FLOOD INSURANCE STUDY

KING COUNTY, WASHINGTON AND INCORPORATED AREAS

Volume 2 of 4

COMMUNITY NAME	COMMUNITY NUMBER	COMMUNITY NAME	COMMUNITY NUMBER
*ALGONA, CITY OF	530072	*MEDINA, CITY OF	530315
AUBURN, CITY OF	530073	*MERCER ISLAND, CITY OF	530083
*BEAUX ARTS VILLAGE, TOWN OF	530242	MUCKLESHOOT INDIAN TRIBE	530066
BELLEVUE, CITY OF	530074	NEWCASTLE, CITY OF	530134
BLACK DIAMOND, CITY OF	530272	NORMANDY PARK, CITY OF	530084
BOTHELL, CITY OF	530075	NORTH BEND, CITY OF	530085
BURIEN, CITY OF	530321	PACIFIC, CITY OF	530086
CARNATION, CITY OF	530076	REDMOND, CITY OF	530087
*CLYDE HILL, CITY OF	530279	RENTON, CITY OF	530088
COVINGTON, CITY OF	530339	SAMMAMISH, CITY OF	530337
DES MOINES, CITY OF	530077	SEATAC, CITY OF	590320
DUVALL, CITY OF	530282	SEATTLE, CITY OF	530089
ENUMCLAW, CITY OF	530319	SHORELINE, CITY OF	530327
FEDERAL WAY, CITY OF	530322	SKYKOMISH, TOWN OF	530236
*HUNTS POINT, TOWN OF	530288	SNOQUALMIE, CITY OF	530090
ISSAQUAH, CITY OF	530079	TUKWILA, CITY OF	530091
KENMORE, CITY OF	530336	WOODINVILLE, CITY OF	530324
KENT, CITY OF	530080	*YARROW POINT, TOWN OF	530309
KING COUNTY, UNINCORPORATED AREAS	530071		
KIRKLAND, CITY OF	530081		
LAKE FOREST PARK, CITY OF	530082		
*MAPLE VALLEY, CITY OF	530078		

*NON-FLOODPRONE COMMUNITIES

PRELIMINARY:

Federal Emergency Management Agency

Flood Insurance Study Number

53033CV002B

Notice

This preliminary FIS report includes only revised Flood Profiles and Floodway Data tables. See "Notice to Flood Insurance Study Users" page for additional details.

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) report may not contain all data available within the Community Map Repository. Please contact the Community Map Repository for any additional data.

The Federal Emergency Management Agency (FEMA) may revise and republish part or all of this FIS report at any time. In addition, FEMA may revise part of this FIS report by the Letter of Map Revision process, which does not involve republication or redistribution of the FIS report. Therefore, users should consult with community officials and check the Community Map Repository to obtain the most current FIS report components.

Selected Flood Insurance Rate Map panels for this community contain information that was previously shown separately on the corresponding Flood Boundary and Floodway Map panels (e.g., floodways, cross sections). In addition, former flood hazard zone designations have been changed as follows:

Old Zone(s)	New Zone
Al through A30	AE
V1 through V30	VE
B	X
C	X

Initial Countywide FIS Effective Date: September 29, 1989

Revised Countywide Date(s): May 16, 1995
May 20, 1996
March 30, 1998
November 8, 1999
December 6, 2001
April 19, 2005
To Be Determined

This preliminary FIS report does not include unrevised Floodway Data Tables or unrevised Flood Profiles. These Floodway Data Tables and Flood Profiles will appear in the final FIS report.

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PUBLISHED SEPARATELY

Flood Insurance Rate Map Index

Flood Insurance Rate Maps

3.3 Wave Height Analysis

This section outlines the technical approach used to simulate waves and water levels in the Puget Sound (King County) and Puget Sound (Vashon Island). Waves in sheltered waters are typically generated by local conditions, so the processes are less complex than open coastal settings. The primary processes affecting waves and water levels in sheltered waters include wind, astronomic tides, tidal residuals (i.e. differences between observed and predicted tides), currents, and tidal wave amplification. Within the study area, the potential effect of currents is negligible, so they were not included in offshore wave modeling. Furthermore, preliminary analyses with the wave model showed that rising and falling tides had no amplifying effect on waves so this factor could also be ignored.

The two-dimensional numerical model SWAN (Simulating Waves Nearshore, Version 40.41) was used to simulate wave generation, including shoaling effects.

For this study, historical wind data was obtained from 19 gages located throughout the Puget Sound region. The length of record at these stations varies greatly, and most of the records contain large gaps, so it was difficult to find periods when data from most or all of the gages were available. The gage at SeaTac International Airport has hourly wind data from 1948 to 2009 with very few gaps, so it was chosen as the primary source of wind data for this study. However, since wind speed and direction are not uniform over the study area, the other 18 gages were used to define spatial variability. These secondary gages were correlated with the SeaTac gage for this purpose as described below.

Figure 1 is a profile for a hypothetical transect showing the effects of energy dissipation on a wave as it moves inland. This figure shows the wave elevations being decreased by obstructions, such as buildings, vegetation, and rising ground elevations and being increased by open, unobstructed wind fetches. Actual wave conditions may not necessarily include all of the situations shown in Figure 1.

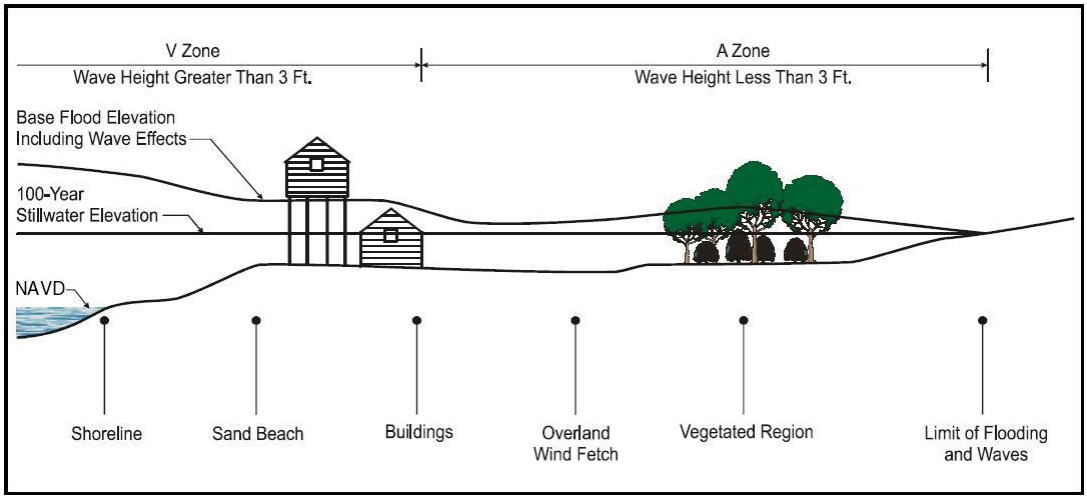

Figure 1 - Transect Schematic

3.4 Vertical Datum

All FIS reports and FIRMs are referenced to a specific vertical datum. The vertical datum provides a starting point against which flood, ground, and structure elevations can be referenced and compared. Until recently, the standard vertical datum used for newly created or revised FIS reports and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD). With the completion of the North American Vertical Datum of 1988 (NAVD), many FIS reports and FIRMs are now prepared using NAVD as the referenced vertical datum.

To accurately convert flood elevations for the streams in King County from the current NGVD29 datum to the newer NAVD88 datum, the following procedure was implemented. Locations at the upstream and downstream end of the stream, as well as a point to represent the intermediate point between the two end points, were evaluated using the

USACE's CORPSCON (Reference 133) datum conversion software. The resulting values for each of the three points were the computed difference between the NGVD29 and NAVD88 elevations. Individual conversion factors at the upstream end, the downstream end, and at an intermediate point, were averaged to develop an average conversion; these factors can be seen in Table 5, Datum Conversion Factors. The final NAVD88 elevations provided were computed by adding the calculated factor to the existing NGVD29 data (References 1-18).

Table 5. Datum Conversion Factors

Stream	Upstream	Middle	Downstream	Vertical Adjustment (feet)
Bear Creek	3.64	3.60	3.58	3.61
Big Soos Creek	3.57	3.56	3.52	3.55
Black River	3.58	3.52	3.49	3.53
Cedar River	3.56	3.56	3.56	3.56
Coal Creek	3.62	3.61	3.58	3.60
Des Moines Creek	3.52	3.53	3.49	3.51
East Fork Issaquah Creek	3.65	3.62	3.60	3.62
Evans Creek	3.59	3.59	3.58	3.59
Forbes Creek	3.59	3.59	3.59	3.59
Gardiner Creek	3.67	3.61	3.61	3.60
Green River	3.58	3.52	3.49	3.53
Holder Creek	3.65	3.61	3.58	3.61
Issaquah Creek	3.58	3.64	3.60	3.61
Issaquah Creek (Gilman Overflow)	3.58	3.64	3.60	3.61
Kelsey Creek	3.58	3.58	3.57	3.58
Kelsey Creek (West Trib)	3.58	3.58	3.58	3.58
Kelsey Creek (East Branch)	3.58	3.58	3.58	3.58
Little Bear Creek	3.63	3.62	3.62	3.62
Longfellow Creek	3.55	3.56	3.56	3.56
Lower Overflow	3.62	3.61	3.61	3.61
Lyon Creek	3.63	3.63	3.62	3.63
McAleer Creek	3.63	3.63	3.62	3.63
Maloney Creek	4.05	4.05	4.05	4.05
May Creek	3.61	3.59	3.57	3.59
May Creek Tributary	3.60	3.60	3.60	3.60
Mercer Creek	3.57	3.57	3.57	3.57
Mercer Creek (North Branch)	3.57	3.57	3.57	3.57
Mercer Creek (Right Channel)	3.57	3.57	3.57	3.57
Meydenbauer Creek	3.57	3.56	3.56	3.56
Meydenbauer Creek (North Fork)	3.57	3.56	3.56	3.56
Middle Fork Snoqualmie River	3.67	3.61	3.61	3.63
Middle Overflow	3.61	3.60	3.60	3.60
Mill Creek - Auburn	3.52	3.51	3.51	3.51
Mill Creek - Kent	3.53	3.53	3.53	3.53
Miller Creek	3.55	3.53	3.48	3.52
North Creek	3.62	3.62	3.62	3.62
North Fork Issaquah Creek	3.60	3.59	3.59	3.59
North Fork Snoqualmie River	3.67	3.63	3.62	3.64
North Fork Thornton Creek	3.62	3.62	3.61	3.62
Patterson Creek	N/A	N/A	N/A	3.58
Raging River	3.61	3.60	3.62	3.61
Richards Creek	3.59	3.59	3.58	3.59
Richards Creek (West Trib)	3.59	3.59	3.58	3.59
Richards Creek (East Trib)	3.59	3.59	3.58	3.59
Rolling Hills Creek	3.63	3.59	3.59	3.60
Sammamish River	3.57	3.60	3.62	3.60
Snoqualmie River	3.61	3.57	3.60	3.59
South Fork Skykomish River	4.08	4.02	3.93	4.01
South Fork Snoqualmie River	3.63	3.59	3.59	3.60
South Fork Thornton Creek	3.61	3.61	3.61	3.61

Table 5. Datum Conversion Factors

Stream	Upstream	Middle	Downstream	Vertical Adjustment (feet)
Springbrook Creek	3.54	3.54	3.55	3.54
Swamp Creek	3.63	3.62	3.62	3.62
Thornton Creek	3.61	3.60	3.59	3.60
Tibbetts Creek	3.61	3.61	3.61	3.61
Tolt River	3.62	3.59	3.57	3.59
Upper North Overflow	3.61	3.60	3.60	3.60
Upper South Overflow	3.60	3.60	3.61	3.60
Vasa Creek	3.62	3.61	3.60	3.61
Walker Creek	3.50	3.49	3.49	3.49
West Fork Issaquah Creek	3.60	3.60	3.60	3.60
White River	3.53	3.53	3.51	3.52
Yarrow Creek	3.59	3.58	3.58	3.58
Stillwater Source				
Lake Sammamish	NA	NA	NA	3.6
Puget Sound	NA	NA	NA	3.5

Flood elevations shown in this FIS report and on the DFIRM are referenced to NAVD88. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between the NGVD and NAVD, visit the National Geodetic Survey website at www.ngs.noaa.gov, or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242
(301) 713-4172 (fax)

Temporary vertical monuments are often established during the preparation of a flood hazard analysis for the purpose of establishing local vertical control. Although these monuments are not shown on the DFIRM, they may be found in the Technical Support Data Notebook associated with the FIS report and DFIRM for this community. Interested individuals may contact FEMA to access these data.

