

# **Technical Support Data Notebook**

For

**Snohomish County, Washington**

**City of Everett, City of Marysville, City of Snohomish, and Unincorporated Areas**

**Restudy Flood Insurance Study**

**Submitted by:**  
WEST Consultants, Inc.



**Date Submitted:**  
**April 30, 2001**

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## **Introduction**

This Technical Support Data Notebook (TSDN) was prepared by the Study Contractor (SC), WEST Consultants, Inc. (WEST), in concordance with the submittal requirements for a Federal Emergency Management Agency (FEMA) Flood Insurance Study (FIS). The TSDN specifications are detailed in the *Guidelines and Specifications for Study Contractors - FEMA 37*, Federal Emergency Management Agency, January 1995, and the supplemental *Guide for Preparing Technical Support Data Notebooks*, Federal Emergency Management Agency, Revised January 1990.

## **Section 1 - General Documentation**

### ***Special Problems Reports***

There were no special problems or issues encountered by WEST.

**Contact Reports (Telephone Conversations and E-mails)**

Study Contractor: WEST Consultants, Inc.			
<p><b>Contact (Telephone Conversation) Reports Index</b> City of Everett, City of Marysville, City of Snohomish, and Unincorporated Snohomish County, Washington FLOOD INSURANCE STUDY</p>			
<b>CR#</b>	<b>Contact Report Date</b>	<b>Firm/Agency</b>	<b>Subject</b>
1	Apr. 9 <sup>th</sup> , 2001	Larry Basich, FEMA	April 24 <sup>th</sup> review meeting
2	Mar. 22 <sup>th</sup> , 2001	Partick Massey, FEMA	Final meeting for floodway alternatives
3	Mar. 8 <sup>th</sup> , 2001	Larry Basich, FEMA	Floodway alternatives 5, 6 & 7
4	Feb. 28 <sup>th</sup> , 2001	Larry Basich, FEMA	Identifying Zone X on the work maps
5	Feb. 14 <sup>th</sup> , 2001	Larry Basich, FEMA	Tualip Landfill Site
6	Feb. 9 <sup>th</sup> , 2001	Larry Basich, FEMA	Floodway alternatives
7	Dec. 13 <sup>th</sup> , 2001	Mike Deering, Seattle Dist.	Digital base maps
8	Nov. 20 <sup>th</sup> , 2000	Larry Basich, FEMA	Regulatory floodway alternatives
9	Nov. 13 <sup>th</sup> , 2000	Larry Basich, FEMA	KCM/TetraTech wanting preliminary results
10	Oct. 19 <sup>th</sup> , 2000	Larry Basich, FEMA	KCM/TetraTech wanting preliminary results
11	Oct. 12 <sup>th</sup> , 2000	Mike Deering, Seattle Dist.	Snohomish base maps
12	Oct. 12 <sup>th</sup> , 2000	Larry Basich, FEMA	Floodway alternatives
13	Sept. 26 <sup>th</sup> , 2000	Larry Basich, FEMA	Snohomish base maps
14	Sept. 26 <sup>th</sup> , 2000	Wayne Wagner, Seattle Dist.	Snohomish base maps
15	June 6 <sup>th</sup> , 2000	Joe Weber, Seattle Dist.	Snohomish base maps
16	May 23 <sup>rd</sup> , 2000	Dan Harvey, Seattle Dist.	Snohomish base maps
17	May 22 <sup>nd</sup> , 2000	Vaughn Collins, Snoh. Co.	DEA survey
18	May 11 <sup>th</sup> , 2000	Vaughn Collins, Snoh. Co.	DEA survey
19	May 5 <sup>th</sup> , 2000	Dan Harvey, Seattle Dist.	Snohomish base maps
20	Apr. 11 <sup>th</sup> , 2000	Vaughn Collins, Snoh. Co.	Snohomish survey
21	Mar. 14 <sup>th</sup> , 2000	Luis Fuste, USGS	USGS gage data
22	Mar. 13 <sup>th</sup> , 2000	Vaughn Collins, Snoh. Co.	Snohomish survey
23	Mar. 2 <sup>nd</sup> , 2000	Vaughn Collins, Snoh. Co.	Gage data

24	Feb. 10 <sup>th</sup> , 2000	Dan Parket, EPA	Data request
25	Feb. 8 <sup>th</sup> , 2000	Joe Weber, Seattle Dist.	Tidal data
26	Feb. 8 <sup>th</sup> , 2000	Vaughn Collins, Snoh. Co.	Levee breach location
27	Jan. 24 <sup>th</sup> , 2000	Vaughn Collins, Snoh. Co.	Observed 1990 stage data
28	Jan. 4 <sup>th</sup> , 2000	Dan Harvey, Seattle Dist.	Snohomish survey
29	Dec. 30 <sup>th</sup> , 1999	Joe Weber, Seattle Dist.	1990 High water marks
30	Dec. 20 <sup>th</sup> , 1999	Joe Weber, Seattle Dist.	1990 High water marks
31	Nov. 30 <sup>th</sup> , 1999	Joe Weber, Seattle Dist.	1990 High water marks
32	Nov. 16 <sup>th</sup> , 1999	Vaughn Collins, Snoh. Co.	Levee profiles
33	Oct. 13 <sup>th</sup> , 1999	Luis Fuste, USGS	USGS gage data
34	Oct. 13 <sup>th</sup> , 1999	Luis Fuste, USGS	USGS gage data
35	Sept. 20 <sup>th</sup> , 1999	Jim Lencioni, Seattle Dist.	Prior FIS
36	Sept. 14 <sup>th</sup> , 1999	Luis Fuste, USGS	USGS gage data
37	Aug. 25 <sup>th</sup> , 1999	Vaughn Collins, Snoh. Co.	Cross-sections
38	Aug. 19 <sup>th</sup> , 1999	Luis Fuste, USGS	USGS gage data
39	Aug. 10 <sup>th</sup> , 1999	Luis Fuste, USGS	USGS gage data
40	Aug. 4 <sup>th</sup> , 1999	Luis Fuste, USGS	USGS gage data
41	July 27 <sup>th</sup> , 1999	Luis Fuste, USGS	USGS gage data
42	July 13 <sup>th</sup> , 1999	Vaughn Collins, Snoh. Co.	Jacknife bridge
43	June 23 <sup>rd</sup> , 1999	Matt Witecki, WSDOT	WSDOT bridge data
44	June 9 <sup>th</sup> , 1999	Vaughn Collins, Snoh. Co.	FEQ files
45	May 24 <sup>th</sup> , 1999	Jim Lencioni, Seattle Dist.	Schedule

**CR#1**

From: "Basich, Lawrence" <Lawrence.Basich@fema.gov>  
To: "'Todd Bennett'" <tbennett@westconsultants.com>  
Subject: RE: April 24th  
Date: Monday, April 09, 2001 1:51 PM

Todd,

No problem. I guess we will see you all there.

Larry

-----Original Message-----

From: Todd Bennett [mailto:tbennett@westconsultants.com]  
Sent: Monday, April 09, 2001 12:09 PM  
To: Larry Basich  
Subject: April 24th

Larry,

Hello. We were talking with Wayne Wagner over at the Seattle District about having a review meeting to go over the Snohomish River UNET model, floodplain mapping, BFE's, etc. He would like to wrap this in with our meeting with you on the 24th of April. Do you have any issues with Wayne (and whoever else from the Corps) being at the meeting we had planned?

Thanks,

~Todd

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**CR#2**

From: "Massey, Patrick" <Patrick.Massey@fema.gov>  
To: "'Todd Bennett'" <tbennett@westconsultants.com>  
Subject: RE: Snohomish Floodway

Date: Thursday, March 22, 2001 1:18 PM

Hi Todd,

Yes, each of the local jurisdictions have confirmed the Tuesday (2/27) meeting. Same time and place -- 1:30 pm at the City of Everett bldg on Wall Street (8th floor).

As far as a meeting on Monday, and if I can be so bold as to speak for Larry, I think that would be a good idea. We could either do it here, or at your office. I'll check with Larry on Friday afternoon, and we'll call you to set a meeting time/place.

Pat.

-----Original Message-----

From: Todd Bennett [mailto:tbennett@westconsultants.com]  
Sent: Thursday, March 22, 2001 12:39 PM  
To: Larry Basich; Massey, Patrick  
Subject: Snohomish Floodway

Larry, Pat,

Hello. Could one of you give me a call or drop me an e-mail when you are in. I know you're both out until Friday afternoon (from your voice mail). Two items for you:

- 1) Have the local municipalities confirmed the Tuesday meeting?
- 2) If possible, I would like to go over the results, as well as the presentation maps & tables before the actual meeting. We've exchanged a lot of e-mails and phone calls since our last in-person meeting and I want to present the exact package you desire. Are either or both of you available any time on Monday? It shouldn't take long and I could meet you at your office if that is easier. If not, I can prepare materials that I could fax over to you on Monday that we could then discuss over the phone.

Thanks,

~Todd

\*\*\*\*\*  
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### **CR#3**

From: "Basich, Lawrence" <[Lawrence.Basich@fema.gov](mailto:Lawrence.Basich@fema.gov)>  
To: "'Todd Bennett'" <[tbennett@westconsultants.com](mailto:tbennett@westconsultants.com)>  
Subject: Snohomish  
Date: Thursday, March 08, 2001 11:43 AM

Todd,

Sorry I missed you at the flood conference today. My back was aching and I couldn't make the trip.

However, I met with our Division and Branch Chiefs yesterday and here is the final, I hope, full meal deal on the Snohomish River study. I also confirmed this with Mark Beardsly with the City of Snohomish - they now want the entire UGA taken out of the floodway density fringe - will the madness ever stop.

What we would like to see is this:

- a. An alternative that shows Harvey Field and the UGA in the density fringe computations - as I and Pat originally asked;
- b. An alternative that shows just the Harvey Field triangle (that is on the large scale county maps that you picked up from the 2-7 meeting) taken out of the density floodway. This would be a with floodway run or would add to the surcharge for the computation of the one foot;
- c. An alternative that shows the entire Harvey Field plus UGA taken out of the floodway fringe and the results added to the surcharge, like a with floodway run.

Todd, I can see that there may be a possibility that the UGA and/or Harvey Field area, when taken out of the fringe will cause a more than one foot rise. If that is the case - we are back to square one. Hopefully they wont. However, even if they do not cause a more than one foot rise, there is a possibility that the 15% will not work anymore.

For this thing to end after your last modeling of the above scenario, we would have to have the UGA (Including Harvey Field) taken out of the density fringe and in the same analysis prove that the 15% at a cross section can still be used everywhere in the density fringe. IF this doesn't happen, we are into the new phase 2.

These alternatives do not affect all of the other changes to date. Those changes still have to be made - and likely, you are the only one who knows all of them.

After this, we should not look for any more modeling. I will be out of the office next week, but I will contact you to see if there is anything that we need to discuss. We are looking for a meeting with the locals at 1:30 pm on March 27. I hope we can get the work done by then.

Again, if you are out of bucks, don't do any work. As arduous as it will be, we will have to get you more money to keep this thing going.

Thanks,

Larry

---

#### **CR#4**

From: "Basich, Lawrence" <Lawrence.Basich@fema.gov>  
To: "'Todd Bennett'" <tbennett@westconsultants.com>  
Subject: RE: Snohomish Floodplain Mapping  
Date: Wednesday, February 28, 2001 1:42 PM

Todd,

I just talked to Jerry Irvin with the City. They are getting the information now, but I don't know when they will have the final maps for us to uses.

I would say now that we should put out maps based on what they told us and we will get the surveyed maps when the City gets them to us. In other words, lets show the Zone Xs as if we had the surveyed maps from the City and we'll confirm them later.

Thanks,

Larry

-----Original Message-----

From: Todd Bennett [mailto:tbennett@westconsultants.com]  
Sent: Tuesday, February 27, 2001 10:21 AM  
To: Larry Basich  
Subject: Snohomish Floodplain Mapping

Larry,

Hello. When we spoke last week we discussed waiting on mapping the Snohomish 100-yr floodplain and floodway until the information on the specific "Zone X" locations came from the City of Everett. Have you received them? If not, did they have an estimate for when they would arrive? I'm just trying to budget our time over the next couple weeks.

Thanks,

~Todd

\*\*\*\*\*

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## **CR#5**

From: "Basich, Lawrence" <[Lawrence.Basich@fema.gov](mailto:Lawrence.Basich@fema.gov)>

To: "'Todd Bennett'" <[tbennett@westconsultants.com](mailto:tbennett@westconsultants.com)>

Subject: FW: Snohomish FIS

Date: Wednesday, February 14, 2001 9:24 AM

Todd,

We understand where Dave is coming from here, and I think we even discussed this a little in one of our many meetings. However, we cannot assume that the tribe will fill all of their lands entirely. Therefore, we have to show only what is out there today.

Thanks,

Larry

-----Original Message-----

From: Massey, Patrick

Sent: Wednesday, February 14, 2001 8:10 AM

To: Basich, Lawrence

Subject: FW: Snohomish FIS

Larry,

FYI -- note from Dave Burdick to Todd Bennett.

-----Original Message-----

From: Burdick, David [<mailto:DBUR461@ECY.WA.GOV>]

Sent: Wednesday, February 14, 2001 9:52 AM

To: 'Todd Bennett'

Cc: 'Patrick Massey (FEMA)'

Subject: RE: Snohomish FIS

Hope the information provides the necessary profiles for the Tualip Superfund Site and also for the tribal land ownership of the Portenga restoration site within the Urban Growth Area of Marysville. Let me know if you need any additional information.

We are taking a blind leap of faith if we assume no no development or zero rise standard would apply to other Tualip Tribal lands (which we have no state of federal regulatory authority) within the Lower Snohomish Floodplain. I suggest for the tribal land north Ebbey Slough and west of I-5 we calculate full encroachment on the floodplain in this area landward of mean high tide.

-----Original Message-----

From: Todd Bennett [mailto:tbennett@westconsultants.com]  
Sent: Thursday, February 08, 2001 7:12 PM  
To: Burdick, David  
Subject: Snohomish FIS

Dave,

Hello. I spoke with the Tribe today and they are mailing to me the required information. Thank you again for your help with this.

