

4.0 REACH INVENTORY AND ANALYSES

This chapter builds on the watershed overviews provided in Chapter 3 and describes conditions directly adjacent to individual shoreline segments (or reaches). According to the state shoreline guidelines (WAC 173-26-201(3)(c)), local governments are required to inventory and report available information at the shoreline reach scale as follows:

- Shoreline and adjacent land use patterns and transportation and utility facilities, including the extent of existing structures, impervious surfaces, vegetation, and shoreline modifications within shoreline jurisdiction;
- Critical areas, including wetlands, aquifer recharge areas, fish and wildlife habitat conservation areas, geologically hazardous areas, and frequently flooded areas;
- Degraded areas and sites with potential for ecological restoration¹;
- Areas of special interest, such as priority habitats, developing or redeveloping harbors and waterfronts, previously identified toxic or hazardous material clean-up sites, dredged material disposal sites, or eroding shorelines;
- Conditions and regulations in shoreland and adjacent areas that affect shorelines, such as surface water management and land use regulations;
- Existing and potential shoreline public access sites, including public rights-of-way and utility corridors;
- General location of channel migration zones (CMZs) and floodplains; and
- Known cultural, historical, and archeological resources.

This section describes pertinent information for planning area reaches for each shoreline water body under SMA jurisdiction, to the extent that such information is readily available. Shoreline areas are grouped according to WRIAs and to general geographic areas (i.e., Southern Toandos Peninsula). Subwatershed names are listed parenthetically as shown on maps 1a and 1b. Each nearshore reach is assigned a unique alpha designation, and each freshwater reach has a numeric designation for purposes of this study. Nearshore reaches are also identified according to the corresponding alpha-numeric drift cell identifier as reported by various sources and documented in the Washington Coastal Atlas and shown on maps in Appendix B (maps from the County's 2005 Shoreline Inventory).

Maps depicting inventory information are provided in the map folio that accompanies this report (Appendix C). Maps 8 through 28 depict shoreline reach attributes as indicated in Table 4-1. Data sources for the inventory attributes reported in this Chapter are indicated in Table 2-3 or otherwise cited in the text.

¹ Potential restoration areas and opportunities are also described in the Draft Restoration Plan, which is being prepared under a separate cover.

Table 4-1. Map Locations for Reach-scale Attributes

Theme	Map Name/ No.
Shoreline Reaches Shoreline Planning Area Watersheds Wetlands Floodplains CMZs	Maps 8, 9, and 10 Aquatic Resources and Shoreline Reaches
Shoreline Modifications (nearshore) Shore Form Type Feeder Bluffs (not mapped)	Maps 11, 12, and 13. Coastal Processes and Modifications
Drift Cells Landslide Hazard Landslide Hazard Zonation Erosion Hazard	Maps 14, 15, and 16. Critical Areas
Priority Fish Presence Priority Habitat Areas Marine Resource Species (geoduck, urchin, oyster, crab, clam, razor clam, surf smelt, sand lance, herring)	Maps 17, 18, and 19. Critical Shoreline Habitat
Eelgrass Kelp	Map 20. Aquatic Vegetation
Land Use / Land Ownership Shoreline Features Zoning Publicly Owned Tidelands	Maps 21, 22, and 23. Land and Shoreline Use Patterns
Commercial Shellfish Growing Areas Biotoxin Closure Zones Recreational Harvest Beaches	Map 24. Shellfish Harvesting
Forest Cover Impervious Surface	Map 25. Forest Cover and Impervious Surface
Marine Shoreline Geomorphic Landforms Lagoons, Salt Marshes, and Intertidal Wetlands Shoreline Slope Stability Landslide Hazard Erosion Hazard	Maps 26 and 27. Geomorphic Classes

1 As discussed in Chapter 1, shorelines of the state were originally codified by Ecology in the
2 early 1970s in WAC 173-18 and 173-20. This list had not been updated until recently, when
3 Ecology revised the list of shoreline streams using data from several regional flow studies
4 conducted by the U.S. Geological Survey (USGS 1998)². The results of the USGS study showed
5 that numerous streams that are not currently designated as shorelines of the state may actually
6 meet the 20 cfs mean annual flow criterion and should be regulated as state shorelines. In other

² The revised list has not been codified, but Ecology is currently in the process of revising state jurisdiction regulations to allow for incorporation of new data during the local SMP amendment process.

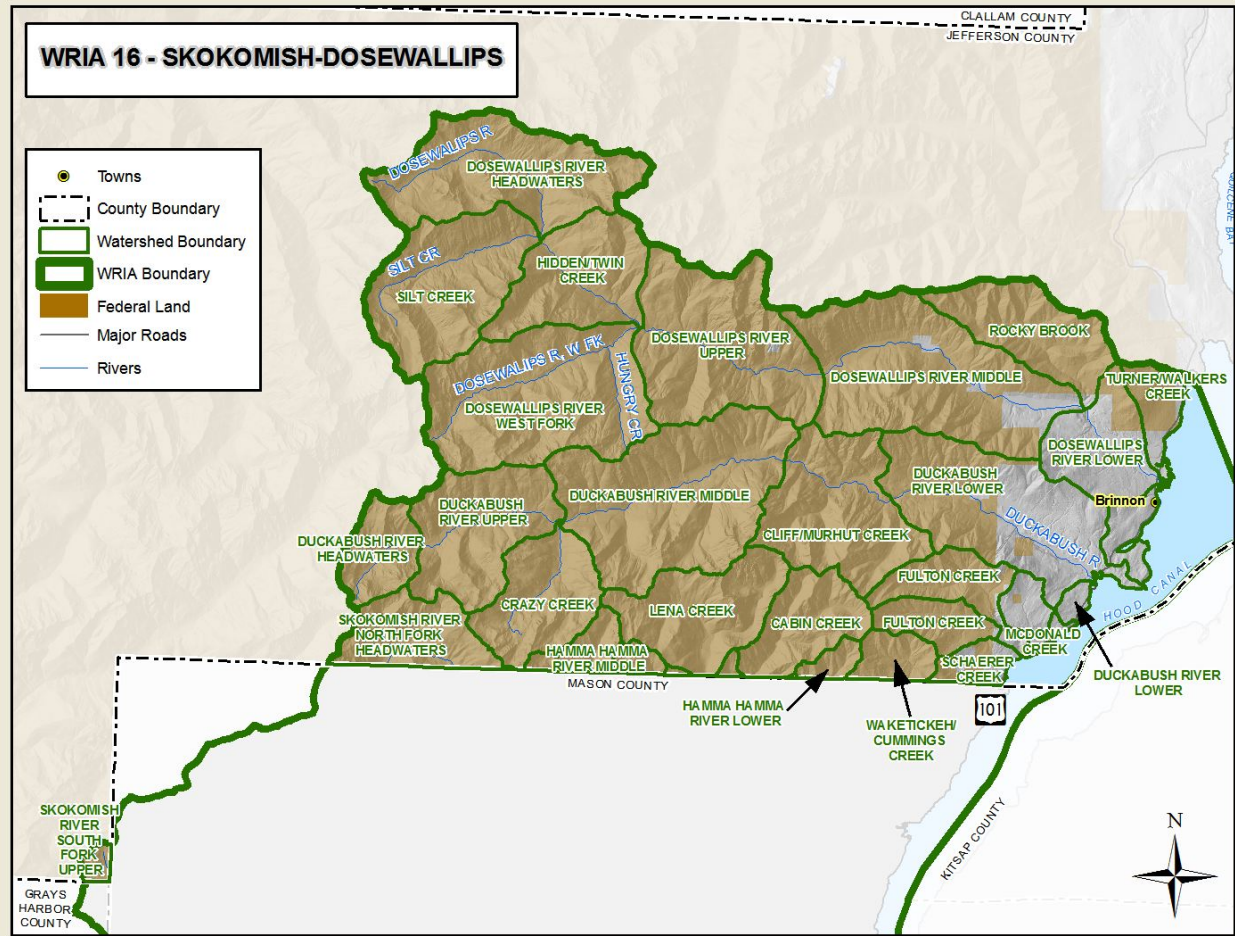
cases, the USGS study relocated the upstream boundary of the 20 cfs point further upstream or downstream from its WAC-designated location. In many cases the new stream flow data show the 20 cfs points in headwaters areas on federal lands, which may or may not be subject to County SMP jurisdiction. The revised list of streams in Jefferson County meeting the 20 cfs mean annual flow criterion is provided in Table 1-1. Mapping of rivers and streams depicted on Maps 1A and 1B in Appendix C have been updated to account for the USGS 1998 study, with most revisions to the codified list of WAC 173-18 and 173-20 occurring on streams located in the western portion of Jefferson County. For comparative purposes, Map 1C depicts shorelines of the state as designated by WAC 173-18 and 173-20 with the updated mapping of shorelines of the state using the USGS 1998 information. All maps in Appendix C depicting the shoreline planning area associated with shorelines of the state include mapping updated per the 20 cfs information (USGS 1998).

Within Chapter 4, the additional streams and lakes are not discussed within the text. Alternatively, Appendix D provides general inventory information for newly added streams and lakes known to be under County jurisdiction. Refer to WRIA information within Appendix D to determine the appropriate section of the following discussion that applies most directly to any feature.

4.1 WRIA 16 - SKOKOMISH-DOSEWALLIPS

The Skokomish-Dosewallips basin encompasses an area of about 660 square miles in northwestern Mason County and southeastern Jefferson County (Figure 4-1). The physiography ranges from the peaks of the Olympic Mountains in the western portion of the basin, to the flatlands of the Skokomish River valley. Principal drainages in the basin are the Dosewallips, Duckabush, Hamma Hamma, and Skokomish Rivers, with many smaller streams along Hood Canal. There are 557 identified streams providing over 825 linear miles of rivers, tributaries, and independent streams in the basin. Main streams and rivers within Jefferson County include Fulton Creek, McDonald Creek, Duckabush and Dosewallips Rivers, and Turner Creek.

Figure 4-1. WRIA 16 in Southeast Jefferson County



In WRIA 16, high-elevation snowfields in the Olympic Mountains direct runoff of precipitation, and groundwater baseflows maintain stream flows. Natural storage of water occurs in snowpack, lakes, wetlands, and groundwater, which collectively function to moderate extreme high- and low-flow stream conditions. Sixty percent of the land area in WRIA 16 is located within the ONP and ONF. The remaining 40 percent is state and privately owned. Commercial forestry is one of the primary land uses in the basin. Hydroelectric dams have significantly changed the streamflow regime of the North Fork of the Skokomish River. Development in the basin is concentrated along the coast. Agricultural activity is concentrated in the lower Skokomish River valley. Shellfish in Hood Canal are important to both tribal interests and the private sector (Golder Associates, 2002).

4.1.1 Fulton Creek Nearshore (Hood Canal West Shore Lower)

4.1.1.1 Overview (Map 1a)

Fulton Creek flows out of the foothills of the Olympic Mountains into Hood Canal north of Triton Cove. Most of the upper watershed is within the ONF. This nearshore segment extends from the Mason/Jefferson County line, just north of Triton Cove, to the north side of McDaniel Cove. The estuary of Fulton Creek provides significant habitat for salmonids and other wildlife, and there is a small estuary where McDonald Creek enters McDaniel Cove. Notable human

impacts to the shoreline in this segment are vacation homes with associated shoreline armoring and docks, and Highway 101.

4.1.1.2 Nearshore Reaches (Map 8)

Reach A: County line north to the terminus of drift cell JE-30.

Reach B: Drift cell JE-29/JE-30.

Reach C: Drift cell JE-29.

4.1.1.3 Physical Environment (Maps 11, 14 and 26)

North of the Mason County line, Reach A is an area of no appreciable drift. This reach is composed of about 400 meters of basalt from the Crescent Formation dating from the Middle Eocene (Ecology, 1978). To the north begins drift cell JE-30, with net shore-drift to the northeast for 1.7 kilometer (km). This drift cell contains two areas of significant fluvial input, Fulton Creek and a smaller, unnamed drainage approximately 0.5 mile south of Fulton Creek. The drift cell terminates 550 yards to the northeast of where Fulton Creek passes under Highway 101 (Johannessen, 1992). Uplands within this drift cell are composed largely of Vashon lodgement till and an area of Vashon Reccessional Outwash around Fulton Creek. The bluffs in this drift cell are considered unstable south of Fulton Creek, and there is at least one area of recent landsliding (Ecology, 1978).

The Reach B shoreline is composed of basalt for 0.5 mile to the northeast, and there is no appreciable net shore-drift (Johannessen, 1992).

Reach C, or drift cell JE-29, originates 0.5 mile northeast of the mouth of Fulton Creek. Net shore-drift continues for 640 yards to the McDaniel Creek delta. Indications of northeasterly drift include sediment accumulations along the southwestern side of numerous rock outcroppings, which partially interrupt the flow of sediment in this cell, and a decrease in sediment size over the length of the cell (Johannessen, 1992). The uplands along this drift cell are composed of basalt with some overlying glacial till deposits (Ecology, 1978).

Much of the shoreline in this area is mapped as landslide hazard area with unstable slopes.

4.1.1.4 Biological Resources (Maps 17, 20, 24 and 26)

Eelgrass is patchy throughout Reach A, and there is little or no overhanging riparian vegetation. Eelgrass is continuous for 360 yards to the south of the unnamed drainage 0.5 mile south of Fulton Creek. Riparian vegetation is largely absent from the southern portion of Reach A. Twenty percent of the upland planning area of Reach A is wetland, with estuarine – intertidal (mix of aquatic bed/unconsolidated shore and unconsolidated shore) as the primary wetland classifications.

Eelgrass beds and *Sargassum* are patchy throughout Reach B. Riparian vegetation increases to the north, covering approximately 40 percent of the northern part of Reach B. Within the upland planning area of Reach B, 4 percent of the land area is unconsolidated shore wetland.

1 The Fulton Creek delta has numerous salt marsh habitats and tidal streams. Coho, fall chum,
2 cutthroat trout, steelhead, and pink salmon spawn in Fulton Creek. In addition, the estuary was
3 found to be important habitat for juvenile coho, chum, and Chinook salmon. May and Peterson
4 (2003) classified the Fulton Creek estuary as an NSE Category B refugia. Some of this fish use is
5 clearly non-natal and indicates the importance of this estuary as part of the regional salmonid
6 migratory corridor (Hirschi et al., 2003a).

7 The estuary is an approved shellfish harvest area and the shoreline north of Fulton Creek has
8 patchy oyster and mussel beds and abundant although patchy *Sargassum*, although there is a
9 shellfish harvest advisory in effect in Reaches A and B. There is patchy eelgrass along Reach C
10 south of McDaniel Cove and little riparian vegetation. *Sargassum* is continuous throughout this
11 reach. Within the cove there are oysters. Coho, cutthroat, and fall chum spawn in McDonald
12 Creek. Within the planning area of Reach C, 7.5 percent of the land area is wetland, with
13 estuarine – intertidal (mix of aquatic bed/unconsolidated shore and unconsolidated shore) the
14 primary wetland classifications.

15 **4.1.1.5 Land Use and Altered Conditions (Maps 11 and 21)**

16 **Land Use and Zoning**

17 The primary land use in the shoreline planning area is rural residential. Within Reaches A and
18 B, 100 percent is zoned Rural Residential, while in Reach C, 75 percent is zoned Rural
19 Residential and the remaining 25 percent is zoned Local Agriculture.

20 **Transportation and Utilities**

21 Within Reaches A, B, and C, Jefferson County and WDNR have mapped 3.1 miles and 2.7 miles
22 of road, respectively. Roadways include Highway 101, with two lanes and shoulder areas, and
23 several intersecting property access roads.

24 **Shoreline Modifications**

25 There is a boat ramp at Triton Cove State Park and numerous private staircases in this area.
26 There is extensive bulkheading and fill where the unnamed drainage south of Fulton Creek enters
27 Hood Canal. This has restricted the access of the stream to the historical delta by pushing the
28 stream channel to the southern edge of the bulkhead.

29 Just south of the Fulton Creek delta, a cabin is built onto fill fronted by a bulkhead. The northern
30 part of Fulton Creek delta is filled, atop which sits a parking lot for a private club. There is fill on
31 the southern part of the McDaniel Cove estuary and a large berm that juts out from the southern
32 shore. Fill in the intertidal zone eliminates shallow water habitat for migrating juvenile salmon.
33 Highway 101 has restricted channel migration where it crosses Fulton Creek and McDonald
34 Creek, again impacting estuary habitat. A rock jetty that appears to serve no purpose extends
35 northward near the mouth of McDaniel Cove in the McDonald Creek estuary.

4.1.1.6 Public Access (Map 21)

At the small delta created by the unnamed tributary south of Fulton Creek there is a public access shellfishing site. There is public access to the shoreline at Triton Cove State Park as well as a boat ramp. The WDFW tideland south of Fulton Creek has public access at a turnout off of Highway 101. The north side of McDaniel Cove is public tideland with boat access only.

4.1.1.7 Restoration Opportunities

Removing fill in the Fulton Creek delta, the delta of the unnamed stream south of Fulton Creek, and from McDaniel Cove would increase shallow water estuarine habitat for migrating juvenile salmonids. The fill around the mouth of the unnamed stream south of Fulton Creek is owned by WDFW and used as a parking area for a shellfishing site. Therefore, it is a good candidate for restoration, as the state already owns the property. Removing or modifying the filled parking area could create a more functional estuary for the small stream and improve alongshore drift processes. Removing the jetty at McDonald Creek could also help restore natural processes.

4.1.2 Fulton Creek

4.1.2.1 Overview (Map 1a)

Fulton Creek flows into Hood Canal north of Triton Cove. Steep concave headwaters drain bedrock slopes, followed by a reduced gradient channel flowing through a series of glacially deposited benches. A steep confined section follows downstream, with steep cascade reaches emptying into a short alluvial fan (Correa, 2003a). This watershed is a designated shoreline of the state below the point where the South Fork of Fulton Creek meets the mainstem at river mile (RM) 1.05 (WAC 173-18-200). Of a total of 5,353 acres of watershed, 4,845 acres are within the ONF.

4.1.2.2 Freshwater Reaches (Map 8)

Fulton Creek 1: From the stream mouth to the falls.

Fulton Creek 2: From the falls to the confluence of Fulton Creek and South Fork Fulton Creek.

4.1.2.3 Physical Environment (Maps 14, 21, and 25)

Land cover in the planning area is 49 percent evergreen forest and 47 percent mixed forest in Reach 1, and 100 percent evergreen forest in Reach 2. The area surrounding Fulton Creek is considered to be a landslide hazard area and unstable slopes occur along Reach 1. The Fulton Creek shoreline is also within a critical aquifer recharge area. There are no mapped or designated CMZs on Fulton Creek.

Upland vegetation near the Highway 101 crossing, including exotic vegetation, is now displacing former salt marsh upstream of the highway crossing. The former remnant salt marsh upstream of the highway appears to have been dredged, possibly due to fill in the intertidal area on the opposite side of the highway. A minimal amount of low-elevation salt marsh now appears seaward of the highway crossing (Todd et al., 2006).

Riparian habitat is in good condition, with 72 percent of this watershed being hydrologically mature (i.e., greater than 70 percent crown coverage and less than 75 percent of crown coverage in hardwoods or shrubs) (Correa, 2003a). Nonetheless, LWD is largely absent from the section of the stream below the falls (Correa, 2003a). Sediment data for this watershed are lacking, although sediment supply is likely within historical levels (Correa, 2003a).

Low summer flows within the stream limit salmonid rearing. In addition, Fulton Creek is listed as a Category 5 water for temperature according to Ecology's 2004 Water Quality Assessment.

4.1.2.4 Biological Resources (Map 17)

Fulton Creek supports coho, fall chum, and pink salmon spawning, as well as cutthroat and steelhead trout. There are no known artificial barriers to anadromous fish in this section of the stream; however, there is a barrier at the natural falls at RM 0.9 (Correa, 2003a). The available habitat below the anadromous barrier has supported up to 100 coho and 1,000 fall chum as recently as 1996, but these numbers of spawners have not been seen since. Escapement goals have not been set for this watershed (Correa, 2003a). There are very few pieces of LWD in the lower reach to the falls (Todd, 2003 as cited in Correa, 2003a). May and Peterson (2003) listed Fulton Creek as a Class A Nodal Riparian Corridor in their study of salmonid refugia in Jefferson County. A Nodal Riparian Corridor is one in which natural ecological integrity has been retained and the historical population and diversity of salmonids remain largely intact. Therefore, this stream continues to have some of the best remaining habitat for salmon in east Jefferson County (May and Peterson, 2003). There are 1.4 acres of wetlands located near the mouth of Fulton Creek, all classified as palustrine scrub/shrub (Correa, 2003a).

4.1.2.5 Land Use and Altered Conditions (Maps 21 and 25)

Land Use and Zoning

The planning area is zoned 57 percent Commercial Forest and 43 percent Rural Residential in Reach 1, and 100 percent Commercial Forest in Reach 2.

Transportation and Utilities

WDNR has mapped 0.2 mile of road within the Reach 1 planning area.

Shoreline Modifications

There are four areas of bank armoring and/or diking in the lower watershed, including bank armoring and dredging just upstream of the Highway 101 crossing (Todd et al., 2006). This results in a loss of floodplain habitat. However, the dredged area now serves as a lagoon habitat supporting chum salmon spawning (Ron Hirschi, personal communication, as cited in Todd et al., 2006). Fill associated with and immediately downstream of Highway 101 eliminates some estuary habitat (Correa, 2003a; Ecology, 2001).

4.1.2.6 Public Access (Map 21)

None identified.

4.1.2.7 Restoration Opportunities

Restoration opportunities identified for Fulton Creek within the Habitat Limiting Factors Analysis include restoring estuary function, removing the old levee near RM 0.4, replacing culverts in the upper watershed, and protecting and restoring riparian function in the lower reach to the falls (Correa, 2003a).

4.1.3 Duckabush River and Black Point Nearshore (Duckabush River)

4.1.3.1 Overview (Map 1a)

From the northern edge of McDaniel Cove to the northern edge of Pleasant Harbor is a marine shoreline that encompasses the major estuary of the Duckabush River and Black Point. The area south of the Duckabush River is primarily a basaltic shoreline with a few pocket beaches. Residential development is concentrated just south of the Duckabush delta and on the north and east sides of Black Point and around Pleasant Harbor. There is a marina in the naturally protected anchorage of Pleasant Harbor. Significant habitats in this area include the sparsely developed marine shoreline north of McDaniel Cove, the Duckabush River and delta, the south side of Black Point, and Quatsap Point spit. The Duckabush River Bridge is on the National Register of Historic Places.

4.1.3.2 Nearshore Reaches (Map 8)

Reach D: North shore of McDaniel Cove (terminus of drift cell JE-29) to start of drift cell JE-28.

Reach E: Duckabush delta to the edge of Quatsap Point (drift cell JE-28).

Reach F: From the origin of drift cell JE-27 to the tip of Quatsap Point spit.

Reach G: Area of no net drift around Black Point.

Reach H: From north to south entrances of Pleasant Harbor.

4.1.3.3 Physical Environment (Maps 11, 14 and 26)

The Duckabush River estuary formed following the most recent glaciation, when large volumes of sediment were carried downstream through a glacially carved valley to form the delta fan at Hood Canal. Historically there were at least two distributary channels within the delta fan. The northernmost branch is now a blind channel that has been disconnected from the current main channel, probably since the Highway 101 causeway was built in the 1930s (Todd et al., 2006). No appreciable net shore-drift occurs within Reach D. In this reach the shore consists of basalt and isolated pocket beaches (Johannessen, 1992).

Within Reach E, the next drift cell, JE-28, begins at the central portion of the Duckabush River delta and continues to the cusped spit at the tip of Quatsap Point. On this high bluff shore, the abundant sediment sources for the drift cell are alongshore, from the feeder bluff on the south side of Quatsap Point, and fluvial sources from the Duckabush River (Johannessen, 1992). The feeder bluff, which is composed of Vashon till overlying older undifferentiated stratified glacial

1 sediment, is an area of numerous landslides (Ecology, 1978, 2001). The intertidal zone in the
2 delta is about 750 feet wide and narrows around the south side of Quatsap Point to a 30-foot-
3 wide beach (WDNR, 2001).

4 Reach F extends across the first drift cell to the north of Quatsap Point, JE-27, which originates
5 at the northeast portion of Black Point and has a southward net shore-drift for a mile along a
6 sinuous shore to Quatsap Point. This area is exposed to northerly and northeasterly fetch that
7 controls net shore-drift. Evidence of this includes a southward sediment size decrease,
8 southeastward stream mouth offset, and southeastward progradation of Quatsap Point spit. The
9 cell terminus is located at Quatsap Point (Johannessen, 1992). Bluffs on the northern half of this
10 drift cell are composed of Vashon lodgement till and are stable, whereas the bluffs composed of
11 Vashon advance outwash in the southern half of the drift cell (except for the spit) are unstable
12 and feed abundant sand and gravel to the intertidal zone. A small drainage that flows through a
13 tidal lagoon in the middle part of Reach F also contributes fluvial sediment to the intertidal zone
14 (Ecology, 1978). This lagoon is an unusual tidal feature that is essentially a kettle lake with an
15 intertidal inlet (Labbe, personal communication, 2004). Kettle lakes are formed when glacial
16 recessional outwash buries or partially buries large blocks of ice. When the ice melts, if the
17 depression is not filled with sediment, it can become a pond or lake. Several other kettle type
18 depressions occur inland on Black Point.

19 The reach south of Black Point (Reach G) consists of several basalt outcroppings separated by
20 pocket beaches. There is no net drift in this area.

21 Pleasant Harbor (Reach H) is a natural harbor bounded on the northwest by Vashon lodgement
22 till, which is intermediately stable, and on the south by Vashon advance outwash that is
23 classified as unstable. To the east the shore is composed of Vashon lodgement till and basalt.
24 There is an accretionary beach at the head of the harbor and beach deposits on both sides of the
25 mouth of the harbor.

26 Wetlands compose 23 percent and 49 percent of the planning area in Reaches D and E,
27 respectively. Fourteen percent or less of the area within all other reaches is composed of
28 wetland. A majority of the wetlands are estuarine – intertidal, with a mix of aquatic
29 bed/unconsolidated shore, emergent, and unconsolidated shore composing the remaining
30 wetlands.

31 Landslide hazards and/or unstable slopes occur along Reaches D, E, F and H.

32 **4.1.3.4 Biological Resources (Maps 17, 20, 24, and 26)**

33 Between the northern edge of McDaniel Cove and the Duckabush delta, there are several areas of
34 patchy and continuous eelgrass beds, as well as patchy areas of kelp and *Sargassum*. This
35 basaltic shoreline supports little riparian vegetation. Riparian vegetation increases to 20 percent
36 just south of the Duckabush delta, but appears to have been adversely affected by residential
37 clearing (WDNR, 2001).

38 The Duckabush delta, the south side of Black Point, and Quatsap Point provide abundant quality
39 habitats. This estuary and delta are used by trumpeter swans and bald eagles, and support
40 regionally significant winter waterfowl use. Harbor seals haul out here throughout the year and

pupping occurs in the winter. The extensive mud and gravel flats contain rich shellfish beds with millions of harvestable oysters and clams (Speck, personnel communication, 2003). Salt marsh habitat dominates the higher areas of the Duckabush delta. In the lower intertidal and subtidal zones, eelgrass beds are continuous from the delta to Quatsap Point. Herring use this eelgrass for spawning (Penttila, 2000). There is abundant riparian vegetation just to the northeast of the delta. The Duckabush River estuary has been placed on the Washington State Department of Health 2006 list of Shellfish Areas of Concern due to elevated bacteria levels at two stations (WDH, 2006a). At the Reach F terminus at Quatsap Point an exemplary cusped spit forms, enclosing a high salt marsh.

Eelgrass beds are patchy throughout Reach F (drift cell JE-27) and herring spawn along the entire shore (Penttila, 2000). Dune grasses are found at the terminus of the cell. The swimming lagoon has a unique biology and intertidal community (Hirschi, personal communication, 2003). The inlet to the lagoon is fringed with salt marsh. The beach north of the outlet is used by sand lance for spawning. Overhanging riparian vegetation is present over about half of this drift cell (WDNR, 2001). Surf smelt spawn on the beaches on the north and south sides of Quatsap Point.

Within Reach G, the central pocket beach south of Black Point is a documented sand lance spawning site (Penttila, 2000). Pacific herring spawn just offshore throughout this area and into Pleasant Harbor (Reach H) (Bargmann, 1998).

Within Reach H, patchy eelgrass is found throughout Pleasant Harbor, and a narrow eelgrass bed lines the northern side of the harbor (Correa, 2003a). Salt marsh habitat is found on the north side of the mouth and at the head of the harbor (WDNR, 2001; Ecology, 1982). Pleasant Harbor is not listed on Ecology's 2004 303(d) list; however, the Washington State Department of Health has prohibited commercial and recreational shellfish harvest in this area (WDH, 2006a, 2006b).

The nearshore area is listed as a Category 2 water of concern for fecal coliform according to the 2004 Ecology Water Quality Assessment. Potential sources of fecal coliform are septic systems or coliform associated with sediment runoff (Golder Associates, 2002).

4.1.3.5 Land Use and Altered Conditions (Maps 11 and 21)

Land Use and Zoning

A majority of the planning area is zoned Rural Residential, with a small percentage represented by Local Agriculture and Water.

Transportation and Utilities

Roadways include Highway 101 (including two lanes and shoulder areas) along the Duckabush estuary shoreline and the north shoreline of Pleasant Harbor, and several intersecting property access roads within Reaches E, F, and G.

Shoreline Modifications

South of the Duckabush River there are several rail boat launches. Built on fill, Highway 101 cuts across the extensive estuary of the Duckabush River, restricting access to side channels and limiting channel migration. Several side roads in this vicinity also constrict channels in the estuary. On the northern edge of the estuary there is cement bulkheading and possible fill of salt marsh habitat. Some of the homes behind the bulkhead may be built on fill placed over salt marsh.

Just north of Quatsap Point, bulkheads front a small housing development at Lackawanda Beach. The bulkhead and adjacent dock may have some effect on the longshore transport of sediment within drift cell JE-27 to Quatsap Point. Some of these bulkheads front fill and do not appear to be protecting structures. Farther north, closer to the origin of this drift cell, numerous staircases lead onto the beach. Approximately 13.8 percent of this drift cell is bulkheaded, primarily in the sediment transport zone (Hirschi et al., 2003b).

Historically a small salt marsh was located just north of the tidal inlet from the kettle lake, but it has been filled by residential development (Todd et al., 2006). Within Pleasant Harbor there are numerous private docks on the south side of the harbor along with two marinas: one smaller marina just inside the spit, and a larger marina along the north shore. A launch ramp and parking area also occur at the head of the bay. Shoreline modifications to this drift cell include about 21 percent bulkheading and a number of docks and stairways along the shoreline (Hirschi et al., 2003b as cited in Todd et al., 2006). In general, shade created by docks can have adverse effects on eelgrass.

A large infestation of invasive tunicates (invertebrates commonly known as “sea squirts”) has been documented within Pleasant Harbor (Lambert, 2005). The club tunicate (*Styela clava*), native to Korea and Japan, can breed rapidly and form highly dense populations that overtake and crowd out other forms of marine life.

4.1.3.6 Public Access (Map 21)

The Duckabush delta is owned by WDFW and is accessible from Highway 101. Part of the shoreline on southern Black Point is owned by WDNR and is accessible by boat. There is a state park with a boat ramp in Pleasant Harbor.

4.1.3.7 Restoration Opportunities

Modifying the Highway 101 crossing of the Duckabush delta would allow for more tidal exchange and channel migration, and would increase salt marsh estuarine habitat. Bulkheads at Lackawanda Beach that are not protecting structures could be removed to increase upper intertidal habitat.

Eradication of invasive tunicates in Pleasant Harbor could protect the diversity of native invertebrates in this area. A November 5, 2005 effort to remove all *Styela clava* from floating docks and moored boats from Pleasant Harbor Marina was not completely successful (Lambert, 2005). Divers contracted through WDFW during summer 2006 removed more than 90 pounds of tunicates from 150 recreational boats at Blaine, Semiahmoo, Pleasant Harbor, and Home Port

1 marinas. They also surveyed about 30,000 square meters of docks in the infested marinas,
2 cleaned about 25 percent of the area, and removed about 2,000 pounds of invasive tunicates
3 (PSAT, 2006). Future restoration opportunities may include additional invasive tunicate surveys
4 and removal efforts.

5 **4.1.4 Duckabush River (Duckabush River)**

6 **4.1.4.1 Overview (Map 1a)**

7 The Duckabush River is one of the largest rivers flowing into Hood Canal. Its watershed covers
8 approximately 75 square miles of the eastern Olympic Mountains. The Duckabush mainstem is
9 24.5 miles long, with 50 tributaries contributing an additional 94.3 stream miles. Average annual
10 discharge is 411 cfs at RM 4.9 (Correa, 2003a). Summer stream low flows are supported
11 primarily by snowpack melt. Groundwater-supported baseflow is minimal as a result of the
12 dominance of bedrock geology (Golder Associates, 2002).

13 The upper portion of the watershed is protected in the ONP and as USFS wilderness. Shoreline
14 designation currently stops at the edge of the ONF at RM 2.3; however the County's jurisdiction
15 extends to private inholdings within the National Forest. The furthest upstream extent of these
16 inholdings is just downstream from the gauging station at RM 4.9. In this lower section, the
17 Duckabush River valley is characterized by steep walls and a relatively wide floodplain.

18 **4.1.4.2 Freshwater Reaches (Map 8)**

19 Duckabush River 1: From the mouth to the National Forest boundary.

20 Duckabush River 2: From the National Forest boundary to the edge of the last private inholding.

21 **4.1.4.3 Physical Environment (Maps 14, 21, and 25)**

22 The lower two-thirds of the watershed is within the basalt-rich Crescent formation. Limited
23 alluvial deposits are found along the lower 6 miles (WDFW and PNPTT, 2000 as cited in Correa,
24 2003a). The river valley walls are generally steep throughout, with a broad floodplain below RM
25 5.0.

26 Land cover within the planning area is composed of 60 percent evergreen forest, 28 percent
27 mixed forest, and 7 percent urban/recreational grasses, with acreages/rural residential
28 representing the remaining land cover. The slopes of either side of the Duckabush River valley
29 are mapped as landslide and erosion hazard areas and the CMZ encompasses much of the
30 floodplain.

31 Within the ONF, the river is within a riparian reserve program that preserves floodplain riparian
32 vegetation (Correa, 2003a). Hydrological maturity of the lower 8 miles of watershed is as
33 follows: approximately 16 percent (181 acres) of the lower watershed is less than 30 years old,
34 67 percent (7,458 acres) is between 31 and 95 years old, 9 percent (1,022 acres) is between 96
35 and 297 years old, and 0.3 percent is greater than 297 years old (USFS, 1998). There are recent
36 clearcuts in the lower 2 miles of the watershed (Correa, 2003a).

Wetlands identified in Reach 1 are 71 percent palustrine forested, 13 percent estuarine - intertidal (associated with river mouth), and 5.5 percent palustrine scrub/shrub.

Portions of the Duckabush River above Reach 1 are listed as a Category 5 water for temperature according to Ecology's 2004 Water Quality Assessment.

4.1.4.4 Biological Resources (Map 17)

The Duckabush River riparian corridor below RM 7.5 was designated a Class A Nodal Riparian Corridor by May and Peterson (2003). Chinook, coho, fall and summer chum, pink salmon, and steelhead and sea-run cutthroat trout use the entire lower segment of the Duckabush River. There are no artificial barriers to anadromous fish in this stretch of river. Two large side channels upstream from the Bonneville Power Administration (BPA) power lines are used heavily by chum salmon for spawning. The river has recently broken through the head of one of these side channels and it may become the new main channel (Correa, 2003a). Of the salmon stocks in the Duckabush River, Chinook salmon are rated critical; summer chum, pink salmon, and winter steelhead are considered depressed; and fall chum and coho salmon are considered healthy according to the Salmon and Steelhead Stock Inventory (SASSI) (WDFW, 2000b).

4.1.4.5 Land Use and Altered Conditions (Maps 21 and 25)

Land Use and Zoning

Timber harvest is the dominant land use in the lower watershed, both on National Forest lands and private lands. Between the USFS boundary and the mouth of the river, zoning is Commercial and Rural Forestry with some Rural Residential.

Transportation and Utilities

Overall, road density in the watershed is low at 0.6 mile of road per square mile of habitat. However, in the lower Duckabush, road density is 2.2 miles of road per square mile of watershed (WDFW and PNPTT, 2000 as cited in Correa, 2003a). Within the planning area of Reach 1, Jefferson County and WDNr have mapped 1 mile and 1.2 miles of road, respectively.

Shoreline Modifications

Streambank armoring restricts the floodplain downstream of the National Forest boundary. Boundaries to the channel migration zone for the Duckabush River were identified as River Drive, Mountain Trail Road, Kelly Road, Highway 101, and the south bank revetment just west of the Highway 101 bridge (Perkins and Klawon, 2004). Floodplain connectivity rates fair overall but poor in the lowest half mile of the river. Below RM 3.0, removal of LWD and rural residential development have confined the river to a single channel, limiting side channel spawning and rearing habitat for salmonids.

In the lower Duckabush watershed, roads have contributed to 31 mass wasting events (33 percent of the total) in the lower 8 miles of watershed. It is estimated that 78 percent of these events contributed sediment to the river (USFS, 1998). In the lower reaches of the river below the ONF, impacts of development are evident: 25 percent of the riparian zone (by area) is developed below

1 RM 3.0 (12 percent urban/commercial, 9 percent rural residences, and 3 percent dikes and
2 roads). Approximately 32 percent of the riparian zone contains small trees less than 12 inches in
3 diameter; 66 percent contains trees of medium diameter between 12 and 20 inches; 2 percent has
4 no trees; and there are no large trees over 20 inches in diameter (Correa, 2003a).

5 **4.1.4.6 Public Access (Map 21)**

6 None identified. Some of the tidelands at the mouth of the river are publicly owned.

7 **4.1.4.7 Restoration Opportunities**

8 Restoration opportunities include improving road management practices to mitigate altered
9 sediment processes, enhancing riparian vegetation to improve cover and LWD recruitment
10 potential, and reconnecting floodplain wetlands and side channels to restore natural channel
11 forming processes and improve habitat.

12 **4.1.5 Dosewallips River and Brinnon Nearshore (Dosewallips River)**

13 **4.1.5.1 Overview (Map 1a)**

14 This marine shoreline extends from the northern edge of Black Point to the head of Right Smart
15 Cove north of Brinnon. It includes three drift cells and the large estuary and river delta of the
16 Dosewallips River. The Dosewallips River is the largest river in eastern Jefferson County with a
17 watershed draining the northeastern Olympic Mountains. The town of Brinnon is located north of
18 the lower Dosewallips River. There is a small commercial district in Brinnon and several
19 residential neighborhoods. There are numerous residential and vacation homes both north and
20 south of Brinnon on Hood Canal.

21 **4.1.5.2 Nearshore Reaches (Map 8)**

22 Reach I: Drift cells JE-26 and JE-25, northeastern edge of Pleasant Harbor to south edge of
23 Dosewallips River delta.

24 Reach J: Dosewallips River delta to the start of drift cell JE-24 in Right Smart Cove.

25 **4.1.5.3 Physical Environment (Maps 11, 14 and 26)**

26 Drift cell JE-26 is a short (550-yard) drift cell within Reach I. This drift cell begins at the
27 northeasternmost basalt outcropping and has a westward and then southwestward net shore-drift
28 across the northern portion of Black Point and then into Pleasant Harbor. Drift sediment is
29 derived from Vashon till overlying basalt.

30 Drift cell JE-25 extends between the Dosewallips River and Pleasant Harbor. It originates at the
31 southern edge of the Dosewallips River delta, with net shore-drift to the southeast for 2.1 km to
32 Pleasant Harbor. Northeastward fetch becomes the controlling factor in this area because this
33 area is sheltered from south winds by Black Point. Southwestward net shore-drift is indicated by
34 minor southwestward beach width increase, sediment size decrease, and southwestward spit
35 progradation just inside the mouth of Pleasant Harbor. The end of this spit is the cell terminus

(Johannessen, 1992). There is an abundant fluvial sediment source at the beginning of the cell, and moderately abundant alongshore sediment in the remainder of the drift cell. Most of the shoreline of this drift cell is composed of Vashon lodgement till and is considered of intermediate stability. There is an area of unstable bluff face about 450 meters south of the southern edge of the Dosewallips delta (Ecology, 1978).

Within Reach J, the Dosewallips estuary includes a deltaic fan with fluvial sediment deposits and a well-developed tidal marsh system. Spit features mark the outer edge of salt marsh in the north part of the delta. The forming of the Dosewallips estuary likely occurred with the fluvial transport of large volumes of sediment down the glacial valley following the retreat of glaciers (Barnard, 2005 as cited in Todd et al., 2006). The delta historically occupied 0.7 square mile (1.8 square km) (Correa, 2003a). Wolcott Slough is the most dominant feature located in the north section of the estuary. The slough is fed by a network of small freshwater streams west of Highway 101 in the Brinnon Flat.

