

Appendix G

Summary of GIS Analysis Completed in Support of the U.S. Fish and Wildlife Service's
Biological Opinion for the Washington Forest Practices Habitat Conservation Plan

The following is a summary of the spatial analysis used to evaluate the environmental baseline and the potential effects of activities analyzed in this Opinion. The objective of this analysis was to estimate the general extent that both aquatic and terrestrial species habitats may be affected by the forest practices activities analyzed in this Opinion. We used a geographic information system (GIS) to estimate the acres of FPHCP covered lands, estimate miles of streams by water-type on the FPHCP covered lands, and estimate the acres of managed riparian area occurring on FPHCP covered lands. The values generated in the GIS analysis are estimates only, and are not meant to be interpreted as absolute values. The software used for the analysis is the ArcGIS 9.1 package developed by ESRI. We obtained GIS data from several different sources to prepare this analysis. Significant data sources and limitations to these data are described below.

G.1 FPHCP COVERED LANDS

The original file displaying the FPHCP covered lands was obtained from Tetra Tech FW, Inc. The file received from Tetra Tech (ffr_lands) contains attributes for non-Federal landownership, forested and non-forested lands, and existing HCPs. Because HCPs and some non-forested lands were included in this original file, there were over 3 million acres of lands included in this file that are not covered by the FPHCP. We modified the ffr_lands file to exclude those areas that are covered by existing HCPs and non-forested areas, except in eastern Washington. East of the Cascade crest, WDNR lands that are covered by an existing HCP for northern spotted owls would also be covered by the FPHCP. Our final selection was saved as FPLands. The total area covered by this file is 9.3 million acres, and excludes all Federal and tribal lands. This is a complex polygon file that includes many small fragments or “micro” polygons that are the result of joining several different data sources. There may be some errors of inclusion or omission associated with this file, but given the size of the area covered, we felt that these errors are minor, and that this file represents the best available GIS data for the FPHCP covered lands.

G.2 STREAM TYPING

We used the 2005 hydrography data for Washington developed by WDNR to analyze water types in the FPHCP area. There were two separate data sets covering eastern and western Washington. These data are mapped at a scale of 1:24,000 and vary in detail depending upon ownership. Generally, we found the hydrography data mapped for non-federal lands to be highly detailed. Stream data for Federal lands was less complete, with fewer small streams mapped. These datasets contained attribute fields for both the forest practices water-typing codes (i.e., Type S, Type F, etc.) and the interim water-typing codes (i.e., Type 1, 2, 3, 4, 5, 9) (Table G-1).

Table G-1. Water-typing values included in the WDNR 2005 hydrography data. Each line segment in the dataset has an assigned value for both attribute fields listed below.

Attribute Field	Attribute Field
FP_WTRTYP_CODE (Forest Practices Types)	FP_WTRTY_1975_Code (Interim Types)
<u>Values</u>	<u>Values</u>
S = Shorelines	Type 1 = “Shorelines of the State”
F= Fish Habitat	Type 2 = High value fish habitat
N = Non-fish Habitat	Type 3 = Fish habitat
U = Unknown	Type 4 = Perennial, non-fish bearing stream
X = No WaterType Designation	Type 5 = Seasonal, intermittent, ephemeral
(e.g., pipelines, flumes)	Type 9 = Unclassified

Because the forest practices water-typing codes did not include a code to identify Type Np or Type Ns waters, we used the following selections to identify Type Np and Type Ns waters:

Np Streams =

FP_WTRTYP_CODE = N and FP_WTRTY_1975_code = 1 or 2 or 3 or 4

Ns Streams =

FP_WTRTYP_CODE = N and FP_WTRTY_1975_code = 5 or 9

In applying the above selections, we classified all non-fish-bearing waters as either Type Np or Type Ns for our stream analysis. All waters typed as “unknown” remained typed as unknown in our analysis dataset. We completed this classification so that we could estimate the miles of each water-type located on the FPHCP covered lands and map riparian areas for each water-type. Miles of lake and wetland shorelines were not calculated separately, but were included in final estimates as stream miles if they were connected to streams. We do not expect that all waters on the FPHCP lands are mapped, or that all mapped waters are typed correctly. However, the WDNR hydrography data is the most comprehensive and detailed dataset available for the analysis area, and therefore represents the best available GIS data for this analysis.

G.3 RIPARIAN MANAGEMENT ZONES

We chose to estimate the area associated with riparian management zones (RMZs) on the FPHCP covered lands by using GIS to map the RMZs and calculate the approximate acres associated with RMZs along each water type. Under the Washington Forest Practices Rules, the width of the RMZ depends upon the stream width, stream type, site class, and whether the site is located on the east or west side of the Cascades. Rather than developing a complex GIS dataset based on each site class and water type, we chose to apply a set of standard assumptions for bankful width, channel migration zones (CMZs), and riparian areas (site potential tree heights) (Table G-2). The assumptions we used to map the RMZs were taken directly from the Appendix B (Riparian Modeling) in the FEIS (USFWS and NMFS 2006).

For each stream in the FPHCP GIS dataset, we used the buffer tool in ArcGIS to map riparian area buffers based on the assumptions listed in Table G-2. We mapped 2 separate riparian buffers for each stream.

One buffer represented the total riparian area width, and the 2nd buffer represented the minimum protected area within the larger RMZ (i.e., bankful width, CMZs, and Core Zones).

Table G-2. Assumptions used to map RMZs on the FPHCP covered lands (all distances are in feet, along each side of a mapped stream in GIS).

Riparian Area Assumptions	Western Washington			Eastern Washington		
	Type S	Type F	Type Np	Type S	Type F	Type Np
Mean riparian tree height	200	155	155	130	100	100
Mean ½ bankful channel width	30	5.25	2.5	25	3.75	2.5
Mean channel migration zone	30	10	0	5	2	0
Total Mean Riparian Area width by Type	260	170.25	157.5	160	105.75	102.5

Protected Area Assumptions	Western Washington			Eastern Washington		
	Type S	Type F	Type Np	Type S	Type F	Type Np
½ mean bankful channel width	30	5.25	2.5	25	3.75	2.5
Mean channel migration zone width	30	10	0	5	2	0
Core Zone or other no-harvest area	50	50	50	30	30	30
Total Mean RMZ width by Type	110	65.25	52.5	60	35.75	32.5

Notes: The Type S riparian buffer is based on a Site Class I 100-year site index tree height. The Type F and Type Np riparian buffer width is based on the average of Site Class II and Site Class III 100-year site index tree heights, because these are the most common Site Class types in Washington. Bankful width and CMZ assumptions are from the FEIS, Appendix B (USFWS and NMFS 2006).