~Todd

\*\*\*\*\*

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**CR#6**

From: "Basich, Lawrence" <Lawrence.Basich@fema.gov>  
To: "'Todd Bennett'" <tbennett@westconsultants.com>  
Subject: RE: 2-7-10 meeting  
Date: Friday, February 09, 2001 2:59 PM

Todd,

Pat and I talked about this and here is our conclusion:

1. Great!
2. We would like to do both the 15% and the 2% - just to get the higher regulatory amount in case we all interpret the County ordinance differently;
5. The County actually wanted the density fringe for the entire stream - from the existing FEMA floodway to the mouth;
7. I agree with you. Since the City has that option, we should model 3' over the entire parcel.

If this work exceeds your budget, you know you aren't approved to do it. Also, it does not look good for modification money this year. Last year it took to September to get it. However, if you need added time or funds, let me know.

I visited the superfund site - it is an enormous fill.

Thanks,

Larry

-----Original Message-----

From: Todd Bennett [mailto:tbennett@westconsultants.com]  
Sent: Thursday, February 08, 2001 7:03 PM  
To: Basich, Lawrence; Massey, Patrick  
Cc: Raymond Walton; Jeff Bradley  
Subject: Re: 2-7-10 meeting

Larry, Pat,

Hello. Thank you for writing this up, it is very helpful. A couple of comments...

On 1), I spoke with the Tribe today (Dave called me and passed along a contact name) and they have sent a plan view of both the landfill and Portinga (sp?) sites.

On 2), Ray pointed out that we can actually reduce the percent that we're removing from Fryelands from 15% to 2% since this is a storage, and not conveyance, area. This is a function of the Snohomish Co. wording that no more than 2% of a "lot" can be filled. I.e., in essence we're considering all of Fryelands (minus the Roosevelt Road fill) a "lot". This should help as begin to incorporate all of the other changes from the County and Cities.

On 5), I wanted to confirm with you two that Snohomish County said their "density fringe" applies only upstream of Hwy-2, correct?

On 7), it is my understanding from our talking after the meeting that if we go with modeling the 3' fill option, in order to be "fair", we would have to consider filling within the entire UGA near the ball fields as Ryan drew it on his map, not just the 305 acre park

---

I did some preliminary modeling after the meeting on Wednesday night and if we incorporate all of the changes from the County and the Cities it potentially could be a significant task. However, we may be able to make a few simplifying assumptions that I wanted to discuss with you. I will call you tomorrow (Friday) in the morning.

~Todd

----- Original Message -----

From: "Basich, Lawrence" <Lawrence.Basich@fema.gov>  
To: "'Todd Bennett'" <tbenett@westconsultants.com>; "Massey, Patrick" <Patrick.Massey@fema.gov>  
Cc: "'Jeff Bradley'" <Jbradley@westconsultants.com>  
Sent: Thursday, February 08, 2001 7:40 AM  
Subject: 2-7-10 meeting

> Dear folks,

>

> At the risk of missing something, I wanted to put down what I thought was  
> the conclusion of our meeting yesterday and where we go from here. To be  
> blunt, Snohomish county did not appear to be in a compromise mode. They  
> seem to feel that its their way or the highway.

>

> Be that as it may, we will still have to produce a map that is in the best  
> interests of everyone, not just the County. I hope that we only need to  
> produce one more run and one more map. If we can do that and show that  
> there is no more than one foot rise, than I think we have succeeded. I  
> think that we can accomplish everyone's goals if we do the following with  
> regard to modeling (Todd - these numbers will not likely match the ones  
you

> did yesterday, but that's okay. For the sake of consistency, I am going  
to

> use the terminology Add Fill or Add storage/conveyance for all modeling  
> actions. Also, the County map is the map that the County gave us  
yesterday

> - which shows the density fringe areas):

>

> 1. Add the fill of the superfund site on the Tulalip Reservation. We  
> had hoped that DOE would have some information on this, but all Dave had  
was

> a web site picture. If needed, a site visit here may be required.

> Otherwise, we should try and get a hold of the tribe or the City of  
> Marysville to determine the extent of this fill. In addition to this,  
there

> is a site near the Marysville fringe that could be added as conveyance or  
> storage;

>

- > 2. Add the fill of the Monroe UGB fill site near a Roosevelt road. We
  - > did not get a firm location of this since Monroe was not there, but we
  - > should have a good idea from the County map. No other adjustment needs to
  - > be made to the storage for the Fryelands. We keep the 15% as in
  - Alternative
  - > 2a/4a', but with the Monroe area removed;
  - >
- > 3. Add the fill of the Lake Stevens lagoon site (this is not really
  - > just fill, but an incorporated area that Lake Stevens uses for their
  - lagoon.
  - > This shows up on the County map;
  - >
- > 4. Add the storage/conveyance of the pink areas on Alternative 4a' on
  - > the east bank of Ebey Slough except for the Lake Stevens lagoon site.
  - This
  - > area goes from the bifurcation point of the Slough and the Snohomish River
  - > in the south to a latitude near the north end of Lake Stevens in the
  - north;
  - >
- > 5. Add fill of the flood fringe areas (Flood fringe differs from
  - > density fringe in that the density fringe applies to all areas in the
  - County
  - > where the density criteria are applied. The Flood fringe, is the area
  - that
  - > the county feels they can feel entirely, like a normal FEMA floodway
  - fringe)
  - > from the County map along the south end of the Marshlands. This is a
  - strip,
  - > maybe 200 feet wide from the Everett ball fields to Fiddlers Bluff, or
  - maybe
  - > further;
  - >
- > 6. Add conveyance/storage in three Everett areas: 1-near north I-5;
  - > 2-near their lagoon; 3-near their fill site at the southernmost pink area
  - > for the city;
  - >
- > 7. Add fill at the ball field - 3 feet over 305 acres. At the meeting
  - > yesterday, we had some discussion about how to do this. To me, since this
  - > area will be filled in the next several years - it is not immanent - we
  - > should treat it like any other fill and determine the affects that this
  - fill
  - > has on the one foot limit. If the one foot limit is exceeded, then this
  - may
  - > have to be an area that is sacrificed by the City. To me, the only other
  - > way to look at it is to determine, as we said yesterday, if this causes
  - any
  - > rise to the 100 year - if it does not, then we don't have to worry about
  - it
  - > again either in modeling or in the ordinance. If it does cause a rise,
  - then
  - > we have to decide if Everett should be allowed to do it in their floodway,
  - > and have a special dispensation for them in their ordinance as a
  - preexisting

- > condition. The City of Everett final map will show this as floodway so we
- > need to think about this;
- >
- > 8. Snohomish adjustments. This may be the most confusing of the lot.
- > The City asked for some areas near the Pilchuck to be added to the
- > storage/conveyance. Currently, those areas are in storage conveyance so
- > there is no change there. There are areas near the lagoon, near the south
- > west of the City and north of the river that are to be added as fill,
- along
- > with a narrow strip between the lagoon and the previously mentioned added
- > storage areas. Harvey field will be left open as area within the density
- > fringe, just like any other area.
- >
- > Yesterday, we asked Todd if we could have this analysis done in two
- weeks -
- > by February 21st. He would still have to check with Jeff to see if he
- could
- > do this.
- >
- > Once this modeling scheme is completed, the check has to be made if the
- one
- > foot rise is exceeded - since there are more areas added to
- > conveyance/storage than taken away, it would appear that we should be
- okay.
- > However, we need to see what the rises are and where. If the rises are
- > close to one foot everywhere, or if we can say that any further
- encroachment
- > may cause the one foot to be exceeded, then, like any other FIS, we can
- say
- > that this is the best floodway scenario and leave it at that. Any
- revisions
- > requested by the locals can be done at their expense.
- >
- > If the rises are not close to one foot, or if there are clearly extra work
- > that could be done without endangering the one foot rise, then FEMA and
- WEST
- > need to meet to decide the next step - a new set of modeling options.
- >
- > So there is my gist.
- >
- > Larry
- >

---

## **CR#7**

From: "Todd Bennett" <tbennett@westconsultants.com>  
To: "Deering, Michael K NWS" <Michael.K.Deering@nws02.usace.army.mil>  
Cc: "Gary Bartlett (Seattle District)" <Gary.E.Bartlett@nws02.usace.army.mil>  
Subject: Re: Snohomish Base Maps  
Date: Wednesday, December 13, 2000 7:25 PM

Mike,

Hello. I wanted to send you an update regarding the Snohomish base maps (you may already know all of this from talking with Gary).

I stopped by the office there, on Monday night, to talk with Gary. We talked for awhile, he showed me what the ArcView files should look like when the project opens correctly, and then I took the CD that he had burned containing the ArcView project with 8 base map panels. The "ArcPress" extension, which had caused the problem on the first CD, was turned off.

On Tuesday, we again ran into problems opening up the ArcView file. It appears that the Image Analysis extension is required (this is how Gary is performing the georeferencing) and we do not own that program. Although we can not open the ArcView project that Gary created, we can at least now import and view the individual, georeferenced, base map themes. But we can not modify them in any way (i.e. remove the black borders) and we have a few problems on occasion when viewing the files. So, in a nut shell, we can work with these files but it would be more efficient if we can get them in another format.

Gary is now looking into ways of possibly doing this, by exporting or saving the georeferenced map images to a format that we can read (i.e. a \*.tif file with an associated world file,\*.twf, containing the georeferenced data).

So, we're almost to the point where we can begin mapping. I will contact you, if I don't hear from you sooner, once Gary and I get this issue sorted out.

~Todd

----- Original Message -----

From: Deering, Michael K NWS  
To: Todd Bennett  
Cc: Wagner, Wayne E NWS ; Bartlett, Gary E NWS  
Sent: Wednesday, December 06, 2000 2:18 PM  
Subject: RE: Snohomish Base Maps

Hi Todd, Give me a call when you return. I don't think you need the ArcPress extension, except the \*.apr file may need to be edited so that it does not call for it. Also, the black areas are a little misleading. We can guide you through the method for making those images viewable. Let's talk when you return. We may have the rest of the files by then.

MKD

-----Original Message-----

From: Todd Bennett [mailto:tbennett@westconsultants.com]  
Sent: Monday, December 04, 2000 02:44  
To: Deering, Michael K NWS  
Subject: Snohomish Base Maps

Mike,

Hello. I just received your CD (I just left you a voice mail regarding this as well). I was at Portland District last week for a MIKE11 training class. I will be out of the office the rest of the week so I wanted to touch base with you.

I tried opening the ArcView project on the CD but I was unsuccessful. It appears that you are running ArcPress there at the District as it asks for this extension when I open the \*.apr file. We don't have a copy of this extension and I don't believe the project will open without it.

To work around this I "added" the themes that were included on the CD into a new ArcView project. When these were brought into ArcView there were four non-georeferenced maps that overlaid each other in addition to four solid black squares (i.e. no topo lines, landmarks, etc.) that appear to be the georeferenced locations for the base maps. Is this what you were referring to when you mentioned "black areas" in your e-mail?

If I don't hear from you today I will try to reach you when I'm back in town. I leave tomorrow morning to teach a RAS class in Raleigh, NC, for the rest of the week.

~Todd

\*\*\*\*\*

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**CR#8**

From: "Todd Bennett" <[tbennett@westconsultants.com](mailto:tbennett@westconsultants.com)>  
To: "Larry Basich" <[lawrence.basich@fema.gov](mailto:lawrence.basich@fema.gov)>  
Subject: Snohomish FIS  
Date: Monday, November 20, 2000 4:56 PM

Larry,

Hello. We have completed the alternatives on the Snohomish River FIS as we discussed and would like to go over the results. In a nut shell, for Alternative 1 the water surface raises close to, but less than, a foot on the Snohomish River, but more than a foot on both Ebey and Steamboat Sloughs. We were concerned about making sure we had a viable floodway for a tentative meeting at the end of the month but in talking with Pat Massey we hear that that meeting was not set up. Will you please call us or e-mail when you return so we can discuss further modeling efforts. I will most likely be out of the office the week of the 27th but Ray will be here.

Talk to you soon,

~Todd

\*\*\*\*\*

Todd H. Bennett  
Senior Project Engineer

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E-Mail: [tbennett@westconsultants.com](mailto:tbennett@westconsultants.com)  
Visit us at: [www.westconsultants.com](http://www.westconsultants.com)

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**CR#9**

From: "Basich, Lawrence" <[Lawrence.Basich@fema.gov](mailto:Lawrence.Basich@fema.gov)>  
To: "'Todd Bennett'" <[tbennett@westconsultants.com](mailto:tbennett@westconsultants.com)>  
Subject: RE: Request for BFE  
Date: Monday, November 13, 2000 6:12 AM

Todd,

Yes, please release the information. I sent the letter out on October 24.  
I will fax a copy of it to you.

Larry

-----Original Message-----

From: Todd Bennett [<mailto:tbennett@westconsultants.com>]  
Sent: Friday, November 10, 2000 11:05 AM  
To: Larry Basich  
Subject: Request for BFE

Larry,

Hello. Sorry to bother you again on this. Alex from KCM/TetraTech called me again about giving him our preliminary, subject to change, BFE in their area of interest near Marysville. He said he had spoken with you and that you had sent a letter out. I haven't recieved anything official here yet but it sounds like you've given the OK. Can I release our initial estimates to him?

~Todd

\*\*\*\*\*

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Visit us at: [www.westconsultants.com](http://www.westconsultants.com) <<http://www.westconsultants.com>>  
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## **CR#10**

From: "Basich, Lawrence" <[Lawrence.Basich@fema.gov](mailto:Lawrence.Basich@fema.gov)>  
To: "'Todd Bennett'" <[tbennett@westconsultants.com](mailto:tbennett@westconsultants.com)>  
Subject: RE: Request for Snohomish River 100-yr WSELEV  
Date: Thursday, October 19, 2000 5:36 AM

Todd,

It looks like the federal funding for our agency is going to be late so I may not be traveling the next two weeks like I planned. If that is the case, I would like to get together with you as soon as possible to talk about this. We can only really discuss this with a map in front of us.

However, to get into the mode of what we were thinking about, at our last meeting we talked a bit about what we would like to see done at the beginning of this analysis.

One scenario we discussed was doing nothing but eliminate the entire French Creek storage area and see what happens. I suggest we do that first and then start doing the work below. We will have to answer that question anyway.

I think that the next thing we want to see is to try and get some of the areas that some of the Cities want out of a floodway out. Now, as I recall, we wanted to look at putting the floodway as close to the outside of the outside most channel on both the left and right bank all the way to the point where the main channel bifurcates at Ebey Slough. This means a very wide floodway from the bifurcation point to the mouth. This should get most of Everett's and all of Marysville's areas out of the floodway.

