2.2 HUMAN ENVIRONMENT

2.2.1 Land Use and Demographics

Watershed History

An extensive, detailed watershed history (updated from earlier work by others) is presented in Clark and Clark (1998), recording human development activities and Dungeness River conditions in tabular format from 1792 through 1998. The timeline includes information from 382 permit actions taken in the Dungeness River vicinity over the 1974-1997 period, compiled by the Clallam County Planning Department. The *Clallam County Profile* (CCDCD 1992) also contains a narrative history of the county.

Native Americans have fished the waters of the Dungeness River and vicinity since the time of the last Ice Age. Indians thrived on abundant fish and shellfish, basing much of their culture and economy on these rich resources, particularly the multiple runs of salmon. Archaeological excavation near Sequim provides evidence that people inhabited the region as early as 11,000 years ago. The earliest explorers arrived with Vancouver's expedition in 1792, but did not settle until the next century. Vancouver's observations indicated that native bands moved between pre-established sites, influenced by the seasons and the availability of food resources (DQ Plan 1994).

The first European settlers arrived in Clallam County in the early 1850s, displacing Natives through both disease and forcible dispersal. Early settlement occurred primarily in the Sequim-Dungeness area west of Sequim Bay, where the towns of New Dungeness and Sequim were founded. With the signing of the Point No Point Treaty in 1855, settlers pressed government agents to relocate the S'Klallam peoples from their traditional territory on the northeast Olympic Peninsula. In 1874,the Dungeness S'Klallam band pooled resources and purchased 200 acres on the shoreline of the Strait of Juan de Fuca between the mouths of Cassalery and Gierin creeks, naming the small property Jamestown.

Settlement proceeded rapidly in locations with good natural harbors, where logging and early sawmills produced lumber for shipment to San Francisco. Timber harvest reduced riparian buffers; the practice of floating timber down the Dungeness undoubtedly degraded banks and channel conditions. A disastrous wildfire in 1890-91 destroyed over 45 square miles of Dungeness River watershed (south of Burnt Hill). Streams were diked for diversions, and agricultural water use was initiated. The area was too dry to farm until, in 1895, the Sequim Prairie Ditch Company was formed to convey Dungeness River water to cleared lands. Dairy farms and creameries followed and, by 1920, twenty-one ditch companies served the area.

By the late 1800s, settlement and land clearing had extended into the foothills. This trend continues today, as the *Clallam County Profile* (CCDCD 1992) notes that the county is experiencing much of its growth in rural unincorporated areas.

Today's drivers of change in both the region's economy and its future development, include changes within the extractive industries sector, outdoor recreation and tourism, an attractive climate, and low housing and land costs.

Population Trends

Historical and current population trends of WRIA 18 provide a useful basis for understanding current water demand and projecting future changes. They also indicate where and how human populations have settled and developed the watershed, leading to changes and impacts on water quality and habitat.

The probable size of the pre-European Native population in the region was relatively small. An estimated 2,000 members of the S'Klallam tribe lived in 17 coastal villages spread from Discovery Bay to Clallam Bay. As of the 2000 census, the Native American population in Clallam County totaled 3,303 (including all tribes, the S'Klallam, Klallam, Quileute, Makah, and Ozette).

Clallam County Population Trends

In 1960, according to US Census data, the total Clallam County population was just over 30,000 (Table 2.2-1). The County grew moderately through the decade of the 1960s, averaging about 1.5 percent per year. Rapid growth followed in the 1970s (4 percent per year), when total population increased by nearly 50 percent. Population growth slowed markedly again through the 1980s (less than 1 percent per year) and gradually increased in the 1990s. Cumulatively since 1960, the County's population had increased 115 percent by the 2000 census (a 1.93%/year rate), reaching a total of 64,525.[1]

Table 2.2-1. Clallam County Population Growth Trends.

Year	Population	Growth in Decade		Cumulative Growth (since 1960)	
		Rate	Total	Rate	Total
1960	30,022	--	--	--	--
1970	34,770	1.48%	16%	1.48%	16%
1980	51,648	4.04%	49%	2.75%	72%
1990	56,464	0.90%	9%	2.13%	88%
2000	64,525	1.34%	14%	1.93%	115%

Source: Table created using US Census 2000 Data

WRIA 18 Population Trends

Table 2.2-2 gathers population growth histories and forecasts from several sources for the County, WRIA 18, and various sub-regions, including the East and West WRIA 18 watershed planning areas.[2] Among the sub-regions included are:

- Five Sequim Bay sub-basins that comprise the WRIA 17 planning area that has been included in this watershed plan

[1] The Puget Sound Action Team recently released a forecast showing a considerably slower projected growth rate (0.74%/year) for Clallam County than shown by either the past decade (1.34%/year) or by 40-year trends (1.93%/year).

[2] Sources include the DQ Plan (1994), Regional Plans for the Sequim-Dungeness and Port Angeles areas, Comprehensive Water System Plans for Sequim and Port Angeles, Washington Office of Financial Management data, US Census data, the Puget Sound Water Quality Action Team, and analysis done for this watershed plan.

Table 2.2-2. WRIA 18 Population Growth Histories and Forecasts.