For Type Np streams, we chose to map the riparian areas based on the average 100-year site index tree height because we assume that forest practices activities that occur within a site-index tree height have the potential to affect the stream (Table G-2). For calculating the total protected acres along Type Np waters, we assumed that only half of the protected areas mapped along Type Np waters would be protected in Type Np RMZs, and the other half could be harvested. To minimize the overlap in the GIS buffers, we mapped buffers sequentially, starting with Type S, then Type F, and finally Type Np. For example, the portions of Type Np streams that occurred within a Type S or Type F buffer were excluded when we mapped the Type Np buffers (Figure G-1).

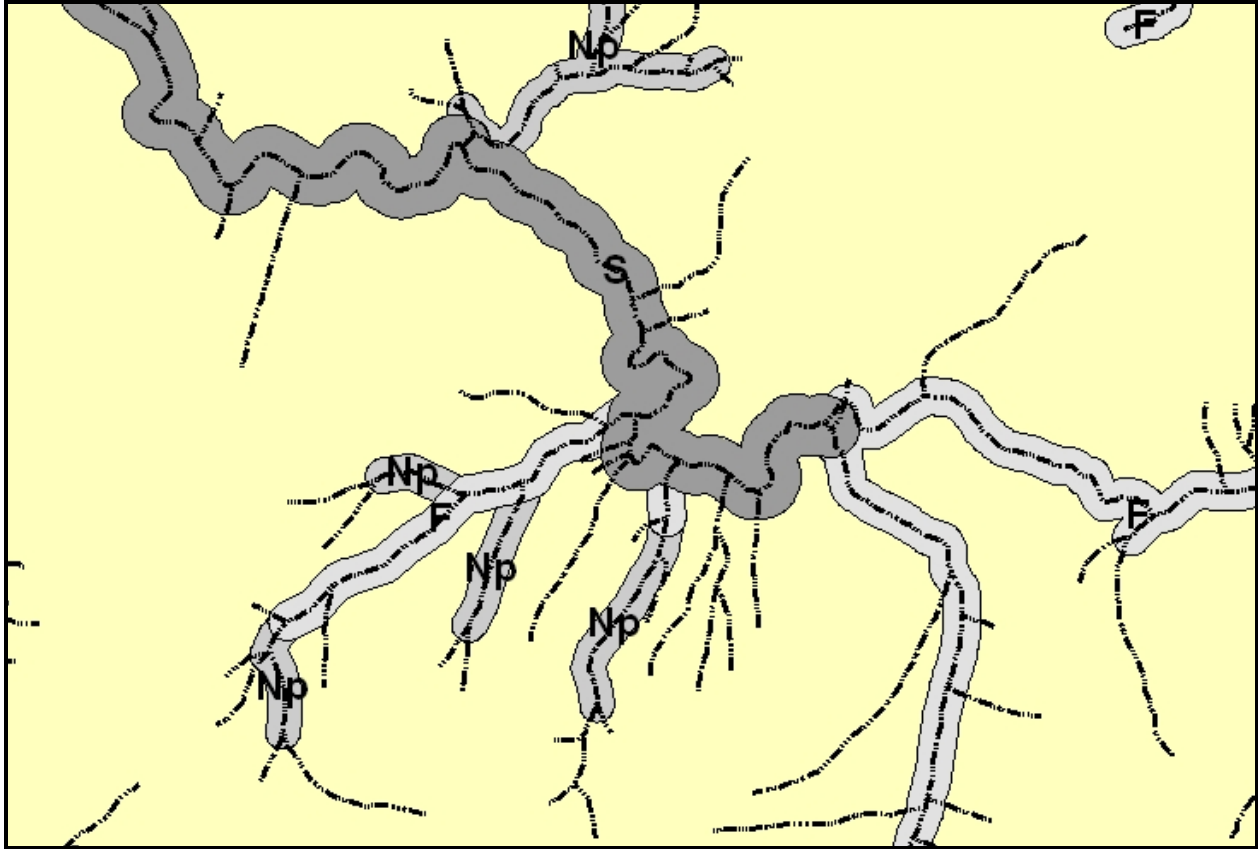


Figure G-1. Example of riparian areas mapped using GIS to create buffers along each side of a mapped stream. Unbuffered streams in this figure were identified as Type Ns waters in our analysis.

G.4 BULL TROUT HABITAT

We used GIS data compiled by the USFWS for bull trout recovery planning and the proposed and final bull trout critical habitat designations for the Coastal-Puget Sound and the Columbia River bull trout distinct populations segments. Bull trout stream data included all areas identified for recovery of the species as determined by the Recovery Plan teams, based on their expertise and knowledge of habitat conditions. The base data source was WDFW 1:100,000 streamnet data, with some local areas digitized from 1:24,000 scale USGS topographic maps where known bull trout spawning and rearing have been documented. Bull trout critical habitat is a subset of the larger bull trout stream data, and is based on individual stream segments identified in the Final Rule (FR 56212-56311). Because these data are mapped at varying scales across the analysis area, we were not always able to make direct comparisons between the WDNR hydrography data and the WDFW streamnet data used to map bull trout habitat. For bull trout analysis areas, we used both data sets – we used the hydrography data to estimate stream density at the local population scale, and overlaid the bull trout stream data to estimate the miles of bull trout habitat within the analysis area. Refer to Appendix A for more information on the GIS analysis for bull trout.