To obtain current elevation, description, and/or location information for benchmarks shown on this map, please contact the Information Services Branch of the NGS at (301) 713-3242, or visit their website at www.ngs.noaa.gov.

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. To assist in this endeavor, each FIS report provides 1-percent-annual-chance floodplain data, which may include a combination of the following: 10-, 2-, 1-, and 0.2-percent-annual-chance flood elevations; delineations of the 1- and 0.2-percent-annual-chance floodplains; and a 1-percent-annual-chance floodway. This information is presented on the FIRM and in many components of the FIS report, including Flood Profiles, Floodway Data tables, and Summary of Stillwater Elevation tables. Users should reference the data presented in the FIS report as well as additional information that may be available at the local community map repository before making flood elevation and/or floodplain boundary determinations.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent-annual-chance flood has been adopted by FEMA as the base flood for flood for floodplain management purposes. The 0.2-percent-annual-chance flood is employed to indicate additional areas of flood risk in the community. For each stream studied by detailed methods except Bear Creek, Des Moines Creek, Little Bear Creek, Miller Creek, North Creek, Sammamish River, Swamp Creek, Thornton Creek Main Branch, North Branch, Overflow, Overflow Bypass, Walker Creek and White River, except, the 1- and 0.2-percent-annual-chance floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at scales of 1:240, 1:1,200, 1:2,400, 1:4,800, and 1:6,000, with contour intervals of 1, 2, 4, 5, and 10 feet (Reference 46 and 63 to 78).

For Puget Sound the 1-percent-annual-chance floodplain boundaries were interpolated using 2 foot contours (Reference, 192).

For Bear Creek, Des Moines Creek, Little Bear Creek, Miller Creek, North Creek, Sammamish River, Swamp Creek, Walker Creek and White River, the topography used to delineate the 1- and 0.2-percent–annual-chance floodplain boundaries are unknown.

For Thornton Creek Main Branch, North Branch, Overflow, Overflow Bypass, the 1-percent-annual-chance floods were delineated using PSLC aerial survey of the City of Seattle in 2000/2001. This bare-earth topographic data has a 6-foot grid spacing with a vertical accuracy approximately ± 1 foot. Because the topography of Jackson Park Golf Course along the North Branch was significantly altered since the PSLC survey, engineering drawings of the golf course (provided by SPU) were used in place of the LiDAR in that area.

The 1- and 0.2-percent-annual-chance floodplain boundaries are shown on the Flood Insurance Rate Map (Exhibit 2). On this map, the 1-percent-annual-chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A, AE, AH, AO, and VE); and the 0.2-percent-annual-chance floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 1- and 0.2-percent-annual-chance floodplain boundaries are close together, only the 1-percent-annual-chance floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For the streams studied by approximate methods, only the 1-percent-annual-chance floodplain boundary is shown on the Flood Insurance Rate Map (Exhibit 2).

Approximate 1-percent-annual-chance floodplain boundaries in some portions of the study area were taken directly from the Flood Hazard Boundary Maps (References 79 to 89), or Flood Insurance Rate Maps (References 90 and 91).

The base flood elevation (BFE) is the water surface elevation for the 1%-annual-chance event. BFEs are the greatest elevation between the "with levee" and "without levee" (discussed in Section 3.2.5.9) simulations. The elevation difference between the two simulations is negligible due to the ineffectiveness of the overbanks in conveying flow. Users should be aware that the BFEs shown on the work maps represent rounded whole-foot elevations and may not exactly reflect the elevations presented on the Flood Profiles (Exhibit 1) or in the Floodway Data Table (Table 6). The BFEs shown on the work maps are primarily intended for illustrative purposes. For construction and/ or floodplain management purposes, users are cautioned to refer to the elevation data presented in the Floodway Data Table as well as the Flood Profiles in conjunction with the data illustrated on the work maps.

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 1-percent-annual-chance floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the base flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

A Regulatory Floodway was delineated for the Lower Green River using the HEC-RAS and FLO-2D models. In general, the floodway was developed to coincide with the effective Green River floodway to the greatest extent possible. The HEC-RAS model was run to determine if the

effective floodway could fully contain the 1-percent-annual-discharge flood without causing surcharges in excess of one foot relative to the "fail all levee" condition. In areas where the one-foot surcharge could not be achieved, the overbank portions of the floodway were delineated using the FLO-2D model as described above in Section 3.2.8.2. Encroachments in the overbank areas were manually defined until a reasonable floodway boundary was established. Floodway widths were computed at each cross-section in the HEC-RAS model and the delineation between section were drawn based on topographic information. At some cross-sections, the floodway boundary coincides with the top of the channel banks and the channel does not encroach into the channel. The floodway along the certified levee near Southcenter (i.e., the Tukwila 205 Levee) was delineated along the landward toe of the levee fill. In locations where the floodway and the 1,-percent-annual-discharge floodplain boundary coincide, only the floodway boundary is shown. Floodway data is not provided for portions of the floodway that were analyzed using FLO-2D.

The floodways presented in this study were computed for certain stream segments on the basis of equal-conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross section (see Table 6, Floodway Data). In cases where the floodway and 1-percent-annual-chance floodplain boundaries are either close together or collinear, only the floodway is shown.

The area between the floodway and 1-percent-annual-chance floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation (WSEL) of the base flood more than 1 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 2.

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE-FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
THORNTON CREEK MAINSTEM								
A	0	22	71	5.9	17.6	17.6	17.6	0.0
B	1,071	23	149	2.8	27.2	27.2	27.8	0.6
C	1,489	27	159	2.6	29.3	29.3	29.9	0.6
D	1,918	29	240	1.8	34.9	34.9	34.9	0.0
E	2,455	21	201	2.1	39.2	39.2	39.2	0.0
F	2,779	42	301	1.4	39.2	39.2	39.5	0.3
G	2,901	35	231	1.8	39.3	39.3	39.6	0.3
H	3,485	19	115	3.8	39.5	39.5	40.3	0.8
I	4,846	22	108	4.4	43.4	43.4	43.7	0.3
J	4,899	14	82	5.8	43.5	43.5	43.8	0.3
K	5,157	81	254	1.9	44.5	44.5	44.9	0.4
L	5,441	19	76	6.9	45.2	45.2	45.6	0.4
M	5,530	17	84	6.2	46.3	46.3	46.6	0.3
N	5,556	21	114	5.0	47.4	47.4	47.8	0.4
O	5,639	18	113	4.6	47.7	47.7	48.1	0.4
P	5,684	17	111	4.7	47.9	47.9	48.3	0.4
Q	5,839	33	160	3.3	48.4	48.4	48.7	0.3
R	5,916	33	142	3.7	48.5	48.5	48.9	0.4

[1]Feet above limit of detailed study

(Limit of detailed study is approximately 1,015 feet downstream of Northeast 93rd Street)

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

KING COUNTY, WA
AND INCORPORATED AREAS

FLOODWAY DATA

THORNTON CREEK MAINSTEM

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE-FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
THORNTON CREEK MAINSTEM (CONTINUED)								
S	5,929	32	146	3.6	48.5	48.5	49.0	0.5
T	6,003	31	156	3.4	48.6	48.6	49.5	0.9
U	6,102	20	138	3.8	49.0	49.0	50.0	1.0
V	6,655	48	252	3.5	49.9	49.9	50.7	0.8
W	6,852	28	139	6.4	51.0	51.0	51.7	0.7
X	7,173	29	111	8.0	53.0	53.0	53.6	0.6
Y	7,212	21	80	11.2	53.7	53.7	54.2	0.5
Z	7,332	119	184	4.9	55.9	55.9	56.6	0.7

[1]Feet above limit of detailed study

(Limit of detailed study is approximately 1,015 feet downstream of Northeast 93rd Street)

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

KING COUNTY, WA
AND INCORPORATED AREAS

FLOODWAY DATA

THORNTON CREEK MAINSTEM

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE-FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
THORNTON CREEK NORTH BRANCH								
AA	7,481	54	166	2.8	56.3	56.3	57.3	1.0
AB	7,912	28	124	3.7	62.2	62.2	63.0	0.8
AC	8,607	22	66	7.1	67.6	67.6	67.6	0.0
AD	9,342	13	34	9.3	83.3	83.3	83.3	0.0
AE	9,959	39	67	4.8	101.4	101.4	101.4	0.0
AF	10,708	18	39	8.3	111.9	111.9	111.9	0.0
AG	11,944	34	166	1.9	140.6	140.6	140.6	0.0
AH	13,570	17	38	8.4	160.9	160.9	160.9	0.0
AI	14,245	14	124	2.6	179.1	179.1	179.1	0.0
AJ	15,100	12	68	4.7	192.7	192.7	192.9	0.2
AK	15,651	14	35	9.1	197.5	197.5	197.5	0.0
AL	16,518	16	38	8.0	210.1	210.1	210.1	0.0
AM	17,195	12	38	8.5	225.4	225.4	225.5	0.1
AN	17,814	25	89	3.6	236.4	236.4	236.4	0.0
AO	18,076	49	57	5.6	237.5	237.5	237.9	0.4
AP	11,804	11	34	4.8	244.7	244.7	245.0	0.3
AQ	20,030	13	190	1.7	266.8	266.8	266.8	0.0
AR	20,887	43	277	0.6	266.8	266.8	266.9	0.1
AS	21,791	27	45	3.6	272.2	272.2	272.2	0.0

[1]Feet above limit of detailed study
(Limit of detailed study is approximately 1,015 feet downstream of Northeast 93rd Street)

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

KING COUNTY, WA
AND INCORPORATED AREAS

FLOODWAY DATA

THORNTON CREEK NORTH BRANCH

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE-FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
THORNTON CREEK NORTH BRANCH (CONTINUED)								
AT	22,759[1]	29	34	4.8	279.3	279.3	279.3	0.0
AU	22,926[1]	29	34	4.8	281.3	281.3	281.3	0.0
AV	23,645[1]	20	29	8.1	288.1	288.1	288.1	0.0
AW	23,791[1]	22	80	2.2	291.5	291.5	291.5	0.0
AX	72[2]	11	15	6.9	303.1	303.1	303.1	0.0
AY	564[2]	10	9	5.4	308.0	308.0	308.0	0.0
AZ	1,397[2]	*	*	*	311.8	311.8	*	*
BA	1,784[2]	*	*	*	311.8	311.8	*	*
BB	2,332[2]	2	10	5.9	321.2	321.2	321.2	0.0
BC	3,234[2]	8	13	6.7	333.0	333.0	333.0	0.0
BD	3,636[2]	3	17	9.7	341.5	341.5	341.5	0.0
BE	4,397[2]	9	16	4.2	352.1	352.1	352.1	0.0
BF	5,763[2]	10	16	2.7	361.8	361.8	361.8	0.0
BG	6,074[2]	24	38	1.1	362.3	362.3	362.3	0.0
BH	6,504[2]	4	7	6.3	364.1	364.1	364.1	0.0
BI	6,864[2]	9	16	2.7	365.3	365.3	365.4	0.1

