). Segments lengths range from 702 to 4972 ft and differ to varying degrees. They are numbered from east to west and Segments 1 and 9 extend beyond the limits of Coupeville's jurisdiction. CGS compiled additional data and field-verified the Shorezone data to confirm the accuracy of segment delineations.

The use of DNR's Shorezone segments for this study was selected for the following reasons:

- Segment breaks appear logical and consistent with initial air photo review and knowledge of the field area
- The length and number of segments seemed appropriate for the study area
- The use of net shore-drift cells for segments was inappropriate since cells are relatively long and continue well beyond the city boundaries, and only 1 cell is present throughout the study area
- Shorezone data has become the leading dataset upon which to base this type of analysis

Shorezone segments were delineated based on discontinuities in the physical processes taking place alongshore. These physical processes include changes in net shore-drift, geomorphic type, backshore characteristics (e.g. bluff height), and presence or absence of shoreline modifications. The following section summarizes the physical and ecological character of each segment as well as the degree to which each segments' shoreline has been modified. In addition, recommendations will be made to improve management and restore or enhance degraded parcels of shoreline.

### **Segment 1**

Segment 1 is the eastern-most shoreline reach, beginning just east of the Coupeville town limits. It extends 1644 ft east from Indian Hill Rd (off Alta Vista Ave) near Long Point. Two different Shore Designations exist within this single unit. The majority of the shoreline is currently designated as Shoreline Residential, however a small western portion of the segment is currently designated as Rural (240 ft). Beach access is limited to private community access.

The direction of net shore-drift is from west to east. Sediment derived from the eroding bluffs in Segment 1 is transported east to the cusped spit at Long Point. A narrow backshore with storm berm is found at the base of the bluff. The berm crest-backshore is composed of sand and pebbles (3-6 ft in width) with overlying beach wrack including driftlogs. Beach sediment is moderately abundant (DNR 2001) and composed primarily of

sand with gravel (dominant/subdominant). The lower intertidal is more exclusively composed of sand.

From the forested upland to the lower intertidal, the Segment 1 nearshore grades from a steep, high bluff (ranging in height from 100-200 ft) to a narrow mixed gravel-sand beach and sand flat. The bluff is composed of slowly eroding Everson gravel overlying undifferentiated Pleistocene sediment (Map 2; DOE 1979). During field reconnaissance and CGS mapping toe erosion and landsliding (debris avalanches and slumping) were observed along more than half the segment (Map 3). Primary data sources have classified this section of shoreline as erosive and actively contributing sediment to downdrift beaches (CGS *in prep.*, Keuler 1988, DNR 2001, DOE 1979). One small area of accretion was mapped in Segment 1 (CGS *in prep.*), evidenced by a small spit prograding eastward.

There are no major modifications (bulkheads, groins, or other shore structures) to this segment of shoreline. There is no significant source of freshwater in Segment 1, however a large stormwater outfall pipe discharges through an energy dissipater near the bluff toe.

The forested uplands of Segment 1 consist primarily of northwest native conifers and shrubs including; Pacific madrone (*Arbutus menziesii*), Douglas fir (*Pseudotsuga menziesii*), western hemlock (*Tsuga heterophylla*) and several other species that can be found listed in Appendix 1. Approximately 90% of the segment offers an overhanging marine riparian area. Substantial clearing and thinning of upland vegetation has taken place landward of the bluff crest. A very thin buffer of conifers is all that remains at the bluff crest (Photo 1).

No species of importance (species listed by the state as threatened, endangered, sensitive, and candidate species by the Washington Department of Fish and Wildlife (WDFW)) have been documented using this forested habitat, however two bald eagles (*Haliaeetus leucocephalus*) nests are located near the boundary of the adjacent Segment 2. Segment 1 therefore falls within the Long Point Bald Eagle Territory (WDFW 2004).

Salmon forage fish, including Pacific sand lance (*Ammodytes hexapterus*) and surf smelt (*Hypomesus pretiosus*), spawn in the upper intertidal sediment of Segment 1 (WDFW 2004, Island County Marine Resource Committee (IC-MRC) 2004). Surf smelt utilize this portion of shoreline during both winter and summer spawning. Sand lance eggs have been found during winter spawning only (IC-MRC 2004).

Eelgrass was documented in Segment 1 by J. Norris Marine Resources Consultants in 2000 (IC –MRC 2001). Norris reported that a broad eelgrass bed is found beginning at Long Point tapering to a much thinner bed to the west. The bed extended –4.6ft MLLW. DNR (2001) reported the presence of patchy eelgrass in Segment 1. During a field visit on April 9<sup>th</sup> of 2004, CGS staff reported no observations of eelgrass in this segment. Additional species of marine algae were observed throughout the intertidal. These include sea hair (*Enteromorpha sp.*), *Porphyra sp.*, sea lettuce (*Ulva sp.*) and rockweed (*Fucus sp.*). Barnacles (*Balanus glandula*), blue mussels (*Mytilus trossulus*), ghost and mud shrimp (*Callinassa californiensis* and *Upogebia pugettensis*), heart cockles (*Clinocardium nuttallii*), and hardshell clams (*Protothaca staminea*, *Tresus nuttallii*, *Saxidomus giganteus*) were also observed (CGS field observation, WDFW 2004, DNR 2001).

### **Recommendations**

In general, physical and biological processes in the nearshore ecosystem are mostly intact in Segment 1. This is a high-bank segment without any houses down by the beach. It also has a relatively low amount of development and shoreline structures. The unstable coastal bluffs have experienced a number of recent landslides and bluff toe erosion is reasonably common. These processes supply sediment to the net shore-drift system that

maintains Long Point. There are no apparent impacts to the existing intertidal flora and fauna, however upland land-clearing has left a very narrow riparian area at the bluff crest.

There are no obvious restoration needs in Segment 1. Conservation of natural processes and the remaining riparian vegetation should be the priorities in this segment. Not allowing the construction of bulkheads or clearing of backshore and bluffs would greatly aid in preserving landforms and habitats.

As previously mentioned, a (fairly) high degree of clearing of upland yards has occurred in Segment 1, in many cases up to or almost up to the bluff crest. This causes increases runoff directed towards these unstable bluffs as well as the loss of root strength in surficial soils. These factors are likely causing some increase in erosion and landsliding, as well as a medium and long-term reduction in the large woody debris (LWD) input to the nearshore. It is recommended to require preservation of bluff top vegetation buffers (with tree limbing and careful vegetation management allowed to enhance views) on the order of 25 – 40ft wide, and establishment of these buffers where they do not exist upon development applications. Stormwater management is also important in minimizing erosion, landsliding and water quality degradation in this segment.

## *Segment 2*

Segment 2 begins just west of the break between sections 34 and 35 (Township 32N, Range 1E). Much of the high steep bluff in the area is heavily forested with fewer residential dwellings than adjacent segments. There are no visible landmarks to further describe this segment break. Segment 2 measures 1083 ft in length and the entire segment currently falls within the Rural Shoreline designation. There is no public access to this reach of shoreline.

Steep, high, forested bluffs best characterize the upland areas of Segment 2. The geology of the segment is composed mainly of the Everson gravels with underlying undifferentiated Pleistocene deposits found in the eastern-most portion of the reach (Map 2; DOE 1979). The bluff is actively eroding, and was classified as unstable and erosive by several sources (DNR 2001, DOE 1979 and CGS *prep.*), however, Keuler's (1988) geomorphic mapping classified this shoreline segment as neutral. CGS observed a relatively large recent slide that extended the entire height of the bluff (Photo 2). The scarp was near the bluff crest and the slide (at beach) measured approximately 100 ft in width. Several large slumps were also noted from mid-bluff height. Toe erosion of colluvium and bluff material was evident at numerous locations throughout the reach. It is clear from field observations and previous research that this shoreline reach is actively contributing sediment to downdrift shorelines and the segment was recently therefore mapped as a feeder bluff (Map 3).

Net shore-drift is transporting sediment east to Segment 1 and the accretion shoreform at Long Point. A storm berm composed of gravel and sand fronts the toe of the bluff. Considerable wrack, including recruited logs from landslides and other marine-derived material, spanned 6-10 ft in width over the beach berm during the field reconnaissance. Moving waterward, the beach composition becomes more sand dominant with an overlying pebble veneer.

An iron-rich freshwater spring was observed flowing from significantly vegetated colluvium approximately 400 ft west of the boundary between Segment 1 and 2 (Photo 3). The spring was significant enough in size that its flow was audible from a considerable distance. The freshwater input also resulted in a band of *Enteromorpha sp.* (marine algae) extending beachface.

Upland vegetation in Segment 2 is predominantly composed of native conifers and shrubs (see Appendix 1), however in areas where recent bluff erosion have taken place, vegetation is characterized by deciduous trees and herbs such as red alder (*Aldus rubra*), bigleaf maple (*Acer macrophyllum*), and cow parsnip (*Heracleum lanatum*). Overhanging

marine riparian vegetation is found throughout the entire segment. Clearing of upland vegetation has taken place at several sites landward of the bluff top, however a thin buffer of conifers remains.

Two bald eagle (*Haliaeetus leucocephalus*) nests are located within the eastern end of the undisturbed forested upland in Segment 2. The nests are located close to one another (WDFW 2004). One nest is located within an old growth fir, at mid-bluff height adjacent to the previously mentioned landslide. The second nest is located approximately 325 ft inland of nest one (WDFW 2004). Segment 2 falls within the Long Point bald eagle territory (WDFW 2004). No other known priority species utilize the habitats included in Segment 2. Belted king fishers (*Ceryle alcyon*) were also observed utilizing the forested upland habitat during the CGS field reconnaissance.

Forage fish have been documented utilizing the Segment 2 shoreline. Surf smelt (*Hypomesus pretiosus*) spawn in the upper intertidal beaches during both the winter and summer spawning periods (IC-MRC 2004, WDFW 2004).

Primary data sources did not report any observations of eelgrass (*Zostera sp.*) in this portion of the study area. DNR (2001) noted a complete absence of eelgrass and CGS scientists did not observe eelgrass within this reach of shoreline during a field reconnaissance (April 9<sup>th</sup>, 2004). J. Norris Marine Resource Consultant's eelgrass underwater video survey of Penn Cove unfortunately did not include this segment of shoreline.

A number of marine algae and marine invertebrates were observed utilizing the intertidal areas in Segment 2. As previously noted *Enteromorpha sp.* was observed growing in a band across shore near a freshwater spring. Other marine alga observed includes *Ulva spc.* and *Porphyra sp.* Barnacles (*Balanus glandula*), blue mussels (*Mytilus trossulus*), ghost shrimp (*Callinassa californiensis*) and blue mud shrimp (*Upogebia pugettensis*) are known to utilize this shoreline reach (CGS field observation, WDFW 2004, DNR 2001).

The shoreline in Segment 2 has not been modified and is in a (relatively) pristine state. Some clearing of vegetation has taken place at the top of the bluff.

### **Recommendations**

The physical and ecological processes taking place in Segment 2 have undergone minimal modification and are mostly well intact. The bluffs are actively contributing sediment to the nearshore system via toe erosion and landslides. An ample marine riparian offers valuable habitat, as it remains the least developed shoreline segment in the study area. Intertidal flora and fauna are unaffected by shore modifications.

Management of Segment 2 should be focused upon conserving the habitat value found within this shore reach. Similar to Segment 1, small patches of land clearing could potentially destabilize the steep erosive bluffs. In addition, removing the forested vegetation found on the bluffs as well as landward of the bluff crest will alter stormwater run off, destroy root strength in surface soils and lead to a long-term reduction in large woody debris supplied to the nearshore. Vegetation removal within much of the segment may also have adverse impacts to the two bald eagle nests located mid-segment. This clearing should be kept to a minimum to prevent further slope failures and conserve valuable bald eagle habitat.

Local scientists are continually gaining awareness of the importance of marine riparian buffers and now acknowledge them as equally valuable as freshwater riparian buffers. A recent literature review (Brennan 2004) summarizes several marine riparian functions that cumulatively emphasize the importance of this ecotone. This document reviews the importance of marine riparian areas for pollutant removal, soil stability, stormwater control and provision of wildlife and fish habitat. Due to the previously mentioned values and concerns, it is recommended to require marine riparian buffers ranging 25-40ft in width

(with tree limbing and careful vegetation management allowed to enhance views) and establishment of these buffers where they do not exist upon development applications.

Limits upon development and/or maintaining the rural designation of this section of shoreline will also assure the preservation of this valuable habitat while deterring the hazards of building on actively eroding high bluffs. Shoreline modifications should not be permitted along this section of shoreline.

### Segment 3

Segment 3 measures approximately 1890 ft in length and is located on the eastern side of Lovejoy Point. The segment starts approximately 650 ft east of NE Moore Pl. off NE Parker Rd. The entirety of this shore segment currently falls within the Shoreline Residential designation. A boat launch exists at the eastern end of the beachfront residential homes however; it is available for use by local residents only (private use).

Primary data sources have classified the stability of the bank in this segment as intermediate (Map 2; DOE 1979, DNR 2001). The intermediate classification was mapped due to the steep slope and low permeability of the strata. The Segment 3 shoreline is distinctly different in character from the previously described segments. In contrast to the adjacent eroding high gradient bluffs, this shore segment has a more extensive low gradient backshore area fronted by an accretionary beach. The beach and backshore are composed of sand and gravel.