G.5 ROADS AND STREAM CROSSINGS

We used the 2005 transportation data for Washington developed by WDNR to analyze roads and stream crossings on the FPHCP covered lands. This data is mapped at the 1:24,000 scale and includes attributes for roads, trails, railroads, railroad grades, ferry crossings, and unknown. We selected the roads from this data set and created a clip with our FPHCP covered lands data to estimate the miles of roads on the FPHCP covered lands. By intersecting the roads data with the stream data, we were able to estimate the number of road-stream crossings by watertype on the FPHCP covered lands. We also estimated stream-adjacent roads by intersecting our riparian buffer layer with the roads layer.

G.6 ANALYSIS AREAS

We used the Water Resource Inventory Areas (WRIA) boundaries developed by the WDOE to subdivide the FPHCP covered lands into watershed analysis areas. For each dataset that we analyzed, we summarized the information by WRIA as a way to refine our analysis and for comparative purposes. For many of the native fish and amphibian species, we did not have GIS data showing the distribution of those species, so we used WRIA boundaries as a surrogate for species distributions. For example, if a species was known to occur in a WRIA, we assumed that all stream miles (of the type(s) associated with that species) in the WRIA would provide habitat for that species. Based on these assumptions, we were able to estimate potential effects and incidental take for each of the non-listed native fish and amphibian species covered under the FPHCP.

For our bull trout analysis, we used bull trout core areas and recovery planning units as identified in the draft bull trout recovery plans (U.S. Fish and Wildlife Service 2002; 2004) to evaluate the FPHCP. The bull trout core areas are not the same as WRIA boundaries, so the values listed for WRIs are not directly comparable with bull trout core areas or recovery units.

G.7 SUMMARY TABLES

The following tables display the results of our GIS analysis used in this Opinion. These are summary tables only. More detailed spreadsheets that list data sources and the analysis methods used are filed in the GIS administrative record for this Opinion.

Table G-3. Summary of estimated stream miles and acres on FPHCP covered lands by WRIA.

WRIA Number	WRIA Name	Total WRIA Acres	Acres of FPHCP Covered Lands in WRIA	Percent of WRIA in FPHCP Covered Lands	Total Stream Miles in WRIA	Stream Miles on FPHCP Covered Lands	Percent of Streams in WRIA on FPHCP Covered Lands
1	Nooksack	1,034,637	255,561	24.7%	4,005.8	1,564.9	39.1%
2	San Juan	397,683	77,260	19.4%	226.1	137.1	60.6%
3	Lower Skagit / Samish	472,175	178,808	37.9%	1,843.4	899.7	48.8%
4	Upper Skagit	1,564,949	123,837	7.9%	6,544.8	853.1	13.0%
5	Stillaguamish	460,483	160,616	34.9%	3,108.6	935.5	30.1%
6	Island	332,085	84,107	25.3%	222.7	140.3	63.0%
7	Snohomish	1,221,290	405,197	33.2%	8,183.2	2,374.0	29.0%
8	Cedar-Sammamish	438,857	106,618	24.3%	1,664.7	467.7	28.1%
9	Duwamish-Green	372,162	108,939	29.3%	1,975.6	598.6	30.3%
10	Puyallup-White	672,848	282,638	42.0%	3,516.5	1,919.6	54.6%
11	Nisqually	491,024	229,349	46.7%	3,398.4	1,534.9	45.2%
12	Chambers-Clover	114,850	21,843	19.0%	113.6	32.5	28.6%
13	Deschutes	186,802	113,420	60.7%	1,018.4	884.7	86.9%
14	Kennedy-Goldsborough	243,990	104,515	42.8%	799.0	351.3	44.0%
15	Kitsap	630,646	298,742	47.4%	1,738.9	1,283.8	73.8%
16	Skokomish-Dosewallips	408,660	44,300	10.8%	1,891.3	277.2	14.7%
17	Quilcene-Snow	400,435	130,722	32.6%	1,250.6	664.7	53.1%
18	Elwha-Dungeness	650,267	54,754	8.4%	1,688.5	264.2	15.6%
19	Lyre-Hoko	502,643	124,122	24.7%	1,888.1	1,054.0	55.8%
20	Soleduc	959,550	233,183	24.3%	6,201.5	2,215.1	35.7%
21	Queets-Quinault	862,967	98,487	11.4%	5,042.3	756.5	15.0%
22	Lower Chehalis	938,847	467,582	49.8%	7,359.4	4,836.5	65.7%
23	Upper Chehalis	830,282	537,167	64.7%	9,224.4	6,781.5	73.5%
24	Willapa	814,678	500,868	61.5%	9,383.9	7,778.6	82.9%
25	Grays/Elochoman	322,903	215,115	66.6%	4,348.0	3,165.3	72.8%
26	Cowlitz	1,594,104	674,950	42.3%	13,697.1	6,797.6	49.6%
27	Lewis	836,885	321,838	38.5%	7,399.2	3,367.2	45.5%
28	Salmon-Washougal	316,669	112,316	35.5%	1,575.7	624.8	39.7%
29	Wind-White Salmon	576,696	196,260	34.0%	3,042.9	1,236.4	40.6%
30	Klickitat	922,718	303,867	32.9%	4,087.2	1,542.3	37.7%
31	Rock-Glade	1,059,603	45,407	4.3%	3,897.3	304.1	7.8%
32	Walla Walla	910,153	67,056	7.4%	4,153.3	584.9	14.1%
33	Lower Snake	463,575	33	0.0%	1,484.8	0.0	0.0%
34	Palouse	1,771,481	33,039	1.9%	6,602.6	168.6	2.6%
35	Middle Snake	1,445,485	31,838	2.2%	7,530.4	301.8	4.0%
36	Esquatzel Coulee	1,060,530	105	0.0%	3,745.5	1.8	0.0%
37	Lower Yakima	1,863,300	43,745	2.3%	9,134.6	377.6	4.1%
38	Naches	706,912	49,688	7.0%	3,345.0	422.5	12.6%
39	Upper Yakima	1,368,976	206,649	15.1%	9,383.9	1,686.0	18.0%
40	Alkali-Squilchuck	539,550	28,589	5.3%	2,046.0	262.4	12.8%
41	Lower Crab	1,623,542	340	0.0%	6,083.5	6.9	0.1%
42	Grand Coulee	484,972	30	0.0%	1,364.1	0.7	0.1%
43	Upper Crab-Wilson	1,187,925	12,248	1.0%	3,549.2	76.4	2.2%
44	Moses Coulee	730,482	5,122	0.7%	2,156.5	17.2	0.8%
45	Wenatchee	878,130	95,266	10.8%	10,151.4	1,651.7	16.3%
46	Entiat	305,693	18,948	6.2%	3,489.8	317.7	9.1%
47	Chelan	667,785	14,476	2.2%	3,844.3	227.5	5.9%
48	Methow	1,358,016	34,112	2.5%	8,062.2	340.9	4.2%
49	Okanogan	1,342,170	275,013	20.5%	7,416.1	1,585.1	21.4%
50	Foster	577,595	228	0.0%	1,965.7	1.5	0.1%
51	Nespelem	144,489	0	0.0%	1,068.8	0.0	0.0%
52	Sanpoil	628,920	71,757	11.4%	4,496.2	452.5	10.1%
53	Lower Lake Roosevelt	326,829	29,186	8.9%	2,163.1	240.0	11.1%
54	Lower Spokane	567,683	181,664	32.0%	3,095.5	1,062.2	34.3%
55	Little Spokane	434,759	267,851	61.6%	2,347.0	1,660.5	70.7%
56	Hangman	292,083	38,934	13.3%	1,193.4	179.1	15.0%
57	Middle Spokane	184,110	75,579	41.1%	1,099.8	655.2	59.6%
58	Middle Lake Roosevelt	708,499	127,360	18.0%	4,594.1	726.1	15.8%
59	Colville	653,505	399,342	61.1%	3,294.9	2,018.3	61.3%
60	Kettle	656,718	167,932	25.6%	3,967.3	1,199.8	30.2%
61	Upper Lake Roosevelt	369,352	226,445	61.3%	1,830.6	1,050.3	57.4%
62	Pend Oreille	791,807	222,128	28.1%	5,135.4	1,288.8	25.1%
	Totals	45,677,416	9,337,092	20.4%	250,131.6	74,207.5	29.7%