Area	Period	Initial Population	Final Population	Growth Rate	Percent Increase over Period	Source
East WRIA 18						
5 Sequim Bay Subbasins	2002-2020	2,092	3,534	2.96%	69%	Clallam County data/GIS
11 Eastside Subareas	1970-1992	11,502	20,129	2.58%	75%	DQ Plan
11 Eastside Subareas	1992-2020	20,129	29,714	1.40%	48%	DQ Plan
14 Eastside Subbasins (comparable to 11 subareas analyzed in DQ)	2002-2020	24,511	33,032	1.67%	35%	Clallam County data/GIS
Sequim-Dungeness Region	1990-2010	17,385	23,969	1.62%	38%	Sequim Dungeness Regional
Sequim	1990-2000	3,617	4,334	1.82%	20%	US Census 2000 data
Sequim	1998-2018	4,164	7,094	2.70%	70%	City of Sequim Comprehensive Water Plan
West WRIA 18						
12 Westside Subbasins	2002-2020	26,484	28,910	0.49%	9%	Clallam County data/GIS
Port Angeles Region: Low Scenario	1990-2010	26,862	29,334	0.44%	9%	Port Angeles Regional Plan
Port Angeles Region: High Scenario	1990-2010	26,862	32,776	1.00%	22%	Port Angeles Regional Plan
Unincorporated East Port Angeles	1990-2000	2,672	3,053	1.34%	14%	US Census 2000 data
Port Angeles Eastern UGA Annexation Area	2000-2020	2,062	2,278	0.50%	10%	City of Port Angeles Comprehensive Water Plan
Port Angeles	2000-2020	18,930	20,916	0.50%	10%	City of Port Angeles Comprehensive Water Plan
Port Angeles	1990-2000	17,710	18,397	0.38%	4%	US Census 2000 data
County & WRIA 18						
Unincorporated Clallam County	1990-2000	32,039	39,890	2.22%	25%	OFM data
Total Clallam County	1990-2000	56,464	64,525	1.34%	14%	US Census 2000 data
Total Clallam County	2000-2020	not given	not given	0.74%	16%	PSWQAT
Total WRIA 18	2000-2020	51,235	64,162	1.13%	25%	Clallam County data/GIS and US Census data

NOTES:

1. The 14 eastside subbasins compared to the DQ Plan 11 eastside subareas are: Bagley, Bear, Bell, Canyon, Cassalery, Dungeness Bay (inner and outer), Dungeness River, Gierin, Matriotti, McDonald, Meadowbrook, Siebert, and Strait small tributaries.
2. The 5 Sequim Bay subbasins are Chicken Coop, Dean, JimmyComeLately, Johnson, and unnamed small Sequim Bay tributaries
3. The 12 westside subbasins are Dry, Elwha, Ennis, Indian, Lees, Little, Morse, PA Harbor small tributaries, Peabody, Tumwater, Valley, and White
4. The Port Angeles Comprehensive Water Plan "base year" is an average of data for 1996-2000, but growth is projected from 2000
5. Total WRIA 18 population 2002 estimate is based on U.S. Census data (2000), distributed into WRIA 18 boundaries using GIS analysis.

- Eleven eastside sub-areas addressed in the DQ Plan and the 14 eastside sub-basins that make up East WRIA 18
- Sequim-Dungeness region
- City of Sequim
- Twelve west-side sub-areas that make up West WRIA 18
- City of Port Angeles, its region, UGA and annexation areas
- Unincorporated Clallam County

Table 2.2-2 includes both population forecasts done for other plans and studies, and those done for this watershed plan. The latter data are summarized in Tables 2.2-3 and 2.2-4, which present buildout and population growth estimates for each WRIA 18 subbasin.

Table 2.2-3 contains the 2002 buildout[3] analysis, and Table 2.2-4 presents the population forecast based on the buildout analysis. Figures 2.2-1 and 2.2-2 show the subbasin areas analyzed for buildout *using updated data from 2004 (see Appendix 2-A, Part II B).* The data in Tables 2.2-3 and 2.2-4 were developed in 2002 based on Clallam County Department of Community Development's Geographic Information System (GIS). The buildout analysis (Table 2.2-3; *updated and enhanced in Appendix 2-A)* shows the number of existing residential units in WRIA 18 by subbasin. Using a vacancy rate from Census 2000, occupied and vacant residential units are calculated. Based on Assessor's records of vacant parcels, GIS was used to calculate the potential additional residential units that could be developed. The table shows full buildout under existing zoning and land division, and at maximum allowable densities assuming clustering and full use of Transferable Development Rights (TDRs).[4] It should be noted that these potential buildout figures represent a "worse case scenario" and are not likely to be realized, given other considerations such as natural resource constraints, available water and other public services, and the overall economy of the area.

The population analysis (Table 2.2-4) is based on Census 2000 data, disaggregated by subbasin using GIS. Household size was calculated from census data for each subbasin, and a subbasin-specific population growth rate was derived for each subbasin from GIS analysis of final building permits issued since 1989.[5] Using GIS buildout data from Table 2.2-3 (total and occupied residential units), household size, and the population growth rates derived for each subbasin, population was projected to three endpoints:

- Population in the year 2020;
- Population at maximum buildout under existing zoning and land division codes;
- Population at maximum allowable densities with clustering and full use of TDRs.

[3] "Buildout" refers to the potential development of land as allowed under current zoning. Full buildout would result in the development of all land to its currently zoned maximum extent.

[4] A "maximum" level of buildout was generally possible to calculate for the County. A redevelopment analysis of the cities was beyond the scope of the watershed plan (although "maximum" numbers for Sequim were developed by assuming a range of intensity for multi-family development).

[5] Population growth rates were derived from the change in number of permitted bedrooms in each subbasin, capturing both redevelopment and new construction growth.

Table 2.2-3 WRIA 18 Buildout Potential by Subbasin.