[1]Feet above limit of detailed study (Limit of detailed study is approximately 1,015 feet downstream of Northeast 93rd Street)

[2]Feet above limit of detailed study (Limit of detailed study is approximately 850 feet downstream of 1st Avenue Northeast)

*No mapped floodway

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

KING COUNTY, WA
AND INCORPORATED AREAS

FLOODWAY DATA

THORNTON CREEK NORTH BRANCH

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE-FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
THORNTON CREEK OVERLFOW BYPASS								
A	152	12	16	3.8	306.3	306.3	306.3	0.0
B	1,013	11	16	3.9	317.0	317.0	317.0	0.0
C	1,519	9	10	6.2	324.9	324.9	324.9	0.0

[1]Feet above convergence with Thornton Creek North Branch

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

KING COUNTY, WA
AND INCORPORATED AREAS

FLOODWAY DATA

THORNTON CREEK OVERFLOW BYPASS

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE-FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
THORNTON CREEK SOUTH BRANCH								
A	587	36	108	4.2	60.7	60.7	61.1	0.4
B	1,139	36	126	3.6	66.5	66.5	67.2	0.7
C	1,473	34	69	6.5	68.5	68.5	68.8	0.3
D	1,900	21	88	5.1	74.6	74.6	75.1	0.5
E	2,578	35	125	3.6	84.6	84.6	84.6	0.0
F	2,867	15	45	10.0	88.6	88.6	88.6	0.0
G	3,161	16	47	9.6	95.0	95.0	95.0	0.0
H	3,756	20	64	7.0	104.9	104.9	105.1	0.2
I	4,580	5	47	7.2	132.2	132.2	132.2	0.0
J	5,508	24	51	6.6	141.8	141.8	141.8	0.0
K	6,327	33	48	7.0	157.0	157.0	157.0	0.0
L	6,951	27	46	7.4	170.4	170.4	170.4	0.0
M	7,723	17	39	8.6	186.8	186.8	186.8	0.0
N	7,836	46	88	3.9	190.5	190.5	190.5	0.0
O	8,955	17	39	8.6	205.1	205.1	205.1	0.0
P	9,563	18	40	8.5	215.6	215.6	215.6	0.0
Q	9,716	13	33	8.5	220.2	220.2	220.2	0.0
R	10,226	33	188	1.4	231.7	231.7	231.7	0.0
S	10,545	14	43	6.3	232.0	232.0	232.2	0.2

[1]Feet above confluence with Thornton Creek Mainstem

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

KING COUNTY, WA
AND INCORPORATED AREAS

FLOODWAY DATA

THORNTON CREEK SOUTH BRANCH

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE-FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
THORNTON CREEK SOUTH BRANCH (CONTINUED)								
T	11,154	10	66	4.1	238.8	238.8	239.6	0.8
U	11,565	10	32	8.4	240.7	240.7	241.3	0.6
V	12,074	17	34	8.0	246.3	246.3	246.4	0.1

[1]Feet above confluence with Thornton Creek Mainstem

TABLE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

KING COUNTY, WA
AND INCORPORATED AREAS

FLOODWAY DATA

THORNTON CREEK SOUTH BRANCH

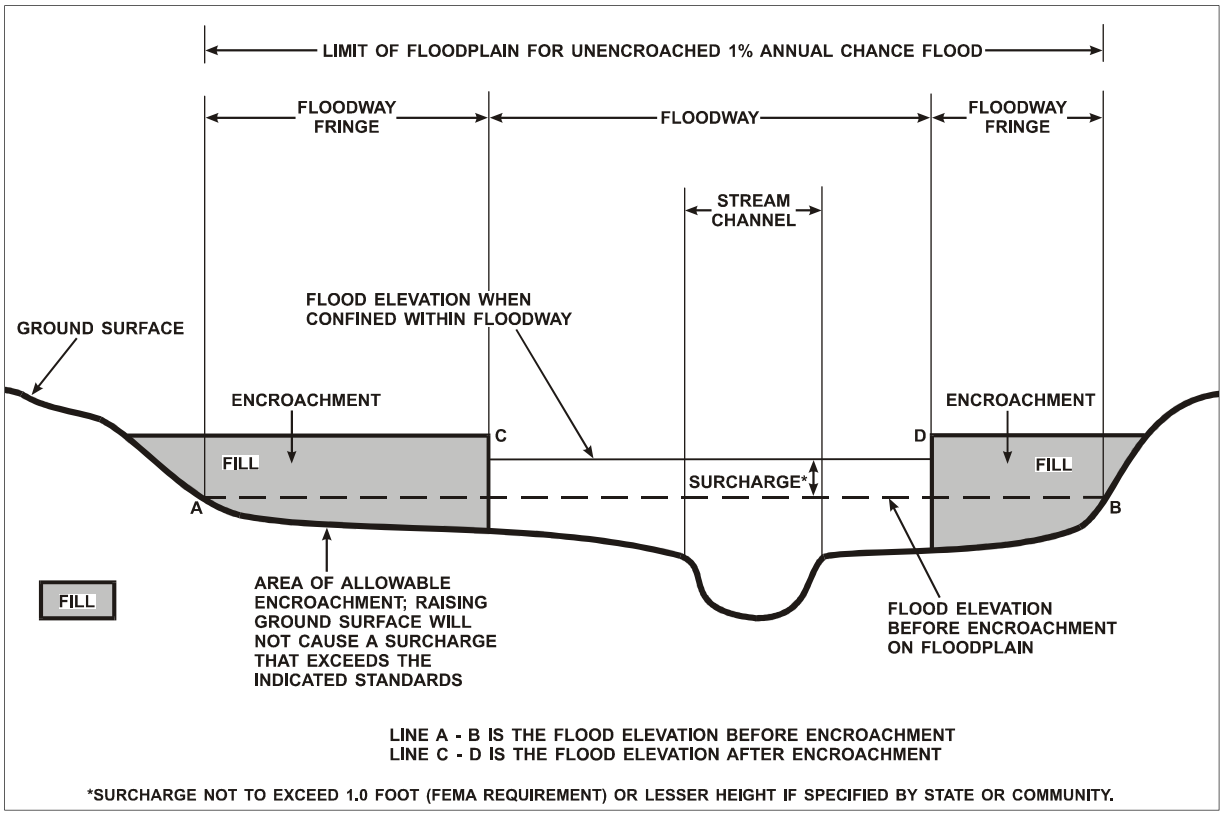

Figure 2. Floodway Schematic

4.3 Base Flood Elevations

Areas within the community studied by detailed engineering methods have BFEs established in AE and VE Zones. These are the elevations of the 1-percent-annual-chance (base flood) relative to NAVD. In coastal areas affected by wave action, BFEs are generally maximum at the normal open shoreline. These elevations generally decrease in a landward direction at a rate dependent on the presence of obstructions capable of dissipating the wave energy. Where possible, changes in BFEs have been shown in 1-foot increments on the FIRM. However, where the scale did not permit, 2- or 3-foot increments were sometimes used. BFEs shown in the wave action areas represent the average elevation within the zone. Current program regulations generally require that all new construction be elevated such that the first floor, including basement, is elevated to or above the BFE in AE and VE Zones.

4.4 Velocity Zones

The USACE has established the 3-foot wave height as the criterion for identifying coastal high hazard zones (Reference 191). This was based on a study of wave action effects on structures. This criterion has been adopted by FEMA for the determination of VE zones. Because of the additional hazards associated with high-energy waves, the NFIP regulations require much more stringent floodplain management

measures in these areas, such as elevating structures on piles or piers. In addition, insurance rates in VE zones are higher than those in AE zones.

The location of the VE zone is determined by the 3-foot wave as discussed previously. The detailed analysis of wave heights performed in this study allowed a much more accurate location of the VE zone to be established. The VE zone generally extends inland to the point where the 1-percent-annual-chance stillwater flood depth is insufficient to support a 3-foot wave.

5.0 INSURANCE APPLICATION

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 1-percent-annual-chance floodplains that are determined in the FIS report by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base (1-percent-annual-chance) flood elevations (BFEs) or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 1-percent-annual-chance floodplains that are determined in the FIS report by detailed methods. Whole-foot BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance rate zone that corresponds to areas of 1-percent-annual-chance shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to areas of 1-percent-annual-chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 1-percent-annual-chance coastal floodplains that have additional hazards associated with storm waves. Whole-foot BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 0.2-percent-annual-chance floodplain, areas within the 0.2-percent-annual-chance floodplain, areas of 1-percent-annual-chance flooding where average depths are less than 1 foot, areas of 1-percent-annual-chance flooding where the contributing drainage area is less than 1 square mile (sq. mi.), and areas protected from the base flood by levees. No BFEs or depths are shown within this zone.

Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The FIRM is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 1-percent-annual-chance floodplains that were studied be detailed methods, shows selected whole-foot BFEs or average depths. Insurance agents use zones and BFEs in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For flood management applications, the map shows by tints, screens, and symbols, the 1- and 0.2-percent-annual-chance floodplains, floodways, and the locations of selected cross sections used in the hydraulic analyses and floodway computations.

The countywide DFIRM presents flooding information for the entire geographic area of King County. Previously, DFIRMs were prepared for each incorporated community and the unincorporated areas of the County identified as flood-prone. This countywide DFIRM also includes flood-hazard information that was presented separately on Flood Boundary and Floodway Maps (FBFMs), where applicable. Historical data relating to the

maps prepared for each community are presented in Table 7, "Community Map History."

7.0 OTHER STUDIES

Due to its more detailed hydraulic analyses, this FIS supersedes all previous FISs/FIRMs covering King County and the incorporated areas (References 1-18, 90-92). The Town of Milton has individual effective FIS (Reference 93).

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting Federal Insurance and Mitigation Division, FEMA Region X, Federal Regional Center, 130 228th Street Southwest, Bothell, Washington 98021-8627.

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISION DATE(S)	FLOOD INSURANCE RATE MAP EFFECTIVE DATE	FLOOD INSURANCE RATE MAP REVISION DATE(S)
Algona, City of[1]	NA	NA	NA	NA
Auburn, City of	May 24, 1974	September 19, 1975	June 1, 1981	
		February 18, 1977		
Beaux Arts Village, Town of[1]	NA	NA	NA	NA
Bellevue, City of	August 2, 1974	August 13, 1976	December 1, 1978	February 23, 1982
Black Diamond, Town of	July 25, 1975	October 30, 1979	October 30, 1979	None
Bothell, City of	May 24, 1974	November 12, 1976	June 1, 1982	March 2, 1994
Burien, City of	September 30, 1994	None	September 30, 1994	May 16, 1995
Carnation, City of	May 31, 1974	March 5, 1976	March 4, 1980	None
Clyde Hill, Town of[1]	NA	NA	NA	NA
Covington, City of	TBD	None	TBD	None
Des Moines, City of	June 28, 1974	January 2, 1976	May 15, 1980	November 15, 1985
Duvall, Town of	August 20, 1976	None	June 4, 1980	None
Enumclaw, City of	September 29, 1989	None	September 29, 1989	None
Federal Way, City of	May 16, 1995	None	May 16, 1995	None
Hunts Point, Town of[1]	NA	NA	NA	NA
Issaquah, City of	February 8, 1974	February 25, 1977	May 1, 1980	None
Kent, City of	June 7, 1974	April 22, 1977	April 1, 1981	None
Kenmore, City of	TBD	None	TBD	None
King Unincorp Areas	January 17, 1975	None	September 29, 1978	None
Kirkland, City of	June 28, 1974	September 12, 1975	June 15, 1981	None
Lake Forest Park, City of	June 28, 1974	February 27, 1976	February 15, 1980	None
Maple Valley, City of[1]	None	None	None	None
Medina, City of[1]	NA	NA	NA	NA
Mercer Island, City of[1]	NA	NA	NA	NA
Muckleshoot Indian Reservation	TBD	None	TBD	None
Newcastle, City of	TBD	None	None	None
Normandy Park, City of	June 28, 1974	October 31, 1975	November 2, 1977	August 5, 1980
North Bend, City of	May 17, 1974	May 7, 1976	August 1, 1984	None
Pacific, City of	June 28, 1974	December 26, 1975	December 2, 1980	None
Redmond, City of	March 22, 1974	July 9, 1976	February 1, 1979	January 19, 1982
Renton, City of	June 7, 1974	November 7, 1975	May 5, 1981	None
Sammamish, City of	November 18, 1999	None	None	None
SeaTac, City of	September 30, 1994	None	September 30, 1994	None
Seattle, City of	July 19, 1977	None	July 19, 1977	None
Shoreline, City of	None	None	None	None
Skykomish, Town of	February 14, 1975	None	July 2, 1981	None
Snoqualmie, City of	December 21, 1973	None	July 5, 1984	None
Tukwila, City of	May 24, 1974	September 13, 1977	August 3, 1981	None
Woodinville, City of	May 16, 1995	None	May 16, 1995	None
Yarrow Point, Town of[1]	NA	NA	NA	NA

[1] No Special Flood Hazard Areas Identified

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

KING COUNTY, WA

AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

9.0 BIBLIOGRAPHY AND REFERENCES

1. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Insurance Study, King County, Washington, (Unincorporated Areas), March 1978.

2. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, City of Auburn, Washington, December 1980.

3. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, City of Bellevue, Washington, February 23, 1982.

4. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, Town of Carnation, Washington, September 1979.

5. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, City of Des Moines, Washington, November 15, 1985.

6. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, Town of Duvall, Washington, December 1979.

7. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, City of Issaquah, Washington, November 1979.

8. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, City of Kent, Washington, October 1980.

9. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, City of Kirkland, Washington, December 15, 1980.

10. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, City of Lake Forest Park, Washington, August 1979.

11. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, City of Normandy Park, Washington, August 1980.

12. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, City of North Bend, Washington, February 1, 1984.

13. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, City of Pacific, Washington, June 1980.

14. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, City of Redmond, Washington, January 1982.

15. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, City of Renton, Washington, November 1980.

16. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, Town of Skykomish, Washington, January 2, 1981.

17. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, City of Snoqualmie, Washington, January 5, 1984.

18. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, City of Tukwila, Washington, February 3, 1981.

19. Puget Sound Council of Governments, "Puget Sound Trends No. 5 (Revised)," July 1986.

20. U.S. Department of Commerce, Bureau of the Census, 1980 Census of Population, Number of Inhabitants, Washington.

21. U.S. Department of Interior, Geological Survey, Magnitude and Frequency in Washington, Open-File Report 74-336 by J.E. Cummans, M.R. Collings, and E.G. Nassar, Tacoma, Washington, 1975.

22. U.S. Department of Interior, Geological Survey, Tacoma, Washington, Personnel Communication, 1986.

23. U.S. Department of the Army, Corps of Engineers, "Green River Flood Reduction Study: Appendix E, Section 1—Hydrology," 1984.

24. U.S. Department of the Army, Corps of Engineers, Seattle District, "Maximum Annual Peak Frequency Curve, Green River Near Auburn," January, 1981; "Maximum Annual Peak Discharge Frequency Curve, Green River at Tukwila," January 14, 1986.

25. King County Department of Public Works, "Green River Management Agreement," 1985.

26. King County Department of Public Works, Surface Water Management, Operation and Maintenance Division "Personal Communication – P1 Pump Station Operation," September and December 1986.

27. U.S. Department of Interior, Geological Survey, "Peak Flows from Drainage Areas in Washington," by J.H. Bartells and G.T. Higgins, July 1966.

28. U.S. Department of the Army, Corps of Engineers, Seattle District, Flood Insurance Study-King County, Washington (Unincorporated Areas), Seattle, Washington, March 1978.

29. Issaquah Environmental Council, "Aerial Photographs and Videotape of November 24, 1986 Flood Event, Issaquah, Washington," January 6, 1986.

30. U.S. Department of Agriculture, Soil Conservation Service, Watershed Work Plan, Appendix A, Preliminary Plans Structural Measures East Side Green River Watershed King County, Washington," April 1965.

31. U.S. Water Resources Council, "A Uniform Technique for Determining Flood Flow Frequencies," Bulletin 15, December 1967.

32. U.S. Department of the Interior, Geological Survey, "Program G745: Flood Flow Frequency Analysis," Olympia, Washington, October 1985.

33. U.S. Department of the Interior, Geological Survey, Office of Water Data Coordination, Bulletin #17B, "Guidelines for Determining Flood Flow Frequency," Revised September 1982.

34. U.S. Department of the Interior, Geological Survey, "Evaluation and Design of a Streamflow-Data Network in Washington," Open-File Report 78-167, by M.E. Moass and W.L. Haushild, Tacoma, Washington, 1978.

35. U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center, "HEC-1 Hydrograph Package Users Manual," Computer Program 723-X6-12010, Revised January 1985.

36. Seattle Engineering Department, Office for Planning, Sewer and Drainage Planning – Rain Gaging Program, "Storm Summaries for Storm of January 17-18, 1986 and Hourly and Daily Rainfall Totals (Stations 1, 2, 4, 5, 14, 15, 17)," January 1986.

37. City of Kent, URS Engineers Matrix Management Group, "City of Kent Surface Drainage Utility Drainage Master Plan," February 1984.

38. U.S. Department of the Army, Corps of Engineers, Flood Plain Management Division, "Green River Interior Runoff Test File, HEC-1 Program Run for Basin E, 100-Year Event," September 1981.

39. U.S. Department of Agriculture, Soil Conservation Service, "Fast Side Green River Watershed: Design Discharges—P1 Channel," April 1980.

40. U.S. Department of the Army, Corps of Engineers, Backwater Channel Capacity Study, R.M. 0.0 to R.M. 28, White River, Auburn, Washington, November 25, 1974.

41. U.S. Department of Agriculture, Soil Conservation Service, Engineering Division, Technical Release No. 20, Computer Program for Project Formulation Hydrology, May 1965.

42. U.S. Department of Interior, Geological Survey, Open-File Report 74-336, Magnitude and Frequency of Floods in Washington, Tacoma, Washington, 1975.

43. Stevens, Thompson and Runyan, Inc., "Sea-Tac Communities Plan, Port of Seattle," August 1974.

44. CH2M HILL, Inc., Contour Maps, Scale 1:1,200, Contour Interval 2 feet, Normandy Park 1963.

45. King County Engineering Department, 1953 Aerial Topographic Survey (Sheets 1 and 2), Scale 1:4,800, Contour Interval 10 feet: Bothell, Washington (1953).

46. U.S. Department of the Army, Corps of Engineers, Topographic Maps, Scale 1:2,400, Contour Interval 2 feet: Auburn, Washington (1984).

47. U.S. Department of the Army, Corps of Engineers, Ortho-Photogrammetric Mapping, Snohomish River Basin, Washington, Scale 1:12,000: Seattle, Washington, June 7, 1975 (revised 1979).

48. CH2M HILL, Inc., Aerial Photographic Mosaic, North Bend, Washington, Scale 1:4,800, Washington, Photographed October 5, 1977.

49. CH2M HILL, Inc., Composite Mapping of North Bend, Washington, Scale 1:4,800, Contour Interval 2 feet, October 5, 1977.

50. U.S. Department of the Army, Corps of Engineers, "Topographic Maps of the Green River and Vicinity," Scale 1:1,200, Reduced to 1:4,800, Contour Interval 2 Feet, 1980.

51. Norman Associates, Inc., Topographic Maps, Scale 1:1,200, Contour Interval 2 feet, 1977.

52. U.S. Department of the Interior, Geological Survey, Geological Survey Open-File Report No. 76-499, Computer Applications for Step Backwater and Floodway Analysis, User's Manual No. 76-499, Reston, Virginia, 1976.

53. American Concrete Pipe Association, Concrete Pipe Design Manual, Arlington, Virginia, February 1974.

54. Portland Cement Association, Handbook of Concrete Culvert Pipe Hydraulics, Chicago, Illinois, 1964.

55. University of California at Berkeley, Street and Highway Drainage Volume 2 – Design Charts, Berkeley, California, November 1969.

56. Washington State Highway Commission, Department of Highways, Highway Hydraulics Manual, Olympia, Washington, 1972.

57. U.S. Department of the Army, Corps of Engineers, Seattle District, Computer Program G37322110, Backwater Curve Method II-With Floodway Analysis, Seattle, Washington.

58. U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center, "HEC-2 Water Surface Profiles, Users Manual," Davis, California, September 1982.

59. U.S. Department of the Army, Corps of Engineers, Coastal Engineering Research Center, "Shore Protection Manual," Fort Belvoir, Virginia, 1973.

60. U.S. Department of the Army, Corps of Engineers, Letter to FEMA, "Green River Levee Freeboard Recommendations," September 1986.

61. U.S. Department of the Army, Corps of Engineers, Coastal Engineering Research Center (CETA 78-2), Revised Wave Runup Curves for Smooth Slopes, July 1978.

62. U.S. Department of the Army, Corps of Engineers, Coastal Engineering Research Center (CETA 79-1), Wave Runup on Rough Slopes, July 1979.

63. Jones and Associates, Inc., "Renton Village Company—1981 Aerial Mapping," Scale 1:600, Reduced to 1:1,200, Contour Interval 1 Foot, September 1981.

64. U.S. Department of the Army, Corps of Engineers, "Topographic Maps of the Green River and Vicinity," Scale 1:1,200, Reduced to 1:4,800, Contour Interval 2 Feet, 1980.

65. CH2M HILL, Inc., "Topographic Maps" Scale 1:4,800, Contour Interval 4 Feet, Big Soos Creek (1986), Bear Creek (1986), Swamp Creek (1986), May Creek (1986), Little Bear Creek (1986), Issaquah Creek (1986), Raging River (1986), Thornton Creek (1986), Longfellow Creek (1986), Cedar River (1986).

66. Kings County Engineering Department, River Valley Topography, Scale 1:2,400, Contour Interval 10 feet, Flood Control Division, Seattle, Washington, December 1961.

67. U.S. Department of the Interior, Geological Survey, Topographic Photo Maps, Scale 1:2,400, Contour Interval 5 feet: City of Bellevue, Washington, 1970.

68. King County Engineering Department, Flood Control Division, River Valley Topography, Scale 1:2,400, Contour Interval 5 feet: Seattle, Washington, December 1961.

69. King County Department of Public Works, Division of Hydraulics, Topographic Maps, Southwestern King County, Washington, Scale 1:2,400, Contour Interval 5 feet, June 1974.

70. Harry P. Jones and Associates, Topographic Maps, Scale 1:2,400, Contour Interval 5 feet: Kirkland, Washington (1967).

71. King County Engineering Department, Aerial Photography, Scale 1:2,400, Contour Interval 5 feet: Sections 3, 4, 9, and 10. T26N, RAE, WM, King County, Washington (1958), Revised (1965).

72. CH2M HILL, Inc., Contour Maps, Scale 1:1,200, Contour Interval 2 feet, Normandy Park, 1963.

73. U.S. Department of the Army, Corps of Engineers, Topographic Mapping of North Bend, Washington, Scale 1:2,400, Contour Interval 2 feet: Seattle, Washington (1978).

74. U.S. Department of the Army, Corps of Engineers, Topographic Maps, Scale 1:4,800, Contour Interval 5 feet: Pacific, Washington (1974).

75. Aerial Mapping Company, Topographic Maps, 1:2,400, Contour Interval 5 feet: Renton, Washington (1968).

76. Harstad Associates, Inc., Topographic Maps, Scale 1:2,400, Contour Interval 5 feet: Town of Skykomish, Washington (June 1979).