Table G-4. Summary of total estimated stream miles by water type on FPHCP covered lands.

WRIA Number	WRIA Name	Type S Stream Miles on FPHCP Covered Lands	Type F Stream Miles on FPHCP Covered Lands	Type Np Stream Miles on FPHCP Covered Lands	Type Ns Stream Miles on FPHCP Covered Lands	Unclassified Stream Miles on FPHCP Covered Lands	Total Stream Miles on FPHCP Covered Lands
1	Nooksack	124.2	278.4	227.9	852.2	82.2	1,564.9
2	San Juan	5.2	44.1	8.0	71.9	7.9	137.1
3	Lower Skagit / Samish	66.7	221.8	123.8	444.9	42.5	899.7
4	Upper Skagit	72.7	169.6	94.1	446.5	70.2	853.1
5	Stillaguamish	86.0	260.3	92.8	437.7	58.7	935.5
6	Island	0.6	39.6	7.8	87.5	4.7	140.3
7	Snohomish	209.3	565.6	282.1	1,032.6	284.3	2,374.0
8	Cedar-Sammamish	35.4	162.8	26.5	195.4	47.6	467.7
9	Duwamish-Green	38.5	124.5	62.3	323.8	49.6	598.6
10	Puyallup-White	131.9	318.7	266.2	1,004.1	198.7	1,919.6
11	Nisqually	131.9	249.3	143.0	741.2	269.5	1,534.9
12	Chambers-Clover	5.5	10.8	2.6	7.5	6.1	32.5
13	Deschutes	50.5	141.4	31.5	527.8	133.4	884.7
14	Kennedy-Goldsborough	37.5	119.6	15.1	162.1	17.1	351.3
15	Kitsap	41.4	434.5	90.7	634.5	82.6	1,283.8
16	Skokomish-Dosewallips	20.4	70.3	32.7	134.3	19.5	277.2
17	Quilcene-Snow	14.9	173.7	37.0	431.3	7.7	664.7
18	Elwha-Dungeness	29.9	92.1	15.3	121.3	5.7	264.2
19	Lyre-Hoko	68.6	281.9	101.8	600.1	1.6	1,054.0
20	Soleduc	170.8	630.3	202.0	1,199.1	13.0	2,215.1
21	Queets-Quinalt	52.2	253.4	39.4	408.9	2.5	756.5
22	Lower Chehalis	253.0	1,272.0	247.7	2,831.1	232.7	4,836.5
23	Upper Chehalis	243.4	1,071.3	320.4	4,115.9	1,030.6	6,781.5
24	Willapa	354.2	1,319.1	349.7	4,238.6	1,517.0	7,778.6
25	Grays/Elochoman	95.4	468.5	146.1	1,765.3	690.0	3,165.3
26	Cowlitz	313.0	1,069.1	554.7	4,007.7	853.2	6,797.6
27	Lewis	153.0	524.9	246.5	1,971.9	470.8	3,367.2
28	Salmon-Washougal	76.1	179.6	42.1	297.7	29.3	624.8
29	Wind-White Salmon	81.0	260.2	38.3	757.9	99.0	1,236.4
30	Klickitat	76.8	170.5	279.2	514.0	501.8	1,542.3
31	Rock-Glade	0.4	42.1	63.5	114.8	83.3	304.1
32	Walla Walla	28.0	94.4	63.9	369.9	28.8	584.9
33	Lower Snake	0.0	0.0	0.0	0.0	0.0	0.0
34	Palouse	6.8	3.8	0.2	2.0	155.8	168.6
35	Middle Snake	2.5	33.1	35.4	122.7	108.0	301.8
36	Esquatzel Coulee	0.0	0.0	0.0	0.0	1.8	1.8
37	Lower Yakima	9.2	46.4	44.1	113.7	164.2	377.6
38	Naches	42.0	43.2	53.4	172.2	111.8	422.5
39	Upper Yakima	193.7	149.6	238.6	669.7	434.4	1,686.0
40	Alkali-Squilchuck	1.1	31.1	39.4	86.0	104.7	262.4
41	Lower Crab	0.0	0.0	0.0	0.0	6.9	6.9
42	Grand Coulee	0.4	0.0	0.0	0.0	0.3	0.7
43	Upper Crab-Wilson	1.0	1.1	0.7	0.4	73.2	76.4
44	Moses Coulee	0.4	0.7	0.5	4.7	10.9	17.2
45	Wenatchee	90.5	66.0	110.1	490.1	895.0	1,651.7
46	Entiat	33.9	6.3	26.7	105.1	145.7	317.7
47	Chelan	9.3	2.5	2.7	19.4	193.6	227.5
48	Methow	47.3	16.4	18.9	39.1	219.1	340.9
49	Okanogan	20.7	163.7	155.2	432.9	812.6	1,585.1
50	Foster	0.2	0.0	0.0	0.0	1.3	1.5
51	Nespelem	0.0	0.0	0.0	0.0	0.0	0.0
52	Sanpoil	8.2	72.2	64.1	190.3	117.7	452.5
53	Lower Lake Roosevelt	0.1	10.9	24.2	73.1	131.8	240.0
54	Lower Spokane	27.2	86.7	97.1	325.4	525.8	1,062.2
55	Little Spokane	120.3	132.8	146.4	577.9	683.1	1,660.5
56	Hangman	16.4	4.5	16.5	44.5	97.1	179.1
57	Middle Spokane	8.1	30.5	42.5	217.0	357.1	655.2
58	Middle Lake Roosevelt	2.0	53.1	48.2	180.4	442.4	726.1
59	Colville	68.0	269.1	258.5	765.2	657.4	2,018.3
60	Kettle	80.8	144.7	164.5	546.3	263.5	1,199.8
61	Upper Lake Roosevelt	53.9	111.2	153.6	516.9	214.6	1,050.3
62	Pend Oreille	85.7	217.1	147.3	471.5	367.1	1,288.8
	Totals	3998.3	12,810.9	6,143.5	37,016.1	14,238.8	74,207.5
	Percent	5.4%	17.3%	8.3%	49.9%	19.2%	100.0%