The southern portion of Reach J is an area of divergence between drift cell JE-25 to the south and JE-24 to the north. It is also the active part of the delta where the river flow meets the sea. Large amounts of fluvial sediment create, on average, a 150-meter-wide intertidal zone primarily of sand and gravel (WDNR, 2001; Correa, 2003a). The Washington State Department of Health has classified this area as a restricted shellfish harvest area due to water quality concerns (WDH, 2006a).

Drift cell JE-24 begins at the northern edge of the Dosewallips delta, with net shore-drift continuing 3.3 miles north of Brinnon into Right Smart Cove. Slope stability is intermediate to stable throughout this drift cell, with Vashon till overlying basalt. The exception is about 0.5 mile of unstable Vashon Recessional Outwash just north of the Dosewallips delta. A substantial portion of the nearshore sediment in this drift cell appears to originate from the Dosewallips River. Evidence of northward drift includes a general increase in beach width, accumulation of sediment on the south side of a riprap seawall and boat ramp at Seal Rock, and the northerly directed mouth of Turner Creek.

The drift cell terminus is located at Right Smart Cove at the eastern end of a spit that encloses a large tidal lagoon (Johannessen, 1992; Ecology, 2001). The lagoon supports native high-marsh vegetation such as pickleweed (*Salicornia virginica*) and sea arrow grass (*Triglochin* spp.). Native forest that originally surrounded the lagoon has been eliminated, and invasive species such as Scot's broom and blackberries have taken its place in many areas (Correa, 2002; Todd et al., 2006). A small stream drains into the lagoon from a large pasture to the north. Tidal connectivity between the tidal lagoon and channel remains functional (Todd et al., 2006), though some of the salt marsh associated with this lagoon has been filled for homes to the east of the tidal inlet.

4.1.5.4 Biological Resources (Maps 17, 20, 24, and 26)

Within Reach I, over half of drift cell JE-25 has overhanging vegetation. There are patchy eelgrass beds near the southern terminus of the drift cell. Patchy areas of *Sargassum* are mapped within Reach I. Sand lance spawn on the beaches just north of Pleasant Harbor's mouth (Penttila, 2000).

1 The Dosewallips delta contains many tidal channels and large amounts of salt marsh habitat. The
2 estuary is an important nursery habitat for summer chum and pink salmon as well as Chinook,
3 coho, and coastal cutthroat trout (May and Peterson 2003). The adjacent nearshore areas provide
4 quality salmonid rearing and migration habitat. Juvenile pink and chum salmon have been found
5 in Wolcott Slough (Hirschi et al., 2003a). May and Peterson (2003) classified the estuary north
6 of the river mouth as a Category A NSE refugia and the area south of the river mouth as a
7 Category D NSE refugia. The Dosewallips River supports runs of pink, Chinook, fall and
8 summer chum, and coho salmon as well as steelhead and cutthroat trout. This area is also an
9 important recreational and tribal shellfish site (see Figure 3-3). Bald eagles and great blue herons
10 nest in Dosewallips State Park.

11 Within Reach J herring spawn in the eelgrass from the mouth of Turner Creek up into Right
12 Smart Cove. Patches of barnacles and oysters are found along this entire segment of shoreline.
13 Patchy areas of *Sargassum* are mapped within Reach J. Sand lance spawn on the beach at the
14 terminus of this drift cell (Penttila, 2000; Long et al., 2005).

15 Invasive clubbed tunicates (*Styela clava*) have recently been discovered in a number of locations
16 around Puget Sound, including on docks and the hulls of boats in Pleasant Harbor Marina
17 (WDFW, 2006). These tunicates, which are native to Asia, have no known predators in Puget
18 Sound and can quickly blanket hard surfaces and out-compete or suffocate other types of sea life,
19 including native clams, mussels, and oysters.

20 **4.1.5.5 Land Use and Altered Conditions (Map 11 and 21)**

21 **Land Use and Zoning**

22 Land used in the planning area is mainly Rural Residential, Commercial Forestry, Rural Forestry
23 with scattered Agriculture and a small area zoned Rural Village Center.

24 **Transportation and Utilities**

25 Within Reaches I and J, Jefferson County and WDNR have mapped 5 miles and 5.4 miles of
26 road, respectively. Roadways include Highway 101 (with two lanes and shoulder areas) and
27 several intersecting property access roads.

28 **Shoreline Modifications**

29 Although there is relatively little bulkheading within drift cell JE-26, there are 11 stair structures
30 within its 787 yards.

31 North of Pleasant Harbor there is a residential area with numerous staircases, some with large
32 decks and small boathouses built on the upper intertidal zone. Approximately 21.2 percent of this
33 drift cell is bulkheaded (Hirschi et al., 2003b). Although much of the sediment for this drift cell
34 is fluvial in nature from the Dosewallips River, the armoring can have significant impacts on the
35 transport of alongshore sediment. In addition, the upper intertidal structures can decrease the
36 amount of beach habitat available for forage fish spawning and reduce shallow water habitat
37 available to migrating juvenile salmonids.

At least six diked areas protected by four tide gates now occupy approximately 15 percent of the Dosewallips estuary, with another 2.5 acres of fill associated with residential and agricultural activities (Correa, 2003a). In the southern part of the Dosewallips delta, there is a derelict barge or backfilled wooden bulkheaded area that has affected shallow water habitat. Highway 101 truncates several sloughs and restricts channel migration near the mouth of the Dosewallips River. Other diked and filled areas occur in the Dosewallips State Park campground and to the north of the main river channel.

North of Brinnon, drift cell JE-24 is 17.1 percent bulkheaded, including several sections of bulkhead extending below the high water mark (Hirschi et al., 2003b). This can decrease shallow water habitat and the recruitment of sediment into the nearshore. It can also impact the longshore transport of sediment, particularly in the area just north of Seal Rock Campground where there are numerous private boat ramps (Ecology, 2001).

The cumulative impacts of the Brinnon Flat armoring and floodplain modifications, the State Park campground infrastructure and bank armoring (upstream and downstream of the highway), the Highway 101 bridge and causeway, and a long history of wood removal have impaired the connectivity between the mainstem river channel and impeded the development of new distributaries. These modifications have also affected the function of other estuarine channels and associated tidal marsh habitats. Sea dikes have eliminated or altered the hydrology of tidal marsh habitat, mainly to the north of the current active channel.

Fecal coliform contamination is a problem in the nearshore marine environment of the Dosewallips River and as a result the nearshore area is a Category 5 water according to the 2004 Ecology Water Quality Assessment. Potential sources of fecal coliform are wastewater and soil coliform associated with sediment runoff (Golder Associates, 2002).

4.1.5.6 Public Access (Map 21)

Dosewallips State Park offers public camping and access to the delta and uplands at the mouth of the Dosewallips River. ONF's Seal Rock Campground is north of Brinnon and offers camping and shoreline access.

4.1.5.7 Restoration Opportunities

The Dosewallips estuary and its lower river corridor have recently become a focus of major habitat restoration planning and implementation. A large portion of the sea dike, visible at least as early as 1939, located near the center of the estuary within the State Park was removed during fall 2004. Additional habitat restoration projects that affect the Dosewallips estuary are currently in the planning and design phases (Todd et al., 2006).

Removing or replacing bulkheads with soft bank protection methods would improve longshore transport of sediment north and south of Brinnon, as would the removal of boat ramps. Several dikes are currently being removed or are proposed for removal from the Dosewallips estuary, which will improve and increase estuarine habitat. The Highway 101 crossing of the Dosewallips River delta truncates and restricts river and tidal channels; restoring the hydrologic function of these channels presents a restoration opportunity.

1 There have been four known infestations of spartina within Hood Canal, at Dosewallips State
2 Park, Bywater Bay, Tarboo Bay, and Thorndyke Bay (WSDA 2001). As of 2006, state
3 eradication efforts have been successful at all locations except Dosewallips State Park, where a
4 small area of spartina remains. The Washington Department of Agriculture intends to continue
5 eradication and post-eradication monitoring at Dosewallips State Park and Thorndyke Bay
6 (WSDA 2007).

7 **4.1.6 Dosewallips River (Dosewallips River)**

8 **4.1.6.1 Overview (Map 1a)**

9 The Dosewallips River drains the eastern Olympic Mountains from the river's headwaters in the
10 vicinity of Mt. Claywood, emptying into Hood Canal at the town of Brinnon. The watershed
11 covers approximately 78,000 acres or 122 square miles (USFS, 1999). The mainstem of the
12 Dosewallips River is 28.3 miles long with 140 miles of tributaries. Overall, the tributaries are
13 steep and the lower mainstem relatively gradual with meanders (Correa, 2003a; USFS, 1999).
14 Private inholdings (and hence County jurisdiction) end at about RM 9, located 1 mile
15 downstream from the Steelhead Campground. The upper 60 percent of the watershed is in ONP,
16 the middle 30 percent is in the ONF, and the lower 10 percent is in private ownership.

17 Annual average discharge of the river is 446 cfs at the gauging station at RM 7.1. There are two
18 runoff peaks: one associated with the winter rains between November and February, and another
19 associated with snowmelt in May and June (USFS, 1999; Correa, 2003a). Groundwater-
20 supported baseflow is minimal as a result of the dominance of bedrock geology (Golder
21 Associates, 2002).

22 **4.1.6.2 Freshwater Reaches (Map 8)**

23 Dosewallips River 1: From the mouth to the ONF boundary.

24 Dosewallips River 2: From the ONF boundary to the upstream extent of private inholdings.

25 Dosewallips Tributary 1: Rocky Brook from the confluence at Dosewallips to the impassable
26 falls.

27 **4.1.6.3 Physical Environment (Maps 14, 21, and 25)**

28 Dominant vegetation along the mainstem river floodplain includes forests of black cottonwood
29 (*Populus trichocarpa*) and red alder (*Alnus rubra*) (Labbe et al., 2005). A riparian forest
30 assessment of the lower 8.7 miles of the mainstem reports 51 percent of the riparian zone has a
31 stand diameter of less than 12 inches, 45 percent has a diameter between 12 and 20 inches, and
32 there are no large trees with a diameter greater than 20 inches. Four percent has no riparian
33 buffer (USFS, 1999 as cited in Correa, 2003a).

34 Land cover in the planning area is 43 percent evergreen forest and 26 percent mixed forest, with
35 the remainder being urban/recreational grasses, acreages/rural residential, recent clearcut,
36 transitional, and low intensity residential.

1 Within Dosewallips River Reach 1, approximately 33 percent of the planning area is wetland,
2 with palustrine forested (41 percent) and riverine upper perennial (33 percent) being the primary
3 wetland classifications.

4 Though much of the lower river floodplain has been modified or developed, a reach lying
5 between the BPA powerlines and the Lazy C housing development is relatively intact, with
6 abundant large wood deposits and off-channel habitat. Removal of the riparian/floodplain forest
7 vegetation, primarily conifers, has decreased the future LWD recruitment potential (Labbe,
8 personal communication, 2003 as cited in Correa, 2003a). The USFS ownership begins at RM
9 6.1 and extends to RM 14.0. A riparian reserve program along the river corridor improves LWD
10 recruitment potential for Reach 2.

11 Ecology's 2004 Water Quality Assessment lists the Dosewallips River (at the mouth) as a
12 Category 5 water for temperature.

13 Habitat within approximately 0.5 mile upstream from the Highway 101 Bridge appears to be a
14 zone of deposition with large gravel bars, multiple channels, and LWD with greater abundance
15 than adjacent reaches. Farther upstream, the channel and migration zone are frequently confined
16 by bedrock or directed bedrock outcroppings (Klawon, 2004). The lower 0.2 mile of Rocky
17 Brook contains excellent spawning gravels. Between 1920 and 1990, approximately 65 percent
18 of the Rocky Brook subwatershed was clearcut. Forty-five mass wasting events have occurred in
19 the Rocky Brook watershed. Within Rocky Brook, LWD recruitment is poor due to the extensive
20 logging in the watershed (Correa, 2003a).

21 **4.1.6.4 Biological Resources (Map 17)**

22 The Dosewallips River supports Chinook, fall and summer chum, pink, and coho salmon as well
23 as steelhead and cutthroat trout spawning (Correa, 2003a; May and Peterson, 2003). The river
24 has very few significant salmon-bearing tributaries, but the tributaries do provide important off-
25 channel areas for juvenile salmonids (May and Peterson, 2003). The Chinook salmon in this
26 system are part of the Mid-Hood Canal stock and according to SASSI are rated as critical, with
27 escapement below the critical threshold of 400 fish for the stock (WDFW, 2000b). The Mid-
28 Hood Canal stock includes Chinook in the Hamma Hamma, Duckabush, and Dosewallips
29 Rivers. Spawning takes place in the lower 12 miles of river between September and October with
30 most spawning taking place below RM 6.7 (Correa, 2003a).

31 Summer chum spawn in the lower 2.3 miles of river from mid-September to mid-October. They
32 are rated as a depressed stock in the SASSI (WDFW, 2000b) and are federally listed as
33 threatened under the Endangered Species Act. Summer chum is a native stock with wild
34 production. Dosewallips summer chum declined in the 1980s but have recently improved
35 (Correa, 2003a). Fall and late-fall chum also spawn in the Dosewallips and these stocks are rated
36 as healthy.

37 Coho spawn primarily in the lower 12 miles of the mainstem and in the lower reaches of
38 numerous tributaries. This coho stock is wild production of mixed composition due to past
39 hatchery releases. Its SASSI stock status is rated as unknown. Pink salmon are rated as depressed
40 after a decline in returns ranging from 400,000 to 100,000 spawners in the 1960s to 10,000 to

40,000 spawners in the 1980s, to low returns in the late 1990s of about 2,000 to 3,000 spawners. Spawning takes place in the lower 7 miles of the mainstem. Summer steelhead stocks are rated as unknown in the SASSI, and winter steelhead are rated as depressed (Correa, 2003a).

There are no artificial barriers to anadromous fish in the Dosewallips River, although a natural falls is a complete barrier at RM 12.5. The Dosewallips, below the anadromous fish barrier at RM 12.5, was found to harbor some of the best remaining refuge habitat for salmonids in eastern Jefferson County (May and Peterson, 2003). In particular, several reaches are noted for the high quality of spawning habitat: RM 0 to 1.8 (Brinnon flats to Lazy C flats), RM 4.5 to 5.3 (Walcott Flats), and RM 7 to 7.8 (Middle River flats).

The lower, middle, and upper Dosewallips river reaches are identified as Category A Nodal Corridors according to May and Peterson (2003). Rocky Brook is also a Category A RNC.

4.1.6.5 Land Use and Altered Conditions (Maps 21 and 25)

Land Use and Zoning

Land use in the basin is dominated by residential development, pastureland, and timberland. From the mouth to RM 3.6, the broad floodplain is zoned Agriculture (3 percent), Forestry (3 percent), Commercial (6 percent), and Rural Residential (7 percent). Dosewallips State Park lies on the south side of the river and estuary, and the town of Brinnon is to the north. Both are within the floodplain-delta area (Correa, 2003a). The USFS ownership begins at RM 6.1 and extends to RM 14.0.

Transportation and Utilities

Within the planning area of Dosewallips River Reach 1, Jefferson County and WDNR have mapped 3.5 miles and 3.9 miles of road, respectively. A County road extends along the left bank of the river from the mouth to RM 3.6. The Highway 101 causeway restricts estuary function and has disconnected some of the side channels from the main river channel (Correa, 2003a).

Dosewallips Tributary Reach 1 has a road density of 3.7 miles of road per square mile of watershed (USFS, 1999 as cited in Correa, 2003a).

Shoreline Modifications

Logging in the Dosewallips watershed began in 1859. A splash dam built by the Sims Logging Company at the head of the Dosewallips canyon in 1917 was in operation for 9 to 10 years. When water was released, most logs that had been accumulated behind the dam were flushed all the way to Hood Canal; the erosive power of these releases was likely catastrophic for salmon and their habitat in the lower river (Labbe et al., 2005). In addition, starting in the 1880s, development transformed the lower river from a valley with many side channels, wetlands, and logjams to a channelized river with adjacent farmland.

Boundaries to the channel migration zone for the Dosewallips River were identified as the town of Brinnon, from Highway 101 to as far west as the existing revetment; Dosewallips State Park east (downstream) of the large levee; and Highway 101 (Perkins and Klawon, 2004). Diking

restricts access to major side channels and floodplain in the lower mile, at RM 2 at the Lazy C housing development. In the vicinity of RM 5 a mile-long side channel has been isolated from the main channel. Loss/destruction of side channels has a major adverse effect on spawning areas and overwintering areas for salmonids (Correa, 2003a; May and Peterson, 2003). Though splash damming, floodplain development, and bank armoring have contributed to extensive habitat loss and degradation at Lazy C, the reach immediately downstream has experienced only limited riparian logging and LWD removal from the active channel.

Wood removal from gravel bars is still occurring in the Brinnon Flat reach, and recent surveys indicate that the low amounts of wood occurring in this reach and in the immediately downstream estuarine reach of the mainstem are responsible for the girth of pool habitat and lack of complexity found in these reaches (Labbe et al., 2005).

4.1.6.6 Public Access (Map 21)

Dosewallips State Park provides access to 5,400 feet of Dosewallips River shoreline between the river estuary and RM 0.9. The 425-acre park extends southwest of the river and also includes marine shoreline. In addition to year-round camping, the park includes 5 miles of hiking and biking trails and extensive shoreline access (WSP, 2006).

4.1.6.7 Restoration Opportunities

Restoration opportunities in the Dosewallips reaches include opening up side channels and reconnecting floodplain habitat by removing bank armoring. A recent property acquisition by Jefferson County in the vicinity of the Lazy C development will allow for the creation of natural side channels. In the lower river estuary, Washington Trout is leading an effort to remove a dike, restore river-estuary connectivity, and improve tidal exchange in a blind tidal slough through culvert replacement. Meanwhile, Jefferson County, Washington State Parks, and the Port Gamble S'Klallam Tribe are collaborating to acquire and permanently protect privately owned, undeveloped riparian-floodplain properties from RM 1.2 to 2.1 (Labbe et al., 2005). As mentioned above, in the nearshore segment, there are opportunities in the lower Dosewallips and estuary to restore a natural estuary with side channels and salt marshes.

4.2 WRIA 17 - QUILCENE-SNOW

WRIA 17, located on the northeastern Olympic Peninsula, includes portions of Jefferson and Clallam Counties (Figures 4-2 and 4-3). It encompasses direct drainages to Puget Sound from Jimmycomelately Creek in the northwest to the Quilcene River in the south. The watershed also contains portions of Hood Canal and the Strait of Juan de Fuca, and the northeast flank of the Olympic Mountains.

Figure 4-2. WRIA 17 (north) in Northeast Jefferson County

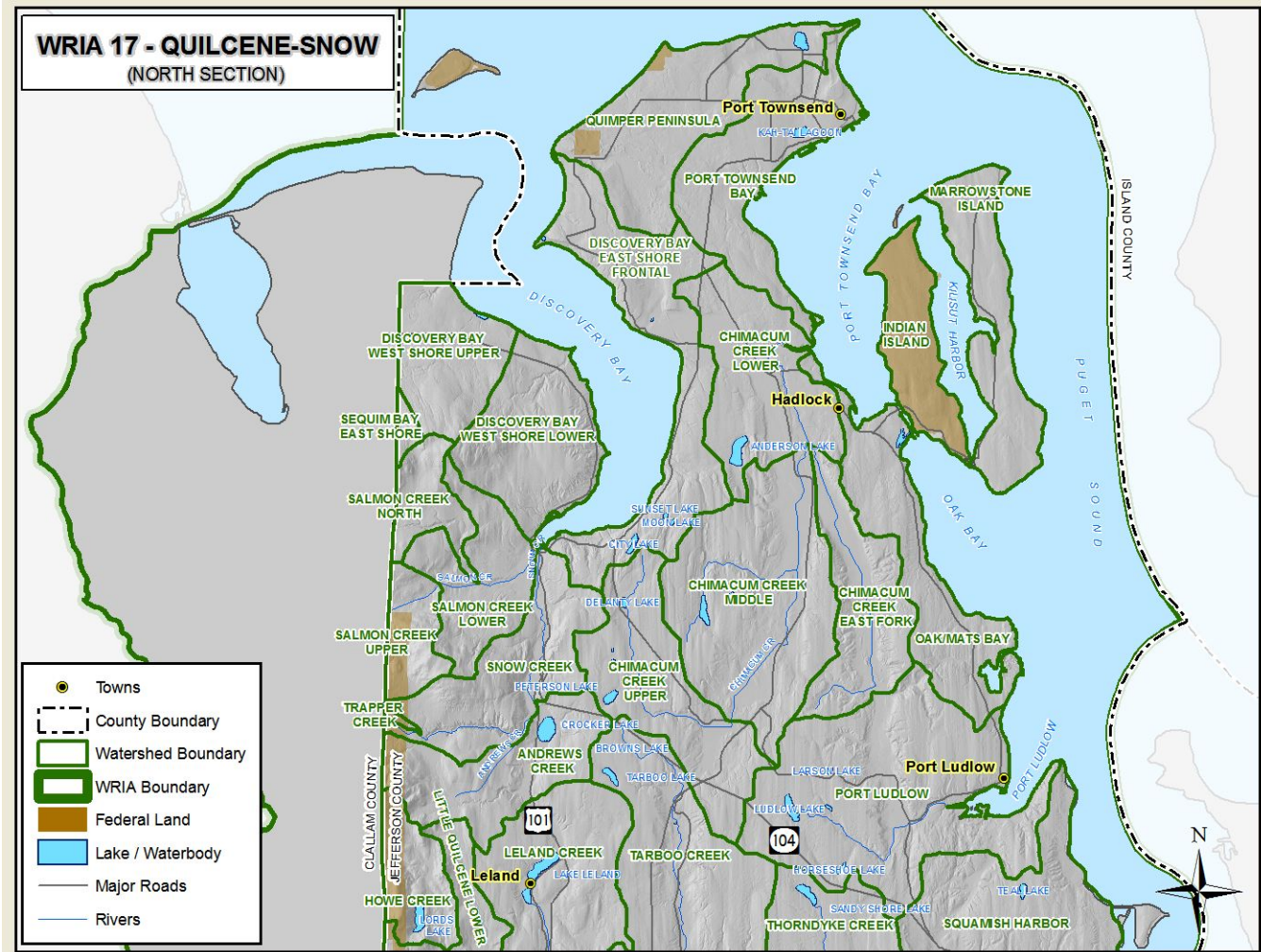
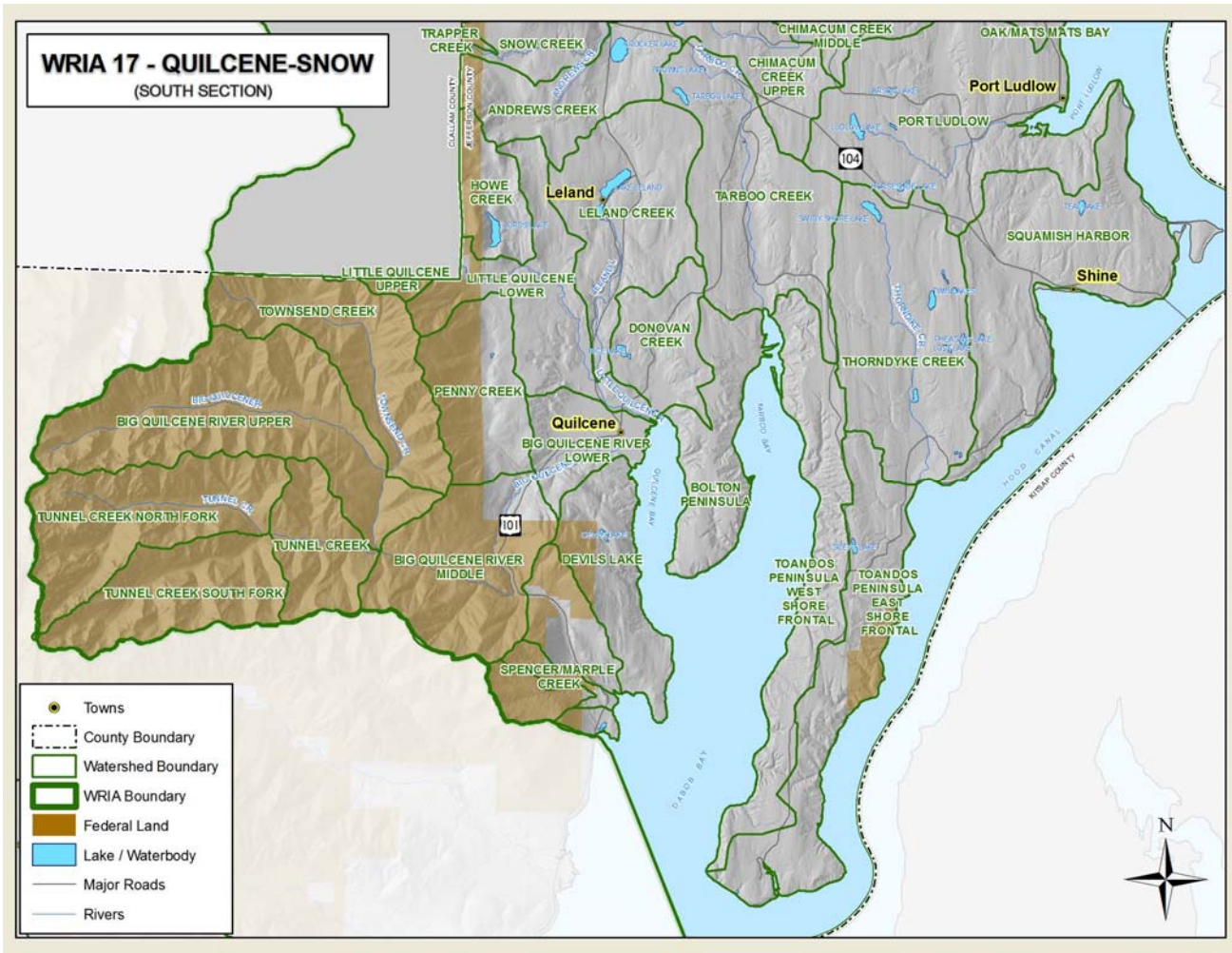


Figure 4-3. WRIA 17 (south) in Northeast Jefferson County



Glaciers shaped the terrain in this WRIA, which includes the steep slopes of the Olympic Mountains and coastal lowlands drained by high-gradient streams. Characteristic soils are deep to moderately deep loams and areas of silt and clay. Within WRIA 17, annual precipitation increases to the south and west. The Quimper subbasin on the eastern edge of the watershed receives 15 to 20 inches of rainfall annually, while the foothills of the Olympic Mountains in the western side of the watershed receive 70 to 80 inches annually. Precipitation also tends to increase as elevation increases. In lowland valleys, pasture vegetation is common, while at higher elevations alders and conifers predominate (Correa, 2002; Parametrix, et al., 2000).

Nearly 40 percent of the 256,783 acres in WRIA 17 is devoted to forestry, including national forests, commercial forest, and inholdings. The Big Quilcene, Salmon-Snow, and Dabob-Thorndyke subbasins have large forested areas. Rural residential is the second most common land use in WRIA 17, with nearly 70,000 acres. Agricultural lands occupy over 4,000 acres, many of which are in the Chimacum subbasin. The majority of the WRIA's commercial and industrial lands are in the Quimper subbasin, where Port Townsend is located. The U.S. Navy has an installation on Indian Island, part of the Indian-Marrowstone subbasin.

More than 70 percent of the WRIA is privately owned; the federal government owns 20 percent and state government owns the remaining 10 percent. Approximately 26,835 people lived in WRIA 17 as of 2003, many of them in Port Townsend, the main population center of the watershed. The population is projected to increase significantly. Estimates developed from the 2000 Census show 2015 populations ranging from 29,935 in the low-growth scenario to 38,197 under the high-growth scenario. Much of this increase is expected to occur in the Quimper subbasin, which includes Port Townsend, and the Ludlow subbasin, which includes Port Ludlow. Growth is also expected in the Chimacum subbasin (Cascadia Consulting Group, 2003).

4.2.1 Jackson Cove (Hood Canal West Shore Upper)

4.2.1.1 Overview (Map 1a)

This shoreline stretches from the head of Right Smart Cove to Point Whitney and encompasses Jackson Cove, Wawa Point, and Pulali Point. Unlike most of Jefferson County's marine shoreline, this area is dominated by a rocky basaltic shoreline with pocket beaches. Three drift cells occur within this section of shoreline along with several areas of no net drift. Highway 101 veers inland away from the shoreline over Mount Walker. This basin is less developed than others in the WRIA, with scattered residential areas, a Boy Scout camp, and the State Shellfish Lab at Point Whitney. Jackson Cove was identified in the Willamette Valley-Puget Trough-Georgia Basin Ecoregional Assessment as a priority conservation area for its high-quality nearshore and terrestrial habitat (Floberg et al., 2004).

4.2.1.2 Nearshore Reaches (Map 9)

Reach K: From the head of Right Smart Cove to Wawa Point.

Reach L: Wawa Point to Point Whitney, including Point Whitney Lagoon, adjacent to Point Whitney State Shellfish Lab.

4.2.1.3 Physical Environment (Map 12, 14, and 26)

Along the eastern shore of Right Smart Cove, drift cell JE-23 extends from 200 meters west of Wawa Point 300 meters to the northwest to converge with drift cell JE-24 at the head of Right Smart Cove. Glacial drift overlies basalt at the cell origin, where a thin, coarse gravel beach sits atop a wide, basalt wave-cut platform. Wawa Point is composed of basalt and there is no net drift in this area for 660 meters (Johannessen, 1992). The major substrates of this cove are sand and gravel (Correa, 2002).

Drift cell JE-22 is isolated between areas of no net drift. It stretches for 900 meters along the western shore of Jackson Cove to terminate at the southern edge of the Spencer Creek delta. There is little sediment transported in this drift cell due to a lack of overlying sediment on the basalt (Johannessen, 1992).

Jackson Cove from Spencer Creek delta around Pulali Point is also an area of no net drift, with pocket beaches between basaltic headlands and a large alluvial fan at the mouth of Spencer Creek. This area is similar in character to many areas of the San Juan Islands.

One-half mile north of Pulali Point, drift cell JE -21 extends northward for 1.5 miles to end at the 100-yard-wide beach just north of the Point Whitney State Shellfish Lab (Johannessen, 1992).

4.2.1.4 Biological Resources (Maps 18, 20, 24, and 26)

Pacific herring spawn in eelgrass along the entire length of Right Smart Cove. Sand lance spawn on the beaches on the east side of Right Smart Cove. Riparian vegetation overhangs about 25 percent of the shoreline in this reach (WDNR, 2001; Penttila, 2000).

A large salt marsh lagoon situated behind the barrier beach at the head of Right Smart Cove is part of the Wawa Point bald eagle territory (Todd et al., 2006). The marsh supports native high marsh vegetation such as pickleweed and sea arrow grass (Correa, 2002).

Eelgrass is continuous and herring use the Wawa Point reach for spawning substrate (Penttila, 2000). Riparian vegetation covers about half of the shoreline (WDNR, 2001).

Marple and Jackson Creeks and Spenser Creek are found at the head of Jackson Cove. Marple Creek supports spawning populations of coho and chum salmon (Correa, 2002). Eelgrass is continuous throughout western Jackson Cove.

Spencer Creek supports spawning habitat for coho and chum salmon, searun cutthroat trout, and winter steelhead. Sand lance spawn on the beach near the Boy Scout Camp, east of Spencer Creek (Penttila, 2000). Patchy eelgrass beds grow offshore between Spencer Creek and Pulali Point, and a geoduck tract is found in the subtidal areas along this reach (Penttila, 2000 as cited in Correa, 2002). Osprey and bald eagles nest in the vicinity of Pulali Point, while all of Jackson Cove is bald eagle territory.

Herring spawn on the eelgrass from Wawa Point north to the middle of Jackson Cove and beyond to Pulali Point (Penttila, 2000), and oysters are continuous along this shoreline (Correa, 2002). Although riparian vegetation increases to about 30 percent in the north, it is absent in front of the State Shellfish Lab. There is a small wetland located behind a barrier beach 900 yards south of Point Whitney. The accretionary beach at northern end of this reach encloses a lagoon that has been highly altered for use by the shellfish hatchery at the State Shellfish Lab at Point Whitney (Correa, 2002; Ecology, 2001; Johannessen, 1992). However, the lagoon and the surrounding tidelands offer clam and oyster shellfishing. Sand lance and surf smelt spawn on the beach in front and to the north of the State Shellfish Lab.

Within Reaches K and L, between 10 percent and 14 percent of the planning area is wetland. The primary wetland classification is estuarine – intertidal (unconsolidated shore, aquatic bed, open water, and emergent).

4.2.1.5 Land Use and Altered Conditions (Maps 12 and 22)

Land Use and Zoning

Land use along the Jackson Cove shoreline is dominated by residential development. Within Reach K, 86 percent of the planning area is zoned Rural Residential. Remaining Reach K zoning

includes Water. Within Reach L, 76 percent of the planning area is zoned Rural Residential. Remaining Reach L zoning includes Parks, Preserves, and Recreation areas.

Transportation and Utilities

Within the planning area of Reaches K and L, Jefferson County and WDNR have mapped 0.75 mile and 1.1 miles of road, respectively. Highway 101 passes within the planning area in Reach K, and portions of intersecting roadways (e.g., Bee Mill Road) pass within both Jackson Cove reaches.

Shoreline Modifications

The terminus of drift cell JE-23 in Right Smart Cove is bulkheaded with cement high in the intertidal. This does not appear to have led to a coarsening of beach sediment based on aerial photos (Ecology, 2001). Just south of the mouth of Marple Creek there is bulkheading and fill. Approximately 20 percent of drift cell JE-22 is armored (Hirschi et al., 2003). The shoreline in front of Camp Parson in Jackson Cove is completely bulkheaded. Historically, a small lagoon and salt marsh occurred at Camp Parsons; it has been largely filled (Todd et al., 2006). The area between Camp Parsons and Point Whitney is largely free of modifications except for a few docks and short bulkheads. The area around Point Whitney State Shellfish Lab is highly altered with bulkheading in front of the parking lot and a dike built across the lagoon to serve a now inactive shellfish hatchery.

4.2.1.6 Public Access (Map 21)

The only public shoreline access by land to this area is at the State Shellfish Lab at Point Whitney, with a beach and a boat ramp. There are WDNR tidelands just southeast of Camp Parsons with no current public access by land. However, this may be a site where public access can be obtained either through Boy Scout land or other private lands off of Pulali Point Road.

4.2.1.7 Restoration Opportunities

The removal of the bulkhead in front of Camp Parsons would afford better access to the beach for the Boy Scouts and create more of a natural backshore. The bulkhead currently protects few if any structures. The fill near the mouth of Marple Creek could be removed to improve net shore-drift. Restoration of the area surrounding Point Whitney could involve relocating the parking lot to an upland location, removing fill and the dike across the lagoon, and returning the spit and lagoon to a more natural state.

4.2.2 Quilcene Bay (Hood Canal West Shore Upper, Big Quilcene River, and Little Quilcene River)

4.2.2.1 Overview (Map 1a)

Quilcene Bay contains three drift cells and a large area of no net drift. There are forested headlands along much of the backshore and large mudflats in the northern end of Quilcene Bay. The sizable Little and Big Quilcene Rivers flow into northern Quilcene Bay through the town of

1 Quilcene, creating an extensive estuary at the head of the bay. A marina and shellfish hatchery
2 associated with the town of Quilcene are situated on the northwest shore of the bay.

3 Clam and oyster harvesting are major businesses in this part of Jefferson County and Quilcene
4 Bay is an important shellfish resource. Residential development is concentrated in the northwest
5 and northeast shores of the bay. Located farther north than Brinnon (and thus farther into the
6 rain shadow of the Olympic Mountains), Quilcene receives about 50 inches of precipitation a
7 year.

8 **4.2.2.2 Nearshore Reaches (Map 8)**

9 Reach M: Point Whitney to Quilcene Boat Haven (now Herb Beck Marina), encompassing drift
10 cells JE-19, JE-19/JE-20, and JE-20.

11 Reach N: Quilcene marina to the southern edge of the Indian George estuary.

12 Reach O: From Indian George estuary to the terminus of drift cell JE-18.

13 Reach P: North edge of Fisherman's Point Salt Marsh to the start of drift cell JE-17.

14 **4.2.2.3 Physical Environment (Maps 11, 14, and 26)**

15 Between Point Whitney and the Herb Beck Marina, two drift cells diverge from an area 0.5 mile
16 south of Frenchmen's Point. This divergence zone contains actively eroding feeder bluffs of
17 glacial drift intermittently overlying areas of basalt. Drift cell JE-20 originates in this area of
18 divergence. Northerly fetch from Quilcene Bay creates southward net shore-drift for 1 mile to
19 the confluence with drift cell JE-21 just north of Point Whitney. North of this divergent feeder
20 bluff area, southern fetch governs the net shore-drift of sediment in drift cell JE-19 north to its
21 terminus at the marina (Johannessen, 1992). A stream draining Devil's Lake also contributes
22 fluvial sediment to this drift cell (Correa, 2002).

23 From the marina to a point approximately 1.3 km south of East Quilcene there is no appreciable
24 net shore-drift (Johannessen, 1992). The marina, which is at the terminus of the drift cell (JE-19),
25 was built on an existing spit; it has filled parts of the former upper intertidal beach with rock
26 armoring. The mouth of the marina is fairly stable and has not needed dredging for decades.

27 Drift cell JE-18 begins just south of Fisherman's Point in a broad area of divergent drift at the
28 base of the Bolton Peninsula. Governed by southern fetch, net shore-drift is northward for 2.6
29 miles along the eastern shore of Quilcene Bay. Its origin is at a poorly vegetated, eroding bluff
30 composed of glacial drift. Northwestward net shore-drift is indicated by a northwestward bluff
31 vegetation increase, northeastward spit progradation enclosing a salt marsh north of Fisherman's
32 Point, northerly sediment size decrease, nearshore bars oriented northwest-southeast, and
33 sediment accumulations on the south side of a filled area in northern Quilcene Bay. The cell's
34 terminus is located at the base of this filled area, as shallow depths prohibit waves from forming
35 that are large enough to cause significant amounts of sediment transport. Northern Quilcene Bay
36 is slowly shoaling with sediment transported from the Quilcene River and Donovan Creek. The
37 Big and Little Quilcene delta fans were formed by alluvial deposition over about the last 12,000
38 years (Todd et al., 2006). The bluffs along this drift cell are generally considered unstable with

1 many recent landslides. Except for the area immediately surrounding Fisherman’s Point, which is
2 composed of Tertiary Sandstone, these bluffs are made up of Double Bluff Drift and
3 undifferentiated glacial stratified sediment predating the Vashon Glaciation (Johannessen, 1992;
4 Ecology, 1978). Quilcene Bay shoreline consists largely of protected and semi-protected sand
5 flat and sand beaches (Correa, 2002).

6 In general, water quality in Quilcene Bay is excellent with the exception of the upper bay, which
7 experiences intermittent fecal coliform problems. The northern part of Quilcene Bay is listed as
8 a Category 5 water for fecal coliform contamination according to Ecology’s 2004 Water Quality
9 Assessment and is periodically closed to shellfish harvest. The Washington State Department of
10 Health has a harvest advisory in effect for public shellfish harvest and some areas were
11 conditionally closed to harvest from May 1 to October 1, 2005, in accordance with the
12 conditional management (WDH, 2006a). Problems with fecal coliform contamination have been
13 attributed in past studies to natural seal populations, animal keeping practices, and onsite septic
14 systems (Parametrix et al., 2000).

15 **4.2.2.4 Biological Resources (Maps 18, 20, 24, and 27)**

16 Reaches M and N are in an area of few homes and steep eroding bluffs. Riparian vegetation is
17 nearly continuous throughout this stretch of shoreline (Ecology, 2001). Patchy to continuous
18 eelgrass beds occur throughout. Oysters and clams are continuous and a geoduck tract extends
19 from just north of the lagoon at Whitney Point to just south of Frenchman’s Point (Correa, 2002).
20 Bald eagles also use this area as habitat. Surf smelt spawn along segments of the beach from
21 Whitney Point to Herb Beck Marina (Long et al., 2005). Sand lance spawn north of Whitney
22 Point and just south of the marina and most of this shore is a designated herring spawning area
23 (Penttila, 2000; Long et al., 2005). Just north of this is a residential area along Linger Longer
24 Road. Eelgrass is continuous along this reach and hard-shelled clams, Pacific oyster, shrimp and
25 Dungeness crab are abundant.

26 The marina and surrounding shoreline is within 0.25 miles of an active bald eagle nest and
27 territory. This area is also within a northern spotted owl territory, but several miles from a nest
28 (WDFW Priority and Habitats Map database).

29 The delta of the Big Quilcene River, the Little Quilcene River, and Donovan Creek (Reach O) is
30 an area of winding tidal channels and salt marsh (Correa, 2002). Eelgrass is continuous
31 throughout the northern end of Quilcene Bay and herring use it for spawning (Penttila, 2000).
32 Quilcene Bay is famous for its clams and oysters; there are several commercial and recreational
33 shellfish harvesting areas within the bay. For example, the allowable, sustainable harvest of
34 manila clams for the WDFW property on Linger Longer Road was about 39,000 pounds in 2003
35 (Speck, personal communication, 2003). In the winter, large concentrations of waterfowl are
36 found in northern Quilcene Bay including trumpeter swans, brant, and diving ducks.