77. U.S. Department of the Army, Corps of Engineers, Topographic Mapping, Scale 1:2,400, Contour Interval 2 feet: Snoqualmie, Washington (1978).

78. Walker and Associates, Topographic Map, Scale 1:2,400, Contour Interval 5 feet: Tukwila, Washington (1974).

79. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Hazard Boundary Map, King County, Washington, January 17, 1975.

80. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Hazard Boundary Map, City of Auburn, Washington, Scale 1:4,800, February 18, 1977.

81. Federal Emergency Management Agency, Federal Insurance Administration, Flood Hazard Boundary Map, City of Bellevue, King County, Washington, August 2, 1974; revised August 13, 1976.

82. Federal Emergency Management Agency, Federal Insurance Administration, Flood Hazard Boundary Map, City of Kent, King County, Washington, April 22, 1977.

83. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Hazard Boundary Map, City of Kirkland, Washington, September 12, 1975.

84. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Hazard Boundary Map, City of North Bend, Washington, Scale 1:9,600, May 7, 1976.

85. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Hazard Boundary Map, City of Pacific, King County, Washington, Scale 1:9,600, December 26, 1975.

86. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Hazard Boundary Map, City of Renton, King County, Washington, Scale 1:9,600, June 7, 1974.

87. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Hazard Boundary Map, Town of Skykomish, King County, Washington, Scale 1:6,000, February 14, 1975.

88. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Hazard Boundary Map, City of Snoqualmie, Washington, Scale 1:7,300, December 21, 1973.

89. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Hazard Boundary Map, City of Tukwila, Scale 1:12,000, May 24, 1974 (Revised September 13, 1977).

90. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Rate Map, City of Seattle, Washington, July 19, 1977.

91. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Rate Map, Town of Black Diamond, Washington, October 30, 1979.

92. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, City of Bothell, Washington, unpublished.

93. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, Town of Milton, Washington, February 17, 1982.

94. Federal Emergency Management Agency, Flood Insurance Study, King County and Incorporated Areas, revised September 29, 1989.

95. Northwest Hydraulic Consultants, Inc., Miller Creek Regional Stormwater Detention Facilities Design Hydrologic Modeling, Report for King County Division of Surface Water Management, Seattle, Washington, November 1990.

96. U.S. Environmental Protection Agency, Hydrologic Simulation Program – FORTRAN (HSPF), USEPA Environmental Research Laboratory, Athens, Georgia, 1988.

97. U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water-Surface Profiles Generalized Computer Program, Davis, California, September 1990.

98. U.S. Department of the Interior, Geological Survey, Roughness Characteristics of Natural Channels, U.S. Geological Survey Water Supply Paper 1849, Denver, Colorado, 1987.

99. Chow, V.T., Open-Channel Hydraulics, McGraw-Hill Book Company, Inc., New York, 1959.

100. Harper Righellis, Inc., King County Flood Boundary Work Map, Scale 1:2,400, Contour Interval 2 feet, December 20, 1993.

101. Hugh G. Goldsmith & Associates, Inc., Klahanie South Final Master Drainage Plan Update, prepared for Lowe Enterprises Northwest, Inc., March 1992.

102. Dinacola, R.S., Characterization and Simulation of Rainfall-Runoff Relations for Headwater Basins in Western King and Snohomish Counties, Washington, U.S. Geological Survey, Water Resources Investigations Report 89-4052, Tacoma, Washington, 1990.

103. City of Issaquah, Draft Supplemental Environmental Impact Statement for the I-90 Corporate Center and Southeast 56th Street Road Improvements, December 1992.

104. U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center, HEC-2-Water-Surface Profiles, User's Manual, Davis, California, September 1990, Revised February 1991.

105. U.S. Department of the Interior, Geological Survey, Roughness Characteristics of Natural Channels, Water Supply Paper 1849, U.S. Geological Survey, Denver, Colorado, 1987, Williams, J.R., Pearson, H.E., and Wilson, J.D., Streamflow Statistics and Drainage-Basin Characteristics for the Puget Sound Regions, Washington, Volume II Eastern Puget Sound from Seattle to the Canadian Border, U.S. Geological Survey, Open-File Report 84-114-B, Tacoma, Washington, 1985.

106. U.S. Department of the Interior, Geological Survey, Guide for Selecting Manning's Roughness Coefficients for Natural Channels and Flood Plains, Water Supply Paper 2339, U.S. Government Printing Office, Washington, D.C., 1989.

107. Alpha Engineering Group, Inc., Avondale Road Improvement Project (Redmond City Limit to N.E. 132nd Street) Mitigation Plan for Floodplain Impacts, Report for King County Department of Public Works, Bothell, Washington, August 1992.

108. Entranco Engineers, Inc., Hydrologic Remodeling Report, Bear Creek, Report prepared for King County Surface Water Management Division, Bellevue, Washington, July 1993.

109. CH2M HILL, Supplemental Information for Request for Letter of Map Revision for Lower Bear Creek, in King County and the City of Redmond, Washington, submitted by the Washington Department of Transportation to King County Department of Public Works and City of Redmond Department of Public Works for their submittal to FEMA, Bellevue, Washington, August 1993.

110. Land Tech, Hydraulic Study, 100 Year Flood Elevations, Bear Creek, Hydraulic Analysis by G.R. Bob Parrott, Consulting Engineer, Topographic Survey by Jim Hart & Associates, 1986.

111. CH2M HILL, Analysis of Flood at Bear Creek Project 86-SD-25, Report to City of Redmond Public Works Department, Bellevue, Washington, July 1986.

112. CH2M HILL and Sajan, Inc., Hydraulic Report and Appendices A through F. SR 520, Old SR 901 Interchange to SR 202, Report for Washington State Department of Transportation, July 1993.

113. U.S. Department of the Interior, Geological Survey, Water Resources Data – Washington Water Year 1986, Water-Data Report WA-86-1, prepared by McGavock, E.H., Wiggins, W.D., Boucher, P.R., Blazs, R.L., Reed, L.L., and Smith, M.L., in cooperation with the State of Washington and other agencies, Water Resources Division, Pacific Northwest District, U.S. Geological Survey, Tacoma, Washington, 1988.

114. Chow, V.T., Open-Channel Hydraulics, McGraw-Hill Book Company, Inc., New York, 1959.

115. Montgomery Water Group, Inc., Letter of Map Revision for Lower Bear Creek at Redmond Town Center, City of Redmond, WA, Kirkland, Washington, July 1994, revised November 1994.

116. Montgomery Water Group, Inc., Redmond Town Center LOMR Supplemental Information, Report to City of Redmond Stormwater Division to satisfy the Appendix M requirements of the Community Development Guide, Kirkland, Washington, November 1994.

117. Montgomery Water Group, Inc., Letter of Map Revision and Conditional Letter of Map Revision for Lower Bear Creek at Redmond Town Center, City of Redmond, WA, Supplemental Information for City of Redmond Community Development Guide, Appendix M, Kirkland, Washington, November 1994, revised May 1994.

118. Federal Emergency Management Agency, Flood Insurance Study, Snohomish County, Washington and Incorporated Areas, Washington, D.C., November 8, 1999.

119. U.S. Environmental Protection Agency, Environmental Research Laboratory, Hydrologic Simulation Program-FORTRAN (HSPF); User's Manual for Release 8.0, EPA 600/3-84-066, Athens, Georgia, 1984.

120. City of Bothell, Department of Public Works, Topographic Map, Scale 1:4,800, Contour Interval 2 feet, Bothell, Washington, 1991.

121. Northwest Hydraulic Consultants, Inc., North Creek, Bothell, Washington, Limited Map Maintenance Study, Work Map, Scale 1:24,000, Contour Interval 2 feet, undated.

122. City of Bothell, Engineering Study, Horse Creek Drainage Area, May 1965.

123. Harper Righellis, Inc., King County Flood Boundary Work Map, Scale 1:2,400, Contour Interval 2 feet, October 17, 1996.

124. U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center, HEC-REGFRQ, Regional Frequency Computation, Computer Program, Davis, California, September 1989.

125. U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center, HEC-FFA, Flood Frequency Analysis, Computer Program, Version 3.1, Davis, California, February 1985.

126. Harper Righellis, Inc., King County Flood Boundary Work Map, Scale 1:2,400, Contour Interval 2 feet, March 31, 1997.

127. U.S. Department of the Army, Corps of Engineers, Seattle District, Draft Detailed Project Report and Environmental Assessment for the Snoqualmie River at Snoqualmie Flood Damage Reduction Study in King County, Washington, January 1999, (draft).

128. Harper Righellis, Inc., South Fork Snoqualmie River, Hydrology and Hydraulics Report, Prepared for King County, Surface Water Management Division, March 13, 1997.

129. Harper Houf Righellis Inc., Technical Support Data Notebook for the Cities of North Bend and Snoqualmie and King County, Washington, Upper Snoqualmie Flood Plain Flood Insurance Study, October 21, 2001.

130. URS Greiner Woodward Clyde, Tollgate Final Environmental Impact Statement Report, Vol. 1 and 2, June 1, 2000.

131. U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center, HEC-RAS, River Analysis System, Computer Program, Version 2.2, Davis California, September 1998.

132. Harper Houf Righellis Inc., Upper Snoqualmie Floodplain Flood Insurance Study Work Maps, Scale 1:2,400, October 2001.

133. U.S. Oceanic and Atmospheric Administration, National Geodetic Survey, Vertcon Conversion Program, Version 6.0.1, 2006.

134. Montgomery Water Group, Inc. Revisions to FEMA Flood Insurance Study, Issaquah Creek and East Fork Task 5 Memorandum – Hydrology Update to April 28, 2000, Memo to Kerry Ritland, City of Issaquah, May 24, 2001.

135. King County, City of Issaquah, and Washington State Department of Ecology, Issaquah Creek Basin Current/Future Condition and Source Identification Report, King County Surface Water Management Division Department of Public Works, City of Issaquah Department of Public Works, Washington State Department of Ecology Water Quality Financial Assistance Program. Seattle, Washington, October 1996.

136. U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center, FEC-FFA Version 3.1. Davis, California, February 1995.

137. U.S. Department of the Interior, Office of Water Data Coordination, Geological Survey, Guidelines for Determining flood Flow Frequency Bulletin 17 B, Revised September 1981.

138. U.S. Department of the Interior, Geological Survey, Magnitude and Frequency of Floods in Washington. Water-Resources Investigations Report 97-4277, 1998.

139. Montgomery Water Group, Inc., Issaquah Creek FIS Revisions-Lower Mainstem Overflow Analysis Summary, Update to April 20, 2001 Memo to Kerry Ritland, City of Issaquah, May 24, 2001.

140. U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center. HEC-RAS, Version 3.0.1, Davis, California, March 2001.

141. Montgomery Water Group, Inc., Bridge and Channel Improvements and Status Update, March 20, 2001.

142. Montgomery Water Group, Inc., Issaquah Creek FIS revisions Draft Work Maps, Scale 1:4,800, August 2001.

143. Hydrologic Engineer Center (HEC), April 2004. HEC-RAS River Analysis System Computer Program, version 3.1.2.

144. U.S. Department of the Army, Corps of Engineers, 2004. Cedar River at Renton Flood Damage Reduction Operation and Maintenance Manual: Cedar River Section 205 (Renton, Washington).

145. King County, March 2000. Memorandum re: Flood Frequency Curve for Year 2000 Floodplain Mapping on the Cedar River. David Hartley, Senior Watershed Hydrologist.

146. U.S. Department of the Army, Corps of Engineers, June 1997. Final Detailed Project Report and Environmental Impact Statement: Cedar River Section 205 (Renton, Washington).

147. U.S. Department of the Interior, Geological Survey, 1987, Roughness Characteristics of Natural Channels, U.S. Geological Survey Water Supply Paper 1849, USGS, Denver, Colorado.

148. U.S. Department of Agriculture, Soil Conservation Service, Flood Hazard Analyses, Tolt River, King County, Washington.