Table G-5. Summary of total estimated riparian acres and minimum “protected” riparian acres on FPHCP covered lands.

WRIA Number	WRIA Name	Total Type S Riparian Area Acres	Type S Protected Area Acres	Type S Riparian Management Acres	Total Type F Riparian Area Acres	Type F Protected Area Acres	Type F Riparian Management Acres	Total Type NP Riparian Area Acres (no F or S overlap)	Type NP Protected Area	50% "no cut" area along NP type	Type NP Riparian Management Acres	Total Riparian Acres all stream types	Total Protected Area Acres all stream types	Totals - Riparian Management Acres - All stream types	FPHCP Acres in WRIA	Percent of FPHCP Lands in Riparian Areas
1	Nooksack	10,219	3,980	6,239	12,173	4,552	7,621	8,880	2,925	1,462	7,418	31,272	9,994	21,278	255,561	12.2%
2	San Juan	443	164	279	2,117	750	1,367	338	106	53	285	2,898	967	1,931	77,260	3.8%
3	Lower Skagit / Samish	4,997	1,958	3,039	9,705	3,617	6,088	4,895	1,598	799	4,096	19,596	6,374	13,222	178,808	11.0%
4	Upper Skagit	6,705	2,515	4,189	7,369	2,768	4,601	3,581	1,195	598	2,984	17,654	5,880	11,774	123,837	14.3%
5	Stillaguamish	7,699	2,958	4,741	11,152	4,207	6,945	3,606	1,188	594	3,012	22,456	7,759	14,697	160,616	14.0%
6	Island	51	19	32	1,815	657	1,157	349	106	53	296	2,215	730	1,485	84,107	2.6%
7	Snohomish	17,628	6,785	10,843	24,513	9,211	15,302	10,830	3,605	1,803	9,027	52,971	17,799	35,173	405,197	13.1%
8	Cedar-Sammamish	2,971	1,128	1,843	7,714	2,756	4,957	1,106	349	174	932	11,791	4,059	7,733	106,618	11.1%
9	Duwamish-Green	3,879	1,412	2,467	5,744	2,078	3,665	2,481	805	402	2,079	12,104	3,892	8,211	108,939	11.1%
10	Puyallup-White	10,743	4,224	6,518	13,308	5,099	8,209	9,722	3,340	1,670	8,052	33,772	10,993	22,780	282,638	11.9%
11	Nisqually	9,785	3,961	5,823	10,594	4,020	6,574	5,376	1,812	906	4,470	25,755	8,888	16,868	229,349	11.2%
12	Chambers-Clover	536	189	347	555	191	364	108	34	17	91	1,199	397	802	21,843	5.5%
13	Deschutes	3,407	1,411	1,996	6,097	2,287	3,810	1,194	399	200	994	10,698	3,898	6,800	113,420	9.4%
14	Kennedy-Goldsborough	2,684	1,085	1,599	5,468	1,986	3,483	615	197	98	516	8,767	3,169	5,598	104,515	8.4%
15	Kitsap	3,003	1,198	1,805	19,097	7,080	12,017	3,583	1,167	583	3,000	25,683	8,862	16,822	298,742	8.6%
16	Skokomish-Dosewallips	1,736	661	1,075	3,107	1,151	1,956	1,245	415	208	1,037	6,088	2,019	4,068	44,300	13.7%
17	Quilcene-Snow	1,110	438	673	7,536	2,812	4,724	1,457	475	238	1,219	10,103	3,488	6,616	130,722	7.7%
18	Elwha-Dungeness	2,282	904	1,377	4,144	1,524	2,620	620	199	99	521	7,045	2,527	4,518	54,754	12.9%
19	Lyre-Hoko	4,544	1,899	2,645	11,579	4,457	7,122	3,663	1,262	631	3,032	19,786	6,987	12,799	124,122	15.9%
20	Soleduc	13,308	5,324	7,984	25,907	9,995	15,911	7,215	2,513	1,257	5,959	46,430	16,576	29,854	233,183	19.9%
21	Queets-Quinalt	4,029	1,619	2,410	10,549	4,035	6,514	1,471	495	247	1,223	16,048	5,901	10,147	98,487	16.3%
22	Lower Chehalis	19,902	7,849	12,053	52,904	20,250	32,654	9,132	3,090	1,545	7,587	81,938	29,644	52,293	467,582	17.5%
23	Upper Chehalis	17,618	7,109	10,508	45,030	17,122	27,908	11,940	4,022	2,011	9,929	74,587	26,242	48,345	537,167	13.9%
24	Willapa	22,906	9,778	13,129	53,911	20,828	33,084	12,660	4,330	2,165	10,495	89,478	32,770	56,707	500,868	17.9%
25	Grays/Elochoman	6,971	2,786	4,185	19,443	7,452	11,991	5,396	1,836	918	4,478	31,810	11,156	20,654	215,115	14.8%
26	Cowlitz	25,037	9,858	15,178	44,913	17,096	27,817	20,896	7,008	3,504	17,392	90,846	30,458	60,387	674,950	13.5%
27	Lewis	11,735	4,725	7,010	22,212	8,421	13,790	9,298	3,117	1,559	7,740	43,245	14,705	28,540	321,838	13.4%