Then, upstream of Ebey Slough, since the City of Snohomish didn't care, we should make a couple of judgments based on topography, where a reasonable equal conveyance reduction would occur. Now, just looking at it without the help of topography, it looks like we can put the floodway limit close to the channel on the North side upstream of Ebey Slough all the way to French Creek. On the south side, well its just a guess where we could put it.

I don't really have any other ideas. We met with the locals and they gave us some areas to try and free up, but some of those areas were within a normal floodway area. I don't see where we can meet that demand just yet. That will have to be discussed at the first meeting with the locals.

Again, if I don't travel the next two weeks, I would like to meet with you next week some time.

Thanks,

Larry

-----Original Message-----

From: Todd Bennett [mailto:tbennett@westconsultants.com]  
Sent: Wednesday, October 18, 2000 3:22 PM  
To: Basich, Lawrence  
Subject: Re: Request for Snohomish River 100-yr WSELEV

Larry,

Thank you. I will pass along the information to KCM.

Regarding our meeting on Nov. 8th (10:00am), do you already have an idea of the scenarios that you would like us to develop in UNET (Task 1)? If so, it would be helpful for us to look those over before the meeting.

Thanks again,

~Todd

----- Original Message -----

From: Basich, Lawrence <mailto:Lawrence.Basich@fema.gov>  
To: 'Todd Bennett' <mailto:tbennett@westconsultants.com>  
Sent: Wednesday, October 18, 2000 2:46 PM  
Subject: RE: Request for Snohomish River 100-yr WSELEV

Todd,

Fine with me to release that information to a local government, again saying that it is "preliminary and subject to change". We have to be careful not to release information to other than local governments since we are in a partnership with the locals and this info is supposed to be between us and them until we go public with it, either at the FCCO meeting following the preliminary draft (BAKER) or at the ICCO meeting following the completion of the study contractor draft (WEST).

However, we should not release any of the very early floodway delineations until we get concurrence from the locals. We can only release BFE information.

Todd, in our last studies with North Bend and Ada County(Boise), we ask the locals to write us a letter asking for the data and we give a letter to the study contractor authorizing release to the local government only. We should do it that way here also unless the City needs it today.

Larry

-----Original Message-----

From: Todd Bennett [mailto:tbennett@westconsultants.com]  
Sent: Wednesday, October 18, 2000 10:28 AM  
To: Wayne Wagner  
Cc: Larry Basich  
Subject: Request for Snohomish River 100-yr WSELEV

Wayne,

Hello. I received a request from KCM. They are interested in knowing a preliminary estimate for the 100-year floodplain on Ebey Slough. They are working on a project for the City of Marysville and would like an "early indication" if our results are "the same, slightly different, or very different" than the existing water surface elevation at a particular location. We need the okay from you to send out a qualitative answer (with all the necessary caveats).

I've cc'd Larry on this as well.

~Todd

\*\*\*\*\*

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## **CR#11**

From: "Deering, Michael K NWS" <Michael.K.Deering@nws02.usace.army.mil>  
To: "Todd Bennett" <tbennett@westconsultants.com>  
Subject: RE: Snohomish Base Maps  
Date: Thursday, October 12, 2000 6:45 AM

Good Morning Todd, Yes I sit in Jim's old cube....see ya in the am.

MKD

-----Original Message-----

From: Todd Bennett [mailto:tbennett@westconsultants.com]  
Sent: Thursday, October 12, 2000 07:25  
To: Deering, Michael K NWS  
Subject: Re: Snohomish Base Maps

Great. I will swing by there between 7:45 and 8:00am tomorrow (Friday) morning if that works for you. Is your office close to where Jim Lencione and Dan Harvey used to sit?

~Todd

----- Original Message -----

From: Deering, Michael K NWS <mailto:Michael.K.Deering@nws02.usace.army.mil>

To: Todd Bennett <mailto:tbennett@westconsultants.com>

Sent: Thursday, October 12, 2000 6:45 AM

Subject: RE: Snohomish Base Maps

Todd, Friday would be good.....I will out all next week.

Thanks

MKD

-----Original Message-----

From: Todd Bennett [mailto:tbennett@westconsultants.com]

Sent: Wednesday, October 11, 2000 08:01

To: Deering, Michael K NWS

Subject: Re: Snohomish Base Maps

Mike,

Hello. Sure - I commute from Seattle to here so I can stop by either on my way to or from work. Does one day or time work better for you? How about Friday morning or Tuesday towards the end of the day? What hours are you usually there?

Sorry I didn't get back to you sooner. Our e-mail has been down all day - something about a fire at the building where our Internet Provider is located...

~Todd

----- Original Message -----

From: Deering, Michael K NWS <mailto:Michael.K.Deering@nws02.usace.army.mil>

To: Wagner, Wayne E NWS <mailto:Wayne.E.Wagner@NWS02.usace.army.mil> ;  
tbennett@westconsultants.com <mailto:tbennett@westconsultants.com>

Sent: Wednesday, October 11, 2000 9:15 AM

Subject: RE: Snohomish Base Maps

Todd, Yes, the maps I referred to (option 1) are designated as file number E-2-6-497. I think we should do two more steps and then we could proceed with the digitizing and georeferencing. First, we need to check our archive files for the originals of E-2-6-497 (what I found were our H&H section copies). Secondly, could you please stop by some time soon and verify the area scope of these maps to make sure they cover all we need (maybe a step not needed but can't hurt to be sure). Thanks.

MKD

-----Original Message-----

From: Wagner, Wayne E NWS  
Sent: Wednesday, October 11, 2000 08:53  
To: Deering, Michael K NWS  
Subject: RE: Snohomish Base Maps

Looks like we should scan all sheets (option 1). I'm surprised that so little of the newer maps exist.

Thanks for following up on this,  
Wayne

-----Original Message-----

From: Deering, Michael K NWS  
Sent: Tuesday, October 10, 2000 2:57 PM  
To: Wagner, Wayne E NWS  
Subject: FW: Snohomish Base Maps

Wayne,

What do you think?

MKD

-----Original Message-----

From: Todd Bennett [mailto:tbennett@westconsultants.com]  
Sent: Tuesday, October 10, 2000 12:56  
To: Deering, Michael K NWS  
Subject: Re: Snohomish Base Maps

Mike,

Wow, quick turnaround...

If you scan all 15 sheets of the "1976 maps", i.e. "Option 1", and they include the Snohomish River Valley from the mouth upstream to SR-522, then we'll definitely make sure that the entire study reach is covered.

If you want to scan only a portion of the "1976" maps, i.e. "Option 2", then we should confirm that the "1976 maps" are the same maps that I referred to as our "working maps" on the phone this morning. I just looked at some of

the references on our "working maps." They are dated 1976 "initial", 1981 "final", and have a District file number of E-2-6-497. Of our sheets, "Sheet 1", the most downstream map, shows the mouth of Ebey Slough, Steamboat Slough, and the Snohomish River, downstream of Highway 99, near Everett. "Sheet 15", our upstream most map, shows SR-522 and the confluence of the Snohomish R. with the Skykomish and Snoqualmie. If you want to verify other sheets, 14 and 15 show the upstream portions of the Fryelands, 9 shows the edge of the City of Snohomish.

The easiest for us would be to have all 15 sheets scanned and georeferenced (Option 1). That way when we plot out the floodplain on the digital maps we will be looking at the same sheets (i.e. the working maps and digital maps we be identical). There is a small amount of complexity if we use some of the prior digital maps that we received from the Seattle District although nothing that can't be worked around. Option 1 will also have less irregularities in the composite digital map since there are fewer sheets and therefore less "seams" between the maps that need to be pasted and georeference together.

If you go with "Option 2", to ensure that there is overlap between the old and new maps I would have sheets 1 through 7, and 10 through 15 scanned (assuming that the "1976" and our "working maps" are the same). That leaves out only 2 sheets (8 and 9). This may or may not be a significant savings depending on what the price is per sheet to convert from paper to digital.

I hope this helps. Let me know if I can clarify anything else.

~Todd

----- Original Message -----

From: Deering, Michael K <mailto:Michael.K.Deering@nws02.usace.army.mil>  
NWS  
To: Todd Bennett <mailto:tbennett@westconsultants.com>  
Sent: Tuesday, October 10, 2000 11:44 AM  
Subject: RE: Snohomish Base Maps

OK Todd, I found 15 sheets of the 1976 maps, I believe extending the full reach of interest. Options,

- 1 - use all 15 maps for the current effort,
- 2 - use the 1976 maps to fill in missing maps from newer set.

Are you familiar with the 1976 set...if so do you know which sheet numbers would we need to fill in missing sheets (option 2)?

MKD

-----Original Message-----

From: Todd Bennett [mailto:tbennett@westconsultants.com]

Sent: Tuesday, October 10, 2000 10:05  
To: Deering, Michael K NWS  
Subject: Re: Snohomish Base Maps

Mike,

Hello. Not a problem.

The base maps that we originally received from you included from approximately the upstream extent of the leveed area (near Fryelands) downstream to near the confluence with Ebey Slough. There were 13 sheets total and they all included topo. I will fax over a schematic of the sheet locations. Will you receive it if I send it to 206-764-6678? Also, you probably already read the e-mail but if not and it's helpful, two of the sheets we received are on our ftp site. The location of the files are shown in the e-mail dated July 24th listed below.

Will you have the maps georeferenced?

Let me know if you need any further clarification.

~Todd

----- Original Message -----

From: Deering, Michael <mailto:Michael.K.Deering@nws02.usace.army.mil> K NWS  
To: Wagner, Wayne E <mailto:Wayne.E.Wagner@NWS02.usace.army.mil> NWS ;  
tbennett@westconsultants.com <mailto:tbennett@westconsultants.com>  
Sent: Tuesday, October 10, 2000 8:38 AM  
Subject: RE: Snohomish Base Maps

Todd, I just discussed with Wayne the situation with the Snohomish base maps. I will attempt to locate the remaining maps....could you please summarize once again which maps you do and don't have, sheet by sheet, with reach descriptors so I can get my bearing? Thanks...sorry to put you through this again. Do the maps you already have contain topo data?

Michael Deering  
Senior Hydraulic Engineer  
Hydrology and Hydraulics Section  
(206) 764-3595

-----Original Message-----

From: Wagner, Wayne E NWS  
Sent: Wednesday, October 04, 2000 10:26  
To: Deering, Michael K NWS  
Subject: FW: Snohomish Base Maps

Mike Let's see how we can get this done.

Wayne

-----Original Message-----

From: Todd Bennett [mailto:tbennett@westconsultants.com]  
Sent: Monday, October 02, 2000 5:47 PM  
To: Wagner, Wayne E NWS  
Subject: Re: Snohomish Base Maps

Wayne,

Hello. Thanks for getting back to me. Will you have them geo-referenced as well?

~Todd

----- Original Message -----

From: Wagner, Wayne E <mailto:Wayne.E.Wagner@NWS02.usace.army.mil> NWS  
To: 'Todd Bennett' <mailto:tbennett@westconsultants.com> ; Wagner, Wayne E <mailto:Wayne.E.Wagner@NWS02.usace.army.mil> NWS  
Cc: lawrence.basich@fema.com <mailto:lawrence.basich@fema.com> ; Deering, <mailto:Michael.K.Deering@nws02.usace.army.mil> Michael K NWS  
Sent: Friday, September 29, 2000 1:04 PM  
Subject: RE: Snohomish Base Maps

Todd:

Joe told me that we don't have them, so we will have to paper copies and scan them for your use. I'll talk to Mike Deering.

Wayne

-----Original Message-----

From: Todd Bennett [mailto:tbennett@westconsultants.com]  
Sent: Tuesday, September 26, 2000 9:52 AM  
To: Wagner, Wayne E  
Cc: lawrence.basich@fema.com <mailto:lawrence.basich@fema.com>  
Subject: Fw: Snohomish Base Maps

Wayne,

Hello. This e-mail is to update you on the ongoing efforts to obtain geo-referenced digital base maps for the Snohomish River.

We received digital files from Michael Baker Jr. Inc. but unfortunately they did not have topo coverage. I spoke with Larry this morning and there was a miscommunication regarding the digital data available. Larry confirmed that

FEMA nor Baker Jr. will have digital topo data. Though they do have paper copies of the original base maps.

So, we are back to square one. Do you know if the missing original base maps were ever located there at the Seattle District (see e-mails below)?

~Todd

----- Original Message -----

From: Weber, Joseph <mailto:Joseph.T.Weber@NWS02.usace.army.mil> T NWS  
To: 'Todd Bennett' <mailto:tbennett@westconsultants.com>  
Cc: Deering, <mailto:Michael.K.Deering@nws02.usace.army.mil> Michael K NWS  
; Lenger, David <mailto:David.T.Lenger@NWS02.usace.army.mil> T NWS  
Sent: Tuesday, August 15, 2000 6:27 PM  
Subject: RE: Snohomish Base Maps

Todd,

We still haven't located the missing base maps. FEMA only has copies of the work maps, and probably only on microfiche. If we can't locate the missing base maps, we will have to scan copies of the work maps covering those areas.

I will be transferring to FEMA on August 28. You should contact Mike Deering after that.

Joe Weber  
Program Manager, Flood Plain  
Management Services

U.S. Army Corps  
of Engineers  
Seattle District  
Hydraulics & Hydrology Section  
PO Box 3755  
Seattle, WA 98124-3755

Phone: (206) 764-3661 voice mail line  
Fax: (206) 764-6678  
E-mail: joseph.t.weber@usace.army.mil

-----Original Message-----

From: Todd Bennett [SMTP:tbennett@westconsultants.com]  
Sent: Tuesday, August 15, 2000 13:30  
To: Weber, Joseph T NWS  
Subject: Re: Snohomish Base Maps

Joe,

Hello. Any luck finding the base maps? If not, would FEMA also have a copy that you could scan?

If I remember correctly you had said that you were going to make the move to FEMA about the middle of this month. Have you narrowed down that day any closer? Should we contact Wayne W. from then on out regarding getting the base maps scanned?

