CHAPTER 2.
BASIN CHARACTERISTICS

2.1 DRAINAGE SUBBASINS AND STREAM REACHES

The Patterson Creek Basin encompasses Patterson Creek and all of its tributary area from the confluence with the Snoqualmie River upstream to the headwaters at Wetland Number 1807.

The basin was divided into five major subbasins, 1 though 5, based on topographic information and King County staff input on critical areas for simulating flow rates. For the hydrologic model use in this study (the HSPF model), Subbasin 2 was further divided into three catchments, 2a, 2b, and 2c. Figure 2-1 shows each subbasin of Patterson Creek. Table 2-1 lists each subbasin's area.

TABLE 2-1.
PATTERSON CREEK SUBBASIN AREAS

Subbasin	Area (acres)
1	1,156
2a	1,167
2b	2,215
2c	1,974
3	2,038
4	2,908
5	1,253
Total	**12,711**

The creek channel was divided into nine reaches based on placement within subbasins, and similarity in stream/channel characteristics. The reaches, designated as "RCHRES" in the hydrologic model, are shown in Figure 2-1. In general, one stream reach was chosen for routing runoff from each subbasin. However, due to the differing channel geometry and the length of channel in Subbasin 2b, the channel in that subbasin was divided into two reaches. Also, separate reaches were designated in Subbasin 5 for the segments upstream and downstream of the confluence with RCHRES 400. Figure 2-2 shows how the subbasins relate to RCHRES segments and how the RCHRES segments are routed through the drainage basin. Channel geometry for a typical section of each RCHRES segment of Patterson Creek was defined based on available information. No field survey was conducted to determine actual cross-sections.

Descriptions of each subbasin and stream reach are provided below.

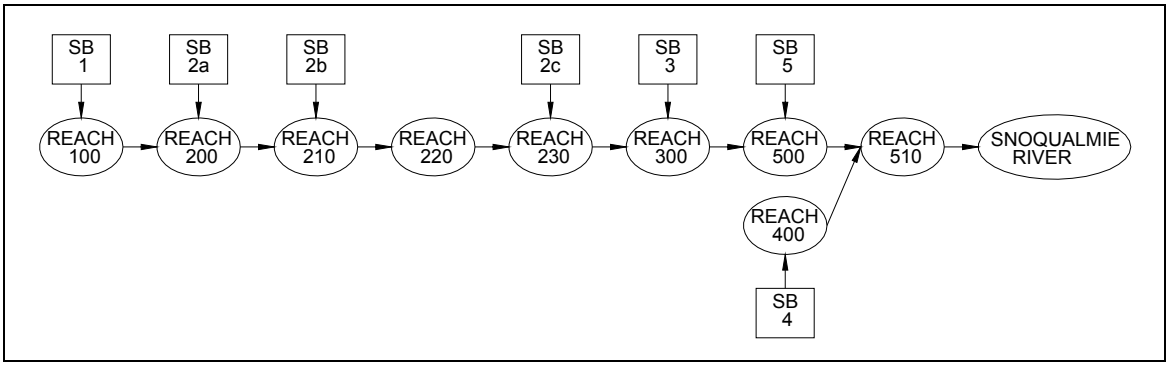

Figure 2-2. Graphic Representation of RCHRES Routing

2.1.1 Subbasin 1

Subbasin 1 is the most upstream subbasin and covers 1,156 acres. Elevations in Subbasin 1 range from 120 feet in the creek channel at the lower end of the subbasin, to 660 feet in the northeast region of the subbasin. This subbasin encompasses the headwaters of Patterson Creek, an upland lake and wetland area at the far north end of the subbasin. A steep channel with a slope of 5.6 percent characterizes the south end of Subbasin 1. The modeled channel reach in this subbasin is designated RCHRES 100.