Net shore-drift travels west to east through this segment, which falls within the net shore-drift cell that including Segments 1 and 2. Segment 3 has experienced a net gain in sediment from up-drift sources. During a field reconnaissance by CGS, it was mapped as an accretion shoreform (Map 3; CGS *in prep*).

Approximately 1650 ft of this low elevation backshore area falls within a Coastal Flood Hazard area as mapped in the Coastal Zone Atlas (DOE 1979). It is very likely that the most low-lying backshore areas have been filled, possibly since this mapping was originally completed. However, during a storm surge in conjunction with a very high tide or a strong NE-wind, it is possible that properties located within the flood hazard area could be inundated with seawater.

Based on familiarity with this type of spit/beach and examination of the historic T-sheet (T-2011 from 1888), it appears that a tidal wetland and/or lagoon existed in the backshore through most of the length of Segment 3. During field reconnaissance several parcels of land with contrasting backshore elevations were observed (Photo 4), implying that widespread filling likely occurred. One property with what appeared to be an unmodified backshore had a small pond surrounded by facultative and obligate wetland species (not inventoried) including; *Rumex sp.*, *Triglochin maritima*, and *Atriplex patula*. The pond was less than 15 ft in length and less than 6 ft in width. Another backshore depression was observed near the eastern end of Segment 3. This backshore area is nearly filled with considerably decayed driftlogs that appear to be acting as nurse logs for several upland species (Photo 5).

Moving waterward from the backshore, the beaches of Segment 3 consist of a sand and shell-hash storm berm with an overlying 3-7 ft wide deposit of driftwood. The mid beach or beachface is composed of sand with some pebble, fining to a tidal flat dominated by sand with a thin veneer of pebble.

There were no signs of freshwater seeps or springs in this segment, however the salinity of the backshore lagoon could be tested.

Backshore vegetation in Segment 3 was composed of dunegrass (*Elymus mollis*), *Atriplex patula*, Pacific gumweed (*Grindelia integrifolia*), silver beachweed (*Ambrosia chamissonis*), Nootka rose (*Rosa nutkana*) and other northwest native shrubs and ornamentals planted by landowners. Only 10% of Segment 3 has overhanging marine

riparian vegetation (DNR 2001, CGS *in prep*, field observation). Backshore vegetation has been cleared for development, view trimming and landscaping throughout most of the segment. However, northwest native shrubs and dune vegetation can be found in pockets throughout the reach.

Several small patches (less than 3 ft in diameter) of *Spartina anglica* were observed growing on the beachface of Segment 3. This aggressive invasive species should be eradicated without delay.

No species of importance (species listed by the state as threatened, endangered, sensitive, and candidate species by WDFW) were found to use the habitat in Segment 3. Though the segment is located within the Long Point Bald Eagle Territory, outlined by WDFW (2004). Surf smelt (*Hypomesus pretiosus*) are also known to utilize the upper intertidal sediment as spawning habitat during both winter and summer spawning (WDFW 2004, IC-MRC 2004).

DNR (2001) and J. Norris Marine Resource Consultants (2000) both observed eelgrass (*Zostera sp.*) in Segment 3. Observations by DNR and Norris were made at contrasting scales, utilizing very different methods, but their reports concur that patchy, intermittent *Zostera sp.* is found within the segment. CGS confirmed these reports during a field reconnaissance on April 9<sup>th</sup>, and May 29<sup>th</sup>, 2004. Sea lettuce (*Ulva sp.*) was the only additional variety of marine algae observed in Segment 3. Two species of marine invertebrates were also observed including barnacles (*Balanus glandula*) and blue mussels (*Mytilus trossulus*) (DNR 2001). WDFW (2004) and DNR (2001) reported the presents of hardshell clams in this segment including; *Protothaca staminea*, *Tresus nuttullii*, and *Saxidomus giganteus*.

A small parcel of the shoreline in Segment 3 has undergone modification. The modification is a bulkhead composed of driftwood, constructed atop the storm berm. It measures approximately 80 ft in length, representing less than 5% of the segment. A vegetated fence backs the structure. It is likely that due to the depositional nature of this landform a bulkhead appears unnecessary at this location. However, it is possible that because natural materials were used in construction (vegetated fence and wood) the structure may provide (minor) habitat values.

### ***Recommendations***

Segment 3 is distinctly different from adjacent segments, consisting of a broad low elevation backshore fronted by an accretionary beach. The beach is receiving sediment from updrift sources. This segment falls within the same large drift cell that transports sediment east and feeds Long Point. Intertidal flora and fauna appear unaffected by the shore modifications found in this segment.

Natural processes in Segment 3 have been altered by vegetation clearing and filling of coastal wetlands for residential development. Residential dwellings are found throughout most of the reach at variable distances from the storm berm. Several dwellings are located within the Coastal Flood Hazard area mapped by the Department of Ecology (1979). There are small sections of shoreline that have not undergone considerable clearing and filling that still possesses coastal wetland characteristics.

There are several opportunities for restoration or habitat enhancement in Segment 3. Marine riparian vegetation could be reestablished along much of the shoreline. This vegetation can provide several functions to enhance nearshore habitat, abate pollution from upland land use and control stormwater (Brennan 2004).

Educating landowners on the values and benefits of coastal wetlands can provide the groundwork for potentially restoring the filled coastal wetlands in Segment 3. Following educating the landowners, introduction to the concept of restoring the wetlands in the coming years will be more positively received.

Conservation of unfilled sites where coastal wetland or backshore vegetation exists should be a priority. Further filling or modification (including bulkheading, rockeries, piers or docks) should not be permitted in this segment for they could dramatically alter the sediment dynamics in Segment 3 as well as down-drift beaches.

Eradication of *Spartina anglica* from the upper beachface should be conducted immediately. This aggressive non-native invasive species can damage eelgrass beds and rapidly alter beach habitat and sedimentation. There are numerous eradication methods; however physically digging up the *Spartina* is most effective when the plant is growing on gravel beaches. Coordination with the Island County Noxious Weed Board and the Island County Beach Watchers is recommended for successful eradication.

## Segment 4

Segment 4 is located at the minor headland of Lovejoy Point. The eastern segment boundary is located where the low elevation backshore area transitions to a low-bank configuration. The beginning of contiguous stretch of shoreline armoring marks the western segment boundary. This shore reach measures 1103 ft and currently falls exclusively within the Shoreline Residential shore designation. There is no public access within this shore reach.

The backshore and upland characteristics of Segment 4 consist of moderately high (< 70ft) eroding bluffs with a narrow band of vegetation (DNR 2001, CGS field observations). The bluff is composed of the Everson glaciomarine drift overlying Vashon till (Map 2; DOE 1979).

The Washington State Coastal Zone Atlas (DOE 1979) and Keuler (1988) mapped this section of bluff as stable or neutral (Map 2). However, more recent mapping performed by DNR (2001) and CGS (*in prep*) classified this reach as erosive or actively feeding sediment to downdrift beaches with the exception of the eastern (approximately) 300 ft of the segment (Map 4). Sediment eroded from the bluffs in Segment 4 are transported alongshore to eastern depositional areas like those found in Segment 3 and east of the study area at Long Point.

There is generally no backshore in Segment 4. A narrow wrack line lies just waterward of the bluffs in Segment 4. The beachface consist of a variety of clast sizes ranging from sand to boulders, but is predominantly composed of pebble with sand and cobble (dominant/subdominant). Moving further waterward sand becomes the dominant sediment size. Boulders were observed throughout the beachface and lower intertidal of this reach. No freshwater seeps or springs were observed in Segment 4.

Much of the upland vegetation in Segment 4 has been cleared for development. A narrow band of loosely distributed northwest native vegetation exists along the bluff crest. This vegetation includes red alder (*Aldus rubra*), Pacific madrone (*Arbutus menziesii*) and Douglas fir (*Pseudotsuga menziesii*). Several non-native invasive species were also observed growing and eroding from the bluffs including; Scotch broom (*Cytisus scoparius*) and English ivy (*Hedera helix*). Overhanging riparian vegetation can be found on less than 40% of the shoreline in Segment 4 or roughly 400ft (DNR 2001, CGS field observation). This number is most likely an overestimate, as data was collected at a distance and researchers could have easily mistaken non-native vegetation for native shrubs.

No species of importance (species listed by the state as threatened, endangered, sensitive, and candidate species by WDFW) were mapped as using the habitat in Segment 4. The eastern half of Segment 4 falls within the Long Point Bald Eagle Territory outline by WDFW (2004). Though surf smelt (*Hypomesus pretiosus*) are known to utilize the upper intertidal sediment as spawning habitat during the summer spawning season (only) (IC-MRC 2004).

Patchy eelgrass (*Zostera sp.*) was observed by both the DNR's Shorezone Inventory (2001) and in a very small portion of the underwater video survey performed by J. Norris Marine Resource Consultants (2000). Three additional varieties of marine algae were observed within this shore reach (DNR 2001, CGS field observations). These included; *Ulva sp.*, *Fucus sp.*, and *Enteromorpha sp.* Barnacles (*Balanus glandula*), blue mussels (*Mytilus trossulus*), and hardshell clams (*Protothaca staminea*, *Tresus nuttallii*, and *Saxidomus giganteus*) were reported as present in Segment 4 by DNR (2001) and WDFW (2004). Norris also reported geoducks (*Panopea generosa*) in this shore reach (2000).

DNR mappers surveyed Coupeville in 1999 for the Shorezone Inventory (2001). At that time, there were no reports of shoreline modifications within this reach of shoreline. However, CGS scientists observed a 150 ft section of shoreline that was riprapped. The landowner likely installed the structure as a means of controlling the bluff erosion taking place on their property. As a result, fourteen percent of shoreline in Segment 4 is now modified.

### *Recommendations*

Segment 4 is characterized by a gravel-sand beach and moderately high (< 70 ft) eroding bluffs with a narrow band of vegetation. The bluff is actively eroding and supplying sediment including very important beach-forming gravel, east to down-drift beaches. Biological processes within Segment 4 are moderately well intact. The existing bulkheads likely remove several feet of upper intertidal area within which forage fish may have spawned. In addition, there are large areas without native overhanging vegetation in this section.

There are few opportunities for restoration within this segment of shoreline. However, enhancing the marine riparian vegetation (northwest native trees and shrubs) throughout the segment in a buffer that would extend from the bluff crest landward, would benefit slope stability, LWD recruitment and enhance habitat values of the beach below.

Conservation measures should be applied to prevent further clearing of remaining marine riparian vegetation. The construction of bulkheads or shoreline rockeries at the base of the bluff should be prohibited unless absolutely necessary for the direct protection of existing houses.

### *Segment 5*

Segment 5 measures 702 ft in length. A creosote-treated wood bulkhead marks the eastern border of the segment. The end of an adjacent bulkhead marks the terminus (Photo 6). This segment falls entirely within the existing Shoreline Residential designation. It has no public access and is predominately developed for residential dwellings.

The upland topography in Segment 5 transitions from a moderately high bluff in Segment 4 to relatively low elevation upland. The bluff elevation change ranges from 60 to 20 feet above MLLW (east to west) throughout this reach of shoreline. The bluff was classified as stable by the Coastal Zone Atlas (Map 2; DOE 1979) and DNR (2001), and is composed primarily of Everson glaciomarine drift (DOE 1979).

Beach sediment was mapped as moderately abundant (DNR 2001) in this segment, however CGS field reconnaissance revealed a relatively low abundance of foreshore sediment in a fairly narrow foreshore and general lack of backshore. Beach material consists of sand with some pebble, fining to sand in the lower intertidal. Bulkheading of this entire shore reach has altered the natural flow of sediment supply to the beach (Map 4). Sediment supply is now derived from adjacent beaches rather than upland sources (CGS field observation, DNR 2001). Net shore-drift travels from west to east (CGS field

observation, Keuler 1988). The lower intertidal forms a tidal sand flat. No significant source of freshwater is found in Segment 5.

The upland areas of this segment are only lightly vegetated due to the close proximity of residential dwellings and abundant land clearing. No overhanging (northwest native) riparian vegetation is found in the reach (DNR 2001). Some non-native invasive species were observed growing in the uplands including Himalayan blackberry (*Rubus discolor*) and Scotch broom (*Cytisus scoparius*). A small patch of native conifers is found behind the bulkhead on the eastern portion of the segment. A narrow band of driftwood and beach wrack is found along the base of the eroding bluffs. Minimal beach wrack and/or vegetation are found at the base of the bulkhead.

No species of importance (species listed by the state as threatened, endangered, sensitive, and candidate species by WDFW) were mapped as using the habitat in Segment 5. Surf smelt (*Hypomesus pretiosus*) are reported to utilize the upper intertidal sediment for spawning (WDFW, 2004, IC-MRC 2004).

Eelgrass was not observed growing in this segment during a submarine survey performed by J. Norris Marine Resource Consultants in 2000. However, DNR's Shorezone database reports patchy eelgrass to be present in this shore segment (2001).

*Ulva sp.* and *Fucus sp.* were the only other marine algae observed in the intertidal of Segment 5. Barnacles (*Balanus glandula*), blue mussels (*Mytilus trossulus*), and hardshell clams (*Protothaca staminea*, *Tresus nuttullii*, and *Saxidomus giganteus*) were reported as present in Segment 5 (DNR 2001, WDFW 2004, CGS field observation 2004). Norris also reported geoducks (*Panopea generosa*) in this shore reach (2000).