37 May and Peterson (2003) identify the Quilcene Bay NSE as a Category A salmonid refugia. The
38 NSE includes the estuaries of the Big Quilcene River, Indian George Creek, Devil’s Lake Creek,
39 numerous small streams, and the nearshore areas linking these habitats.

1 Surf smelt spawn throughout drift cell JE-18, and sand lance spawn in a small stretch near the
2 center of this cell (Long et al., 2005). A 2-acre salt marsh is enclosed by a spit just north of
3 Fisherman's Point (Fisherman's Point Salt Marsh) (Leon and Driscoll, 1975; Ecology, 2000).
4 This salt marsh and lagoon have remained similar to its form in the late 1800s (Todd et al.,
5 2006). North of Fisherman's Point, eelgrass beds are continuous throughout the reach and
6 herring use it for spawning (Penttila, 2000). The east shore of Quilcene Bay is a year-round
7 haulout site and seasonal pupping site for harbor seals. Riparian vegetation is heavy through the
8 reach (WDNR, 2001).

9 Within Reaches M and N, 10 percent to 15 percent of the planning area is wetland. Within
10 Reaches O and P, 40 percent to 70 percent of the planning area is wetland. The majority of
11 wetlands in all Quilcene Bay reaches are estuarine – intertidal (aquatic bed/unconsolidated shore,
12 emergent, and unconsolidated shore).

13 **4.2.2.5 Land Use and Altered Conditions (Maps 12 and 22)**

14 **Land Use and Zoning**

15 Land use along the Quilcene Bay shoreline is dominated by residential development and
16 commercial timber and agriculture uses. Within Reaches M, N, and O, 47 percent to 64 percent
17 of the planning area is zoned Rural Residential (100 percent Rural Residential in Reach P).
18 Remaining reach areas are zoned Commercial Forest (Reaches M and N), Commercial
19 Agriculture (Reach O), Parks, Preserves, and Recreation, and Rural Forest. In the vicinity of the
20 Boat Haven (Herb Beck Marina) shoreline use consists of several homes and several commercial
21 buildings related to shellfish/aquaculture. The marina has a sewage pump-out and the upland
22 toilets are on septic.

23 **Transportation and Utilities**

24 Within the Quilcene Bay shoreline planning area, Jefferson County and WDNR have mapped 4
25 miles and 4.5 miles of road, respectively. Along the eastern shoreline of the bay, East Quilcene
26 Road parallels the shorelines of Reaches O and P, and is within the planning area across the
27 majority of the reaches. Roads associated with the town of Quilcene are within the planning
28 areas of Reaches N and O.

29 **Shoreline Modifications**

30 Shoreline alterations are concentrated near the marina, in east Quilcene, and in the area of no net
31 drift in northern Quilcene Bay. North of Point Whitney, shoreline modifications are absent from
32 the West Quilcene Bay reach. At the terminus of JE-19 the marina and residential and business
33 areas to the north are extensively bulkheaded (WDNR, 2001; Ecology, 2001; Hirschi et al.,
34 2003b). Bulkheads to the north encroach into the nearshore, encroaching upon vital shallow
35 water habitat for migrating juvenile salmonids (Correa, 2002).

36 Linger Longer Road and a landing strip north of the marina eliminated some of the upper marsh
37 and tidal channels (Todd et al., 2006). Some restoration has taken place in the Indian George
38 Creek estuary by removing dikes, fill associated with a parking lot at a WDFW shellfish
39 harvesting site, and an abandoned barge.

In the Quilcene estuary, diking has eliminated large amounts of high salt marsh, intertidal channels, and riparian vegetation, based on differences between the 1880s coastal surveys and current aerial photos (Correa, 2002) (see Todd et al., 2006 for further details). A large area of fill extends into the intertidal zone in East Quilcene Bay at the terminus of drift cell JE-18. This fill eliminates shallow water habitat. Despite this feature, drift cell JE-18 has retained fluvial function with little shoreline alteration south of its terminus (Ecology, 2001).

4.2.2.6 Public Access (Map 21)

Public access to Quilcene Bay is available by land at Point Whitney State Shellfish Lab, on Port of Port Townsend land off Linger Longer Road, at the public shellfishing site by Linger Longer Road (owned by WDNr with upkeep by WDFW), on WDFW property in the Quilcene delta, and at East Quilcene County Park. WDNr also owns the shoreline south of the Quilcene Boat Haven.

4.2.2.7 Restoration Opportunities

Restoration opportunities in Quilcene Bay are centered in the deltas of the Big and Little Quilcene Rivers. In the lower Big Quilcene River potential actions include removing dikes, restoring salt marsh habitat, and reconnecting the main river channel with tidal channels. Plans for this are currently being developed by the Hood Canal Salmon Enhancement Group and other partners. Between the Quilcene Boat Haven and Indian George Creek, the shoreline could be further restored using soft armoring techniques. Removing dikes on both banks could restore the estuary of the Little Quilcene River. East Quilcene Road interferes with natural backshore sediment processes and constricts Donovan Creek; this area could be enhanced if the road were reconfigured to allow for these processes. Acquiring and removing fill at the terminus of drift cell JE-18 would allow for natural deposition of sediment into northern Quilcene Bay and increase shallow water habitat.

Additionally, best management practices could be implemented to control stormwater and agricultural runoff, and to protect water quality from septic systems and marina and boating activity, to help maintain the shellfish industry.

4.2.3 Rice Lake (Hood Canal West Shore Upper)

Rice Lake is the only SMA-designated lake which drains directly to Quilcene Bay (Reach O).

4.2.3.1 Freshwater Reaches (Map 8)

Rice Lake: Approximately 1.5 miles north of the City of Quilcene, approximately 0.5 miles east of Highway 101.

4.2.3.2 Description

Rice Lake has a surface area of approximately 21 acres. Rice Lake drains to Quilcene Bay via Donovan Creek, which does not meet SMA criteria. Downstream of Rice Lake, Donovan Creek has high temperatures according to Ecology's 2004 Water Quality Assessment. Rice Lake is not listed as impaired for temperature or other monitored parameters according to Ecology. The

majority of the lake, and the entire perimeter of the lake, is mapped as lacustrine wetland by Jefferson County and NWI wetlands mapping. Rice Lake is presumed habitat for coho salmon, steelhead, and cutthroat trout.

Rice Lake is bordered by a relatively high number of residential lots. Current land uses are a mix of rural residential (Rural Residential 1:5 and Rural Residential 1:20 zoning) and managed forest (Rural Forest and Commercial Forest zoning). There is no public access to Rice Lake. Within the Rice Lake planning area, the only public road appears to be Rice Lake Road, which extends towards the lake from Highway 101 to the west. In addition, a significant utility corridor passes to the east of the lake, however is located approximately 800 feet away from the shoreline and is likely outside of the lake planning area.

4.2.4 Big Quilcene River (Big Quilcene River)

4.2.4.1 Overview (Map 1a)

The Big Quilcene River flows out of the Olympic Mountains, south of the town of Quilcene and into Quilcene Bay. The watershed is 69.5 square miles with a mainstem length of 19 miles and tributary length of 80 miles, with elevations up to 7,800 feet. The watershed experiences a relatively mild marine climate with an average annual precipitation of 61 inches (51 inches in Quilcene and at the river mouth; 76 inches in the upper watershed). Upper portions of the Big Quilcene watershed are protected by the ONP and USFS wilderness areas (Correa, 2002).

The City of Port Townsend maintains a 30 cfs water right to the Big Quilcene River. This water is diverted out of the basin at RM 9.4. The effect this diversion has on the overall hydrology and fish habitat quality is unknown (Correa, 2002).

4.2.4.2 Freshwater Reaches (Map 9)

Big Quilcene River 1: From the upper edge of the estuary to the fish hatchery at the confluence with Penny Creek (RM 2.8).

Big Quilcene River 2: From the fish hatchery to the National Forest boundary.

4.2.4.3 Physical Environment (Map 15, 22, and 27)

As the river leaves its bedrock channel at about RM 4, the streambed is composed of large boulders and cobbles that grade into gravel and sand as it approaches the mouth at Quilcene Bay (Simonds et al., 2003). Reaches on the Big Quilcene River appear to alternate between relatively straight, narrow reaches with little LWD and few secondary channels, and sinuous wide reaches with greater amounts of LWD and multiple channels (Klawon, 2004). The groundwater flow system is dominated by the presence of volcanic bedrock in the upper reaches of the subbasin with some alluvial or glacial deposits present along major streams. In the lower portions of the subbasin, glacial deposits and alluvium are extensive. At the mouth of the Big Quilcene River, these deposits compose the principal aquifer for many of the domestic wells in this area (Parametrix et al., 2000; Simonds et al., 2003).

Downstream of Highway 101, small conifers are scattered throughout a largely deciduous riparian zone at the pole/sapling stage. From Highway 101 upstream to Hiddendale, the riparian condition is degraded by rural development (Correa, 2002).

Within the planning area of Reach 1, land cover includes herbaceous rangeland/grassland (53 percent of total area), evergreen forest (21 percent), and mixed forest (12 percent). Within the planning area of Reach 2, land cover includes evergreen forest (63 percent) and mixed forest (21 percent).

Surrounding the Big Quilcene River, 22 percent to 30 percent of the planning area is wetland. Palustrine forested (53 percent) and palustrine scrub/shrub (42 percent) are the primary classifications of Reach 1 wetlands. Palustrine forested (75 percent) and palustrine scrub/shrub (25 percent) are also the primary classifications of Reach 2 wetlands.

Within Reach 2, from RM 2.8 to the residential development of Hiddendale at RM 3.2, the river channel migrates south to north with signs of beaver activity on the east valley wall. Some armoring and diking have occurred in this area.

The entire mainstem below Hiddendale (RM 3.2), with the exception of the section between Rogers Street Bridge and Highway 101, is lacking LWD due to removal for bank protection or firewood. Between RM 1.1 and the Highway 101 Bridge, LWD is accumulating, although overall levels are low. This section has good instream structure and side channel development. The riparian zone is also recovering (Correa, 2002) and the frequency of pools increases upstream to the National Forest boundary. Large boulders between Hiddendale and the falls at RM 7.8 provide some fish habitat. There is one small logjam within the canyon but no other significant LWD (Labbe, personal communication, 2002 as cited in Correa, 2002).

Two stretches of the lower Big Quilcene River in Reach 1 are impaired according to Ecology's 2004 Water Quality Assessment. The lower reach is a Category 5 water for temperature, and a Category 4c water for fish habitat. Contamination by fecal coliform bacteria has also been an issue in the lower reaches of the river. Ecology lists the downstream reach as a Category 2 water of concern for fecal coliform.

4.2.4.4 Biological Resources (Map 18)

The Big Quilcene is a Category C nodal corridor for salmonids (May and Peterson, 2003). The stretch from the mouth to about RM 1.1 supports spawning by fall chum, summer chum, Chinook and pink salmon and steelhead despite significant impacts from levee construction, water withdrawal (upstream), dredging, and other stream and shoreline modifications (May and Peterson 2003). The upper reaches are important rearing habitat for coho and steelhead.

4.2.4.5 Land Use and Altered Conditions (Maps 22 and 25)

Land Use and Zoning

Thirty-one percent of the watershed (the headwaters of the Big Quilcene River) is protected in the USFS Buckhorn Wilderness and the ONP. Downstream of this, most of the watershed is managed as commercial timberland. Jefferson County zoning indicates 93 percent of the

watershed is Forestry (including public and private working timberland), 4 percent is Rural Residential, 0.2 percent is Agricultural, and 0.1 percent is Commercial (Correa, 2002). Within the planning area, Reach 1 is zoned 53 percent Rural Residential and 43 percent Local Agriculture, while Reach 2 is zoned 92 percent Rural Residential.

Transportation and Utilities

Within the planning area of the Big Quilcene River, Jefferson County and WDNr have each mapped 1.5 miles of road. Highway 101 is aligned within and around the Big Quilcene River planning area within both reaches. Additional intersecting roads associated with the town of Quilcene and vicinity are also located within the planning area. Roads are located within the floodplain from Rogers Street to Linger Longer Bridge (Todd, personal communication, 2006).

Shoreline Modifications

There are no natural barriers to anadromous fish below the National Forest boundary at about RM 4.0. However, the Quilcene National Fish Hatchery operates an electronic weir at RM 2.8. When this weir is in operation between September and December, it is a total barrier to upstream passage of fish. It is also a barrier during low river flows. In addition, the fish hatchery diverts water from the Big Quilcene River and also from Penny Creek, a tributary. This water intake structure permanently blocks fish access to Penny Creek, a potentially excellent refugium (Correa, 2002; May and Peterson, 2003).

Boundaries to the channel migration zone for the Big Quilcene River were identified as the USFWS hatchery; Highway 101 near the bridge; and along the south side of river in Quilcene, from the second dike west of Rogers Street to the east side of the BPA lines (Perkins and Klawon, 2004). From the mouth to RM 1.1, extensive diking and armoring isolate the river from its floodplain. This has also led to channel aggradation, which increased channel streambed elevation and extended the river mouth 1,700 feet into the estuary between 1971 and 1993. In sum, these modifications have led to a near complete loss of floodplain habitat (Correa, 2002), although the left bank dike at the river mouth was removed in 2005.

The reach of the river that flows by and through the National Fish Hatchery has been modified by riprap, water diversion, and an electronic fish weir (Correa, 2002). Upstream to the National Forest boundary the river flows past the Hiddendale residential development where there is some diking, riprap, and development in the floodplain. However, in general, the channel is allowed to migrate in this section.

Livestock access coupled with malfunctioning onsite septic systems have been considered to be the fecal coliform loading sources for the lower river reach (Parametrix et al., 2000).

4.2.4.6 Public Access (Map 21)

None identified.

4.2.4.7 Restoration Opportunities

Opportunities include restoring fish passage into Penny Creek around the fish hatchery water intake. Below RM 1.1, there may be opportunities to remove some of the extensive diking and channel-constricting fill. This would increase estuary function and salt marsh habitat, which are important for summer chum survival.

4.2.5 Lake Leland and Lords Lake (Little Quilcene River)

Two SMA-designated lakes are located in this area: Lake Leland and Lords Lake, which drain into the Little Quilcene River.

4.2.5.1 Freshwater Reaches (Map 9)

Lake Leland: Approximately 4.5 miles north of the City of Quilcene, immediately west of Highway 101.

Lords Lake: 0.6 mile north of Little Quilcene River 2.

4.2.5.2 Description

Lake Leland has a surface area of 108 acres. Leland Creek downstream of Lake Leland has high temperatures, although the lake is not listed as impaired for temperature according to Ecology's 2004 Water Quality Assessment. Sixty-four percent of the lake's shoreline planning area is mapped as wetland, with the primary wetland classification being lacustrine – limnetic (open water).

Lake Leland is presumed habitat for coho salmon, steelhead, and cutthroat trout, as well as bald eagle foraging territory. Growth of invasive weeds such as reed canarygrass and Brazilian elodea have contributed to habitat degradation and extremely low dissolved oxygen conditions in the summer (Correa, 2002). Lake Leland is a Category 4c water for invasive aquatic species according to Ecology's 2004 Water Quality Assessment.

Lake Leland is surrounded by moderately dense rural residential development (Rural Residential 1:5). There is public access to Lake Leland via a County boat launch and a County park that includes camping. Within the Lake Leland planning area, Jefferson County and WDNR have mapped 1.2 and 1.5 miles of road, respectively.

Lords Lake is a reservoir in the water supply system for the City of Port Townsend. Created by damming Howe Creek, the lake receives water from the Little Quilcene River. The City has a 9.6 cfs water right to the Little Quilcene River to fill Lords Lake. Water from the lake is used during times when water cannot be diverted from the Big Quilcene River for municipal use due to low flows or excessive suspended sediment. "Moderate" and "slight" landslide potential areas are mapped in 31.5 percent of the planning area. Approximately 47 percent of the Lords Lake planning area is mapped as wetland (primarily lacustrine – limnetic open water).

Lords Lake was created by the construction of a dam at the north end of the lake. The facility includes a lake inflow (from Little Quilcene River diversion) and an outflow (Port Townsend

water supply) as well as a spillway. Forest and Rural Residential zoning surround the lake, and Jefferson County and WDNR have mapped 0.45 mile of road within the Lords Lake planning area. There is no mapped public access to Lords Lake.

4.2.6 Little Quilcene River (Little Quilcene River)

4.2.6.1 Overview (Map 1a)

The Little Quilcene River's headwaters are on the northern side of Mount Townsend in the northeast Olympic Mountains. The river flows generally southeast to empty into northern Quilcene Bay just north of the town of Quilcene. In contrast to other rivers flowing out of the northeast Olympic Mountains, only a small portion of the Little Quilcene's headwaters are protected in the National Park or National Forest designated wilderness. County jurisdiction begins at RM 6 at the ONF boundary. Downstream from there, the river flows through commercial timberland for roughly 2 miles and then through rural residential land, finally crossing about 0.5 mile of agricultural land just upstream from the mouth.

4.2.6.2 Freshwater Reaches (Map 9)

Little Quilcene River 1: River mouth to approximately RM 3.0.

Little Quilcene River 2: RM 3.0 to the ONF boundary.

4.2.6.3 Physical Environment (Maps 15, 22, and 27)

The Little Quilcene River flows over bedrock until about RM 3 where the streambed is composed of boulders and cobbles that grade into gravel and sand near the mouth at Quilcene Bay (Simonds et al., 2003). A moderate rate of groundwater recharge in the basin is largely controlled by the presence of bedrock and till, which cover approximately 62 percent and 27 percent of the basin, respectively. In the lower portions of the Little Quilcene River subbasin, recessional outwash and alluvium are extensive near the mouth of the Little Quilcene River, Leland, Donovan, and Jakeway Creeks. Similar to the Big Quilcene subbasin, these deposits may compose the principal aquifer for many of the domestic wells in this area (Parametrix et al., 2000, Simonds et al., 2003).

From the mouth to RM 1.3, the gradient is less than 1 percent and the channel is unconfined. The lower 0.2 mile is tidally influenced, and the channel is wide relative to the upstream segments due to the presence of beaver ponds. The channel is highly unstable and confined by dikes in this segment, and contains very few pieces of LWD. The substrate is predominantly sand and gravel. From RM 1.3 to 3.3, the channel is moderately confined and the gradient between 1 and 2 percent. The upper reaches hold more LWD, but pools are still infrequent. Channel substrate is predominantly gravel (Parametrix et al., 2002). Below RM 3.0, the riparian zone is dominated by young deciduous or mixed-species forest with numerous exotic species such as ivy, holly, blackberry, and reed canarygrass (Parametrix et al., 2000; Correa, 2002), so LWD recruitment potential is low. Between RM 2.7 and 5.2, percent pool habitat is poor at 23 to 25 percent. LWD is generally lacking; however, it appears that there is a potential for recruitment if the riparian

1 zone can be preserved. The riparian zone is rather narrow but appears to have a high percentage
2 of conifers (Correa, 2002).

3 Within the planning area of the Little Quilcene River, land cover includes evergreen forest (55
4 percent of total area) and mixed forest (27 percent). Shrub and brush rangeland, deciduous
5 forest, herbaceous rangeland/grassland, recent clearcut, and pasture/hay represent the remaining
6 land cover. Surrounding the Little Quilcene River, less than 1 percent of the planning area is
7 wetland (palustrine open water).

8 There are no barriers to fish migration in the lower 6 miles of the river (Correa, 2002). LWD has
9 been removed from the reach between the mouth and RM 2.7 (Reach 1). The riparian zone lacks
10 conifer trees and has limited future LWD recruitment (Labbe, personal communication, 2002 as
11 cited in Correa, 2002). There is less than one piece of wood per channel width throughout this
12 segment. The lower 0.2 mile has good pool habitat but this habitat feature diminishes upstream
13 (Correa, 2002).

14 In past years residential development and agriculture have been suspected as a source for the
15 low-level fecal coliform measured in the Little Quilcene River (Gately, 1992 as cited in
16 Parametrix et al., 2000).

17 **4.2.6.4 Biological Resources (Maps 17 and 18)**

18 Summer chum, fall chum, and coho salmon and winter steelhead trout spawn in the Little
19 Quilcene River. This summer chum salmon run is part of the Hood Canal summer chum ESU.
20 Both the fall and summer runs of chum have been extremely low in recent years, and both runs
21 contain strays from the Big Quilcene hatchery (Correa, 2002). The coho run on the Little
22 Quilcene is a distinct stock from that on the Big Quilcene with a significantly later run timing.
23 Winter steelhead status and origin are unknown on the Little Quilcene (Correa, 2002).

24 The lower Little Quilcene was divided into three Nodal Riparian Corridors, all classified as
25 Category B, by May and Peterson (2003). The first extends from the mouth to RM 0.8. This
26 reach of stream has been heavily impacted by channelization, loss of floodplain habitat, levee
27 construction, upstream water withdrawal, loss of LWD, forest conversion to agriculture and
28 pastureland, gravel dredging, and residential land uses. The lower Nodal Riparian Corridor
29 remains important spawning habitat for summer and fall chum salmon (May and Peterson,
30 2003). The Nodal Riparian Corridor from RM 0.8 to RM 3.0 also serves as spawning habitat for
31 summer chum and other salmonids.

32 **4.2.6.5 Land Use and Altered Conditions (Map 22 and 25)**

33 **Land Use and Zoning**

34 Conversion of floodplain habitat to agriculture and pastureland has impacted the Nodal Riparian
35 Corridor from RM 0.8 to RM 3.0. It is estimated that about 50 percent of the floodplain of the
36 lower Little Quilcene has been developed (May and Peterson, 2003). Within the lower river
37 reach (Little Quilcene River 1) planning area, 60 percent of land cover is rural residential and 24
38 percent is commercial forest. Within the upper river reach (Little Quilcene River 2) planning
39 area, commercial forest (77 percent) and rural forest (13 percent) are the predominant land cover.

A total of 52 percent of the watershed is zoned Forestry, 17 percent Rural Residential, and 0.8 percent Agriculture (Correa, 2002)

Transportation and Utilities

The lower reach of the Little Quilcene mainstem between the mouth and RM 2.7 has 5.2 miles of road per square mile of watershed. Road density from RM 2.7 to RM 6.8 is 3.3 miles of road per square mile of watershed (Correa, 2002).

Within the river's planning area, Jefferson County has mapped 0.8 mile of road, and WDNR mapped 0.9 mile of road. Major roadways include Highway 101 to RM 2 and Lords Lake Loop Road above RM 2.

Shoreline Modifications

Between 6 cfs and 9.6 cfs of water are diverted from the Little Quilcene River for the City of Port Townsend's water supply into Lords Lake. This diversion is within the National Forest at RM 7.1; however it affects the downstream water flow within the County's jurisdiction. There is also an unscreened irrigation canal on the Little Quilcene River which is operated haphazardly, allowing coho, cutthroat, and steelhead juveniles access to the canal. These juvenile fish are then stranded upon closing of the intake or pumped through the irrigation systems and spread on agricultural fields (Davis, personal communication). Boundaries to the channel migration zone for the Little Quilcene River were identified as Highway 101, East Quilcene Road, Center Road, Brush Plant Loop, and the Avulsion Hazard Zone on both sides of Frank Beck Road (Perkins and Klawon, 2004).

4.2.6.6 Public Access (Map 22)

None identified.

4.2.6.7 Restoration Opportunities

In the middle reach of the Little Quilcene River, riparian plantings would provide shade and improve habitat where there is currently a lack of riparian cover. Floodplain acquisition and restoration could be completed to provide off-channel rearing opportunities for salmonids. In the lower reach, riparian planting would lead to increasing future LWD recruitment potential. In the delta and estuary, removing or pulling back dikes and levees would create channel sinuosity and connectivity. This action would also increase salt marsh habitat.

4.2.7 Dabob Bay (Hood Canal West Shore Upper)

4.2.7.1 Overview (Map 1a)

Dabob Bay is a long bay with relatively little development along its shores. Around the bay are steep, eroding feeder bluffs interspersed with low, forested bluffs. About 400 acres are protected as state-owned Natural Area Preserves, including the lower mile of Tarboo Creek and the coastal spits and adjoining upland forest (Bahls, 2004). Tarboo-Dabob Bay is at the center of The Nature Conservancy's priority conservation area in eastern Jefferson County (Bahls, personal

1 communication, 2006). This area also appears to support the largest high quality salt marsh
2 complex remaining in the Hood Canal and Straits region (Todd et al., 2006).

3 There are several spit and salt marsh complexes, including the estuary of Tarboo Creek at Dabob
4 Bay's northern tip, Broad Spit, Tarboo Bay, the mouth of Camp Discovery Creek, and at
5 Zelatched Point. These marshes are important stops for migrating juvenile summer chum salmon.
6 Summer chum inhabit Tarboo-Dabob Bay for over three months, from late January through early
7 May (Bahls, 2004). Tarboo Creek flows into Tarboo Bay and it supports runs of coho and fall
8 chum salmon, as well as a small number of Chinook salmon.

9 Dabob Bay has some residential and vacation homes along its shores, primarily concentrated at
10 Lindsay Beach, Camp Discovery, and Camp Harmony. The U.S. Navy uses Dabob Bay as a
11 torpedo and submarine testing area, and a small base at Zelatched Point supports these
12 operations. Overall this region maintains a rural natural character. As in Quilcene Bay, Dabob
13 Bay is a major shellfish producing area.

14 **4.2.7.2 Nearshore Reaches (Map 8)**

15 Reach Q: From the center of the divergence zone between drift cells JE-17 and JE-18 to the
16 terminus of drift cell JE-17 at Tarboo Bay barrier spits.

17 Reach R: Tarboo Bay north of the barrier spits and Long Spit.

18 Reach S: From the center of the JE-15/JE-16 divergence zone north along the west shore of
19 Toandos Peninsula to the terminus of drift cell JE-16.

20 **4.2.7.3 Physical Environment (Maps 11, 14, and 26)**

21 As part of the Dabob-Thorndyke subbasin, this shoreline area receives a relatively high rate of
22 predicted groundwater recharge, which is influenced by relatively high precipitation (averaging
23 39 inches per year) and extensive outwash deposits (Parametrix et al., 2000).

24 Dabob Bay is bounded by long drift cells on each side: JE-17 (5.9 miles) to the west, and JE-16
25 (13 miles) to the east. JE-17 originates on the southern Bolton Peninsula and has a general
26 northward net shore-drift along the western shore of Dabob Bay to terminate at Tarboo Bay. It
27 originates from a broad zone of drift divergence west of Red Bluff. This feeder bluff consists of
28 red coarse-grained sandstone and conglomerate that is overlain by sandy glacial drift fronted by a
29 poorly sorted beach. This steep bluff is poorly vegetated and has experienced recent slope
30 failure. Evidence of northeast followed by northern drift includes the presence of red sand on the
31 beach northeast of the red sandstone outcrop at the cell origin, northward sediment size decrease,
32 northward progradation of Broad Spit, and the northeastward progradation of nearshore bars at
33 the head of the bay.

34 Protected within the bars at the head of Dabob Bay is Tarboo Bay, composed primarily of
35 mudflat and salt marsh lagoons and slowly filling with sediment supplied by Tarboo Creek
36 (Johannessen, 1992; Bahls, 2004). Outside of the spits, Dabob Bay plunges to a depth of more
37 than 500 feet (Bahls, 2004). The shoreline along the west side of Dabob Bay is generally
38 considered unstable, except for low areas around Lindsay Beach and Broad Spit. The bluffs here

are, in general, composed of a shallow layer of Vashon till overlying thicker layers of undifferentiated stratified sediments and a base of Double Bluff Drift. This bluff area is prone to failure and contributes abundant sediment to the nearshore (Ecology, 1978; Correa, 2002).

Reach S includes the longest drift cell in eastern Jefferson County, JE-16, with net shore-drift running northward for 13 miles from just north of Oak Head to Long Spit. The drift cell originates within the broad zone of divergence between Tskutsko Point and Oak Head. Northward net shore-drift is indicated by northward and northeastward stream mouth offset throughout the drift cell, northward spit progradation north of Camp Harmony, sediment accumulation on the south side of rock groins north of Camp Harmony, the erosional nature of the bluff at the southwest shore 1.3 miles north of Camp Discovery, the northward bluff vegetation increase north of this location, and the northward progradation of the mile-long spit (Long Spit) at the drift cell's terminus (Johannessen, 1992). Along this shoreline there are numerous areas of recent sliding and, except for some areas of low marsh and Long Spit, this area is classified as unstable. In general, the bluffs here are composed of a relatively thin layer of Vashon till, overlying Vashon advance outwash, and a large layer (several hundred feet) of undifferentiated stratified sediments on a base layer of Double Bluff Drift. Numerous slides mark the shoreline, including a spectacular slide between Long Spit and Camp Discovery that is roughly 120 yards high, 160 yards wide, and extends about 100 yards into the intertidal (Ecology shoreline photo #010522-111636). Just south of this slide are several homes perched on top of similar, steep, high bluffs (Ecology, 2001, 1978).

Within Dabob Bay Reaches Q and S, between 13 percent and 16 percent of the planning area is wetland. Within Reach R, 78 percent of the planning area is wetland. Estuarine – intertidal (aquatic bed/unconsolidated shore) is the primary wetland classification within all shoreline reaches.

4.2.7.4 Biological Resources (Maps 17, 20, 24, and 26)

Dabob Bay contains some of the most valuable and pristine nearshore habitat in Hood Canal and should be a top conservation priority for Jefferson County (May and Peterson 2003). Eelgrass beds are patchy or continuous throughout drift cell JE-17. However, they are absent from Tarboo Bay. Broad Spit has both commercial and recreational shellfish harvesting (Correa, 2002). There is also a bald eagle nest at Broad Spit. Broad Spit contains a salt marsh of about 2 acres. Sand lance spawn on the north side of the spit, and juvenile summer chum were found in the salt marsh and along the shore (Leon and Driscoll, 1976; Penttila, 2000; Bahls, 2004; Long et al., 2005). Habitat includes relatively small patches of salt marsh and drift logs around the mouth of the stream, and narrow fringes of marsh along the margins of the bay (Todd et al., 2006). Sand lance spawning has been documented at several sites north of Broad Spit in Reaches Q and R on the west side of Tarboo Bay (Long et al., 2005). Riparian vegetation appears to be healthy in these reaches along western Dabob Bay, except in areas where it is absent because of bluff erosion and isolated development (Ecology, 2001).

Eelgrass beds are patchy at the origin of drift cell JE-16, but with few exceptions are continuous along East Dabob Bay. Dabob Bay is a major breeding habitat for bald eagles with several recent nest sites documented in Reach S. Other priority species located in this reach include nesting great blue herons and nesting ospreys.

Camp Discovery Creek lagoon was found to harbor juvenile Chinook, coho, and chum salmon (Hirschi et al., 2003a). This watershed also supports coho and chum salmon spawning (Correa, 2002). May and Peterson (2003) identify all of Dabob Bay as a NSE salmonid refugia. Both the east and west bay are classified as Category A refugia. The NSE includes the full bay, plus many small coastal streams and Camp Discovery Creek.

Dabob Bay is one of the top oyster seed growing areas in the world (May and Peterson 2003). Forage fish spawn in numerous locations along this drift cell, including areas along Long Spit, south of Camp Discovery, and north of Tabook Point (Long et al., 2005).

A salt marsh lagoon at the mouth of a presumed salmon stream occurs just north of Zelatched Point (Correa, 2002). This habitat complex consists of a barrier spit that partially envelops two tidally connected lagoons and associated marsh. Small freshwater streams enter both lagoons, and a sizable deltaic fan occurs where a channel enters Dabob Bay (Todd et al., 2006).

The barrier spit at the head of Tarboo Bay and Long Spit are home to rare plant communities of native salt marsh and berm plants. It is identified as one of the best spit habitats with native vegetation in Washington State and is currently protected by the WDNR's Natural Heritage Program. The spit is jointly owned by the WDNR and The Nature Conservancy. The adjoining lagoons were seined for fish use by Peter Bahls of the Northwest Watershed Institute in 2003, and were found to harbor significant numbers of juvenile Chinook, summer and fall chum, coho, and cutthroat trout (Bahls, 2004).

Tarboo Creek runs into the head of the bay and supports coho, Chinook, and chum salmon spawning, as well as searun and resident cutthroat trout and steelhead (Bahls, personal communication, 2006). A small number of Chinook adults were observed spawning in the lower mile of Tarboo Creek between 1994 and 2003. The population may have originated from a release of hatchery smolts in the early 1990s, but is believed to be naturally reproducing at this point (Bahls, 2004). The lower mile of the stream has an intact riparian corridor with conifer and deciduous mixed forest throughout the floodplain, and is owned by WDFW (Correa, 2002). For this reason the Tarboo Bay estuary, spit, and lagoon complex should also be afforded County protection as a natural shoreline.

Low summer flow has been identified as a factor that limits coho salmon production in Tarboo Creek, but if estimates are correct, it is unlikely that consumptive use of groundwater has materially influenced streamflow. There are consumptive use rights for surface water totaling 2.31 cfs, and claims of 2.96 cfs. If actual use approaches the claimed volume, it could significantly influence summer low flow (Parametrix et al., 2000).

4.2.7.5 Land Use and Altered Conditions (Maps 11 and 21)

Land Use and Zoning

Land use along the Dabob Bay shoreline is zoned primarily for Rural Residential development. Within all reaches, 75 percent to 88 percent of the planning area is zoned Rural Residential (this varies by reach). Remaining reach areas are zoned Commercial Forest, Local Agriculture, Parks, Preserves, and Recreation, and Military Reservation.

Transportation and Utilities

Within the Dabob Bay marine planning area, Jefferson County and WDNR have mapped 1.8 miles and 2.3 miles of road, respectively. Roads providing access to rural residential areas and the marine shoreline are intermittent within the planning areas of all reaches.

Shoreline Modifications

Lindsay Beach on the west shore and several areas north of Tabook Point on the east shore are relatively heavily armored (60 percent at Lindsay Beach). These are pockets between pristine and relatively untouched shoreline. There are several houses perched on top of eroding bluffs, and there may be pressures to protect the toe of the bluff from erosion (e.g., the residence in Ecology photo #010522-110544). In general, however, fluvial processes appear to be healthy in western Dabob Bay, with shoreline armoring concentrated in areas without bluffs and that are not likely contributing much sediment to the nearshore. Areas without bluffs were about 11 percent armored (out of a total of 13 km). Only approximately 2 percent of the high or low bluff areas were armored (out of a total of 23 km) (Hirschi et al., 2003b).

Along the eastern shore of the bay, drift cell JE-16 is 6 percent armored out of 19 km of total length (Hirschi et al., 2003b). Some of these structures may interfere with the longshore transport of sediment, particularly a set of groins south of Camp Discovery. About 11 percent of the historical marsh at Zelatched Point Lagoon has been lost, mostly in the far west side near the origin of the spit as a result of filling for a parking area and helicopter pad (Todd et al., 2006).

4.2.7.6 Public Access (Map 21)

At the head of Tarboo Bay there is public WDFW land. There is boat access to Broad Spit, with WDNR tideland containing extensive shellfish beds, and County-owned uplands. There are WDFW public tidelands on the east shore of the bay north of and adjacent to Camp Discovery, and another north of Tabook Point. Between the Navy property at Zelatched Point and Fisherman's Harbor, South Toandos State Park includes the beaches along this shoreline, but no upland access.

4.2.7.7 Restoration Opportunities

Restoration opportunities are somewhat limited. There are existing shoreline structures that interfere with longshore transport of sediment and may alter migration pathways used by juvenile salmon. These structures could be replaced with soft bank armoring. The protection of high-quality habitat, including forage fish spawning beaches and the bluffs that supply these beaches, should be a high priority.

4.2.8 Tarboo Lake, Sandy Shore Lake, and Wahl Lake (Hood Canal West Shore Upper)

4.2.8.1 Freshwater Reaches (Map 9)

Tarboo Lake: 5.5 miles to the north of Tarboo Bay's northern boundary, adjacent to the headwaters of Tarboo Creek.

1 Sandy Shore Lake: Approximately 1.5 miles to the west of the intersection of Highway 104 and
2 State Route 19, at 47°53'26"N and 122°46'00"W.

3 Wahl Lake: Approximately 2.2 miles to the west of northwest extent of Squamish Harbor, at
4 47°51'50"N and 122°44'22"W

5 **4.2.8.2 Description**

6 Generally, there is limited information on lakes in this area. Tarboo Lake is located between
7 Highway 104 and Lake Leland within commercial forestland. It has no outlet and a surface area
8 of 20.3 acres. Land use in the Tarboo Lake planning area is dominated by commercial forest
9 activities. Ninety percent of the planning area is zoned Commercial Forest. Agricultural
10 practices in the Tarboo Bay basin are a primary source of fecal coliform in Dabob Bay
11 (Parametrix et al., 2000). There has been no recent timber cutting adjacent to the lake. Public
12 access is provided by a WDFW-owned boat ramp at the end of Tarboo Lake Road. It is a popular
13 trout fishing lake.

14 No significant geologically hazardous areas or aquifer recharge areas are mapped within the
15 Tarboo Lake planning area. The lake is mapped with lacustrine – limnetic (open water) wetland
16 over 66 percent of the planning area.

17 Tarboo Lake is mapped with less than 200 feet of road by both Jefferson County and WDNR.
18 Mapping indicates the lake access point at the end of Tarboo Lake Road.

19 The area surrounding Sandy Shore Lake is commercial timberland. South of the lake there is a
20 recent timber cut as determined from aerial photography. The planning area of the lake is zoned
21 Commercial Forest. Sandy Shore Lake is presumed coho, cutthroat, and steelhead habitat
22 (Correa, 2002). Pope Resources owns the property surrounding Sandy Shore Lake, and allows
23 conditional recreation use of their land at both locations. Less than 200 feet of road are mapped
24 by WDNR at Sandy Shore Lake, and Sandy Shore Lake Road ends on the west shore of the lake
25 within the planning area.

26 Wahl Lake is south of Highway 104 near Shine. Its surface area is 21.6 acres. Surrounding the
27 lake, 54 percent of the planning area is mapped as wetland, with palustrine scrub/shrub and open
28 water the primary wetland classifications. Wahl Lake is home to several rare wetland plants and
29 plant assemblages. It is one of several isolated lakes in the Thorndyke Creek/Shine area.

30 Wahl Lake is located on commercial timberland owned by Pope Resources, and the surrounding
31 area has experienced recent logging. Pope Resources allows conditional recreation use of their
32 land at this location. The planning area of the lake is zoned Commercial Forest with a Mineral
33 Resource Lands Overlay. Fred Hill Materials gravel mine operates adjacent to Wahl Lake. This
34 gravel mine, permitted in 2005, allows the proposed 137-acre extraction area to be mined
35 sequentially, in segments ranging in size from 12 to 15 acres (JCDCD, 2005). Less than 200 feet
36 of road are mapped by WDNR at Wahl Lake.

4.2.9 Southern Toandos Peninsula, Thorndyke Bay, and Squamish Harbor (Hood Canal West Shore Upper)

4.2.9.1 Overview (Map 1a)

This Hood Canal shoreline faces Kitsap County. The uplands are relatively low glacial deposits. There are long stretches of pristine shoreline south of the Thorndyke Creek estuary, which is one of the finest examples of an unaltered estuary in Jefferson County. The Nature Conservancy has identified this area as a priority conservation area. There are three drift cells along this shoreline.

The southwestern shore of Squamish Harbor has little development and is generally in pristine condition. Shine Creek enters the harbor at its head after flowing through a large estuarine wetland. Near the head of the harbor and along its northern shore (Shine) there is moderately dense residential development. East of Shine there is an area of massive erosion that threatens several structures on the top of the bluffs.

4.2.9.2 Nearshore Reaches (Map 9)

Reach T: From center of divergence between drift cell JE-15 and JE-16 to terminus of drift cell JE-15 at Hazel Point.

Reach U: Drift cell JE-14, Hazel Point to center of divergence zone JE-13/JE-14.

Reach V: Toandos Peninsula along Hood Canal, from the center of divergence zone JE-13/JE-14, including drift cells JE-13 and JE-12, to the terminus of drift cell JE-12 at Squamish Harbor.

Reach W: Drift cell JE-11, including areas inside the spit at the head of Squamish Harbor that are part of the extensive estuary of Shine Creek.

4.2.9.3 Physical Environment (Maps 11, 12, 14, 15, 26, and 27)

The Dabob-Thorndyke subbasin receives a relatively high rate of precipitation (averaging 39 inches per year), and is characterized by high levels of groundwater recharge. Principal aquifer materials in the Shine area are composed of pre-Vashon stratified glacial drift and interglacial deposits. In addition, Vashon advance outwash materials may be saturated in places. Exposures of principal aquifer materials are present along the incised channels. Recessional outwash and alluvial materials have subsequently filled in portions of the channels (Parametrix et al., 2000).

Reach T begins in a zone of divergence that encompasses sediment sources for drift cells JE-16 and JE-15. The first drift cell in this reach, JE-15, has its origin at the broad zone of divergence between Tskutsko Point and Oak Head. Sediment is derived from bluffs cut into sandy glacial drift of the Double Bluff formation, pre-Vashon Stade sediments, and Vashon till. Net shore-drift is to the southeast past Oak Head and northeast to Hazel Point where the drift cell terminates at the end of a cusped spit. Net shore-drift is indicated by northeastward progradation of the bay mouth spit across the mouth of Fisherman's Harbor, and progradation of the cusped spit at Hazel Point. It is thought that much of the sediment is lost to deep water (70 to 90 yards deep) immediately off of the point (Johannessen, 1992). This shoreline is generally considered unstable with numerous recent landslides (Ecology, 1978).