2.1.2 Subbasin 2a

Subbasin 2a is south and east of Subbasin 1 and covers 1,167 acres. The subbasin encompasses the section of Patterson Creek just downstream of Subbasin 1. Elevations in Subbasin 2a range from approximately 120 feet at the stream channel to 660 feet at the far north portion of the subbasin. This subbasin encompasses three wetlands (Numbers 4804, 4805, and 4806) in the far northeast corner and urban residential development just off the Union Hill Road northeast of the channel. The channel is much flatter in this subbasin than in Subbasin 1, with a slope of 0.2 percent. The channel is approximately 2.5 feet deep on average with 2:1 side slopes. Wetlands approximately an eighth-mile wide surround the channel. The modeled channel reach in this subbasin is designated RCHRES 200.

2.1.3 Subbasin 2b

Subbasin 2b is south of Subbasin 2a and covers 2,215 acres. Elevations in Subbasin 2b range from approximately 100 feet at the stream channel to 540 feet in the southwest corner of the subbasin. Northeast of the channel is a residential area; on the southwest are public/park land and two small lake/wetland areas. A small portion of the southwest corner of the subbasin is within the incorporated limits of the City of Sammamish. Channel characteristics in this subbasin are very similar to those in Subbasin 2a. The channel is approximately 2.5 feet deep on average with 2:1 side slopes and a bottom slope of 0.2 percent. The channel is surrounded by wetlands approximately an eighth-mile wide along the upper reach (RCHRES 210) and approximately a quarter-mile wide along the lower reach (RCHRES 220).

2.1.4 Subbasin 2c

Subbasin 2c is just south of Subbasin 2b and covers 1,974 acres. Elevations in Subbasin 2c range from approximately 100 feet at the stream channel to 500 feet at the western subbasin boundary. The western portion of this subbasin is mainly public/park land to the north, and incorporated area of the City of Sammamish to the south. Redmond-Fall City Road is just east of the channel. The upper 1.5 miles of channel are surrounded by wetlands; the lower half-mile of channel is surrounded by herbaceous vegetation. Channel characteristics in this subbasin are similar to the channel sections of Subbasins 2a and 2b. Slope is 0.2 percent and the channel is approximately 2.5 feet deep on average with 2:1 side slopes. The modeled channel reach in this subbasin is designated RCHRES 230.

2.1.5 Subbasin 3

Subbasin 3 covers 2,038 acres in the lower west portion of the Patterson Creek Basin, south and west of Subbasin 2c. Subbasin 3 encompasses the Canyon Creek tributary to Patterson Creek. It also includes a localized closed depression on its west side that is outside the modeled boundary of the Patterson Creek Basin. This area has been included with Subbasin 3 to include in this study the drainage complaints that have been registered in it. Elevations in Subbasin 3 range from approximately 100 feet at the confluence of Canyon and Patterson creeks to 640 feet at the west edge of the basin boundary. In the northwest portion of the subbasin is a residential neighborhood, which is part of the incorporated City of Sammamish. Several wetlands in this area feed a tributary to Canyon Creek. In the western portion of the subbasin is a large tract of parks and other public land and a large wetland at the headwaters for Canyon Creek. There are no Patterson Creek channel segments in Subbasin 3. Runoff from Subbasin 3 is routed through RCHRES 300 in Subbasin 5 for modeling purposes.

2.1.6 Subbasin 4

Subbasin 4 is the most southern subbasin in the Patterson Creek drainage basin and covers 2,908 acres. Elevations in this subbasin range from approximately 80 feet at Patterson Creek to 1,400 feet in the western portion of the subbasin. Subbasin 4 is characterized by two distinct regions, a steep forested area to the south, and a flatter area to the north with large wetlands and a significant tributary stream (WRIA 7 Stream Number 0377) to Patterson Creek. The channel of this tributary from its confluence with Patterson Creek upstream approximately 1 mile is designated RCHRES 400. The channel section for RCHRES 400 is approximately 2.5 feet deep on average with side slopes of 2:1 and a bottom slope of 0.6 percent.