Subbasin	Existing Total Residential Units (GIS 2002)	Residential Vacancy Rate (Census 2000)	Existing Occupied Residential Units (GIS 2002)	Vacant Residential Units (Census 2000 Vacancy Rate)	Potential Additional Residential Parcels (GIS 2002)	Total Potential Residential Parcels	Maximum Potential Residential Units w/Clustering and TDRs
Bagley Creek	298	6.84%	278	20	624	922	1295
Bear Creek	163	8.42%	149	14	271	434	434
Bell Creek	1304	8.76%	1190	114	2304	3608	5116
Canyon Creek	39	0.00%	39	0	72	111	111
Cassalery Creek	788	6.14%	740	48	526	1314	1493
Chicken Coop Creek	115	11.57%	102	13	377	492	492
Dean Creek	14	6.02%	13	1	91	105	105
Dry Creek	246	5.47%	233	13	680	926	2959
Dungeness Bay inner	689	10.90%	614	75	860	1549	1549
Dungeness Bay outer	570	17.30%	471	99	808	1378	1572
Dungeness River	1625	7.18%	1508	117	1587	3212	3652
Elwha River	259	10.05%	233	26	673	932	1362
Ennis Creek	536	10.43%	480	56	690	1226	1938
Gierin Creek	1941	10.36%	1740	201	2340	4281	7181
Indian Creek	256	55.49%	114	142	1009	1265	1293
Jimmy Come Lately	49	10.53%	44	5	416	465	465
Johnson Creek	204	10.86%	182	22	696	900	1309
Lees Creek	1117	7.77%	1030	87	1724	2841	9285
Little River	20	9.68%	18	2	98	118	118
Matriotti Creek	1274	9.48%	1153	121	2100	3374	3126
McDonald Creek	439	7.32%	407	32	645	1084	1084
Meadowbrook Creek	128	11.11%	114	14	226	354	354
Morse Creek	687	7.99%	632	55	1117	1804	2534
PA small tributaries	1740	6.36%	1629	111	3994	5734	7377
Peabody Creek	2818	7.58%	2604	214	3548	6366	6773
Sequim Bay small tributaries	300	20.24%	239	61	1299	1599	1610
Siebert Creek	350	4.27%	335	15	612	962	1213
Strait small tributaries	1146	9.22%	1040	106	1184	2330	2441
Tumwater Creek	1404	7.10%	1304	100	1095	2499	2553
Valley Creek	1033	7.10%	960	73	2353	3386	3585
White Creek	391	6.62%	365	26	1159	1550	1853
TOTAL	**21,943**	**9.22%**	**19,961**	**1,982**	**35,178**	**57,121**	**76,232**

Source: Based on buildout analysis by Clallam County Department of Community Development 2002. See Appendix 2-A for updated data.

Notes

1. Maximum potential residential units is calculated based on maxmimum development allowed with clustering and transferable development rights (TDRs).
2. It is assumed that vacancy rates in the future approximate those of the 2000 Census.
3. City of Sequim and City of Port Angeles existing residential units were analyzed in GIS together with the unincorporated WRIA 18 residential units. These data are distributed into subbasins in the table. However, vacant parcels and potential buildout for the City of Sequim were not available in GIS by subbasin. Therefore, these data are shown for the City independent of subbasin. Sequim buildout is based on the number of acres of vacant land and applicable zoning (Sequim Comprehensive Plan 1996). Port Angeles buildout was available through the GIS analysis and is distributed into subbasins in the table.

Table 2.2-4 WRIA 18 Population Growth Under Current Zoning and Land Division by Subbasin.

Subbasin	Census 2000 Population	Estimated Existing Population (Census 2000 escalated to 2002)	Projected Population Year 2020	Projected Population with Additional Residential Development	Maximum Population w/Clustering and TDR	Number of Years to Reach Max Potential Growth	Year in which Maximum Population Growth is Reached	Household Size (Census 2000 data)	Forecasted Population Growth Rate (percent/year)
Bagley Creek	1259	1314	1925	2917	3701	49	2051	2.57	2.14%
Bear Creek	232	243	363	965	904	59	2061	2.67	2.26%
Bell Creek	2400	2461	3085	7244	9682	109	2111	2.08	1.26%
Canyon Creek	0	2	3	168	168	501	2503	2.30	0.86%
Cassalery Creek	1881	1968	2951	3165	3475	25	2027	2.28	2.28%
Chicken Coop Creek	277	293	479	1268	1156	50	2052	2.59	2.78%
Dean Creek	393	416	698	645	632	15	2017	2.52	2.92%
Dry Creek	690	697	769	2509	7529	441	2443	2.66	0.54%
Dungeness Bay inner	1566	1627	2302	3543	3334	37	2039	2.23	1.94%
Dungeness Bay outer	1099	1171	2069	2815	2857	28	2030	2.04	3.21%
Dungeness River	3377	3477	4517	6989	7640	54	2056	2.21	1.47%
Elwha River	921	1011	2334	2787	3629	27	2029	2.64	4.76%
Ennis Creek	1102	1113	1218	2640	3892	250	2252	2.21	0.50%
Gierin Creek	3938	4021	4847	8795	13605	117	2119	2.04	1.04%
Indian Creek	364	374	477	2697	1437	99	2101	2.30	1.36%
Jimmy Come Lately	84	89	146	1116	1008	88	2090	2.47	2.79%
Johnson Creek	477	508	896	1903	2482	50	2052	2.00	3.21%
Lees Creek	2997	3019	3224	6978	20319	522	2524	2.30	0.37%
Little River	64	66	84	290	268	104	2106	2.29	1.36%
Matriotti Creek	2638	2714	3500	7629	6638	63	2065	2.34	1.42%
McDonald Creek	1588	1638	2162	3223	3107	42	2044	2.46	1.55%
Meadowbrook Creek	501	512	624	1000	946	56	2058	2.16	1.11%
Morse Creek	1309	1334	1585	4157	5629	151	2153	2.53	0.96%
PA small tributaries	4445	4447	4462	14250	17402	7107	9109	2.45	0.02%
Peabody Creek	7209	7215	7271	15191	15432	1778	3780	2.25	0.04%
Sequim Bay small tributaries	743	787	1314	3667	3104	48	2050	2.22	2.89%
Siebert Creek	295	302	368	1913	2478	191	2193	2.63	1.11%
Strait small tributaries	2208	2277	3002	4986	4967	51	2053	2.29	1.55%
Tumwater Creek	3683	3696	3811	6263	6198	302	2304	2.34	0.17%
Valley Creek	2534	2543	2625	7723	7762	630	2632	2.20	0.18%
White Creek	961	969	1049	3602	4071	328	2330	2.27	0.44%
TOTAL	**51,235**	**52,301**	**64,162**	**133,037**	**165,453**			**2.28**	**1.13%**

