MEMORANDUM

Project: Snohomish River FIS

Subject: Preliminary Review of FIS Impacts in French Slough Area

Date: June 29, 2007

To: Vaughn Collins, Snohomish County

From: Raymond Walton, Ph.D., P.E., D.WRE, WEST Consultants, Inc.

Introduction

Starting in June 2006, WEST Consultants, Inc. (WEST) attended a meeting at Snohomish County to discuss the French Slough Diking District's concerns about the elevation of the BFE in their area. At the meeting were people from the French Slough Flood Control District, FEMA, and Snohomish County staff. After the meeting, WEST conducted a thorough review of (1) the levee elevations along the French Slough and Marshlands reach of the Snohomish River (roughly River Miles RM 13-16.5), and (2) considered the Diking District's concern that some levees along the lower Pilchuck River should have been included in the FIS as they potentially represented a longer length of relatively lower levees for flood waters to exit the French Slough area (identified as "Fryelands" Storage Area "#1" in Figure 1; see also Figure 2). The original FIS study used the Corps of Engineers' one-dimensional unsteady hydraulic model, UNET (version 3.2), and modeled conveying reaches and "Storage Areas".

During this investigation, we discovered a "non-fatal" mistake in the calibration of the UNET hydraulic model to the November 1990 overbank flooding event, related to a levee elevation. After this was corrected and the models re-run, we concluded that adding some of the Lower Pilchuck River levees (Figure 2), to extend the levees bounding the French Slough storage area, would allow more flood waters to over flow back to the Snohomish River. The result of this was (1) the BFE in the French Slough storage area #1 would decrease from 32 ft to 31 ft NGVD, (2) and the BFEs in the adjacent reach of the Snohomish River would increase.

This memo documents the changes made to the effective FIS.