As previously mentioned, this entire reach of shoreline has been modified. A creosote-treated wood bulkhead extends across the eastern half, and an adjacent wood (possibly treated; not creosote) bulkhead extends west to the terminus of the segment. These modifications have drastically altered the sediment dynamics within this section of shoreline. Without the modifications it is likely that the uplands would be slowly eroding and supplying sediment to the beaches, similar to neighboring segments. Instead the upper extent of the beach has remained in this position, while the adjacent bluffs have eroded approximately 10 – 20 ft horizontally. Beach material also appears to be in lesser quantity, most notably on the western end of the segment (Photo 6).

In addition to the bulkheading, a large over-water structure (private residence) shades the intertidal in eastern Segment 5. The structure appeared to be constructed from creosoted wood and pilings, and extends over 30 ft from the backshore. Several pilings are also found in the vicinity of the over-water structure.

### *Recommendations*

Segment 5 transitions from a moderately high to relatively low bluff and is completely modified. Bulkheading of this entire shore reach deprives the beach system of upland sediment sources and beach material is now exclusively derived from up-drift westerly beaches. The biological processes within Segment 5 are fair and of low value. The existing bulkheads remove at least several feet of upper intertidal areas within which forage fish may spawn.

Several restoration opportunities exist in Segment 5. Numerous derelict pilings are found near an over-water structure (residence) located at the eastern end of the segment. Removal of these pilings will increase the value of the underlying and adjacent habitat (Poston 2001). Pilings that are treated with creosote should be viewed as a higher priority for removal.

Removal of the large over-water structure (and associated piles and bulkhead) should be the medium to long-term goal for shoreline restoration. Large over-water structures have often been cited as potential migratory barriers (due to shading) and areas of increased

predation for juvenile salmonids migrating along shallow water marine shorelines (Nightingale and Simenstad 2001).

Restoration or enhancement of existing marine riparian vegetation can be performed to increase bluff stability and underlying habitat value (Brennan 2004).

The long bulkhead present on the western half to two-thirds of Segment 5 should also be prioritized for removal over the medium to long-term. The large setback of the house in this location precludes the need for a bulkhead. This bulkhead appears to have been constructed over the upper beach and covers a portion of the upper beach in an area mapped as surf smelt spawning habitat (WDFW 2004, IC-MRC 2004). The bulkhead also interrupts natural bluff erosion (very gradual in this location) and therefore has negative impacts on beach erosion and the associated down-drift habitats.

## Segment 6

Segment 6 extends for 1154 ft, beginning directly north of Lasalle St. and extending to the western border of Captain Thomas Coupe Park. The eastern three-quarters of the segment falls within the existing Shoreline Residential designation, and the western quarter (approximately 350 ft) is currently considered Urban shoreline. Public access to the beach is available at Captain Thomas Coupe Park, which includes a boat launch. Much of the Segment 6 uplands are associated with the park and sewer/stormwater processing facility, private residences, and NE 9<sup>th</sup> Street.

In general, the beaches in Segment 6 can be characterized as a mixed sand and gravel beaches with a low elevation, developed upland. Much of the shoreline has been modified thereby altering the natural sediment dynamics. The upland geology is composed of the Everson glaciomarine drift (Map 2; DOE 1979). Beach material consists of sand with pebble and some boulder. The lower intertidal consists of finer material, dominated by sand.

Net shore-drift travels west to east in this segment. Due to shoreline modifications, only one small pocket of beach is functioning naturally and able to accrete sediment (Map 4). This pocket exists due to the failure of a bulkhead, located approximately 550 ft east of the boat launch. The beach is now forming a natural storm berm, consisting primarily of large pebbles with sand, and beach wrack including driftlogs, is beginning to accumulate. There are numerous opportunities to further enhance and/or restore this reach of shoreline, outlined in the Recommendation section below.

A small freshwater seep is found within the segment, just east of the boat launch. A culvert drains near the seep, contributing additional fresh water. The freshwater is evident by an extensive bed of the green algae *Enteromorpha sp.* In addition, a 20-inch stormwater-outfall culvert is located at the western end of the segment.

Due to the proximity to downtown Coupeville, this segment is highly developed and has very little upland vegetation. No overhanging riparian vegetation is found within the reach. Most of the upland vegetation found within segment is in small patches and at too far of a distance to provide shade or other function to the intertidal. Some Nootka rose (*Rosa nutkana*) is found above the shore armoring below NE 9<sup>th</sup> St, however it appears to be competing for space with non-native Himalayan blackberry (*Rubus discolor*). Upper intertidal vegetation is also non-existent due to the presents of shore armoring, however invasive *Spartina anglica* was observed during a recent CGS field reconnaissance, and should be eradicated without delay.

No species of importance (species listed by the state as threatened, endangered, sensitive, and candidate species by WDFW) were found to use the habitat in Segment 6. Though surf smelt (*Hypomesus pretiosus*) are reported to utilize the upper intertidal sediment for spawning (WDFW 2004, IC-MRC 2004). WDFW (2004) mapped that sand lance also utilize the upper intertidal sediments east of the boat launch for spawning habitat.

J. Norris Marine Resource Consultants (2000) and DNR's Shorezone database (2001) reported that eelgrass (*Zostera sp.*) beds are found in the eastern portion of Segment 6. Several other marine algae have been reported to inhabit Segment 6. These algae include; *Fucus sp.*, *Porphyra sp.*, *Ulva spc*, and *Enteromorpha sp.* (DNR 2001). The marine invertebrates observed and reported to inhabit Segment 6 include; barnacles (*Balanus glandula*), blue mussels (*Mytilus trossulus*), and hardshell clams (*Protothaca staminea*, *Tresus nuttullii*, and *Saxidomus giganteus*) (CGS field observation, WDFW 2004, DNR 2001).

Close to 100 percent of the shoreline in Segment 6 has been modified from its original form. The small portion of unmodified shoreline is located on the eastern portion of the segment. Accretion is occurring at this unmodified stretch of shoreline (Photo 8). A small portion of a relict wooden bulkhead is located near the storm berm. Additional relict failed steel structures are found in the intertidal of the eastern adjacent property (Photo 7). The remaining shoreline within Segment 6 is armored with combinations of riprap, concrete rubble and ecology blocks (Photo 10).

Thomas Coupe Park contains a filled area that occupies up to a 380 ft long section of the shoreline, as measured alongshore. The elevation of the fill area is generally between +12 and +20 ft mean lower low water (MLLW), and rises in elevation to the south. Examination of historic aerial photos revealed that the fill area appears to have been constructed between 1957 and 1968. A small section of the stacked concrete slab bulkhead is failing at the eastern end of the lawn in Thomas Coupe Park (Photo 9). The west edge of the boat ramp was armored with large boulders that extended approximately 3-4 ft above the level of the ramp. The east shore of the fill area was armored with a rock and concrete block/slab bulkhead.

Two large docks (associated with the Town's boat launch) were stored on the intertidal at the eastern end of Captain Thomas Coupe Park. These docks are likely compacting sediment and preventing species from utilizing the underlying habitat.

### *Recommendations*

Segment 6 can be characterized as mixed sand and gravel beaches with low elevation, developed uplands. Much of the shoreline has been extensively modified thereby altering the natural sediment dynamics. The waterward portion of Captain Thomas Coupe Park contains fill and upper intertidal bulkheads. Net shore-drift travels from west to east in Segment 6.

Generally, the biological processes within Segment 6 are adversely impacted by shoreline modifications and have low habitat value. The existing bulkheads and rockeries likely remove many feet of upper intertidal area within which forage fish may spawn. A complete lack of overhanging marine riparian vegetation degrades the habitat quality of this segment.

Several restoration opportunities exist in Segment 6, a number of which are specific to Thomas Coupe Park, which will be outlined below. Outside the park two restoration opportunities exist. At the eastern end of the segment, relict steel structures are found embedded in the intertidal sediment. These corroded structures are degrading the habitat quality of the nearshore and should be removed. Nearby, the remaining portions of a wood bulkhead and associated piles (Photo 7) should be removed as it serves no purpose for erosion control and contains creosoted wood.

Immediately to the west, another minor restoration opportunity exists. A small portion of wooden bulkhead (perhaps an extension of the old bulkhead discussed above) is found well landward of the storm berm and active beachface. The short bulkhead is an unnecessary erosion control structure at this location. Removal of the bulkhead will restore the natural sediment dynamics at this site and remove creosote and other treated wood from the marine environment.

Restoration opportunities for Park include removing rock and concrete debris from the beach, especially on the northwest side of the park. The northwest shore could also be enhanced by minor nourishment and establishment of a native plant buffer along the shore to reestablish riparian vegetation. This would aid in preventing desiccation of forage fish eggs more than in other segments since this is a low bank, north facing site and vegetation would therefore provide shade to the upper intertidal. Immediately west of the current boat ramp, the old concrete ramp could be removed as well as the old outfall pipe on the beach.

Storage of the docks on the uplands (while not in use) is recommended to eliminate having the docks covering the intertidal, and potential forage fish spawning grounds, as well as to reduce damage to the docks.

The beach immediately east of the boat ramp would seem appropriate for beach nourishment, due to its pocket shape. Removal of rubble and rock from the beach should occur first. Pulling back the bulkhead in this area would allow for upper intertidal and backshore restoration and allow for the enlargement of a beach area for recreation. This could occur in the future perhaps at the time of needed bulkhead repair, as the bulkhead does not appear well designed and will likely require repair in the near future.

*Spartina anglica* should be eradicated from this segment prior to it spreading further. Himalayan blackberry and other invasive species should be removed from the bluff particularly west of the boat ramp.

## Segment 7

Segment 7, extends 1632 ft west from the western border of Captain Thomas Coupe Park. The terminus is located below N. Main Street, in downtown Coupeville. The upland is densely developed and currently designated as an Urban shoreline. Tidelands are accessible via Thomas Coupe Park (Segment 6), stairs near the Coupeville wharf or from the stairs down from the viewing deck (Segment 8).

The upland topography in Segment 7 consists of a steep low elevation bank, roughly 15 – 25 ft in height, grading to a mixed sand and pebble beach with a sand flat. Throughout the eastern portion of the reach, the bank shows signs of toe erosion and is slowly contributing sediment to the beaches (CGS, in prep.). The eroding bank is composed of Vashon till (Map 2; DOE 1979). Segment 7 possesses characteristics of both a sediment source and a transport zone (Map 5). Net shore-drift travels from west to east.

The upper intertidal consists of a sand and pebble berm with an accumulation of driftwood approximately 5 ft in width. Moving waterward, the beach material transitions to pebble and sand with some cobble and shell hash. The beachface in Segment 7 is relatively wide. Sediment fines to sand in the lower intertidal sand flat. Several small freshwater seeps were observed along the beachface, evidenced by the marine algae *Enteromorpha sp.*

The upland portion of the backshore of Segment 7 is moderately vegetated with several invasive species, northwest native shrubs, and scattered trees. The vegetation observed included: red elderberry (*Sambucus racemosa*), tall Oregon grape (*Mahonia aquifolium*), Nootka rose (*Rosa nutkana*), snowberry (*Symphoricarpos albus*), red alder (*Aldus rubra*), willow (*Salix sp.*) and several additional species listed in Appendix 1. Non-native invasive Himalayan blackberry (*Rubus discolor*), Scotch broom (*Cytisus scoparius*) and English ivy (*Hedera helix*) were also found. Overhanging riparian vegetation shaded approximately 30% (1305 ft) of the segment (CGS field observation, DNR 2001). Dunegrass (*Elymus mollis*) and *Atriplex patula* were observed growing in the some lower portions of the backshore, just landward of the driftwood accumulation.

No species of importance (species listed by the state as threatened, endangered, sensitive, and candidate species by WDFW) were found to use the habitat in Segment 7.

Surf smelt (*Hypomesus pretiosus*) are reported to utilize the upper intertidal sediment for summer spawning (WDFW 2004, IC-MRC 2004).

Underwater video surveys performed by J. Norris Marine Resource Consultants (2000) concurs with DNR's (2001) report of patchy eelgrass (*Zostera sp.*) in Segment 7. Norris observed eelgrass beds to depths of -0.7ft MLLW. Other marine algae observed in Segment 7 include *Enteromorpha sp.*, *Fucus sp.*, and *Ulva sp.* Marine invertebrates found utilizing the intertidal habitat of Segment 7 include: ghost and mud shrimp (*Callinassa californiensis* and *Upogebia pugettensis*), hardshell clams (*Protothaca staminea*, *Tresus nuttullii*, *Saxidomus giganteus*), starfish (*Pisaster brevispinus*), green urchins (*Strongylocentrotus droebachiensis*), blue mussels (*Mytilus trossulus*), and barnacles (*Balanus glandula*) (CGS field observation, WDFW 2004, DNR 2001).