28	Salmon-Washougal	6,124	2,398	3,726	8,001	2,959	5,042	1,701	547	273	1,428	15,826	5,630	10,196	112,316	14.1%
29	Wind-White Salmon	5,187	2,413	2,774	10,933	4,167	6,766	1,455	486	243	1,211	17,574	6,823	10,751	196,260	9.0%
	Westside subtotals	227,237	90,748	136,489	457,587	173,529	284,058	144,812	48,620	24,310	120,502	829,636	288,587	541,049	6,263,115	13.2%
30	Klickitat	2,771	1,132	1,639	4,166	1,453	2,712	7,059	2,220	1,110	5,949	13,995	3,695	10,301	303,867	4.6%
31	Rock-Glade	25	7	18	1,191	381	809	1,731	520	260	1,470	2,947	649	2,298	45,407	6.5%
32	Walla Walla	936	335	601	2,240	747	1,493	1,715	521	260	1,454	4,890	1,342	3,548	67,056	7.3%
33	Lower Snake	0	0	0	0	0	0	0	0	0	0	0	0	0	33	0.0%
34	Palouse	432	132	301	130	39	91	6	2	1	5	569	172	397	33,039	1.7%
35	Middle Snake	125	38	86	901	288	613	984	292	146	838	2,010	472	1,537	31,838	6.3%
36	Esquatzel Coulee	0	0	0	0	0	0	0	0	0	0	0	0	0	105	0.0%
37	Lower Yakima	426	150	276	1,217	406	811	1,074	344	172	902	2,716	728	1,989	43,745	6.2%
38	Naches	1,319	559	760	1,172	385	787	1,433	434	217	1,216	3,923	1,160	2,763	49,688	7.9%
39	Upper Yakima	6,478	2,639	3,839	4,133	1,341	2,792	6,123	1,899	950	5,174	16,735	4,930	11,805	206,649	8.1%
40	Alkali-Squillchuck	71	22	49	865	280	585	1,028	316	158	870	1,964	461	1,503	28,589	6.9%
41	Lower Crab	2	0	2	0	0	0	0	0	0	0	2	0	2	340	0.7%
42	Grand Coulee	35	9	26	0	0	0	0	0	0	0	35	9	26	30	100.0%
43	Upper Crab-Wilson	77	22	55	34	11	23	19	5	3	16	129	35	93	12,248	1.1%
44	Moses Coulee	41	10	31	19	6	13	15	4	2	13	74	18	57	5,122	1.5%
45	Wenatchee	3,439	1,313	2,125	1,753	577	1,176	2,940	895	447	2,492	8,132	2,338	5,794	95,266	8.5%
46	Entiat	964	404	560	176	57	120	758	223	111	647	1,898	572	1,327	18,948	10.0%
47	Chelan	531	165	366	73	23	50	80	23	11	69	685	199	486	14,476	4.7%
48	Methow	1,490	577	912	475	151	324	516	155	78	439	2,481	805	1,675	34,112	7.3%
49	Okanogan	1,142	372	771	4,286	1,444	2,842	3,777	1,222	611	3,166	9,206	2,427	6,779	275,013	3.3%
50	Foster	21	5	16	0	0	0	0	0	0	0	21	5	16	228	9.4%
51	Nespelem	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%
52	Sanpoil	353	127	225	1,891	636	1,255	1,611	510	255	1,356	3,855	1,018	2,837	71,757	5.4%
53	Lower Lake Roosevelt	10	2	8	323	101	223	683	202	101	582	1,016	204	813	29,186	3.5%
54	Lower Spokane	1,922	578	1,344	2,456	789	1,667	2,523	785	392	2,131	6,901	1,759	5,141	181,664	3.8%
55	Little Spokane	3,861	1,576	2,285	3,456	1,176	2,281	3,704	1,168	584	3,121	11,022	3,336	7,687	267,851	4.1%
56	Hangman	734	254	480	156	45	111	499	142	71	428	1,388	369	1,019	38,934	3.6%
57	Middle Spokane	556	173	383	796	265	531	1,091	337	169	922	2,443	607	1,837	75,579	3.2%
58	Middle Lake Roosevelt	118	36	82	1,444	471	973	1,213	381	190	1,023	2,774	697	2,077	127,360	2.2%
59	Colville	2,710	1,000	1,710	6,965	2,353	4,612	6,442	2,044	1,022	5,420	16,117	4,374	11,742	399,342	4.0%
60	Kettle	2,822	1,184	1,639	3,811	1,277	2,534	4,221	1,315	658	3,563	10,854	3,119	7,735	167,932	6.5%
61	Upper Lake Roosevelt	2,401	847	1,554	2,826	963	1,863	3,814	1,213	606	3,208	9,041	2,416	6,625	226,445	4.0%
62	Pend Oreille	3,897	1,367	2,529	5,468	1,894	3,574	3,648	1,165	582	3,066	13,013	3,844	9,169	222,128	5.9%
	Eastside subtotals	39,708	15,035	24,673	52,422	17,557	34,865	58,706	18,336	9,168	49,539	150,837	41,760	109,076	3,073,977	4.9%
	TOTALS	266,945	105,783	161,162	510,009	191,087	318,923	203,519	66,956	33,478	170,041	980,473	330,347	650,126	9,337,092	10.5%

Table G-6. Summary of estimated road miles and stream crossings on FPHCP covered lands.