149. U.S. Department of the Interior, Geological Survey, 7.5-Minute Series Topographic Maps, Scale 1:24,000, Contour Interval 20 feet, Bothell, Washington, 1953 (Photorevised 1981); Kirkland, Washington, 1950 (Photorevised 1968 and 1973).

150. U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center, HEC-DSS, User's Guide and Utility Manuals, User's Manual, Davis, California, October 1994.

151. U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center, STATS, Statistical Analysis of Time-Series Data, Computer Program, Davis, California, May 1997.

152. U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center, STATS, Statistical Analysis of Time-Series Data, Input Description, Davis, California, May 1987.

153. U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center, HEC-FFA, Flood Frequency Analysis, User's Manual, Davis, California, May 1992.

154. U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center, Regional Frequency, User's Manual, Davis, California, July 1972.

155. U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center, UNET, One-Dimensional Unsteady Flow Through a Full Network of Open Channels, Computer Program, Version 3.2.0, Davis, California, August 1997.

156. U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center, HEC-RAS, River Analysis System, User's Manual, Version 2.0, Davis, California, April 1997.

157. U.S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-RAS, River Analysis System, Hydraulic Reference Manual, Version 2.0, Davis, California, April 1997.

158. U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center, HEC-RAS, River Analysis System, Application's Guide, Version 2.0, Davis, California, April 1997.

159. King County, Surface Water Management Division, Basin Planning Program Sediment Transport Along the South Fork and Mainstem of the Snoqualmie River, June 1991.

160. Converse Consultants, NW, Report on Geotechnical Services, Snoqualmie Falls Hydroelectric Project, Snoqualmie, Washington, Prepared for Puget Sound Power and Light Company, October 1991.

161. Horton Dennis and Associates, Inc., South Fork Snoqualmie River, Aerial Mapping and Flood Plain Analysis, King County Surface Water Management, Harper Righellis, Inc., Temporary Benchmarks, August 1995.

162. Northwest Hydraulics, Inc., Snoqualmie River Flood Control Project, Pre-Feasibility Investigation Final Report, Prepared for King County, Surface Water Management Division, March 1996.

163. King County, Surface Water Management Division, Environmental Assessment, Reif Road Project, FEMA DR-833-WA, May 24, 1996.

164. King County, Department of Public Works, Surface Water Management Division, River Management Section, Reif Road Flood Hazard Reduction Project, Design Report, Draft, July 31, 1995.

165. King County, Engineering Department, Flood Control Division, Snoqualmie River Valley Topography, Scale 1:2,400, Contour Interval 5 feet, December 1961.

166. U.S. Geological Survey, North Bend, Washington 7.5-Minute Quadrangle Map, Scale 1:24,000, Contour Interval 40 feet, 1993.

167. U.S. Department of the Interior, Geological Survey, Snoqualmie, Washington 7.5-Minute Quadrangle Map, Scale 1:24,000, Contour Interval 20 feet, 1953, Photorevised 1968.

168. Montgomery Water Group, Inc., Preliminary Review Draft, Tollgate EIS, Hydraulics Model Study of South Fork Snoqualmie River and Gardiner Creek, September 1997.

169. Montgomery Water Group, Inc., Appendix, Hydraulic Modeling Analysis of South Fork Snoqualmie River and Gardiner Creek, Tollgate Preliminary Draft EIS, December 1997.

170. Montgomery Water Group, Inc., Middle Fork Snoqualmie River Overflow Work Map, November 1997.

171. King County, Surface Management Division, Preliminary Work Maps for Middle Fork Snoqualmie River, Prepared by Harper Righellis, Inc.

172. U.S. Department of the Army, Corps of Engineers, Seattle District, Snoqualmie River Flood Insurance Study Drawings, 1971.

173. City of Issaquah. 2000. City of Issaquah Comprehensive Plan. Adopted 1995 and amended in 2000. City of Issaquah Planning Department, Issaquah, Washington.

174. Federal Emergency Management Agency. September 29, 1989. Flood Insurance Study for King County, Washington and Incorporated Areas. FEMA Region X.

175. King County and Issaquah/East Lake Sammamish Watershed Management Committee. December 1996. Final Issaquah Creek Basin and Nonpoint Action Plan. King County Department of Natural Resources, Seattle, Washington.

176. Montgomery Water Group, Inc. September 25, 2001. FEMA FIS Elevation and Discharge Comparison Memorandum.

177. Montgomery Water Group. April 30, 1996. Preliminary Hydraulic Modeling Analysis of Issaquah Creek for Proposed Basin Flood Control Program. Prepared for RH2 Engineering, Inc., and City of Issaquah Public Works Department. Kirkland, Washington.

178. Montgomery Water Group, Inc. (2003). "Kelsey Creek Center Redevelopment at Kelsey Creek Center". LOMR Case No. 03-10-0399P. Prepared for Franklin West L.P. November 5.

179. Federal Emergency Management Agency (1995) "Flood Insurance Study of King County and Unincorporated Areas"

180. Northwest Hydraulic Consultants, Inc., (2002). "Hydrologic Study of Kelsey Creek Basin". Prepared for City of Bellevue Utility Department. December.

181. U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center. (2004) Corpscon, Version 6.0.1.

182. U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center. (2005) HEC-RAS River Analysis System Computer Program, Version 3.1.3.

183. U.S. Census Bureau, State and County Quickfacts, 2010 Population for King County, Washington. Retrieved August 9, 2012, from http://quickfacts.census.gov.

184. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Rate Map, Town of Blac Washington, October 30, 1979.

185. Delft University of Technology. 2004. SWAN User Manual. Delft University of Technology: Department of Civil Engineering. Delft, The Netherlands.

186. U.S. Army Corps of Engineers (2004). Mud Mountain Dam Water Control Manual. Seattle, Washington.

187. West Consultants, (2004). Sammamish River Transition Zone Hydrologic and Hydraulic Investigation, report prepared for King County Department of Natural Resources and Parks, Water and Land Resources Division.

188. HEC (Hydrologic Engineering Center), (2008). HEC-RAS, Version 4.0 [Computer Program], Davis, CA

189. U.S. Geological Survey, Peak Stream for the Nation, USGS 12125200 Sammamish River near Woodinville, Washington. Retrieved August 15, 2012 from http://nwis.waterdata.usgs.gov/nwis.

190. Federal Emergency Management Agency, Flood Insurance Study, Guidelines and Specifications for Flood Hazard Mapping Partners (2003).

191. U.S. Army Corps of Engineers, Guidelines for Identifying Coastal High Hazard Zones, Galveston District, Galveston, Texas, June 1975.

192. 3Di, Inc., Topographic Data, Contour Interval 2 feet, March 19, 2010.

193. ENTRANCO, Draft Thornton Creek Hydrologic and Hydraulic Modeling: Hydrologic and Hydraulic Model Plan, 2000.

194. Northwest Hydraulic Consultants, Inc., Flood Insurance Study for North Branch Thornton Creek – Ronald Bog to Interstate 5, Shoreline, WA. Prepared for the City of Shoreline, WA, 2009.

195. Northwest Hydraulic Consultants, Inc., Flood Insurance Study for Thornton Creek and its Tributaries – Lake Washington to Interstate 5. Prepared for Seattle Public Utilities, Drainage & Wastewater Division, Seattle, WA, 2010.

196. Northwest Hydraulic Consultants, Kramer Creek HSPF Modeling and Calibration and XP-SWMM Updates, Technical Memorandum, 2006.

197. Ritchie, Andy, Meadowbrook Flood – 3 December 2007 [Online Photo Album], Seattle, WA. Retrieved 2007 from http://picasaweb.google.com/andy.ritchie/MeadowbrookFlood3December2007.

198. Tetra-Tech/KCM, Inc., Thornton Creek and West Lake Washington Basins Characterization Report, 2004.

199. US Army Corps of Engineers, Northwestern Division, Dataquery. Retrieved 2009 from http://www.nwd-wc.usace.army.mil/perl/dataquery.pl.

200. U.S. Environmental Protection Agency, BASINS (Better Assessment Science Integrating point & Non-point Sources), Retrieved from http://www.epa.gov/waterscience/basins/bsnsdocs.html#hspf.

10.0 REVISION DESCRIPTIONS

This section has been added to provide information regarding significant revisions made since the original Flood Insurance Study was printed. Future revisions may be made that do not result in the republishing of the Flood Insurance Study report. To assure that any user is aware of all revisions, it is advisable to contact the community repository of flood hazard data located at the Department of Land and Water Resources, 201 South Jackson Street, Suite 600, Seattle, Washington 98104-3855 and at the Department and Environmental Services, 900 Oaksdale Avenue Southwest, Renton, Washington 98057.

10.1 First Revision

The purpose of this revision is to update the corporate limits of the City of Bothell and to add floodplain information for Miller Creek that affects the unincorporated areas of King County, Washington (Reference 94), and then incorporated Cities of Normandy Park (Reference 11) and SeaTac. Approximately 4 miles of Miller Creek were studied by detailed methods. The revised floodplain along North Creek shown within the City of Bothell is for information only.
For flood insurance purposes, refer to the separately published Flood Insurance Rate Map. Detailed information regarding this revision is presented throughout the main body of this FIS report.

The information for this restudy of Miller Creek supersedes the data presented in the previous Flood Insurance Study for King County, dated September 29, 1989 (Reference 94). The discharges used in this study of Miller Creek were revised to account for the effects of urbanization and operations of the newly constructed Lake Reba Detention Pond. This restudy was completed in September 1991.

10.2 Second Revision

This study was revised on May 16, 1995, to incorporate the results of an analysis of existing hydraulic studies that was performed for the Snoqualmie River in the vicinity of the City of Snoqualmie. The analysis was performed by nhc, the study contractor, for FEMA under Contract No. EMW-90-L-3134, as part of its Limited Map Maintenance Program, (LMMP).

In addition to the analysis for existing hydraulic studies that was performed for the Snoqualmie River, this revision also identifies that the mapping for King County has been prepared using digital data. Previously published Flood Insurance Rate Map data produced manually have been converted to vector digital data by a digitizing process. These vector data

were fit to raster digital images of the USGS quadrangle maps of the county area to provide horizontal positioning.

Road, highway names, and centerline data have been obtained from an enhanced TIGER (Topologically Integrated Geographic Encoding and Referencing) File, obtained through the King County Computer and Communications Services Division. For county areas outside of the City of Seattle, the centerlines were modified to the positional accuracy of the USGS quadrangle maps, and the roads, highways, and street names, if needed, were taken from the Flood Insurance Rate Map panels, where appropriate. The adjusted centerline data were then computer plotted with the digitized floodplain data to produce the countywide Digital Flood Insurance Rate Map panels.

Several additional incorporated areas have been identified in this update. They are the Cities of Algona, Burien, Bothell, Federal Way, Hunts Point, Medina, Mercer Island, Woodinville, and Yarrow Point and the Town of Clyde Hill and Beaux Arts Village.

The LOMR issued on December 18, 1990, for the City of North Bend, to show the effects of more detailed hydrologic/hydraulic information along the Snoqualmie River, was included in this update. As a result of more detailed hydrologic/hydraulic information, the floodway was revised along the Snoqualmie River throughout the corporate limits of the City of North Bend.

The LOMR issued on May 13, 1992, for the unincorporated areas of King County, to show the effects of more detailed topographic information adjacent to the Sammamish River, was included in this update. As a result of the more detailed topographic information, the 1-percent-annual-chance floodplain boundary was revised to exclude the K & S Business Park from the 1-percent-annual-chance floodplain.

The LOMRs issued on April 28, 1994, for the City of Redmond and the unincorporated areas of King County, to show the effects of more detailed hydrologic/hydraulic information along Bear Creek, were included in this update. As a result of the more detailed hydrologic/hydraulic information, the Flood Insurance Rate Map was revised to modify elevations, floodplain and floodway boundary delineations, and zone designations along Bear Creek from its confluence with the Sammamish River to State Highway 202 (Redmond Way). In addition, a Flood Profile Panel was included for the Bear Creek Overflow Channel.

