

### 6.5.4 Reach Analysis

This section includes reach summaries (as reach information sheets) for the Skagit / Stillaguamish Estuaries and Port Susan marine shorelines of Camano Island, as depicted in Figure 6-5.

Figure 6-5. Skagit / Stillaguamish Estuaries and Port Susan marine reaches of Camano Island.





# REACH CAM01

Arrowhead Beach to Juniper Beach Including English Boom Park

## SHORELINE LENGTH:

6.16 Miles

## REACH AREA:

189 Acres

## PSNERP PROCESS UNITS:

Delta STL, 6050, 6051, 6062

### REACH SUMMARY

Arrowhead Beach to Juniper Beach (Reach CAM01) extends from Point Brown at the northern tip of Camano around the northeast head of the island to east of Livingston Bay. The reach is heavily influenced by the Skagit River and Stillaguamish River deltas, providing sediment and organic input to the aquatic environment. Geomorphic processes are characterized by estuary influences, with east-trending drift cells on the north and south shores of the reach; drift cells transport sediments from the feeder bluffs into a long accretion shoreform throughout the eastern extent of the reach.

Delta estuary wetlands and coastal lagoons occur in the reach; but have been modified by agricultural land uses. Nine stream mouths in the reach are located primarily along the eastern end of the reach and appear to be ditched through agricultural properties. These streams are short and do not support salmonids. Habitat is mapped within aquatic areas, which support waterfowl, forage fish, Dungeness crab and harbor seals.

Dense shoreline residential development limited to south end of reach along Juniper Beach. State Route 532 (2-lanes) provides all auto access to the Island crossing the South Pass and West Pass Sloughs between CAM01 and the Snohomish County mainland shoreline to the east. The sloughs provide watercraft linkage between Port Susan and Skagit Bay.

### GEOMORPHIC KEY INFORMATION

#### Geomorphic Shoretype (Map 9)

Feeder Bluffs (14%) at northwest and southwest extremes of reach, along with significant delta processes to east, feed Accretion Shoreform (81% of reach)

#### Net Shore Drift (Map 8)

Two drift cells (located both north and south of the Stillaguamish Delta) converge into a large area of No Appreciable Drift at Port Susan.

#### Shoreform Current (Map 10)

Bluff-backed Beach (19%) extending east into Barrier Beach (25%) and Delta (56%); Delta shoreform surrounds northeast shoreline, driven by Skagit & Stillaguamish estuaries to the east

#### Overall Rating of Degradation

Least (16%); Less (18%); More (66%)