Approximately twenty percent of the shoreline in Segment 7 has been modified from its original form. These previously unreported modifications (including in: DNR 2001) were observed in a CGS field reconnaissance. The dominant modification types were riprap and rockery (sometimes including concrete rubble), which were likely constructed to control toe erosion. Additionally, a wharf (with building) with several associated pilings is build over the intertidal near the western end of the segment. Over-water structures are known to shade marine beaches thereby affecting the migration of juvenile salmonids alongshore as well as contributing to their increased predation (Nightengale and Simenstad 2001). Impacts to wave energy are also known to occur as a result of the pilings that support over-water structures. These piles dissipate wave energy and reduce net shore-drift beneath the structure.

Remnants of older modifications were also observed during the reconnaissance, including several low, eroded wooden pilings associated with a flat wooden structure that measures approximately 30 x 80 ft. This remnant structure lays atop and below beach sediment, smothering underlying habitat across the entire beach profile, from the bank to the lower intertidal. It is partially buried by sediment and shellfish (Photo 11).

### *Recommendations*

Segment 7 consists of a steep low elevation bank, grading to a mixed sand and pebble beach with a sand flat. The bank shows signs of erosion and is slowly contributing sediment to the beach. Only 20 percent of this urban shoreline is modified. However, the marine riparian areas are moderately vegetated, much of which is invasive non-native species.

Generally, the biological processes within Segment 7 are moderately impacted and the habitat value is relatively low in value. The existing bulkheads likely remove many feet of upper intertidal area within which forage fish may spawn. In addition, there are large areas without native overhanging vegetation in this section. Additionally, old pier sections and wood platforms in this segment may be shading out the eelgrass that is found only in patches. Adding light penetration devices when there are requests for modification would enable eelgrass to persist under those existing structures.

Several restoration opportunities exist in Segment 7. The first of which includes the removal of the remains of a wood structure overlaying intertidal sediment and associated wood pilings. This wood structure smothers the intertidal sediment, and likely has for many decades.

If there are no cultural constraints, then the over-water structure (boathouse) located just east of the boundary between Segments 7 and 8 could be deconstructed. Removal of this structure and the associated pilings could greatly improve the habitat value of the underlying beach. Removal of additional derelict piles west of the over-water structure (boathouse) would provide minor improvement to existing conditions.

Removal of the concrete debris on the beach near the bank toe approximately 300 ft west of Thomas Coupe Park would be a relatively simply restoration opportunity for freeing up upper beach habitat.

Removal of a near-vertical rockery structure east of the over-water house in this segment offers another restoration opportunity. This rockery provides minimal erosion control due to the fact that erosion is very slow and scattered throughout this segment of shoreline and prevents upland sediment sources from nourishing the beach.

Enhancement of marine riparian areas offers another restoration opportunity. Currently much of the marine riparian vegetation is composed of non-native invasive species that provide few if any functions to the nearshore. Removing invasive vegetation and enhancing the northwest native shrubs and trees would provide several previously mentioned functions including; water pollution abatement, soil and slope stability, storm-water control, shading, and wildlife habitat (Brennan et al. 2004).

## Segment 8

Segment 8 extends 725 ft from the base of N. Main Street to approximately 130 ft west of the Coupeville wharf. It is currently classified as Urban shoreline and includes several structures built over the intertidal and the Coupeville wharf. The beach can be easily accessed by the public via stairs on either side of the wharf.

The upland gradient and topography are very similar to Segment 7, characterized by low elevation (15-25 ft), slowly eroding bank with moderate vegetation cover. The bank material is composed of Vashon till (Map 2; DOE 1979).

Net shore-drift travels from west to east through Segment 8. Original mapping by Keuler (1988) shows easterly transport throughout the segment, however Department of Ecology's digital coastal atlas erroneously mapped net shore-drift. The DOE digital atlas display a divergence approximately 100 ft west of the break between Segments 7 and 8 followed by westerly drift (DOE 2004). Sediment moves alongshore throughout this segment, with no (considerable) net loss or gain of sediment; making it a transport zone (CGS in prep., Map 5). Comparable sedimentation on either side of the Coupeville wharf conveys that the direction of net shore-drift is negligibly dominant (Photo 12).

The uplands in Segment 8 encompass some of the oldest developed areas of Coupeville. A number of structures are built over the intertidal, which alter the natural sediment dynamics taking place in this parcel of shoreline. Two small storm water outfalls are located on either side of the Coupeville wharf. Erosion caused by the eastern outfall and the (partial) wave shadow created by the wharf pilings, has helped to create a micro-spit like feature prograding east, affirming the direction of littoral drift at the time of the field visits.

The upper intertidal sediment in Segment 8 consists of sand and small pebble, with scattered boulder (Photo 13). The small sections of shoreline without modifications had wrack accumulations with driftwood and storm berms with dunegrass (*Elymus mollis*). Beachface sediment is dominated by sand with pebble and cobble, and some boulder. These boulders originated from bluff recession dropping larger clasts in place, while others may have made their way from the upper foreshore to the lower foreshore. Sediment fines and the beach gradient drops as the beachface transitions to sand flat.

Though most of the Segment 8 shoreline is developed, there are two small sections of shoreline with moderately vegetated uplands. The vegetation found in these areas includes northwest native deciduous trees such as bigleaf maple (*Acer macrophyllum*) and willow (*Salix sp.*), and native shrubs including: tall Oregon grape (*Mahonia aquifolium*), ocean-spray (*Holodiscus discolor*), and snowberry (*Symphoricarpos albus*). Several non-native invasive species are also found in the vegetated uplands including Himalayan blackberry (*Rubus discolor*), Scotch broom (*Cytisus scoparius*) and English

ivy (*Hedera helix*). An intact overhanging marine riparian exists on only 10% of this shoreline.

No species of importance (species listed by the state as threatened, endangered, sensitive, and candidate species (WDFW 2004) were found to use the habitat in Segment 8. Surf smelt (*Hypomesus pretiosus*) reportedly spawn in the upper intertidal sediment of this reach (WDFW 2004).

Underwater video surveys performed by J. Norris Marine Resource Consultants confirm the DNR's report that patchy eelgrass beds are found in Segment 8. Norris (2000) observed eelgrass beds to depths of -0.7ft (MLLW). Other marine algae observed in Segment 8 include *Enteromorpha sp.*, *Fucus sp.*, and *Ulva sp.* Marine invertebrates found utilizing the intertidal habitat of Segment 8 include: hardshell clams including *Protothaca staminea*, *Clinocardium nuttullii*, *Tresus nuttullii*, and *Saxidomus giganteus*, starfish (*Pisaster brevispinus*), green urchins (*Strongylocentrotus droebachiensis*), blue mussels (*Mytilus trossulus*), and barnacles, (*Balanus glandula*) (WDFW 2004, DNR 2001, CGS field observation).

Approximately 90 percent of the shoreline in Segment 8 has been modified from its original form (DNR 2001, CGS field observation 2004). Several different types of modifications can be found in this short segment including over-water structures, a wharf with adjoining docks, shoreline armoring in the form of riprap and the likely filling of backshore areas.

Several of the buildings along the Coupeville waterfront including the Coupeville wharf were built 90 - 120 years ago. These over-water structures were constructed prior to known impacts to intertidal flora and fauna. Currently it is well documented that large over-water structures similar to the Coupeville wharf lead to increased predation and potential barriers to juvenile salmonid migration along shallow marine beaches (Nightengale and Simenstad 2001). Over-water structures are typically built upon pilings, sometimes with surrounding wooden fencing to prevent structural damage from shifting drift logs. Pilings are known to diminish wave energy thereby slowing littoral drift rates. This results in sediment deposition on the updrift side of the structure. This phenomenon is exemplified in photos 12 and 14 taken above and beneath the Coupeville wharf. Photo 12 displays the beach progradation under the length of the wharf, extending across the littoral zone. Wooden seawalls built at the base of over-water structures are the predominant form of shoreline modification in this shore reach (DNR 2001, CGS field observation). Shoreline rockeries are also found in Segment 8, though with less frequency.

Miscellaneous fill material, including wood debris, was observed along a small stretch of the bank. This fill appears to have been in place for a considerable portion of time. Further historical analysis (going beyond the scope of this study) may answer these questions.

### *Recommendations*

Segment 8 is characterized by low elevation (15-25 ft), slowly eroding banks with moderate vegetation cover. Net shore-drift travels west to east. It is located within the most densely developed areas of Coupeville. Numerous shore modifications exist that are likely impacting the physical and ecological processes taking place in the nearshore. The habitat is generally low in value. Existing modifications (wood bulkheads, riprap and rockeries) remove at least several feet of upper intertidal area within which forage fish may spawn. There is also very little overhanging vegetation.

Numerous opportunities for restoration exist in Segment 8, however several are not feasible due to cultural constraints. For example, despite the previously mentioned impacts associated with the Coupeville wharf it is a provided allowance under the Shoreline Management Act RCW 90.58.100 (2)g, which states that "allowances be

provided for the protection and restoration of buildings, sites and areas with historic or cultural values". However, where cultural constraints do not exist, further construction of buildings over the intertidal should not be permitted.

Several shoreline modifications could be removed to restore and enhance the shoreline in Segment 8. There are several small sections of shoreline armoring or rockery, which provide little erosion control in this very slowly eroding section of shoreline. It may be feasible to remove these rockeries, thereby restoring upland sediment sources that nourish the Segment 8 beaches.

Invasive non-native species found in the Segment 8 uplands could be eradicated so as to enhance the marine riparian buffers found in this shore reach. Invasive species rapidly out-compete native species and create a monoculture. This process degrades biodiversity and the ecosystem services taking place within these riparian areas including soil erosion, slope stability, water pollution abatement and wildlife habitat.

## Segment 9

Segment 9 is the longest shoreline reach in the study area measuring 4972 ft. It extends well beyond the limits of the study area, reaching its terminus in the southwest corner of Penn Cove (Map 6). This shore reach is of variable character. This description covers all of Segment 9, including beaches falling outside the study area. The segment begins 130 ft west of the Coupeville wharf, at the western end of the rockery that extends west of Coupeville wharf. Public access is available via the dock and the stairs (Photo 13). Two different shoreline designations are found in Segment 9. The eastern-most portion of the segment is currently classified as Urban, and extends from the eastern end of Segment 9 to the beach below the western end of the Coupeville Town Park (located and terminus of NW Broadway St). The shoreline is designated as Rural west of the Town Park and NW Broadway St.

Forested bluffs with mixed sand and pebble beaches with tide flats characterize the nearshore in Segment 9. From east to west the upland topography increases in gradient, and backshore areas narrow. The eastern portion of the segment is composed of colluvium or material deposited from landsliding (Map 2; DOE 1979). This material is classified as "Unstable, Recent slide" by the Coastal Zone Atlas (DOE 1979). During a CGS field reconnaissance, landsliding and toe erosion were frequently observed throughout this section of Segment 9, which is actively contributing sediment to the down-drift shoreline (Maps 5, 6). A small portion of this shoreline has been armored thus blocking the input of sediment to the beach. The bluffs of the adjacent, western portion of shoreline are composed of Everson glaciomarine drift overlying Vashon till. These bluffs are higher gradient and rated "Unstable" by the Coastal Zone Atlas (DOE 1979). The western portion of Segment 9 is eroding at a slower rate (than the adjacent eastern portion), thus contributing substantially less sediment to the down-drift shoreline. The dominant coastal process occurring in the western portion of Segment 9 is sediment transport, while the eastern portion is providing sediment to beaches in the remainder of the study area (CGS in prep).

Net shore-drift has been erroneously mapped by Department of Ecology for this segment of shoreline (CGS, *in prep.*). Original mapping by Keuler (1988) shows net shore-drift from west to east, with a very long divergent zone located near the western limit of the Coupeville study area. The exact location of the divergence is difficult to determine due to negligible sediment transport and spatial variability of landslides over time. The Department of Ecology (2004) mapped sediment transport traveling east to west throughout this segment with the divergence zone located in Segment 8, which does not concur with Keuler and CGS field observations but this data is generally considered invalid. During a field reconnaissance and mapping performed by CGS, numerous observations were made concurrent with Keuler including: micro-spits prograding west to

east, sediment accumulations on western side of net shore-drift impediments such as boulder piles and drift log accumulations oriented toward the east.

The beaches in Segment 9 are composed of sediment varying in size. Backshore areas are narrow, with 3-7 ft of beach wrack, including driftwood. Upper intertidal substrate includes pebble, cobble and shell hash, with underlying sand. Boulders are found throughout the upper intertidal zone (Photo 15). Mid-way down the beachface, sediment becomes more sand-dominant. The lower intertidal-tidal flat sediment is predominantly composed of sand.

No major sources of freshwater were observed or noted in previous reports and maps, in Segment 9.

The uplands in segment 9 are forested primarily with deciduous trees with some conifers and northwest native shrubs. Backshore vegetation varies throughout the segment based on backshore character. For example, backshores with active landslides are typically relatively free of vegetation, but those with only toe erosion may be considerably vegetated above the area of erosion (CGS field observation 2004). In addition, vegetation is often found growing on colluvium. The DNR's Shorezone Inventory (2001) conservatively estimated the percent overhanging riparian in Segment 9 as 50% (2001). During a CGS field reconnaissance (2004), overhanging riparian vegetation was noted for near 80% of the segment (most of the segment excluding two small sections of modified shoreline). Riparian vegetation observed includes: red alder (*Aldus rubra*), willow (*Salix sp.*), bigleaf maple (*Acer macrophyllum*), Douglas fir (*Pseudotsuga menziesii*) and Pacific madrone (*Arbutus menziesii*), ocean-spray (*Holodiscus discolor*), red elderberry (*Sambucus racemosa*), thimbleberry (*Rubus parviflorus*), Nootka rose (*Rosa nutkana*) and snowberry (*Symphoricarpos albus*). The upland backshore vegetation transitions to lowland backshore and upper intertidal communities. Species observed in this transition include: bedstraw (*Galium spc*), dunegrass (*Elymus mollis*), *Atriplex patula*, *Spartina anglica* and *Salicornia virginica*.