Thanks,

~Todd

----- Original Message -----

From: Weber, Joseph T NWS <mailto:Joseph.T.Weber@NWS02.usace.army.mil  
<mailto:Joseph.T.Weber@NWS02.usace.army.mil> >  
To: 'Todd Bennett' <mailto:tbennett@westconsultants.com  
<mailto:tbennett@westconsultants.com> >  
Cc: Lenger, David T NWS <mailto:David.T.Lenger@NWS02.usace.army.mil  
<mailto:David.T.Lenger@NWS02.usace.army.mil> >  
Sent: Monday, August 07, 2000 11:58 AM  
Subject: RE: Snohomish Base Maps

Todd,

We can't find the rest of the base maps. They were probably misfiled. We are still looking for them.

Joe Weber  
Program Manager, Flood Plain  
Management Services

U.S. Army Corps  
of Engineers  
Seattle District  
Hydraulics & Hydrology Section  
PO Box 3755  
Seattle, WA 98124-3755

Phone: (206) 764-3661 voice mail

line

Fax: (206) 764-6678  
E-mail: joseph.t.weber@usace.army.mil

-----Original Message-----

From: Todd Bennett [SMTP:tbennett@westconsultants.com]  
Sent: Monday, August 07, 2000 11:43  
To: Weber, Joseph T NWS

Cc: lawrence.basich@fema.gov  
Subject: Re: Snohomish Base Maps

Joe,

Hello. Just checking in on the progress of scanning the remaining base maps. Do you have an estimate of when the work will be completed? Will they also be able to geo-reference the maps this time as part of the scanning?

Thanks,

~Todd

----- Original Message -----

From: Weber, Joseph T NWS <<mailto:Joseph.T.Weber@NWS02.usace.army.mil>>  
<mailto:Joseph.T.Weber@NWS02.usace.army.mil> >>  
To: Lenger, David T NWS <<mailto:David.T.Lenger@NWS02.usace.army.mil>>  
<mailto:David.T.Lenger@NWS02.usace.army.mil> >>  
Cc: 'Todd Bennett' <<mailto:tbennett@westconsultants.com>>  
<mailto:tbennett@westconsultants.com> >>  
Sent: Monday, July 24, 2000 12:58 PM  
Subject: RE: Snohomish Base Maps

Dave,

I need the following 1"=200' topo maps for the Snoqualmie River S-73020. I checked your map storage area (tubes 67 and 68) and they aren't there. Looks like you will have to pull them from archival storage.

Joe Weber

-----Original Message-----

From: Todd Bennett [SMTP:tbennett@westconsultants.com]  
Sent: Monday, July 24, 2000 10:30  
To: Weber, Joseph T NWS  
Subject: Fw: Snohomish Base Maps

Joe,

Hello. We took a look at the base maps this morning as per our discussion on Friday night. S-73020-10 is the number on the CD base maps that we received from you.

Also, I have placed on our FTP site <ftp.westconsultants.com <<<ftp://ftp.westconsultants.com <ftp://ftp.westconsultants.com> >>>> copies of two of the georeferenced sheets (sheets 3 and 4). The folder structure

containing the files is: /outgoing/bennett/snohomish/. These files are georeferenced (the \*.twf files are also on the ftp site) so when you bring them into Arcview you can see how they line up as we discussed on Friday.

FYI: We scaled the maps from 1"=200' to 1"=500' before georeferencing them in order to reduce file size. If the company doing the scanning is also going to georeference the additional maps they would need to do this same scaling in order for the previously scanned maps to line up with the newly scanned maps.

Please let me know if you have any questions,

~Todd

----- Original Message -----

From: Todd Bennett <<<mailto:tbennett@westconsultants.com  
<mailto:tbennett@westconsultants.com>>>>  
To: Weber, Joseph T NWS <<<mailto:Joseph.T.Weber@NWS02.usace.army.mil  
<mailto:Joseph.T.Weber@NWS02.usace.army.mil>>>>  
Sent: Wednesday, July 05, 2000 3:35 PM  
Subject: Snohomish Base Maps

Joe,

Hello. As we discussed earlier today, I have faxed over to you a sheet showing the location of the base maps that we've received. They are sheets 1 through 13, on 6 CDs. Sheet 13 is the most downstream section (near the confluence with Ebey Slough) and sheet 6 is the most upstream section (near the upstream end of Marshlands) of what we have received. Sheets 1 through 5 cover roughly the Frylands.

Please call me if you have any questions.

~Todd

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mailto:tbennett@westconsultants.com <mailto:tbennett@westconsultants.com>  
>>>>

Visit us at: www.westconsultants.com <<< http://www.westconsultants.com  
<http://www.westconsultants.com>>>>

\*\*\*\*\*

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**CR#12**

From: "Basich, Lawrence" <Lawrence.Basich@fema.gov>  
To: "'Todd Bennett'" <tbenett@westconsultants.com>  
Subject: RE: Snohomish River - Additional work under new FEMA contract  
Date: Thursday, October 12, 2000 5:05 AM

Todd,

Based on my existing schedule, those weeks are totally booked up for me except for November 8. If we can make it November 8, that would be good. Any time is fine - your call, preferably between 9:00 am and 3:00 pm. Between now and then, if you want to meet earlier, I am open next wednesday, October 18. Those are the only two days I have open until after Thanksgiving.

Larry

-----Original Message-----

From: Todd Bennett [mailto:tbenett@westconsultants.com]  
Sent: Wednesday, October 11, 2000 8:09 PM  
To: Larry Basich  
Cc: Raymond Walton  
Subject: Snohomish River - Additional work under new FEMA contract

Larry,

Hello. Ray and I would like to set up a meeting to identify the additional tasks to do for the Snohomish River FIS under our new FEMA contract (EMS-2000-CO-0058). What days are available for you? Right now, for the most part, the week of Oct. 30th and Nov. 6th are open for us.

~Todd

\*\*\*\*\*

Todd H. Bennett  
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\*\*\*\*\*

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**CR#13**

From: "Basich, Lawrence" <Lawrence.Basich@fema.gov>  
To: "Todd Bennett" <tbennett@westconsultants.com>  
Subject: RE: Snohomish Base  
Date: Tuesday, September 26, 2000 8:58 AM

Todd,

I just talked with Joe Weber, he is with FEMA now. Apparently, Wayne will likely tell you that what you have is all you will get. I guess the scanner at the Corps cannot handle the mylars. However, they should have the same thing that we have.

Larry

-----Original Message-----

From: Todd Bennett [mailto:tbennett@westconsultants.com]  
Sent: Tuesday, September 26, 2000 9:55 AM  
To: lawrence.basich@fema.gov  
Subject: Fw: Snohomish Base

> Steve,

>

> Hello. This is a follow up to our phone conversation last week regarding  
> the Snohomish River Base Maps. I spoke with Larry Basich this morning and  
> there was a miscommunication among the parties involved regarding the  
> digital data that was available. Digital topo was never supplied to the  
> FEMA and therefore you will not be able to find it in your search. Thank  
> you very much for your assistance in this matter.

>

> ~Todd

>

> \*\*\*\*\*

> Todd H. Bennett

> Senior Project Engineer

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> Bellevue, WA 98005-2535

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>

> E-Mail: tbennett@westconsultants.com

> Visit us at: www.westconsultants.com

> \*\*\*\*\*

>

> ----- Original Message -----

> From: "Steve Van Epps" <SVANEPPS@mbakercorp.com>

> To: <Tbennett@westconsultants.com>

> Sent: Friday, September 15, 2000 12:02 PM

> Subject: Snohomish Base  
>  
>  
> Ray,  
> Here is the file you have requested. If you have any questions, please  
feel  
> free to give me a call. Thanks,  
>  
>  
> Steve Van Epps  
> DFIRM Supervisor  
> Michael Baker Jr. Inc.  
> (703) 317 3069  
>  
>  
>

---

## **CR#14**

From: "Todd Bennett" <tbennett@westconsultants.com>  
To: <Wayne.E.Wagner@nws02.usace.army.mil>  
Cc: <lawrence.basich@fema.com>  
Subject: Fw: Snohomish Base Maps  
Date: Tuesday, September 26, 2000 8:52 AM

RE: Snohomish Base Maps

Wayne,

Hello. This e-mail is to update you on the ongoing efforts to obtain geo-referenced digital base maps for the Snohomish River.

We received digital files from Michael Baker Jr. Inc. but unfortunately they did not have topo coverage. I spoke with Larry this morning and there was a miscommunication regarding the digital data available. Larry confirmed that FEMA nor Baker Jr. will have digital topo data. Though they do have paper copies of the original base maps.

So, we are back to square one. Do you know if the missing original base maps were ever located there at the Seattle District (see e-mails below)?

~Todd

----- Original Message -----

From: Weber, Joseph T NWS  
To: 'Todd Bennett'  
Cc: Deering, Michael K NWS ; Lenger, David T NWS  
Sent: Tuesday, August 15, 2000 6:27 PM  
Subject: RE: Snohomish Base Maps

Todd,

We still haven't located the missing base maps. FEMA only has copies of the work maps, and probably only on microfiche. If we can't locate the missing base maps, we will have to scan copies of the work maps covering those areas.

I will be transferring to FEMA on August 28. You should contact Mike Deering after that.

Joe Weber  
Program Manager, Flood Plain  
Management Services

U.S. Army Corps  
of Engineers  
Seattle District  
Hydraulics & Hydrology Section  
PO Box 3755  
Seattle, WA 98124-3755

Phone: (206) 764-3661 voice mail line  
Fax: (206) 764-6678  
E-mail: joseph.t.weber@usace.army.mil

-----Original Message-----

From: Todd Bennett [SMTP:tbennett@westconsultants.com]  
Sent: Tuesday, August 15, 2000 13:30  
To: Weber, Joseph T NWS  
Subject: Re: Snohomish Base Maps

Joe,

Hello. Any luck finding the base maps? If not, would FEMA also have a copy that you could scan?

If I remember correctly you had said that you were going to make the move to FEMA about the middle of this month. Have you narrowed down that day any closer? Should we contact Wayne W. from then on out regarding getting the base maps scanned?

Thanks,

~Todd

----- Original Message -----

From: Weber, Joseph T NWS <mailto:Joseph.T.Weber@NWS02.usace.army.mil>  
To: 'Todd Bennett' <mailto:tbennett@westconsultants.com>  
Cc: Lenger, David T NWS <mailto:David.T.Lenger@NWS02.usace.army.mil>  
Sent: Monday, August 07, 2000 11:58 AM  
Subject: RE: Snohomish Base Maps

Todd,

We can't find the rest of the base maps. They were probably misfiled. We are still looking for them.

Joe Weber  
Program Manager, Flood Plain  
Management Services

U.S. Army Corps  
of Engineers  
Seattle District  
Hydraulics & Hydrology Section  
PO Box 3755  
Seattle, WA 98124-3755

Phone: (206) 764-3661 voice mail line  
Fax: (206) 764-6678  
E-mail: joseph.t.weber@usace.army.mil

-----Original Message-----

From: Todd Bennett [SMTP:tbennett@westconsultants.com]  
Sent: Monday, August 07, 2000 11:43  
To: Weber, Joseph T NWS  
Cc: lawrence.basich@fema.gov  
Subject: Re: Snohomish Base Maps

Joe,

Hello. Just checking in on the progress of scanning the remaining base maps. Do you have an estimate of when the work will be completed? Will they also be able to geo-reference the maps this time as part of the scanning?

Thanks,

~Todd

----- Original Message -----

From: Weber, Joseph T NWS <<mailto:Joseph.T.Weber@NWS02.usace.army.mil>>  
To: Lenger, David T NWS <<mailto:David.T.Lenger@NWS02.usace.army.mil>>  
Cc: 'Todd Bennett' <<mailto:tbennett@westconsultants.com>>  
Sent: Monday, July 24, 2000 12:58 PM  
Subject: RE: Snohomish Base Maps

Dave,

I need the following 1"=200' topo maps for the Snoqualmie River S-73020. I checked your map storage area (tubes 67 and 68) and they aren't there. Looks like you will have to pull them from archival storage.

Joe Weber

-----Original Message-----

From: Todd Bennett [SMTP:tbenett@westconsultants.com]  
Sent: Monday, July 24, 2000 10:30  
To: Weber, Joseph T NWS  
Subject: Fw: Snohomish Base Maps

Joe,

Hello. We took a look at the base maps this morning as per our discussion on Friday night. S-73020-10 is the number on the CD base maps that we received from you.

Also, I have placed on our FTP site < ftp.westconsultants.com < <ftp://ftp.westconsultants.com>>>> copies of two of the georeferenced sheets (sheets 3 and 4). The folder structure containing the files is: /outgoing/bennett/snohomish/. These files are georeferenced (the \*.twf files are also on the ftp site) so when you bring them into Arcview you can see how they line up as we discussed on Friday.

FYI: We scaled the maps from 1"=200' to 1"=500' before georeferencing them in order to reduce file size. If the company doing the scanning is also going to georeference the additional maps they would need to do this same scaling in order for the previously scanned maps to line up with the newly scanned maps.

Please let me know if you have any questions,

~Todd

----- Original Message -----

From: Todd Bennett < <mailto:tbenett@westconsultants.com>>>>  
To: Weber, Joseph T NWS < <mailto:Joseph.T.Weber@NWS02.usace.army.mil>>>>  
Sent: Wednesday, July 05, 2000 3:35 PM  
Subject: Snohomish Base Maps

Joe,

Hello. As we discussed earlier today, I have faxed over to you a sheet showing the location of the base maps that we've received. They are sheets 1 through 13, on 6 CDs. Sheet 13 is the most downstream section (near the confluence with Ebey Slough) and sheet 6 is the most upstream section (near the upstream end of Marshlands) of what we have received. Sheets 1 through 5 cover roughly the Frylands.

Please call me if you have any questions.

~Todd

\*\*\*\*\*

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\*\*\*\*\*

---

## **CR#15**

From: "Todd Bennett" <[tbennett@westconsultants.com](mailto:tbennett@westconsultants.com)>  
To: "Weber, Joseph T NWS" <[Joseph.T.Weber@NWS02.usace.army.mil](mailto:Joseph.T.Weber@NWS02.usace.army.mil)>  
Subject: Fw: Snohomish Topo Files  
Date: Tuesday, June 06, 2000 6:32 AM

Snohomish Topo Files

Joe,

Hello. We had no legibility problems with the latest color scanned map file that you sent over. We feel that the color version, and not the scanned grayscale, will work the best. Let me know if you have any questions.