#### Coastal Floodplain:

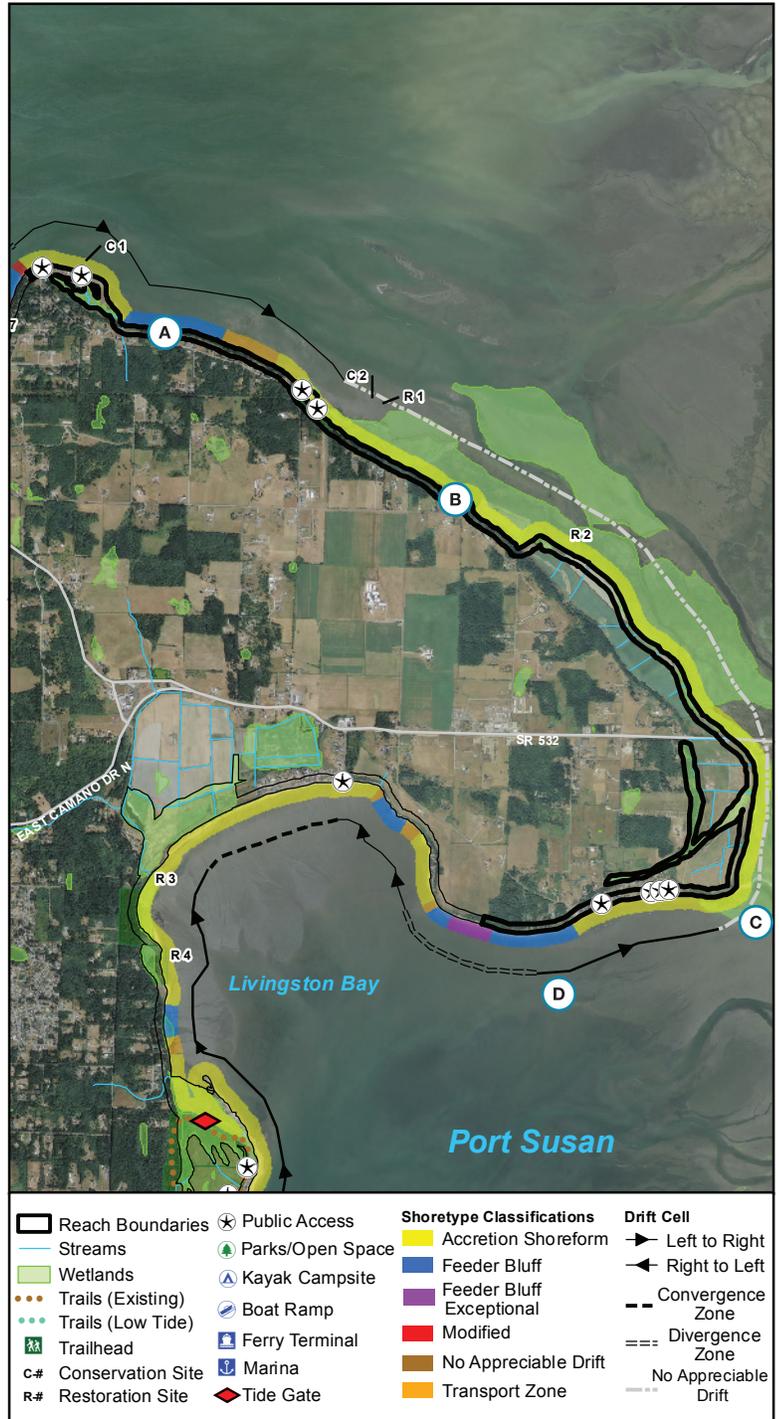
53%

#### Coastal Landslides & Toe Erosion:

Landslides and toe erosion along the bluff backed beaches just west of Juniper Beach.

#### Steep Slopes

21%



Shoreline Oblique Photos (2006)





# REACH CAM02

Livingston Bay

## SHORELINE LENGTH:

5.62 Miles

## REACH AREA:

224 Acres

## PSNERP PROCESS UNITS:

6048 - 6050

### REACH SUMMARY

Reach CAM02 includes Livingston Bay and adjacent shorelines to the east and south. Geomorphic processes are primarily influenced by two drift cells flanking the bay, providing sediment from the northeast and south to a long barrier beach (accretion shoreform) within bay.

The coastal lagoon at the south end of CAM02 provides significant aquatic habitat; the feature has been partially modified by agricultural development. A network of ditched streams are mapped through the agricultural areas along the bay, including 3 coastal stream mouths with no salmonid use. Aquatic habitats include a harbor seal haulout site, waterfowl concentrations and gray whale seasonal feeding habitat.

Primary land uses within the shoreline area include shoreline residential development, agriculture and open space. Most of the undeveloped open space area is mapped as wetland associated with the marine shoreline. Residential development is densely focused in two short shoreline beaches: along the Bay's north shoreline and fronting a coastal lagoon located at the south end of the Bay. The shoreline is generally unmodified and without overwater or in-water structures.