Several small patches (less than 3 ft in diameter) of *Spartina anglica* were observed growing on the beach face of Segment 9 (Photo 16). This aggressive invasive species should be eradicated without delay.

No species of importance (species listed by the state as threatened, endangered, sensitive, and candidate species by WDFW) were mapped as utilizing the habitat in Segment 3. Though the segment is located within the Coupeville Bald Eagle Territory, outlined by WDFW (2004). Pigeon guillemots (*Cepphus columba*) and bank swallows (*Riparia riparia*) were observed nesting in the bluffs (CGS field observation 2004).

It has been reported that two species of salmon forage fish utilize the upper intertidal sediment for spawning in Segment 9. Surf smelt (*Hypomesus pretiosus*) reportedly spawn in this segment during both winter and summer spawning. Sand lance (*Ammodytes hexapterus*) utilize this shoreline reach during winter spawning (WDFW 2004, IC-MRC 2004).

Underwater video surveys performed by J. Norris Marine Resource Consultants (2000) confirm DNR's report of patchy eelgrass (*Zostera sp.*) in Segment 9. Norris mapped eelgrass beds to depths of -0.3 ft (2000). Other marine alga observed in Segment 9 includes *Enteromorpha sp.*, *Fucus sp.*, and *Ulva sp.* (DNR 2001, CGS field observation 2004). Marine invertebrates found utilizing the intertidal habitat of Segment 9 include: hardshell clams including *Protothaca staminea*, *Clinocardium nuttullii*, *Tresus nuttullii*, and *Saxidomus giganteus*, starfish (*Pisaster brevispinus*), green urchins (*Strongylocentrotus droebachiensis*), blue mussels (*Mytilus trossulus*), barnacles, (*Balanus glandula*), and sand dollars (*Dendraster excentricus*) (CGS field reconnaissance, WDFW 2004, Norris 2000, DNR 2001).

Three relatively short sections of shoreline in Segment 9 have been modified. These sections cumulatively represent less than 20% of the total Segment 9 shoreline (~950 ft)

(CGS field observations). The larger of the two modifications is a 400 ft stretch of rockery in the eastern end of the segment, below the Coupeville Town Park. The other two modifications in Segment 9 are west of the Coupeville town limits and include a wooden bulkhead constructed with soldier piles and a vertical concrete seawall, located in the western end of the segment. The concrete seawall was constructed lower on the beach profile and appears to have been backfilled.

### *Recommendations*

Segment 9 is of variable character and extends well beyond the Coupeville limits. The eastern portion of the segment is actively eroding and feeding sediment to down-drift beaches (eastern beaches). Geomorphic processes in the western portion of the segment are dominated by alongshore transport of sediment. Forested uplands transition to halophytic herbs moving seaward. Diverse assemblages of intertidal flora and fauna are found throughout the reach. Segment 9 has relatively high habitat value.

Several restoration projects can be undertaken in Segment 9, in addition to several conservation measures. Enhancement of marine riparian where vegetation where it is sparse is recommended for additional vegetation will enhance nearshore habitat in multiple ways. Marine riparian areas provide a number of valuable ecosystem services including soil and slope stability, water pollution abatement (from roads), LWD recruitment, wildlife habitat and shade for forage fish spawning areas (Brennan 2004).

Several small patches of *Spartina anglica* were observed near the western Coupeville boundary. As previously stated, this aggressive non-native invasive species should be eradicated without further delay. There are numerous methods, however physically digging up the *Spartina* is the most effective eradication method for gravel beaches. Consultation with the Island County Noxious Weed Board is recommended to assure successful eradication.

Construction of shoreline modifications, especially any impediments to net shore-drift should not be permitted in Segment 9. Shore armoring, including the construction of bulkheads or rockery, should also be prohibited unless houses are at risk of being destroyed. Upland vegetation clearing should be limited and marine riparian buffers should be outlined wherever possible to preserve the rural character of this shore segment. If further upland development is to occur then, careful planning will be required to manage storm-water runoff and prevent exacerbation of bluff erosion and destabilization of bluffs.

### III. LAND USE

#### ***A. Historic Land Use Conditions***

Penn Cove had long been the site of several villages of the Salish people prior to Captain George Vancouver's exploration of the area in 1792. Settlement of the area by whites began in earnest following the Donation Land Claim Act of 1850. Commercial development along the waterfront began in the 1860s, with the construction of several small businesses and a wharf. By the time the Town was incorporated in 1910, several stores, hotels, and the County courthouse had been built. The development pattern that was to follow was largely established by the filing of early plats. For example, the 1883 filing of the first Town of Coupeville plat, which established a grid of 35 blocks, each 200'x200', to the east of Main Street and extending landward from Front Street, has shaped development of much of the "downtown" residential area.

The existing wharf, originally constructed in 1905, is the only one remaining of several docks and wharfs that had been constructed along Coupeville's shoreline. Extensive commercial development of the shoreline north of Front Street and east of Main Street occurred during the early 1900s, and by the 1950s most development potential in this area had been exhausted. Today the commercial core within shoreline jurisdiction along Front Street remains substantially as it existed in the 1950s (see Maps 8 and 9).

Infrastructure development along the shoreline saw significant changes during the 1950s, with the paving of several streets, including Main and Front Streets, and the establishment of a sanitary sewer system, complete with a treatment plant at the current location north of 9<sup>th</sup> Street, between Gould and Otis Streets. The existing secondary treatment plant was built at this site in 1982.

A number of buildings along the shoreline, and portions of Front Street, threatened by the receding bluff, were moved landward. At least two homes are reported to have been lost to landslides (Sheridan 1998). Evidence of numerous attempts to slow erosion are today visible at several locations along Coupeville's shoreline.

Residential growth was relatively slow until the period between the 1950s through the present, during which the Town's population has grown by more than 20% per decade. Most of the recent residential development has occurred outside of shoreline jurisdiction, south of Front Street and 9<sup>th</sup> Street.

Historic and cultural resource issues are further discussed in later sections of this analysis report.

#### ***B. Present Land Use Conditions***

The type and extent of existing land use within the shoreline jurisdiction are visible in the aerial photographs of Maps 8 and 9 and illustrated in Maps 10 through 12. As of 2000, Coupeville had a population of 1723 occupying 820 dwelling units (Census 2000). Despite the Town's steady population growth since the 1950s, development within shoreline jurisdiction has not changed much during this period. As of 1999 there were about 100 structures within Coupeville's shoreline jurisdiction. Many of the commercial and residential structures within the shoreline area are over 100 years old.

Steep eroding bluffs line most of the shoreline within the Town, and the more recent development has generally respected a prudent setback from the bluff edge. In particular, both the western and eastern extremes of the shoreline within Town boundaries are largely comprised of slopes of unaccommodating steepness, and little development within shoreline jurisdiction has occurred in these areas. These areas include the western part of Segment 9 and most of Segments 1 and 2 to the east.

Public lands in shoreline jurisdiction include the Town Park in Segment 9 at the west end of Coupeville's shoreline, and within Segment 6, the sewage treatment plant and Thomas Coupe Park on 9<sup>th</sup> Street between Gould Street and Otis Street. The Town owns the tidelands fronting the Town Park, and the Port of Coupeville has ownership of the tidelands at the wharf and along parts of Front Street.

Several of the historic structures within the commercial core in Segment 8, along Front Street, between Alexander Street and Main Street, extend into the intertidal area, and are supported by pilings or heavy concrete bulkheads. Two homes, between Main Street and the sewage treatment plant, also encroach over the water. Land use in Segment 8 is primarily commercial, and consists of the wharf, shops, small business offices, restaurants, bed-and-breakfasts, and a museum. In most cases, the private upland ownerships extend out to the meander line.

Moderate-density residential housing is the primary land use in shoreline jurisdiction in Segments 5, 6 and 7, between Main Street and Leach Street. Low-density residential development on large lots dominate the eastern part of Coupeville's shoreline jurisdiction, in Segments 1-4. While some clearing has occurred near the bluff, as described above in Section II, many of the homeowners retained significant native vegetation in this area, and much of the land in east Coupeville that was forested in the late 1950s remains forested today.

Approximately 150 Coupeville parcels have at least a portion of their boundaries within shoreline jurisdiction. Of these, approximately 30 are undeveloped and have at least theoretical development potential. For the purposes of this analysis, "development potential" is considered to exist for an undeveloped parcel within shoreline jurisdiction if it has at least 1000 square feet of area landward of the shoreline. This figure is admittedly arbitrary, and should be considered a rough guide only. Some uses can occur on some lots with less area, other uses may require much more area. Based on this definition, total undeveloped area with development potential within shoreline jurisdiction is around 470,000 square feet or 10.8 acres.

Most of these undeveloped lands within shoreline jurisdiction lie on steep, and often unstable, slopes, where building or other land uses are not physically feasible. The portion of the single undeveloped parcel in Segment 1 which is subject to shoreline jurisdiction, and the large undeveloped parcel north of Madrona Way in Segment 9, are both located on steep and basically unbuildable slopes. Some of the lands with "development potential" are protected from development by existing conservation easements. Inadequate space between bluffs and required setbacks from roads or other features also limits development potential, as with a number of lots within Segments 7 and 8. The low-density residential zoning on the undeveloped lands east of Leach Street, in Segments 3 and 4, and the medium-density zoning west of Broadway Street, in Segment 9, reduce available development options even further.

In summary, potential for new development on previously-undeveloped lands within Coupeville's shoreline jurisdiction is extremely limited. Redevelopment potential is also limited due to the local and state regulations and policies regarding historic preservation. Table 1 summarizes existing land uses and development potential for each of the nine shoreline segments.

### ***C. Land Use Planning and Development Regulations***

Among the majority of the central Whidbey Island community, the protection of rural character, historic features, and agricultural heritage has been a high priority since the early 1970s. The Town of Coupeville's Comprehensive Plan, first adopted in the 80s and most recently revised in 1999, has as a primary land use goal "to promote a development pattern that recognizes and enhances Coupeville's historic small-town character".

The Town's current Shoreline Master Program consists of a 1996 City Ordinance (Chapter 16.32) and the adoption of the version of Island County's SMMP in effect at that time. Since then, Island County has adopted a revised SMP and development regulations. Existing shoreline designations are shown on Map 10.

Also illustrated on Map 10 are the Town's current zoning designations, as established by Chapter 16.08 of the Coupeville Development Regulations. Zoning is generally consistent with existing land use. The shoreline area is dominated by residential zoning designations, with approximately 44% of zoning within shoreline jurisdiction within the Low Density Residential zone and 39% in the Medium Density Residential zone. Public lands and parks total around 9%. The Historic/Limited Commercial zone occupies 8%, and the High Density Residential zone is less than 1% of the zoned lands in shoreline jurisdiction.

All of the lands within shoreline jurisdiction between the sewage treatment plant and the Coupeville Town Park lie within the Historic Restoration Overlay. The Overlay ensures compatibility of new development or redevelopment with the historic character of the existing land uses. Additionally, all commercial development within the Town is subject to review by the Design Review Board, which considers compatibility with the Town's historic character and makes recommendations to the Town's building and planning officials.

Clearing and grading within Town limits is regulated through Coupeville Town Code Chapter 16.20. The Island County Health Department provides regulatory oversight of on-site sewage disposal systems within areas of the Town not currently served by sanitary sewers.

Island County's Comprehensive Plan of 1998 recognizes the Town's limited development capacity and primary community goals of maintaining small-town character and historic integrity. Unlike other Urban Growth Areas, such as that of Oak Harbor to the north, significant urban development is not planned or proposed for the area in and around Coupeville. In further recognition of the unique conditions of the Town, in 2004 the Washington State Legislature passed Senate Bill 6367, which exempts jurisdictions lying entirely within national historic districts from some of the urban development goals of the Washington Growth Management Act, and provides Coupeville with greater control over the amount of growth it must plan to accommodate than other similarly-sized jurisdictions. Under the new legislation, the Town does not have to plan for or accommodate all forms of urban development in the intensity and density of other UGAs which lack the unique historic and cultural importance of towns such as Coupeville.

## ***D. Infrastructure***

Several Town streets lie within shoreline jurisdiction. Madrona Way brings traffic across town limits from the west, within Segment 9. North Main Street is the primary route to the shoreline area from uplands to the south, and enters shoreline jurisdiction near the break between Segments 7 and 8. Front Street provides access to the commercial core along the shoreline, running nearly the length of Segments 7 and 8. Leisure Street and Leach Street provide access to residential areas in the shoreline area in Segments 4 and 5, respectively. There are no public roads within the Town's shoreline jurisdiction east of Leisure Street.

The Town's Comprehensive Plan evaluates future traffic demand, and concludes that forecasted traffic growth will not result in capacity deficiencies in any of the Town's major arterials. Private road development and improvements to public streets may occur in conjunction with new development, but no major expansions or improvements are planned for public roads within the shoreline area. Minor improvements, such as widening of certain streets, bike path, and sidewalks, along with improvements to parking and lighting, are planned within the shoreline jurisdiction.