1 Reach U encompasses drift cell JE-14, which begins 2.25 miles northwest of Hazel Point. Drift
2 cell JE-14 has a net shore-drift to the southeast to terminate at Hazel Point. Drift here is governed
3 by a northerly fetch of up to 17 miles causing southward and southeastward net shore-drift.
4 Evidence of southward drift includes the buildup of sediment on the north side of boat ramps,
5 southward stream mouth offset, and the progradation of Hazel Point (Johannessen, 1992). Bluffs
6 in this drift cell and in the zone of divergence to the north are considered unstable with several
7 recent landslides. These bluffs are of similar composition to others on the Toandos Peninsula:
8 Vashon till overlying thicker layers of Possession Drift, older, undifferentiated stratified
9 sediments, and Double Bluff Drift (Ecology, 1978).

10 Reach V originates from the same zone of divergence as JE-14, located 3.6 km north of Hazel
11 Point, and encompasses drift cells JE-13 and JE-12, terminating at the head of Squamish Harbor.
12 Within drift cell JE-13, net shore-drift is generally northeastward for 17 km to terminate at the
13 northern tip of the South Point Spit. Drift cell sediment is initially derived from exposed bluffs
14 cut into sandy glacial drift and streams that are found intermittently along the cell. Northward
15 and northeastward net shore-drift to Thorndyke Bay is indicated by northward offset of two
16 small deltas located 1 and 2 miles south of Brown Point, nearshore bars oriented northeast-
17 southwest that are moving northward in the southern portion of the cell, progradation of two
18 looped bars (that bear a superficial resemblance to a cusped spit but are much more blunt) from
19 uplands, which project seaward slightly, and the northward stream mouth offset on these features
20 (Johannessen, 1992).

21 Within marine Reaches T, U, and V, 7 percent to 17 percent of the planning area is wetland, with
22 estuarine – intertidal the primary wetland classification.

23 Just north of the Thorndyke estuary, several homes sit on top of eroding bluffs (Ecology, 2001).
24 This is an area of frequent slides that contribute abundant sediment to this long drift cell. The
25 shoreline is characterized by areas of heavy riparian vegetation between the eroding bluffs
26 (Ecology, 2001; WDNR, 2001). Water quality in Thorndyke Bay is generally considered good
27 (Parametrix et al., 2000).

28 The long and narrow South Point Spit was formed by sediment transport from an extensive drift
29 cell from the south. The habitat complex historically supported fringing tidal marsh and lagoon
30 habitat protected behind the spit (Todd et al., 2006). Historically, net shore-drift continued north
31 of here to terminate at the head of Squamish Harbor (where JE-12 now terminates). However,
32 dredging the entrance of the marina at Bridgehaven and the jetty to the north of this entrance
33 have interrupted continued net shore-drift to the north (Hirschi et al., 2003b; Johannessen, 1992).

34 Immediately to the north of the jetty at the entrance to Bridgehaven Marina begins drift cell JE-
35 12. This drift cell continues north for about 2 miles terminating at the head of Squamish Harbor,
36 near the mouth of Shine Creek. The spit at the origin of the cell used to be prograding to the
37 north, but this seems to have ceased and the spit has now become detached from the mainland
38 due to the reduction of sediment reaching it, possibly resulting from the shoreline alterations at
39 Bridgehaven (Johannessen, 1992) and the jetty that marks the entrance to the marina. Northward
40 net shore-drift in this part of Squamish Harbor is indicated by northward beach increase (north of
41 the spit), sediment accumulations on the south side of several large trees lying across the beach,

1 and the northward progradation of the small spit 300 yards south of the terminus of the cell
2 (Johanessen, 1992).

3 The northern shore of Squamish Harbor (Reach W) is bounded by drift cell JE-11 which
4 encompasses net shore-drift for 2 miles from the large glacial drift bluff 0.5 mile southwest of
5 the Hood Canal Bridge to the head of the harbor, converging with drift cell JE-12. Abundant
6 sediment is derived from a high bluff west of Termination Point composed of various layers of
7 glacial sediment. A house is perched precariously on the top. This shoreline is classified as
8 unstable recent landslide (Ecology, 1978). Net shore-drift to the west is indicated by sediment
9 accumulations on the east side of obstacles and the westward prograding spit at the mouth of
10 Shine Creek.

11 Within marine Reach W, 27 percent of the planning area is wetland, with estuarine – intertidal
12 (53 percent) and palustrine forested/emergent/scrub-shrub (46 percent) the primary wetland
13 classifications. Sandy Shore Lake is in the upper Thorndyke Creek watershed. Its surface area is
14 34.9 acres. Surrounding the lake, 66 percent of the planning area is mapped as wetland, with
15 lacustrine – limnetic (open water) the primary classification.

16 **4.2.9.4 Biological Resources (Maps 17, 18, 20, 26, and 27)**

17 Major habitat features along drift cell JE-15 include a brackish marsh just northwest of Oak
18 Head, Fisherman's Harbor estuary and mudflats, and a salt marsh enclosed by Hazel Point. Two
19 small drainages into Fisherman's Harbor support chum and coho spawning (Correa, 2002). Bald
20 eagle territory includes the area between Tskutsko Point and Oak Head and the area between
21 Fisherman's Harbor and Hazel Point. Several bald eagle nests are located in this vicinity.
22 Riparian vegetation covers 60 to 80 percent of this shoreline; eelgrass beds are patchy to
23 continuous throughout (WDNR, 2001).

24 Salt marshes occur at Hazel Point and behind a longshore spit 1.7 km to the north (Southeast
25 Toandos Lagoon) (Todd et al., 2006). A surface channel connection is evident between the
26 lagoon and adjacent nearshore waters. It appears that the lagoon receives freshwater inputs from
27 a ditch draining a large lawn area located immediately upslope, and possibly through a narrow
28 forested ravine to the northwest. The native vegetation surrounding the complex to the south has
29 apparently been removed but native conifers occur to the west and north (Todd et al., 2006).
30 This marsh may have been encroached upon from the north by the development of a road and
31 boat ramp. Sand lance spawn just south of this salt marsh; surf smelt also spawn farther north in
32 the zone of divergence between JE-14 and JE-13 (Long et al., 2005). Riparian vegetation is
33 abundant throughout this drift cell except in a few areas of development and bluff face sliding
34 (Ecology, 2001). Eelgrass is patchy in the northern section of this drift cell and largely absent
35 toward the south. There is a bald eagle nest located north of Hazel Point.

36 Eelgrass beds are patchy throughout the length of drift cell JE-13. In general the East Toandos
37 shoreline reach retains function, with undisturbed feeder bluffs interspersed by lower banks
38 covered in healthy riparian vegetation. There is little shoreline alteration to interrupt alongshore
39 drift. Numerous barrier spit salt marshes, often associated with small stream mouths, occur
40 primarily on Navy property, between the origin of the cell and Thorndyke Bay (Ecology, 2001).
41 There are several bald eagle nests in the vicinity of Brown Point. Sand lance spawn in several

1 locations north and south of Brown Point including on the alongshore spit formations mentioned
2 above (Penttila, 2000; Long et al., 2005).

3 The Thorndyke Bay shoreline is one of the least developed areas on Hood Canal and as result is
4 considered one of the top priorities for estuarine conservation in the Puget Sound region (May
5 and Peterson, 2003). Thorndyke Creek estuary is an example of an intact estuary of a mid-sized
6 stream, which is relatively rare in the Puget Sound basin. It is unique for several reasons,
7 including a lack of road crossings, little residential development, and beaver dams in the lower
8 reaches of the stream down to the high-tide line (Correa, 2002; Hirschi, personal communication,
9 2001). It has a large (32-acre) marsh and mudflat complex enclosed by a barrier beach (Leon and
10 Driscoll, 1975). *Spartina*, an invasive cordgrass, had established and spread over large areas of
11 the mudflats by early 2000, but persistent eradication efforts by the Washington State
12 Department of Agriculture have been successful (WSDA 2007). Bald eagles and osprey nest in
13 this area. May and Peterson (2003) identify the Thorndyke Creek estuary as a Category A NSE
14 refugia for salmonids. Thorndyke Bay is also a regionally significant overwintering site for
15 waterfowl.

16 Low summer flow, which may be related to consumptive use of groundwater, has been identified
17 as a factor that limits coho salmon production in Thorndyke Creek. There are consumptive use
18 rights for surface water totaling 2.31 cfs, and claims of 2.96 cfs. If actual use approaches the
19 claimed volume, it could significantly influence summer low flow (Parametrix et al., 2000).
20 Despite a history of logging activity in the watershed and apparent log storage in the estuary, the
21 general extent and configuration of major habitat features are similar to historical conditions.
22 The overall connectivity of the Thorndyke Creek estuary appears relatively unimpaired (Todd et
23 al., 2006).

24 Sand lance spawn just north of the Thorndyke estuary (Penttila, 2000; Long et al., 2005).
25 Nordstrom Creek runs into Hood Canal just south of South Point; its mouth is marked by a small
26 salt marsh of the type favored by juvenile salmonids, and coho and steelhead spawn upstream
27 (Hirschi, personal communication, 2004; Correa, 2002). There are few houses in this area, which
28 appears to be a well functioning ecosystem.

29 Despite shoreline alteration in the South Point area, sand lance spawn both south of South Point
30 and north along the outside of the spit. Surf smelt spawn on the shore just north of the spit
31 (Penttila, 2000; Long et al., 2005).

32 Behind Bridgehaven in a slough dredged for a marina, juvenile salmonids were not found,
33 whereas they were found immediately to the north in the relatively unaltered backshore of the
34 spit at the origin of drift cell JE-12. The southern part of drift cell JE-12, from the origin to the
35 small point about 1.25 miles to the north, has healthy riparian vegetation (100 percent) often with
36 large trees growing over the intertidal zone. This may be because this area is somewhat protected
37 from southern fetch (Correa, 2002; WDNR, 2001). In the nearshore, eelgrass beds are
38 continuous along the outside and the inside of the South Point Spit and patchier farther north to
39 the point mentioned above. The characteristics of this reach are unique. A small stream enters
40 Squamish Harbor near the middle of this drift cell and is presumed cutthroat trout habitat
41 (Correa, 2002).

1 Development increases in the northern end of the drift cell to the head of the harbor, and riparian
2 vegetation decreases to cover about 20 percent of the shoreline (WDNR, 2001). Eelgrass beds
3 are patchy throughout with barnacles and *Ulva*. There is also a bald eagle nest in this area.

4 At the terminus of this drift cell is the Shine Creek estuary, with an extensive salt marsh totaling
5 85 acres with about 5 acres of intertidal habitat. Shine Creek supports chum and coho salmon
6 and cutthroat and steelhead trout spawning. The wetlands are also important rearing habitat for
7 natal and non-natal juvenile pink, chum, coho, and Chinook salmon (Hirschi et al., 2003a).

8 May and Peterson (2003) identify Squamish Harbor and the Shine Creek estuary as a Category A
9 NSE salmonid refugia. The intertidal marsh, mud flat, sand pit and other features of the harbor
10 and estuary provide habitat diversity that increases their ecological value. The NSE refuge
11 provides highly productive rearing habitat for salmon and other species.

12 With the exception of the area in front of the feeder bluff, eelgrass is continuous in the eastern
13 half of drift cell JE-11 and patchy in the western end. Riparian vegetation is sparse along this
14 reach, never covering more than 10 percent of the shoreline. This is primarily due to clearing for
15 views in front of the many houses along this stretch of shoreline (Ecology, 2001). Sand lance
16 spawn along the western end of this reach (Reach W) and herring spawn in the eelgrass beds
17 offshore (Penttila, 2000; Long et al., 2005).

18 **4.2.9.5 Land Use and Altered Conditions (Maps 11, 12, 21, and 22)**

19 **Land Use and Zoning**

20 The dominant land use in this area is commercial timberland. Areas of shoreline residential use
21 are concentrated at the southern end of the Toandos Peninsula, south of the Thorndyke estuary,
22 South Point, and Bridgehaven. Within all marine reaches, between 50 percent and 100 percent
23 of the planning area is zoned Rural Residential. Other significant planning area zoning includes
24 Military Reservation and Commercial Forest.

25 **Transportation and Utilities**

26 Throughout the marine planning area, Jefferson County and WDNR have mapped 14 miles and
27 28 miles of road, respectively. Mapped roads are focused around areas of higher population
28 density, including Fisherman's Harbor at the south end of Toandos Peninsula, Thorndyke Bay,
29 South Pt/Bridgehaven Marina, and Squamish Harbor near Shine. Planning areas of Reach U and
30 the majority of Reach V are largely without roadways.

31 **Shoreline Modifications**

32 There is no shoreline armoring of note along drift cell JE-15. However, there are several docks
33 and overwater structures in Fisherman's Harbor, some in disrepair (Ecology, 2001).

34 Just north of Hazel Point a residential bulkhead extends into the upper intertidal zone, possibly
35 interfering with longshore transport of sediment to the point. This house is also set on the very
36 seaward edge of the bulkhead. Otherwise drift cell JE-14 is minimally altered. The feeder bluffs
37 in the zone of divergence between JE-14 and JE-13 are not armored. JE-13 is subject to only

1 minor bulkheading until the broad point 1,600 meters south of the Thorndyke Creek estuary.
2 There are several extensive bulkheads and a private gazebo or deck structure on the backshore.

3 The forested uplands surrounding the Thorndyke Creek estuary have been logged at least once,
4 and apparently the lagoon itself was used to store and transport logs. Fencing occurs in parts of
5 the estuary, suggesting the area was once used for pasture (Todd et al., 2006). Between the
6 Thorndyke estuary and South Point there are no bulkheads or shoreline alterations of note. Just
7 south of the old South Point ferry dock, several bulkheads extend into the upper intertidal.

8 From South Point ferry dock (now abandoned) northward through the Bridgehaven development
9 the shoreline is severely altered. The entire outer shoreline of the spit has been armored with
10 riprap or concrete bulkheads, while the complete interior side of the spit has a wooden seawall
11 with backfill. In addition, the former salt marsh has been dredged to provide space for the
12 marina. The access road to Bridgehaven constricts tidal exchange to the little salt marsh that
13 remains. There is a riprap jetty north of the entrance to the marina that stops longshore transport
14 of sediment. Developments on the spit complex at the terminus of drift cell JE-13 have severely
15 altered the deposition zone of this drift cell. The former ferry terminal at South Point also
16 interrupts longshore transport of sediment (Correa, 2002).

17 Due to the armoring of the South Point reach shoreline, a coarsening and eroding of the beach
18 has occurred along the southern half of Bridgehaven. This has likely decreased the fine
19 sediments needed by forage fish for spawning (Hirschi et al., 2003b).

20 Shoreline armoring is absent from the southern end of drift cell JE-12, while roughly 30 percent
21 of the northern portion of the drift cell is armored (Hirschi et al., 2003b). This armoring may
22 interfere with longshore transport of sediment and beach substrate composition. Fill and several
23 culverts under Shine Road that modify and restrict flow were replaced with a full-span bridge in
24 2005 (Davis, personal communication, 2006) with the intent of increasing tidal exchange to the
25 upper estuary.

26 Shoreline armoring is prevalent along the north shore of Squamish Harbor, with about 26 percent
27 of this reach armored (Hirschi et al., 2003b). Two boat ramps, one at a County park, extend into
28 the intertidal, with parking lots located on fill. A considerable portion of the lower Shine Creek
29 estuary salt marsh has been filled for residential development, probably beginning in the 1960s
30 (Todd, personal communication, 2006). There are several large riprap bulkheads covering the
31 bluff in front of residences. At the terminus of drift cell JE-11 in the depositional zone, there are
32 several cement bulkheads that may have limited usefulness since erosion is not a major issue at
33 this location. Sediment for this drift cell primarily comes from the large feeder bluff west of
34 Termination Point. Erosion and landsliding are inherent features of this area (Ecology, 2001).

35 **4.2.9.6 Public Access (Maps 21 and 22)**

36 South Toandos State Park provides boat access at Oak Head. Brown Points WDNR tidelands are
37 accessible by boat. The possibility of upland access to this area through Pope Resources land or
38 Navy property should be explored.

39 Case Shoal offshore in the southern part of Squamish Harbor, only exposed at low tide, is owned
40 by the WDNR and is open to recreational shellfishing. The WDNR timberland north of the spit

on the west side of the bay is open to public access; however there are no facilities or improvements. Hicks County Park on the north shore of Squamish Harbor has a boat ramp and there are public WDNR tidelands to the east of the park.

4.2.9.7 Restoration Opportunities

Unused docks and pilings could be pulled from Fisherman’s Harbor. The South Point/Bridgehaven area could benefit from actions that improve sediment function and provide salt marsh habitat for juvenile salmonids. This area is heavily developed and immediate restoration actions are not clear. Potential opportunities include improving/replacing the culvert at the remnant South Point salt marsh to provide fish access.

The reach between South Point Spit and Shine Creek is in pristine condition and should be protected; part of it is already WDNR timberlands (Correa, 2002). Removing or reconfiguring the boat ramps on the north side of the bay would allow for longshore transportation of sediment and increase shallow water habitat. In the North Squamish and Shine reaches, alternatives to bulkheads and restoration of nearshore riparian habitat would improve longshore transport of sediment and enhance shallow water/nearshore habitat.

4.2.10 Hood Canal Bridge to Tala Point (Admiralty Inlet)

4.2.10.1 Overview (Map 1a)

This shoreline is situated between the Hood Canal Bridge and Port Ludlow. Some pristine areas are located in Bywater Bay and around Hood Head. Residential development is concentrated in Reach AA; however, scattered homes are found throughout this section of shoreline. Hood Head is an island connected to the mainland by a tombolo (or spit) and is predominantly undisturbed by development. Development pressures in this area are concentrated south of Tala Point, White Rock Cove, and Bywater Bay.

4.2.10.2 Nearshore Reaches

Reach X: Drift cell JE-10, including Termination Point, the western shore of Bywater Bay, and Wolfe Property State Park.

Reach Y: Drift cell JE-9 on the western side of Hood Head.

Reach Z: Drift cell JE-8 on the east side of Hood Head.

Reach AA: From Point Hannon to Tala Point, including north Hood Head, White Rock Cove, and Paradise Bay.

4.2.10.3 Physical Environment (Maps 12, 15, and 27)

A large basalt bedrock body occurs south of Ludlow Bay. It underlies the principal aquifer between Ludlow Bay and Squamish Harbor at elevations ranging from land surface to several hundred feet below sea level (Parametrix et al., 2000).

1 Drift cell JE-10 originates at the depositional bluffs at Termination Point and continues north to
2 the head of Bywater Bay. At the base of the Hood Canal Bridge, significant progradation
3 seaward (to the southwest) occurred, allowing sediment to continue to travel northward
4 (Johannessen, 1992). Eroding bluffs dominate the shoreline of Bywater Bay, and are unstable
5 from just north of the parking lot at Termination Point to the mouth of a small stream 500 yards
6 south of the end of Seven Sisters Road. Beach width and riparian vegetation increase northward
7 to where the drift cell terminates in a 500-yard-long, broad sand and pea gravel spit at the head
8 of Bywater Bay in Wolfe Property State Park (Johannessen, 1992).

9 Drift cell JE-9 originates at the erosional headland at the southern tip of Hood Head, and net
10 shore-drift is to the north 1 mile to terminate at the head of Bywater Bay (Johannessen, 1992).

11 The next drift cell, JE-8, extends from the feeder bluffs on south Hood Head 1 mile to the
12 northeast to terminate at Point Hannon on Whiskey Spit. South Hood Head is a steep headland of
13 glacial drift that supplies abundant sand and gravel to the intertidal (Johannessen, 1992). This
14 bluff is composed of Vashon lodgement till over a layer of undifferentiated stratified sediments
15 overlying a layer of Possession Drift. Although Vashon lodgement till is considered relatively
16 stable, the underlying sediments are considered unstable on slopes greater than the angle of
17 repose (generally slopes greater than 30 to 39 degrees). Several recent landslides mark this area
18 and, as with all the bluffs on the east side of Hood Head, landslide hazard is considered high
19 (Ecology, 1978).

20 Drift cell JE-7 extends for 4.9 miles from the erosional feeder bluffs at Tala Point in the north to
21 Point Hannon in the south. The sediment source in this drift cell comes from eroding bluffs
22 composed of sandy glacial drift found in the northern and central parts of the cell. Beach
23 characteristics and sediment composition vary as the level of beach exposure varies. Sandy drift
24 material is abundant in the bluffs close to Tala Point but relatively scarce farther south where the
25 bluffs are composed of silt and clay-rich glacial till, with little sand or gravel to replenish the
26 beach (Johannessen, 1992). The remaining shoreline from Paradise Bay to Tala Point is semi-
27 protected, with the majority of the abundant sediment coming from backshore sources.

28 Net shore-drift in cell JE-7 creates the tombolo to North Hood Head, a narrow, low berm that is
29 overtopped at high storm tides. The drift cell terminates at Point Hannon, a cusped spit that
30 extends more than 300 yards from the uplands and is a zone of drift convergence in common
31 with drift cell JE-8 (Johannessen, 1992).

32 Within marine Reaches X and Y, 22 percent to 27 percent of the planning area is wetland.
33 Within marine Reaches Z and AA, 6 percent to 8 percent of the planning area is wetland.
34 Estuarine – intertidal (unconsolidated shoreline and emergent) is the primary wetland
35 classification within all shoreline reaches.

36 ***4.2.10.4 Biological Resources (Maps 18, 20, 24, and 27)***

37 A freshwater marsh lies on the landward side of Shine Tidelands State Park. It is cut off from salt
38 water by riprap fronting a parking lot (Correa, 2002). An osprey pair nests on the peninsula
39 jutting into the tidal lagoon formed by the spit. As of 1999 there was a great blue heron colony of
40 three nests near the end of Seven Sisters Road. Sand lance and surf smelt spawn along the Wolfe

Property State Park from near the end of Seven Sisters Road northward to the beginning of the spit (Penttila, 2000). Brown kelp and eelgrass are continuous to patchy in Bywater Bay, with several dense beds of eelgrass about 200 meters north of the Hood Canal Bridge (Woodruff et al., 2002). Chum salmon are found in the large tidal lagoon in Wolfe Property State Park created by the spit at the head of Bywater Bay. In addition, the small stream draining into the tidal lagoon presumably provides cutthroat trout habitat (Correa, 2002).

Water quality in this entire shore segment is generally good and most areas are approved for shellfish harvest (WDH, 2006). The area at the head of Bywater Bay and the area immediately adjacent to the spit and lagoon are private tidelands belonging to Shellfish Farm, LLC. (Adams, personal communication, 2006). Other tidelands in the area are also privately owned.

The end of drift cell JE-9 encloses a salt marsh along the northeastern shore of Hood Head. Riparian vegetation along this segment is generally dense with the exception of the erosional headlands on the southern end. Eelgrass is patchy in this area of Bywater Bay.

Riparian vegetation is healthy in the northern half of drift cell JE-8, whereas in the southern half much of the riparian vegetation has slid into the nearshore. Sand lance spawning is documented along the south side of Whiskey Spit at Point Hannon (Penttila, 2000). Patches of eelgrass and *Ulva* are found along the southern and eastern sides of Hood Head.

An open water lagoon, with no outlet to the nearshore and surrounded by marsh, occurs at the base of Whiskey Spit. Juvenile Chinook salmon have been observed along Point Hannon Spit feeding on sand lance. Sand lance spawning has been documented on the north side of this spit (Long et al., 2005). The remainder of the spit is covered in dune grass, the only disturbance being a small abandoned cabin and navigational light. This area has been identified as an example of a healthy cusped spit habitat type (Correa, 2002).

Near Tala Point, tall bluff-top trees harbor a bald eagle nest and an osprey nest. The sandy gravel beaches south of Tala Point provide sand lance and surf smelt spawning habitat. There are several additional surf smelt spawning beaches in this reach (Penttila, 2000; Long et al., 2005). The riparian vegetation along this reach is nearly continuous. A brackish marsh is situated south of the unnamed broad point south of Tala Point. Clearing of riparian vegetation for views has occurred, particularly north of Paradise Bay and in White Rock Cove (Ecology, 2001). Patches of *Fucus*, barnacles, *Ulva*, and soft brown kelp, with continuous eelgrass beds, are present in White Rock Cove. Patches of barnacles, eelgrass, and *Ulva*, with some soft brown kelp, are found in the nearshore reaches from Paradise Bay to Tala Point (Correa, 2002).

Patches of *Ulva* and continuous eelgrass occur along drift cell JE-7. A bald eagle nest is located on the northern bluffs of Hood Head.

4.2.10.5 Land Use and Altered Conditions (Maps 12 and 22)

Land Use and Zoning

Land use along the marine shoreline is dominated by residential development. Within all reaches, 100 percent of the planning area is zoned Rural Residential.

1 **Transportation and Utilities**

2 Throughout the marine planning area, Jefferson County and WDNR have mapped 14 miles and
3 28 miles of road, respectively. Mapped roads are focused around areas of higher population
4 density. However, there are roads along the majority of the shoreline throughout the marine
5 planning area.

6 **Shoreline Modifications**

7 Shoreline modifications in this segment include less than 2 miles of bulkhead. The footing of the
8 Hood Canal Bridge interferes with the longshore transport of sediment (Johannessen, 1992). Just
9 to the north of the Hood Canal Bridge, a long riprap bulkhead protects the road and parking lot at
10 Shine Tidelands State Park. Considerable changes have taken place to the marsh/lagoon at Shine
11 Tidelands State Park. There is question as to whether a tidal inlet ever occurred at this site, but
12 the marsh/lagoon was probably dredged at one time (perhaps for log storage) and the current fill
13 and riprap surrounding the marsh/lagoon prevents any regular tidal connection (Todd, personal
14 communication, 2006).

15 Besides some shoreline armoring above the intertidal zone along the west side of Hood Head,
16 Bywater Bay is largely free of bulkheads. No shoreline armoring exists on the north or east sides
17 of Hood Head (Hirschi et al., 2003). White Rock Cove is 20 percent armored with riprap
18 (WDNR, 2001). To the north of Paradise Bay a private access road with a bulkheaded landing
19 extends into the intertidal and interrupts net shore-drift (Correa, 2002). Just north of this, a large
20 riprap bulkhead was installed to protect a large stairway structure and a house situated close to
21 the edge of a slumping bluff (Ecology, 2001). The high bluff at the origin of the drift cell at Tala
22 Point is armored at the toe, which interrupts sediment source for drift cells JE-6 and JE-7
23 (Correa, 2002).

24 ***4.2.10.6 Public Access (Map 22)***

25 Just north of the Hood Canal Bridge, Shine Tidelands State Park provides access to the shoreline
26 north to Hood Head. In addition, there is another parking area at the end of Seven Sisters Road
27 for beach access north to Wolfe Property State Park. Properties on the north shore of Hood Head
28 are owned by WDNR. Some parcels between the state park and DNR tidelands are in private
29 ownership. Point Hannon is owned by Washington State Parks. North of the Paradise Bay
30 development is WDNR-owned public access shoreline that ends just south of the broad point
31 south of Tala Point. A water access primitive campground is planned for State Park land on Point
32 Hannon.

33 ***4.2.10.7 Restoration Opportunities***

34 Moving the parking lot to the south and removing the bulkhead at Shine Tidelands State Park
35 would open up the marsh to the nearshore, providing potential rearing habitat for migrating chum
36 and pink salmon (Correa, 2002). Several bulkheads extending into the nearshore in the Tala
37 Shores area could be removed to allow for improved longshore transport of sediment. Removal
38 of riprap at the base of the bluff at Tala Point would recover the natural rate of sediment input
39 into the nearshore.

4.2.11 Port Ludlow (Admiralty Inlet)

4.2.11.1 Overview (Map 1a)

Port Ludlow, which is designated a Master Planned Resort, is an area of relatively intense residential development. Future development in this area could include expansion of the marina and associated condominium development. Port Ludlow retains some valuable natural habitat including at least one salmon spawning creek (Ludlow Creek), several salt marsh areas, and numerous forage fish spawning beaches. Two drift cells occur in this area as well as extensive back bay areas of no net shore-drift. The geology of this area is mainly glacial drift derived bluffs; however, there are several basaltic outcroppings in southwest Ludlow Bay and farther north at Basalt Point.

4.2.11.2 Nearshore Reaches (Map 9)

Reach BB: Drift cell JE-6 from the origin at Tala Point to the salt marsh at the terminus of drift cell JE-6.

Reach CC: Ludlow Bay from the terminus of drift cell JE-6 to Ludlow Spit, including the Twins, the two basaltic islands in the southern bay.

Reach DD: Drift cell JE-5, the Mats Mats shoreline from Ludlow Spit north to the south jetty at the barge harbor near Basalt Point.

4.2.11.3 Physical Environment (Maps 12, 15, and 27)

Principal aquifer materials in the Port Ludlow area include pre-Vashon stratified glacial drift and interglacial deposits. In addition, Vashon advance outwash materials may be saturated in places. Exposure of principal aquifer materials is noted along the incised channels. Recessional outwash and alluvial materials have subsequently filled in portions of the channels. A large bedrock body occurs south of Ludlow Bay, and underlies the principal aquifer between Ludlow Bay and Squamish Harbor at elevations ranging from land surface to several hundred feet below sea level. The bedrock is composed of basalt (Parametrix et al., 2000).

The tall eroding feeder bluffs on Tala Point provide much of the sediment for the south shore of Ludlow Bay. Tala Point is a classic feeder bluff with little vegetation due to near constant erosion. Drift cell JE-6 begins at this feeder bluff, and net shore-drift continues southeast for about 2 miles into Ludlow Bay. Farther west, contributing bluffs, often forested with patches of even-aged trees indicating past bluff failures, add more sediment to this drift cell. There is abundant evidence of recent landslides along this shoreline including large boulders in the intertidal. Net shore-drift continues to the west to form an accretionary beach in front of a salt marsh. Several groins placed to capture sediment and a turn-of-the-century shipwreck interfere with net shore-drift (Johannessen, 1992; Correa, 2002).

There is no appreciable net shore-drift occurring within Ludlow Bay (Reach CC), the southern shore of which is composed of basalt. Although sandy beach occurs over parts of the harbor, low wave energy and substantial human modification preclude net shore-drift from occurring (Shipman, 1991).

Drift cell JE-5, originating just south of Basalt Point, has net shore-drift to the south for 2.6 miles to the marina at Port Ludlow. Sediment for this drift cell is supplied by several sources, including a contributing bluff composed of compact glacial till, sometimes overlying basalt at the beginning of the cell; a feeder bluff south of this, supplying sediment rich in gravel; and another contributing bluff south of the village of Mats Mats. A large housing development is located on top of this southernmost contributing bluff, near the southern end of Reach DD. Poor drainage management appears to have aggravated and accelerated bluff erosion. This development corresponds to the area listed as unstable recent slides in the Coastal Zone Atlas (Johannessen, 1999; Ecology, 1982). The drift cell terminates at the depositional beach in front of the Port Ludlow resort and restaurant. This is a modified spit complex that still maintains a wide beach with minimal shoreline armoring.

Along the marine shoreline, less than 13 percent of the planning area is wetland in all reaches (less than 0.5 percent in Reach DD). The primary wetland classification is estuarine – intertidal (unconsolidated shoreline and rocky shore. Reach land cover within the planning area is predominantly evergreen forest, bare rock/sand/clay, and acreages/rural residential. Additional areas of commercial/industrial/transportation, deciduous forest, low intensity residential, urban/recreational grasses, transitional, woody wetlands, and mixed forest land cover are mapped.

4.2.11.4 Biological Resources (Maps 18, 20, and 27)

Eelgrass beds are continuous and riparian vegetation is heavy in Reach BB. Eelgrass beds are patchy to continuous within the southern portion of this reach, with riparian vegetation decreasing to the west due to clearing of trees for development and views. Two marshes, the East Ludlow Marsh and Ludlow Lagoon, are found in this reach. East Ludlow Marsh is a small fringing salt marsh that is supported by limited tidal connection and at least one small freshwater stream (Todd et al., 2006). Ludlow Lagoon is important habitat for juvenile salmonids, though some diking and filling of the salt marsh and lagoon has occurred since the 1800s (Todd, personal communication, 2006). The stream flowing into the marsh supports cutthroat trout (Correa, 2002). The Tala Point bald eagle territory includes Tala Point and West Tala Point (Reaches AA and BB). Surf smelt spawn in the middle of the reach, while both surf smelt and sand lance spawn on the barrier beach at the western end of Reach BB (Penttila, 2000; Long et al., 2005).

The back bay area of West Port Ludlow contains the small estuary of Ludlow Creek, which supports coho, chum, cutthroat, and steelhead. The estuary is truncated by fill and culverts associated with the Paradise Bay Road crossing. Juvenile cutthroat and coho use the tidal channels cut into the road fill. In North Port Ludlow, there is an area of fill and scattered residential development with sparse riparian vegetation. Surf smelt and sand lance spawn just west of the marina (Long et al., 2005). The small stream entering Ludlow Bay between Ludlow Creek and the marina supports cutthroat trout and possibly chum salmon, although available habitat is limited due to a blocking culvert at the Oak Bay Road crossing (Hirschi, 1999). Patchy eelgrass beds occur throughout the northern portion of Reach CC.

Forage fish spawning along Reach DD is extensive, with sand lance spawning sites along Ludlow Spit and south of the Mats Mats quarry, and extensive surf smelt spawning along the

1 middle of the drift cell (Long et al., 2005). Nine winter surf smelt sites were found by North
2 Olympic Salmon Coalition studies in the past few years. Two summer surf smelt spawning sites
3 were also found, a rarity in east Jefferson County (Long et al., 2003). These findings reconfirm
4 and expand the spawning sites documented by Dan Penttila of WDFW in the 1990s (Penttila,
5 2000).

6 Riparian vegetation is sparse along the northern part of this shoreline, although in the middle it
7 covers roughly 60 percent of the backshore. Clearing has contributed to the spottiness of
8 backshore riparian vegetation. The preservation of existing vegetation might alleviate some of
9 the erosion of the bluffs in the North Port Ludlow development (Johannessen, 1999; Ecology,
10 2001). Eelgrass beds are continuous in the central portion of this reach, and patchy at the north
11 end and along Ludlow Spit. Offshore, the Colvos Rocks are documented as a seal pupping and
12 haulout area.

13 The enclosed bay of Port Ludlow provides significant nearshore habitat for salmonids (May and
14 Peterson, 2003). The estuary area at mouth of two small season streams at the east edge of the
15 bay is classified as a Category A NSE salmonid refugia. The remainder of the Ludlow Bay NSE
16 is a Category C refugia (May and Peterson, 2003).

17 ***4.2.11.5 Land Use and Altered Conditions (Maps 12, 22, and 25)***

18 **Land Use and Zoning**

19 Land use along the Port Ludlow shoreline is dominated by residential development and resort
20 communities. Within Reaches BB and DD, 65 percent and 48 percent (respectively) of the
21 planning area is zoned Rural Residential. Within all reaches, 32 percent to 57 percent of the
22 planning area is zoned Master Plan Resort – Single Family. Other Master Plan Resort zoning
23 (Resort Complex/Community Facilities and Multiple Family) exists within Reaches CC and DD.

24 **Transportation and Utilities**

25 Within the Port Ludlow shoreline planning area, Jefferson County and WDNR have mapped 1.4
26 miles and 0.7 mile of road, respectively. Shoreline roads include Ludlow Bay Road, South Bay
27 Lane, Skiff Lane, Camber Lane, and Paradise Bay Road along the south shoreline of Port
28 Ludlow, and Oak Bay Road, North Bay Lane, and Gull Drive along the north shoreline of the
29 port. Continuing north along Reach DD, Montgomery Lane and Olympus Boulevard parallel the
30 shoreline.

31 **Shoreline Modifications**

32 Development has encroached into the salt marsh at the terminus of drift cell JE-6. There are
33 several docks in the vicinity of The Twins in the southwest part of the harbor. Six dock-pier
34 structures are mapped in Reach BB, and nine dock-pier structures are mapped in Reach CC.
35 Additionally, a rail launch is mapped within Reach BB. Along the shoreline to the northeast of
36 Ludlow Creek, a log storage yard and loading area was active for many decades. The site today
37 appears abandoned and future plans for restoration of the site are unknown (Todd et al., 2006).
38 In Reach CC there is major shoreline alteration associated with the marina and resort (Ecology,
39 2001). The back of the 2,000-square-foot marina is completely armored. Construction of the mill

in the 1800s resulted in substantial filling of shallow tide flats (Todd et al., 2006). Concrete and rock bulkheading have been identified and mapped along the shoreline as follows: 0.3 mile within Reach BB, 100 feet within Reach CC, and 0.5 mile within Reach DD. Between the barge harbor at Mats Mats and Port Ludlow, drift cell JE-4 is about 9 percent armored with a majority of this armoring in the sediment transport zone.

The few groins and bulkheads along the southern shore of Ludlow Bay do not appear to significantly impact the overall transport of sediment to the accretion beach at the terminus of drift cell JE-6. A greater threat to this drift cell would be armoring of the contributing or feeder bluffs near Tala Point. The Paradise Road crossing at Ludlow Creek, although not a barrier to fish, does interfere with the natural aggradation of the salt marsh into the bay. The marina on the north side of the bay could be impacting the growth of eelgrass. Private docks are also abundant throughout Ludlow Bay, which can have an adverse effect on the growth of eelgrass. Despite the high level of development at Port Ludlow, natural shore forms have largely been maintained, except near the old mill and current marina/resort.

Groundwater contamination has been diagnosed from a leaking underground storage tank at the Port Ludlow Golf Course. Cleanup has been initiated at the site, and the site is not listed as containing groundwater contamination that affects drinking water (Ecology and WDOH, 1999 as cited in Parametrix et al., 2000).

4.2.11.6 Public Access (Map 22)

The beaches of Port Ludlow are private.

4.2.11.7 Restoration Opportunities

Fluvial flow under the Paradise Bay Road crossing could be improved. As the docks are replaced in Port Ludlow, opportunities to reduce overwater coverage could be explored. There is currently an experiment at the NW Maritime center dock in Port Townsend examining “eelgrass friendly” docks, and the results of this study may be applicable in this and other areas. Restoring a more natural lagoon with flow into the bay and a vegetated shoreline on the current site of the tidal pond behind the marina has the potential to increase juvenile migratory salmonid habitat. The need for some of the bulkheads north of Port Ludlow should be explored and alternatives to bulkheads should be assessed. The restoration of native vegetation on the bluffs north of Port Ludlow may help stabilize the bluffs.

4.2.12 Mats Mats Bay (Admiralty Inlet)

4.2.12.1 Overview (Map 1a)

This shoreline extends from the Mats Mats quarry south of Basalt Point to Olele Point, and includes Mats Mats Bay. Three streams enter the west side of Mats Mats Bay, including Piddling Creek.

4.2.12.2 Nearshore Reaches (Map 9)

Reach EE: Olele Point to Basalt Point, including the entire Mats Mats Bay shoreline.

4.2.12.3 Physical Environment (Maps 12, 15, and 27)

The bedrock along the coast at Mats Mats Bay is composed of basalt (Parametrix et al., 2000). A zone of no net shore-drift exists between the barge harbor located south of Basalt Point, north to Olele Point and includes Mats Mats Bay. The only sediment present is on small isolated pocket beaches between basalt outcroppings. Within Mats Mats Bay there is not enough wave action to create net shore-drift (Johanessen, 1992). The mouth of Piddling Creek and a small drainage to the south once formed a wetland complex, but the extent of the original habitat is unknown (Todd et al., 2006).

Six percent of the planning area is mapped as wetland, with 85 percent of the wetland area classified as estuarine – intertidal (aquatic bed/unconsolidated shoreline) and 15 percent classified as palustrine emergent/forested.

Within the shoreline planning area of Mats Mats Bay, reach land cover is predominantly evergreen forest. Areas of bare rock/sand/clay, quarries/strip mines/gravel pits, and low intensity residential land cover are also mapped.

Water quality, specifically fecal coliform contamination, is a problem in Mats Mats Bay, which is considered a Category 5 water for fecal coliform according to Ecology's 2004 Water Quality Assessment. Dissolved oxygen in Mats Mats Bay is depressed in the autumn because of upwelling from Admiralty Inlet (Parametrix et al., 2000).

4.2.12.4 Biological Resources (Maps 18, 20, 24, and 27)

Riparian vegetation has been cleared around the Mats Mats quarry barge harbor. North of this, in the southern entrance to Mats Mats Bay, the riparian buffer is intact.

The North Mats Mats marsh is a tiny fringing salt marsh located on a point in Mats Mats Bay. Though a defined channel is not evident at this marsh, it is of such a low elevation that it probably becomes inundated frequently. There are no known freshwater inputs at the site. Within the Piddling Creek estuary, it is possible that former marsh was filled for residential lawns. An extremely limited amount of tidal marsh is available near the mouth of at least one of the streams near Piddling Creek. A narrow fringing salt marsh at the south end of Mats Mats Bay has been filled for the development of houses, and access to a pier. Much of the shoreline at the south end of the bay appears bulkheaded (Todd et al., 2006).

Mats Mats Bay was newly classified as a seasonal conditionally approved shellfish harvest area in 2005. The marine waters of Mats Mats Bay are impaired by fecal coliform due to elevated levels of bacteria. A management plan requires the seasonal conditionally approved area to be closed to harvest from June through September (WDH, 2006a).