Source: Based on buildout analysis by Clallam County Department of Community Development 2002

Notes

1. The year in which the maximum potential growth is reached was cacluated by applying the assumed growth rate for each subbasin to the existing population until growth reached the maximum buildout potential.
2. Canyon Creek has 0 existing residential units. In order to forecast buildout and population growth, it was assumed that one unit housing the watershed-average number of persons (2.3/household) existed in this watershed. A 0.86% growth rate was assumed, based on Clallam County data for unincorporated areas (Steve Gray pers. comm. 11-26-02)
3. Dean Creek has a small stock of existing residential units with proportionately large recent development, leading to an unrealistically high buildout growth rate (42%/year). Therefore, Dean Creek growth rate was estimated as the average of the Johnson Creek, Chicken Coop Creek, JimmyComeLately Creek and Sequim Bay small tributaries growth rates.
4. Little River had too few recent building permits to calculate a growth rate. Indian Creek is used as a proxy for growth in Little River.
5. Population growth rates were calculated for each subbasin based on GIS analysis of historical growth (since 1988) in the number of bedrooms permitted under final building inspections

Figure 2.2-1. Subbasin Areas Analyzed for Buildout – East WRIA 18.

SEE SEPARATE FILE.

Take this page out of copy master.

Remove this page from copy master.

Table 2.2-4 also shows the year in which maximum potential population growth would be reached for each subbasin (given the growth rate shown in the table). Most WRIA 18 sub-basins have small growth rates and would not reach their full buildout for long periods under these assumptions. The estimated WRIA 18 2002 population, including Sequim Bay, is 51,235, and the projected year 2020 WRIA 18 population is 64,162 (using the average growth rate for WRIA 18 sub-basins as determined by GIS analysis of building permit trend data since 1989). WRIA 18 population at full buildout under current zoning and land division regulations would be 133,037 and at maximum density could reach 165,453.

Regional Growth Patterns

Tables 2.2-2 and 2.2-4 show that growth is occurring most rapidly on the east side of WRIA 18, and very slowly on the west side. Growth rates are highest in the most easterly region (reaching a maximum in Sequim Bay, at nearly 3%/year). Growth may have passed a peak in East WRIA 18: growth reported in the DQ Plan for the 1970-1992 period was 2.58%/year. This is consistent with countywide census data showing a growth surge in the 1970s.[6] Analysis shows growth slowing to a rate of 2.09%/year over the past decade.

The DQ Plan (1994) applied GMA projections through 2020 to eleven Clallam County planning sub-areas and forecasted that population would increase at a rate of 1.4%/year through 2020. The DQ analysis was based on projections of growth at 1.3%/year until 2000 and 1.1%/year thereafter for all areas except Sequim and its western growth area. These two areas were projected to grow at 2.6%/year until 2000 and 2.43%/year thereafter. The DQ Plan projection is directly comparable to the estimate for the 14 eastside subbasins made in this plan. The 14 eastside sub-basins of East WRIA 18 (the DRMT management area) are expected to grow more slowly, at 1.67%/year to the year 2020; this is very close to the rate forecast in the *Sequim-Dungeness Regional Plan*, 1.62%/year.

Growth rates for the City of Sequim vary markedly between US Census data, which shows a 1.82%/year growth rate from 1990-2000, and the City's *Comprehensive Water System Plan*, which projects a 2.7%/year growth rate to the year 2018. The previous *City of Sequim Comprehensive Water Plan* (Polaris Engineering and Surveying, Inc. 1993) stated that Sequim experienced a 2.7%/year population growth over the 1980s and forecasted growth averaging 2.8%/year. The newer 2000 *Comprehensive Water System Plan* (Gray and Osborne, Inc. 2000) makes a very marginal reduction in forecasted growth, and appears to continue the expectation of growth rates experienced in the 1970s and 1980s.

On the west side of WRIA 18, much slower growth is expected. GIS analysis forecasts 0.49%/year growth for 12 west-side sub-basins, a rate that accords well with census data for the City over the past decade (0.38%/year), the *Port Angeles Regional Plan* low scenario (0.44%/year) and the *City of Port Angeles Comprehensive Water System Plan* (0.5%/year). However, Census 2000 data show a much faster growth rate for the unincorporated east Port Angeles area (1.34%/year). By contrast, the City's *Comprehensive Water System Plan* applies the same 0.5%/year rate to the UGA annexation area as it does to the City proper.

[6] City of Sequim's Comprehensive Water Plan (Polaris Engineering and Surveying, Inc. 2000) noted that the Dungeness River watershed experienced a 2.95%/year growth rate during the 1980s

Washington Office of Financial Management data (1990-2000) suggest that growth is now occurring more rapidly in the unincorporated areas throughout the County (2.22%/year).

Land use changes and growth rates

Thomas et al. (1999) state that most land use in the Sequim-Dungeness area was agricultural in 1960 and the population was about 5,000. Since 1960, the population has steadily increased and land use has been changing from agricultural to residential. GIS analysis of building permit data yields a growth rate of 1.60%/year (2002-2020).

Population Density

Data published in the 1994 DQ Plan indicate that the 1992 population density within the Clallam County portion of the DQ planning area (roughly corresponding to the Dungeness River Basin and East WRIA 18) was 177 persons per square mile. This is roughly equivalent to about one household per 8 to 10 acres.