10.3 Third Revision

This study was revised on May 20, 1996, to incorporate the results of detailed hydrologic and hydraulic analyses of the Raging River affecting King County, Washington. The revised analyses for the reach of the Raging River from its confluence with the Snoqualmie River to approximately 0.6 mile upstream of Interstate Highway 90 (I-90) (downstream reach) were performed by Harper Righellis, Inc., Portland, Oregon, for the King County Surface Water Management Division. The revised analyses for the reach from approximately 0.6 mile upstream of I-90 to approximately 0.3 mile upstream of the second Upper Preston Road bridge (upstream reach) were performed by FEMA. This work was completed in March 1995. Detailed information regarding this revision is presented throughout the main body of this FIS report.

10.4 Fourth Revision

This study was revised on March 30, 1998, to incorporate the results of detailed hydrologic and hydraulic analyses of North Fork Issaquah Creek in the City of Issaquah, Bear and Evans Creeks in the City of Redmond, South Fork Skykomish River in the Town of Skykomish and the unincorporated areas of King County, and the Middle and North Fork Snoqualmie Rivers in the unincorporated areas of King County.
This study also incorporates the results of an approximate analysis of Tate Creek in the unincorporated areas of King County. Detailed information regarding this revision is presented throughout the main body of this FIS report.

10.5 Fifth Revision

This study was revised on November 8, 1999, to incorporate the Flood Insurance Study information and data for the City of Bothell into the Flood Insurance Study report for King County, Washington and Incorporated Areas. The City of Bothell is located in the Puget Sound region of northwestern Washington, approximately 3.5 miles northeast of the City of Seattle. The City of Bothell is a bi-county community within King and Snohomish Counties. Because the Flood Insurance Rate Map and Flood Insurance Study report for Snohomish County, Washington and Incorporated Areas is being published in a countywide format (Reference 118), the portions of the City of Bothell that lie within King County are included on the Flood Insurance Rate Map for King County, and the portions of the City of Bothell that lie within King County are included on the Flood Insurance Rate Map for King County, and the portions of the City of Bothell that lie within Snohomish County are included on the Flood Insurance Rate Map for Snohomish County. Detailed information

regarding this revision is presented throughout the main body of this FIS report.

This study has also been revised to incorporate Letters of Map Revision (LOMRs) issued on March 3, 1995 (Case Nos. 94-10-053P and 94-10-067P), and July 5, 1995 (Case No. 95-10-41P). The March 3, 1995, LOMR revised Flood Insurance Rate Map Panel 0007 C, dated March 2, 1994, to show the effects of a private flood protection system along North Creek from just upstream of I-405 to just downstream of Monte Ville Parkway.

10.6 Sixth Revision

This study was revised on December 6, 2001, to incorporate the results of detailed hydrologic and hydraulic analyses of the Tolt River in the Town of Carnation and the unincorporated areas of King County; and the South Fork Snoqualmie River from I-90 to approximately 4,000 feet upstream of 468th Avenue. Detailed information regarding this revision is presented throughout the main body of this FIS report.

The restudy for the South Fork Snoqualmie River covers the mainstem of the Snoqualmie River from Meadowbrook Bridge to the confluence of the Middle and South Fork.

The hydraulic analysis of the South Fork Snoqualmie River upstream of I-90 was initially performed by Harper Righellis, Inc., Portland, Oregon, for the King County Surface Water Management Division. The data prepared by Harper Righellis were incorporated into the analysis performed by the USACE and revised where necessary.

The USACE restudy was requested because the USACE, Seattle District, determined that the levees on the South Fork do not meet FEMA's current standards for providing protection from the 1-percent-annual-chance flood.

10.7 Seventh Revision

This FIS was revised on April 19, 2005, to incorporate the results of revised hydraulic analysis of Snoqualmie River main stem, South Fork and Middle Fork of the Snoqualmie River, performed by Harper Houf Righellis Inc., completed in October 2001. This revision affects the Cities of North Bend and Snoqualmie, and the unincorporated areas of King County, Washington.

In addition, this revision will incorporate the results of a revised hydrologic and hydraulic analysis of Issaquah Creek, East Fork Issaquah

Creek, and Gilman Boulevard Overflow of Issaquah Creek, performed by Montgomery Water Group Inc., completed in August 2001. This revision affects the City of Issaquah, and the unincorporated areas of King County, Washington.

This revision will incorporate the results of a revised hydraulic analysis of Tibbetts Creek performed by Concept Engineering, Inc. This revision affects the City of Issaquah, and the unincorporated areas of King County, Washington. Detailed information regarding this revision is presented throughout the main body of this FIS report.

Tibbetts Creek LOMR

The LOMR issued on February 23, 2005, for the City of Issaquah and the unincorporated areas of King County, to show the hydraulic effects of the channel relocation and fill along Tibbetts Creek, was included in this update. As a result of the channel relocation, fill and more detailed topographic information, the Flood Insurance Rate Map, Flood profiles, and Floodway Data tables were revised to modify elevations, floodway data, and floodplain and floodway boundary delineations along Tibbetts Creek from approximately 150 feet upstream of I-90 (eastbound) to approximately 700 feet downstream of Newport Way Northwest.

10.8 Eighth Revision

This FIS was revised on {date to be determined}, to incorporate the results of revised hydraulic analysis of Cedar River, Paterson Creek, Snoqualmie River, and Springbrook Creek.

In addition, this revision converts all NGVD29 elevations to NAVD88. All elevations shown on the Flood Insurance Rate Map, Flood Profiles, and Floodway Data tables are referenced to NAVD88. Refer to section 3.3 Vertical Datum for a more detailed explanation of the datum conversion including datum conversion factors used for King County.

Cedar River Study - The purpose of this revision is to prepare a flood study of Cedar River. The revised floodplain and floodway maps will reflect the current hydraulic and hydrologic conditions of the rivers and will replace the effective maps which were prepared prior to the 1980s.

The hydrologic and hydraulic analyses for this study were prepared by nhc for the City of Renton. Agencies contacted for information relevant to this study included: the City of Renton, King County Department of Natural Resources-Water and Land Resources Division, and the United States Army Corps of Engineers-Seattle District (USACE).

This report describes an investigation of riverine flooding along the Cedar River within the city of Renton, Washington. The study reach begins at the river outlet at Lake Washington and extends 5.36 miles upstream to the Renton City Limits at 149th Avenue Southeast and extends to Landsburg Road crossing in the unincorporated area of the King County. The purpose of this study is to update the existing FEMA Flood Insurance Study (FIS) for King County, Washington and Incorporated Areas (FEMA, November 1999*)* to reflect current hydraulic conditions along the Cedar River using higher revised peak discharges and updated geometry

Kelsey Creek - The upstream limit of the Kelsey Creek study reach begins just upstream of the culvert crossing of NE 6th Street, west of 148th Avenue NE at Cross Section AQ. The floodplain both upstream and downstream of this crossing consists of a wide, undeveloped wetland area. Floodplain widths range from approximately 200 to 600 feet Downstream, Kelsey Creek crosses NE 8th Street through a culvert into Kelsey Creek Regional Pond 133, located northeast of the corner of 148th Avenue NE and NE 8th Street. Pond elevation and discharge are controlled by a weir/culvert structure located just downstream of Cross Section AO. Overtopping of the control structure is not expected during the 1-percent-annual-chance event, and the floodplain is confined to the vegetated corridor both upstream and downstream. Downstream, the floodplain remains within the channel corridor with widths varying from 30 to 65 ft. Flooding of low-lying areas of a few residential parcels upstream of the 148th Avenue NE culverts is expected, but water levels do not reach buildings or other structures. Overtopping the 148th Avenue NE roadway is not expected as it is substantially elevated.

Downstream of the 148th Avenue NE culverts, Kelsey Creek enters a steep, forested ravine-like corridor. Flooding is contained within the banks of the narrow channel with widths varying from 15 to 45 feet. This reach continues downstream for approximately 0.5 mile until it encounters a series of culverts at the Illahee Apartment Complex. Here, backwater caused by the driveway embankment and culvert group is expected to flood the floor level units on the right bank. Downstream of the Illahee Apartments to 140th Avenue NE, flooding is contained within the vegetated channel corridor. The confluence with the first major tributary to Kelsey Creek is Valley Creek. Overtopping of the 140th Avenue NE Bridge is not expected.

Downstream of 140th Avenue NE, Kelsey Creek flows adjacent to Bel-Red Road and commercial properties. Along this reach the stream is confined within a channelized corridor and is crossed by several driveway bridges. These bridges are elevated well above the computed 1-percent-

annual-chance flood profile, thus they have no impact on flood levels. Floodplain widths range from 15 to 55 feet.

The Kelsey Creek diverges from Bel-Red Road, turns southwesterly, and enters a reach surrounded by office and apartment buildings. Several bridges and culverts located along the reach adequately convey flow with the exception of the office park driveway bridge; overtopping of this structure is expected during the 1-percent-annual-chance event. Flood levels are not expected to encroach on any structures in this reach as the floodplain remains relatively confined to the channel corridor with widths varying from 15 to 45 feet.

Continuing downstream, Kelsey Creek meanders through a winding, but still entrenched, vegetated corridor, flanked by residential parcels. The floodplain remains confined to the corridor with widths varying from 15 to 70 feet. Upstream of the NE 8th Street culvert, the floodplain expands over the right bank to inundate an adjacent pond area. Floodplain widths in this short reach range from 60 to 200 ft; however, nearby residential structures remain outside the inundation limits.

A grade control structure consisting of a series of concrete weirs is located immediately upstream of the NE 8th Street culvert (near 132nd Av NE). At this structure it was assumed flow would transition from sub-critical to super-critical, thus be critical, at the upstream crest of the structure.

Downstream of NE 8th Street, Kelsey Creek enters the Glendale Golf Course. Along the first 0.6 miles of this reach the channel is steep and entrenched. Several small pedestrian bridges cross the stream, but most are elevated above the computed flood profile thus they generally have no significant impact. In addition, there are several groups of concrete grade control structures located in the channel; these structures were modeled as inline weirs in the HEC-RAS model. Flooding along the Kelsey Creek golf course reach remains confined within the channel until where overtopping into the left bank floodplain begins as the channel gradient lessens and the channel becomes less entrenched. The floodplain expands over both the left and right banks with a floodplain width of approximately 200 feet.

Downstream of the Glendale Golf Course, Kelsey Creek enters the City of Bellevue's Kelsey Creek Park. Here, the floodplain abruptly transitions from well manicured fairways to a densely vegetated channel corridor. Furthermore, the right floodplain of Kelsey Creek is confined and divided by a pathway and earthen embankment structure from the adjacent swale to the west. As discussed in the previous sections, because these structures are not certified by FEMA, they were not considered to provide flood protection. As a result, it is assumed the embankment does not exist and thus have allowed water to overtop the natural right bank of Kelsey Creek,

via lateral weirs, into the adjacent swale to the west. A separate flood profile was computed along the length of the swale feature. In addition, the area in between the swale and main channel of Kelsey Creek was designated as Zone X, because: 1) flooding depth is expected to be less than 1 foot; and 2) accurate BFE's could not be defined due to two-dimensional flow in the area.

Beyond the park, Kelsey Creek flows into an expansive wetland area that is confined by the Lake Hills Connector roadway embankment along the south and west boundaries. The confluence with the West Tributary is located about half way into the wetland, and the confluence with Richards Creek occurs further downstream near. Flooding in this area is primarily controlled by a series of culvert/roadway embankments at the Lake Hills Connector and 121st Avenue SE. Overtopping is not expected along 121st Avenue SE or the southbound lanes of the Lake Hills Connector, but floodwaters are expected to overtop the northbound lanes of the Lake Hills Connector. The BFE of floodwaters upstream of the Lake Hills Connector are nearly constant at an elevation of approximately 32.5 ft, NAVD 88. At this elevation, overflow of SE 7th Place (north and east of Lake Hills Connector) into a wetland area to the north of SE 7th Place is expected, but does not contribute conveyance area to the system.