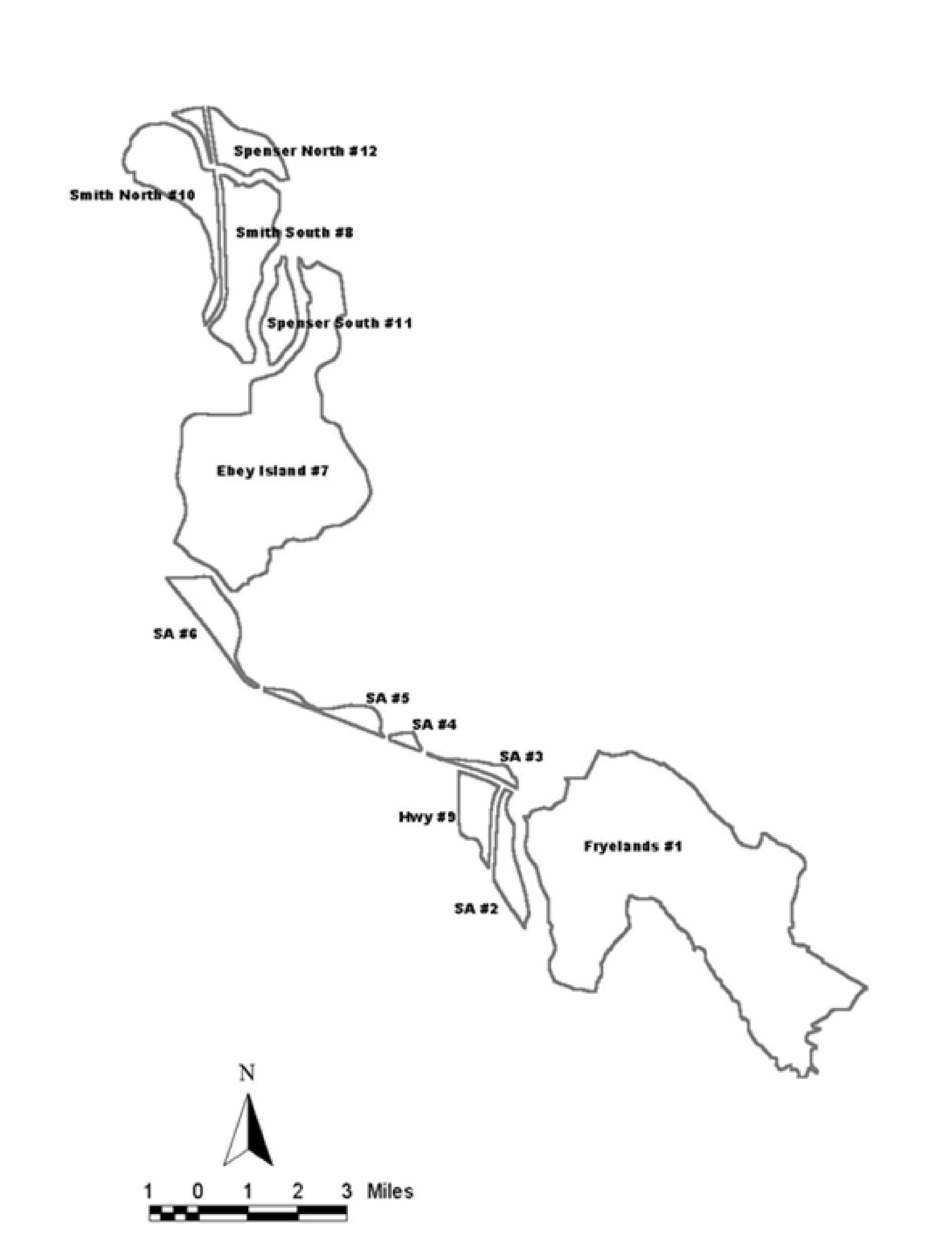

Figure 1. Storage Areas Used in Hydraulic Model

Figure 2. French Slough Area Showing Pilchuck Levee

Changes to the November 1990 UNET Model Calibration

When we reviewed the original UNET hydraulic model development, specifically the levee elevations along the French Slough and upper Marshlands reach of the Snohomish River (RM 13-16.5), we discovered a mistake in the model calibration. This had no effect on the final model results, as we will describe below. The "mistake" was an incorrect levee elevation along the French Slough portion of the Snohomish River levees, and was discovered when we compared the levee elevations in the UNET model with levee drawings from 1987 provided by Snohomish County. When the "mistake" was corrected, we re-examined the UNET model calibration to the November 1990 flood, which inundated both storage areas. The only additional model adjustment was to re-define the elevation at which the Marshlands levee would begin to breach. Figure 3 shows that the revised model actually results in an improved simulation of the timing and of the levee breach and shape of the hydrograph peak.

The reason that this "mistake" does not affect the original model study is that after the November 1990 flood, parts of the French Slough and Marshlands levees along the Snohomish River were modified. These modifications were reflected the effective FIS UNET model used to simulate the 10-through-500-year flows. No changes were made to model sections or hydraulic parameters.

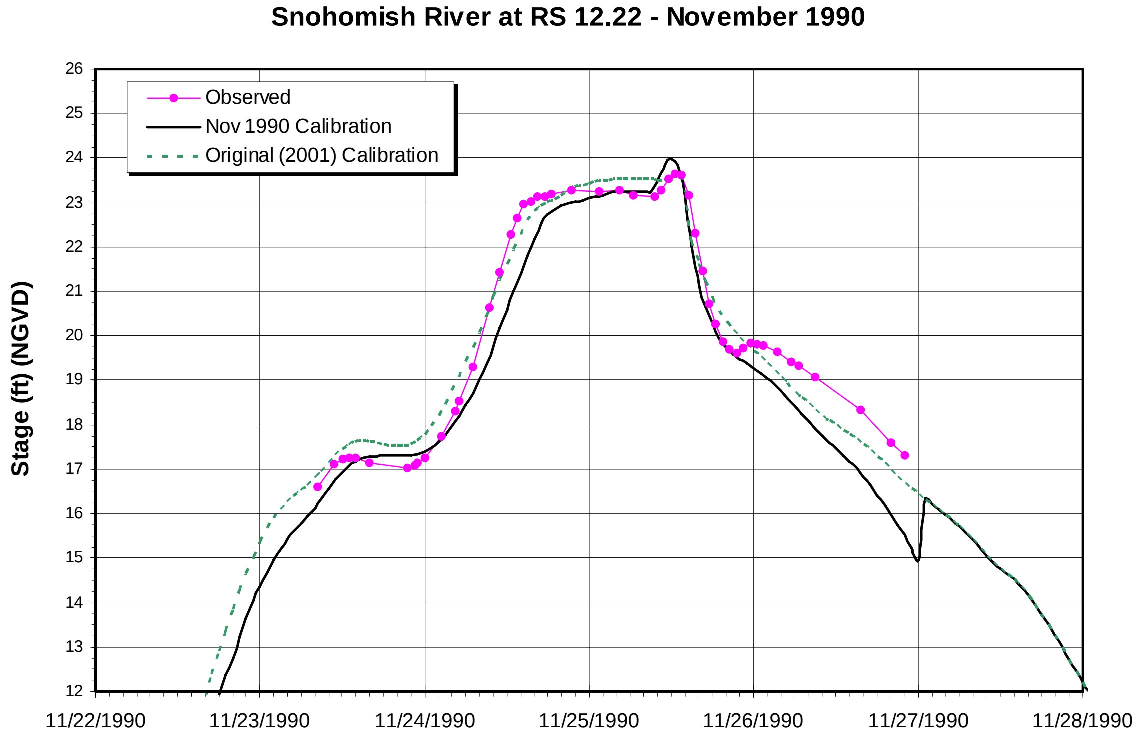

Figure 3. Re-calibration of November 1990 Flood

Changes to the Effective FIS Hydraulic Model

After the November 1990 flood, some modifications were made to the Marshland and French Slough levees along the Snohomish River. In 2000, Snohomish County surveyed the top-on-levees along the Snohomish River. As we compared the 2000 survey with the elevations in the effective UNET model, we did two things:

1. We refined the levee information in UNET, to improve the model representation of the French Slough and Marshland levees along the Snohomish River between RM 13.94-16.53
2. We added 4,200 feet of the Lower Pilchuck River levee (essentially the northwest boundary of French Slough, Figure 2), and connected French Slough ("Fryelands #1", Figure 1) to the Snohomish River at RM 13.6 and 13.2.