WRIA Number	WRIA Name	Square Miles of FPHCP Covered Lands in WRIA	Total Road Miles on FPHCP Covered Lands	Road Density on FPHCP Covered Lands (mi./sq.mi.)	Type S stream crossings	Type F Stream Crossings	Type NP Stream Crossings	Type Ns Stream Crossings	Unclassified Stream Crossings	Total Stream Crossings on FPHCP Covered Lands
1	Nooksack	399.3	1,574.5	3.9	56	454	384	1,444	1,054	3,392
2	San Juan	120.7	355.5	2.9	0	95	10	56	57	218
3	Lower Skagit / Samish	279.4	1,234.9	4.4	40	376	224	616	622	1,878
4	Upper Skagit	193.5	985.5	5.1	31	367	176	771	733	2,078
5	Stillaguamish	251.0	1,056.4	4.2	28	410	184	633	479	1,734
6	Island	131.4	503.1	3.8	0	94	9	73	82	258
7	Snohomish	633.1	2,721.4	4.3	102	1,025	523	1,533	1,471	4,654
8	Cedar-Sammamish	166.6	719.3	4.3	19	259	27	172	284	761
9	Duwamish-Green	170.2	781.8	4.6	15	176	88	511	379	1,169
10	Puyallup-White	441.6	1,859.3	4.2	40	393	469	1,630	1,037	3,569
11	Nisqually	358.4	1,842.6	5.1	64	363	285	1,656	1,448	3,816
12	Chambers-Clover	34.1	191.4	5.6	7	16	3	7	35	68
13	Deschutes	177.2	924.2	5.2	23	215	50	1,433	863	2,584
14	Kennedy-Goldsborough	163.3	813.5	5.0	19	269	28	221	171	708
15	Kitsap	466.8	2,202.7	4.7	30	772	123	811	648	2,384
16	Skokomish-Dosewallips	69.2	365.9	5.3	6	122	63	228	194	613
17	Quilcene-Snow	204.3	959.7	4.7	6	292	82	652	389	1,421
18	Elwha-Dungeness	85.6	444.9	5.2	11	124	21	166	149	471
19	Lyre-Hoko	193.9	850.7	4.4	27	283	206	838	210	1,564
20	Soleduc	364.3	1,587.1	4.4	51	842	425	1,507	374	3,199
21	Queets-Quinalt	153.9	513.5	3.3	22	269	61	391	99	842
22	Lower Chehalis	730.6	2,662.1	3.6	90	1,052	237	1,500	523	3,402
23	Upper Chehalis	839.3	4,268.2	5.1	133	1,362	455	8,290	4,539	14,779
24	Willapa	782.6	3,718.7	4.8	207	1,372	388	5,394	3,664	11,025
25	Grays/Elochoman	336.1	1,876.3	5.6	74	661	251	3,601	2,761	7,348
26	Cowlitz	1,054.6	5,874.5	5.6	161	1,690	1,342	9,089	5,633	17,915
27	Lewis	502.9	2,895.8	5.8	87	874	612	4,908	3,179	9,660
28	Salmon-Washougal	175.5	712.3	4.1	46	274	50	357	285	1,012
29	Wind-White Salmon	306.7	1,186.6	3.9	47	384	85	932	858	2,306
30	Klickitat	474.8	1,536.7	3.2	19	85	265	555	1,146	2,070
31	Rock-Glade	70.9	154.8	2.2	0	8	42	93	95	238
32	Walla Walla	104.8	302.8	2.9	15	111	56	431	114	727
33	Lower Snake	0.1	0.1	2.4	0	0	0	0	0	0
34	Palouse	51.6	113.4	2.2	1	0	0	3	44	48
35	Middle Snake	49.7	132.0	2.7	0	22	19	137	200	378
36	Esquatzel Coulee	0.2	0.2	1.2	0	0	0	0	1	1
37	Lower Yakima	68.4	223.4	3.3	6	49	71	171	273	570
38	Naches	77.6	245.1	3.2	24	39	86	227	296	672
39	Upper Yakima	322.9	1,069.4	3.3	60	142	266	721	1,257	2,446
40	Alkali-Squillchuck	44.7	174.0	3.9	0	31	57	136	433	657
41	Lower Crab	0.5	1.2	2.2	0	0	0	0	2	2
42	Grand Coulee	0.0	0.2	3.9	0	0	0	0	0	0
43	Upper Crab-Wilson	19.1	48.0	2.5	0	0	1	1	16	18
44	Moses Coulee	8.0	12.4	1.6	0	1	1	2	3	7
45	Wenatchee	148.9	645.3	4.3	42	103	180	984	2,930	4,239
46	Entiat	29.6	151.1	5.1	19	4	25	222	739	1,009
47	Chelan	22.6	85.7	3.8	2	5	3	30	401	441
48	Methow	53.3	115.5	2.2	8	12	31	52	364	467
49	Okanogan	429.7	1,063.0	2.5	7	0	154	467	1,753	2,381
50	Foster	0.4	0.3	0.8	0	108	0	0	0	108
51	Nespelem	0.0	0.0	0.0	0	0	0	0	0	0
52	Sanpoil	112.1	312.0	2.8	5	52	73	231	330	691
53	Lower Lake Roosevelt	45.6	83.1	1.8	0	7	19	42	144	212
54	Lower Spokane	283.9	890.6	3.1	5	37	94	423	1,258	1,817
55	Little Spokane	418.5	1,267.9	3.0	27	95	139	720	1,510	2,491
56	Hangman	60.8	185.8	3.1	6	1	7	46	113	173
57	Middle Spokane	118.1	399.5	3.4	2	35	32	289	803	1,161
58	Middle Lake Roosevelt	199.0	684.6	3.4	0	54	68	273	1,234	1,629
59	Colville	624.0	1,858.8	3.0	13	199	251	949	1,720	3,132
60	Kettle	262.4	651.4	2.5	19	110	228	695	700	1,752
61	Upper Lake Roosevelt	353.8	1,080.1	3.1	20	100	184	679	752	1,735
62	Pend Oreille	347.1	1,187.0	3.4	19	154	171	641	1,039	2,024
	Totals	14,589.2	60,357.7	4.1	1,761	16,449	9,384	58,640	51,890	138,124

Table G-7. Summary of road miles located in riparian areas on FPHCP covered lands.