2.1.7 Subbasin 5

Subbasin 5 is the furthest downstream subbasin on Patterson Creek and covers 1,253 acres. Elevations in this subbasin range from approximately 70 feet at the confluence with the Snoqualmie River to 760 feet in the southwest corner of the basin. Three stream segments are in this subbasin: RCHRES 300 is the upstream channel, RCHRES 500 is the middle channel, and RCHRES 510 is the lower channel to the confluence with the Snoqualmie River. The channel for RCHRES 300 and 500 is approximately 2.5 feet deep on average with 2:1 side slopes and a bottom slope of approximately 0.2 percent. A much deeper

channel, approximately 15 feet deep, with 2:1 side slopes, characterizes the lower reach. The bottom slope is also 0.2 percent.

2.2 LAND COVER ANALYSIS

PACE used GIS analysis to compute the pervious (PERLND) and impervious (IMPLND) land cover area in each subbasin for the HSPF model. The pervious input parameter represents a composite of land cover type, soils, and topography. The impervious areas are based on an effective impervious area (EIA) being applied to each of the land cover types. All data used was provided by King County. Data shape files used to compile land surface types were clipped to the boundaries of the Patterson Creek subbasins.

It should be noted that effective impervious area is not the same as actual impervious area. In rural areas where the impervious area is not connected to a surface water conveyance system, the effective impervious area is less than the actual impervious area because much of the runoff from impervious areas will be infiltrated.

2.2.1 Land Cover

Figure 2-3 shows the existing (2001) distribution of land cover through the basin, consisting of the following types of cover:

- Urban/High Density Developed
- Mixed Urban/Low Density Developed
- Water
- Bare Earth
- Conifer Forest
- Deciduous Forest
- Mixed Forest
- Herbaceous Vegetation
- Shrub/Scrub Vegetation

Wetlands were not computed separately, but rather are included in the overlying land cover type. The GIS land cover types were converted to equivalent HSPF classifications using the equivalencies shown in Table 2-2, which were provided by King County. Table 2-3 lists the EIA defined for each land cover type, as provided by King County.

Future-condition impervious area was determined by assuming full development to the density allowed by existing zoning. Due to the uncertainty on how future development would occur spatially within the basin, computation of future forested conditions were not included in the scope of work. Figure 2-4 shows the zoning in the basin, and Table 2-4 lists the EIA for each zoning category, as provided by King County. Table 3 in Appendix A lists land cover types by subbasin for future buildout conditions.

2.2.2 Soils

Figure 2-5 shows soil types in the basin. Portions of Subbasins 1, 2b, and 4 were not covered by the County-supplied GIS soils file, so hard copies of the King County Soils Survey Maps were used to determine soil types in these areas. Table 2-5 lists the NRCS soil type and the associated HSPF soil type.

TABLE 2-2.
PERVIOUS LAND COVER TYPE EQUIVALENCY FOR HSPF

Land Cover Type (Shape File)	HSPF Pervious Land Cover Type
Bare Earth	Grass
Mixed Urban/Low Density Developed	90% Grass & 10% Forest
Urban/High Density Developed	90% Grass & 10% Forest
Conifer Forest	Forest
Deciduous Forest	Forest
Mixed Forest	Forest
Herbaceous Vegetation	Pasture
Shrub/Scrub Vegetation	Pasture

TABLE 2-3.
EFFECTIVE IMPERVIOUS AREA

2001 Land Cover Type (Shape File)	EIA
Bare Earth	3.00%
Mixed Urban / Low Density Developed	19%
Urban/High Density Developed	45%
Conifer Forest	0.50%
Deciduous Forest	0.50%
Mixed Forest	0.50%
Herbaceous Vegetation	1%
Shrub / Scrub Vegetation	1%
Water	100%