### GEOMORPHIC KEY INFORMATION

#### Geomorphic Shoretype (Map 9)

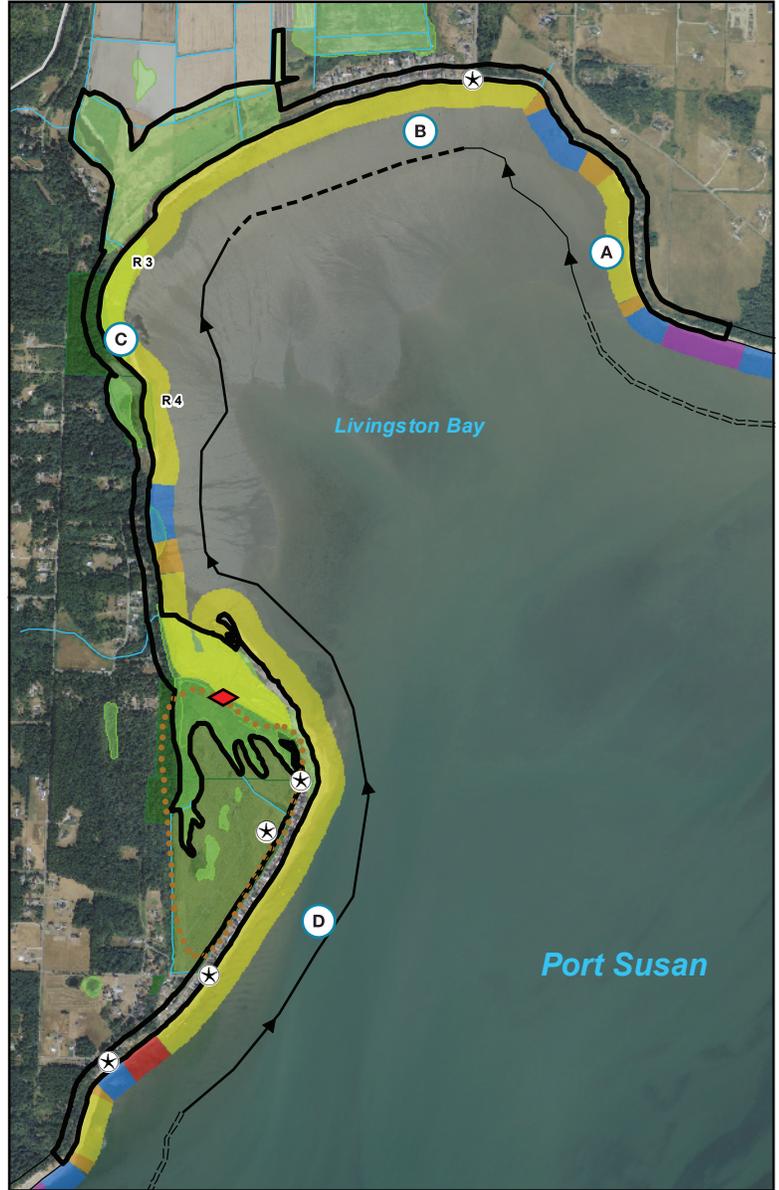
Primarily Accretion Shoreform (82%) with intermittent Feeder Bluffs (11%) and Transport Zones (5%); minimal Modified shoreline (2%)

#### Net Shore Drift (Map 8)

Northeastward drift originating just south of Sunrise Point converges with northwestward drift in the center of Livingston Bay.

#### Shoreform Current (Map 10)

Barrier Beach (51%) primarily within and south of Livingston Bay; Bluff-backed Beach (36%); Barrier Lagoon (13%) at south end of bay



#### Overall Rating of Degradation

Least (35%); Less (65%)

#### Coastal Floodplain:

66%

#### Coastal Landslides & Toe Erosion:

Landslides and toe erosion along the bluff backed beaches located near both drift cell origins.

#### Steep Slopes

10%



Shoreline Oblique Photos (2006)

**HABITATS & SPECIES**

**Significant & Unique Features (Maps 5-7)**

Patchy eelgrass mapped through majority of Bay and south end of reach; Port Susan Bay including Livingston Bay designated as an Audubon Important Bird Area.

**Shoreland Priority Habitats & Species (Map 5)**

Bald Eagle (habitat buffers); Cliffs-Bluffs; Wetlands

**Marine Priority Habitats & Species (Map 5)**

Waterfowl Concentrations throughout reach's aquatic area; 1 harbor seal haulout site (offshore in Livingston Bay); Estuarine Zone south of Bay; designation as Gray Whale habitat

**Salmonid Fish Use (Map 5)**

Nearshore areas are designated ESA critical habitat for Chinook (Puget Sound ESU) and bull trout.

<b>Coastal Lagoons</b>	<b>Coastal Stream Mouths</b>	<b>Wetlands (Map 4)</b>
35 acres (15%)	3	55%

**Forage Fish**

**Sandlance** 3%

**Smelt** 12%

**Herring** None mapped

**LAND & SHORELINE USE**

**Shoreline Modifications (Map 13)**

Armoring along east shoreline of bay, extending south from bay (associated with residential development); tide gate located at southern edge of Livingston Bay.

**Public Access (Map 16)**

Access provided at Livingston Bay Park (<1acre; limited parking at end of Fox Trot Way) and Iverson Preserve (120 acres, including coastal lagoon and wetland areas at south end of bay; provides beach access, wildlife viewing, limited parking).

**Armoring (% of shoreline) (Map 13)** 13%

**Zoning (Map 11)**

Rural (51%); Commercial Agriculture (3%); Rural Agriculture (34%); Rural Residential (12%)

**Overwater Structures (Map 14)**

1 private structure (potentially ramp and pier) south of Livingston Bay.