Thanks,

~Todd

----- Original Message -----

From: Todd Bennett  
To: Weber, Joseph T NWS  
Sent: Friday, June 02, 2000 5:17 PM  
Subject: Re: Snohomish Topo Files

Thanks Joe. I will take a look at them tonight or on Monday and then I will get back to you.

Have a good weekend,

~Todd

\*\*\*\*\*

Todd H. Bennett  
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Visit us at: [www.westconsultants.com](http://www.westconsultants.com)

\*\*\*\*\*

----- Original Message -----

From: Weber, Joseph T NWS  
To: Todd Bennett (E-mail)  
Sent: Friday, June 02, 2000 5:14 PM  
Subject: Snohomish Topo Files

Todd,

I zipped sample files of the color and grayscale TIFF files and put them on your FTP site.

These files were scanned at 100 DPI, full size. I viewed them in ArcView and they look OK when you zoom in on them.

The grayscale has a very dark Grey background, while the color has a white background.

Let me know if the grayscale is sufficient. Otherwise we will get the files scanned in color.

There is only a slight difference in cost but the color files will require more CDs due to their larger size.

Joe Weber

---

## **CR#16**

From: "Todd Bennett" <[tbennett@westconsultants.com](mailto:tbennett@westconsultants.com)>  
To: "Dan Harvey" <[Daniel.R.Harvey@nws02.usace.army.mil](mailto:Daniel.R.Harvey@nws02.usace.army.mil)>  
Subject: Snohomish River Base Maps  
Date: Tuesday, May 23, 2000 6:26 AM

Dan,

Good morning. After talking with our GIS guy and looking at the files, our recommendation would be to continue scanning the maps as you had the first one done. As is, the map is legible. We tested reducing the scale (by 50%) and lost a fair amount of readability. Please let me know if you have any questions.

~Todd

\*\*\*\*\*

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\*\*\*\*\*

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**CR#17**

From: "Collins, Vaughn" <[Vaughn.Collins@co.snohomish.wa.us](mailto:Vaughn.Collins@co.snohomish.wa.us)>  
To: "Todd Bennett" <[tbennett@westconsultants.com](mailto:tbennett@westconsultants.com)>  
Subject: RE: DEAorig.xls  
Date: Monday, May 22, 2000 2:45 PM

The sine088 worksheet is the original from DEA -- elevations are in meters NAVD88. DEA surveyed 15 HWM's, but most were established by establishing a TBM, then running a level loop to the HWM, therefore they did not give me horizontal coordinates for them.

This should be good to use:

name,	X-coord,	Y-coord,	A1990hwmelNGVD29
SNOR1,	1313138.88,	345969.72,	14.91
SNOR2,	1313354.25,	344696.75,	16.06
SNO3,	1316115.75,	340611.72,	16.03
SNOR4,	1317672.00,	339613.63,	17.35
SNOF6,	1336187.88,	325577.06,	30.43
SNOF6-A,	1336187.88,	325577.06,	30.56
SNOF7,	1334175.38,	325931.09,	29.34
SNOF8,	1332204.88,	328505.75,	29.31
SNOF9,	1335645.38,	320383.75,	29.93
SNOF11,	1344415.38,	321346.44,	29.61
SNOF12,	1349704.75,	322156.34,	29.78
SNODD13,	1313120.00,	342376.00,	16.58
SNO14,	1341507.13,	305711.00,	37.63
SNO17,	1337302.13,	309603.66,	35.90
SNO18,	1336028.50,	313242.47,	34.42

Vaughn Collins, P.E.  
Snohomish County Public Works, Surface Water Management  
2731 Wetmore Av, Ste 300  
Everett, WA 98201-3581  
425.388.3464 x4619 FAX 425.388.6455  
[vaughn.collins@co.snohomish.wa.us](mailto:vaughn.collins@co.snohomish.wa.us)

-----Original Message-----

From: Todd Bennett [mailto:tbennett@westconsultants.com]  
Sent: Monday, May 22, 2000 3:32 PM  
To: Collins, Vaughn  
Subject: Re: DEAorig.xls

Vaughn,

Hello. Would you please clarify: There are 5 elevations labeled as "HWM". There are another 8 points labeled as "TBM" that were at the locations identified by the Corps. If I understand your e-mail correctly, if we ignore the TBM elevations that would leave us with only 5 of the roughly 15 high-water marks. Is this correct?

There was another sheet on the Excel file that you sent, labeled "S1NEO88". It appears to show elevations of 15 Corps high-water marks although the elevations do not appear to be anywhere near the correct stage.

Thanks,

~Todd

----- Original Message -----

From: Collins, Vaughn <Vaughn.Collins@co.snohomish.wa.us>  
To: 'Todd Bennett' <tbennett@westconsultants.com>  
Sent: Monday, May 22, 2000 2:14 PM  
Subject: RE: DEAorig.xls

> 1. I believe TBM refer to GPS positions that were established in order to  
> shoot levels to the actual HWM which were not directly satellite  
> surveyable.  
> Should probably just ignore.  
>  
> 2. Horizontal datum in NAD83  
> 3. levee cl file is attached below.  
>  
> Hope this helps  
>  
> Vaughn Collins, P.E.  
> Snohomish County Public Works, Surface Water Management  
> 2731 Wetmore Av, Ste 300  
> Everett, WA 98201-3581  
> 425.388.3464 x4619 FAX 425.388.6455  
> vaughn.collins@co.snohomish.wa.us  
>  
>  
> -----Original Message-----  
> From: Todd Bennett [mailto:tbennett@westconsultants.com]  
> Sent: Monday, May 22, 2000 10:46 AM

> To: Collins, Vaughn  
> Subject: Re: DEAorig.xls  
>  
>  
> Vaughn,  
>  
> Hi. Last week I was looking at the files in ArcView. Are the points  
> identified as temporary bench marks ("TBM") also high-water marks? They  
> seem to correspond with the unsurveyed high-water marks labeled by the  
> Corps.  
>  
> Would you send over the ArcView shape files that you mentioned. Also, for  
> the horizontal datum, State Plane, Washington North, is it NAD83 or NAD27?  
> We converted the surveyed points assuming NAD83 and are having problems  
> precisely lining up with the themes the Corps sent over.  
>  
> Thanks,  
>  
> ~Todd  
>  
>  
>  
> ----- Original Message -----  
> From: Collins, Vaughn <Vaughn.Collins@co.snohomish.wa.us>  
> To: 'Todd Bennett' <tbenett@westconsultants.com>  
> Sent: Tuesday, May 16, 2000 4:21 PM  
> Subject: RE: DEAorig.xls  
>  
>  
>> State Plane Washington North feet.  
>> I can send you native Arcview shape files if you wish  
>>  
>> Vaughn Collins, P.E.  
>> Snohomish County Public Works, Surface Water Management  
>> 2731 Wetmore Av, Ste 300  
>> Everett, WA 98201-3581  
>> 425.388.3464 x4619 FAX 425.388.6455  
>> vaughn.collins@co.snohomish.wa.us  
>>  
>>  
>> -----Original Message-----  
>> From: Todd Bennett [mailto:tbenett@westconsultants.com]  
>> Sent: Tuesday, May 16, 2000 4:15 PM  
>> To: Collins, Vaughn  
>> Subject: Re: DEAorig.xls  
>>  
>>  
>> Vaughn,  
>>  
>> Thanks. We're bringing the file into ArcView now. What coordinate  
system  
>> are the data in (State Plane? UTM?)? I assume the X and Y coordinates  
> are

>> in feet, correct?  
>>  
>> ~Todd  
>>  
>>  
>>  
>> ----- Original Message -----  
>> From: Collins, Vaughn <Vaughn.Collins@co.snohomish.wa.us>  
>> To: Todd H. Bennett (E-mail) <tbennett@westconsultants.com>  
>> Sent: Tuesday, May 16, 2000 3:47 PM  
>> Subject: DEAorig.xls  
>>  
>>  
>>> <<DEAorig.xls>> Todd: Heres the survey data in excel format. You  
should  
>> be  
>>> able to bring it into Arcview with no problem. FYI, I used CORPSCON  
>> program  
>>> to convert the data to NGVD29 vertical datum.  
>>>  
>>> Vaughn  
>>>  
>>  
>  
>

---

**CR#18**

From: "Collins, Vaughn" <Vaughn.Collins@co.snohomish.wa.us>  
To: "'Todd Bennett'" <tbennett@westconsultants.com>  
Subject: RE: Snohomish River Data from DEA  
Date: Thursday, May 11, 2000 9:41 AM

I am booked up probably the rest of the week, but have mostly finished the data conversion. I will try to get to you maybe Friday, or next Monday. Do you run ArcView?

We are surveying cross sections right now, will be a couple more weeks for those.

Vaughn Collins, P.E.  
Snohomish County Public Works, Surface Water Management  
2731 Wetmore Av, Ste 300  
Everett, WA 98201-3581  
425.388.3464 x4619 FAX 425.388.6455  
vaughn.collins@co.snohomish.wa.us

-----Original Message-----  
From: Todd Bennett [mailto:tbennett@westconsultants.com]  
Sent: Monday, May 08, 2000 11:23 AM

To: Vaughn Collins  
Cc: Dan Harvey  
Subject: Fw: Snohomish River Data from DEA

Vaughn,

Hello. Hope you had a good weekend. Just checking in to see what the latest news is on the QAQC of the data and the conversion to NGVD. Let me know when you get a chance.

Thanks,

~Todd

----- Original Message -----

From: Ray Walton <mailto:rwalton@westconsultants.com>  
To: Collins, Vaughn <mailto:Vaughn.Collins@co.snohomish.wa.us>  
Cc: Todd Bennett <mailto:tbennett@westconsultants.com> ; Chris Eggers <mailto:ceggers@westconsultants.com>  
Sent: Thursday, April 27, 2000 9:17 AM  
Subject: Re: Snohomish River Data from DEA

Vaughn:

Todd is out this week anyway. So, please go ahead and process the data for the vertical datum. I would then be grateful if you would send the corrected (finalized) data directly to Todd.

Thanks

Ray Walton

I have the surveys in hand. I can email as is, or you can wait until I do a little processing. Right now the data is in NAVD88 meters, and I will be converting it to NGVD29 ft. I also have not done any quality checks on the levee profile points yet. What is your preference? If I don't hear otherwise, I will send you converted data hopefully by end of the week. Vaughn Collins, P.E.

Snohomish County Public Works, Surface Water Management  
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-----Original Message-----

From: Todd Bennett [mailto:tbennett@westconsultants.com  
<mailto:tbennett@westconsultants.com> ]

Sent: Monday, April 24, 2000 12:34 PM  
To: Vaughn Collins  
Cc: Raymond Walton  
Subject: Data from DEA

Vaughn, Hi. I hope all is going well up in Snohomish County. As I mentioned on the phone last week I will be working out of the office until Tuesday, May 2nd. When you hear from DEA on the survey data will you cc: Ray as well to give him the update? Thanks, ~Todd

\*\*\*\*\*

Todd H. Bennett  
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## **CR#19**

From: "Harvey, Daniel R NWS" <[Daniel.R.Harvey@NWS02.usace.army.mil](mailto:Daniel.R.Harvey@NWS02.usace.army.mil)>  
To: "Todd Bennett" <[tbennett@westconsultants.com](mailto:tbennett@westconsultants.com)>  
Cc: "Weber, Joseph T NWS" <[Joseph.T.Weber@NWS02.usace.army.mil](mailto:Joseph.T.Weber@NWS02.usace.army.mil)>; "Wagner, Wayne E NWS" <[Wayne.E.Wagner@NWS02.usace.army.mil](mailto:Wayne.E.Wagner@NWS02.usace.army.mil)>  
Subject: RE: Snohomish River Data from DEA  
Date: Friday, May 05, 2000 8:29 AM

Todd, No we haven't completed the scanning yet but we will get on this right away.

Dan Harvey  
X3660

-----Original Message-----

From: Todd Bennett [[SMTP:tbennett@westconsultants.com](mailto:tbennett@westconsultants.com)]  
Sent: Friday, May 05, 2000 08:16  
To: Dan Harvey  
Subject: Fw: Snohomish River Data from DEA

Dan,

Hello. If you haven't heard already from Vaughn, the Snohomish survey is completed and now they are quality checking the data and converting it to NGVD (see forwarded e-mail below). I wanted to check in with you to see where the scanning of the base maps stands. Has the Corps finished having the maps converted to digital format?

Thanks. Have a good weekend.

~Todd

----- Original Message -----

From: Ray Walton <mailto:rwalton@westconsultants.com>  
To: Collins, Vaughn <mailto:Vaughn.Collins@co.snohomish.wa.us>  
Cc: Todd Bennett <mailto:tbennett@westconsultants.com> ; Chris Eggers <mailto:ceggers@westconsultants.com>  
Sent: Thursday, April 27, 2000 9:17 AM  
Subject: Re: Snohomish River Data from DEA

Vaughn:

Todd is out this week anyway. So, please go ahead and process the data for the vertical datum. I would then be grateful if you would send the corrected (finalized) data directly to Todd.

Thanks

Ray Walton

I have the surveys in hand. I can email as is, or you can wait until I do a little processing. Right now the data is in NAVD88 meters, and I will be converting it to NGVD29 ft. I also have not done any quality checks on the levee profile points yet. What is your preference? If I don't hear otherwise, I will send you converted data hopefully by end of the week. Vaughn Collins, P.E.

Snohomish County Public Works, Surface Water Management

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vaughn.collins@co.snohomish.wa.us

-----Original Message-----

From: Todd Bennett [mailto:tbennett@westconsultants.com <mailto:tbennett@westconsultants.com> ]  
Sent: Monday, April 24, 2000 12:34 PM  
To: Vaughn Collins  
Cc: Raymond Walton  
Subject: Data from DEA

Vaughn, Hi. I hope all is going well up in Snohomish County. As I mentioned on the phone last week I will be working out of the office until Tuesday, May 2nd. When you hear from DEA on the survey data will you cc: Ray as well to give him the update? Thanks, ~Todd

\*\*\*\*\*

Todd H. Bennett

Senior Engineer  
WEST Consultants, Inc.  
12509 Bel-Red Road, Suite 100  
Bellevue, WA 98005-2535  
(425) 646-8806  
(425) 646-0570 Fax E-Mail:

tbennett@westconsultants.com <mailto:tbennett@westconsultants.com>  
Visit us at: www.westconsultants.com  
<http://www.westconsultants.com>

\*\*\*\*\*

---

**CR#20**

From: "Collins, Vaughn" <Vaughn.Collins@co.snohomish.wa.us>  
To: "Todd Bennett" <tbennett@westconsultants.com>  
Subject: RE: Snohomish River Survey  
Date: Tuesday, April 11, 2000 8:05 AM

DEA stopped by yesterday. HWMs should be in this week 2 days. Levees are being surveyed now and should be processed by next week. We are starting XS surveys this week, but will probably be 3 weeks for that data if ready.