Table 2.2-5 presents population and residential density by subbasin (outside incorporated areas), based on Clallam County GIS analysis. As might be expected, subbasin densities are greatest in the Port Angeles urban drainages, reaching 617 residences and 1387 persons per square mile in Peabody Creek. In East WRIA 18, the greatest densities are reached in the Cassalery, Gierin and Bell subbasins, which surround the City of Sequim, and in the Dungeness Bay area (Figure 2.2-1). Here densities peak at 774 persons and 379 residences per square mile. Density in the East WRIA 18 planning area is currently about 85 persons per square mile and one residence per about 17 acres (37 residences/mi^2). In the WRIA 17 (Sequim Bay) planning area, density drops to about 37 persons per square mile and one residence per about 39 acres (16 residences/mi^2). In West WRIA 18 (Figure 2.2-2), density is about 57 persons per square mile and one residence per about 26 acres (25 residences/mi^2). Countywide, density is about 67 persons per square mile and one residence per about 22 acres (29 residences/mi^2).

Population Age Structure

An age class analysis taken from the 2000 Census indicated that Clallam County had more elderly (65+) persons, and fewer persons in the 18-44 age range than the norm for Washington State. Sequim had an even more exaggerated age profile, with a far greater proportion of senior citizens, possibly reflecting the combined attractions of climate, relatively low housing costs, and desirable services and opportunities for a retired population. Age distributions shown in the *Sequim-Dungeness Regional Plan* corroborate this profile. The Port Angeles age structure shows only a slightly higher than normal senior population. These differences may affect water resource use and conservation attitudes and use rates (DQ Plan 1994).

Table 2.2-5. WRIA 18 Population and Residential Density by Subbasin.

Subbasin	Number of Residences	Watershed Acres	Residences per Square Mile	Population per Square Mile
Bagley Creek	298	4337	44	113
Bear Creek	163	2671	39	104
Bell Creek	1304	4856	172	357
Canyon Creek	0	4981	0	0
Cassaley Creek	788	2281	221	503
Chicken Coop Creek	115	3827	19	50
Dean Creek	14	1861	5	12
Dry Creek	246	4088	39	103
Dungeness Bay inner	689	2164	204	454
Dungeness Bay outer	570	2662	137	279
Dungeness River	1625	111567	9	21
Elwha River	259	180085	1	2
Ennis Creek	536	5649	61	134
Gierin Creek	1941	3276	379	774
Indian Creek	256	11542	14	33
Jimmy Come Lately	49	10277	3	8
Johnson Creek	204	3955	33	66
Lees Creek	1117	3718	192	442
Little River	20	14656	1	2
Matriotti Creek	1274	8859	92	215
McDonald Creek	439	14938	19	46
Meadowbrook Creek	128	608	135	291
Morse Creek	687	36583	12	30
Port Angeles small tributaries	1740	2418	461	1130
Peabody Creek	2818	2923	617	1387
Sequim Bay small tributaries	300	6799	28	63
Siebert Creek	350	12027	19	49
Strait small tributaries	1146	6068	121	277
Tumwater Creek	1404	3866	232	545
Valley Creek	1033	2600	254	560
White Creek	391	1351	185	421
TOTAL	21904	477493	29	67

Based on buildout analysis by Clallam County Department of Community Development 2002

Note: The Elwha River, Little River, Morse Creek and other streams with upper watersheds in Olympic National Park have low densities due to inclusion of full watershed area (including land within the Park) in calculations of density.

Land Cover and Use

Natural land cover has changed in synchrony with climate and geology. According to the DQ Plan (1994) "the warmth of the climatic optimum or hypsithermal period is thought to have resulted in the growth of conifers and deciduous trees, to be eventually replaced in cooler, wetter times" by the old growth climax that characterized the mountain and foothill forests of the region prior to the initiation of timber harvest.

Figure 2.2-3 depicts the dramatic changes in land use and land cover that occurred in the Dungeness River area between 1858 and 1994 (taken from Eckert 1998). Clearly, what had been a predominantly forested area slowly became an agricultural area, with many acres of hemlock- and fir-covered area lost. In 1960, according to Thomas et al. (1999), the Sequim-Dungeness area was predominantly agricultural; since then, land use has been changing and residential/urban development now presents the more immediate challenge in terms of new demands on water. Table 2.2-3 shows that about 34 percent of total buildout potential has been realized; stated another way, it is possible that the existing level of development could nearly triple, given current zoning. Many WRIA 18 subbasins can receive a significant amount of new development. Again, these potential buildout figures represent a "worse case scenario" and are not likely to be realized (as discussed above).

Thomas et al. (1999) reported that their 116 mi^2 Sequim-Dungeness study area was covered 53 percent in conifer forest; 30 percent in natural grassland, brush, and non-irrigated pasture; 10 percent by residential and urban development; and 7 percent by irrigated agriculture. The *Dungeness River Area Watershed Characterization* (PSCRBT 1991) reported forest cover over 43 percent of the watershed, while rural/agricultural land occupied 21 percent of the area. The disparity between the two sources of land cover information may be due to the way in which dairies and several tree farms in the Sequim-Dungeness Valley were accounted for in the two analyses.

The *Clallam County Profile* (CCDCD 1992: Section IV) contains a land use profile and provides background on the land use classes contained in the Comprehensive Plan. Map IV-1 from that profile shows that by 1992 much of the East WRIA 18 lowlands were already in rural low and high density use, with a core of urban land use at Sequim and in a few pockets along the coast.

Land management designations providing federal and some state protection to the upper and middle Dungeness/Gray Wolf basins are described below. Much privately held land is consolidated in large timber holdings, although the DQ Plan (1994) reported changing ownership trends, with forest lands converted to residential development. Existing zoning in forested and agricultural areas may allow future land conversions.

The Sequim-Dungeness Regional Plan (CCDCD 1994, Figures 8 and 9) maps fish and wildlife corridors with land use designations. The Dungeness River, Siebert Creek, and McDonald Creek are among the major designated river and stream corridors.