Shallow flooding of the northbound lanes of the Lake Hills Connector may also occur along the left bank. At the 1-percent-annual-chance level, flooding over the Lake Hills Connector may be on the order of 1 foot deep and overtopping flows will likely discharge over the roadway to the southwest into Richards Creek. A preliminary HEC-RAS model included lateral weirs to route flow into Richards Creek, but the resulting flow depths were not significantly changed. To accurately define the 1-percent-annual-chance hazard area and BFEs over this portion of the Lake Hills Connector, the effective FIS of Richards Creek, i.e. hydraulic model, may need to be reevaluated. At this time the 1-percent-annual-chance flood hazard area over the Lake Hills Connector has been designated a shaded Zone X (shallow flooding).

Downstream of the southbound lanes of Lake Hills Connector, flooding is confined to the wide, wetland corridor, with widths ranging from 200 to 740 f1. Further downstream, at the 121st Avenue SE culverts, Kelsey Creek again becomes entrenched. Flooding here is confined to a vegetated corridor as it passes under the Wilburton Railroad Trestle and finally to the I-405 culverts. Flooding on the order of 12 feet deep is computed upstream of the I-405 culvert, but is well confined by the elevated freeway and adjacent hillsides.

West Tributary of Kelsey Creek - The West Tributary study reach begins at the northernmost boundary of the Glendale Golf Course. Minor flooding of the left and right bank floodplains occurs along the upper

reach, but downstream of the flow expands significantly with widths up to 430 f1. Several small bridges located in the golf course reach of the West Tributary obstruct flow and thus contribute to flooding.

Downstream of the golf course, the West Tributary enters Kelsey Creek Park. Flooding in the upper portion of the park is related to the constriction caused by the north parking lot and bridge. Here, flooding is generally contained within the wetland to the north of the parking lot, but some shallow flooding of the lot itself is expected. Downstream of the parking lot, the West Tributary splits with a channel to the west, and a swale-like feature that flows directly south. Although at the l-percent-annual-chance level the area between the channels is expected to remain dry, it was modeled as single reach because the cross section density and orientations were sufficient to compute reasonable profiles.

Further downstream, the West Tributary crosses two pedestrian bridges and elevated pathways. Flood levels in this portion of the park are generally controlled by these structures with a uniform floodplain width of approximately 300 feet.

Downstream of Kelsey Creek Park, the West Tributary flows through a densely vegetated corridor and into the wetland and finally joins the main stem of Kelsey Creek. Flow in this area is likely very two-dimensional as the West Tributary expands overbank into the wetland.

The 1-percent-annual-chance floodway boundaries developed in this study were determined with the HEC-RAS model, with the general assumption of equal conveyance reduction from each side of the floodplain (HEC-RAS method 4). At a few locations, applying the automatic encroachment feature available in HEC-RAS produced flood elevation increases greater than 1 foot and resulted in an unusual floodway shape. As a result, the encroachments were manually adjusted (HEC-RAS method 1) until a reasonable floodway was established. At many cross sections the floodway boundaries coincide with the top of the channel banks, yet a 1-foot rise is not achieved at these sections. As required by FEMA, the floodway cannot encroach into the active channel; therefore, the rise is limited to something less than 1 foot. However, for mapping purposes, in locations where the floodplain is contained within the active channel banks the floodway is coincident with the floodplain boundary.

Floodway widths were computed at each cross section. Between sections, the floodway boundaries were estimated by first attempting to maintain a relatively uniform width, then adjusting the boundaries to include or exclude topographic features that have a significant effect on flow conveyance.

Patterson Creek - The purpose of this revision is to prepare a flood study of Patterson Creek. The revised floodplain and floodway maps will reflect the current hydraulic and hydrologic conditions of the rivers and will replace the effective maps which were prepared prior to the 1980s.

This study was completed by nhc under contract to King County Department of Natural Resources and Parks (KCDNRP). The County is a Cooperating Technical Partner (CTP) with the Federal Emergency Management Agency (FEMA) for purposes of conducting flood insurance studies. King County provided project management and technical review of all study products. The County also supplied relevant study data including hydrometric data for the Patterson Creek watershed and information on past watershed flooding.

Lower Snoqualmie River Study - The purpose of this revision is to update the lower Snoqualmie River. The revised floodplain and floodway maps will reflect the current hydraulic and hydrologic conditions of the rivers and will replace the effective maps which were prepared prior to the 1980s.

This study was completed for FEMA at the request of King County. The County served as Cooperating Technical Partners (CTP), providing relevant study data, first-hand information on the watersheds and associated flooding issues, and technical review of all study products. King County also served in the role of Project Manager and contracted with nhc to provide technical analyses for the FIS updates.

Springbrook Creek Study - The purpose of this revision is to update Spingbrook Creek between the Black River Pump Station (BRPS) and SW 43rd Street (also referred to as South 180th Street). The revised floodplain and floodway maps will reflect the current hydraulic and hydrologic conditions of the rivers and will replace the effective maps which were prepared prior to the 1980's.

The hydraulic and hydrologic analyses for this study were conducted following the approach described in an earlier memorandum by nhc. This approach was reviewed and approved by the FEMA Map Coordination Contractor in a letter to the City of Renton, dated September 25, 2002. Continuous hydrologic simulation modeling for a 53 year period of record (October 1, 1948 through September 30, 2002) was used to identify and adjust storm inflow hydrographs to Springbrook that correspond to recurrence intervals required for unsteady flow hydraulic modeling and subsequent floodplain mapping. Two types of potential flood generating peak events were identified for hydraulic analysis: a Storage Scenario, which includes events that produce very high water surface elevation at the Black River Pump Station due to pumping restrictions caused by high

flows in the Green River, and a Conveyance Scenario which includes events that exhibit maximum peak flows into the pump station forebay. This study was completed in June 2006.

Green River Study – The Green River floodplain was redelineated from Cross Section N through just upstream of Cross Section CE based on the Green River (Without Levee) regulatory base flood water surface elevations in the King County FIS. The without levee flood water surface elevations were compared to the surrounding topography assuming that levees and levee-type structures would not prohibit water from leaving the river channel. One exception was that the Tukwila 205 levee was considered to provide protection from flooding. Topography data from 2006 was used to perform the comparison. In locations where the 1- and 0.2-percent-annual-chance boundaries coincide, only the 1-percent-annual-chance boundary has been delineated on the maps. This includes nearly the entire overbank area where the 1- and 0.2-percent-annual-chance floodplains would coincide since maximum water levels in the levee failure scenarios are controlled by the latter half of the flow hydrograph (in the modeling, these areas take several days to reach equilibrium conditions) and flows for this portion of the 1- and 0.2-percent-annual-chance hydrographs for the Lower Green River are the same due to the regulation provided at the USACE's Howard A Hanson Dam. In general, the floodway was developed to coincide with the effective Green River floodway to the greatest extent possible. The HEC-RAS model was run to determine if the effective floodway could fully contain the 1-percent-annual-chance flood without causing surcharges in excess of 1 foot relative to the "fail all levee" condition. In areas where the 1-foot surcharge could not be achieved, the overbank portions of the floodway were delineated using the FLO-2D model. Encroachments in the overbank areas were manually defined until a reasonable floodway boundary was established.

Floodway widths were computed at each cross section in the HEC-RAS model and the delineation between sections was drawn based on topographic information. At some cross sections, the floodway boundary coincides with the top of the channel banks. The floodway does not encroach into the channel and the floodway along the certified levee near Southcenter (i.e. the Tukwila 205 Levee) was delineated along the landward toe of the levee fill. Floodway data is not provided for portions of the floodway that were analyzed using FLO-2D.

In locations where the floodway and the 1-percent-annual-chance floodplain boundary coincide, only the floodway boundary is shown on the map.

Middle Green River –A Regulatory Floodway was delineated for the Middle Green River using the HEC-RAS model. In general, the floodway was developed using Encroachment Method 4 in HEC-RAS. In locations where the floodway and the 1-percent-annual-chance floodplain boundary coincide, only the floodway boundary is shown on the maps.

Method 4 automatically computes encroachment stations by attempting to achieve a predefined surcharge (1 foot) while targeting an equal loss of conveyance on each overbank, if possible. At some locations, applying the automated encroachment computation produced surcharges significantly different from 1 foot and/or resulted in an unreasonable floodway shape. As a result, encroachments in some locations were manually adjusted using HEC-RAS Method 1 until a reasonable floodway boundary was established. At some cross sections, the floodway boundary coincides with the top of the channel banks and the floodway does not encroach into the active channel.

Floodway widths were computed at each cross section. Between sections, the floodway boundary was interpolated based on topographic information and to reflect assumed flood flow characteristics.

The Mill Creek floodway and storage floodway were preserved and shown on the map. Additionally, the floodway from the Springbrook Creek restudy was shown on the map. Otherwise, Green River floodplain inundation of the Mill and Springbrook Creeks floodplains was shown. The Green River floodplain was shown as an AE-Zone with BFEs.

10.9 Ninth Revision

This FIS was revised on **To Be Determined**, to incorporate the results of revised hydraulic analysis of Sammamish River, and White River and the coastal analysis from Puget Sound.

Puget Sound-The purpose of this project was to develop up-to-date and accurate coastal flood hazard analyses for incorporated areas of King County, Washington along the entire coastline of Puget Sound. This study was conducted using FEMA's Guidelines for Coastal Flood Hazard Analysis and Mapping for the Pacific Coast of the United States (Pacific Coast Guidelines (FEMA, 2005). As one of the first studies to use the new guidelines for the Pacific Coast, this project also serves as a case study for implementing the methods and recommendations outlined in the Pacific Coast Guidelines. The products of this study will be submitted to FEMA to be integrated into FEMA's County-wide DFIRM for King County.

Sammamish River-The purpose of this project was to prepare a flood study of the Sammamish River that can be submitted to FEMA to initiate

a revision to the published FIRMs and FIS for both Incorporated and Unincorporated Areas of King County in the State of Washington. The revised floodplain and floodway maps reflect the current hydraulic and hydrologic conditions of the Sammamish River and will replace the effective maps which were prepared in 1978.

White River - The purpose of this project was to prepare a flood study of the White River that can be submitted to FEMA to initiate a revision to the published FIRMs and FIS for Unincorporated Areas of King County in the State of Washington. The revised floodplain and floodway maps reflect the current hydraulic and hydrologic conditions of the White River and will replace the effective maps which were prepared in the 1980s.

10.10 Tenth Revision

This FIS was revised on **To Be Determined**, to incorporate the results of the hydraulic analysis of the Thornton Creek study.

Thornton Creek - This floodplain mapping study comprises an investigation of riverine flooding on Thornton Creek within the City of Seattle. This study was performed using detailed hydrologic and both detailed and approximate hydraulic methods approved by FEMA. The detailed study reach covers approximately 6.8 miles of Thornton Creek and its two principal tributaries, the North Branch and South Branch. Beginning at Thornton Creek's mouth at Matthews Beach Park on the shores of Lake Washington, the study reach is continuous through the North Branch upstream to its crossing of Interstate 5. The South Branch study reach begins at its confluence with the mainstem and continues upstream to 5th Avenue Northeast, near the Northgate Mall.

This study also includes the analysis of five tributaries to Thornton Creek using approximate methods. These five tributaries are Littlebrook, Willow, Victory, Kramer, and Maple Creeks. The study limit for Littlebrook, Willow, and Victory Creeks was approximately three-quarters of a mile. The study limit for Kramer Creek and Maple Creek was less than 600 feet.