Regarding levee and XS data:

I intend to send you to send you the XYZ points files only for the levee elevations and let you process them into profiles if needed. Since UNET can't handle real profiles anyway you may not even need to generate true profiles. The cross sections we will process unless you want the points file to process yourself in the interest of time.

Vaughn Collins, P.E.  
Snohomish County Public Works, Surface Water Management  
2731 Wetmore Av, Ste 300  
Everett, WA 98201-3581  
425.388.3464 x4619 FAX 425.388.6455  
vaughn.collins@co.snohomish.wa.us

-----Original Message-----

From: Todd Bennett [mailto:tbennett@westconsultants.com]  
Sent: Monday, April 10, 2000 4:17 PM  
To: Collins, Vaughn  
Cc: Dan Harvey; Raymond Walton  
Subject: Re: Snohomish River Survey

Vaughn,

Hello. Just checking in to see how the survey is coming along. How is DEA progressing?

Thanks,

~Todd

----- Original Message -----

From: Collins, Vaughn <Vaughn.Collins@co.snohomish.wa.us>  
To: Todd H. Bennett (E-mail) <tbennett@westconsultants.com>;  
<rwalton@westconsultants.com>  
Sent: Tuesday, March 28, 2000 9:58 AM  
Subject: Snohomish River Survey

> DEA is starting survey this week, and estimates HWM will be available end  
> of  
> next week. Levee data will be available another couple weeks after that.  
>  
> Vaughn Collins, P.E.  
> Snohomish County Public Works, Surface Water Management  
> 2731 Wetmore Av, Ste 300  
> Everett, WA 98201-3581  
> 425.388.3464 x4619 FAX 425.388.6455  
> vaughn.collins@co.snohomish.wa.us  
>

---

## **CR#21**

From: <lafuste@usgs.gov>  
To: "Todd Bennett" <tbennett@westconsultants.com>  
Subject: Re: Measured Discharge on the Snohomish River at Monroe  
Date: Tuesday, March 14, 2000 2:42 PM

I found the summary of discharge measurements containing the information you needed less the time of the measurement. I annotated the time of completion of the measurement from the actual field measurement sheets except for the two oldest measurements (#38 and #46). These field notes reside in Federal Archives and would need to be requested. I do not know how critical is the time of the measurement for your purposes. You will need to ascertain whether or not it is worth checking the archive records. For the other measurements, I am sending you hard copies of the 9-207 forms containing the summaries and I am indicating via this email the time of measurement derived from the field notes:

Measurement No.	Time
38	unknown
46	unknown

98	1735
105	1405
118	1145
119	1120
133	1216
140	1500
147	1240

Questions? Call me or send email.  
If you wish to contact me directly:

Name: Luis A. Fuste  
Occupation: Information Officer (Hydrologist)

Address: U.S. Geological Survey  
Water Resources Division  
1201 Pacific Avenue - Suite 600  
Tacoma, WA 98402

Telephone: 253-428-3600, Extension 2653 (voice mail)

FAX: 253-428-3614

E-mail: lafuste@usgs.gov  
pubinfo@fs02dwatcm.wr.usgs.gov

Business  
hours: 6:30 AM to 3:00 PM normally.  
(I am occasionally here until 4:30 PM)

"Todd Bennett"  
<tbennett@westconsultants.com> To: "Luis A Fuste" <lafuste@usgs.gov>  
cc:  
Subject: Measured Discharge on the Snohomish River at Monroe  
03/09/00 09:46 AM

Luis,

Hello. I hope all is going well over at the GS.

Evan Templeton just called and said he had spoken to you regarding this.  
So here are the details regarding what we are looking for.

We would like to get the date, time, stage, and discharge of the measured points above 30,000 cfs on the rating curve for USGS Gage #12150800, Snohomish River at Monroe. This appears to be a total of about 9 points from the graphical plot of the rating curve and measured discharge at the gage.

I have the measured discharge prior to Dec. 1983 for rating #8 and #9

(these are measured discharges numbered 158 through 227) from what you had previously sent to us. Unfortunately, none of these points are on the high water curve.

Is this doable? Please call or e-mail if you have any questions.

Thank you for your help,

~Todd

\*\*\*\*\*

Todd H. Bennett  
Senior Engineer  
WEST Consultants, Inc.  
12509 Bel-Red Road, Suite 100  
Bellevue, WA 98005-2535  
(425) 646-8806  
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Visit us at: [www.westconsultants.com](http://www.westconsultants.com)

For water resources info: [www.wreinfo.com](http://www.wreinfo.com)

\*\*\*\*\*

---

## **CR#22**

From: "Collins, Vaughn" <[Vaughn.Collins@co.snohomish.wa.us](mailto:Vaughn.Collins@co.snohomish.wa.us)>  
To: "'Todd Bennett'" <[tbennett@westconsultants.com](mailto:tbennett@westconsultants.com)>  
Subject: RE: 95STAGE.XLS  
Date: Monday, March 13, 2000 10:52 AM

I don't recall converting 95 data to flow.  
I finally got all my req'd signatures and met with David Evans survey crew last week. They should give me firm timeline by tomorrow or Wednesday. HWMs are priority and will be done first.

Vaughn Collins, P.E.  
Snohomish County Public Works, Surface Water Management  
2731 Wetmore Av, Ste 300  
Everett, WA 98201-3581  
425.388.3464 x4619 FAX 425.388.6455  
[vaughn.collins@co.snohomish.wa.us](mailto:vaughn.collins@co.snohomish.wa.us)

-----Original Message-----

From: Todd Bennett [<mailto:tbennett@westconsultants.com>]  
Sent: Monday, March 13, 2000 10:49 AM  
To: Collins, Vaughn  
Subject: Re: 95STAGE.XLS

Vaughn,

Hi. Hope you had a good weekend.

Two items for you. One, just checking in on the latest estimate on completion of the levee and high water mark survey. Two, I wanted to confirm that for the Monroe data you sent last week that Snohomish Co. hasn't already converted to flow from the stage data. On the latter, we're converting selected data points based on the rating curve and just wanted to make sure we weren't duplicating efforts.

Thanks,

~Todd

----- Original Message -----

From: Collins, Vaughn <Vaughn.Collins@co.snohomish.wa.us>

To: Todd H. Bennett (E-mail) <tbennett@westconsultants.com>

Sent: Wednesday, March 08, 2000 8:10 AM

Subject: 95STAGE.XLS

> <<95STAGE.XLS>> Todd:

> This data from our Emer. Mngt folks calling the NWS gages during the event.

> I am looking for 1990 French Cr stage data. I somewhere have a copy of the

> circular strip chart record from the recorder. I suspect we never digitized

> this in, or did the survey needed to get the data on NGVD29. - Vaughn

>

---

## **CR#23**

From: "Todd Bennett" <tbennett@westconsultants.com>

To: "Vaughn Collins" <Vaughn.Collins@co.snohomish.wa.us>

Subject: Fw: Snohomish River

Date: Thursday, March 02, 2000 2:02 PM

Vaughn,

Hi again. I should have been more specific in the e-mail I sent - we're searching for hourly data. I wanted to check to see if you had anything readily available before trying to get data through the USGS.

Thanks,

~Todd

----- Original Message -----

From: Todd Bennett  
To: Vaughn Collins  
Sent: Thursday, March 02, 2000 1:57 PM  
Subject: Snohomish River

Vaughn,

Hi. Hope all is going well up there in Snohomish County.

I have a question for you regarding stage data on the Snohomish River. On January 24th you sent an e-mail to us with a stage hydrograph for the Dec. 1990 event at the City of Snohomish gage. Do you have a similar observed hydrograph for this event at the French Slough Pumping Station? I saw stage data with time at both of these gages for the Nov. 1989 event in a copy of a Snohomish County report so I thought I'd check with you.

Also, we're looking at the characteristics of the November 1995 flood. Do you have a flow or stage hydrograph for this event (or any other out-of-bank events)?

Thanks again for your continuing help.

~Todd

\*\*\*\*\*

Todd H. Bennett  
Senior Engineer  
WEST Consultants, Inc.  
12509 Bel-Red Road, Suite 100  
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(425) 646-8806  
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E-Mail: [tbennett@westconsultants.com](mailto:tbennett@westconsultants.com)  
Visit us at: [www.westconsultants.com](http://www.westconsultants.com)

For water resources info: [www.wreinfo.com](http://www.wreinfo.com)  
\*\*\*\*\*

---

**CR#24**

From: "DAN PARKER" <[PARKER.DAN@epamail.epa.gov](mailto:PARKER.DAN@epamail.epa.gov)>  
To: <[tbennett@westconsultants.com](mailto:tbennett@westconsultants.com)>  
Subject: STORET request  
Date: Thursday, February 10, 2000 8:13 AM

Hello,

I have attached the file TBENNETT.TXT which contains the output from a STORET data retrieval report based on your request. The report indicates there was only one observation found for the data you requested.

Dan Parker  
STORET

---

## **CR#25**

From: "Weber, Joseph T NWS" <Joseph.T.Weber@NWS02.usace.army.mil>  
To: "Todd Bennett" <tbennett@westconsultants.com>  
Subject: RE: Everett Tidal Frequency Curve Data  
Date: Wednesday, February 09, 2000 9:09 AM

Todd,

If you need the Tidal Datum Plane data, you can find it on our WEB site <http://www.nws.usace.army.mil/> under Water Management, Reservoir Control Center, Tide Datums.

Joe Weber

> -----Original Message-----

> From: Todd Bennett [SMTP:tbennett@westconsultants.com]  
> Sent: Tuesday, February 08, 2000 17:47  
> To: Weber, Joseph T NWS  
> Subject: Re: Everett Tidal Frequency Curve Data

>

> Joe,

>

> Thanks for the quick reply.

>

> ~Todd

>

>

> ----- Original Message -----

> From: Weber, Joseph T NWS <Joseph.T.Weber@NWS02.usace.army.mil>  
> To: Todd Bennett (E-mail) <tbennett@westconsultants.com>  
> Cc: Wagner, Wayne E NWS <Wayne.E.Wagner@NWS02.usace.army.mil>  
> Sent: Tuesday, February 08, 2000 4:28 PM  
> Subject: Everett Tidal Frequency Curve Data

>

>

>> Todd,

>>

>> Here's an Excel workbook with the Puget Sound Tidal Frequency data.

>> <<Tidal Elevations for Puget Sound.xls>>

>>

>> Everett is one of the stations included in the workbook.

>>

>> Joe Weber

>> Program Manager, Flood Plain  
>> Management Services  
>>  
>>  
>> U.S. Army Corps  
>> of Engineers  
>> Seattle District  
>> Hydraulics & Hydrology Section  
>> PO Box 3755  
>> Seattle, WA 98124-3755  
>>  
>> Phone: (206) 764-3661 voice mail line  
>> (206) 764-3660 rings till  
>> answered  
>> Fax: (206) 764-6678  
>> E-mail: joseph.t.weber@usace.army.mil  
>>  
>>  
>>

---

**CR#26**

From: "Collins, Vaughn" <Vaughn.Collins@co.snohomish.wa.us>  
To: "Todd H. Bennett (E-mail)" <tbennett@westconsultants.com>  
Subject: Breach locations photo  
Date: Tuesday, February 08, 2000 10:55 AM

<<snobrch.jpg>> My approx scaling shows large ds breach about 1000 ft  
(although scour hole is only about 500 ft wide) and second breach about 250  
ft. No useful snohomish stage data found. - Vaughn

---

**CR#27**

From: Vaughn Collins [mailto:Vaughn.Collins@co.snohomish.wa.us]  
Sent: Monday, January 24, 2000 10:43 AM  
To: 'ceppers@westconsultants.com'  
Subject: Snohomish 1990 Flood data

Attached is an excel ss with Snohomish @ Snohomish observed stage data (red  
font in test90b worksheet). Also chart "SNAW CH" shows my results of  
running 1990 flood with and without Marshland breaches & compared with  
observed data.

Snohomish County Public Works, Surface Water Management  
2731 Wetmore Av, Ste 300  
Everett, WA 98201-3581  
425.388.3464 x4619 FAX 425.388.6455  
vaughn.collins@co.snohomish.wa.us  
<<TEST90B2.XLS>>

---

**CR#28**

From: "Todd Bennett" <tbennett@westconsultants.com>  
To: <Daniel.R.Harvey@nws02.usace.army.mil>; "Raymond Walton" <rwalton@westconsultants.com>  
Subject: Snohomish River Survey  
Date: Tuesday, January 04, 2000 6:43 PM

Dan,

Hello. I hope the Holidays treated you well.

I spoke with Vaughn yesterday and I just wanted to let you know they're estimating that they may be able to complete the top-of-levee and highwater mark survey near the end of January. Just wanted to keep you up-to-date.

Take care,

~Todd

\*\*\*\*\*  
Todd H. Bennett  
WEST Consultants, Inc.  
12509 Bel-Red Road, Suite 100  
Bellevue, WA 98005-2535  
(425) 646-8806  
(425) 646-0570 Fax  
E-Mail: tbennett@westconsultants.com  
Visit us at: www.westconsultants.com  
\*\*\*\*\*

---

**CR#29**

From: "Weber, Joseph T NWS" <Joseph.T.Weber@NWS02.usace.army.mil>  
To: "Todd Bennett (E-mail)" <tbennett@westconsultants.com>  
Subject: FW: Snohomish 1990 High Water Marks  
Date: Thursday, December 30, 1999 5:11 PM

Todd,

I reworked some of the files for the Snohomish 1990 high water marks so they could be properly displayed and sent them to Snohomish County. Here's a copy for you.