**Current Land Use (Map 12)**

**Number of Parcels** 205      **Average Parcel Size** 2.43 Acres

Primarily rural residential and agriculture; higher density shoreline residential development focused on Bay's north shoreline and barrier beach fronting coastal lagoon at south end of Bay.

**Shellfish & Aquaculture (Map 15)**

Unclassified (Port Susan and Livingston Bay extent); no mapped shellfish beaches.

**KEY MANAGEMENT ISSUES**

- Water quality issues associated with additional development (subdivision / intensified use) — including implications of septic systems, road runoff and agriculture.
- Drinking water supply (aquifer) issues associated with additional development (subdivision / intensified use) — saltwater intrusion and potential exacerbation from sea level rise (SLR). Portions of reach area mapped as 'Very-High Risk' for saltwater intrusion (Island County Risk Rating Map).
- Potential implications of sea level rise SLR on coastal lagoons, barrier beaches and associated wetlands (loss of habitat).
- Potential implications of SLR and coastal flooding on development within or near coastal floodplain areas (agricultural uses, shoreline residential development).

**RESTORATION OPPORTUNITIES**

Restoration sites were identified in 2004 by Coastal Geologic Services (Appendix H).

- R3:** Connect and restore channels to salt marsh in order to re-establish tidal flow and fish access. Restoration site R3 additionally identified by Island County Estuarine Restoration Program report (2001).
- R4:** Remove portions of dike to re-establish better tidal flow and fish access into old saltmarsh (1800' of shoreline; identified as a PSNERP Candidate Restoration Site [Livingston Bay restoration] in 2010).



# REACH CAM03

Triangle Cove South to Mountain View Road

## SHORELINE LENGTH:

8.01 Miles

## REACH AREA:

365 Acres

## PSNERP PROCESS UNITS:

6047 - 6048

### REACH SUMMARY

Triangle Cove South to Mountain View Road (Reach CAM03) is characterized by relatively dense shoreline residential development fronting and extending south from Triangle Cove (Oblique Photo A), a coastal lagoon. Shoreline geomorphic processes are primarily influenced by a long, north-trending drift cell, feeding accretion areas (barrier beach), including the cell terminus area at Triangle Cove.

CAM03 includes both Triangle Cove and an additional coastal lagoon area to the south. Coastal lagoon areas and associated wetlands provide important aquatic habitat. Salmon use is documented in the stream draining to the Cove from Kristoferson Lake, suggesting that associated wetlands and coastal lagoons provide significant juvenile rearing habitat. Other mapped aquatic habitats include waterfowl concentrations, gray whale seasonal feeding habitat and Bald Eagle habitat.

Dense shoreline residential development fronts both coastal lagoons, located at the north end of the reach and in the vicinity of the Camano Country Club (Oblique Photos C and D). Shoreline residential lots are commonly bulkheaded; less modification occurs along bluff-backed beach areas and along the barrier beach fronting Triangle Cove.