Piddling Creek supports chum salmon and cutthroat trout and once supported coho. However, past land use practices (clearcutting the upper watershed) and an impassable culvert at Oak Bay Road have extirpated the coho. Efforts are underway by Trout Unlimited to reintroduce coho and fix the culvert (Hirschi, 1999). Riparian vegetation is largely intact along the Olele Point reach; this area also supports at least one pair of nesting bald eagles (Correa, 2002). Patchy eelgrass beds line the entrance of Mats Mats Bay.

4.2.12.5 Land Use and Altered Conditions (Maps 12, 22, and 25)

Land Use and Zoning

Land use is predominantly rural residential, reflecting the zoning within Mats Mats Bay and in the areas between Basalt Point and Olele Point. Mats Mats quarry and the associated barge facility dominate the shoreline land use to the south of Basalt Point. The quarry is used for mineral extraction.

Transportation and Utilities

Within the Mats Mats Bay marine planning area, Jefferson County and WDNR have both mapped 0.5 mile of road. Roads within the planning area are part of a network of roads serving the Mats Mats Bay community and the Mats Mats quarry.

Shoreline Modifications

Several rock jetties extend from the Mats Mats quarry barge harbor located to the south of Basalt Point. Twenty-two docks and one boat launch ramp are documented within Mats Mats Bay. Most of the bay has a developed and cleared shoreline, with the exception of the area around the mouth of Piddling Creek, though it appears some filling of former wetland has occurred here and native vegetation has been replaced by lawns and drainage ditches near Piddling Creek (Todd, personal communication, 2006). Within the reach there is 0.37 mile of bulkhead (predominantly rock).

4.2.12.6 Public Access (Map 22)

There is public access to Mats Mats Bay at the public boat ramp on the south side of the bay.

4.2.12.7 Restoration Opportunities

If the basalt quarry ceases operations and is available, it could be an excellent park and restoration site. Riparian vegetation could be planted throughout the shore of Mats Mats Bay where it is lacking.

4.2.13 Oak Bay (Admiralty Inlet)

4.2.13.1 Overview (Map 1a)

This shoreline stretches from Olele Point to the Port Townsend Ship Canal. Development along this shoreline is nearly continuous but less intense compared to the larger scale housing developments in Port Ludlow. Much of this shoreline has sandstone outcroppings at the base of the bluff, so the amount of sediment transported is moderate. Four drift cells extend from Olele Point to the Ship Canal.

4.2.13.2 Nearshore Reaches (Map 9)

Reach FF: Drift cells JE-3 and JE-4.

Reach GG: Drift cell JE-2.

Reach HH: Divergent zone JE-1/JE-2, and drift cell JE-1 to Washington Street, south of Oak Bay County Park.

Reach II: Origin of drift cell JE-1 through Oak Bay County Park, as well as the west shore of the Portage Canal.

4.2.13.3 Physical Environment (Map 12, 15, and 27)

Principal aquifer material along the coast at Oak Bay is composed of sedimentary bedrock (Parametrix et al., 2000). The southernmost reach in this segment of shoreline is Reach FF, encompassing drift cells JE-3 and JE-4. In drift cell JE-4 net shore-drift is to the west from glacial drift deposits immediately to the west of the basaltic headland of Olele Point. The depositional area for this cell is the beach (spit) in front of a salt marsh 780 yards west of Olele Point. Likely there is some continuity of drift with drift cell JE-3, the next drift cell to the west. This is a reinterpretation of the original drift cell study published in 1992 by Johannessen (Johannessen, 1999). Drift cell JE-3 continues to the west 330 yards to a broad 120-yard-long beach that serves as a shared depositional shore form with drift cell JE-2.

Drift cell JE-2 (Reach GG) extends from a zone of divergence about 1.5 miles northwest of Olele Point to the shared zone of deposition with JE-3 located 1 mile west of Olele Point. Net shore-drift is to the south, a local reversal due to the sheltering of this shoreline from fetch by Olele Point. Sediment is derived from Vashon till overlying Quimper sandstone. Advance outwash sand and gravel underlies the till along much of the reach. This layer supplies the greatest amount of sediment to the beach. Mass wasting is not extensive due to the relatively erosion-resistant sandstone toe of the bluff; thus the landslide hazards are low. Erosion in this area is generally triggered by surface water flow and ground saturation (Johannessen, 1999).

Reach HH encompasses much of drift cell JE-1 from its origin to the southern end of Oak Bay County Park. Drift cell JE-1 originates at the same zone of divergence as drift cell JE-2 and has a northward net shore-drift for 5 km to Oak Bay County Park. A small amount of sediment is transported in this drift cell, with geology similar to that of JE-2. Northward net shore-drift is indicated by sediment size decrease, northward bluff vegetation increase, and beach width increase.

Drift cell JE-1 within Reach II terminates at the riprap jetty on the western side of the Portage Canal (Johannessen, 1999). A small stream enters Oak Bay here, where the original spit likely started (Johannessen, 1999). The mouth of Little Goose Creek once entered the extensive salt marsh now trapped behind the riprap associated with the park and dredged canal. The western side of the Portage Canal is an area of no net drift.

Within Reach FF, 8 percent of the planning area is wetland, with estuarine – intertidal, unconsolidated shore (79 percent) and palustrine emergent (21 percent) wetland classifications.

1 Within Reaches GG and HH, 12 percent of the planning area is wetland classified as estuarine –
2 intertidal (aquatic bed/unconsolidated shore). Within Reach II, 33 percent of the planning area is
3 wetland, with estuarine – subtidal (31 percent) and estuarine – intertidal (69 percent) the wetland
4 classifications.

5 **4.2.13.4 Biological Resources (Maps 18, 20, 24, and 27)**

6 Riparian habitat is fragmented along Reach FF, with only about 20 percent remaining uncleared
7 (WDNR, 2001; Ecology, 2000). Eelgrass is nearly continuous along drift cell JE-4 and patchy
8 eelgrass beds occur in front of drift cell JE-3. A salt marsh occurs behind the depositional spit at
9 the terminus of drift cell JE-4. It is located along a pocket beach bounded to the west and east
10 between outcrops of Crescent basalts; the beach has been incrementally filled for development
11 and is truncated by a driveway (Hirschi, 1999; Ecology, 2000; Todd et al., 2006). Sand lance
12 spawn along the beach fronting the marsh and at the shared terminus of cells JE-3 and JE-2
13 (Penttila, 2000; Long et al., 2005).

14 Eelgrass beds are patchy throughout Reach GG. Riparian vegetation ranges from 20 percent to
15 50 percent with patches of trees separated by areas cleared for views. There is a bald eagle nest
16 in the northern part of this reach.

17 Eelgrass beds are continuous in the northern part of Reach HH and patchy in the south, providing
18 a migratory corridor for juvenile salmonids. Riparian vegetation is patchy, being cleared in front
19 of many houses to provide views; locally, there are several large intact regions of vegetation.
20 Surf smelt spawn on a pocket beach in the southern part of the reach (Long et al., 2005).

21 Reach II includes the accretionary zone of drift cell JE-1, about 1 km of shore in the minor
22 embayment in the northwest corner of Oak Bay that has developed into a spit and barrier beach
23 system. The north side is a broad depositional beach and spit that has been bulkheaded to
24 stabilize it for a campground and parking lot associated with the Oak Bay County Park. This spit
25 and the jetty on the west side of the Portage Canal keep the salt marsh isolated from the bay,
26 although in recent years, the spit has eroded and riprap is failing, allowing for a regular tidal
27 connection with the saltmarsh/lagoon behind the spit (Todd, personal communication, 2006)

28 Sand lance spawn on the Oak Bay Spit beach (Penttila, 2000; Long et al., 2005). Although
29 previous reports (Hirschi 1999) suggested that coho no longer inhabited Little Goose Creek,
30 local residents have observed coho and resident cutthroat salmon in Little Goose Creek on
31 several occasions during recent years (Davis, personal communication, 2006, Clogston and
32 Hopkins, Personal communication 2007).

33 **4.2.13.5 Land Use and Altered Conditions (Maps 12, 22, and 25)**

34 **Land Use and Zoning**

35 Land use along the Oak Bay watershed is dominated by residential development and commercial
36 forestry. Within all reaches except for Reach II, 100 percent of the planning area is zoned Rural
37 Residential (69 percent in Reach II). Remaining Reach II areas are zoned Parks, Preserves, and
38 Recreation, and Water.

Transportation and Utilities

Within the Oak Bay planning area, Jefferson County and WDNR have mapped 0.8 mile and 0.6 mile of road, respectively. Roadways within the planning area provide access to residential properties along and near the shoreline.

Shoreline Modifications

Residential development has encroached on the salt marsh on the north side of Olele Point. There are relatively few bulkheads along this stretch of shoreline. However, at the terminus of drift cell JE-2 at the spit in front of the salt marsh at Oak Bay County Park there is major shoreline alteration. The front of the spit is armored with riprap for park access and the campground. Combined with the jetty along the Ship Canal, this cuts off the salt marsh from the nearshore under most conditions. Due to major erosion during winter 2005/2006, there is now tidal access to the marsh/lagoon. Dredging of the Ship Canal resulted in major loss of tidal flat by conversion to deep water and upland fill of the salt marsh (Todd, personal communication, 2006). In addition, at Little Goose Creek, a small coho stream, was rerouted out of the marsh and through a culvert to the southwest of the Oak Bay Lagoon.

Bulkhead and stairways are mapped along the Oak Bay shoreline as follows: Reach FF, 280 feet of rock and wood bulkhead and 3 stairways; Reach GG, 130 feet of wood bulkhead and 12 stairways; Reach HH, 0.3 mile of concrete, rock, and wood bulkhead and 8 stairways; Reach II, 0.2 mile of rock bulkhead and 1 stairway. A landfill is mapped within Reach II.

4.2.13.6 Public Access (Map 22)

There are WDNR tidelands south of Oak Bay County Park accessible by boat. Oak Bay County Park has beach and salt marsh access, shellfish beds, and camping.

4.2.13.7 Restoration Opportunities

Enhancing and/or preserving bluff-top vegetation in this reach could reduce surface runoff which is a primary cause of bluff erosion in this area. The salt marsh at Olele Point could be partially restored.

4.2.14 South Indian Island and Marrowstone Island (Admiralty Inlet)

4.2.14.1 Overview (Map 1a)

Indian and Marrowstone Islands are situated between Port Townsend Bay and Admiralty Inlet. Except for the County park on the southern shore, Indian Island is owned by Naval Magazine Indian Island, a federal naval munitions base for forces stationed in Puget Sound; hence, it is not within County shoreline jurisdiction. However, management of Indian Island shoreline reaches may affect shoreline processes along adjacent shorelines within the County's jurisdiction. Habitat on Indian Island is regionally significant as it is an important nesting area for bald eagles (eight pairs) and its beaches are host to numerous spawning sites for surf smelt and sand lance (Kalina, personal communication, 2000; Penttila, 2000; Long et al., 2005).

Historically connected across a spit/salt marsh, Marrowstone Island is currently connected to Indian Island by a causeway built on fill. Marrowstone Island is primarily rural residential with state parks at both the northern end (Fort Flagler) and the southern end (Kinney Point, accessible only by boat). Growth on Marrowstone Island has been slowed by the general lack of fresh water, although this may change with the construction of a public water system. Between the two islands are Kilisut Harbor and Scow Bay with rich shellfish beds, herring spawning grounds, and large concentrations of overwintering waterfowl.

4.2.14.2 Nearshore Reaches (Map 9)

Reach JJ: Western shore of Indian Island along Portage Canal.

Reach KK: Drift cell JEF-2, from Portage Canal east to the divergence zone JEF-2/JEF-3 between Kinney Point and Lilip Point.

Reach LL: Divergence zone JEF-2/JEF-3 and drift cell JEF-3 to Marrowstone Point.

Reach MM: Drift cell JEF-4 and eastern part of divergence zone JEF-4/JEF-5.

Reach NN: Feeder bluffs in zone of divergence JEF-4/JEF-5 and drift cell JEF-5, including the end of the spit by the Flagler Campground.

Reach OO: Area of divergence JEF-6/JEF-7, drift cell JEF-6 north to the Flagler Campground.

Reach PP: Area of divergence JEF-6/JEF-7, and drift cell JEF-7.

Reach QQ: Mystery Bay and eastern end of divergence zone JEF-8.

Reach RR: Drift cell JEF-9, from the eastern edge of Mystery Bay State Park to the terminus in Scow Bay.

Reach SS: Scow Bay Marsh, the area of undefined drift at the head of Scow Bay.

4.2.14.3 Physical Environment (Maps 12, 15, and 27)

The Indian-Marrowstone Island subbasin is characterized by extensive areas covered with dense basal till overlying glacial sediments and bedrock of volcanic and sedimentary origin. Bedrock is exposed on the southern end of Indian Island and along various coastal locations on Marrowstone Island such as south of Mystery Bay. On Marrowstone Island, the till overlies Vashon advance outwash sediments in most locations. However, in a few locations the till immediately overlies bedrock. On the southern end of Marrowstone Island, outwash deposits reach thicknesses as great as 100 feet but are thin or absent in places. On the northern end of the island, glacial deposits reach thicknesses as great as 1,400 feet (Parametrix et al., 2000).

The east side of the Portage Canal is an area of no net drift, and in the northern half it contains bluffs composed of hard shale and mudstone (Ecology, 1978). Drift cell JEF-2 extends from a zone of divergence between Kinney and Lip Lip Points on Marrowstone Island northwestward to the riprap jetty on the east side of the Portage Canal. Sediment is supplied to this drift cell by

erosion in the zone of divergence and contributing bluffs on southeastern Marrowstone Island. Major depositional areas occur in Reach KK, on the barrier spit fronting a lagoon between the islands, and on the barrier beaches protecting salt marshes in the last kilometer of the drift cell.

Reach LL begins at the zone of divergence with JEF-2 and net shore-drift is generally northward along the entire eastern side of Marrowstone Island. The drift cell terminates at the cusped spit at Marrowstone Point (Keuler, 1988). An interesting rocky intertidal zone occurs at Nodule Point where there is an outcropping of tertiary sandstone. In general, the uplands are stable; however the immediate bluff faces along most of this segment are unstable and marked by many small slides (Ecology, 1978). North of Sound View Cemetery, for example, there are a number of houses now very close to the bluff edge (several meters) where the bluff has shown a steady retreat due to many rather small block slides coming off a steep bluff of compacted fine, silty, Vashon advance outwash. Each slide has removed a couple of meters of bluff top, creating a serious threat to property. Lack of bluff-top vegetation, ground and surface water erosion, and bluff toe erosion all appear to have contributed to this problem.

Drift cells JEF-4 and JEF-5, in Reaches MM and NN respectively, occur completely within Fort Flagler State Park and govern net shore-drift on the northern shore of Marrowstone Island. Both drift cells begin at a large feeder bluff 0.5 mile west of Marrowstone Point. Sediment is derived from 100-foot-tall bluffs composed of Vashon till overlying advance outwash sediments. Net shore-drift in Reach MM is to the east from this feeder bluff and terminates at the cusped spit at Marrowstone Point. Net shore-drift in JEF-5 extends from the same feeder bluff as JEF-4 for 2 miles to the southwest tip of Rat Island (Keuler, 1988). Rat Island was originally a spit but was breached in the middle of the last century (Correa, 2002). It is now grouped into Reach VV, and is not addressed due to its proximity to Indian Island.

Drift cell JEF-6 originates at a zone of divergence 1 mile north of Mystery Bay, and net shore-drift extends about 2 miles to the north to terminate inside the spit at Fort Flagler. This drift cell is within relatively sheltered Kilisnoe Harbor with limited southern fetch (Keuler, 1988). Sediment is derived from eroding bluffs near the origin of the cell and alongshore (WDNR, 2001). Depositional beaches occur in the middle of the cell and at the terminus (Keuler, 1988).

Drift cell JEF-7 originates in the same zone of divergence as JEF-6. Net shore-drift is to the south for 1 mile into Mystery Bay, terminating in the vicinity of Mystery Bay State Park (Keuler, 1988). Sediments are derived from Vashon till and advance outwash deposits (Ecology, 1978).

An area of divergence occurs from the relatively tall bluffs cut into shale and mudstone on the northern side of Griffiths Point. Keuler (1988) shows some net drift occurring to the east into Mystery Bay; however, the current Ecology Coastal Zone Atlas shows this as an area of divergence but no significant drift to the east (Keuler, 1988). To the west and then south from this zone of divergence, drift cell JEF-9 encompasses net shore-drift for 1.7 miles into southern Scow Bay. Sediment is derived from mixed shale/mudstone and glacial till feeder bluffs in southern Kilisnoe Harbor (Keuler, 1988).

The Scow Bay habitat complex forms the low-lying connection between Indian and Marrowstone Islands. A broad spit defines the southern margin of the marsh. Sediments forming this spit are derived primarily from the south shoreline of Marrowstone Island. The

1 overall connectivity has been severely impaired by the road causeway through the middle of the
2 marsh, eliminating a southern tidal connection with adjacent open waters (Todd et al., 2006).

3 Within Reaches JJ, KK, LL, MM, NN, PP, and RR, 8 percent to 16 percent of the planning area
4 is wetland. Within Reaches OO, QQ, and SS, 29 percent to 54 percent of the planning area is
5 wetland. The majority of these wetland areas are estuarine – intertidal (aquatic
6 bed/unconsolidated shore is the most common classification, with additional areas of
7 emergent/unconsolidated shore).

8 Land cover within the shoreline planning area is primarily evergreen forest (20 percent to 60
9 percent, varies reach to reach) and bare rock/sand/clay (33 percent to 53 percent in all reaches
10 except KK and SS). The remaining land cover includes acreages/rural residential (significant in
11 reaches NN and QQ), low intensity residential (significant in Reaches KK and SS), mixed forest
12 (18 percent in Reach SS), pasture/hay, deciduous forest, transitional, woody wetland, and
13 urban/recreational grasses.

14 **4.2.14.4 Biological Resources (Maps 18, 20, 24, and 27)**

15 Sand lance spawn along the southeast shore of the Portage Canal and at two pocket beaches
16 between the north end of the Portage Canal and the Navy property boundary (Penttila, 2000;
17 Long et al., 2005). A salt marsh is protected by an extensive barrier beach along the southern part
18 of the Portage Canal (Ecology, 2001; Todd et al., 2006). The South Indian Island Lagoon,
19 located just east of the Portage Canal, has formed where a westward-pointed spit partially
20 encloses a tidally connected lagoon and fringing marsh. In recent years, it appears that subspits
21 or bars have formed immediately offshore, possibly a result of deflection of sediment from
22 extension of the jetty (Todd et al., 2006).

23 Patchy eelgrass beds occur throughout drift cell JEF-2. There is a bald eagle nest on Kinney
24 Point. This part of Oak Bay serves as an overwintering area for waterfowl including brant.
25 Juvenile salmonids are found in South Indian Island Marsh (Hirschi et al., 2003a). In the County
26 park on South Indian Island, riparian vegetation has been preserved and there are extensive salt
27 marshes. South Indian Island is a popular area for recreational clam digging (Speck, personal
28 communication, 2003). Sand lance spawn on the barrier beach connecting the islands and along
29 the central portion of Indian Island's southern coast (Penttila, 2000; Long et al., 2005).

30 Eelgrass beds are patchy to continuous along East Marrowstone Island. Riparian vegetation is
31 fragmented due to clearing for views in the southern portion (south of East Beach County Park)
32 but is mostly intact in the northern portion (Correa, 2002). Sand lance spawn north of East Beach
33 Park as well as on the depositional beach along Marrowstone Point (Penttila, 2003; Long et al.,
34 2005). Three bald eagle nest sites have been documented within this reach.

35 Eelgrass is absent along drift cells JEF-4 and JEF-5, except for patchy beds around Rat Island.
36 Sand lance spawn on the north side of the spit near Flagler Campground (Long et al., 2005).
37 Bald eagles nest in Reach NN. Riparian vegetation is largely absent from the high bluff areas;
38 however, it is present in the lower bluff areas along this shoreline. Also, LWD is recruited off of
39 the tops of the high bluffs as they erode. Rat Island is a haulout and pupping site for harbor seals
40 and a nesting area for gulls. A brackish marsh at Marrowstone Point apparently has never had an

outlet to Admiralty Inlet (Correa, 2002). Marrowstone Point is home to prairie plants including menzies larkspur (*Delphinium menziesii*) and chocolate lily (*Frittilaria lanceolata*).

Eelgrass occurs in patchy beds throughout drift cell JEF-6. Herring spawn on eelgrass throughout Kilisut Harbor. Surf smelt and sand lance spawn along most of drift cell JEF-7 (Long et al., 2005). There is little riparian vegetation in Reaches PP and QQ (WDNR, 2001). The depositional beach in Reach PP encloses a salt marsh. This part of Kilisut Harbor is also an important overwintering area for brant and other waterfowl.

A depositional spit at the northern tip of Mystery Bay encloses a salt marsh lagoon (Ecology, 1978). Another salt marsh is protected behind a barrier beach within Mystery Bay State Park. Native riparian vegetation has been mostly cleared between the west and east lagoons (Todd et al., 2006). Within Mystery Bay there is no net shore-drift. A small salt marsh is isolated by driveway fill at the southern tip of the bay (Correa, 2002). Eelgrass is nearly continuous north of, and within, Mystery Bay except for patchy beds at the head of the bay. Sand lance spawn on the beaches just north of Mystery Bay and just south of and in the state park (Penttila, 2000; Long et al., 2005). The Mystery Bay shellfish harvest area is listed as an area of concern due to the number of boats, some of which are live-aboards, moored in Mystery Bay (WDH, 2006a). Kilisut Harbor and Mystery Bay are regionally significant overwintering areas for diving ducks.

Development around Nordland has eliminated riparian vegetation on the eastern shore of the bay; in contrast, about 65 percent of riparian vegetation remains on the western shore (WDNR, 2001). Historically, a small salt marsh occurred near the Nordland Store and main road. It has been completely filled (Todd, personal communication, 2006).

Riparian vegetation along the northern side of Griffiths Point is fragmented (Ecology, 2001). Eelgrass is continuous along Reach RR. Surf smelt and sand lance use this shoreline for spawning (Penttila, 2000; Long et al., 2005). This is an important overwintering area for waterfowl and spawning grounds for herring (herring roe is important food for diving ducks). There is commercial aquaculture in Scow Bay. Reach SS has extensive salt marshes.

4.2.14.5 Land Use and Altered Conditions (Maps 12, 22, and 25)

Land Use and Zoning

Land use on Marrowstone Island is primarily rural residential along with farming and forestland. North of Fort Gate Road the entirety of Marrowstone Island is Fort Flagler State Park. Land use on Indian Island is related to the U.S. Navy operations. Zoning in the shoreline planning areas of all reaches reflects current land use.

Transportation and Utilities

Within the South Indian and Marrowstone Island planning area, Jefferson County and WDNR have mapped 4.2 miles and 3.8 miles of road, respectively. Along the south shoreline of Indian Island and continuing north along the southwest shoreline of Marrowstone Island, State Route 116 is within the shoreline planning area. Bridges pass over Portage Canal (between mainland and Indian Island) and the south end of Scow Bay (linking Indian Island and Marrowstone Island). Additionally, stretches of East Marrowstone Road, Griffith Point Road, Flagler

Campground Road, Beach Drive, and other park and residence access roads pass within the shoreline planning area of all reaches.

Shoreline Modifications

The Naval Magazine Indian Island (formerly Port Hadlock Detachment-Indian Island) Superfund site was used by the Navy for munitions storage and handling from 1939 to 1984. Disposal activities at several locations resulted in soil, groundwater, sediment, and shellfish contamination from ordnance compounds, heavy metals, polychlorinated biphenyls (PCBs), and pesticides.

The site was added to the National Priorities List (NPL) (Superfund) in June 1994. Following extensive remedial activities, the site was removed from the NPL in June 2005. Additionally, Ecology indicates a Hazardous Waste Generator within the planning area of Reach JJ and a State Cleanup Site within the planning area of Reach NN.

Within Reach KK, the parking lot for the South Indian Island County Park is constructed on fill placed behind a riprap bulkhead on the beach. Within Reaches KK and LL, the marine shoreline is intact, with feeder bluffs and extensive salt marshes. A small area of shoreline modification exists along the southwest face of Marrowstone, which includes a paved boat ramp, and bulkhead section in front of a resort. A total of 0.65 mile of bulkhead and 17 stairways are mapped within Reaches KK and LL.

In Reaches MM and NN, the parking lot and campground at Fort Flagler State Park are constructed on fill placed on top of approximately 22 acres of historic salt marsh (Correa, 2002). A riprap bulkhead protecting the Coast Guard facility interferes with sediment transport along the north side of Marrowstone Point in Reach MM. The terminus of drift cell JEF-5 in front of the campground at Fort Flagler is altered. Historically, Rat Island was a spit extending from the point. This spit enclosed what was historically an approximately 22-acre salt marsh where the campground now sits (Correa, 2002). In the 1940s the spit was breached by dragging boats over it during military exercises (Hirschi et al., 2003a). Since that time a combination of currents and the interruption of sediment transport have kept Rat Island separated from Marrowstone Island except during low tides. Longshore sediment transport has been interrupted by the little-used boat ramp on the north side of the point (one of two boat ramps existing in Reach NN) (Hirschi et al., 2003a).

Little or no armoring occurs on East Marrowstone except for the bulkhead protecting the parking lot at East Beach County Park. An abandoned pier at Fort Flagler State Park disrupts longshore transport of sediment. On the inside of Kilisut Harbor (Reach OO) there is a boat ramp and dock at Fort Flagler with some nearby associated bulkheading. However, this drift cell, JEF-6, is not highly altered and there is very little armoring of its contributing and feeder bluffs. To the south there is extensive bulkheading in front of the feeder and contributing bluffs in drift cell JEF-7 (Reach PP) amounting to 32.5 percent of the total length of the drift cell (Hirschi et al., 2003b).

Within Mystery Bay State Park, at the north end of the Reach QQ shoreline, there is a dock and boat ramp. There are three docks associated with the town of Nordland and several buildings and filled areas intruding into the nearshore. Just south and north of the Nordland Store, Highway 116 is bulkheaded, possibly eliminating shallow water habitat for juvenile salmonids. At the head of Mystery Bay a driveway truncates a salt marsh. In Scow Bay (Reaches RR and SS)

1 residential bulkheading amounts to 16.1 percent of the total length of drift cell JEF-9, a small
2 house is built on stilts over the intertidal, and there are 11 staircases. Additional modifications
3 include three dock/pier structures and one rail launch. At the head of Scow Bay, along the border
4 of Reaches SS and KK, the causeway that connects Marrowstone Island to Indian Island
5 interrupts tidal flow.

6 Extensive bulkheading in front of the feeder and contributing bluffs in drift cell JEF-7,
7 amounting to 32.5 percent of the total length of the drift cell, could lead or have already
8 contributed to erosion of the alongshore and depositional spits just north of Mystery Bay State
9 Park.

10 **4.2.14.6 Public Access (Map 22)**

11 At the southern tip of Marrowstone, Kinney Point is owned by Washington State Parks and the
12 tidelands are owned by WDNR. Although currently only accessible by boat, this state park
13 property abuts the end of Baldwin Road, so upland access could be possible with parking and
14 road improvements. On the east side of Marrowstone Island there is beach access at East Beach
15 County Park. Fort Flagler at the north end of the island provides access to miles of shoreline
16 along with a campground, shellfish beds, and a boat ramp. Mystery Bay State Park in Nordland
17 has about 700 feet of public access shoreline, a boat ramp, and a dock. In Scow Bay there is
18 WDNR shoreline accessible by boat. There is a street easement extending to the water at
19 Strawberry Lane to the west of Flagler Road where public access from land might be possible,
20 but parking may be a problem due to lack of space between the bluff and the road. The entire
21 south shore of Indian Island is public access and there are several parking areas at South Indian
22 Island County Park off of Highway 116.

23 **4.2.14.7 Restoration Opportunities**

24 There are numerous restoration opportunities in Oak Bay and Marrowstone Island. Juvenile
25 salmonid migratory habitat could be improved by replacing undersized culverts under the road
26 between Marrowstone and Indian Islands to allow for the passage of juvenile salmonids (Correa,
27 2002). A larger culvert or culverts could be placed under the causeway between Marrowstone
28 and Indian Islands to improve tidal exchange between Scow Bay and Oak Bay and improve
29 water quality in Kilisut Harbor, especially near the Scow Bay aquaculture operations.

30 Moving the parking lot at East Beach County Park to an upland site would increase shallow
31 water habitat for migratory salmonids (pink and chum salmon). Removal of an abandoned pier at
32 Fort Flagler along with random creosote pilings in this area would improve transport of sediment
33 north to the terminus of drift cell JEF-3 at Marrowstone Point and decrease creosote input to the
34 water. Removing the bulkhead and restoring the salt marsh at Marrowstone Point would
35 improve beach habitat and increase migratory salmonid habitat. This may entail the removal or
36 relocation of the USGS laboratory at Marrowstone Point and/or the automated Coast Guard light
37 (Correa, 2002). If the little-used boat ramp on the north side of the spit (by the campground at
38 Fort Flagler) were removed, it would improve sediment transport to the terminus of the drift cell
39 on Rat Island (Hirschi et al., 2003b). Restoring at least part of the historic salt marsh at the
40 campground at Fort Flagler could improve habitat for juvenile salmonids and other salt marsh
41 dependent species.

1 Removing the bulkheads within drift cell JEF-7 would improve sediment recruitment and could
2 help sustain beaches north of Mystery Bay. Removal of fill within a salt marsh in Reach PP
3 would increase salt marsh habitat (Correa, 2002). A driveway truncating the salt marsh at the
4 head of Mystery Bay could be removed to provide access to salmonids and other wildlife. A
5 neighboring driveway can be used for access (as is evident from the Ecology shoreline photos).
6 Unused creosoted pilings could be removed from Mystery Bay State Park to improve water
7 quality (Correa, 2002).

8 **4.2.15 Port Townsend Bay (Admiralty Inlet)**

9 **4.2.15.1 Overview (Map 1a)**

10 This area contains the most intense development within the County's jurisdiction at Port Hadlock
11 and near the Port Townsend Paper Mill. This area also includes the relatively undeveloped areas
12 south of Hadlock and between Chimacum Creek and Glen Cove. This shoreline is within the
13 watershed of the Tri-area Urban Growth Area around Port Hadlock and Irondale. There are five
14 drift cells and a portion of another cell within this area. This area is drier than areas farther south
15 in the County, with approximately 28 inches of annual rainfall in the Chimacum area, and 18
16 inches a year in Port Townsend.

17 The City of Port Townsend has shoreline jurisdiction along the eastern portion of Reach CCC
18 and the eastern portion of Reach EEE.

19 **4.2.15.2 Nearshore Reaches (Map 9)**

20 Reach YY: From the origin to the terminus of drift cell JEF-16.

21 Reach ZZ: Hadlock Lagoon, drift cell JEF-17, and the southern end of divergence zone JEF-18.

22 Reach AAA: The northern end of divergence zone JEF-18 and the Chimacum Creek estuary.

23 Reach BBB: Kala Point, including drift cells JEF-19, JEF-20, JEF-21, and the divergence zone
24 JEF-21/JEF-22.

25 Reach CCC: Drift cell JEF-22, including the shoreline from the north edge of Old Fort
26 Townsend State Park to the City of Port Townsend boundary.

27 **4.2.15.3 Physical Environment (Maps 12, 15, and 27)**

28 Drift cell JEF-16 begins at the northwest edge of the broad point to the north of the Portage
29 Canal and continues about 1 km to terminate at a depositional beach just to the west of the Inn at
30 Port Hadlock. The average rate of erosion near the origin of the drift cell is 4 cm a year based on
31 a greater than 20-year record (Keuler, 1988). Sediment is derived from contributing bluffs of till
32 overlying sandstone at the origin of the cell and just east of the Inn at Port Hadlock
33 (Johannessen, 1999).

1 The depositional beach just west of the Inn at Port Hadlock encloses a small salt marsh, which is
2 part of Reach ZZ (Ecology, 2001). Skunk Island is a basaltic outcropping covered in vegetation
3 just south of Port Hadlock. It remains in a relatively undisturbed state.

4 Drift cell JEF-17 originates north of Port Hadlock, and net shore-drift is south to terminate at the
5 spit south of lower Port Hadlock. Sediment is derived from the steep feeder bluffs south of
6 Irondale. The bluff is composed of sandy recessional outwash, over till, over advance glacial
7 outwash which, in sum, provides abundant sediment to the nearshore. This bluff (Hadlock
8 Bluffs) has not experienced any large failures recently; however, it remains the only long-term
9 sediment source for drift cells JEF-17 and JEF-18 (Johannessen, 1999). This shoreline is
10 classified as unstable with recent landslides (Ecology, 1978). A wide depositional beach is
11 present along the Port Hadlock waterfront and continues to form a long (780-yard) depositional
12 spit enclosing a large tidal lagoon south of lower Port Hadlock (Hadlock Lagoon). This spit still
13 appears to be prograding to the southeast (Johannessen, 1999).

14 Drift cell JEF-18 originates from the same feeder bluffs as JEF-17. Net shore-drift is northward
15 to the mouth of Chimacum Creek in Reach AAA. A small accretionary beach forms at the end of
16 the extensive bulkheading and fill from the iron and paper mills (Keuler, 1988). This fill was
17 removed in spring 2006 (Todd, personal communication, 2006).

18 Two drift cells (JEF-19 and JEF-20) occur between the mouth of Chimacum Creek and Kala
19 Point, diverging from a shared feeder bluff. This feeder bluff, composed of advance outwash
20 overlain by glacial till, contributes high-quality sediment to the nearshore (Johannessen, 1999)
21 and marks the boundary between Reaches AAA and BBB. This 330-yard-wide bluff just north of
22 Chimacum Creek feeds the short drift cell JEF-19 with sediment for net shore-drift to the south
23 to terminate at the mouth of Chimacum Creek. It also feeds sediment into drift cell JEF-20,
24 which has northeastern net shore-drift, to terminate at the mouth of the lagoon on Kala Point, a
25 cusped spit. This lagoon with its associated tidal channels is encircled by the spit and maintains
26 a vigorous tidal exchange with Port Townsend Bay. These reaches are not subject to any
27 shoreline modification and exhibit relatively natural function (Johannessen, 1999).

28 The subestuary at the mouth of Chimacum Creek is in good condition. There are no roads,
29 jetties, or dikes encroaching on the small, 5.2-acre delta. Several acres of the tidal marsh were
30 filled in the late 1800s; a road crosses this filled area. A small area of the delta has been used for
31 log storage (Parametrix et al., 2000). WDFW purchased the old log dump area south of the
32 mouth of Chimacum Creek in 2003 and removed the fill from approximately 6 acres to restore
33 the beach and shoreline in 2006; riparian vegetation is also being restored (Todd, personal
34 communication, 2006; Davis, personal communication, 2006).

35 The geology of the Quimper Peninsula (including Reaches BBB and CCC) is characterized by
36 extensive areas covered with dense basal till, by broad channels eroded through the till into
37 underlying principal aquifer materials, and by the presence of loose ablation till overlying
38 portions of the basal till. Principal aquifer materials are predominantly composed of Vashon
39 advance outwash, pre-Vashon stratified glacial drift, and interglacial deposits (Parametrix et al.,
40 2000).

1 Drift cell JEF-21 (Reach BBB) originates from a zone of divergence in the southern shore of Old
2 Fort Townsend and exhibits net shore-drift to the south to the lagoon entrance on the southern
3 side of Kala Point (Keuler, 1988; Johannessen, 1999). The bluffs forming divergence zone JEF-
4 21/JEF-22 are composed of glacial till overlying Vashon advance outwash sediments and are
5 classified as unstable with many recent slides (Ecology, 1978). A rarity in the Puget Sound
6 region, small sand dunes occur along the north side of the spit at Kala Point (Todd et al., 2006).

7 Reach CCC includes the next drift cell and the last in this segment, JEF-22, as well as the
8 northern portion of the feeder bluffs in divergence zone JEF-21/JEF-22 in Old Fort Townsend
9 State Park. Net shore-drift is to the northeast and then northwest to Point Wilson, being
10 interrupted along the modified portions of shoreline by the Port Townsend Paper Mill and City
11 of Port Townsend. The paper mill, at the northeast end of a major depositional beach, has filled
12 over a portion of a backshore marsh/lagoon at Glen Cove; the complex encloses a glacial
13 depression that supports marsh and lagoon habitat features (Keuler, 1988; Ecology, 2001; Todd
14 et al., 2006). The City of Port Townsend municipal boundary is just north of the paper mill. For
15 more information about the shorelines within the City of Port Townsend, refer to the *Shoreline*
16 *Inventory Summary Report* (Nightingale, 2002) and *Final Report Characterization of Functions*
17 *& Ecosystem-wide Processes* (GeoEngineers, 2004).

18 Water quality in Port Townsend Bay is generally considered good, although residential and
19 urban areas have been identified as the primary non-point sources of pollutants, as well as the
20 relatively high abundance of farms and livestock rearing activities (Parametrix et al., 2000). The
21 Washington State Department of Health (2006) has classified the nearshore area of Reach YY as
22 a prohibited shellfish harvest area and the bay is identified as a Biotoxin Closure zone.

23 With variation from reach to reach, between 6 percent and 20 percent of the shoreline planning
24 area is wetland, with estuarine – intertidal (aquatic bed/unconsolidated shore) the most common
25 wetland classification. Significant areas of palustrine open water wetlands are mapped in Reach
26 CCC.

27 Land cover within the shoreline planning area is primarily evergreen forest (27 percent to 48
28 percent, varies reach to reach) and bare rock/sand/clay (29 percent to 39 percent in Reaches YY
29 and BBB). The remaining land cover includes commercial/industrial/transportation (significant
30 in Reach CCC), residential (significant in Reaches ZZ and AAA), urban/recreational grasses
31 (significant in Reaches ZZ and AAA), woody wetland (16.5 percent in Reach ZZZ), mixed
32 forest, low intensity residential, and acreages/rural residential.

33 ***4.2.15.4 Biological Resources (Maps 18, 20, 24, and 27)***

34 Riparian vegetation is fragmented along the drift cell JEF-16 shoreline (WDNR, 2001, 2005;
35 Ecology, 2001). Eelgrass is continuous and sand lance spawn along much of this drift cell
36 (Penttila, 2000; Long et al., 2005).

37 Riparian vegetation in the Hadlock Bluffs area is largely intact, but it is largely absent from the
38 Hadlock Waterfront area of Reach ZZ (Ecology, 2001). Sand lance spawn along the length of
39 these beaches. Surf smelt spawn just north of the waterfront (Penttila, 2000; Long et al., 2005).
40 Eelgrass is continuous along Hadlock Bluffs and patchy beds occur in front of the waterfront,

1 spit, and lagoon. The small salt marsh and lagoon has exchange with the bay, and contains
2 shallow water foraging habitat for juvenile salmonids (Hirschi, 1999). Low and high salt marsh
3 lines the perimeter of this lagoon (Leon and Driscoll, 1976). A small unnamed stream flows into
4 the lagoon and at one time possibly provided salmonid spawning habitat; however, recent
5 salmonid use was not found (Hirschi, 1999). This lagoon is also an important area for
6 overwintering waterfowl.

7 Riparian vegetation is present along the moderately high feeder bluffs at the southern part of
8 Reach AAA. However, it is absent throughout the modified part of this reach (Ecology, 2001).
9 Clam digging is locally popular at the mouth of Chimacum Creek. The estuary of Chimacum
10 Creek contains salt and brackish marsh (Todd et al., 2006).

11 Collectively, the beaches, intertidal areas, and nearshore areas from Pulali Point to just south of
12 Chimacum Creek are considered to be a Category A NSE salmonid refugia (May and Peterson,
13 2003). The estuary provides quality rearing habitat for juvenile coho, searun cutthroat trout, and
14 summer and fall chum salmon. The summer chum salmon run has been restored to Chimacum
15 Creek after being extirpated in the early 1990s, and the estuary and nearshore are important
16 nursery habitat for this species (May and Peterson, 2003).

17 The riparian zone is intact along the lower section of Chimacum Creek (May and Peterson,
18 2003). Eelgrass beds offshore provide more habitat. Sand lance spawn along the beaches south of
19 the Chimacum Creek estuary (Long et al., 2005). The mouth of Chimacum Creek is also
20 important habitat for waterfowl.

21 Eelgrass beds are patchy to continuous south of Kala Point in Reach BBB, providing a migratory
22 corridor for juvenile salmonids and spawning substrate for herring. The lagoon at Kala Point and
23 its associated 8.5-acre salt marsh are likely intimately associated with the success of
24 outmigrating salmonids from Chimacum Creek (Hirschi, 1999; Leon and Driscoll, 1976). Sand
25 lance spawn just south of the outlet to the lagoon and on the north side of the point (Penttila,
26 2000; Long et al., 2005). This shoreline supports a bald eagle territory and significant waterfowl
27 concentrations. Riparian vegetation is largely intact, but some bluff-top clearing has occurred for
28 new home sites (Ecology, 2001). The bluff immediately to the north of Chimacum Creek was
29 recently purchased with State Salmon Recovery Funding Board (SSRFB) funds.