We then conducted a sensitivity analysis of including a portion of the lower Pilchuck River levee along the northwest side of the French Slough storage area. If the Lower Pilchuck levee is included in the model, the BFE in the French Slough storage area decreases from 32 ft to 31 ft NGVD, and there is an associated rise where the flow re-enters the Snohomish River over the Pilchuck levee. Snohomish County concluded that this would more appropriately model the dynamics of the interaction of French Slough and the Snohomish River.

If the Lower Pilchuck levees are included in the FIS hydraulic model, we propose that the BFE in Storage Area #1 be established at 31 ft NGVD (effective is 32 ft NGVD), and the BFE in Storage Area #3 (see Figure 1) be established at 27 ft NGVD (effective is 26 ft NGVD). The remaining Storage Areas would be not be altered. In addition, Table 1 shows the proposed changes of greater than 0.1 ft along the main stem of the Snohomish River. Other reaches would not be affected.

Table 1. Changes in BFE of Greater Than 0.1 ft

Snohomish River Station (RM)	Revised BFE (ft NGVD)	Revised Condition	Effective BFE (ft NGVD)	Effective Condition	Change in BFE (ft)
19.51	37.94	With levee	37.84	With levee	0.1
19.04	37.14	With levee	37.03	With levee	0.11
18.5	36.5	With levee	36.37	With levee	0.13
18.3	36.27	With levee	36.13	With levee	0.14
18.02	35.96	With levee	35.81	With levee	0.15
17.5	35.23	With levee	35.06	With levee	0.17
16.86	34.62	With levee	34.44	With levee	0.18
16.53	34.28	With levee	34.09	With levee	0.19
16.01	33.11	With levee	32.76	With levee	0.35
15.68	32.78	With levee	32.59	With levee	0.19
15.42	32.15	Without RL	32.11	With levee	0.04
15.2	31.87	Without RL	31.71	With levee	0.16
14.85	31.47	Without RL	31.4	With levee	0.07
14.57	31.25	Without RL	30.95	With levee	0.3
14.15	30.69	Without RL	30.57	Without RL	0.12
13.94	30.32	With levee	30.19	Without RL	0.13
13.6	30.33	With levee	29.74	With levee	0.59
13.303	30.21	With levee	29.44	With levee	0.77
13.302	30.13	With levee	29.41	With levee	0.72
13.301	30.12	With levee	29.41	With levee	0.71
13.3	30.2	With levee	29.41	With levee	0.79
13.2	30.13	With levee	29.27	With levee	0.86
13.003	29.7	With levee	28.49	With levee	1.21
13.002	29.58	With levee	28.47	With levee	1.11
13.001	29.56	With levee	28.47	With levee	1.09
13	29.68	With levee	28.47	With levee	1.21
12.703	27.57	With levee	27.01	With levee	0.56
12.702	27.11	With levee	27.01	With levee	0.1
12.701	27.14	With levee	27.01	With levee	0.13
12.7	27.66	With levee	27.01	With levee	0.65
12.69	27.56	With levee	26.91	With levee	0.65
12.23	25.51	With levee	25.26	With levee	0.25

12.229	25.43	With levee	25.26	With levee	0.17
12.223	25.39	With levee	25.26	With levee	0.13
12.222	25.5	With levee	25.26	With levee	0.24
12.119	25.52	With levee	25.26	With levee	0.26
12.017	25.51	With levee	25.24	With levee	0.27
11.915	25.47	With levee	25.2	With levee	0.27
11.813	25.36	With levee	25.09	With levee	0.27
11.711	25.25	With levee	24.98	With levee	0.27
11.608	25.1	With levee	24.83	With levee	0.27
11.506	24.9	With levee	24.64	With levee	0.26
11.404	24.65	With levee	24.39	With levee	0.26
11.302	24.24	With levee	23.99	With levee	0.25
11.208	23.65	With levee	23.46	With levee	0.19
11.114	23.23	With levee	23.07	With levee	0.16
11.02	22.86	With levee	22.71	With levee	0.15
10.988	22.81	With levee	22.66	With levee	0.15
10.882	22.54	With levee	22.4	With levee	0.14
10.776	22.25	With levee	22.12	With levee	0.13
10.67	22.05	With levee	21.92	With levee	0.13
10.565	21.94	With levee	21.81	With levee	0.13
10.459	21.88	With levee	21.74	With levee	0.14
10.353	21.76	With levee	21.63	With levee	0.13
10.247	21.68	With levee	21.54	With levee	0.14
10.141	21.53	With levee	21.4	With levee	0.13
10.035	21.4	With levee	21.27	With levee	0.13
9.93	21.31	With levee	21.17	With levee	0.14