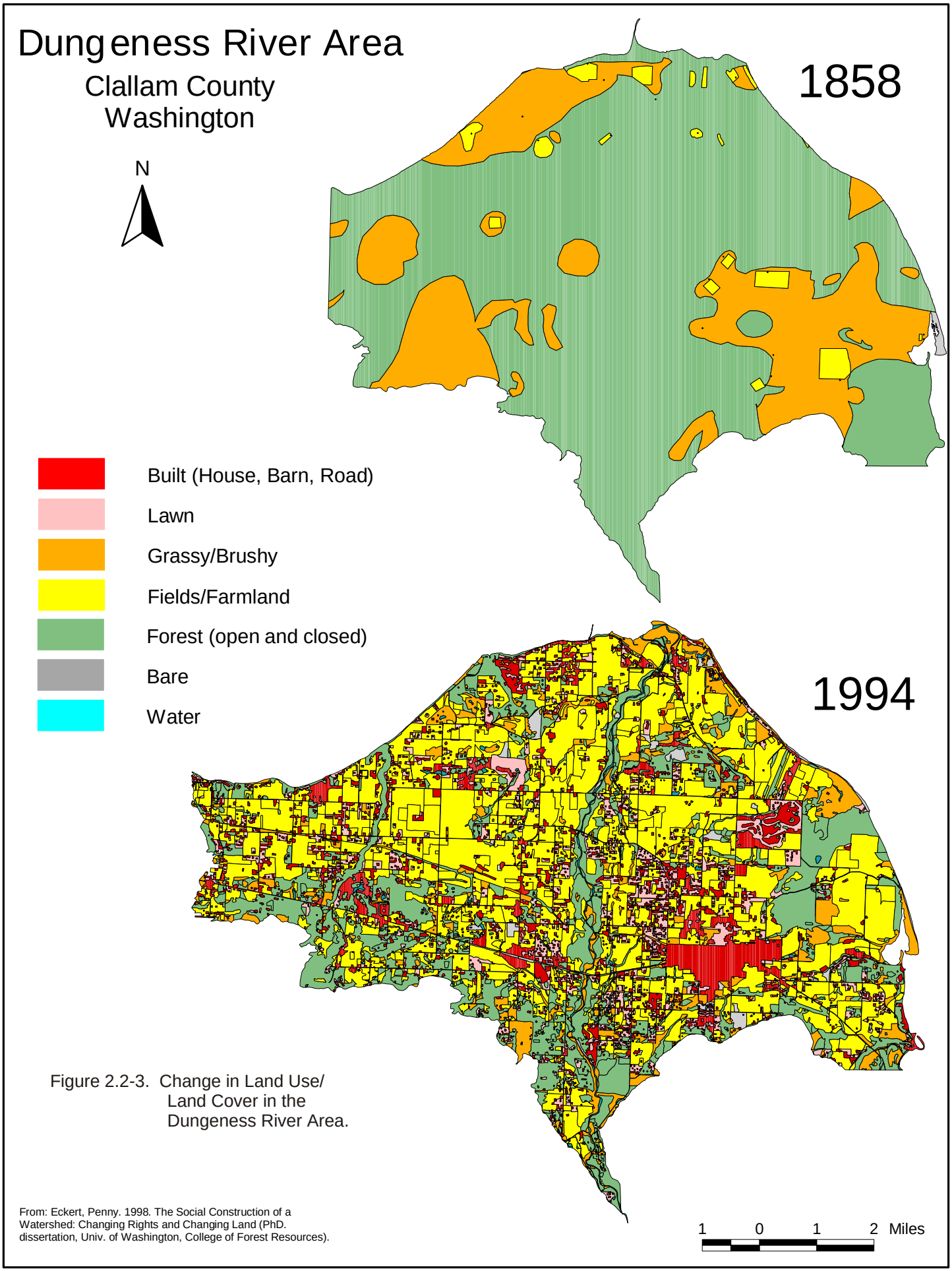

Figure 2.2-3. Change in Land Use/ Land Cover in the Dungeness River Area.

From: Eckert, Penny. 1998. The Social Construction of a Watershed: Changing Rights and Changing Land (PhD. dissertation, Univ. of Washington, College of Forest Resources).

This page intentionally left blank.

Forest Management

The USFS (DAWACT 1995) maps potential forest vegetation zones, showing that a potential western hemlock climax forest covers most of the watershed, with scattered patches of silver fir and Douglas fir, and sub-alpine fir in the upper watershed. The majority of currently forested lands are found in the foothills and higher elevations of the Olympic National Park and Olympic National Forest.

The predominant resource land occurring in Clallam County is commercial forest, forming large tracts in every regional planning area of the county. Most of the commercial forests of WRIA 18 are in federal, state, or large private land holdings committed to long-term commercial timber production. These areas are regulated by the U.S. Forest Service or the Washington State Department of Natural Resources. Only those privately-owned lands in Class 4 conversions, or in mixed use residential/ commercial forestry, fall under the jurisdiction of Clallam County (CCDCD 1996).

Agriculture

A general and possibly accelerating land use trend is apparent in the loss of agricultural land over the past 40 years. Land use changes in the last 30 years have resulted in a significant decrease of farming and other agriculture, which has significantly changed the associated patterns of water use. Agriculture has been replaced with rural residential development to a large extent (Eckert 1998). Where agriculture persists, flood irrigation is no longer permitted (WUA 2001). According to the Clallam County Agricultural Lands Advisory Committee, there were just over 36,000 acres of farmland in Clallam County in 1969. The most recent inventory of farmland occurred in 1997, when the County had declined to 21,253 acres of farmland. A 2003 update is expected to show a less drastic decrease.