30 North of Kala Point, eelgrass meadows are continuous and the Port Townsend Bay herring stock
31 uses them for spawning substrate (Penttila, 2000). Sand lance and surf smelt spawn at the north
32 end of Reach BBB into Reach CCC (Long et al., 2005). This shoreline is also one of the few in
33 Jefferson County where summer surf smelt spawn.

34 Historically, there have been bald eagle nests along this shoreline and it is a bald eagle territory.
35 Riparian vegetation is generally healthy in this segment. While some bluff-top clearing has
36 occurred, there has historically been an effort in the Kala Point Development to preserve riparian
37 vegetation (Ecology, 2001). This has maintained relatively stable bluffs and preserved shoreline
38 ecology.

39 Drift cell JEF-22 south of the paper mill is rather pristine and is contained in Reach CCC.
40 Eelgrass is continuous along this segment, becoming patchy in front of the barrier beach just

1 south of the paper mill, and again serves as spawning substrate for herring (Penttila, 2000). Surf
2 smelt and sand lance spawn on the beaches in Old Fort Townsend State Park, in the southern
3 portion of this drift cell, and on the beach in the center of Glen Cove (Penttila, 2000; Long et al.,
4 2005). The pond and marsh at Glen Cove harbors significant waterfowl concentrations. Riparian
5 vegetation from the origin of this drift cell north to Glen Cove is intact (Ecology, 2001).

6 **4.2.15.5 Land Use and Altered Conditions (Map 12 and 22)**

7 **Land Use and Zoning**

8 Land use along the Port Townsend Bay drainage is dominated by residential development.
9 Except for small areas of Parks, Preserves, and Recreation (11 percent in Reach BBB) and Rural
10 Village Center (11 percent in Reach ZZ), zoning throughout the planning reflects rural
11 residential land use.

12 The Inn at Port Hadlock, Port Hadlock, Irondale, and Port Townsend Paper are within
13 commercial and industrial zoning. Irondale is registered as a state historic district and had
14 extensive charcoal kilns and concrete tanks on the waterfront, along with deepwater piers. The
15 ironworks also mined all the iron and charcoal deposits from “Chimacum Bog”. There are plans
16 for concentrating commercial development along the shoreline at the Inn at Port Hadlock and at
17 Port Hadlock, which include increased boat and water access (and dock expansion). These plans
18 could affect future shoreline use and habitat functions.

19 **Transportation and Utilities**

20 Within the Port Townsend Bay planning area, Jefferson County and WDNR have mapped 1.7
21 miles and 1.9 miles of road, respectively. Road densities are higher to the south and north of Old
22 Fort Townsend State Park, with roads in proximity to the shoreline providing access to
23 residences.

24 **Shoreline Modifications**

25 A large marina with about 100 small slips is located in front of the Inn at Port Hadlock in Reach
26 YY. However based on an examination of Ecology shore photos, it does not appear to
27 significantly affect net shore-drift. Approximately 177 meters of drift cell JEF-16 are armored,
28 representing about 17 percent of its total shoreline. Modifications appear concentrated along the
29 low bank area near the origin of the cell (Hirschi et al., 2003; Ecology, 2001). Three wooden
30 bulkheads along the contributing bluff area of this drift cell may limit sediment recruitment into
31 the nearshore (Johannessen, 1999).

32 Numerous docks, bulkheads, a boat ramp, and other structures are present along Reach ZZ.
33 Extensive bulkheading has occurred just north of the waterfront in front of low-bank residential
34 property. On the spit south of Hadlock there has been some bulkheading and a dock associated
35 with a house (Johannessen, 1999; Ecology, 2001). Overall, shoreline armoring impacts 335 yards
36 of drift cell JEF-17, or 31 percent of its length (Hirschi et al., 2003b). However, it appears that
37 net shore-drift is not completely impaired as the spit southeast of the waterfront continues to
38 prograde.

1 Reach AAA is extensively modified with 513 yards of bulkhead fronting fill in its depositional
2 zone along the former iron mill and log dump sites (Johannessen, 1999). Most likely a salt marsh
3 spit complex prior to fill activity, this site has been publicly acquired for a park, and the rock
4 bulkhead and fill have been removed to restore shallow water habitat for juvenile salmonids and
5 beach habitat for forage fish spawning (Hirschi et al., 2003b; Todd, personal communication,
6 2006). The restoration project has been funded by the State Salmon Recovery Funding Board to
7 remove the fill and restore the depositional beach (Correa, 2002). Two facilities are monitored
8 by Ecology within Reach AAA, including one State Cleanup Site and one Underground Storage
9 Tank.

10 A dock and boat ramp on the north side of Kala Point, within Reach BBB, do not appear to
11 impede significant amounts net shore-drift (Ecology, 2001). A bulkhead extends into the
12 intertidal zone in Old Fort Townsend State Park.

13 Within Reach CCC, the salt marsh at Glen Cove is extensively filled and modified for settling
14 ponds and other structures associated with the Port Townsend Paper Mill. The paper mill is built
15 over the water and is the site of extensive bulkheading and shoreline armoring. There are also
16 several large docks and barge unloading facilities at this location. Several facilities are monitored
17 by Ecology within Reach CCC, including five Hazardous Waste Generators, six Underground
18 Storage Tanks, one Leaking Underground Storage Tank Facility, one Voluntary Cleanup Site,
19 and two Enforcement Final Locations (Ecology, 2006). The shoreline north of the mill to the
20 City of Port Townsend boundary is bulkheaded, fronting a converted railroad grade (which is
21 now a public path) and isolating the bluff from the nearshore (Ecology, 2001; Correa, 2002).

22 **4.2.15.6 Public Access (Map 22)**

23 A public boat ramp is located on the lower Hadlock waterfront. In Irondale the shoreline from
24 the old iron mill site to Chimacum Creek is a combination County park and WDFW lands. A
25 major restoration occurred in 2006 with the removal of fill associated with the log dump and the
26 reestablishment of a beach. There is waterfront access at Old Fort Townsend State Park south of
27 Port Townsend. Between the Port Townsend Paper Mill and the Port of Port Townsend there is a
28 public waterfront trail (the Larry Scott Trail).

29 **4.2.15.7 Restoration Opportunities**

30 The lower Hadlock waterfront should be examined for opportunities to remove alterations that
31 interfere with longshore transport of sediment. The restoration of the beach at the old log dump
32 is a major project completed in 2006. This should improve estuarine and forage fish spawning
33 habitat. The removal of the filled bulkheaded area at Old Fort Townsend would improve the
34 longshore transport of sediment and increase shallow water nearshore habitat. The opening of an
35 outlet that would allow fish passage to the lagoon south of the paper mill would increase salt
36 marsh habitat for summer chum and pink salmon. Studies and possible modification of the paper
37 mill to allow for less disruption to salmon migration could be explored. Alterations to the mill
38 could happen as part of normal maintenance and refurbishment. The removal or modification of
39 the Larry Scott Trail north of the paper mill would allow for the recruitment of sediment into the
40 nearshore.

4.2.16 Chimacum Creek (Admiralty Inlet)

4.2.16.1 Overview (Map 1a)

Chimacum Creek has a watershed of about 33 square miles, with headwaters in the coastal hills south of the town of Chimacum. The stream flows north through the Chimacum, Port Hadlock, and Irondale communities into Port Townsend Bay. The shoreline of the state begins at the mouth and stretches to the fork at about RM 2.9 to create the east and west forks. There are four lakes and the mill settling pond in this watershed that are subject to the County's SMP.

4.2.16.2 Freshwater Reaches (Map 9)

Chimacum Creek 1: From the end of tidal influence to just downstream of where east and west forks diverge.

Chimacum Creek 2: From downstream of where east and west forks diverge to approximately RM 3.3.

Chimacum Creek 3: From approximately RM 3.3 to near the crossing of State Route (SR) 19.

Chimacum Creek 4: From near SR 19 to near the crossing of Highway 104 and Center Road.

4.2.16.3 Physical Environment (Maps 15, 22, and 25)

The upland geology of the Chimacum Creek basin consists of quaternary glacial deposits as much as 900 feet thick overlying shale, sandstone, and lava, while the lowland valleys are characterized by deep muck and peat soil. Principal aquifer materials are composed of pre-Vashon stratified glacial drift, interglacial deposits, and Vashon advance outwash. Exposures of principal aquifer materials are noted along the incised valleys. Bedrock exposures are present along the western edge of the subbasin near Anderson Lake, Gibbs Lake, southeast of Peterson Lake, and along the east fork of Chimacum Creek (Parametrix et al., 2000; Simonds et al., 2003).

From the mouth to RM 1.3 the stream flows through a tightly constricted ravine with good riparian cover and fair pool habitat (May and Peterson, 2003). For the lower 0.2 mile, Chimacum Creek is tidally influenced, with salt marsh and lagoon habitat, and relatively unaltered by development. Between RM 1.3 and 2.9 the riparian area is generally in good condition with medium to high quality spawning and rearing habitat and floodplain wetlands; however, adjacent commercial and residential development are increasing (May and Peterson, 2003).

Above RM 3.0, Chimacum Creek has been channelized via maintenance dredging associated with reed canarygrass removal. Historic beaver ponds/wetlands have been converted to agriculture and rural residential use and are now predominantly ditches without structure, complexity, or well vegetated riparian zones. LWD is lacking in this segment and future recruitment potential is limited due to lack of a forested riparian zone (Correa, 2002). A number of channelized reaches have had meanders reincorporated, and native riparian plantings have been installed in recent years (Todd, personal communication, 2006).

Chimacum Creek in Reach 4 is listed as a Category 5 water for temperature according to the 2004 Ecology Water Quality Assessment.

Within Chimacum Creek Reaches 1, 2, and 3, approximately 25 percent to 40 percent of the planning area is wetland. Within Reach 4, 93 percent of the planning area is wetland. The majority of wetlands are classified palustrine emergent and scrub/shrub in Reaches 1, 2, and 3 and palustrine forested in Reach 3. A small area of estuarine – intertidal wetland is mapped at the mouth of the stream.

4.2.16.4 Biological Resources (Map 18)

Coho, summer chum, fall chum, steelhead, and cutthroat use this watershed for spawning. Coho salmon spawn from the lower reaches of Chimacum Creek up to the headwaters, and are considered a healthy stock with spawning surveys indicating an increasing trend (Parametrix, 2000). Summer chum were extirpated from Chimacum Creek in the early 1990s and have since been reintroduced. Summer chum spawned in the lower mile of stream, below the Irondale Road crossing. The population, already critical, was unable to spawn after a culvert failure at Irondale Road sent tons of fine sediments into the stream in the winter of 1985-1986. This cemented the spawning gravels together, reducing reproductive success and causing eventual extirpation (Lowrie, personal communication, 2005). This population has since been reintroduced with stock from Salmon Creek in a volunteer broodstock hatchery program. The first returning spawning adults were counted in 1999, and in 2001 the estimated return based on spawning surveys was about 900 adults (Correa, 2002). Recent returns have been even higher, estimated at over 1,300 in 2004-2006 (Latham, personal communication, 2006). In 2004-2006 summer chum spawned up to Ness's Corner Road, a mile farther than previously observed. This may have been a reestablishment of historical spawning habitat (Long, personal communication, 2004).

4.2.16.5 Land Use and Altered Conditions (Maps 22 and 25)

Land Use and Zoning

Land use in the upper Chimacum watershed is characterized by public and private forestry, while the middle section is characterized by agriculture, rural residences, commercial enterprise, industry, and parks. At the reach scale, zoning along Reach 1 is mainly Rural Residential with some Light Industrial (Commercial). The middle reaches are zoned Rural residential with some Park land (Reach 2 and 3). Reach 4 is mostly zoned for Agriculture.

Transportation and Utilities

Within the planning area of Chimacum Creek Reaches 1 through 4, Jefferson County and WDNR have mapped 0.5 mile and 1.5 miles of road, respectively. Roadways within the planning area never parallel the stream, with the exception of a short stretch of West Valley Road within Reach 4. A total of 14 road crossings occur within the four stream reaches, the majority of which involve culverts.

Jefferson County and WDNR have mapped 0.44 mile and 0.34 mile of road, respectively, within the planning area of Gibbs Lake. Gibbs Lake Road parallels the eastern shore of the lake.

1 **Shoreline Modifications**

2 Historically this area, and the broad agriculturally dominated valley upstream, was a complex of
3 beaver ponds and cedar/spruce swamp. This type of habitat provided excellent coho rearing
4 habitat. Subsequently, much of this area was drained and channelized, altering flow and
5 destroying 90 percent of juvenile salmonid rearing habitat in the watershed (Correa, 2002).
6 Agriculture such as livestock production in the Chimacum Creek valley has been identified as
7 one of the main sources of pollutants in this subbasin. Voluntary implementation of agricultural
8 best management practices by landowners in recent years has improved salmon habitat and
9 reduced the impacts of farming operations on water quality. Residential development in the
10 towns of Chimacum, Port Hadlock, and Irondale is also a potential non-point source.

11 West of Chimacum Creek in an area of Vashon advance outwash, Jefferson County Public
12 Utility District #1 withdraws groundwater at a rate of approximately 555 gallons per minute from
13 a highly transmissive zone known as the Sparling Aquifer to supply the communities of
14 Chimacum, Irondale, and Port Hadlock (Simonds et al., 2003). Groundwater contamination
15 from a leaking underground storage tank is reported at the Chimacum School District; however,
16 reviewed references provide no evidence that this leak has compromised drinking water for other
17 groundwater users (Parametrix et al., 2000).

18 ***4.2.16.6 Public Access (Map 22)***

19 The area surrounding Chimacum Creek is privately owned throughout all reaches except at road
20 right-of-way crossings of the stream.

21 ***4.2.16.7 Restoration Opportunities***

22 Most of the restoration opportunities on Chimacum Creek occur upstream on the East and West
23 Forks where there are opportunities to restore the channelized stream to a more natural system.
24 In the lower section, protecting existing riparian vegetation and maintaining water quality are
25 essential.

26 Water quality problems, which include high temperature, low dissolved oxygen, and elevated
27 fecal coliform levels, could be alleviated with significant recovery of the riparian zone
28 (Parametrix et al., 2000). In addition, restoration of lost/degraded wetlands and floodplain
29 reconnection would improve ecological function in this area.

30 **4.2.17 Gibbs, Beausite, Anderson, Peterson, Ludlow, and Teal Lakes**
31 **and Mill Pond (Admiralty Inlet)**

32 ***4.2.17.1 Freshwater Reaches (Map 9)***

33 Gibbs Lake: Approximately 0.9 mile northwest of the intersection of Gibbs Lake Road and West
34 Valley Road.

35 Beausite Lake: Approximately 0.5 miles east of Gibbs Lake and 0.4 miles west of the
36 intersection of Beausite Lake Road and West Valley Road.

Anderson Lake: Approximately 1.2 miles west of Chimacum Creek 2 and Chimacum Creek 3 reaches.

Peterson Lake: Near the intersection of Highway 104 and Highway 101.

Ludlow Lake: Approximately 3.3 miles west of Port Ludlow and 0.4 miles northeast of the intersection of Highway 104 and North Sandy Shore Road.

Teal Lake: Approximately 1.4 miles south of Port Ludlow and immediately to the west of the intersection of Teal Lake Road and Andy Cooper Road.

Mill Settling Pond: Located directly east of the Port Townsend Paper Mill facility, near Glenn Cove.

4.2.17.2 Description

Gibbs Lake is located southwest of Chimacum in the Naylor's Creek watershed, which flows into Chimacum Creek. The lake has a surface area of 35.5 acres. Around the shoreline of Gibbs Lake, 75 percent of the area is wetland (primarily lacustrine – limnetic open water). Primary land cover is evergreen forest within the lake planning area, with additional areas of bare rock/sand/clay, deciduous forest, and mixed forest.

In high-flow years, coho salmon spawn just downstream from Gibbs Lake in Naylor's Creek, and upstream of the lake to spawn in two small tributaries (Correa, 2002). There is evidence that coho use Gibbs Lake for rearing and may be trapped in the lake during dry years (Soehl, personal communication, 2001).

The shorelands and uplands surrounding Gibbs Lake are a County park, providing both passive and active recreational public access. There is public access to the lake from Gibbs Lake Road.

Beausite Lake is also located southwest of Chimacum, approximately 0.5 miles east of Gibbs Lake, and drains to Chimacum Creek via a left bank tributary stream. The lake has a surface area of approximately 20 acres. Immediately along the shoreline of Beausite Lake, the majority of the area is mapped as wetland (primarily lacustrine – limnetic open water). Primary land cover is evergreen forest within the lake planning area, with additional areas of deciduous forest and mixed forest. There is no documented anadromous salmonid use of Beasite Lake.

The shorelands and uplands surrounding Beausite Lake are predominantly County park lands, which is leased to the Northwest Kiwanis. The leased land, encompassing a total of approximately 50 acres, is used as the Northwest Kiwanis Camp and as a event rental facility during non-summer months. The leased parks property is accessed via Beausite Lake Road to the south of the lake. It is along the southern lake shoreline where all existing development is located, including several structures and a dock. Limited public access is available through the Northwest Kiwanis rental and camp programs.

Anderson Lake is located west of Chimacum in the Chimacum watershed. The surface area of the lake is 57.3 acres. Its outflow is to Chimacum Creek via Putaansuu Creek through a wetland with no definitive channel. Seventy-five percent of the Anderson Lake planning area is mapped

1 as wetland, with lacustrine – limnetic (open water) the primary wetland classification (NWI,
2 2005). Primary land cover is evergreen forest within the lake planning area, with additional
3 areas of bare rock/sand/clay, woody wetlands, shrub and brush rangeland, and mixed forest.

4 Surrounded by 410 acres of forest and wetland within Anderson Lake State Park, Anderson Lake
5 provides high-value habitat to trout, eagles, herons, waterfowl, and many other wildlife species
6 (WSP, 2006). Surrounding forested areas include cedar, fir, and alder-dominated communities.

7 Anderson Lake is surrounded by state park land and, except for park facilities, is quite pristine. It
8 is a popular seasonal fishing spot and provides additional passive and active public recreational
9 opportunities, including swimming and hiking. Walking, running, and biking trails skirt the
10 lakeshore.

11 Within the planning area of Anderson Lake, WDNR has mapped 300 feet of road. From
12 Anderson Lake Road, a small roadway approaches the lake and state park facilities from the
13 southwest.

14 In June 2006, the Department of Ecology warned areas residents of blue-green algal blooms on
15 Anderson lake. The algae, or cyanobacteria, typically occur in nutrient-rich lakes, with
16 excessive phosphorus. The blooms accumulate near shore as a thin bright green surface scum.
17 Some blue-green algae blooms cause health problems, especially for pets but also for humans.

18
19 Peterson Lake is located south of Discovery Bay in the Chimacum Creek watershed (Map 16).
20 The surface area of the lake is 22.6 acres. Seventy-one percent of the Peterson Lake planning
21 area is mapped as wetland (primarily lacustrine – limnetic open water) (NWI, 2005). Land cover
22 is primarily evergreen forest and mixed forest within the lake planning area, with Commercial
23 Forest zoning. The area has seen recent (1999) clearcutting, although a buffer was left around
24 the lake. Peterson Lake is a bald eagle territory. It is also presumed habitat for anadromous
25 steelhead and cutthroat trout (Correa, 2002).

26
27 Within the planning area of Peterson Lake, WDNR has mapped 132 feet of road. From Peterson
28 Road, a small, unpaved roadway approaches the lake from the east. There is no public access to
29 Peterson Lake.

30 Ludlow Lake is located to the west of Port Ludlow in the headwaters of the Port Ludlow
31 drainage basin. The lake has a surface area of approximately 20 acres. The lake is documented
32 as a high value habitat: it is within WDNR's NHP for Low Elevation Bog and few flower sedge
33 (*Carex pauciflora*). Ludlow Lake was also identified by Tomassi et al. (2004) as part of a
34 habitat corridor and lying within a Type 1 Core Habitat (most intact habitat type in the County).
35 This habitat corridor extends further into the headwater areas of the drainage basin, primarily to
36 the north and southeast of the lake, and downstream of the lake along the Ludlow Creek riparian
37 corridor. According to the Jefferson County wetland inventory, the majority of the lake is
38 mapped as wetland and areas of lacustrine wetland are mapped to the south and north along the
39 lakes shoreline.

40 The Ludlow Lake area has seen relatively recent clearcutting to the east and northeast of the
41 lake. Adjacent zoning to Ludlow Lake is Commercial Forest and most of the lake is surrounded

by forested buffers. A short roadway extends into and dead-ends within the east side of the lake's shoreline planning area. There is no existing public access to Ludlow Lake. Ludlow Lake is not on Ecology's 303d list for any water quality parameters, and no other documented water quality concerns are known.

Teal Lake is located to the south of Port Ludlow along Teal Lake Road. The lake drains to Port Ludlow via an non-SMA jurisdictional stream. Teal Lake is within WDNR's current NHP for Low Elevation Sphagnum Bog and Labrador Tea (*Ledum groenlandicum*)/Alpine Laurel (*Kalmia microphylla*)/Sphagnum Species Shrubland. The majority of the lake is mapped as lacustrine wetland according to the Jefferson County inventory, with additional wetland mapped to the north of the lake along the outlet stream.

Teal Lake is surrounded by forested land and zoned Rural Residential 1:20. There is very limited existing development within the lake's shoreline area. The intersection of Teal Lake Road and Anderson Cooper Road is located directly west of the lake, within the lake's shoreline area.

The Mill Settling Pond is a highly altered water body that serves industrial purposes, located just east of the Port Townsend Paper Mill. The total surface area of the pond is 30.5 acres. Around the shoreline of the Mill Settling Pond, 57 percent of the area is palustrine open water wetland (NWI, 2005). The primary land cover around the pond is commercial/industrial/transportation, with areas of evergreen forest and low intensity residential.

The Mill Settling Pond has little apparent habitat value. Historically this pond was part of a larger salt marsh in Glen Cove that included some of the filled area where the mill now sits and the 15-acre salt marsh adjacent to the south.

The Mill Settling Pond is currently designated an urban shoreline due to its industrial use. Zoning is 98 percent Heavy Industrial within the planning area.

Jefferson County and WDNR have mapped 0.6 mile and 1.5 miles of road, respectively, within the planning area of Mill Settling Pond. Mill Road, South 8th Street, and several other roads surround the settling pond. There is no public access to the Mill Settling Pond.

4.2.18 Strait of Juan de Fuca and Discovery Bay

4.2.18.1 Overview (Map 1a)

This shoreline stretches from the boundary of the City of Port Townsend in the east to the boundary of Clallam County in the west. The shoreline along the Strait of Juan de Fuca is subject to the greatest wave action in eastern Jefferson County and is characterized by tall, steep, eroding bluffs. Discovery Bay is a protected embayment with some development in the areas around Cape George, Beckett Point, and Adelma Beach. It was here Captain Vancouver first anchored while exploring Puget Sound in 1792. Early in the development of Puget Sound it was the location of a lumber mill and port at Mill Point. Salmon and Snow Creeks drain into Discovery Bay and support populations of chum, coho, cutthroat, and steelhead. The Washington State Department of Health has listed Discovery Bay as a threatened shellfish growing area, with

portions of the area closed due to biotoxin from September 16 to October 6, 2005 (WDH, 2006a).

Unarmored shorelines within and near Discovery Bay support a number of depositional features at the terminal ends of their drift cells, and point bar features formed at the convergence of neighboring drift cells. These features are often associated with a wide intertidal and shallow subtidal shelf, creating an extensive area within the photic zone. This is important because the waters of outer Discovery Bay and the Eastern Strait are otherwise quite deep (PSAT, 2005). A brief discussion of Protection Island National Wildlife Refuge is included in this section.

4.2.18.2 Nearshore Reaches (Map 9)

Reach EEE: East end of divergence zone JEF-23/JEF-24 and drift cell JEF-23 to the City of Port Townsend boundary.

Reach FFF: West end of divergence zone JEF-23/JEF-24 and drift cell JEF-24 to the northern edge of Beckett Point.

Reach GGG: Segment of undefined drift around Beckett Point.

Reach HHH: Northern half of divergence zone JEF-25/JEF-26 and drift cell JEF-25.

Reach III: Southeast Discovery Bay, from the south edge of divergence zone JEF-25/JEF-26 south through the Salmon/Snow Creek delta.

Reach JJJ: Drift cell JEF-27 including Mill Point, and the southern half of divergence zone JEF-27/JEF-28.

Reach KKK: Northern half of divergence zone JEF-27/JEF-28 and drift cell JEF-28 to south of Contractor's Point.

Reach LLL: The shoreline from the terminus of drift cell JEF-29 to the Jefferson/Clallam County boundary.

4.2.18.3 Physical Environment (Maps 15, 22, and 25)

Reach EEE originates at a zone of net shore-drift divergence between McCurdy Point and Cape George to the City of Port Townsend boundary. These tall feeder bluffs (50 to 70 meters high) are composed of Vashon till overlying weaker layers of advance outwash, unidentified glacial sediment, and a base layer of Double Bluff Formation (Ecology, 1978; Keuler, 1988). In general, there is a wave-cut cliff under a steep vegetated slope, topped with another tall cliff of glacial sediments (Ecology, 2001). Net shore-drift is east to Point Wilson in the City of Port Townsend. The bluffs in this reach are considered unstable. In addition, east of McCurdy Point there are many recent and old landslides (Ecology, 1978). The estimated annual rate of bluff retreat at the end of Elmira Street near the City/County boundary is 6 cm a year (Keuler, 1988).

Reach FFF, encompassing drift cell JEF-24, originates from the same feeder bluffs as drift cell JEF-23 and net shore-drift is to the southwest to terminate at Beckett Point (Keuler, 1988).

1 Accretionary zones occur at the Cape George marina (historically a salt marsh and lagoon) and at
2 the terminus at Beckett Point (Reach GGG), a cusped spit with salt marsh and lagoon. Erosion is
3 severe just north of Cape George and has endangered homes (Gerstel et al., 1997). With the
4 exception of accretionary shoreforms, this shoreline is considered unstable with frequent
5 landslides (Ecology, 1978). An enclosed brackish lagoon is located within Beckett Point with no
6 open water outlet to the bay (Correa, 2002). Historically, this lagoon/marsh complex was
7 considerably larger and had more regular tidal connection through an inlet to the south. Roads
8 and residential development have filled former wetlands and eliminated tidal connection (Todd,
9 personal communication, 2006).

10 The next drift cell (JEF-25) originates at a zone of divergence south of Adelma Beach. Net
11 shore-drift is to the northwest for approximately 4.4 miles to terminate at the cusped spit at
12 Beckett Point (Keuler, 1988). Sediment is derived from Vashon till, undifferentiated Pleistocene
13 sediments, and Vashon advance outwash. This shoreline is generally considered unstable
14 (Ecology, 1978). Salt marshes occur behind deposition beaches in this drift cell, two in the
15 vicinity of Tukey Spit and Chevy Chase and one at Beckett Point (Leon and Driscoll, 1975).

16 South Discovery Bay (Reach III) encompasses an area of net shore-drift divergence and drift cell
17 JEF-26 south of Adelma Beach to the Snow Creek delta. Drift cell JEF-26 originates from this
18 zone of divergence, and net shore-drift is to the south to terminate at the delta of Snow Creek
19 (Keuler, 1988; Correa, 2002). Sediment is derived from Vashon till; along the shore there is an
20 area of tertiary basalt between Woodman and Fairmont. There is a brackish marsh at Woodman
21 that has no open water connection to the bay (Ecology, 1978). A salt marsh at Fairmont is
22 isolated from the bay by an abandoned railroad bed (Correa, 2002; Ecology, 2001).

23 A drift cell analysis is not available for Discovery Bay south of the 48th parallel (roughly from
24 Woodman south). Sediment is deposited at the head of the bay at the estuary formed by the
25 deltas of Salmon and Snow Creeks (Correa, 2002). Water quality sampling in Discovery Bay
26 during 2006 showed that all stations met water quality standards for approved classification,
27 except Station #48 (near the boundary with drift cell JEF-27) continues to be listed as threatened
28 because the 90th percentile for the station is near the upper range of the water quality standard.
29 At this point, however, the threatened listing for Station #48 is based on sample results obtained
30 in 2002 and 2003.

31 The geology of the Quimper Peninsula (including Reaches EEE, FFF, GGG, HHH, and III) is
32 characterized by extensive areas covered with dense basal till, by broad channels eroded through
33 the till into underlying principal aquifer materials, and by the presence of loose ablation till
34 overlying portions of the basal till. Principal aquifer materials are predominantly composed of
35 Vashon advance outwash, pre-Vashon stratified glacial drift, and interglacial deposits
36 (Parametrix et al., 2000).

37 Reach JJJ, encompassing drift cell JEF-27, originates from a zone of divergence north of Mill
38 Point. Net shore-drift is south to the delta of Salmon and Snow Creeks. A narrow spit occurs
39 perpendicular to shore at Mill Point. Sediments are derived from Vashon recessional outwash,
40 and the bluffs are generally considered unstable with the exception of Mill Point and the
41 depositional beaches and flats at the terminus of the cell (Ecology, 1978; Keuler, 1988).

1 Drift cell JEF-28 (Reach KKK) originates from the same zone of divergence as drift cell JEF-27.
2 Net shore-drift is north 1.5 km to terminate on the cusped spit at Contractor's Point. Sediments
3 are derived from the same parent material as JEF-27. Depositional areas are at Kisset Point and
4 Contractor's Point (Keuler, 1988).

5 Reach LLL encompasses drift cell JEF-29 and Contractor's Point spit. Drift cell JEF-29
6 originates at the Clallam County boundary. Net shore-drift is southeast toward Contractor's
7 Point, with areas of deposition in front of the Gardiner salt marsh and Contractor's Point (Keuler,
8 1988).

9 The geology of Reaches JJJ, KKK, and LLL is characterized by extensive areas covered with till
10 and narrow exposures of alluvium, recessional outwash, and advance outwash along the coast.
11 Bedrock is present in Reach JJJ. The principal aquifer system beneath the till is relatively
12 stratified. The shallow aquifer is primarily composed of Vashon glacial sediments, while both
13 the middle and deep aquifers (where present) are composed of pre-Vashon materials (Parametrix
14 et al., 2000).

15 **4.2.18.4 Biological Resources (Maps 18, 20, 24, and 27)**

16 There is little riparian vegetation in Reach EEE; however, there is significant bluff-top and bluff-
17 side vegetation along this shoreline. Some clearing for views has occurred which may accelerate
18 the inevitable erosion of the shoreline in this reach (Ecology, 2001). One bald eagle nest and
19 patchy kelp have been documented within this reach.

20 Two bald eagle nests have been documented in Reach FFF. Patchy beds of bull kelp (*Nereocystis*
21 *luetkeana*) are found north of Cape George. Eelgrass beds are patchy in front of Cape George
22 and Beckett Point and continuous in between. Riparian vegetation is largely intact between the
23 Cape George development and Beckett Point, but some clearing for views has occurred
24 (Ecology, 2001).

25 Historically, the cusped spit at Beckett Point enclosed a backshore lagoon and fringing marsh
26 connected to the open water via a surface channel along the south shore of the spit. The spit has
27 been entirely developed, though a remnant of the historical lagoon and fringing salt marsh
28 remains; the tidal connection has been eliminated (Todd et al., 2006).

29 Within Reach HHH, South and North Tukey Marshes near Chevy Chase have no direct
30 connection to the salt water and are contained by alongshore spits. South Tukey Marsh appears
31 to hold little or no open water, whereas North Tukey Marsh contains a lagoon (Ecology, 2001).
32 This northern marsh also has a small stand of garry oak (*Quercus garryana*) and other native
33 and uncommon prairie plants along its shores (Admiralty Audubon Society, 1990). There is a
34 bald eagle nest within this reach as well. Sand lance spawn on the north side of both of these
35 spits (Penttila, 2000; Long et al., 2005). Eelgrass beds are patchy in front of Beckett Point and
36 near Adelma Beach; otherwise eelgrass grows continuously along this shoreline and the
37 Discovery Bay herring stock uses it for spawning (Penttila, 2000). Sand lance spawning habitat
38 is continuous along Adelma Beach, and surf smelt spawn at the southern end of this reach
39 (Penttila, 2000; Long et al., 2005).

1 The steep, unstable bluffs south of Beckett Point harbor uncommon prairie species, including
2 prickly pear cactus (*Optunia fragilis*), threadleaf phacelia (*Phacelia linearis*), menzies larkspur
3 (*Delphinium menziessi*), chocolate lily (*Fritilaria lanceolata*), and harvest brodiaea (*Brodiaea*
4 *coronaria ssp. coronaria*) (Gorsline, personal communication, 2004). This is the only site in
5 Jefferson County where prickly pear cactus and thread-leaf phacelia are found, and it is a rare
6 example of the dry, post-glaciation vegetation on the northeast Olympic Peninsula. In addition,
7 this area harbors the only significant old-growth Douglas fir forest on the Quimper Peninsula.
8 Most likely, it was passed over for cutting due to the trees being severely pruned and topped by
9 strong winds out of the Strait of Juan de Fuca, and the very steep nature of the bluffs. It is a rare
10 example of a Douglas fir, madrona, and snowberry dominated ecosystem.

11 Riparian vegetation is spotty throughout drift cell JEF-25 due to clearing in the Adelma Beach
12 reach and erosive bluffs in the reaches north. A house is perched on top of an active feeder bluff
13 (essentially a landslide) in the South Beckett Point Bluffs area (Ecology, 2001). In general, the
14 area between Tukey and Beckett Point is a quite pristine area of erosive bluffs and forested
15 slopes with intermittent meadows that support uncommon prairie plants (WDNR, 2001; Ecology,
16 2001).

17 Eelgrass is continuous in the northern part of Reach III and patchy near the head of the bay;
18 herring use it for spawning (Penttila, 2000). Two bald eagles have been documented within this
19 reach. Surf smelt and sand lance spawn near the origin of drift cell JEF-26 as well as in front of
20 the old mill pond; sand lance spawn in front of Fairmont (Penttila, 2000; Long et al., 2005).
21 Riparian vegetation is generally sparse and absent from the southern part of drift cell JEF-26 due
22 to the abandoned railroad grade (WDNR, 2001). Some salt marsh vegetation is present in
23 Fairmont Marsh and Discovery Junction Marsh. It is likely that a shift has occurred from salt
24 marsh domination to a mixture of fresh and salt marsh vegetation in Fairmont Marsh. A limited
25 saltwater connection occurs today through a pipe, and a small delta is present on the beach (Todd
26 et al., 2006).

27 The estuaries of Salmon and Snow Creeks provide salt marsh and shallow water habitat for
28 juvenile salmonids. Salmon Creek supports spawning by summer chum and coho (Correa, 2002).
29 Maynard Lagoon, located just north of the Salmon Creek estuary, was historically an open tidal
30 flat, with at least two streams entering the nearshore at this site. This area has received fill for a
31 mill and Highway 101. The Chicago, Milwaukee, and St. Paul railroad grade has enclosed the
32 lagoon, resulting in filling with sediment due to a reduction in tidal exchange (Todd et al., 2006).

33 In Reach JJJ, eelgrass is patchy toward the end of drift cell JEF-27 and in front of Mill Point.
34 Otherwise, eelgrass grows continuously along this drift cell. Herring use this eelgrass for
35 spawning. Sand lance spawn on the north side of Mill Point, just north of Trend West
36 Condominiums and continuously for the last kilometer of the cell (Penttila, 2000; Long et al.,
37 2005). Riparian vegetation covers about 20 percent of the shoreline south of Trend West and is
38 heavy north of Mill Point. However, for the most part it is lacking over the remainder of this
39 shoreline (WDNR, 2001). A bald eagle nest occurs within this reach as well.

40 Eelgrass is continuous along Reach KKK with patches of brown kelp and *Ulva*. There is a salt
41 marsh at Kalset Point. Oysters are found south of Contractor's Point and an aquaculture facility
42 is located at Kalset Point (Correa, 2002). Sand lance spawn at the origin of the cell and on Kalset

Point, while herring spawn offshore (Penttila, 2000; Long et al., 2005). The shoreline between Kalset Point and Contractor's Point spit is pristine with abundant riparian vegetation, as is the area south of Kalset Point (Ecology, 2001; Correa, 2002). The area surrounding Contractors Point spit has been cleared and fragmented by numerous private roads and drives (WDNR 1994, 2000 aerials). The lower half-mile of Contractor's Creek was routed through a series of culverts and the adjacent riparian zone filled for private development. A blocked culvert at the Old Gardiner Highway temporarily dammed Contractors Creek, which then undercut the highway and washed the highway and large volumes of highway fill into a new floodway on the north side of the spit. After the flood, the property owner rerouted the creek back into the culverts and the Jefferson County Public Works Department replaced the highway and re-routed the creek channel into a deep ditch. Upstream of Old Gardiner Highway, the Contractors Creek crossing at State Route 101 has been identified as a Chronic Environmental Deficiencies area due to a continual need for infrastructure maintenance that is damaging to fish habitat (WSDOT 2007). A bald eagle nest is located within this reach, and the spit at Contractor's Creek is a haulout area for harbor seals.

Eelgrass and *Ulva* are continuous along Reach LLL. Sand lance spawn along the Gardiner shoreline and on the north side of Contractor's Point (Penttila, 2000; Long et al., 2005). Aerial photos show that large salt marsh occurs at Gardiner (Ecology, 2001); although truncated by a road, it appears to provide habitat suitable for juvenile salmonids. This salt marsh is also important waterfowl and shorebird habitat. Riparian vegetation in this segment is generally good, with some clearing for views. A pristine area occurs south of Gardiner (Ecology, 2001). Gardiner Lagoon is located in a small glacial depression with a narrow barrier spit enclosing tidal marsh and lagoon habitat. A small stream enters the marsh near its west end. Eagle Creek estuary on the Clallam/Jefferson County line is a bar bound estuary with salt marsh and potential for fish use (Correa, 2002). Sand lance spawn continuously from the County line south through Gardiner (Penttila, 2000).

Protection Island north of Discovery Bay is a National Wildlife Refuge and Washington State Seabird Sanctuary, with a few residential properties (Murray and Ferguson 1998). The Island is not subject to County shoreline jurisdiction. It harbors significant marine mammal populations and 80 percent of the nesting seabirds in Puget Sound, including rhinoceros auklets, pigeon guillemots, black oystercatchers, and glaucous-winged gulls (Nightingale, 2000; Jefferson County, 2002). The surrounding waters and County shorelines provide foraging areas for these animals. Two geoduck tracts north of Protection Island are classified as approved for shellfish harvest; however these areas were closed for 21 days in 2005 due to high levels of biotoxin (WDH, 2006a).

Within all shoreline reaches, 13.5 percent or less of the planning area is wetland (variation from reach to reach), with estuarine – intertidal the primary classification. No wetland data are available in Reach EEE. Significant areas of palustrine wetland (emergent, scrub/shrub, unconsolidated shore) are located within Reaches GGG, HHH, and III.

4.2.18.5 Land Use and Altered Conditions (Maps 12 and 22)

Land Use and Zoning

Land use along the shoreline is dominated by residential development in all reaches. Rural Residential zoning over more than 98 percent of the planning area reflects existing land use.

Transportation and Utilities

Within the marine planning area, Jefferson County and WDNR have mapped 4.4 miles and 11.6 miles of road, respectively. Along the Strait of Juan de Fuca, Lands End Lane, Porter Lane, and several roads within Cape George parallel the shoreline. Within Discovery Bay, from Beckett Point to the northern boundary of Reach LLL, Beckett Point Road, Cliffside Drive, South Discovery Road (State Route 19), Lower Aldema Beach Road, Madrona Beach Road, State Route 20, Woodman Road, Fairmount Road, Old Gardiner Road, Orcas Drive, Bachelor Road, and Gardiner Beach Road parallel the shoreline.

Shoreline Modifications

Shoreline modification statistics for these nearshore reaches are as follows:

- Reach EEE area: No bulkhead data, 3 stairways; 1 launch ramp.
- Reaches FFF, III, and JJJ: 2.5 miles of bulkhead (82 percent to 93 percent rock; concrete and/or wood in remaining bulkhead areas); 2, 11, and 4 stairways, respectively; 5 docks/piers in Reach III, 3 in Reach JJJ; 1 rail launch in Reach JJJ; 1 marina in Reach FFF.
- Reach GGG: 0.4 mile of bulkhead (74 percent concrete, 16 percent wood, and 9 percent rock); no stairs; 1 launch ramp.
- Reach HHH: 0.4 mile of bulkhead (96 percent wood and 4 percent concrete); 11 stairways; 2 docks/piers; 1 rail launch.
- Reaches KKK and LLL: 0.5 mile of bulkhead (97 percent to 100 percent rock, concrete in all remaining bulkhead areas); 1 stairway in Reach LLL; 1 dock/pier in both Reaches LLL and KKK.
- Facilities include a State Cleanup Site in Reach EEE.

The Cape George development has seen extensive clearing, possibly contributing to erosion (Ecology, 2001). Stormwater entering the nearshore is an issue at Cape George. Several private stormwater drains enter the beach and one large storm drain empties into a ravine, which then drains untreated into the bay (Correa, 2002).

The marina at Cape George, covering 1,917 square feet, is protected by a jetty that interrupts longshore transport of sediment and is constructed on a depositional beach or historic salt marsh and lagoon. In addition, there is extensive shoreline armoring near the marina. There is extensive armoring with seawalls and riprap along the northwest shore of Beckett Point (Ecology, 2001). Alongshore drift is interrupted on the north side of Beckett Point by a boat ramp, which has led to erosion on the down drift side of the boat ramp, toward the tip of the spit. Both the north and south sides of Beckett Point have several sizable bulkheads, which may be adversely affecting net shore-drift of sediment.