### GEOMORPHIC KEY INFORMATION

#### Geomorphic Shoretype (Map 9)

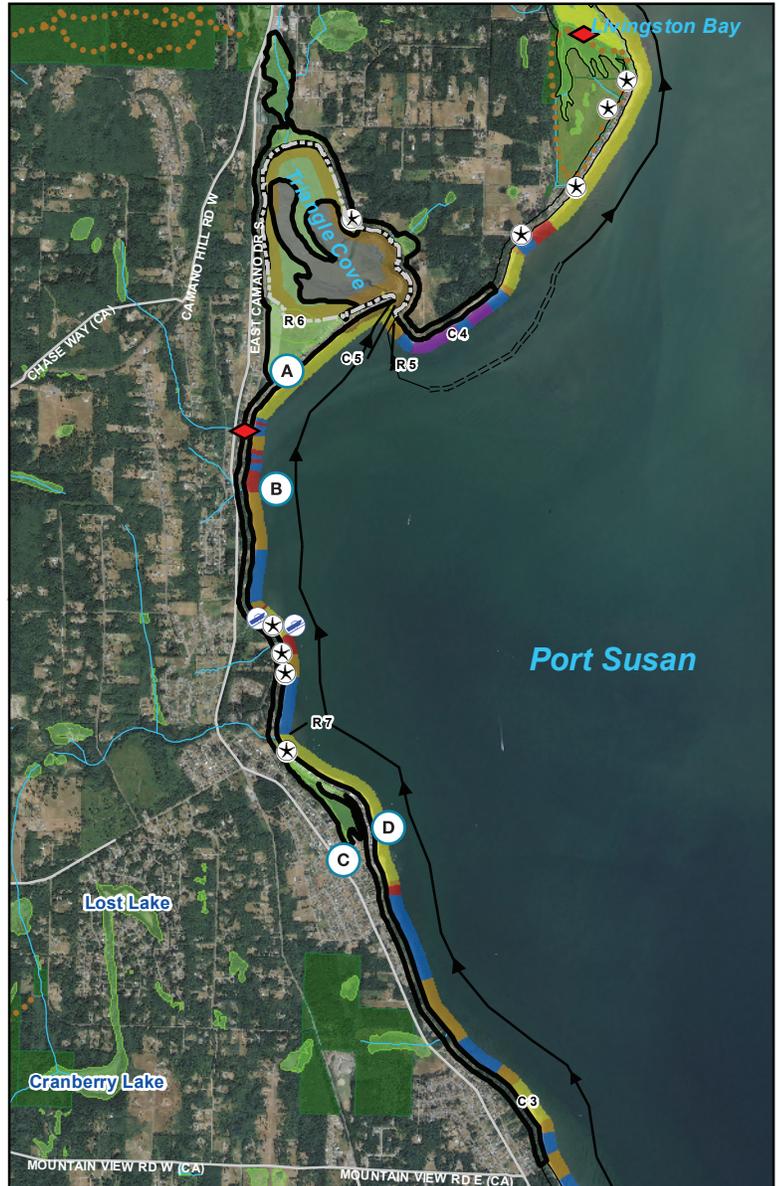
Intermittent Feeder Bluff (24%), Modified shoreline (4%), and Transport Zone (13%) focused to longer stretches of Accretion Shoreform (26%); area of No Appreciable Drift (33%) through Triangle Cove

#### Net Shore Drift (Map 8)

Two drift cells converge at Triangle Cove. Northwestward drift occurs along the eastern cell, which originates at Barnum Point. The much longer long drift cell southwest of Triangle Cove exhibits northward drift originating near Mountain View Beach.

#### Shoreform Current (Map 10)

Bluff Backed Beach (48%) and Barrier Beach (20%) along Port Susan shoreline; Barrier Estuary (32%) within Triangle Cove



#### Overall Rating of Degradation

Least (29%); Less (71%)

#### Coastal Floodplain:

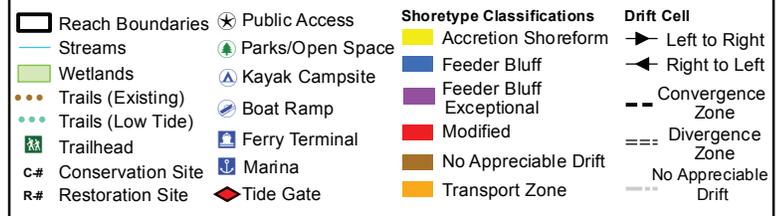
32%

#### Coastal Landslides & Toe Erosion:

Along shoreline immediately east of Triangle Cove.

#### Steep Slopes

13%



Shoreline Oblique Photos (2006)





# REACH CAM04

Mountain View Rd South to Tillicum Beach and Tye Beach

**SHORELINE LENGTH:**

4.89 Miles

**REACH AREA:**

122 Acres

**PSNERP PROCESS UNITS:**

6047

**REACH SUMMARY**

Mountain View Rd South to Tillicum Beach and Tye Beach (Reach CAM04) geomorphic processes are primarily influenced by a long, north-trending drift cell, feeding accretion areas (barrier beach) within the reach and to the north (extending into CAM03).

A coastal lagoon area is located along the reach shoreline behind a barrier beach shoreform (Oblique Photo B). The lagoon is modified by an access road, including a narrow pile-supported causeway, leading to a private community recreation area between the lagoon and the Port Susan shoreline. One stream (no salmon use) drains to the shoreline. Mapped aquatic areas provide significant forage fish, gray whale and Dungeness crab habitat.

Reach land use is characterized by a series of narrow barrier beaches that are densely developed with shoreline residential development. Low-bank development is less common through the north portion of CAM04, where steep slopes extend to the shoreline. Rural residential development occurs throughout the reach landward of steep slope areas; however, these slopes are generally far less dense than low-bank shoreline development. Public access is provided by a boat ramp at Tillicum Beach.