TABLE 2-4.
EFFECTIVE IMPERVIOUS AREA BY ZONING CODE

Zoning Designation	Description	EIA
A-10	Agriculture – 10 acre lot	1%
A-35	Agriculture – 35 acre lot	1%
RA-2.5	Rural Area – 2.5 acre lot	4%
RA-5	Rural Area – 5 acre lot	4%
RA-10	Rural Area – 10 acre lot	2%
R-1	Urban Residential – 1 dwelling unit/acre	4%
R-4	Urban Residential – 4 dwelling units/acre	26.4%
R-6	Urban Residential – 6 dwelling units/acre	33%
R-8	Urban Residential – 8 dwelling units/acre	48%
ROW	Right-of-way	85%
Buffer Area	Area with Sensitive areas/buffers	0%

TABLE 2-5.
SOIL TYPE TRANSFORMATION FOR HSPF

Soil Name (from NRCS)	HSPF Soil	Soil Name (from NRCS)	HSPF
Alderwood	Till	Pits	Outwash
Bellingham	Till	Puget	Till
Everett	Outwash	Puyallup	Till
Indianola	Outwash	Ragnar	Outwash
Kitsap	Till	Sammamish	Till
Mixed Alluvial	Till	Seattle	Wetland
Nooksak	Till	Shalcar	Till
Norma	Till	Snohomish	Till
Orcas	Wetland	Tukwila	Till
Oridia	Till	Water	Water
Ovall	Till		

2.2.3 Topography

King County provided two files containing topographic information (see Figure 2-6). Combined, these files had no slope data for several areas in the Patterson Creek Basin. Based on surrounding characteristics, these areas were assigned the HSPF slope classification of "moderate" or "flat." Table 2-6 correlates the percent slope provided by King County to an equivalent HSPF slope category.

TABLE 2-6.
SLOPE CATEGORY EQUIVALENCY FOR HSPF

Percent Slope (King County Data)	HSPF Slope
0-10	Flat
10-20	Moderate
20-30	Steep
30-40	Steep
>=40	Steep
no data	Moderate or Flat

2.2.4 GIS Analysis

Table 2-7 lists the possible composite categories for land surface types used in the HSPF model. GIS land cover, soil, and slope data were used to determine areas of each composite category in each subbasin. Tables 2-8, 2-9, and 2-10 summarize the results for the predeveloped, existing and future conditions, respectively.

TABLE 2-7.
LAND SURFACE TYPES FOR HSPF

HSPF Category	Description
TF/MILD	Till Forest Mild Slope
TF/MODERATE	Till Forest Moderate Slope
TF/STEEP	Till Forest Steep Slope
TP/MILD & MOD	Till Pasture Mild and Moderate Slope
TP/STEEP	Till Pasture Steep Slope
TG/MILD	Till Grass Mild Slope
TG/MODERATE	Till Grass Moderate Slope
TG/STEEP	Till Grass Steep Slope
OF	Outwash Forest
OP/MILD & MOD	Outwash Pasture Mild and Moderate Slope
OP/STEEP	Outwash Pasture Steep Slope
OG	Outwash Grass
WETLANDS	Wetlands
IMPERVIOUS	Impervious

Note: For this analysis there are no slope categories for the outwash forest and outwash grass groupings or for the wetland cover type. Pasture has been divided into two slope categories—mild/moderate and steep.

TABLE 2-8.
PREDEVELOPED LAND SURFACE SUMMARY

	Area (acres)							
Land Surface	Subbasin 1	Subbasin 2a	Subbasin 2b	Subbasin 2c	Subbasin 3	Subbasin 4	Subbasin 5	**Total**
TF/Mild	959	592	809	1,085	933	1,007	589	**5,974**
TF/Moderate	102	387	648	579	278	759	225	**2,977**
TF/Steep	59	89	238	80	74	484	120	**1,144**
OF	0	4	149	24	666	504	271	**1,618**
Wetlands	35	96	372	203	82	154	46	**987**
Water	2	0	0	4	5	0	1	**12**
Total	**1,156**	**1,167**	**2,215**	**1,974**	**2,038**	**2,908**	**1,253**	**12,711**