1 The shoreline armoring and fill along the Adelma Beach reach (Reaches HHH and III) may be
2 affecting sediment recruitment into the nearshore (Correa, 2002). In addition, it may interrupt
3 longshore transport and increase wave reflection, resulting in a coarsening of the beach.

4 South of Woodman, an aquaculture facility interrupts longshore transport of sediment (Correa,
5 2002). Between Woodman and the delta of Salmon and Snow Creeks, the backshore is isolated
6 by a bulkheaded railroad grade that is 2.5 km long. At Fairmont there is extensive armoring
7 including structures built on armored fill extending into the nearshore (Correa, 2002; Ecology;
8 2001). The salt marsh at Fairmont is isolated by the railroad grade (Correa, 2002). Due to failure
9 of a culvert in early 2005, there may currently be limited tidal connection (Todd, personal
10 communication, 2006).

11 The shared delta of Salmon and Snow Creeks, at the southern extent of Reach III, is subject to
12 extensive modification. Snow Creek and Salmon Creek historically converged 100 meters south
13 of Highway 101 and shared an estuary. However, due to rechannelization, Snow Creek and
14 Salmon Creek now flow separately to the salt water. Snow Creek's estuarine function is largely
15 lost due to channelization, dikes, fill, and truncation by the abandoned railroad grade. Likewise,
16 Salmon Creek has lost estuary and salt marsh habitat due to truncation by the railroad grade. Mill
17 ponds northwest of the mouth of Salmon Creek, which are located on a historic broad tide flat
18 with fringing salt marsh (Todd, personal communication, 2006), have been truncated by road fill.

19 The Trend West condominiums in the JEF-27 reach are built on armored fill that extends over
20 the intertidal, eliminating shallow water habitat essential for the migratory success of juvenile
21 summer chum (Correa, 2002). The mouth of Contractor's Creek has been highly altered by being
22 moved and forced through a series of undersized culverts. In addition, portions of Contractor's
23 Point spit have been armored for a peripheral access road, eliminating 2 acres of historic salt
24 marsh (Correa, 2002; Ecology, 2001; Todd et al., 2006). The spit is also covered in invasive non-
25 native vegetation (Ecology, 2001).

26 Upland agricultural practices, stormwater runoff, and failing or lack of septic systems may also
27 contribute non-point pollution to Discovery Bay (Berbells, 2003).

28 ***4.2.18.6 Public Access (Map 22)***

29 Although the residents of Discovery Bay often have access to the bay through private easements,
30 public access is limited. Members of the public often walk the beach from North Beach County
31 Park within the City of Port Townsend down to Middlepoint. There is access at the head of
32 Discovery Bay in the estuaries of Salmon and Snow Creeks on WDFW property. There is a
33 public boat ramp maintained by the Port of Port Townsend in Gardiner. There is also a stretch of
34 WDNR tidelands with boat access between Adelma Beach and Cape George.

35 ***4.2.18.7 Restoration Opportunities***

36 Habitat could be restored at the mill ponds northwest of the mouth of Salmon Creek by removing
37 fill. Likewise, removing the fill under the railroad grade and pulling back dikes would increase
38 intertidal salt marsh habitat and water flow (Correa, 2002). The restoration of the combined
39 estuary of Salmon and Snow Creek has received funding from the State Salmon Recovery
40 Funding Board. This restoration will improve water flow and natural vegetation by removing

dikes, and will also place LWD into the nearshore and estuary habitats. The removal of the bulkheaded railroad grade would increase shallow nearshore habitat and sediment recruitment into the nearshore.

Contractor's Point spit is highly altered and the restoration of the salt marsh and creek mouth would improve salmonid habitat.

4.2.19 Snow Creek and Salmon Creek (Discovery Bay)

4.2.19.1 Overview (Map 1a)

Snow Creek's headwaters are in the eastern foothills of the Olympic Mountains, draining a watershed area of approximately 22 square miles, with a mainstem length of about 10 miles. Flow is to the north to Discovery Bay (Correa, 2002). Salmon Creek originates on the northern slopes of Mount Zion, has a watershed area of 23.6 square miles, and flows 9 miles into Discovery Bay. Prior to development in the area, which resulted in the present channelized outlet at the east side of the valley, Snow Creek emptied into Salmon Creek near its estuary. During certain flood events, Snow Creek overflows into its original channel in the pasture, reestablishing some direct contact with Salmon Creek. Snow Creek still joins Salmon Creek in the intertidal area during low tides (Correa, 2002).

Over 90 percent of the watersheds are forested with coniferous forest in various stages of development. Both drainages have an average annual precipitation of 35.5 inches (Correa, 2002).

4.2.19.2 Freshwater Reaches (Map 9)

Snow Creek 1: River mouth to approximately RM 1.2.

Snow Creek 2: RM 1.2 to approximately RM 3.3, below Crocker Lake.

Salmon Creek 1: River mouth to approximately RM 0.75.

Salmon Creek 2: RM 0.75 to approximately RM 1.5.

4.2.19.3 Physical Environment (Maps 15, 22, and 25)

Over 50 percent of the Salmon-Snow Creek basin is underlain by till soils, and approximately 3,000 acres is covered by palustrine or estuarine wetlands, or hydric soils. A relatively low rate of groundwater recharge is predicted, which is largely controlled by the presence of bedrock, which covers about 72 percent of the subbasin (Parametrix et al., 2000). The Salmon Creek watershed is underlain primarily by the Crescent basalt formation consisting of basalt flows and mudflow breccias. The basalts are generally harder and more erosion-resistant than the sedimentary rocks in this area. A fault, running approximately east-west, terminates the basalt exposure on the watershed's southern boundary (Tabor and Cady, 1978). The lower watershed is characterized by sand, gravel, and clay deposited during glaciation. Material transported from the upper watershed forms a broad alluvial fan (Bernthal et al., 1999 as cited in Parametrix et al., 2000).

1 The lower reaches of Snow Creek, from the mouth to RM 4.1, course through a wide alluvial
2 valley. The Snow Creek riparian zone, once dominated by conifers, is now dominated by
3 deciduous trees and is rather narrow (76 percent is less than 66 feet wide) (Correa, 2002).

4 The Salmon Creek riparian zone has largely been converted to agriculture. Cattle exclusion
5 fencing does exist in Reach 1 with the exception of access points for livestock watering. In 2002
6 WDFW purchased a 100-acre farm containing most of the summer chum habitat downstream of
7 Uncas Road. Approximately 2,500 feet of new channel was constructed, and a riparian forest
8 buffer was planted on this property (Latham, personal communication, 2006).

9 **4.2.19.4 Biological Resources (Map 18)**

10 Snow Creek and Salmon Creek support runs of coho, steelhead, and summer chum salmon. Coho
11 and steelhead are listed as critical in SASSI, and summer chum are listed as threatened under the
12 Endangered Species Act (Correa, 2002). Other fish species found here include sculpins
13 (*Cottidae*), Pacific lamprey (*Lampetra tridentatus*), and brook lamprey (*L. richardsoni*)
14 (Parametrix et al., 2000), as well as white sturgeon (*Acipenser transmontanus*) (Todd, personal
15 communication, 2006).

16 The entire lower stream valley is described in the 1869-1870 coastal survey mapping (T-sheet) as
17 a wetland upstream of the County road, with areas of scrub/shrub or wooded wetlands.
18 Specifically, the lower 0.3 mile of stream valley was described as dominated by “salmonberry
19 brier” (Todd et al., 2006).

20 Within the lower basin (reaches Snow Creek 1, Salmon Creek 1 and 2), 13.5 percent of the
21 planning area is wetland. Within Snow Creek 2, 33 percent of the planning area is wetland.
22 Between 40 percent and 70 percent of all wetland is classified as palustrine emergent. Forested,
23 scrub/shrub, and open water palustrine wetlands represent the remaining wetland cover.

24 **4.2.19.5 Land Use and Altered Conditions (Maps 12 and 22)**

25 **Land Use and Zoning**

26 Zoning is 70 percent Rural Residential and 20 percent Commercial Agriculture along Snow
27 Creek. Zoning is 90 percent Commercial Agriculture along lower Salmon Creek, and 98 percent
28 Commercial Forest along upper Salmon Creek.

29 Land use in the Snow Creek and Salmon Creek basin is a mix of rural residential and agricultural
30 land adjacent to the stream, and commercial forestry dominating the watershed.

31 **Transportation and Utilities**

32 Within the planning area of Snow Creek Reach 1, Jefferson County and WDNR have mapped
33 1.35 miles and 1.75 miles of road, respectively. West Uncas Road and National Forest Road
34 2986 are within the planning area of Salmon Creek. Highway 101, along with interchanges with
35 Highway 104 and State Route 20, are all near or within the planning area of Snow Creek.

36 **Shoreline Modifications**

The estuary of both Salmon and Snow Creeks is heavily impacted by transportation, commercial development, and some residential development associated with the Highway 101 corridor that passes around the southern end of Discovery Bay. Lower Snow Creek has been channelized both upstream and downstream of Highway 101. A railroad grade also parallels the highway, transecting the delta. Extensive logging has occurred in these basins. The timber harvest rate in the Salmon-Snow watershed has been 19 to 23 percent, higher than the generally accepted rate of 16 percent (Parametrix, 2000).

WDFW operates a salmonid population monitoring weir on Snow Creek at approximately RM 0.8, and on Salmon Creek during August, September, and October at approximately RM 0.3. Both weirs restrict gravel, sediment, and LWD movement downstream. In Snow Creek, gravel and sediments are removed periodically and disposed of at an upland site. LWD is passed downstream and contributes to habitat structure (Correa, 2002). Activities at the Salmon Creek weir were scheduled to terminate in 2004.

A portion of Snow Creek below RM 3.5 has been armored with riprap.

Forestry and agricultural operations such as livestock and hay production have been identified as the main potential sources of non-point pollution (such as fecal coliform, excessive nitrogen loads, and sediment) in the Salmon-Snow subbasin. The Washington State Department of Health has listed an area within the southwest portion of Discovery Bay as threatened with closure due to increasing fecal coliform contamination, though recent trends may be improving (WDH, 2006a). Urban and residential use is sparse, and although failing septic systems and urban runoff occur within this subbasin, they are not considered major sources of non-point pollution (Parametrix et al., 2000).

4.2.19.6 Public Access (Map 22)

There is access at the head of Discovery Bay in the estuaries of Salmon and Snow Creeks on WDFW property.

4.2.19.7 Restoration Opportunities

Portions of Snow Creek could be re-meandered and riparian planting could take place to improve channel condition and riparian cover. The extensive restoration of the estuary by members of the Chumsortium, a local salmon recovery group that includes the North Olympic Salmon Coalition, should improve juvenile salmonid survival.

4.2.20 Crocker Lake (Discovery Bay)

4.2.20.1 Freshwater Reaches (Map 9)

Crocker Lake: 0.5 mile south of the upstream limit of Snow Creek 2.

4.2.20.2 Description

Crocker Lake is in the Snow Creek watershed, discharging to Anderson Creek, which flows to Snow Creek at RM 3.5. The total surface area of the lake is 74 acres. Crocker Lake is used as

1 rearing habitat by coho salmon. The lake is closed to fishing due to the presence of the Snow
2 Creek Research Station, operated by WDFW, downstream of the lake. Bald eagle habitat has
3 been mapped across Crocker Lake and in the surrounding area.

4 Crocker Lake is an area of low-density residential and agricultural lands. Eighty-four percent of
5 the planning area surrounding the lake has been mapped as wetland (primarily lacustrine –
6 limnetic). Within the planning area of Crocker Lake, Jefferson County and WDNR have mapped
7 0.35 mile and 0.26 mile of road, respectively. Fuller Road, Lake View Drive East, East Snow
8 Creek Way, Crocker Lake Road, and Highway 101 are all within the planning area of Crocker
9 Lake.

10 There is a public boat launch on Crocker Lake. Possible restoration on Crocker Lake might
11 include the planting of native riparian vegetation along its shores and the control of non-native
12 reed canarygrass.

13 **4.2.21 Additional Lakes in WRIA 17**

14 There are several additional lakes in WRIA 17 that have been determined to be too small to
15 qualify as shorelines of the state. Horseshoe Lake is just north of State Route 104, and is
16 surrounded primarily by a narrow buffer of trees within commercial forestland. Washington
17 Department of Natural Resources (WDNR) lists Horseshoe Lake in its Natural Heritage Program
18 (NHP) database, for Low Elevation Freshwater Wetland and Western Spiraea (*Spiraea*
19 *douglasii*) Shrubland. Horseshoe Lake, along with Teal Lake, is within WDNR's historic NHP
20 for Golden Indian Paintbrush (*Castilleja levisecta*).

21 East Wahl Lake (also referred to as Twin Lakes) is north and east of Wahl Lake Road, and
22 within Commercial Forest zoning. Surrounding lands are mostly forested. WDNR's historic
23 NHP includes East Wahl Lake for Golden Indian Paintbrush (*Castilleja levisecta*), and its current
24 NHP includes the lake for Three-Way Sedge (*Dulichium arundinaceum*) Seasonally Flooded
25 Herbaceous Vegetation; Western Inflated Sedge (*Carex exsiccata*) Herbaceous Vegetation
26 (Provisional); Baltic Rush (*Juncus balticus*) Herbaceous Vegetation; Western Spiraea (*Spiraea*
27 *douglasii*) Shrubland; Oregon Crabapple (*Malus fusca*) Shrubland; Low Elevation Bog; and Low
28 Elevation Freshwater Wetland.

29 Embody Lake lies just west of SR 19 and south of Embody Road. Adjacent zoning is Rural
30 Residential 1:10, and surrounding land includes forest and open areas with some residential
31 housing on the lake's west side. Embody Lake was identified by Tomassi et al. (2004) as Type 3
32 Core Habitat (composed mostly of historic wetlands, and selected primarily for their restoration
33 and enhancement potential).

34 Delaney Lake lies east of Eaglemount Road. Surrounding land is primarily open, with scattered
35 residential units set back from the eastern shoreline, and may be used for agriculture. Zoning is
36 Rural Residential 1:20. Delaney Lake was identified by Tomassi et al. (2004) as Type 3 Core
37 Habitat (composed mostly of historic wetlands, and selected primarily for their restoration and
38 enhancement potential).

Browns Lake is a small lake, less than 9 acres in size, located approximately 0.6 miles to the northeast of Tarboo Lake. The lake is located in the headwaters of the Tarboo Creek watershed, which drains to Tarboo Bay. The County's wetland inventory maps wetlands extending around the shoreline of the lake and along the outlet stream. Adjacent zoning is entirely Commercial Forest. Land use is largely coniferous and mixed forest, with no recent logging activity. There is no public access to the lake and minimal development of any kind within the shoreline area.

Thorndyke Lake is a very small lake with less than one acre of open water according to Bahls et al. 2006. It is located approximately 0.3 miles to the north of the Hood Canal shoreline near the intersection of Thorndyke Road and Kelly Drive. NWI mapping and the County wetland inventory map the entire area as wetland. Adjacent zoning is a mix of Rural Forest, Commercial Forest, and Rural Residential. Land use is largely undeveloped, consisting of open areas and mixed forest. Residential land uses are located to the south of the lake, along Thorndyke Road and the Hood Canal shoreline. There is no public access to the lake and minimal development of any kind within the shoreline area.

Larson Lake lies just north of Larson Lake Road at French Road and approximately one mile to the northeast of Ludlow Lake. The lake is less than 5 acres in size, and from aerial photography appears to seasonally lose all open water areas. NWI mapping and the County wetland inventory map the entire area as wetland. Adjacent zoning is Commercial Forest and Inholding Forest, and surrounding land includes forest and open areas with some small structures and graded areas located to the north of the lake off of French Road. There is no existing public access to Larson Lake.

None of the lakes listed above are listed as impaired on Department of Ecology's 2004 Water Quality Assessment.

4.3 WRIA 20 – SOL DUC-HOH

The Sol Duc-Hoh WRIA includes the northwest corner of Jefferson County and parts of Clallam County (Figure 4-4). The largest basin in WRIA 20 is the Quillayute with its four major subbasins: the Dickey, Calawah, Bogachiel, and Sol Duc Rivers. Other basins include the Waatch, Sooes, Ozette, and Hoh systems, as well as several small independent streams. Within this WRIA are 569 streams and 1,355 stream miles.

Annual rainfall in the basin is the highest in the state, ranging from 80 inches near the coast to 240 inches in the Olympic Mountains. This region is often exposed to high wind and heavy rainstorms. Unlike many other areas of the state, this region has a significant portion of unlogged forestland, located in the ONP. In these undisturbed areas, temperate, coniferous, old-growth rainforests are dominated by Sitka spruce in the lowlands and western hemlock with silver fir in the higher elevations. Bigleaf maple is also a component of the rainforests. The old-growth conifers can reach up to 200 feet in height, and are characterized by somewhat open canopies and low densities.

Outside of ONP boundaries, timber harvest generally began in this region in the 1920s-1930s, using rail to transport the logs. Road construction for log trucks began in the 1940s, and early roads often used side-cast technology on steep slopes, which still create sediment problems

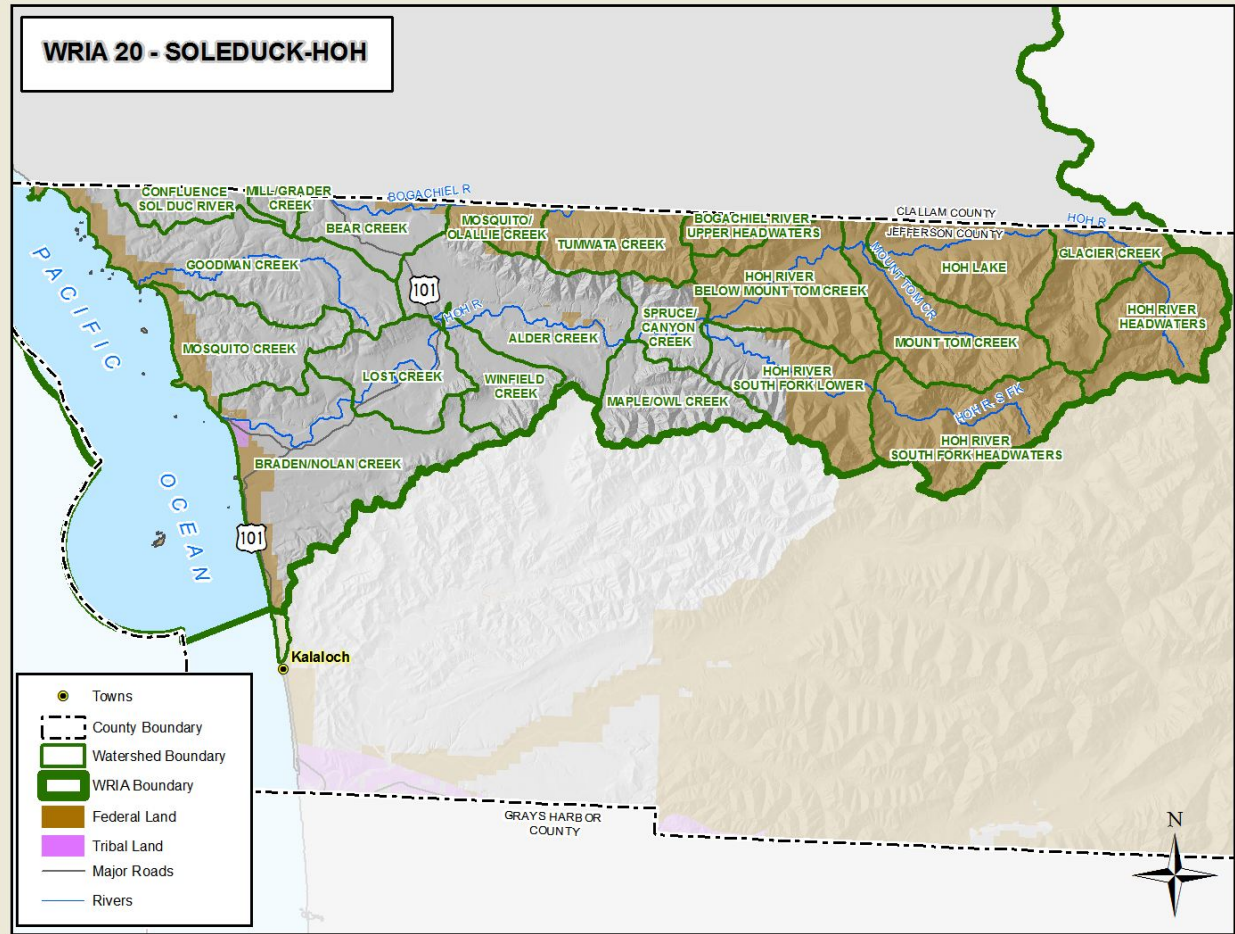
1 today. From the 1960s through the 1980s, extensive clearcutting and road construction occurred
2 throughout the WRIA except in the ONP, which has remained undisturbed. Current timber
3 harvest practices have improved to increase riparian buffers and reduce road impacts (Smith,
4 2000).

5 **4.3.1 Bogachiel River (Bogachiel River Lower)**

6 **4.3.1.1 Overview (Map 1b)**

7 The Bogachiel River has its headwaters in the Olympic Mountains in the Seven Lakes basin, and
8 flows west to meet with the Quillayute River west of Forks in Clallam County (Map 20). The
9 upper reaches of the Bogachiel River lie within the ONP, while the middle and lower reaches are
10 used primarily for timber production and farming. The lower Bogachiel River area is
11 agricultural and also supports the southern edge of the City of Forks. There is also a state fish
12 hatchery near Forks (for summer and winter steelhead) at the confluence of the Bogachiel and
13 Calawah Rivers (Hook, 2004). This report pertains to approximately 4 miles of the river
14 upstream of the Clallam County line to the boundary of the ONP. The Bogachiel River is a
15 shoreline of statewide significance.

1 **Figure 4-4. WRIA 20 in Northwest Jefferson County**



Washington State Department of Ecology

4.3.1.2 Freshwater Reaches (Map 10)

The entire length of the Bogachiel River within western Jefferson County and outside of federal land is treated as one reach. The reach extends from approximately RM 17 to RM 22.

4.3.1.3 Physical Environment (Maps 19 and 23)

Vegetation within the planning area is composed of 44 percent evergreen forest, 19 percent bare rock/sand/clay, and 17 percent deciduous forest. Transitional, shrub and brush rangeland, and mixed forest represent the remaining land cover.

Collapsing banks have been a problem in this section of the Bogachiel River, leading to sedimentation of the streambed. This erosion has also necessitated moving several roads back from the river. Channel incision has also exposed clay layers, the erosion of which has led to a worsening of sediment quality. This parameter is listed as “poor” (Smith and Caldwell, 2000). The area in the vicinity of Hemp Hill Creek is listed on the 303(d) list for high water temperatures and low dissolved oxygen.

1 Within the Bogachiel River reach, 14 percent of the planning area is wetland. The primary
2 wetland classifications are palustrine forested and scrub/shrub (63 percent) and riverine upper
3 perennial (37 percent).

4 **4.3.1.4 Biological Resources (Map 19)**

5 The Bogachiel River supports coho salmon; summer, fall, and spring Chinook salmon; and
6 winter and summer steelhead trout. The coho and fall Chinook populations are listed as healthy,
7 whereas the summer Chinook stock is listed as threatened. The status of the spring Chinook
8 stock is unknown. The winter steelhead trout run is listed as healthy, and the status of the
9 summer steelhead run is listed as unknown.

10 LWD levels are low downstream of Hemp Hill Creek and better upstream. Although systematic
11 data are lacking, the riparian condition of this stretch of river is thought to be “fair” (Smith and
12 Caldwell, 2000).

13 Roads within the floodplain act as dikes, disconnecting potential off-channel habitat and
14 increasing sediment input to the river.

15 **4.3.1.5 Land Use and Altered Conditions (Map 23)**

16 **Land Use and Zoning**

17 Land use in this reach of the Bogachiel River is primarily residential and forestry. Zoning within
18 the reach planning area reflects this, with 55 percent of the area zoned Rural Residential, 29
19 percent ONF, and 11.6 percent Commercial Forest.

20 **Transportation and Utilities**

21 Within the planning area of the Bogachiel River, Jefferson County and WDNR have mapped 3.9
22 miles and 7.2 miles of road, respectively. Highway 101, South Bogachiel Road, and Kallman
23 Road run along the south bank of the river reach. Undie Road runs along the north bank through
24 the reach.

25 **Shoreline Modifications**

26 Some of the major habitat problems for the Bogachiel mainstem include “poor” riparian and
27 LWD conditions downstream of the ONP boundaries, as well as an aggraded mainstem that
28 worsens downstream (Smith, 2000). The lack of LWD on the mainstem has led to increased
29 water velocity and sediment transport on the mainstem of the Bogachiel. This in turn has
30 increased channel incision and exposed unstable clay layers. This incision has released sediment
31 into the river and has resulted in a level of fines greater than 17 percent. Collapsing banks from
32 the Hemp Hill confluence to Highway 101 have required localized road relocation (Hook, 2004).
33 No information on shoreline modifications specific to this reach is available.

4.3.1.6 Public Access (Map 23)

Except for areas of federally owned national forest and park, land along the Bogachiel reach is privately owned by timber companies and individuals.

4.3.1.7 Restoration Opportunities

Restoration opportunities identified for the Bogachiel River include increasing the amount of LWD in areas rated as “poor,” routing road sediments to the forest floor rather than to stream channels, decommissioning side-cast roads, and improving road surfacing to reduce sediment inputs into streams (Smith, 2000).

4.3.2 Goodman Creek (Goodman Creek)

4.3.2.1 Basin Overview (Map 1b)

Goodman Creek flows into the Pacific Ocean south of the Quillayute River and north of Mosquito Creek. The lower 2 miles of the stream are within the ONP, and the headwaters are in the coastal hills west of Highway 101. There is little information on this watershed.

4.3.2.2 Freshwater Reaches (Map 10)

Goodman Creek 1: From the ONP boundary upstream to the confluence with Minter Creek.

Goodman Creek 2: From the confluence of Minter Creek upstream to the divergence of the east and west forks.

Goodman Creek 3: East and west forks of Goodman Creek.

Minter Creek: From the confluence with Goodman Creek to the upstream extent of shoreline jurisdiction.

4.3.2.3 Physical Environment (Maps 19 and 23)

Land cover within the Goodman Creek basin planning area is 88 percent evergreen forest, with bare rock/sand/clay, deciduous forest, shrub and brush rangeland, and mixed forest representing the remaining land cover. Goodman Creek contains a high density of wetlands indicating high groundwater inputs. Approximately 52.4 percent of the area within Reach 1 is wetland; however, less than 7 percent of the planning area above the Goodman – Minter convergence is wetland.

Information concerning LWD and other habitat attributes in Goodman Creek are lacking; however, it has been noted that LWD was rated “good” in this basin, except where LWD and spawning gravel are lacking from Road G 2108 to the G 3000 bridge (Silver, personal communication, as cited in Smith, 2000). There is also a lack of deep pools and an alder-dominated riparian zone in the middle section of mainstem Goodman Creek (Silver, personal communication, as cited in Smith, 2000). Pool habitat, water temperature, and hydrologic maturity within Goodman Creek have been rated as poor.

1 Less than 7 percent of the planning area is wetland above the convergence of Goodman Creek
2 and Minter Creek. Downstream of the convergence (Goodman Creek 1), 52 percent of the
3 planning area is wetland. The primary wetland classification throughout the Goodman and
4 Minter Creeks planning area is palustrine scrub/shrub and forested. In Goodman Creek Reaches
5 1 and 2 there are significant areas of riverine upper perennial wetland (NWI, 2005).

6 **4.3.2.4 Biological Resources (Map 19)**

7 Fall coho salmon and winter steelhead and cutthroat trout spawn in Goodman Creek but the
8 status of these stocks is unknown (Smith, 2000).

9 **4.3.2.5 Land Use and Altered Conditions (Map 23)**

10 **Land Use and Zoning**

11 Land use within the Goodman Creek planning area is predominantly forestry. In the mainstem,
12 land use is 66 percent to 100 percent commercial forest, and up to 33 percent rural residential.
13 Within the Minter Creek reach, land use is 100 percent commercial forest.

14 Extensive logging within the Goodman Creek basin has increased the risk of damaging peak
15 flow events. Evidence of changes is already noted, such as bank erosion, gravel bar movement,
16 and scour (Smith, 2000).

17 **Transportation and Utilities**

18 WDNR has mapped 3.3 miles of road within this planning area. Utilities are unknown.

19 **Shoreline Modifications**

20 Three blocking culverts on left bank tributaries to Goodman Creek created by Roads G 3300 and
21 G 3310 affect coho, steelhead, and cutthroat habitat. Blocking culverts are also created by Roads
22 G 2170 and G 2100, affecting coho, cutthroat, and steelhead habitat on five right bank
23 tributaries.

24 With a road density of 3.2 miles per square mile and a road erosion rate of 148 percent,
25 Goodman Creek was rated “poor” for both road density and road erosion (Smith, 2000).
26 Extensive logging within the basin has increased the risk of damaging peak flow events (Smith,
27 2000).

28 **4.3.2.6 Public Access (Map 23)**

29 The upper watershed is WDNR land.

30 **4.3.2.7 Restoration Opportunities**

31 The primary opportunities for restoration in this watershed involve replacement of culverts that
32 are blocking access to anadromous habitat.

4.3.3 Mosquito Creek (Goodman Creek)

4.3.3.1 Overview (Map 1b)

There is little information on Mosquito Creek. The lower approximately 1.5 miles are within the ONP. The headwaters are in the coastal hills west of Highway 101.

4.3.3.2 Freshwater Reaches (Map 10)

Mosquito Creek 1: From the ONP boundary upstream to RM 5.2.

Mosquito Creek 2: From RM 5.2 to the upstream extent of shoreline jurisdiction.

4.3.3.3 Physical Environment (Maps 19 and 23)

Vegetation within the Mosquito Creek planning area consists of 84 to 89 percent evergreen forest, with the remainder composed of deciduous forest, shrub and brush rangeland, transitional, and mixed forest. Less than 4 percent of the Mosquito Creek planning area is wetland. More than 75 percent of these wetlands are palustrine forested, while the remainder are scrub/shrub.

Mosquito Creek had water temperatures that exceeded state standards. However, these areas are located in the ONP in old-growth forest and represent natural conditions (Smith, 2000).

4.3.3.4 Biological Resources (Map 19)

Fall coho and winter steelhead use this watershed for spawning; the health of these runs remains unknown (Smith, 2000).

4.3.3.5 Land Use and Altered Conditions (Map 23)

Land Use and Zoning

The middle and upper reaches of Mosquito Creek are surrounded by private and state timberlands. Land use in the Mosquito Creek planning area is more than 94 percent commercial forest, with 5.5 percent zoned Rural Residential in the upper reach.

Transportation and Utilities

WDNR has mapped 2.2 miles of road within the Mosquito Creek planning area. Mapped roadways provide access to the commercial forest and are predominantly unpaved.

Shoreline Modifications

There are several blocking culverts on Mosquito Creek. Sedimentation due to altered riparian conditions and forest road usage has degraded channel conditions.

Public Access

Mosquito Creek flows through WDNR land for about a mile just upstream of the ONP boundary.

1 **4.3.3.6 Restoration Opportunities**

2 There are several blocking culverts on Mosquito Creek. These should be replaced to open up
3 anadromous fish habitat (Silver, personal communication, 2000).

4 **4.3.4 Hoh River and Tributaries (Hoh River Lower, Middle and South**
5 **Fork)**

6 **4.3.4.1 Overview (Map 1b)**

7 The headwaters of the Hoh River are in the snowfields and glaciers of Mount Olympus. This
8 glacially fed river flows out of the Olympic Mountains and winds across a broad floodplain
9 through coastal hills. The upper watershed is protected in the ONP, and the lower mile of the
10 river lies within the Hoh Indian Reservation.

11 The Hoh watershed, and other watersheds on the west side of the Olympic Peninsula, are subject
12 to the greatest annual precipitation in the U.S. outside of Hawaii, ranging from 70 to 100 inches
13 of precipitation at the coast, to 150 to 200 inches a year in the foothills of the Olympics.
14 Although data are sparse for the higher elevations, during the 1957-1958 water year, 542 inches
15 of snow was recorded at Blue Glacier at the headwaters of the Hoh River. Precipitation was 15
16 percent below normal that year in the lowlands. The temperate rainforest supports the growth of
17 enormous moss-covered conifers and bigleaf maples. From the ocean to the ONP boundary the
18 mainstem of the Hoh River is classified as a shoreline of statewide significance. Its larger
19 tributaries—Nolan Creek, Winfield Creek, Maple Creek, Owl Creek, and the South Fork of the
20 Hoh River—all are shorelines of the state.

21 **4.3.4.2 Freshwater Reaches (Map 10)**

22 Hoh River 1: From the Hoh Indian Reservation boundary upstream to the confluence with Nolan
23 Creek.

24 Hoh River 2: From the confluence with Nolan Creek to the confluence with Winfield Creek.

25 Hoh River 3: From the confluence with Winfield Creek to the confluence with Maple Creek.

26 Hoh River 4: From the confluence with Maple Creek to the confluence with Owl Creek.

27 Hoh River 5: From the confluence with Owl Creek to the ONP boundary.

28 Hoh River South Fork: From the confluence with the mainstem to the upstream extent of
29 shoreline jurisdiction.

30 Nolan Creek: From the confluence with the Hoh River mainstem to the upstream extent of
31 shoreline jurisdiction.

32 Winfield Creek: From the confluence with the Hoh River mainstem to the upstream extent of
33 shoreline jurisdiction.

1 Maple Creek: From the confluence with the Hoh River mainstem to the upstream extent of
2 shoreline jurisdiction.

3 Owl Creek 1: From the confluence with the Hoh River mainstem to the impassable falls.

4 Owl Creek 2: From the falls to the upstream extent of shoreline jurisdiction.

5 **4.3.4.3 Physical Environment (Maps 19 and 23)**

6 The Hoh River is a gravel-bed stream with an average slope of 1.3 percent, falling about 3,950
7 feet in 56 river miles. The Hoh River has a large natural sediment load consisting of material
8 ranging in size from predominantly silt (glacially derived rock flour) to cobbles. About 35
9 percent of the basin is covered by Quaternary surficial deposits of glacial and non-glacial origin,
10 generally consisting of unconsolidated sand, gravel, silt, and clay. These deposits have an
11 average thickness between 20 and 100 feet, but locally may be up to several hundred feet thick
12 (Tabor and Cady, 1978 as cited in BOR, 2004). Underlying the surficial deposits are sedimentary
13 and metamorphic bedrock composed predominantly of sandstone, conglomerate, siltstone,
14 argillite, slate, and phyllite. The bedrock is exposed along the active channel in Spruce Canyon
15 (RM 25.5 to 27.2) and Oxbow Canyon, and crops out in a few locations between Oxbow Canyon
16 and the mouth of the Hoh River (BOR, 2004). The active channel width has ranged between 150
17 and 800 feet.

18 The mean daily flow for the period of record is 2,524 cfs. The majority of floods occur between
19 November and March. It takes a discharge greater than 16,000 cfs at the USGS gauge (RM 15.4)
20 to completely inundate the active channel (1.5- to 2-year flood), and a 10-year flood completely
21 inundates the active channel and floodplain (BOR, 2004). Along the lower 4 miles, the river
22 migrates across a 3,000-foot-wide floodplain bounded by glacial terraces and bedrock. The
23 floodplain narrows to 400 feet at the river mouth where it is constricted by bedrock on both sides
24 (Perkins Geosciences and TerraLogic GIS, 2004).

25 Historic channel migration zones (HCMZ) on the Hoh River between RM 17 and RM 40 are
26 thoroughly described in BOR (2004). The CMZ on the lower 4 miles are described in Perkins
27 Geosciences and TerraLogic GIS (2004). The HCMZ can be bounded by terraces composed of
28 glacial material (till, outwash, or lacustrine sediments) or alluvium, alluvial fans, bedrock, or
29 engineered bank protection (riprap, engineered logjam, bridge abutment, levees, road
30 embankment). Overall, the active channel in the ONP is wider, more dynamic, has multiple
31 channels and more LWD deposited, and runs straighter relative to the valley than reaches of the
32 Middle Hoh.

33 The Middle Hoh receives significant flow from the South Fork and woody debris is not as
34 common in the active channel flow path. Herrera (2004, in BOR, 2004) found more LWD
35 within the HCMZ (relative to the active channel area) in the upstream ONP reaches than in the
36 Middle Hoh reaches, creating pools and more complex channels. Logging and clearing of wood
37 within the river channel limit the amount of large wood that may be recruited to these reaches
38 downstream from the South Fork confluence (BOR, 2004).

39 Between the U.S. Highway 101 Bridge (RM 14.8) and the mouth of Nolan Creek (RM 6.2),
40 meander migration rates have varied between 30 and 50 feet per year since 1939. Upstream from

1 the Highway 101 Bridge (between RM 17 and RM 25), meander migration rates fall within the
2 range of 13 to 76 feet per year (Herrera Environmental and Northwest Hydraulic Consultants,
3 2002 as cited in BOR, 2004). Average channel migration rates for the lower 4 river miles over
4 the period 1952 to 1998 varied between 25 and 88 feet per year (Perkins and TerraLogic GIS,
5 2004).

6 Because it is fed by glacial meltwater, the Hoh River exhibits more stable flows in summer than
7 in adjacent non-glacially influenced watersheds (Haggerty, 2003 as cited in 10,000 Years
8 Institute, 2004). Rain-on-snow events below 610 m elevation frequently initiate floods from
9 October to March (WDNR, 1999 as cited in 10,000 Years Institute, 2004). Winter peak flows
10 approach 63,000 cfs at the Hoh oxbow gage, while extreme summer low flows can fall to around
11 300 cfs (Haggerty, 2003 as cited in 10,000 Years Institute, 2004). The hydrology of tributary
12 streams outside ONP is predominately influenced by a combination of rainfall and both shallow
13 and deep groundwater (WDNR, 1999 as cited in 10,000 Years Institute, 2004).

14 Vegetation within the Hoh River planning area is 25 percent to 50 percent evergreen forest
15 throughout the mainstem (higher percentages in upper reaches), and 70 percent to 90 percent
16 evergreen forest along tributaries. Bare rock/sand/clay, deciduous forest, shrub and brush
17 rangeland, and mixed forest represent significant portions of land cover along mainstem lower
18 reaches.

19 Riparian condition in the Hoh basin is variable. The upper reaches within the ONP remain in
20 good condition. Historically, the watershed was dominated by large old-growth hemlock and
21 Sitka spruce. However, in the middle reaches of the Hoh River prior to regulation, many of these
22 areas were logged to the water's edge. Thus, most of the mainstem of the Hoh downstream of the
23 South Fork has poor riparian condition, as well as lower Winfield Creek and Maple Creek. The
24 riparian condition of the South Fork of the Hoh is rated as fair. Good riparian conditions occur in
25 Nolan, upper Winfield, and Owl Creeks (Smith, 2000).

26 Wetlands compose 30 percent to 50 percent of the planning area along the mainstem and South
27 Fork reaches, while less than 10 percent of the planning area is wetland along the tributary
28 reaches. Riverine upper perennial wetlands are most common (more than 80 percent) in all
29 reaches.

30 Water quality problems exist in the Hoh watershed. Portions of the following tributaries are on
31 the 1998 Ecology 303(d) list for high water temperature: Anderson, Nolan, Small, Willoughby,
32 Maple, Owl, and Canyon Creeks as well as a portion of the South Fork of the Hoh River. The
33 background sediment yield from erosion of tributary channel beds was estimated at 531 tons per
34 year for the Upper Hoh River, and 1,811 tons per year for the Middle Hoh, while the total
35 sediment erosion from roads was estimated at 2,159 tons per year (Powell, 1999 as cited in BOR,
36 2004).

37 Mass wasting is a natural process in the Hoh River basin. About 90 percent of inventoried
38 landslides in the Middle Hoh River watershed are either shallow rapid failures or debris flows,
39 and about 80 percent of observed landslides are associated with human disturbance (timber
40 harvest, roads, etc.) Debris flows regularly occur in areas such as Owl Creek and Maple Creek
41 (BOR, 2004). A large, active, deep-seated landslide that has not been mapped enters the river on

the right bank downstream of Nolan Creek, below RM 4. This slide is increasing in size and may have influenced a major channel shift that took place downstream during a flood event in October 2003 (Howell, 2004 as cited in 10,000 Years Institute, 2004).

4.3.4.4 Biological Resources (Map 19)

The Hoh River watershed supports breeding populations of bald eagle, harlequin duck, marbled murrelet, and spotted owl.

The Hoh River supports Chinook, coho, fall chum salmon, steelhead and cutthroat trout, and bull trout/Dolly Varden spawning. There are no barriers to anadromous fish on the mainstem of the Hoh River. All runs are thought to be of native origin with few outside introductions. The spring/summer Chinook run is thought to be stable with most spawning occurring within the ONP. Recent information indicates that the fall Chinook stock has shown a decline in spawning activity within the Hoh River tributaries and the side channels of the Middle Hoh River that have been impacted by sluice-outs and channel instability (Golder Associates, 2005). However, all of these Chinook runs have shown some recent decline. The fall chum run is in a long-term decline and was probably never abundant. The fall coho run is healthy, but again has shown some recent decline. Winter steelhead have maintained healthy levels within the Hoh system (Golder Associates, 2005). Quinault River steelhead are planted in the Hoh annually but have different run return timing and high exploitation rates, resulting in limited interaction with wild fish (Hook, 2004). The status of the Hoh cutthroat and bull trout runs is unknown.