**GEOMORPHIC KEY INFORMATION**

**Geomorphic Shoretype (Map 9)**

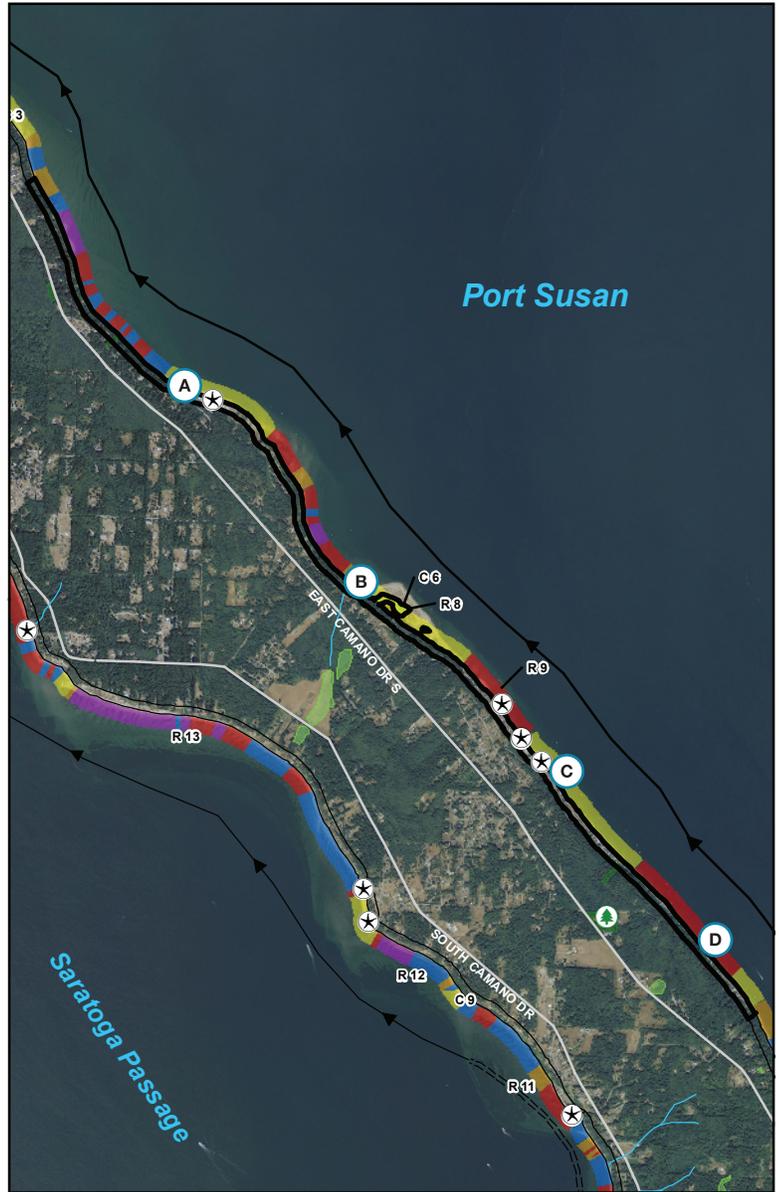
Modified shoreline (38%) and Accretion Shoreform (40%) fronting residential development; intermittent Feeder Bluff (15%) and Transport Zone (7%) focused in northern end of reach

**Net Shore Drift (Map 8)**

Northward net shore-drift occurs throughout this reach. The drift cell originates at Camano Head and terminates at Triangle Cove.

**Shoreform Current (Map 10)**

Bluff-backed Beach (70%) and Barrier Beach (30%)



**Overall Rating of Degradation**

Less (100%)

**Coastal Floodplain:**

26%

**Coastal Landslides & Toe Erosion:**

Landslides and toe erosion along the northern end of reach; some additional toe erosion south of Bretland.

**Steep Slopes**

46%

Reach Boundaries	Public Access	<b>Shoretype Classifications</b>	<b>Drift Cell</b>
Streams	Parks/Open Space	Accretion Shoreform	Left to Right
Wetlands	Kayak Campsite	Feeder Bluff	Right to Left
Trails (Existing)	Boat Ramp	Feeder Bluff Exceptional	Convergence Zone
Trails (Low Tide)	Ferry Terminal	Modified	Divergence Zone
Trailhead	Marina	No Appreciable Drift	No Appreciable Drift
C# Conservation Site	Tide Gate	Transport Zone	
R# Restoration Site			



Shoreline Oblique Photos (2006)