Joe Weber

> -----Original Message-----  
> From: Weber, Joseph T NWS

> Sent: Thursday, December 30, 1999 17:03  
> To: Christine Coats (E-mail)  
> Subject: Snohomish 1990 High Water Marks  
>  
> Christine,  
>  
> I have been working with Deb Haynes to fix the high water mark shape files  
> I recently sent you. The previous files were stored in a projected  
> fromat. I worked with our GIS Coordinator to get them stored in standard  
> Lat./Long. format. Attached is a Winzip file containing ArcInfo and  
> ArcView versions of the files in the following two standard formats:  
> UTM-1927 and UTM-1983.  
> <<Sno.zip>> The USGS quads are not included. Also, I added the following  
> fields to each of the attributes tables: Name, which contains the high  
> water mark name or number; and 1990hwmel, wich contains the 1990 flood  
> elevation. This allows both of these fields to be displayed beside the  
> high water marks via the auto-label function.  
>  
> Please let me know if you are able to successfully use the files.  
>  
>  
> Joe Weber  
> Program Manager, Flood Plain  
> Management Services  
>  
>  
> U.S. Army Corps  
> of Engineers  
> Seattle District  
> Hydraulics & Hydrology Section  
> PO Box 3755  
> Seattle, WA 98124-3755  
>  
> Phone: (206) 764-3661 voice mail line  
> (206) 764-3660 rings till answered  
> Fax: (206) 764-6678  
> E-mail: joseph.t.weber@usace.army.mil  
>

---

**CR#30**

From: "Weber, Joseph T NWS" <Joseph.T.Weber@NWS02.usace.army.mil>  
To: "Todd Bennett (E-mail)" <tbennett@westconsultants.com>  
Subject: Snohomish River 1990 High Water Marks  
Date: Monday, December 20, 1999 12:32 PM

Todd

The attached Winzip file contains the ArcView files for the 1990 high water

marks on the Snohomish River.

<<Snohomish.zip>>

After you unzip the file, please let me know if you are able to successfully read the unzipped files in ArcView.

Joe Weber  
Program Manager, Flood Plain  
Management Services

U.S. Army Corps  
of Engineers  
Seattle District  
Hydraulics & Hydrology Section  
PO Box 3755  
Seattle, WA 98124-3755

Phone: (206) 764-3661 voice mail line  
(206) 764-3660 rings till answered  
Fax: (206) 764-6678  
E-mail: joseph.t.weber@usace.army.mil

---

## **CR#31**

From: Weber, Joseph T NWS [mailto:Joseph.T.Weber@NWS02.usace.army.mil]  
Sent: Tuesday, November 30, 1999 4:42 PM  
To: Vaughn Collins (E-mail)  
Cc: Harvey, Daniel R NWS; Wagner, Wayne E NWS; Lawrence P. Basich, P.E. (E-mail); Tom Grindeland (E-mail)  
Subject: Snohomish RFIS High Water Marks

Vaughn,

Per our telephone conversation, I set the 1990 high water marks north of Marshlands and in the Fryelands ponding area last week. I will send you copies of my field notes and map showing the location of the high water marks next week so your crew can survey the elevations. We still need to get some additional marks upstream of Marshlands to HWY 522. I plan to do that next week and will forward the information for these additional marks A.S.A.P.

When do you expect to let the survey contract.?

Joe

---

## **CR#32**

From: "Todd Bennett" <tbennett@westconsultants.com>

To: "Vaughn Collins" <Vaughn.Collins@co.snohomish.wa.us>  
Subject: Levee profiles  
Date: Tuesday, November 16, 1999 6:10 PM

Vaughn,

Hi. I just left you a voice mail regarding this. We do not have the report that you mentioned that includes the levee profiles. Will you please send us one? Our address is below if you don't have it handy. Thanks!

~Todd

\*\*\*\*\*  
Todd H. Bennett  
WEST Consultants, Inc.  
12509 Bel-Red Road, Suite 100  
Bellevue, WA 98005-2535  
(425) 646-8806  
(425) 646-0570 Fax  
E-Mail: tbennett@westconsultants.com  
Visit us at: www.westconsultants.com  
\*\*\*\*\*

---

**CR#33**

From: "Luis A Fuste, Hydrologist, Tacoma, WA " <lafuste@usgs.gov>  
To: <tbennett@westconsultants.com>  
Cc: "Luis A Fuste, Hydrologist, Tacoma, WA " <lafuste@usgs.gov>  
Subject: re: peaks prior to 1963 for 12150800  
Date: Wednesday, October 13, 1999 7:48 AM

Todd: I was able to find the published (in Water Supply Paper 1932)  
annual maximum gage heights prior to 1963

02/27/1932 34.0  
12/27/1933 34.2  
02/10/1951 35.8  
12/15/1959 34.1  
01/08/1962 27.64  
11/20/1962 31.27

I am sending you via fax copies of the data retrieved from the Water Supply Paper as well as a note from a former employee dated 4/27/62. I was unable to locate the stage data cited as approximate annual maximum stage for water years 1921, 1949-50, 1952-59, and 1961.

You are advised to contact John Jern to ascertain if he knows the whereabouts of these data. He can be reached at jjerns@usgs.gov. Another possible contact is William Wiggins, Tacoma Field Office Chief at wwiggins@usgs.gov

I was unable to locate the records in archives.

If you wish to contact me directly:

Name: Luis A. Fuste  
Occupation: Information Officer (Hydrologist)

Address: U.S. Geological Survey  
Water Resources Division  
1201 Pacific Avenue - Suite 600  
Tacoma, WA 98402

Telephone: 253-428-3600, Extension 2653 (voice mail)

FAX: 253-428-3614

E-mail: lafuste@usgs.gov  
pubinfo@fs02dwatch.wr.usgs.gov

Business

hours: 6:30 AM to 3:00 PM normally.  
(I am occasionally here until 4:30 PM)

---

## **CR#34**

From: "Luis A Fuste, Hydrologist, Tacoma, WA " <lafuste@usgs.gov>  
To: "Todd Bennett" <tbennett@westconsultants.com>  
Cc: "Luis A Fuste, Hydrologist, Tacoma, WA " <lafuste@usgs.gov>  
Subject: Re: Annual peaks for 12150800  
Date: Wednesday, October 13, 1999 6:06 AM

Todd: Here are the annual peaks requested for station 12150800:

Water Year	Date	Flow	Stage
1996	11/30/95	132000	24.10
1997	03/20/97	65800	16.84
1998	10/30/97	52500	14.23
1999	12/30/98	64300	16.56

Questions? Call me or send email.

On Fri, 8 Oct 1999 09:07:33 -0700  
"Todd Bennett" said:  
> This is a multi-part message in MIME format.  
>  
> -----=\_NextPart\_000\_0007\_01BF116C.8E4E4EA0  
> Content-Type: text/plain;  
> charset="iso-8859-1"

> Content-Transfer-Encoding: quoted-printable  
>  
> Luis,  
>  
> Hello. I hope your work still isn't going at the same crazy pace it was =  
> the last time we talked.  
>  
> When you have an opportunity could you have someone pull the annual peak =  
> flows for Snohomish River Near Monroe, Station 12150800, for water years =  
> 1996 through 1999. Also, are annual peaks prior to water year 1963 =  
> available (we've downloaded WY 1963 - 1995 from your web page)? The =  
> Water Resources Data Report for Washington refers to data recorded =  
> prior to then, especially in the 30's through the 60's. We are =  
> performing a sensitivity analysis on how this additional data affects =  
> the flood flow frequency values.  
>  
> Thank you for your help,  
>  
> ~Todd  
>  
>  
>  
> \*\*\*\*\*  
> Todd H. Bennett  
> WEST Consultants, Inc.  
> 12509 Bel-Red Road, Suite 100  
> Bellevue, WA 98005-2535  
> (425) 646-8806  
> (425) 646-0570 Fax  
> E-Mail: tbennett@westconsultants.com  
> Visit us at: www.westconsultants.com  
> \*\*\*\*\*  
>

If you wish to contact me directly:

Name: Luis A. Fuste  
Occupation: Information Officer (Hydrologist)

Address: U.S. Geological Survey  
Water Resources Division  
1201 Pacific Avenue - Suite 600  
Tacoma, WA 98402

Telephone: 253-428-3600, Extension 2653 (voice mail)

FAX: 253-428-3614

E-mail: lafuste@usgs.gov  
pubinfo@fs02dwatcm.wr.usgs.gov

Business  
hours: 6:30 AM to 3:00 PM normally.

(I am occasionally here until 4:30 PM)

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**CR#35**

From: "Lencioni, James L NWS" <James.L.Lencioni@NWS02.usace.army.mil>  
To: "Todd Bennett" <tbennett@westconsultants.com>  
Subject: RE: Snohomish River FIS Progress Report  
Date: Monday, September 20, 1999 11:27 AM

Todd, Attached are two files from the previous FIS. File snoho1.gr is the groundline data and file snoho2 is the backwater model. When you come by tomorrow morning I will explain to you the format for the backwater model input. PLEASE NOTE that the distances in the cross section file need to be MULTIPLIED by 10 and the overbank elevations have been raised in some areas to reflect ineffective flow area. I also have the plotted cross sections at my desk for your review and use. Unfortunately, I am not sure that the overbank elevations on the cross section plots are actual values or whether some of it also has been raised for ineffective flow purposes.

<<SNOHO1.GR>>                      <<SNOHO2>>                      Jim

> -----Original Message-----

> From: Todd Bennett [SMTP:tbennett@westconsultants.com]  
> Sent: Monday, September 20, 1999 11:03 AM  
> To: Jim Lencioni  
> Cc: Raymond Walton; Vaughn Collins  
> Subject: Snohomish River FIS Progress Report

>

> Jim,

>

> Hi. Attached is a summary of our phone conversation earlier this morning.

> It is in Word 97 format.

>

> ~Todd

>

>

> \*\*\*\*\*

> Todd H. Bennett  
> WEST Consultants, Inc.  
> 12509 Bel-Red Road, Suite 100  
> Bellevue, WA 98005-2535  
> (425) 646-8806  
> (425) 646-0570 Fax  
> E-Mail: tbennett@westconsultants.com <mailto:tbennett@westconsultants.com>  
> Visit us at: www.westconsultants.com <http://www.westconsultants.com>

> \*\*\*\*\* << File: Memo 9-20-99 -

> Progress Report.doc >>

---

**CR#36**

From: "Luis A Fuste, Hydrologist, Tacoma, WA " <lafuste@usgs.gov>  
To: <tbennett@westconsultants.com>  
Cc: "Luis A Fuste, Hydrologist, Tacoma, WA " <lafuste@usgs.gov>  
Subject: re: records restoration  
Date: Tuesday, September 14, 1999 2:25 PM

Todd: The data requested now reside on our anonymous ftp server. The file to retrieve is

BENNETT.DAT

Questions? Call me or send email. You will receive a bill for \$100 to cover the cost of processing this request.

If you wish to contact me directly:

Name: Luis A. Fuste  
Occupation: Information Officer (Hydrologist)

Address: U.S. Geological Survey  
Water Resources Division  
1201 Pacific Avenue - Suite 600  
Tacoma, WA 98402

Telephone: 253-428-3600, Extension 2653 (voice mail)

FAX: 253-428-3614

E-mail: lafuste@usgs.gov  
pubinfo@fs02dwatch.wr.usgs.gov

Business

hours: 6:30 AM to 3:00 PM normally.  
(I am occasionally here until 4:30 PM)

NOTICE: ANY DATA YOU HAVE SECURED FROM THE USGS NATIONAL WATER INFORMATION

SYSTEM (NWIS), FOR THE TIME PERIOD UP TO SEPTEMBER 30, 1998, HAVE BEEN APPROVED FOR RELEASE AND PUBLICATION BY THE DIRECTOR OF THE USGS. THIS DATABASE HAS BEEN SUBJECTED TO RIGOROUS REVIEW AND IS SUBSTANTIALLY COMPLETE. (THE USGS RESERVES THE RIGHT TO REVISE THE

DATA PURSUANT TO FURTHER ANALYSIS AND REVIEW, HOWEVER.)

THE DATA FROM NWIS FOR THE TIME PERIOD OF OCTOBER 1, 1998 TO THE

PRESENT HAVE NOT RECEIVED DIRECTOR'S APPROVAL AND AS SUCH ARE PROVISIONAL AND SUBJECT TO REVISION. THESE DATA ARE REVIEWED THOROUGHLY AFTER THE END OF THE WATER YEAR, AND ARE APPROVED BY THE DIRECTOR USUALLY BY APRIL-AUGUST OF THE FOLLOWING YEAR. THE DATES ON THIS NOTICE CHANGE WHEN THAT ANNUAL APPROVAL OCCURS.

ALL DATA ARE RELEASED ON THE CONDITION THAT NEITHER THE USGS NOR THE UNITED STATES GOVERNMENT MAY BE HELD LIABLE FOR ANY DAMAGE RESULTING FROM ITS AUTHORIZED OR UNAUTHORIZED USE.

ANY QUESTIONS REGARDING THIS POLICY CAN BE ADDRESSED TO LUIS A. FUSTE, INFORMATION OFFICER.

Instructions for users of the anonymous ftp on how to retrieve:

---

1. type either the name or address of the Internet address:

ftp fs01dwatchm.wr.usgs.gov  
ftp 130.118.134.92

2. when name is asked type: anonymous

3. when password is asked: (anything will do)

4. type: cd pub/inquiries

5. type: get 'filename'

6. type: quit

#### FOR USERS WHO HAVE ACCESS TO A WEB BROWSER:

1. Using the web browser, open the USGS - Water Resources of Washington's Web Page, which is:

<http://wwwdwatchm.wr.usgs.gov>

2. Once connected to our web page, click on the link "Public Inquiries: Can I help you?"

3. Next, click on "Inquiry files customer pick up"

4. This will display a list of files in our inquiries pick up directory (anonymous ftp server). Click on the name of the file you are retrieving. The name of the file(s) to be retrieved are obtained through the Information Officer.

5. The file will be displayed on your screen. Using your web browser, you will need to 'save' the file to your system/site.

6. Once you are done saving the file, you are done retrieving the file. Therefore, you can now exit the browser.

7. The last step is for you to import the file(s) that were retrieved into whatever software program you plan on using.

\*\*\*\*\*  
\*\*\*\*\*NOTICE\*\*\*\*\*  
\*\*\*\*\*

Files that are downloaded into the ftp anonymous server will be deleted after ten days.