WRIA Number	WRIA Name	Total Road Miles on FPHCP Covered Lands	Miles of Roads located in Type S Riparian Zones	Miles of Roads located in Type F Riparian Zones	Miles of Roads located in Type Np Riparian Zones	Total Road miles located in Type S, F, or Np Riparian Zones	Percentage of Road Miles located in Type S, F, or Np Riparian Zones
1	Nooksack	1,574.5	39.7	66.3	46.4	152.4	9.7%
2	San Juan	355.5	2.4	12.2	2.1	16.8	4.7%
3	Lower Skagit / Samish	1,234.9	25.1	64.6	32.4	122.1	9.9%
4	Upper Skagit	985.5	26.1	44.5	20.1	90.8	9.2%
5	Stillaguamish	1,056.4	26.9	54.9	20.9	102.7	9.7%
6	Island	503.1	0.3	10.4	2.2	12.9	2.6%
7	Snohomish	2,721.4	88.6	146.0	60.5	295.1	10.8%
8	Cedar-Sammamish	719.3	23.1	54.8	6.9	84.8	11.8%
9	Duwamish-Green	781.8	23.5	31.4	11.7	66.6	8.5%
10	Puyallup-White	1,859.3	44.4	67.5	48.7	160.6	8.6%
11	Nisqually	1,842.6	45.4	59.8	31.6	136.8	7.4%
12	Chambers-Clover	191.4	4.0	4.9	2.0	10.9	5.7%
13	Deschutes	924.2	17.1	36.6	6.1	59.8	6.5%
14	Kennedy-Goldsborough	813.5	12.1	33.7	3.7	49.4	6.1%
15	Kitsap	2,202.7	17.1	108.4	21.0	146.5	6.7%
16	Skokomish-Dosewallips	365.9	4.5	20.2	6.9	31.7	8.7%
17	Quilcene-Snow	959.7	6.5	51.3	7.8	65.6	6.8%
18	Elwha-Dungeness	444.9	9.9	22.5	3.2	35.6	8.0%
19	Lyre-Hoko	850.7	26.1	44.4	15.7	86.2	10.1%
20	Soleduc	1,587.1	38.0	106.3	36.4	180.8	11.4%
21	Queets-Quinault	513.5	9.8	35.5	5.1	50.4	9.8%
22	Lower Chehalis	2,662.1	71.3	161.3	22.0	254.6	9.6%
23	Upper Chehalis	4,268.2	128.8	258.3	54.5	441.6	10.3%
24	Willapa	3,718.7	147.6	216.8	35.7	400.1	10.8%
25	Grays/Elochoman	1,876.3	65.0	120.1	26.5	211.6	11.3%
26	Cowlitz	5,874.5	139.6	276.0	126.0	541.6	9.2%
27	Lewis	2,895.8	72.7	141.0	59.2	272.9	9.4%
28	Salmon-Washougal	712.3	33.6	42.0	6.8	82.5	11.6%
29	Wind-White Salmon	1,186.6	27.9	86.0	10.7	124.5	10.5%
30	Klickitat	1,536.7	18.0	21.6	44.3	83.9	5.5%
31	Rock-Glade	154.8	0.2	3.0	7.0	10.2	6.6%
32	Walla Walla	302.8	4.8	37.5	17.8	60.1	19.8%
33	Lower Snake	0.1	0.0	0.0	0.0	0.0	0.0%
34	Palouse	113.4	2.2	0.1	0.1	2.4	2.1%
35	Middle Snake	132.0	0.9	12.7	5.2	18.8	14.3%
36	Esquatzel Coulee	0.2	0.0	0.0	0.0	0.0	0.0%
37	Lower Yakima	223.4	3.8	11.6	9.4	24.8	11.1%
38	Naches	245.1	11.7	12.6	13.8	38.2	15.6%
39	Upper Yakima	1,069.4	23.4	38.6	60.8	122.7	11.5%
40	Alkali-Squilchuck	174.0	0.4	5.6	6.7	12.7	7.3%
41	Lower Crab	1.2	0.0	0.0	0.0	0.0	2.3%
42	Grand Coulee	0.2	0.0	0.0	0.0	0.0	0
43	Upper Crab-Wilson	48.0	0.2	0.1	0.1	0.4	0.9%
44	Moses Coulee	12.4	0.1	0.1	0.1	0.3	2.2%
45	Wenatchee	645.3	18.9	19.1	33.6	71.6	11.1%
46	Entiat	151.1	7.7	2.7	7.9	18.3	12.1%
47	Chelan	85.7	4.2	1.7	0.5	6.4	7.5%
48	Methow	115.5	5.4	3.8	3.7	12.9	11.2%
49	Okanogan	1,063.0	6.5	27.5	17.0	51.0	4.8%
50	Foster	0.3	0.0	0.0	0.0	0.0	0
51	Nespelem	0.0	0.0	0.0	0.0	0.0	0
52	Sanpoil	312.0	2.3	14.6	12.5	29.4	9.4%
53	Lower Lake Roosevelt	83.1	0.0	2.1	10.8	12.9	15.5%
54	Lower Spokane	890.6	5.4	13.2	23.0	41.6	4.7%
55	Little Spokane	1,267.9	9.1	31.2	30.0	70.3	5.5%
56	Hangman	185.8	2.3	0.4	2.2	4.9	2.6%
57	Middle Spokane	399.5	2.5	7.2	8.1	17.8	4.5%
58	Middle Lake Roosevelt	684.6	1.1	17.2	11.6	30.0	4.4%
59	Colville	1,858.8	9.2	50.0	49.5	108.7	5.8%
60	Kettle	651.4	15.3	32.4	40.9	88.6	13.6%
61	Upper Lake Roosevelt	1,080.1	11.5	22.3	25.2	59.0	5.5%
62	Pend Oreille	1,187.0	11.1	29.5	18.9	59.5	5.0%
Totals		60,357.7	1,355.5	2,796.4	1,193.6	5,345.5	8.9%