TABLE 2-9.
EXISTING (2001) LAND SURFACE SUMMARY

	Area (acres)							
Land Surface	Subbasin 1	Subbasin 2a	Subbasin 2b	Subbasin 2c	Subbasin 3	Subbasin 4	Subbasin 5	**Total**
TF/Mild	647	292	586	636	509	496	116	**3,282**
TF/Moderate	66	229	473	385	232	514	138	**2,036**
TF/Steep	51	76	201	57	72	368	79	**905**
TP/Mild & Mod	230	351	154	315	224	670	476	**2,419**
TP/Steep	6	9	15	12	1	111	40	**194**
TG/Mild	80	51	102	169	177	44	46	**669**
TG/Moderate	9	25	80	71	10	17	21	**234**
TG/Steep	1	2	14	8	0	2	1	**28**
OF	0	2	82	12	441	333	92	**961**
OP/Mild & Mod	0	1	32	7	93	112	152	**395**
OP/Steep	0	0	0	0	1	3	2	**5**
OG	0	0	27	4	100	41	19	**193**
Wetlands	34	95	362	198	80	150	45	**964**
Water	2	0	0	4	5	0	1	**12**
EIA (Excluding open water)	29	34	86	97	93	49	25	**413**
Total	**1,156**	**1,167**	**2,215**	**1,974**	**2,038**	**2,908**	**1,253**	**12,711**

TABLE 2-10.
FUTURE LAND SURFACE SUMMARY

	Area (acres)							
Land Surface	Subbasin 1	Subbasin 2a	Subbasin 2b	Subbasin 2c	Subbasin 3	Subbasin 4	Subbasin 5	**Total**
A-10	0	0	0	0	18	41	223	**282**
A-35	0	0	0	0	0	20	307	**327**
RA-2.5	54	9	87	0	0	60	38	**248**
RA-5	963	870	1369	988	1167	1445	426	**7228**
RA-10	0	22	288	261	0	746	57	**1374**
R-1	0	32	2	220	268	0	18	**540**
R-4	0	8	7	0	0	41	0	**56**
R-6	0	0	41	29	279	0	0	**349**
R-8	0	0	0	182	14	0	0	**196**
ROW	28	51	84	60	70	40	33	**366**
Buffer	111	175	337	234	222	515	151	**1745**
Total	**1,156**	**1,167**	**2,215**	**1,974**	**2,038**	**2,908**	**1,253**	**12,711**
EIA (included in above total)	44	45	90	158	165	92	30	**624**

Table 2-11 shows the percent of EIA under existing conditions and future buildout and the forest cover under existing conditions. Forest cover for future conditions was not included in the scope of work for this study. The EIA for future buildout was calculated based on existing zoning. The percent forest cover is based on current conditions. Subbasins with greater than 10 percent EIA or less than 65 percent forest cover are considered "impacted" by development. Subbasins with more than 10 percent EIA or more than 65 percent forest cover are designated "sensitive."

TABLE 2-11.
EXISTING AND FUTURE EIA, FOREST COVER, AND SUBBASIN CLASSIFICATION

		Percent EIA			Existing Forest Cover		
Subbasin	Area (Acres)	Existing	Future	Percent Increase	Area (acres)	Percent	Classification
1	1,156	2.5%	3.8%	52%	764	66%	Sensitive
2A	1,167	2.9%	3.9%	34%	599	51%	Impacted
2B	2,215	3.9%	4.1%	5%	1342	61%	Impacted
2C	1,974	4.9%	8.0%	63%	1090	55%	Impacted
3	2,038	4.6%	8.1%	76%	1254	62%	Impacted
4	2,908	1.7%	3.2%	88%	1711	59%	Impacted
5	1,253	2.0%	2.4%	20%	425	34%	Impacted
Basinwide	12,711	3.2%	4.9%	53%	7184	57%	Impacted