Analysis for this watershed plan suggests that about 19,000 acres of agricultural land remain in WRIA 18. The CCDCD (GIS data) indicates that WRIA 18 currently contains 13,886 acres of agricultural land outside of WUA boundaries. Within the WUA, an additional approximately 5,000 acres are commercially irrigated (WUA 1999). Common crops include hay, grain, berries, orchard fruits, and turf (CCDCD 2002). Lavender has recently increased in importance as well (Sequim Chamber of Commerce 2000) (Foster Wheeler 2002). The *County-Wide Comprehensive Plan* (CCDCD 1995c) designates approximately 6,400 acres in the Sequim-Dungeness region as “agricultural resource lands”, providing development restrictions and land use designations conducive to the retention of parcel sizes and ownership patterns conducive to the continuation of agriculture.

Land Development & Urbanization

The *Sequim-Dungeness Regional Plan* and the *County-Wide Comprehensive Plan* (CCDCD 1994, 1995c) designate Urban Growth Areas (UGAs) for the City of Sequim and for the village of Carlsborg. The Plan refers to “urban centers” at Diamond Point, Blyn, and Sunland, recognizing that these areas are developed, but that they cannot receive significant additional development. The *Port Angeles Regional Plan* and the *County-Wide Comprehensive Plan* (CCDCD 1994, 1995) similarly designate UGAs for the City of Port Angeles.

The State of Washington defines the purpose of the Urban Growth Area, as areas designated to receive growth around an existing population center (typically, but not always, around an incorporated city). The intent is to concentrate development in areas where services exist and to keep development out of resource areas that may be sensitive and do not have public services needed to serve more intense levels of development. UGAs are areas that are anticipated to have the type of urban services (public water, sewer and other capital infrastructure) that will allow development to occur at higher levels of intensity over the defined planning period. In most cases, it is anticipated that the UGA around a city will be annexed (pers. comm., Brad Collins, City of Port Angeles; Andy Meyer, Clallam County 2002).

Land Use Planning and Growth Management

The *Sequim-Dungeness Regional Plan* (CCDCD 1994), the *Port Angeles Regional Plan* (Clallam County Planning Division et al. 1994) and the *County-Wide Comprehensive Plan* (CCDCD 1995c), prepared pursuant to the Growth Management Act, provide policy and regulatory guidance for growth and development outside urban boundaries. The regional comprehensive plans specifically address the unincorporated areas of the Sequim-Dungeness and Port Angeles regional planning areas. The plans include general policies pertinent to watershed inventory and planning, addressing public water systems, fish and wildlife habitat, wetlands, erosion and landslide areas, and critical aquifer recharge areas. These plans have legal authority with regard to land use decisions in the County.

Water and watershed resources are addressed in the *Sequim-Dungeness Regional Plan*'s section on Open Space and the Environment (Section 31.03.195). This plan includes specific policies that pertain to such issues as designating open space corridors for wildlife, developing Dungeness River corridor-specific policies, and ensuring that land uses within river corridors are consistent with the goals of protecting habitat and water quality, both ground and surface. This plan also provides policy reinforcement for sound, comprehensive watershed planning.

The *Sequim-Dungeness Regional Plan* Public Facilities and Services Section (31.0-31.20) establishes policies that public water systems should be provided within designated urban growth areas, rural centers, and villages. It states that these public and municipal systems (i.e., Clallam County PUD and City of Sequim) should be limited in rural lands to those that can demonstrate water quality limitations, water quality problems, or hydraulic continuity. While level of service is based upon expected land use densities established by the regional plan, the extension or existence of public water service in rural areas is to be timed to meet the needs of development as it occurs.

The *Port Angeles Regional Plan* contains similar policies related to water use and service within the City and the designated urban growth areas.

Figures 2.2-4 and 2.2-5 show current zoning, parcel divisions, and Urban Growth Area (UGA) boundaries. Further detailed information is also available at: www.clallam.net.

Rural Roads

In WRIA 18, considerable discussion (Rural Road Standards Advisory Committee, Clallam County, December, 2000) has taken place regarding the need to potentially

change rural road design standards in order to maintain a rural atmosphere, to decrease the potential for increased travel speeds, and to decrease the need for additional impervious surfaces. The design and maintenance of rural roads presents challenges to local and state government due to the inherent conflicts between accommodating increased residential density, and keeping streams and rivers from accepting added run-off. Flexible road standards allow those involved in road design, building, and maintenance the option of maintaining the winding, slower, narrower roads that have proven environmental, safety, and livability benefits. Of particular relevance to stormwater management is an exception which allows rural roads to be repaired or replaced, but not widened.

Effects of Current and Anticipated Land Use

Haring (1999) emphasizes the need to change land use regulations in order to protect natural ecological processes in the marine, instream, and riparian corridors of WRIA 18, including measures to keep impervious surfaces within limits that will allow natural hydrology to be maintained.

Areas Protected

More than 25 percent of the Dungeness watershed is protected within Olympic National Park and more than 33 percent is in Olympic National Forest. The national park (which is also designated as an International Biosphere Reserve) and the Buckhorn Wilderness in Olympic NF together make up 43 percent of the watershed. Upper watershed tributaries in the national park include Royal Basin and Royal Creek--nearly to its confluence with the Dungeness; the tip of Heather Creek; and the upper Gray Wolf River, including Cameron Creek and Grand Creek. Olympic National Forest, including the Buckhorn Wilderness, encompasses most of Copper Creek and the upper Dungeness below the National Park boundary and above about RM 13.3. Park and wilderness designations protect more than 95 percent of the Gray Wolf River basin.

Additional Forest Service land in the middle Dungeness is designated as a Critical Habitat Unit. Below the National Forest boundary, Washington DNR holdings are scattered through the foothills. The *Sequim-Dungeness Regional Plan* also shows fish and wildlife corridors with protective land use designations (CCDCD 1994: Figure 8), including the Dungeness River and other creeks and streams. The USFS (DAWACT 1995: Map 6) provides a useful map of administrative boundaries for these lands.