It is thought that the Hoh River system supports the largest run of char on the coast (Smith, 2000). While the range of Dolly Varden trout (*Salvelinus malma*) overlaps with that of bull trout on the Olympic Peninsula, and they are difficult to differentiate, Dolly Varden do not occur in the Hoh River (10,000 Years Institute, 2004). Bull trout are thought to use the Hoh River as a migratory corridor and possibly spawn and rear in side channels of the mainstem; the majority of the redds have been identified within the ONP boundary (Hook, 2004; 10,000 Years Institute, 2004). Anecdotal evidence suggests that bull trout have historically found thermal refugia in Nolan, Winfield, and Owl Creeks. Tagged anadromous bull trout from the Hoh River were found to visit multiple adjacent estuaries during their lives including Kalaloch Creek (Brenkman, 2004 as cited in 10,000 Years Institute, 2004).

The Hoh River mainstem and Nolan Creek provide spawning and rearing habitat for anadromous salmonids and resident fish species, such as pink salmon, sockeye salmon, longnose dace (*Rhinichthys cataractae*), mountain whitefish (*Prosopium williamsoni*), shorthead sculpin (*Cottus confusus*), torrent sculpin (*C. rhotheus*), reticulate sculpin (*C. perplexus*), Pacific lamprey (*Lampetra tridentata*), and Olympic mud minnow (*Novumbra hubbsi*) (10,000 Years Institute, 2004).

Western Rivers Conservancy and the Wild Salmon Center are working to acquire over 7,000 acres of land along the Hoh River between ONP and the Pacific Ocean to serve primarily as a sanctuary for salmon and steelhead, while also providing protection for several wildlife species such as marbled murrelet, northern spotted owl, bald eagle, and bull trout (Western Rivers Conservancy, 2006).

4.3.4.5 Land Use and Altered Conditions (Map 23)

Land Use

Native Americans have been utilizing the Hoh River valley for many centuries. The entire Hoh watershed lies within the Usual and Accustomed Fishing Grounds of the Hoh Tribe. The Hoh valley was opened to homesteading by non-Indians in 1862, but documentation of land management history begins in the 1880s (Wray, 1999 as cited in BOR, 2004). In 1891, the Forest Reserve Act established the Olympic Forest Reserve which included the Hoh River valley, but the enforcement of this was suspended until March 1, 1898, so prospectors could make claims on their homesteads or trade the land for other public land in a different area (BOR, 2004). Valley bottom forests were initially logged around 1950; logging began in the 1960s along the steep South Fork, but most occurred from the 1970s through the 1990s (Perkins Geosciences and TerraLogic GIS, 2004).

Between the ONP and the Hoh Reservation, most of the land is currently working timberland either privately or WDNR owned and has been subject to timber harvest. Other uses include recreational and commercial fishing, and homesteads and agriculture (cattle). Gravel mines operated by private landowners and the WDNR are located in the Middle and Lower Hoh watershed (10,000 Years Institute, 2004). Within the planning area, 60 percent has been zoned Rural Residential along the mainstem (with areas of approximately 20 percent variation), 30 percent Local Agriculture (along upper and lower reaches of mainstem), and more than 80 percent Commercial Forest along all tributaries, except Nolan Creek, which is 54 percent Commercial Forest.

Transportation and Utilities

Roads were not constructed in the Hoh River basin until the 1930s (BOR, 2004). Jefferson County databases describe 14 miles of road in these reaches, while the WDNR database identifies 28 miles of road. Highway 101 is aligned near the south bank of the Hoh River from RM 4 to approximately RM 15.5 (within Reach Hoh River 2) and regularly passes within the mainstem river's wide planning area. At RM 15.5, the highway crosses the Hoh River and continues to the north, outside of the planning area. Other roadways within the planning area of the Hoh mainstem and tributaries are narrower in width and are frequently unpaved. Roads are mapped throughout the drainage basin but are most dense in the lower reaches.

Shoreline Modifications

Flood frequency has increased on the Hoh River in recent years. Potential reasons for this increase include changes in weather patterns; increases in cleared areas and roads due to timber harvest in the Middle Hoh resulting in increased total runoff and the magnitude of peaks flowing into the Hoh River during storms; and decreased forest cover canopy (Edmonds et al., 1998 as cited in BOR, 2004).

Large sections of Nolan Creek and a 200-foot section of Winfield Creek are impacted by cedar spalts (Silver, personal communication, 2006). Cedar spalts are waste wood left over from salvage operations. Instream accumulations can impede water flow, elevating water temperatures, and leach tannins into the water, thereby affecting water quality. This has

1 contributed to sections of Winfield and Nolan Creeks being on the 1998 303(d) list for elevated
2 water temperature (Ecology, 1998). Many other smaller tributaries (not shorelines of the state) to
3 the Hoh River that are affected by cedar spalts include Pins Creek, Braden Creek, Sand Creek,
4 Clear Creek, Elk Creek, Lost Creek, and Red Creek (Silver, personal communication, 2006).

5 Blocking culverts occur on the following tributaries as well as several unnamed smaller
6 tributaries to the Hoh River: Dismal Creek, Alder Creek, Nolan Creek, Braden Creek, Canyon
7 Creek, Cassel Creek, Mosquito Creek, Cedar Creek, Rock Creek, Elk Creek, Hell Roaring Creek,
8 and Iota Creek. Numerous unnamed tributaries as well as many acres of floodplain habitat are
9 also affected.

10 Constriction from a bridge in the South Fork Hoh River resulted in channel incision and
11 channelization (Smith, 2000). Channelization due to lack of LWD has also resulted in
12 sedimentation problems in Nolan and Owl Creeks.

13 Roads in the floodplain have also reduced floodplain habitat. During floods these act as dikes,
14 isolating the river from the floodplain. Several streams are rated “poor” for floodplain impact,
15 including the mainstem Hoh River and Owl Creek. Floodplain habitat is not only important as
16 rearing habitat for salmonids, but also for groundwater recharge and flow moderation in the Hoh
17 River (Smith, 2000). The Upper Hoh Road is of particular concern not only because it impacts
18 floodplain habitat but because continued road maintenance costs millions of dollars.
19 Traditionally, the County has shored up the road with rock riprap, which has an adverse effect on
20 salmonid habitat. Recently however, engineered logjams have been placed to protect the road
21 while improving salmon habitat. Although not all the logjams remained in place, they are still
22 providing some protection for the road. A larger project by the Washington State Department of
23 Transportation to protect Highway 101 using engineered logjams was completed in 2004. During
24 storm events, forest roads contribute significant amounts of highly turbid water (1,728 tons of
25 fines per year from 293 miles of road in the Middle Hoh) (WDNR, 1999 as cited in 10,000 Years
26 Institute, 2004).

27 The most extensive human impacts in the reaches within the ONP are at the Hoh Ranger Station,
28 the Rainforest Campground, and other facilities near RM 37. Another prominent human feature
29 is Taft Pond, which was created by construction of the Park Road some time between 1950 and
30 1977. Park Road, which parallels the right HCMZ boundary between the Hoh Ranger Station
31 and the park boundary, restricts movement of the channel along the right bank (BOR, 2004).

32 **4.3.4.6 Public Access (Map 23)**

33 There are five WDNR campgrounds along the Hoh River.

34 **4.3.4.7 Restoration Opportunities**

35 Throughout the Hoh River basin, fish access to tributary and floodplain habitat could be
36 improved by replacing barriers to fish passage. In addition, the removal of cedar spalts would
37 increase habitat access and improve water quality. The acquisition and protection of existing
38 high-quality floodplain habitat is a high priority. Riparian plantings of conifers could increase the
39 long-term recruitment of LWD.

4.3.5 Cedar Creek (Hoh River Lower)

4.3.5.1 Basin Overview (Map 1b)

Cedar Creek is a small independent drainage south of the Hoh River. Most of the lower watershed is in the ONP. About a mile of the stream upstream of the ONP is within the shoreline of the state jurisdiction. This section runs through private timberland.

4.3.5.2 Freshwater Reaches (Map 10)

Cedar Creek has been treated as one reach, from the ONP boundary to approximately RM 6.6.

4.3.5.3 Physical Environment (Maps 19 and 23)

The Cedar Creek basin is 90 percent evergreen forest. Vegetation in the remainder of the planning area is recent clearcut, deciduous forest, shrub and brush rangeland, and mixed forest. Only 3 percent of the planning area is wetland, classified entirely as palustrine scrub/shrub. Other habitat data for the watershed are lacking.

4.3.5.4 Biological Resources (Map 19)

Cedar Creek supports coho and winter steelhead trout spawning. The status of these stocks is unknown (Smith and Caldwell, 2000).

4.3.5.5 Land Use and Altered Conditions (Map 23)

Land Use and Zoning

Land use in the Cedar Creek planning area is 52.5 percent commercial forest and 47.5 percent rural residential.

Transportation and Utilities

The WDNR database identifies 1.35 miles of road within the planning area.

Shoreline Modifications

Cedar Creek has been impacted by cedar spalts, has a reduced level of macroinvertebrates, and was rated as “poor” for water quality (Smith, 2000). Sedimentation and an altered riparian zone are problems in some reaches as well.

4.3.5.6 Public Access (Map 23)

There is no public access in this reach.

4.3.5.7 Restoration Opportunities

Opportunities include removing spalts, and surveying for and repairing other fish passage blockages (i.e., culverts).

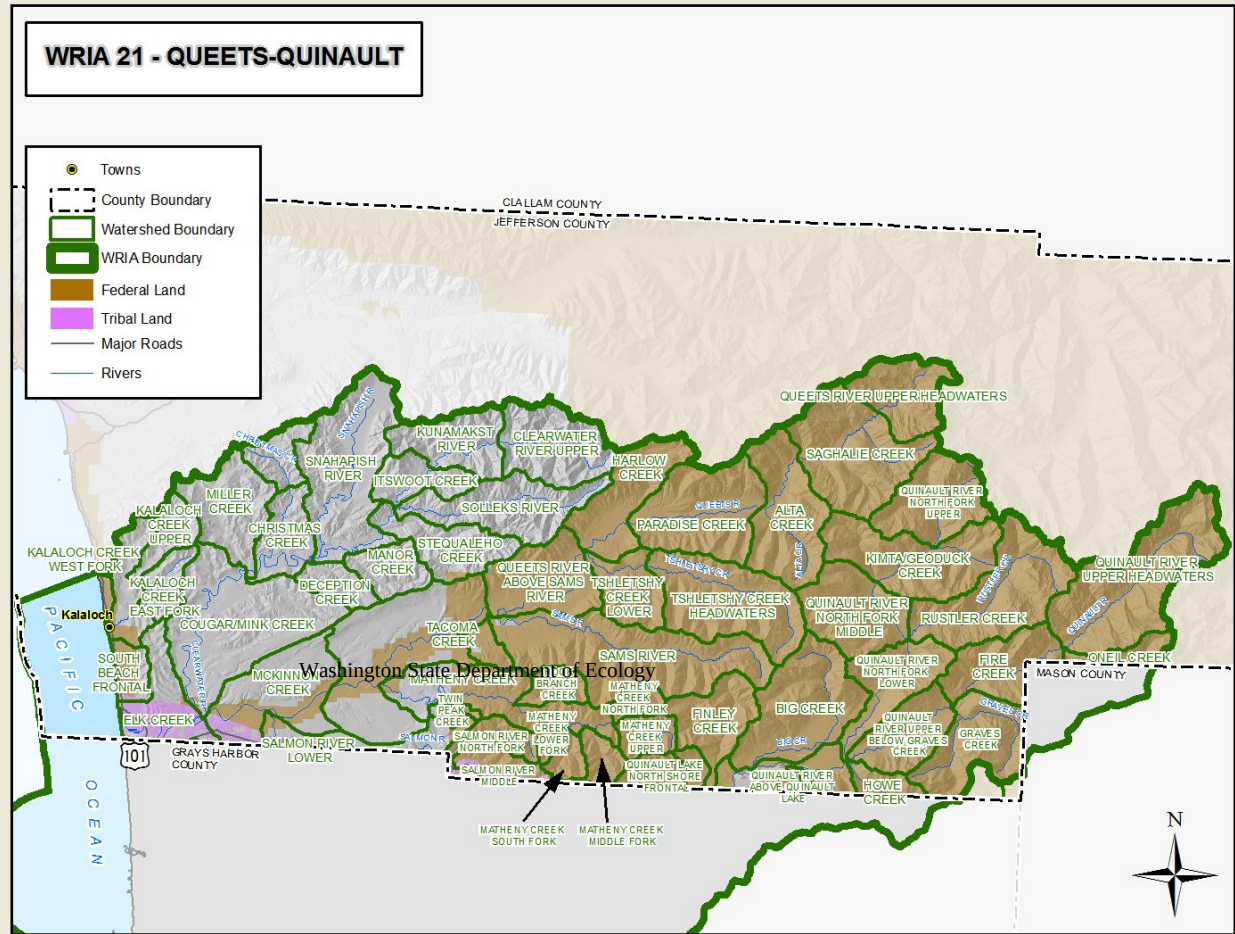
4.4 WRIA 21 - QUEETS-QUINAULT

The southwest corner of Jefferson County and parts of Grays Harbor County are in WRIA 21 (Figure 4-5). WRIA 21 includes Kalaloch Creek to the north and Conner Creek to the south. The largest basins within the WRIA are the Queets and Quinault basins.

Both the Queets and Quinault Rivers drain southwest from the glaciated Olympic Mountains, with peaks higher than 2,200 m. The rivers exit the mountains and flow across a 10 to 30 km wide coastal piedmont underlain by Quaternary glaciofluvial sediment. The Queets River drains a total area of about 1,170 km² and the Quinault River drains 1,134 km². During fall, winter, and spring, these basins are repeatedly subject to large storms from the southwest, delivering substantial rainfall at lower elevations and snow in the higher Olympic Mountains. Summers are relatively dry. The large precipitation volumes are reflected in high average flows. Average annual flow generation is 3.4 m³/m² for the Queets basin and about 3.7 m³/m² for the Quinault basin (O'Connor et al., 2003).

Current land uses within the Quinault and Queets basins include timber harvest, agriculture, fishing, recreation, and tourism. The major landowner in the Quinault basin is the ONP. The Quinault Indian Nation owns 32 percent of the basin, while the remainder is owned or managed by the USFS (13 percent) and private landholdings (4 percent). Present-day settlements are small and include the village of Taholah and the Amanda Park and Neilton areas in the Quinault basin, and the small communities of Queets and Clearwater in the Queets basin. Currently, two hatcheries operate within the Quinault watershed: the Quinault National Fish Hatchery, located near Cook Creek, and the Quinault pen rearing facility, located in Lake Quinault.

Figure 4-5. WRIA 21 in Southwest Jefferson County



4.4.1 Kalaloch Creek (Kalaloch Creek)

4.4.1.1 Overview (Map 1b)

Kalaloch Creek runs south through private and state timberland and then west through ONP to empty into the Pacific Ocean between the Queets and Hoh Rivers (Map 20). Shoreline of the state designation begins at the ONP boundary (roughly RM 1) and continues roughly 2 miles upstream to where the West Fork of Kalaloch Creek branches from the mainstem.

The Kalaloch basin is 13,649 acres in size including four small, unnamed, independent tributaries that drain to the Pacific Ocean to the south of Kalaloch Creek. Most of the drainage consists of either privately owned land (40 percent) or WDNR lands (41 percent). The ONP owns 18 percent of the basin, including the coastal strip and approximately 1 mile of lower Kalaloch Creek. The Quinalt Indian Nation lands include 1 percent of the drainage.

4.4.1.2 Freshwater Reaches (Map 10)

Kalaloch Creek 1: From the ONP boundary to the impassable falls.

Kalaloch Creek 2: From the impassable falls to the upstream extent of shoreline jurisdiction.

4.4.1.3 Physical Environment (Maps 19 and 23)

The Kalaloch Creek planning area is composed of 94 percent evergreen forest. The vegetation in the remaining area is shrub and brush rangeland, and mixed forest. Only 4.4 percent of the planning area is wetland (palustrine scrub/shrub). Riparian conditions in the basin are mostly “fair” to “good” and hydrologic maturity is rated “good.” (Smith and Caldwell, 2000).

Kalaloch Creek has a fairly confined channel due to topography, but channel conditions, floodplain connectivity, and sediment conditions are a data gap. The reach upstream from the ONP is on the 303(d) list for water temperature (Ecology, 1998).

4.4.1.4 Biological Resources (Map 19)

Kalaloch Creek supports coho salmon, winter steelhead, bull trout, and coastal cutthroat trout. Historically, a small run of chum salmon was also present in the watershed (Smith and Caldwell, 2000). All of these runs are wild, native stocks and their current status is unknown.

4.4.1.5 Land Use and Altered Conditions (Map 23)

Land Use and Zoning

Land use is predominantly forestry. Within the planning area, 66 percent to 85 percent is zoned Commercial Forest (with higher percentages in the upstream reach), and 25 percent Inholding Forest in the lower reach. The remainder of the planning area is composed of ONP and areas not zoned.

Although the timber harvest history for the private lands is not known, it is surmised that the WDNR lands were most heavily harvested between the 1940s and mid-1980s (Smith and Caldwell, 2000).

Transportation and Utilities

Road density is generally high in the Kalaloch Creek basin, at 4.08 miles of road per square mile of watershed. Within the planning area, WDNR has mapped 1.2 miles of road.

Shoreline Modifications

Shoreline modifications within the Kalaloch Creek planning area are primarily culverts. The WDFW SSHEAR database documented passage barriers at five culverts under Highway 101 within this drainage (WDFW, 2000b).

4.4.1.6 Public Access (Map 23)

None identified.

4.4.1.7 Restoration Opportunities

Smith and Caldwell (2001) identified several restoration opportunities in this basin, including:

- Address potential sediment sources from roads, especially roads with large fills or undersized culverts (those that do not meet 100-year flows plus debris).
- Address other road sediment problems, including specific road decommissioning, stabilization, and improvements. This also includes removal of side-cast material.
- Limit inappropriate removal of instream LWD.
- Increase channel complexity. Use instream structures as an interim part of a broader restoration plan in appropriate areas.
- Hardwood riparian areas that were historically conifer should be managed to allow conifer introduction through the planting and release of shade-tolerant trees with a goal to increase the size, abundance, and distribution of large conifers.

4.4.2 Clearwater River and Tributaries (Clearwater River Lower and Upper)

4.4.2.1 Overview (Map 1b)

The Clearwater River is a tributary of the Queets River that drains the foothills between the Queets and Hoh Rivers. It is a shoreline of statewide significance from downstream of the Miller Creek confluence to the ONP boundary (near the Clearwater's confluence with the Queets). Upstream of this it is classified as a shoreline of the state, as are the following system tributaries: Hurst Creek, Miller Creek, Christmas Creek, Snahapish River, Stequaleho Creek, and Sollecks River.

WDNR lands compose 79 percent of the Clearwater basin. These are managed as part of the Olympic Experimental Forest, which has the objective of managing the landscape for both habitat conservation and timber production. The riparian conservation plan for this forest includes both riparian and windthrow buffers. Upstream of the confluence with the Snahapish River, the mainstems of the Clearwater and Snahapish Rivers are part of the Clearwater Corridor Natural Resource Conservation Area (NRCA), an area also owned and managed by WDNR.

4.4.2.2 Freshwater Reaches (Map 10)

Clearwater River 1: From the ONP boundary to the confluence with Shale Creek.

Clearwater River 2: From the confluence with Shale Creek to the confluence with Miller Creek.

Clearwater River 3: From the confluence with Miller Creek to the confluence with Christmas Creek.

- 1 Clearwater River 4: From the confluence with Christmas Creek to the confluence with the
2 Snahapish River.
- 3 Clearwater River 5: From the confluence with the Snahapish River to the confluence with
4 Stequaleho Creek.
- 5 Clearwater River 6: From the confluence with Stequaleho Creek to the confluence with the
6 Sollecks River.
- 7 Clearwater River 7: From the confluence with the Sollecks River to the impassable falls.
- 8 Clearwater River 8: From the falls to the upstream extent of shoreline jurisdiction.
- 9 Hurst Creek: From the confluence with the mainstem Clearwater River to the upstream extent of
10 shoreline jurisdiction.
- 11 Shale Creek: From the confluence with the mainstem Clearwater River to the upstream extent of
12 shoreline jurisdiction.
- 13 Miller Creek: From the confluence with the mainstem Clearwater River to the upstream extent of
14 shoreline jurisdiction.
- 15 Miller Creek East Fork 1: From the confluence with the mainstem Miller Creek to the
16 impassable falls.
- 17 Miller Creek East Fork 2: From the impassable falls to the upstream extent of shoreline
18 jurisdiction.
- 19 Christmas Creek: From the confluence with the mainstem Clearwater River to the upstream
20 extent of shoreline jurisdiction.
- 21 Snahapish River: From the confluence with the mainstem Clearwater River to the upstream
22 extent of shoreline jurisdiction.
- 23 Stequaleho Creek 1: From the confluence with the mainstem Clearwater River to the impassable
24 falls.
- 25 Stequaleho Creek 2: From the impassable falls to the upstream extent of shoreline jurisdiction.
- 26 Sollecks River 1: From the confluence with the mainstem Clearwater River to approximately
27 RM 6.3.
- 28 Sollecks River 2: From RM 6.3 to the upstream extent of shoreline jurisdiction.

29 **4.4.2.3 Physical Environment (Maps 19 and 23)**

30 The Clearwater River planning area is 62 percent to 86.5 percent evergreen forest throughout the
31 mainstem (higher percentages in upper reaches), and greater than 81 percent evergreen forest
32 along the tributaries. Deciduous forest, pasture hay, recent clearcut, shrub and brush rangeland,

1 and mixed forest represent the remaining land cover. The entire Clearwater subbasin is rated
2 “poor” for hydrologic maturity.

3 Wetlands compose 25 percent to 41 percent of the mainstem planning area below the Sollecks
4 River, while less than 4.5 percent of the planning area along the tributaries and upper mainstem
5 reaches is wetland. Wetland classifications include riverine upper perennial, and palustrine
6 forested and scrub/shrub.

7 Stequaleho Creek rated “poor” for percent pool habitat. Segments of the Sollecks River rated
8 from “poor” to “fair” for percent pool habitat. In addition, Snahapish River had segments that
9 range from “poor” to “good.” “Good” percent pool habitat was measured in Christmas, East
10 Fork Miller, Hurst, and Shale Creeks, and the West Fork Snahapish River.

11 Water temperatures greater than the state Class AA standard (up to 20.1°C) were found in the
12 lower Clearwater River.

13 **4.4.2.4 Biological Resources (Map 19)**

14 Chinook and steelhead spawn in the mainstem of the Clearwater River, Miller Creek, Christmas
15 Creek, and the Sollecks and Snahapish Rivers. Coho spawn in the mainstem of the Clearwater
16 River and all accessible tributaries. Chum salmon spawn in the lower mainstem of the
17 Clearwater River. Fish access conditions have not been fully mapped in the Clearwater
18 watershed.

19 Downstream of the Snahapish River confluence, “good” riparian conditions were found on 54
20 percent of the buffer, 27 percent rated as “fair,” and 19 percent rated as “poor.” Upstream from
21 this, including the tributaries of the Snahapish and Sollecks Rivers, Stequaleho Creek and other
22 tributaries, the riparian conditions were rated as 69 percent good, 19 percent fair, and 11 percent
23 poor. Levels of instream LWD are unknown; however in the Snahapish River levels of old-
24 growth LWD increased from 56 pieces per 100 meters of stream in 1982, to 63 pieces per 100
25 meters in 1993 (McHenry et al., 1998 as cited in Smith, 2000).

26 **4.4.2.5 Land Use and Altered Conditions (Map 23)**

27 **Land Use and Zoning**

28 The Clearwater basin is under intensive old-growth timber management by the WDNR, which
29 manages over 80 percent of the drainage basin. As of 1980, the basin was 40 percent clearcut
30 (Cederholm et al., 1980).

31 Land use along the Clearwater River mainstem below Shale Creek is zoned 41 percent Rural
32 Residential, 32.5 percent Commercial Forest, and 22.3 percent Rural Forest. Above Shale
33 Creek, land use is 76 to 100 percent Commercial Forest, with minimal Rural Residential zoning.
34 More than 94 percent of land is zoned Commercial Forest along the tributaries, except Miller
35 Creek East Fork, which is 76 percent Commercial Forest.

1 **Transportation and Utilities**

2 Road density is rather high (3.7 and 3.2 miles per square mile for lower and upper Clearwater
3 basin, respectively) and there are likely many blockages to fish passage. As of 1980, over 650
4 km of logging road existed in the basin, and over half were built with side-cast construction
5 (Cederholm et al., 1980). Jefferson County databases describe 4.2 miles of road in the planning
6 area, while WDNR has identified 15 miles of road.

7 Sedimentation due to landslides and debris torrents has historically been a serious problem;
8 much of this has been related to road failure and timber harvest activities. Levels of fine
9 sediments in spawning gravels have been found to be directly related to road density. Salmonid
10 egg mortality is directly related to higher levels of fine sediments in the spawning gravels. The
11 rate of timber harvest has slowed in recent decades. The management of the upper Clearwater
12 River as a Natural Resource Conservation Area (NRCA) by the WDNR should improve the
13 situation. Side-cast roads have already been removed in the Miller and Christmas Creek
14 drainages. However there is a data gap in determining if the rate of debris flow and
15 sedimentation has actually decreased (Smith, 2000).

16 Utilities within the Clearwater River basin have yet to be inventoried.

17 **Shoreline Modifications**

18 Loss of off-channel habitat is a major concern in the Clearwater basin. Timber management
19 along the Clearwater, Salmon, and Sams Rivers, and Matheny Creek has resulted in increased
20 sediment inputs and loss of LWD recruitment (Smith, 2000).

21 The impact of roads on the floodplains has not been fully assessed in the Clearwater watershed.
22 WDFW documented filled areas and blocked culverts to identify areas suitable for restoration.
23 However, because there has not been a full study the full extent of the impacts is unknown.
24 Likely the rating is not “good” (Smith, 2000).

25 ***4.4.2.6 Public Access (Map 23)***

26 None identified.

27 ***4.4.2.7 Restoration Opportunities***

28 In the Clearwater basin, blocking culverts should be replaced with fish-passable structures.
29 Roads that are contributing to mass wasting and erosion should be either decommissioned or
30 repaired so they no longer contribute fine sediments to the system. Riparian planting where trees
31 are lacking would provide shade and increase LWD input over the long term.

32 The WDFW has mapped a total of 49 off-channel rearing habitat areas in the Clearwater River
33 subbasin for potential enhancement or restoration opportunities (Smith and Caldwell, 2001).

34 Some restoration activity has occurred for sediment problems in the Clearwater subbasin. For
35 example, side-cast removal projects have been completed in the Miller Creek and Christmas
36 Creek watersheds.

4.4.3 Salmon River (Queets River and Salmon River)

4.4.3.1 Overview (Map 1b)

The Salmon River flows into the Queets River in ONP. On some maps this stream is marked as Salmon Creek. From its headwaters in the ONF and the Quinault Indian Reservation, the Salmon River flows through two sections of WDNR land and one privately held parcel as well as the Quinault Indian Reservation before flowing into the Queets River in the ONP.

4.4.3.2 Freshwater Reaches (Map 10)

The sections within the shoreline jurisdiction are less than 2 miles in total length, and are therefore considered a single reach.

4.4.3.3 Physical Environment (Maps 19 and 23)

Vegetation within the planning area is 97 percent evergreen forest. Shrub and brush rangeland and mixed forest compose the remaining land cover. Sitka spruce, Douglas fir, and western red cedar dominated the historical riparian vegetation, but with past land management, some conversion to younger conifers and hardwoods has occurred. A greater ratio of hardwoods to conifers than was historically present is found in many riparian stands, although hardwoods have always been a component of riparian stands along the mainstem Salmon River and larger tributaries. While many of the mainstem Salmon River riparian areas currently have a low recruitment potential rating for LWD, many of the tree sizes are approaching the diameter where they would be classified as “medium” size and rated as good recruitment potential (Smith and Caldwell, 2001). Land vegetation cover is rated as “good” for the Salmon River watershed, with only 19 percent immature vegetation in the lower Salmon River area. High-turbidity events are not common or chronic in the Salmon River.

4.4.3.4 Biological Resources (Map 19)

Chinook, coho, chum, sockeye, and pink salmon, and winter steelhead have been identified in the Salmon River. Most of the salmonid stocks within the Queets basin are currently believed to be healthy. Spring/summer Chinook are depressed, while all others are either healthy or unknown.

4.4.3.5 Land Use and Altered Conditions (Map 23)

Land Use and Zoning

Land use within the planning area is entirely forestry. Timber harvest began during the 1940s and 1950s in the Sams, Matheny, Salmon, and Clearwater subbasins, with the peak of timber harvest taking place between 1960 and the mid-1980s (Smith and Caldwell, 2001).

Transportation and Utilities

Within the planning area surrounding all basin reaches, WDNR has mapped 450 feet of road. Jefferson County databases have no mapped roads within the planning area. Unpaved National Forest Roads Nf 2446, Nf 2405, and Nf 2331 all pass within the planning area.

Shoreline Modifications

An assessment of culverts found no blocking culverts in the lower Salmon River in 1998 and 1999, and thus the lower river was rated as “good” for fish habitat access. No loss of fish habitat access from culverts or other structures was found in the North, Middle, and South Forks of the Salmon River. In addition, fish access to the floodplain was found to be good and there was no evidence that land use actions had isolated floodplain habitat.

The Salmon River watershed analysis team noted that timber harvest and road construction have increased the amounts of sediment entering the Salmon River tributaries over natural levels, which results in a “poor” rating for sediment quantity (Smith and Caldwell, 2001).

4.4.3.6 Public Access (Map 23)

No information.

4.4.3.7 Restoration Opportunities

Opportunities appear limited in this area. Improved road management in the watershed could help to improve altered sediment processes.

4.4.4 Matheny Creek (Queets/Matheny Creek)

4.4.4.1 Overview (Map 1b)

Matheny Creek originates on the slopes of Matheny Ridge and Higley Peak and flows west through a narrow valley with a moderate gradient through its lower 14.5 miles to its confluence with the Queets River at RM 15.8 (Phinney and Bucknell, 1975). A majority of this watershed is within ONP.

4.4.4.2 Freshwater Shoreline Reaches (Map 10)

The segment of Matheny Creek that falls within shoreline jurisdiction extends from the ONP boundary upstream to the ONF boundary.

4.4.4.3 Physical Environment (Maps 19 and 23)

Land cover within the planning area is 68 percent evergreen forest. Bare rock/sand/clay (15 percent), shrub and brush rangeland (4 percent), and mixed forest compose the remaining land cover (7 percent). Most of Matheny Creek rated “poor” for hydrologic maturity.

1 Riparian timber harvest and lack of LWD in the lower 2.7 miles of Matheny Creek have
2 contributed to channel widening. This, coupled with increased sediment yields in headwater
3 regions, has caused aggradation, which in turn, has contributed to loss of off-channel habitat.

4 Water temperatures greater than the state Class AA standard were found in lower Matheny
5 Creek, and it is listed on the 2004 303(d) list for temperature (Ecology, 2006).

6 **4.4.4.4 Biological Resources (Map 19)**

7 Matheny Creek provides spawning, rearing, and migratory habitat for Chinook, coho, and chum
8 salmon as well as steelhead (Phinney and Bucknell, 1975; Smith and Caldwell, 2001). Spawning
9 occurs upstream as far as RM 14.5 (Phinney and Bucknell, 1975). Deposition of fine sediment
10 and embedded substrates indicate degraded spawning habitat in the unconfined, lower-gradient
11 reaches of Matheny Creek (RM 0 to 2.7).

12
13 Wetlands compose 27.7 percent of the planning area. Of this, 67 percent are riverine upper
14 perennial, 15 percent are palustrine scrub/shrub, and 15 percent are palustrine forested.

15 **4.4.4.5 Land Use and Altered Conditions (Map 23)**

16 **Land Use and Zoning**

17 Land use within the planning area is 99 percent commercial forestry, and 1 percent ONF and
18 ONP. Timber harvest began during the 1940s and 1950s in the Sams, Matheny, Salmon, and
19 Clearwater subbasins, with the peak of timber harvest taking place between 1960 and the mid-
20 1980s (Smith and Caldwell, 2001).

21 **Transportation and Utilities**

22 Within the planning area surrounding all basin reaches, WDNR has mapped 0.3 mile of road.
23 Jefferson County databases have no mapped roads within the planning area. Unpaved National
24 Forest Road Nf 2405 and an unnamed road which crosses the stream are both aligned within the
25 planning area.

26 **Shoreline Modifications**

27 There are large numbers of in-channel disturbances in Matheny Creek tributaries. Management-
28 related mass wasting events include coarse and fine sediment inputs from channel-adjacent
29 landslides, and shallow rapid landslides triggered by clearcuts or roads (USFS, 1995 as cited in
30 Smith and Caldwell, 2001). Road-related problems include fill and side-cast failure and fine
31 sediment delivery, and are often associated with mid-slope locations. This results in a “poor”
32 rating for sediment quantity for Matheny Creek (Smith and Caldwell, 2001).

33 Two bridge crossings have been identified on Matheny Creek that constrict the river channel at
34 the point of crossing. A short distance (140 feet) of bank hardening was identified in Matheny
35 Creek at RM 0.4.

4.4.4.6 Public Access (Map 23)

WDNR owns and uses the land adjacent to the Matheny Creek 1 reach as timberland. There is no current or planned public access to the stream or planning area.

4.4.4.7 Restoration Opportunities

Recent road stabilization and decommissioning projects are addressing these issues (McConnell, personal communication, 2001 as cited in Smith and Caldwell, 2001).

4.4.5 Quinault River (Quinault River Upper)

4.4.5.1 Overview (Maps 1b and 28)

The Quinault River drains the southeastern Olympic Mountains, with the upper watershed completely protected in ONP. The headwaters are in the vicinity of Mount Anderson and Mount Christie. The Quinault River then flows into Lake Quinault, a 3,729-acre natural lake. Downstream of the lake, the Quinault River flows for 33 miles to the Pacific Ocean. The total watershed area is 293,880 acres. The lowlands in the western part of this watershed contain several hundred feet of glacial deposits with lake and swamp deposits formed in interglacial periods. The low terrain downstream of Lake Quinault contrasts with the steep slopes and high relief of the areas around Lake Quinault and in the headwaters.

Yearly precipitation is high, averaging 146 inches at Lake Quinault. In the upper watershed, much of this precipitation falls as snow, while most falls as rain downstream of the lake. The steep topography and shallow soils of the upper watershed generate both a quick hydrologic response and a high susceptibility to mass wasting events. In contrast, the relatively flat terrain and outwash silts and clays downstream of the lake result in a low susceptibility to mass wasting events and a slower hydrologic response. Because Lake Quinault traps all sediment coarser than silt, the river downstream of the lake is a product of the interactions between the floodplain and the surrounding coastal piedmont (the area between the mountains and the ocean).

Most of the watershed lies within the Sitka spruce and silver fir vegetation zones. Mountain hemlock and subalpine and alpine meadows border the mainstem and North Fork Quinault Rivers. The most common historic disturbances within the watershed have been wildfire and windstorms. Windstorms typically come from the southwest, heavily affecting the coastal plain and the windward mountain slopes. The most common recent disturbance within the watershed has been timber harvest, which has included clearcutting, broadcast burning, and planting of Douglas fir (Smith and Caldwell, 2001).

4.4.5.2 Freshwater Reaches (Map 28)

A 4.9-mile section of the Quinault River downstream of the park boundary and upstream of the Grays Harbor county line is classified as a shoreline of statewide significance. This section of river is upstream of Lake Quinault.

4.4.5.3 Physical Environment (Map 28)

The upper Quinault River is aggrading behind Lake Quinault, a natural lake that traps most sediment and wood transported from the Olympic Mountain headwaters. On the upper Quinault River, logjams promote bar growth and consequent channel shifting, short-distance avulsions, and meander cutoffs, resulting in mobile and wide active channels. The average floodplain width is 2,470 m; the active channel width averages 240 m, which is almost everywhere at least twice as wide as the low-flow channel. The average channel migration rate was found to be 12.7 ± 3.3 meters per year between 1900 and 1994. Floodplain channel erosion occurs at a rate of about 0.2 percent of the floodplain area per year, with a corresponding floodplain half-life (length of time in which the channel occupies half of the total floodplain area) of 300 to 500 years. Floodplain width does not correlate with local geologic controls such as low-flow width, active channel width, or the frequency of low-flow channels, but is more directly related to overall sediment, wood, and flow regimes (O'Connor et al., 2003).

Water quality in the Quinault River, just upstream of the lake, can be poor with elevated temperatures in the summer. This may be a natural condition due to low elevation and channel width.

4.4.5.4 Biological Resources (Map 28)

The Quinault River has healthy runs of fall Chinook, sockeye, winter steelhead trout, bull trout, and Dolly Varden. Even though they are currently classified as “healthy,” runs of coho, sockeye, and winter steelhead have declined as compared to historical levels. The spring/summer run of Chinook is rated as depressed. The stock status of chum and pink salmon, cutthroat trout, bull trout, and Dolly Varden is unknown. All of these species use this stretch of river to spawn or rear.

4.4.5.5 Land Use and Altered Conditions (Map 28)

Land Use and Zoning

Prior to the Cosmopolis and Quinault River Treaties (circa 1855), the Quinault watershed was claimed by the Quinault Tribe as their ancestral homeland and was used for subsistence fishing, hunting, and use of plants for food, medicine, and tools. Formal land ownership began with the Quinault River Treaty in 1855. Euroamerican settlers arrived in the late 1880s, resulting in subsistence farming and grazing in valley bottomlands, primarily in the Quinault Lake and Cook Creek watersheds. Timber harvest began in earnest in 1916, when cedar was salvaged from the 300-acre “Neilton burn.” Railroad construction provided access for timber harvest in the Quinault River and Cook Creek watersheds between 1917 and 1940. Extensive road construction and subsequent timber harvesting occurred between 1950 and 1980. While the level of old-growth harvesting has declined in recent years, second-growth forest management and specialty forest products continue to be economically important.

In 1978, the Quinault Nation embarked on a program to reacquire lands on the reservation to return them to tribal ownership and coordinated management. Most or all lands within the Quinault Indian Reservation and USFS ownership have been harvested at least once. This includes the lowlands, Quinault valley, and areas on Higley and Quinault Ridges. Much of the Cook Creek watershed and the lands north and east of Lake Quinault were declared part of the

Olympic Forest Reserve in 1897. The USFS managed the area until the establishment of the Olympic National Park (ONP) in 1938. The USFS designated the Quinault Recreation Area in 1922 and the Quinault Research Natural Area in 1932. The Colonel Bob Wilderness was included in the federal wilderness areas in 1984 (James, 1999 as cited in Smith and Caldwell, 2001).

Current land uses within the basin include timber harvest, fishing, and tourism. The major landowner is the ONP, which includes all of the Mount Lawson and Enchanted valley watersheds. The Quinault Indian Nation owns 32 percent of the basin, comprising most of the area downstream of Lake Quinault. The USFS manages 13 percent of the watershed, including the eastern part of the Cook Creek watershed and the southwest half of the Lake Quinault watershed between Quinault Ridge and the upper Quinault River. Private landholdings compose only 4 percent of the lands in the basin. Rayonier Timberlands Company is the largest private landholder, managing 14,030 acres in the Cook Creek area (Quinault Indian Nation and USFS, 1999 as cited in Smith and Caldwell, 2001). State lands managed by the WDNr encompass 0.1 percent of the drainage area.

Present-day settlements are small and include the village of Taholah and the Amanda Park and Neilton areas. Currently, two hatcheries operate within the watershed. The Quinault National Fish Hatchery is located near Cook Creek, and the Quinault pen rearing facility is located in Lake Quinault.

Transportation and Utilities

Within the planning area surrounding all basin reaches, WDNr has mapped 0.3 mile of road. Jefferson County databases have no mapped roads within the planning area. Unpaved National Forest Road Nf 2405 and an unnamed road which crosses the river are both aligned within the planning area.

Shoreline Modifications

No information.

4.4.5.6 Public Access (Map 28)

The ownership of this section of river is the ONP on the northern bank, and a mix of private and ONF land on the south bank. The vast majority of the river's watershed within this reach is protected either in ONP or in National Forest riparian reserve and wilderness.

4.4.5.7 Restoration Opportunities

None identified.

4.5 OTHER WEST END SHORELINES (MAPS 1B AND 1C)

Sufficient information was not available to fully address all of the tributaries to the major west county rivers (i.e., Clearwater, Hoh, Bogachiel, Queets, and Quinault) and significant percentage of the river miles that meet the SMP jurisdiction criteria (20 cfs mean annual flow or more) occur on federal or tribal land and are not under County jurisdiction. Information on the

- 1 tributary streams that are within county jurisdiction is provided in Appendix D.