The Town's sewage treatment plant is located at Thomas Coupe Park, north of the corner of Gould and 9<sup>th</sup> Streets, within Segment 6. An 18" sewage outfall pipe extends approximately 1470' northerly into Penn Cove. Discharge is monitored for compliance with National Pollutant Discharge Elimination System (NPDES) requirements under a permit issued by the

Washington Department of Ecology. In 2001 a number of flow capacity improvements were made to the existing plant. Further improvements to increase biological oxygen demand (BOD) capacity are currently underway. The existing chlorine treatment process is being replaced by a UV treatment system.

Within shoreline jurisdiction, concrete sewer pipes of 8" to 12" in diameter run along Town rights-of-way. A pump station and 12" overflow pipe are located just west of the town wharf, at the intersection of Front and Alexander Streets, within Segment 8 (Schaefer and Bratton 1996).

Stormwater is collected and discharged at the shoreline at two main locations. The outfall near the Town Wharf in Segment 8 conveys untreated water. Stormwater discharged through the second outfall, at Thomas Coupe Park within Segment 6, is first treated through the sewage treatment plant. Additional small outfalls, mostly private discharges from downspouts and other local runoff sources, occur along the shoreline, and are further described above in Section II (Schaefer and Bratton 1998).

The Town is reliant on groundwater supplies, carefully balancing additional withdrawals with increasing demand. Potable water is provided by a number of wells and a treatment plant located near Fort Casey. Individual private wells are not permitted within the Town limits where the municipal water supply is available.

See Map 13 for locations of major infrastructure elements, and Table 1 for a summary of infrastructure within the shoreline segments.

## ***E. Recreation and Open Space***

Public access to the shoreline is provided at four locations within the Town, all within the western portion of the Town's shoreline jurisdiction (see Map 13). The Comprehensive Park Plan of 1995 lists major park and recreational facilities within the Town. The largest, at 3.8 acres, is the Town Park at NW Coveland and Colburn Streets, which has over 500 feet of frontage on Penn Cove, and is located within Segment 9. A winding trail down the bluff fronting the park provides shoreline access. The park is developed with restrooms, playground equipment, a cookhouse, several tables and other picnic facilities, a tennis court, and a covered pavilion where outdoor concerts and other events are held. A gravel-surfaced trail crossing private property via easements connects the Town Park with sidewalks along Front Street.

A stairway providing public access to the beach is located at the Town Wharf, within Segment 8. While the Wharf is owned by the Port of Coupeville, the stairway is located within an easement across private property. Sidewalks connect this access to another stairway at 6 NW Front Street, an access point owned and maintained by the Town, also within Segment 8. This stairway has two large landings providing seating and viewing areas, and is scheduled to be rebuilt over the next few years.

The seaward terminus of the Town Wharf is built on aquatic lands leased from the Washington Department of Natural Resources. Moorage is provided at the floating dock at the east side of the Wharf, and marine fueling services are provided at another floating dock at the north end of the Wharf. Retail services and public restrooms are housed in the building at the north end of the Pier. The Port also owns the building just east of the Wharf, at 24 NW Front Street, which houses retail space and the Port offices.

The sidewalks along Front Street connect directly to a gravel trail with continues east over 1500' to Captain Coupe Park, located at 602 NE Ninth Street, within Segment 6. The park features a boat ramp, floating dock, parking area for boat trailers, picnic tables, fire pits, and a public restroom. A 1997 Master Plan adopted by the Town for the park proposes improvements for access and use by both pedestrians and kayakers, ADA compliance, shoreline restoration, and bank stabilization.

See Table 1 for a summary of shoreline access and recreational opportunities within each of the nine shoreline segments.

## **IV. CULTURAL RESOURCES AND MANAGEMENT**

### ***A. Archaeological Resources***

The use of the Penn Cove area by Salish Indian peoples was extensive prior to settlement of the area by European descendants in the mid-1800s. Several permanent villages and structures were reported by earliest visitors to the area (Wessen 1988). While much evidence of the long-term presence by Native Americans has been eradicated by development and natural processes of erosion and decay, a number of sites of archaeological significance remain within Coupeville's shoreline area. The site records maintained by the Washington Office of Archaeological and Historic Preservation (OAH 2004), a division of the Washington Department of Community, Trade and Economic Development describe burials, cairns, middens, lithologic remnants, artifacts, and structures throughout Penn Cove. Some artifacts that have been recovered in the Penn Cove area are thousands of years old. Within Coupeville's shoreline jurisdiction, there are six individual sites listed in OAH records, within which have been found shell middens, projectile points, stone and bone tools, and human burials. Most of these sites have been significantly disturbed, through natural processes of beach erosion, inadvertently during development, or plundered for artifacts. Some of the burials have been recovered and reinterred elsewhere. Due to the sensitivity of these sites and the unfortunate deliberate disturbance through vandalism or looting that such archaeological sites have suffered, the locations of these features are not publicly disseminated and do not appear on the maps attached to this report. Knowing and willful disturbance of archaeological sites is prohibited by Washington's Indian Graves and Records Act (RCW 27.44).

### ***B. Historic Resources***

The rapid growth of the 1960s and 1970s resulted in the loss of several historic structures and alteration of the landscape that lent much of the rural character to the central Whidbey Island area. With more pre-1870s structures than any other community in the state, the Coupeville area was recognized by community members as having historical and cultural significance meriting extraordinary measures for protection. The 1972 formation of the Central Whidbey Island Historic District, which encompassed the Town of Coupeville, marked the first of several legislative actions to protect the historical community as a whole. The formation of the District was followed in 1978 by the passage of Section 508 of the National Parks and Recreation Act of 1978, which established the Ebey's Landing National Historic Reserve as a unit of the National Park system. The Reserve, with boundaries and intent similar to the Historic District, was the first of its kind in the country. While the establishment of the Reserve did not actually establish any regulatory controls on development of the land, it set the stage for acquisition of development rights using Federal monies and has led to permanent protection of the Ebey's Prairie area.

By the time the District and Reserve were formed, the Town of Coupeville boasted over 50 properties listed on the National Register of Historic Places. In 1995, the Town of Coupeville adopted the Historic Restoration Overlay District and established a review process with the intent of protecting and restoring the historic features in the downtown Coupeville commercial core. The Historic Preservation Element of Coupeville's 1999 Comprehensive Plan establishes a neighborhood approach to describe the different parts of Coupeville and how each contributes to the Town's strong historic flavor. Seven neighborhoods have been identified in the Comprehensive Plan; three possess a shoreline component and are described in the following paragraphs.

### *Historic Downtown*

The Historic Downtown neighborhood includes the northern Main Street, western Town boundary, and NW Front Street areas. The Comprehensive Plan describes the historic commercial district along NW Front and Coveland Streets as the “heart of Coupeville”, the former commercial core, with most businesses now tourist-oriented. Structures are primarily wooden, including several original late 1800s buildings with original false fronts. The wooden boardwalks and narrow streets make this area pedestrian-friendly.

Also included in this neighborhood is the west entrance to Coupeville on Madrona Way. The Town Park and a number of heavily wooded lots are interspersed with views of open fields and Penn Cove. Historic homes and cottages are mixed with modern and pre-1960s residential structures. The madrona trees and bluff are dramatic elements of the landscape.

### *Old Coupeville*

This area includes the primarily single-family residential lands north of 3<sup>rd</sup> Street and the shoreline area between Center and Leach Streets. The Old Coupeville neighborhood includes the original residential core of the Town of Coupeville, marked by the symmetrical layout of the original plats of the late 1800s between Center and Gould Streets. These plats formed a number of regular blocks of 200’ by 200’, each consisting of eight 50’-wide lots. Many of these lots have been combined and developed with homes ranging from small cottages to large modern houses, with a variety of styles and quality of construction. Outbuildings, small orchards, gardens, and open fields with hedgerows, especially on the hillside leading up to Leach Street, contribute to the somewhat rural character of the shoreline area of this neighborhood.

### *Parker Road*

Extending east from Leach Street to the eastern Town limits, this area was annexed to the Town in 1959. Unlike the other two shoreline neighborhoods, most development in this area has occurred since the 1960s. Larger parcels characterize this area. With the exception of areas such as the 1966 Plat of Captain’s Choice on Lovejoy Point, a former homestead and orchard and now an upscale neighborhood with a mix of modern housing types, the area is characterized primarily by evergreen forest with a dense understory of salal and sword fern. East of Leisure Street are long, narrow lots on the northern waterfront side of Parker Road, many undeveloped, and several of the developed ones are marked only by mailboxes and narrow dirt driveways. Many landowners along the water side of Parker Road have preserved trees and native vegetation, though some clearing has occurred along the bluff edge to take advantage of views of Penn Cove.

## **V. CRITICAL AREAS**

The Growth Management Act (GMA) requires local governments in Puget Sound to inventory, designate, and protect sensitive environmental features, collectively referred to as Critical Areas. To date, the Town has employed provisions of the State Environmental Policy Act (SEPA) to protect Critical Areas during development review processes. The GMA establishes five types of Critical Areas, as follows:

### ***A. Fish and Wildlife Habitat Conservation Areas***

The GMA includes in the definition of Fish and Wildlife Habitat Conservation Areas such features as, among others, kelp and eelgrass beds, forage fish spawning areas, commercial and recreational shellfish harvesting areas, and bald eagle nest sites.

As discussed in detail in Section II, the entire Coupeville shoreline serves as one or more of these habitat types, and meets designation criteria as Fish and Wildlife Habitat Conservation Areas under the GMA.

## ***B. Wetlands***

Neither the National Wetlands Inventory nor wetlands maps maintained by Island County indicate the presence of wetlands landward of the shoreline within Coupeville town limits. As discussed in Section II, it appears that much of Segment 3 was historically wetlands, now mostly filled for residential development, with only small remnants of the former tidal wetland or lagoon remaining. Despite their diminutive nature, the wetlands serve important habitat functions, meet the definition of this type of Critical Area under the GMA.

## ***C. Geologically Hazardous Areas***

The bluffs along Coupeville's shoreline are clearly unstable in several locations, with exposed faces and relatively fresh slide debris piled at the toe. Wave action continuously undercuts many of Coupeville's bluffs, and groundwater seeps along bluff faces also contribute to instability. Some areas within Segments 3, 5 and 6 have no-bank waterfront, but the remainder of the Town's shoreline consists of steep bluffs of varying heights. These features and processes are more completely described Section II.

## ***D. Frequently Flooded Areas***

No part of Coupeville's shoreline jurisdiction upland of the shoreline is mapped as a frequently flooded area according to the Federal Emergency Management Agency's Flood Insurance Rate Maps. Shoreline areas themselves are mapped as experiencing "coastal flood with velocity hazard (wave action)" and are designated as Coastal High Hazard Areas. Most of the Town rises quite steeply from the shoreline, and there is little hazard of flooding of uplands, with the exception of portions of Segment 3, which includes residential development at a low enough elevation that it is potentially exposed to tidal flooding during storms combined with high tides.

## ***E. Critical Aquifer Recharge Areas***

Island County was assigned the Federal Sole Source Aquifer designation in 1983 by the US Congress, with the regulatory effect of additional review of projects promulgated or funded with Federal dollars. The designation was made in recognition of the limited supplies of ground water available to serve the county's population. The Town is entirely dependent upon ground water for potable water supplies. No public supply wells are located within or near Coupeville's shoreline jurisdiction, and because of the threat of seawater intrusion, future well drilling is unlikely near the shoreline. Island County is currently reviewing the criteria for establishing Critical Aquifer Recharge Areas.

# **VI. CONCLUSIONS AND RECOMMENDATIONS**

In the beginning of this report, the following questions were posed:

- Where is development likely to occur?
- What will be the likely impacts of future development?
- Where are opportunities for public access to the shoreline, and where can these opportunities be enhanced?
- Where can water-oriented uses be most appropriately located?

Following is a discussion of the findings of the this analysis report in the context of these specific questions.

## ***A. Future Development Potential and Impacts***

Areas of future development potential are limited. Within Segments 1 through 6, only a few lots with portions within shoreline jurisdiction remain completely undeveloped. The nature and scale of any future development on these lots has essentially been pre-determined through configuration of existing lots, existing development, zoning, and topography. The steep bluffs along most of the shoreline within these segments limit possible locations of future development, particularly within Segments 1, 2 and 9. The potential number of new lots that could be created is slight in the areas of Low Density Residential zoning designation. Even in the areas with higher densities permissible under zoning, such as the RM-9600 zoning in Segments 5, 6, 7 and 9, there simply are not many parcels within shoreline jurisdiction that could feasibly be subdivided.

Within the commercial core of Segment 8 and the west part of Segment 7, commercial development or redevelopment is likely to occur, especially on the lots south of Front Street. Within Segment 7, there are a number of undeveloped lots north (waterward) of Front Street, but there is generally insufficient room between the existing road and the steep and moderately high bluff for any development to occur. The Town is currently reviewing a proposed restaurant waterward of Front Street on one of the last shoreline lots in Segment 8 with any development potential.