All of the subbasins except Subbasin 1 have less than 65 percent forest cover. The overall forest cover for the basin is about 57 percent. The EIA in each subbasin is well below 10 percent for current conditions. At future buildout conditions, the EIA will increase in all subbasins, most dramatically in Subbasins 2C and 3, with increases of 63 and 76 percent, respectively. The EIA in Subbasin 2B will increase only about 5 percent. This analysis suggests that the Patterson Creek Basin is more impacted by reduced forest cover than by increase in impervious area. However, an EIA 0f 8.0 or 8.1% is considered high enough to cause moderate degradation of salmonid habitat.

2.2.5 Riparian Corridor Land Cover Analysis

A stream riparian corridor of 200 feet total width was analyzed for 2001 land use conditions (see Figure 2-7). A summary of the land use types in the riparian corridor by basin is shown in Table 2-12. An analysis for future conditions assumed that sensitive area regulations would protect the stream corridor in the future. It was not feasible to accurately predict the spatial orientation of future development within and adjacent to the floodplain.

TABLE 2-12.
EXISTING (2001) LAND SURFACE SUMMARY FOR 200-FOOT RIPARIAN CORRIDOR

	Area (acres) and *Percentages*							
Land Surface	Subbasin 1	Subbasin 2a	Subbasin 2b	Subbasin 2c	Subbasin 3	Subbasin 4	Subbasin 5	**Total**
Bare Earth	3.3	0.9	8.0	1.7	5.2	8.1	1.2	**28**
	2.9%	*0.7%*	*3.5%*	*1.0%*	*2.2%*	*1.4%*	*0.7%*	***1.7%***
Coniferous Forest	3.5	18.3	29.9	14.4	33.3	74.9	8.8	**183**
	3.1%	*13.4%*	*13.2%*	*8.7%*	*14.4%*	*13.1%*	*5.2%*	***11.4%***
Deciduous. Forest	2.1	5.5	5.6	5.6	3.2	32.7	5.4	**60**
	1.9%	*4.0%*	*2.5%*	*3.4%*	*1.4%*	*5.7%*	*3.2%*	***3.7%***
Herbaceous Forest	4.4	24.5	34.1	63.7	31.7	117.9	96.3	**373**
	3.9%	*17.9%*	*15.0%*	*38.6%*	*13.7%*	*20.7%*	*57.0%*	***23.1%***
Mixed Forest	83.5	56.9	83.9	56.4	135.8	249.3	32.9	**699**
	74.6%	*41.5%*	*37.0%*	*34.2%*	*58.5%*	*43.7%*	*19.5%*	***43.4%***
Mixed Urban Low Density	5.4	10.8	7.9	7.5	7.5	15.3	6.4	**61**
	4.8%	*7.9%*	*3.5%*	*4.5%*	*3.2%*	*2.7%*	*3.8%*	***3.8%***
Scrub/Shrub	8.2	18.4	54.9	15.4	14.3	67.4	16.9	**196**
	7.3%	*13.4%*	*24.2%*	*9.3%*	*6.2%*	*11.8%*	*10.0%*	***12.2%***
Urban High Density	1.0	1.5	2.3	0.1	1.2	3.4	0.0	**10**
	0.9%	*1.1%*	*1.0%*	*0.1%*	*0.5%*	*0.6%*	*0.0%*	***0.6%***
Water	0.8	0.0	0.0	0.0	0.0	0.3	1.1	**2**
	0.7%	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*0.1%*	*0.7%*	***0.1%***
Total	**112**	**137**	**227**	**165**	**232**	**570**	**169**	**1,612**

2.3 RECOMMENDATIONS

The basin characteristics were derived from specific GIS data provided by King County. The effective impervious area was derived from a range of values provided by King County based on specific land use or zoning (see Tables 2-3 and 2-4). In order to develop a more accurate representation of cover types and EIA, it is recommended that this information be developed from current orthophotos of the basin that could be digitized and specific areas computed.