# REACH CAM05

## Tyee Beach South to Camano Head

### SHORELINE LENGTH:

2.83 Miles

### REACH AREA:

68 Acres

### PSNERP PROCESS UNITS:

6046 - 6047

### REACH SUMMARY

Tyee Beach South to Camano Head (Reach CAM05) is characterized by a largely unmodified shoreline area consisting of mixed forest riparian cover through steep slope areas. Geomorphic shoreline processes are primarily influenced by a long, north-trending drift cell, feeding accretion areas (barrier beach) to the north of CAM05 (within CAM04 and CAM03). Feeder bluff and transport zone shoretypes are mapped throughout the reach, providing sediment to accretion areas to the north. More than 90 percent of reach area is mapped with steep slopes, with similar extensive mapping of steep slopes extending back 400-600 feet from the shoreline.

One stream (no salmon use) drains to the shoreline. No inventoried wetlands or coastal lagoons are mapped. Aquatic areas provide mapped Pacific herring, pandalid shrimp, Dungeness crab and gray whale habitats.

Rural residential development (located along East Camano Drive South) is generally set back 500 or more feet from the shoreline. Public tidelands are located to the north of Camano Head, although the reach provides no physical access opportunities.

### GEOMORPHIC KEY INFORMATION

#### Geomorphic Shoretype (Map 9)

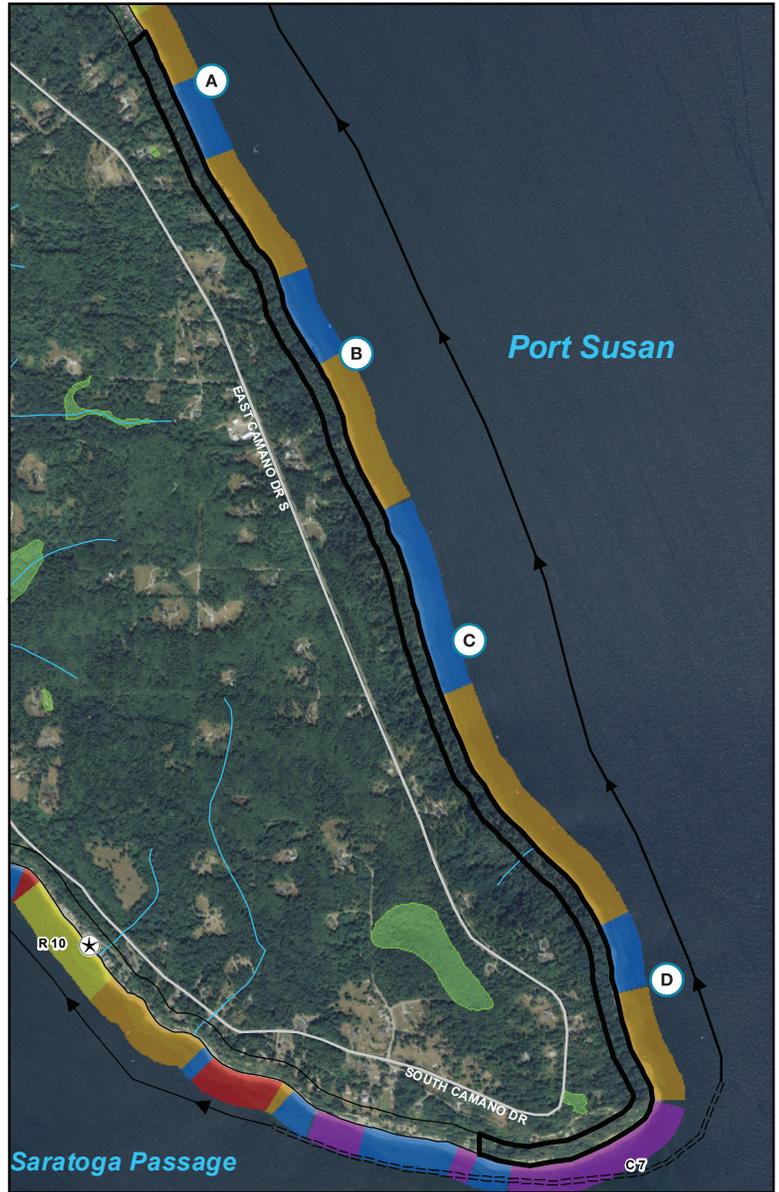
Intermittent Feeder Bluff (46%) and Transport Zone (54%)

#### Net Shore Drift (Map 8)

Northward net shore-drift occurs throughout this reach. The drift cell originates at Camano Head and terminates at Triangle Cove.