The existing Town Wharf and other commercial over-water structures within Segments 7 and 8 may be proposed for eventual maintenance or replacement, but new incursions into the intertidal area are unlikely to occur.

Some improvements are likely to be proposed at the Thomas Coupe Park in Segment 6, and the sewage treatment plant near the park will probably experience ongoing maintenance and upgrades to keep up with the demands posed by anticipated growth within Town limits.

Any new development or redevelopment will likely be undertaken with greater sensitivity than past development practices, and interruption of shoreline processes or further decline of habitat will probably be discouraged, if not prohibited, under shoreline and critical areas regulations that will accompany the Town's SMP update.

## ***B. Opportunities for Public Access and Recreation Enhancement***

The four locations that the public can access the shoreline within Coupeville's town limits – the Town Park in Segment 9, the two stairways between the rustic historic buildings in Segment 8, and Thomas Coupe Park near the sewage treatment plant in Segment 6 – are interconnected via upland trails and sidewalks. These well-maintained and frequently used beach accesses are important attractions of the tourist-oriented commercial downtown area.

The stairway near the Knead and Feed restaurant in Segment 8 is proposed for rebuilding. The new stairway may include larger landings and more seating. A number of improvements are being considered at Thomas Coupe Park in Segment 6, the site of the Town's only public boat launch. Storms have damaged floats used for mooring, and decisions are pending on how best to restore and enhance recreational and access opportunities at the site. Economic and regulatory factors limit the choices available to the Town, and a design process is underway.

Opportunities for public access are absent in Segments 1 through 5 and Segment 7 due to lack of any public ownership. Additionally, the steep bluffs along much of the shoreline within these segments further limit access opportunities.

If and when properties with access or recreational potential become available, the Town will consider additional acquisitions for public use.

## ***C. Water Oriented Uses***

With the prevalence of residential uses in Segments 1-5, 7, and 9, commercial water-oriented uses are inappropriate, and in any case would be restricted under existing zoning. Within

Segments 6 and 8, there are no low- or no-bank waterfront properties with potential for completely new water-oriented uses, such as a marina, boat repair or rentals, docks, or similar activities could reasonably occur. New non-residential water-oriented uses are therefore unlikely to become established in Coupeville. It is however possible that a new non-residential water-oriented use could be established in the commercially-zoned downtown core of Segment 8 through redevelopment or addition to an existing use.

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Table 1. Summary of Segment Characteristics

| Segment | Length (ft) | Shoreline Modifications (% of segment) | % Overhanging Marine Riparian Vegetation | Forage Fish Spawning | Eelgrass                     | Bluff (high, medium, low, none) | Bluff stability                      | Nearshore ecosystem quality | Spartina present?  |
|---------|-------------|--|--|----------------------|------------------------------|---------------------------------|--------------------------------------|-----------------------------|--------------------|
| 1       | 1644        | 0                                      | 90                                       | Smelt, sand lance    | Present, patchy <sup>1</sup> | High                            | Unstable, recent slides, toe erosion | Good                        | No                 |
| 2       | 1083        | 0                                      | 100                                      | Smelt                | None                         | High                            | Unstable, recent slides, toe erosion | Good                        | No                 |
| 3       | 1890        | <5                                     | 10                                       | Smelt                | Present, patchy              | Medium                          | Intermediate                         | Fair                        | Yes, small patches |
| 4       | 1103        | 14                                     | <40                                      | Smelt                | Present, patchy              | Medium                          | Eroding                              | Fair                        | No                 |
| 5       | 702         | 100                                    | 0  | Smelt                | Maybe – conflicting reports  | Medium to low                   | Stable                               | Poor                        | No                 |
| 6       | 1154        | Near 100                               | 0  | Smelt, sand lance    | Present, patchy              | Low                             | N/A                                  | Poor                        | Yes, small patches |
| 7       | 1632        | 20                                     | 30                                       | Smelt, sand lance    | Present, patchy              | Medium                          | Stable, slow erosion                 | Fair                        | No                 |
| 8       | 725         | 90                                     | 10                                       | Smelt                | Present, patchy              | Medium                          | Stable, slow erosion                 | Fair                        | No                 |
| 9       | 3280        | <20                                    | 80                                       | Smelt, sand lance    | Present, patchy              | Medium to high                  | Unstable                             | Good                        | Yes, small patches |

<sup>1</sup> CGS found no eelgrass in this section during their site visit in April 2004

Table 1. Summary of Segment Characteristics (continued)

| Segment | Existing Shoreline Designation <sup>2</sup> | Zoning <sup>3</sup>         | Existing Land Use Type       | No. of Lots in Segment <sup>4</sup> | Number of Undeveloped Lots | Major utilities or infrastructure          | Public Access           | Restoration opportunities and recommendations  |
|---------|---|-----------------------------|------------------------------|-------------------------------------|----------------------------|--|-------------------------|--|
| 1       | SR (1400 ft), R (240 ft)                    | LDR                         | Residential                  | 6                                   | 1                          | None                                       | No                      | Stormwater management, enhance marine riparian vegetation  |
| 2       | R   | LDR                         | Residential                  | 9                                   | 0                          | None                                       | No                      | None   |
| 3       | SR  | LDR                         | Residential                  | 17                                  | 4                          | None                                       | No                      | Remove fill, eradicate <i>Spartina</i>   |
| 4       | SR  | LDR                         | Residential                  | 10                                  | 1                          | None                                       | No                      | Enhance marine riparian vegetation   |
| 5       | SR  | LDR (200'), RM-9600 (500')  | Residential                  | 5                                   | 1 <sup>5</sup>             | None                                       | No                      | Enhance marine riparian vegetation, remove relict and unnecessary shoreline structures   |
| 6       | U (800'), SR (350')                         | RM-9600 (500'), P (650')    | Residential, Municipal, Park | 5                                   | 0                          | Sewage treatment plant, stormwater outfall | Yes (Thomas Coupe Park) | Enhance marine riparian vegetation, remove relict and unnecessary structures, remove rock and concrete debris near park, eradicate <i>Spartina</i> |
| 7       | U   | RM-9600 (1150'), HLC (500') | Urban commercial             | 30                                  | 12                         | None                                       | No                      | Enhance marine riparian vegetation, remove relict and unnecessary structures, remove rockery and concrete debris on beach                          |

<sup>2</sup> SR = Shoreline Residential, R = Rural, U = Urban. Total length may not equal segment length due to rounding.

<sup>3</sup> HDR = High Density Residential, HLC = Historic/Limited Commercial, LDR = Low Density Residential, RM-9600 = Medium Density Residential, P = Public, TC = Town Commercial. Total length may not equal segment length due to rounding, and because streets are not included in calculating length of zoning designations.

<sup>4</sup> Some lots span segment boundaries, and others have been segregated since the data used for the maps was generated. Therefore, these numbers are estimates.

<sup>5</sup> An undeveloped lot spans the break between Segments 4 and 5, and is counted in Segment 4.

| Segment | Existing Shoreline Designation <sup>2</sup> | Zoning <sup>3</sup>                 | Existing Land Use Type                           | No. of Lots in Segment <sup>4</sup> | Number of Undeveloped Lots | Major utilities or infrastructure                  | Public Access                          | Restoration opportunities and recommendations                             |
|---------|---|-------------------------------------|--|-------------------------------------|----------------------------|--|--|---|
| 8       | U   | HLC (600), TC (125)                 | Urban commercial                                 | 27                                  | 4                          | Stormwater outfall, sewage pump station & overflow | Yes Wharf and stairs near Knead & Feed | Enhance marine riparian vegetation, remove unnecessary shoreline armoring |
| 9       | U (1050'), SR (2250')                       | HDR (75'), RM-9600 (2600'), P(500') | Urban residential, park, low-density residential | 18                                  | 5                          | None   | Yes, Town Park                         | Enhance marine riparian vegetation, eradicate <i>Spartina</i>             |

## Coupeville SMP Update – Segment description photos



Photo 1. Segment 1. Vegetation clearing up to bluff crest



Photo 2. Segment 2. Landslide from bluff crest



Photo 3. Segment 2. Iron rich spring flowing from bluff



Photo 4. Segment 3. Backshore wetland and elevation contrast between adjacent lots indicative of backshore filling



Photo 5. Segment 3. Backshore depression with LWD with colonizing upland vegetation



Photo 6. Segment 5. Lack of beach sediment and backshore beneath bulkheaded shoreline



Photo 7. Segment 6. Relict steel structures in intertidal



Photo 8. Segment 6. Accretion adjacent to relict bulkhead (restoration opportunity)



Photo 9. Segment 6. Failing bulkhead in Thomas Coupe Park



Photo 10. Segment 6. Shoreline armoring consisting of concrete debris and rock



Photo 11. Segment 7. Flat wooden structure with small piles over intertidal



Photo 12. Segment 8. Coupeville Wharf; sedimentation and over-water structures



Photo 13. Segment 8. Fine gravel and sand beach and boulders scattered over upper beachface and wooden seawall at base of overwater structures



Photo 14. Segment 8. Beneath Coupeville Wharf; note erosion right of stairs, accretion of sand beneath building.