The Strait of Juan de Fuca, bordering WRIA 18 to the north, is designated as a shoreline of statewide significance under the Shoreline Management Act of 1971 (RCW 90.58 and the Clallam County Shoreline Master Program). The *Clallam County Shoreline Master Plan* also lists specific portions of the shoreline within designations that include Natural Environment, Conservancy Environment, and Rural Environment (see SEPA checklist, MWG 1999). The Dungeness River, from the Olympic National Forest boundary downstream to its mouth at Dungeness Bay, is listed as a Rural Shoreline Environment. The Dungeness National Wildlife Refuge is a federally protected area, which is also adjacent to a Clallam County park.

Much of the upper Elwha River watershed is similarly protected within Olympic National Park, and a comparatively small part of the middle watershed is within a unit of Olympic NF. Headwaters of some of the larger WRIA 18W streams (Peabody, Ennis, and Morse creeks) also extend into the national park. Local protective actions have been undertaken on Valley and Ennis creeks, leading to public ownership and parkland status for portions

of Valley Creek and to public ownership and conservation easement agreements along portions of Ennis creek. These local efforts can be expected to continue, leading to further protection of these important local stream corridors.

Several private land protection organizations have developed land protection strategies for areas within WRIA 18. The North Olympic Land Trust, a non-profit organization, holds conservation easements on the Dungeness River and elsewhere, providing permanent land protection within the riparian corridor. Friends of the Fields, another nonprofit organization, has identified agricultural properties of interest and has retired development rights on one farm in the Sequim-Dungeness Valley for permanent protection. Both of these groups have received private and public funding for their land and easement acquisition work. This trend towards private land protection efforts is becoming increasingly effective as a means to leverage multiple funding sources and non-governmental involvement in land conservation.

The Dungeness River Restoration Work Group, a sub-group of the DRMT, has identified properties from the estuary area upstream to as far as RM 11 (in the area of the WDFW hatchery) for floodplain restoration, estuary restoration, habitat protection, and riparian restoration. A portion of those properties, at River's End, near the mouth of the Dungeness River, includes eighteen or more "at risk" parcels that have been identified for purchase from willing sellers and protection by a consortium of funding entities, with Clallam County operating as the lead agency. These properties have been prioritized based on their hydrologic and habitat values, flood susceptibility, and water quality and public health impact potential.

Areas Most Affected

Watershed resources within WRIA 18 (including surface water, groundwater, and habitat) which are most affected by the cumulative effects of land use, development, forest and agricultural conversions, and other human impacts are generally located in areas which have experienced urbanization or in river corridors where development has encroached on floodplains and riparian zones. In particular these areas include the lower eleven miles of the Dungeness River, where development has occurred in the floodplain and the river corridor, particularly where levees and other bank-hardening activities have disconnected the river from its floodplain, blocked access to side channels, and altered river processes. Within the irrigated areas of the Dungeness River watershed, large-scale effects on groundwater recharge areas have occurred over a long period, creating artificial wetlands, adding to natural wetlands, increasing stream base flows (including instances where ephemeral streams change to perennial flow patterns), and affecting the water table in the shallow aquifer. Also, as development intensifies without the provision of sewer infrastructure and as the density of developments on septic systems increases, some areas have shown elevated nitrate concentrations in groundwater (e.g., Carlsborg).

Other streams significantly affected by floodplain and riparian development include Bell Creek, McDonald Creek, and the lower three miles of Morse Creek (where a significant amount of bank-hardening and channel straightening has occurred). Most of the Port Angeles urban drainages (Dry Creek, Tumwater Creek, Valley Creek, Peabody Creek, White Creek, Lees Creek) have been subjected to extensive impacts typical of urban areas. These urban impacts include stormwater run-off from roadways, which ultimately enters streams and rivers and affects water quality and flow. Stream habitat in these urban streams is degraded, and in some cases streams have been culverted for long

Figure 2.2-4. Urban Growth Areas (UGAs) in East WRIA 18.

This page intentionally left blank.

Figure 2.2-5. Urban Growth Areas (UGAs) in West WRIA 18.

This page intentionally left blank.

stretches (e.g., Tumwater, Valley, Peabody & White creeks). Diking along portions of both sides of the lower Elwha River has separated it from substantial portions of its historic floodplain and riparian areas. Port Angeles harbor development, both onshore and intertidally, has significantly altered the nearshore environment and the estuaries of the urban streams (Tumwater, Valley, Peabody, and Ennis creeks) draining into the harbor.

Areas at Greatest Risk of Future Impacts

Areas at risk of future impacts are those that, by virtue of their zoning, surrounding land use pattern, regional trends, or location within a designated growth area stand to continue to be affected by urbanizing trends, urban uses, or continued river corridor development. In the Sequim-Dungeness Valley, many farms have been taken out of agricultural production, subdivided, and parcels sold for residential development. The potential impacts from these land conversions include an increase of impervious surfaces, increased pressure for urban services such as water and sewer, and the loss of critical mass of farmland to sustain a farming region. Similar impacts are associated with conversion of forested lands to residential uses, with the addition of a particular loss of habitat and connected corridors. Forest land conversions have occurred throughout WRIA 18. Infilling within UGAs will increase densities in those stream corridors that lie within the UGAs.

Without adequate legal protection, many of the smaller subbasins listed above remain at risk for future impacts. In particular, those subbasins within urban growth areas are particularly vulnerable due to the potential for increased urbanization and the related impacts. Ennis Creek, within the Port Angeles Urban Growth Area, has particularly high value habitat for an urban stream that could be affected by additional development. Potential future industrial use at the former Rayonier mill site could affect water quality, estuarine function, and river restoration. Indian Creek, a tributary to the Elwha originating in Lake Sutherland has raised concern with regard to growth pressure. The Carlsborg Urban Growth Area may be at greater risk than other areas due to existing elevated levels of nitrate in the groundwater there.

This page intentionally left blank.