#### Shoreform Current (Map 10)

Bluff-backed Beach (100%)



#### Overall Rating of Degradation

Less (100%)

#### Coastal Floodplain:

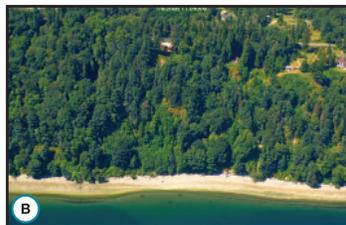
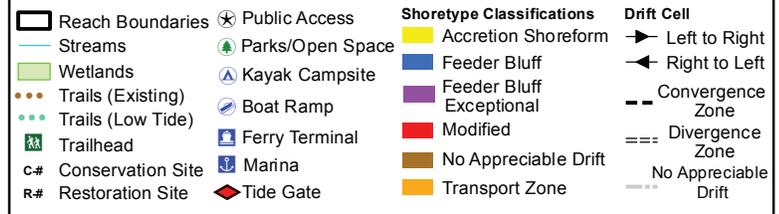
8%

#### Coastal Landslides & Toe Erosion:

Landslides and toe erosion primarily along the central and southern portions of reach shoreline; many landslides at the southern tip of Camano Island.

#### Steep Slopes

93%



Shoreline Oblique Photos (2006)

**HABITATS & SPECIES**

**Significant & Unique Features (Maps 5-7)**

Dungeness crab through aquatic extent; offshore pandalid shrimp habitat; intermittently mapped patchy eelgrass; patchy kelp at Camano Head.

**Shoreland Priority Habitats & Species (Map 5)**

Bald Eagle (habitat buffers); Cliffs-Bluffs; Wetlands

**Marine Priority Habitats & Species (Map 5)**

Gray Whale habitat (majority of reach)

**Salmonid Fish Use (Map 5)**

Nearshore areas are designated ESA critical habitat for Chinook (Puget Sound ESU) and bull trout.

**Coastal Lagoons** None mapped      **Coastal Stream Mouths** 1      **Wetlands (Map 4)** None mapped

**Forage Fish**

**Sandlance** None mapped      **Smelt** 89%

**Herring** Spawning habitat along shoreline; offshore holding area;

**LAND & SHORELINE USE**

**Shoreline Modifications (Map 13)**

Unmodified shoreline.

**Public Access (Map 16)**

Public tidelands north of Camano Head; no public physical access (improved or unimproved).

**Armoring (% of shoreline) (Map 13)** < 1%

**Overwater Structures (Map 14)**

None mapped

**Zoning (Map 11)**

Rural (100%)

**Current Land Use (Map 12)**

**Number of Parcels** 65      **Average Parcel Size** 3.64 Acres

Rural and vacant lands; very little development within shoreline area due to significant steep slopes/bluffs.

**Shellfish & Aquaculture (Map 15)**

Approved shellfish growing area; no mapped or classified shellfish beaches.

**KEY MANAGEMENT ISSUES**

- Slope / bluff stability impacts of potential future intensified land uses (clearing / subdivision) at the top of slopes (considering land uses and modifications such as clearing, creation of impervious surfaces, modified surface / groundwater dynamics).
- Management of shoreline steep slope areas extending outside of shoreline jurisdiction.
- Potential increases in coastal flooding and rates of bluff erosion due to sea level rise (SLR) or other factors that may affect shoreline residential development.
- Slope stability and shoreline view / aesthetic implications of additional private shoreline access points on high bank shorelines (accessory to residential development).
- Potential implications of SLR barrier beaches (loss of habitat).
- Water quality issues associated with additional development (subdivision / intensified use) — including implications of septic systems and road runoff.
- Drinking water supply (aquifer) issues associated with additional development (subdivision / intensified use) — saltwater intrusion and potential exacerbation from SLR. Reach area mapped as ‘Very-High Risk’ for saltwater intrusion (Island County Risk Rating Map).

**RESTORATION OPPORTUNITIES**

Restoration sites were identified in 2004 by Coastal Geologic Services (Appendix H).

Potential restoration sites were not identified along the reach shoreline; there is minimal existing shoreline development and limited shoreline alteration. Conservation opportunity was identified along the entire reach (CGS Conservation Potential — Camano #7 in Appendix H).

**CONSERVATION OPPORTUNITIES**

**C7:** Conserve Exceptional Feeder Bluff & prohibit bulkheads (1800 ft alongshore).