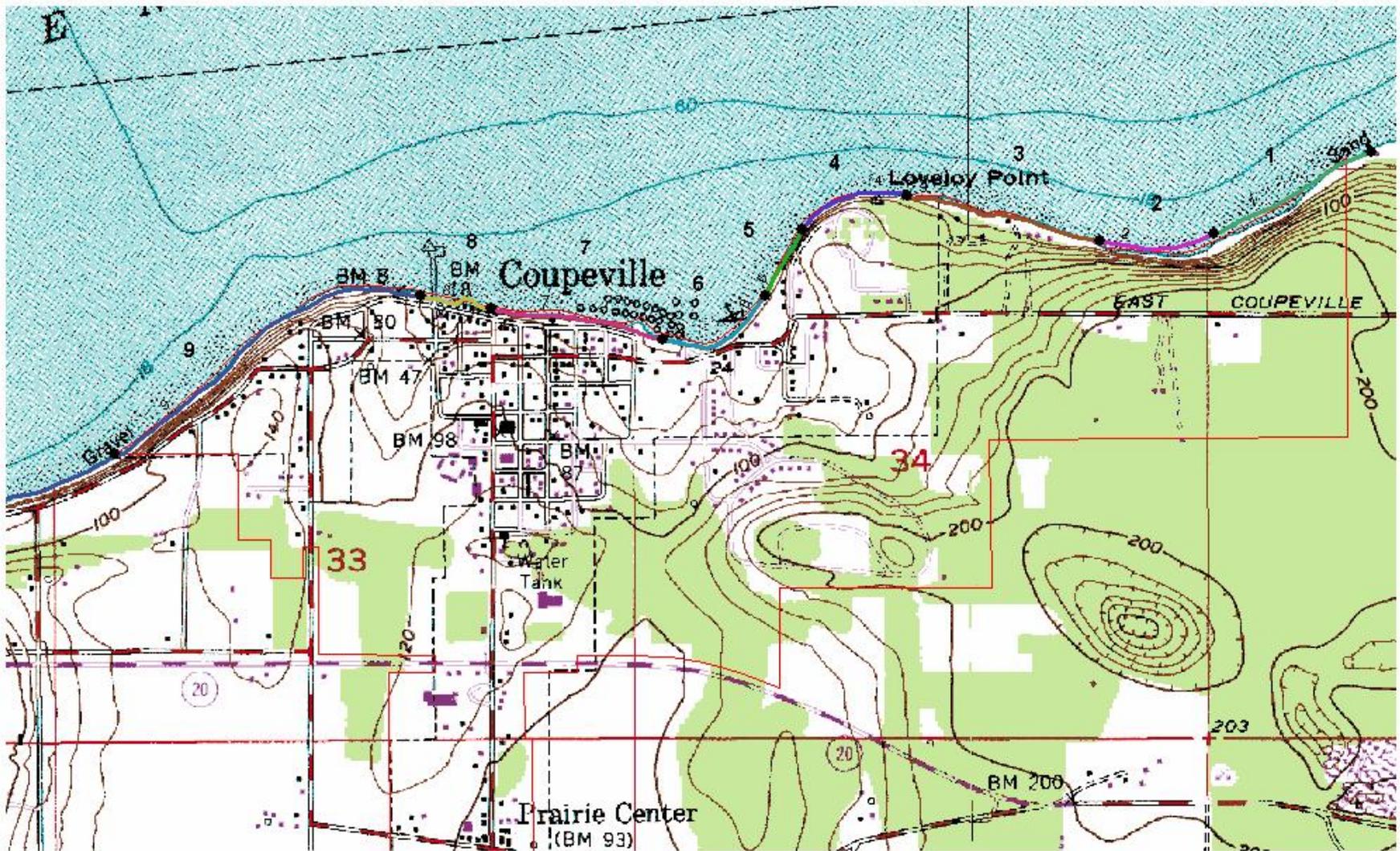


Photo 15. Segment 9. Boulders on lower high-tide beach and eroding bluffs



Photo 16. Segment 9. *Spartina anglica* growing on mixed sand/pebble foreshore



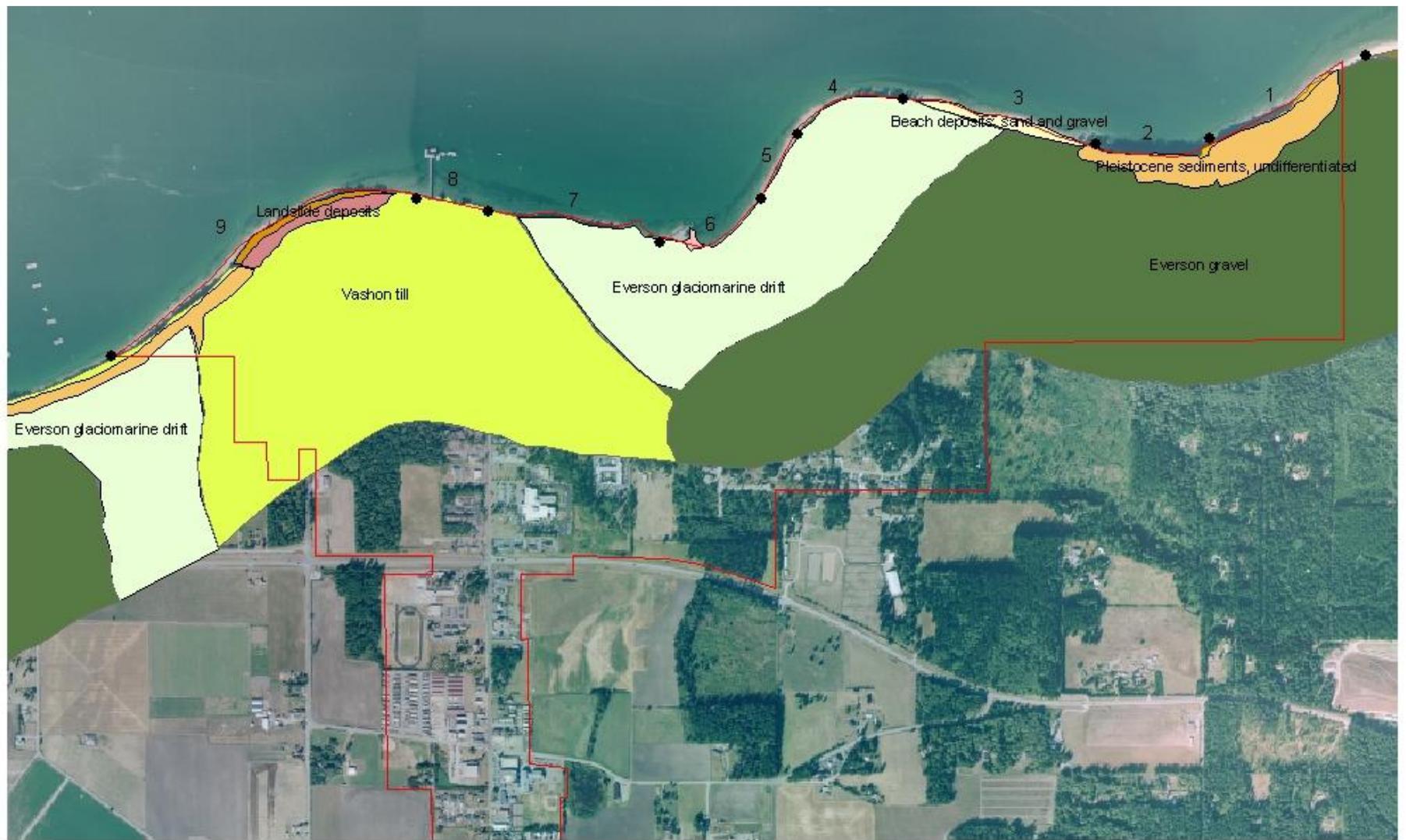


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**Map 1 - Segment delineations**  
**Coupeville Shoreline Management Plan Update**

0 250 500 1,000 Feet 1:15,000





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## Map 2 - Geology and Slope Stability Coupeville Shoreline Management Plan Update

0 250 500 1,000 Feet

1:15,000



| Legend                  |     |
|-------------------------|-----|
| ● Segment breaks        | Qb  |
| □ Coupeville limits     | Qe  |
| □ Intermediate          | Qeg |
| □ Modified              | Qls |
| □ Unstable              | Qu  |
| □ Unstable Recent Slide | Qut |



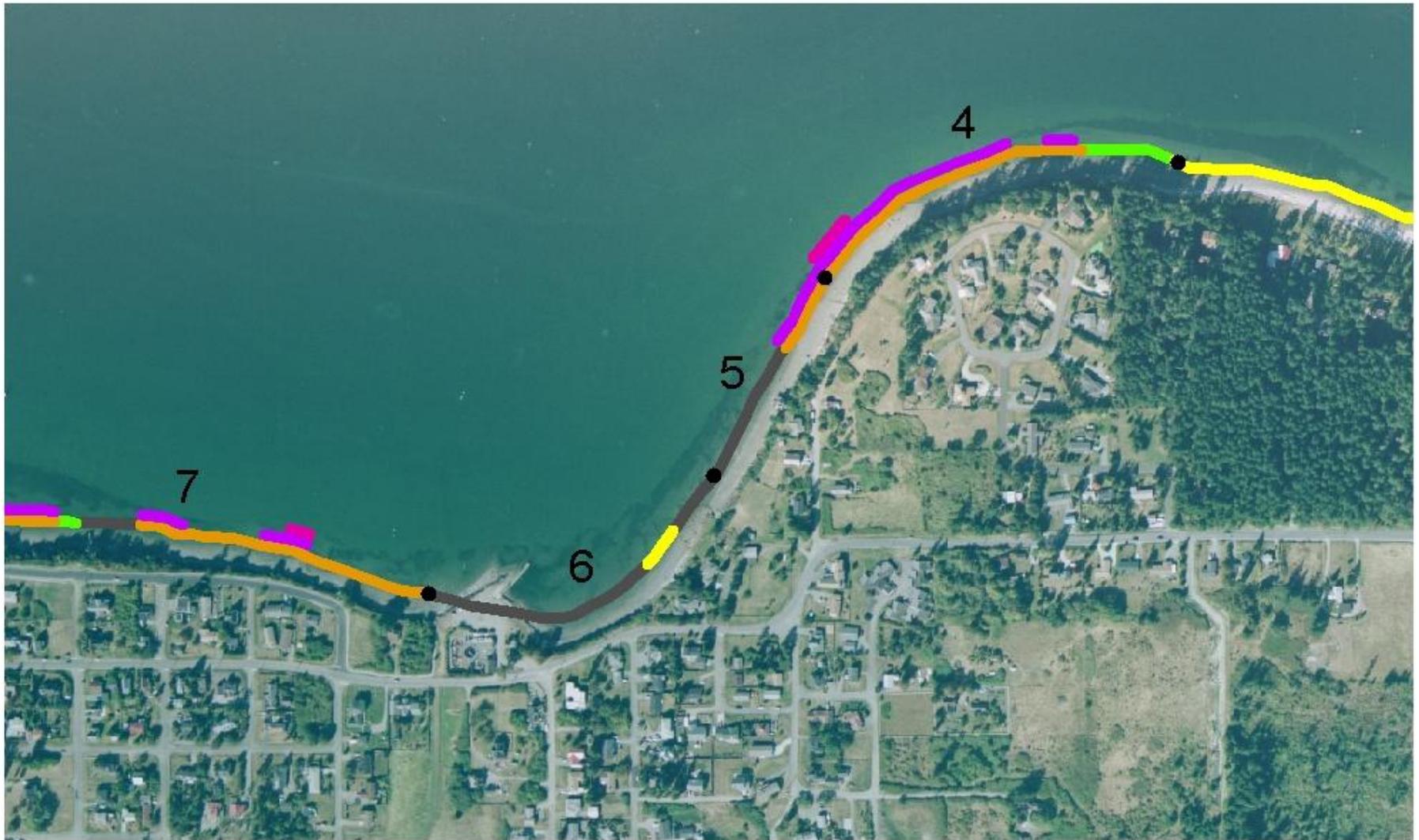
Map 3 - Geomorphic conditions; Segments 1 - 3  
Coupeville Shoreline Management Plan Update



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| Legend |                     |
|--------|---------------------|
|        | Toe erosion         |
|        | Landsliding         |
|        | Feeder bluff        |
|        | Transport zone      |
|        | Modified            |
|        | Accretion shoreform |
|        | Segment breaks      |

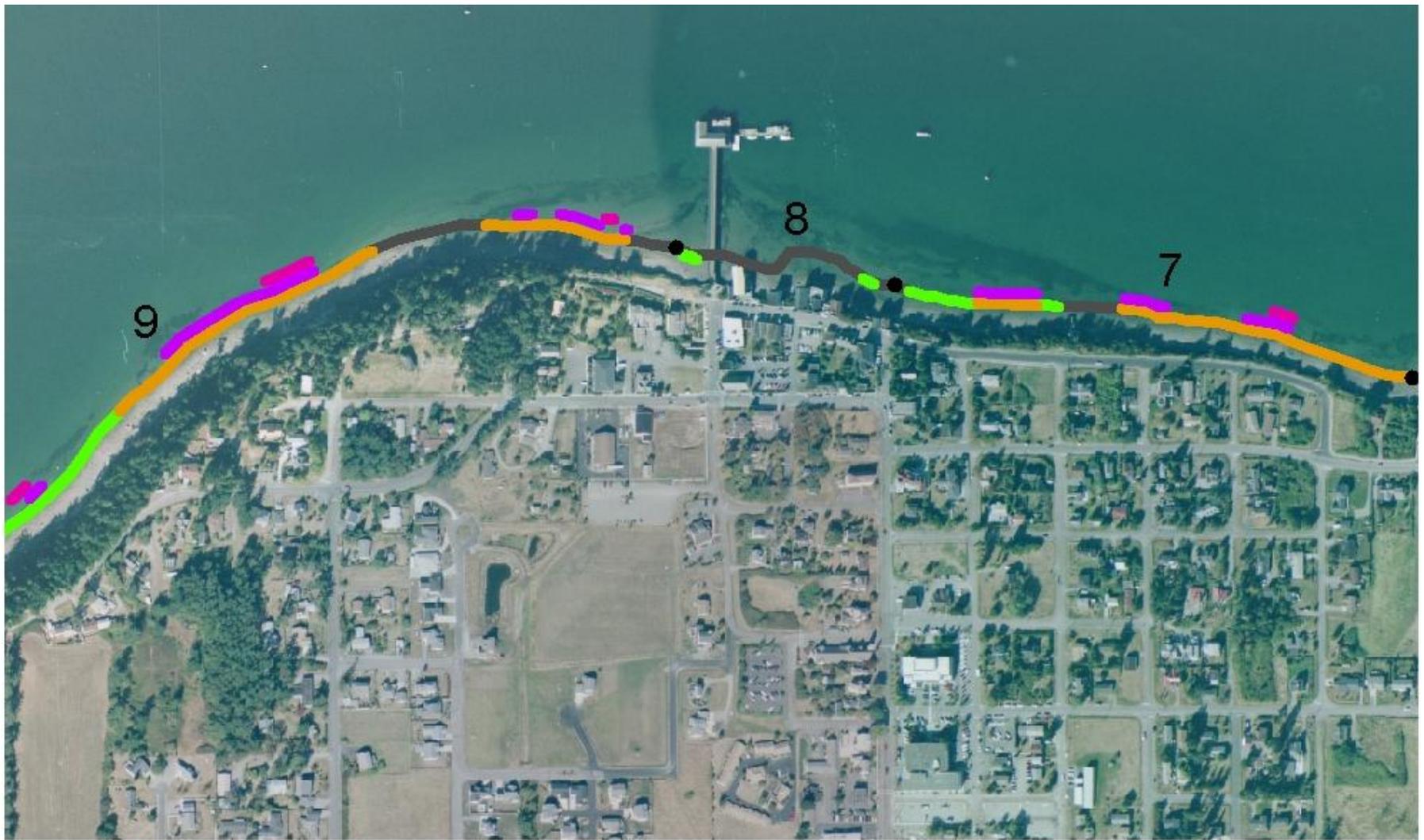


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Map 4 - Geomorphic conditions; Segments 4 - 6  
 Coupeville Shoreline Management Plan Update



| Legend |                     |
|--------|---------------------|
|        | Toe erosion         |
|        | Landsliding         |
|        | Feeder bluff        |
|        | Transport zone      |
|        | Modified            |
|        | Accretion shoreform |
|        | Segment breaks      |



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**Map 5 - Geomorphic conditions; Segments 7 - 9  
 Coupeville Shoreline Management Plan Update**

1:5000



| Legend                                |                     |
|---------------------------------------|---------------------|
| <span style="color: purple;">■</span> | Toe erosion         |
| <span style="color: pink;">■</span>   | Landsliding         |
| <span style="color: orange;">■</span> | Feeder bluff        |
| <span style="color: green;">■</span>  | Transport zone      |
| <span style="color: brown;">■</span>  | Modified            |
| <span style="color: yellow;">■</span> | Accretion shoreform |
| <span style="color: black;">●</span>  | Segment breaks      |



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### Map 6 - Geomorphic conditions; Segments 9 (all) Coupeville Shoreline Management Plan Update

1:6000



| Legend |                     |
|--------|---------------------|
|        | Toe erosion         |
|        | Landsliding         |
|        | Feeder bluff        |
|        | Transport zone      |
|        | Modified            |
|        | Accretion shoreform |
|        | Segment breaks      |
|        | Coupeville limits   |