\*\*\*\*\*NOTICE\*\*\*\*\*  
\*\*\*\*\*

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**CR#37**

From: "Todd Bennett" <tbennett@westconsultants.com>  
To: "Vaughn Collins" <Vaughn.Collins@co.snohomish.wa.us>  
Subject: Ebey Slough Cross-section ES 6.4  
Date: Wednesday, August 25, 1999 6:51 AM

Vaughn,

Hello. Thanks again for taking the time out yesterday to answer my Snohomish R. FEQ questions.

Last night I took a look at the Ebey Slough field data for the cross-section with the anomalous data point (ES 6.4). It appears that the stationing for elev. -33.7 and -11.7 were switched. If you look at the depth sounding chart Pt. A is shown at Station 140, Pt. B at Station 97, but on the hand written notes in the upper right had corner of the chart these stations are reversed. Take a look at it when you get a chance and see if you concur. When these stations are swapped the cross-section plot looks much more similar to what is shown on the sounding chart.

~Todd

\*\*\*\*\*  
Todd H. Bennett  
WEST Consultants, Inc.  
12509 Bel-Red Road, Suite 100  
Bellevue, WA 98005-2535  
(425) 646-8806  
(425) 646-0570 Fax  
E-Mail: tbennett@westconsultants.com  
Visit us at: www.westconsultants.com  
\*\*\*\*\*

**CR#38**

From: "Todd Bennett" <tbennett@westconsultants.com>  
To: "Luis A Fuste" <lafuste@usgs.gov>  
Subject: Fw: USGS Station 12150800, Snohomish River near Monroe, WA  
Date: Thursday, August 19, 1999 8:31 AM

Luis,

Hello. I received your voice mail this morning. Sounds like you start your work day very early.

In addition to the data that Scott Knowles is compiling for us we would like to obtain hourly flow and stage data for the water years when the stage/discharge relationship (rating curve) was developed for the Monroe gage. It is my understanding that the days and times when the discharge measurements were collected in the field are flagged in the USGS data base. Please call or e-mail if this is not the case or if you have any further questions.

Thank you,

~Todd

----- Original Message -----

From: Luis A Fuste, Hydrologist, Tacoma, WA <lafuste@usgs.gov>  
To: Scott M Knowles, Hydrologist, Tacoma, WA <sknowles@usgs.gov>  
Cc: Luis A Fuste, Hydrologist, Tacoma, WA <lafuste@usgs.gov>; <tbennett@westconsultants.com>  
Sent: Tuesday, August 10, 1999 8:37 AM  
Subject: re: request for records restoration

Scott: I need unit values of flow and stage restored for Station 12150800 for Water Years 1987, 1990, and 1991.

The request is for Todd Bennett of West Consultants. Thanks. Please let me know when the data are restored. Mr. Bennett would appreciate receiving the data by next week.

----- Forwarded Message

From: Luis A Fuste, Hydrologist, Tacoma, WA <lafuste@usgs.gov>  
To: <tbennett@westconsultants.com>  
Cc: Luis A Fuste, Hydrologist, Tacoma, WA <lafuste@usgs.gov>; Scott M Knowles, Hydrologist, Tacoma, WA <sknowles@usgs.gov>  
Sent: Wednesday, August 04, 1999 8:15 AM  
Subject: re: Snohomish River near Monroe data requested

Tod: In response to your telephone call of July 26 and email on July 27 message:

The cost to restore the data requested is \$50 per station per year. The total cost for your request to for flow and stage data for station 12150800 for Water Years 1987, 1990, and 1991 will be \$150. If you wish to proceed with this request please advise whether you accept the

associated fee. We will restore the records and send them via anonymous ftp server. We will send you the bill via separate mail.

If you wish to contact me directly:

Name: Luis A. Fuste  
Occupation: Information Officer (Hydrologist)

Address: U.S. Geological Survey  
Water Resources Division  
1201 Pacific Avenue - Suite 600  
Tacoma, WA 98402

Telephone: 253-428-3600, Extension 2653 (voice mail)

FAX: 253-428-3614

E-mail: lafuste@usgs.gov  
pubinfo@fs02dwatch.wr.usgs.gov

**Business**

hours: 6:30 AM to 3:00 PM normally.  
(I am occasionally here until 4:30 PM)

----- Forwarded Message

From: Todd Bennett  
To: Luis A Fuste  
Sent: Tuesday, July 27, 1999 3:46 PM  
Subject: USGS Station 12150800, Snohomish River near Monroe, WA

Luis,

Hello. I left you a voice mail on Monday of this week regarding this as well.

We are constructing a hydraulic model of the Snohomish River for the Army Corps of Engineers. If possible, we would like to get both the original (hourly?) stage and flow data recorded at USGS Station 12150800 (Snohomish River near Monroe).

The dates we are most interested in are:  
November 1 - December 31, 1986,  
December 1 - December 31, 1989, and  
November 1 - November 30, 1990.

Depending on the size of the files and the cost to retrieve the data, we would also like the original stage and flow data for the 24 hours both before and after what I believe are called "skeleton points," or the data points used to define the stage-discharge curve at the station. It is my understanding that these points are flagged in the USGS database.

Please call or e-mail me with any questions or concerns. Thank you very much for your help in this matter.

~Todd

\*\*\*\*\*  
Todd H. Bennett  
WEST Consultants, Inc.  
12509 Bel-Red Road, Suite 100  
Bellevue, WA 98005-2535  
(425) 646-8806  
(425) 646-0570 Fax  
E-Mail: tbennett@westconsultants.com  
Visit us at: www.westconsultants.com  
\*\*\*\*\*

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**CR#39**

From: "Luis A Fuste, Hydrologist, Tacoma, WA " <lafuste@usgs.gov>  
To: "Scott M Knowles, Hydrologist, Tacoma, WA " <sknowles@usgs.gov>  
Cc: "Luis A Fuste, Hydrologist, Tacoma, WA " <lafuste@usgs.gov>; <tbennett@westconsultants.com>  
Subject: re: request for records restoration  
Date: Tuesday, August 10, 1999 7:38 AM

Scott: I need unit values of flow and stage restored for Station  
12150800 for Water Years 1987, 1990, and 1991.

The request is for Todd Bennett of West Consultants. Thanks. Please let  
me know when the data are restored. Mr. Bennett would appreciate  
receiving the data by next week.

----- Forwarded Message

Luis,

Hello. Thank you again for your help with this. As we just discussed on  
the phone please proceed with this request and send the bill for \$150 to  
our  
office. The address is listed below.

Thank you,

~Todd

\*\*\*\*\*  
Todd H. Bennett  
WEST Consultants, Inc.  
12509 Bel-Red Road, Suite 100  
Bellevue, WA 98005-2535  
(425) 646-8806

(425) 646-0570 Fax

E-Mail: [tbennett@westconsultants.com](mailto:tbennett@westconsultants.com)

Visit us at: [www.westconsultants.com](http://www.westconsultants.com)

\*\*\*\*\*

- ----- Original Message -----

From: Luis A Fuste, Hydrologist, Tacoma, WA <[lafuste@usgs.gov](mailto:lafuste@usgs.gov)>

To: <[tbennett@westconsultants.com](mailto:tbennett@westconsultants.com)>

Cc: Luis A Fuste, Hydrologist, Tacoma, WA <[lafuste@usgs.gov](mailto:lafuste@usgs.gov)>; Scott M Knowles, Hydrologist, Tacoma, WA <[sknowles@usgs.gov](mailto:sknowles@usgs.gov)>

Sent: Wednesday, August 04, 1999 8:15 AM

Subject: re: Snohomish River near Monroe data requested

Tod: In response to your telephone call of July 26 and email on July 27 message:

The cost to restore the data requested is \$50 per station per year. The total cost for your request to for flow and stage data for station 12150800 for Water Years 1987, 1990, and 1991 will be \$150. If you wish to proceed with this request please advise whether you accept the associated fee. We will restore the records and send them via anonymous ftp server. We will send you the bill via separate mail.

If you wish to contact me directly:

Name: Luis A. Fuste

Occupation: Information Officer (Hydrologist)

Address: U.S. Geological Survey  
Water Resources Division  
1201 Pacific Avenue - Suite 600  
Tacoma, WA 98402

Telephone: 253-428-3600, Extension 2653 (voice mail)

FAX: 253-428-3614

E-mail: [lafuste@usgs.gov](mailto:lafuste@usgs.gov)

[pubinfo@fs02dwatch.wr.usgs.gov](mailto:pubinfo@fs02dwatch.wr.usgs.gov)

Business

hours: 6:30 AM to 3:00 PM normally.

(I am occasionally here until 4:30 PM)

----- End of Forwarded Message

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**CR#40**

From: "Luis A Fuste, Hydrologist, Tacoma, WA " <lafuste@usgs.gov>  
To: <tbennett@westconsultants.com>  
Cc: "Luis A Fuste, Hydrologist, Tacoma, WA " <lafuste@usgs.gov>; "Scott M Knowles, Hydrologist, Tacoma, WA " <sknowles@usgs.gov>  
Subject: re: Snohomish River near Monroe data requested  
Date: Wednesday, August 04, 1999 7:15 AM

Tod: In response to your telephone call of July 26 and email on July 27 message:

The cost to restore the data requested is \$50 per station per year. The total cost for your request to for flow and stage data for station 12150800 for Water Years 1987, 1990, and 1991 will be \$150. If you wish to proceed with this request please advise whether you accept the associated fee. We will restore the records and send them via anonymous ftp server. We will send you the bill via separate mail.  
If you wish to contact me directly:

Name: Luis A. Fuste  
Occupation: Information Officer (Hydrologist)

Address: U.S. Geological Survey  
Water Resources Division  
1201 Pacific Avenue - Suite 600  
Tacoma, WA 98402

Telephone: 253-428-3600, Extension 2653 (voice mail)

FAX: 253-428-3614

E-mail: lafuste@usgs.gov  
pubinfo@fs02dwtcm.wr.usgs.gov

**Business**

hours: 6:30 AM to 3:00 PM normally.  
(I am occasionally here until 4:30 PM)

---

**CR#41**

From: "Todd Bennett" <tbennett@westconsultants.com>

To: "Luis A Fuste" <lafuste@usgs.gov>  
Subject: USGS Station 12150800, Snohomish River near Monroe, WA  
Date: Tuesday, July 27, 1999 2:46 PM

Luis,

Hello. I left you a voice mail on Monday of this week regarding this as well.

We are constructing a hydraulic model of the Snohomish River for the Army Corps of Engineers. If possible, we would like to get both the original (hourly?) stage and flow data recorded at USGS Station 12150800 (Snohomish River near Monroe).

The dates we are most interested in are:  
November 1 - December 31, 1986,  
December 1 - December 31, 1989, and  
November 1 - November 30, 1990.

Depending on the size of the files and the cost to retrieve the data, we would also like the original stage and flow data for the 24 hours both before and after what I believe are called "skeleton points," or the data points used to define the stage-discharge curve at the station. It is my understanding that these points are flagged in the USGS database.

Please call or e-mail me with any questions or concerns. Thank you very much for your help in this matter.

~Todd

\*\*\*\*\*  
Todd H. Bennett  
WEST Consultants, Inc.  
12509 Bel-Red Road, Suite 100  
Bellevue, WA 98005-2535  
(425) 646-8806  
(425) 646-0570 Fax  
E-Mail: tbennett@westconsultants.com  
Visit us at: www.westconsultants.com  
\*\*\*\*\*

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**CR#42**

From: <Vaughn.Collins@co.snohomish.wa.us>  
To: <tbennett@westconsultants.com>  
Subject: Re: Snohomish River Data  
Date: Tuesday, July 13, 1999 1:58 PM

Todd:  
Attached should be an excel spreadsheet with bridge and xs data plotted orthogonal to flow. We call it the Jackknife bridge (after its predecessor).

Vaughn Collins  
Snohomish County Surface Water Management  
2731 Wetmore Av, Ste 300  
Everett, WA 98201-3581  
425.388.3464 fax 425.388.6455  
vaughn.collins@co.snohomish.wa.us

-----  
Original Text

From "Todd Bennett" <tbennett@westconsultants.com>, on 6/30/99 1:16 PM:  
Vaughn,

Hi. Here's the pertinent info. Thanks,

~Todd

Todd H. Bennett  
WEST Consultants, Inc.  
12509 Bel-Red Road, Suite 100  
Bellevue, WA 98005-2535  
(425) 646-8806  
(425) 646-0570 Fax  
E-Mail: tbennett@westconsultants.com  
Visit us at: www.westconsultants.com

----- Original Message -----

From: <Vaughn.Collins@co.snohomish.wa.us>  
To: <TBennett@westconsultants.com>  
Sent: Wednesday, June 30, 1999 1:04 PM  
Subject: Snohomish River Data

Todd:

I found the bridge 1 file but lost your address and fax in our office move.  
I will mail as soon as I you send your address.

Vaughn Collins  
Snohomish County Surface Water Management  
2731 Wetmore Av, Ste 300  
Everett, WA 98201-3581  
425.388.3464 fax 425.388.6455  
vaughn.collins@co.snohomish.wa.us

InetReceived: from mail.nwrain.com by OASrv20.co.snohomish.wa.us via  
205.134.220.7 with SMTP-TCP; Wed, 30 Jun 1999 13:16:08 PDT  
InetReceived: from tbennett (tbennett.westconsultants.com [205.134.205.45])

by mail.nwrain.com (Post.Office MTA v3.1.2 release (PO203-101c) ID#  
0-34776U2500L250S0) with SMTP id AAA22502 for  
<Vaughn.Collins@co.snohomish.wa.us>; Wed, 30 Jun 1999 13:14:57 -0700

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**CR#43**

From: "Todd Bennett" <tbennett@westconsultants.com>  
To: <WiteckM@wsdot.wa.gov>  
Subject: WSDOT Bridges over the Snohomish River  
Date: Wednesday, June 23, 1999 2:30 PM

Matt,

Hello. I just left you a voice mail regarding this as well. Any help you can lend us would be greatly appreciated.

The U.S. Army Corps has contracted us to perform a Flood Insurance Study for the Snohomish River for submittal to FEMA. I am trying to obtain channel cross-section and bridge structure data (bridge widths, high/low chord, any pier lengths/diameters, etc.) for the State bridge crossings. Digital copies of any HEC-RAS models that were done for scour studies would also be useful. We have compiled a list of the bridges from the WSDOT 1997 Bridge List (M 23-09) [see below].

Would you please call or reply to this e-mail when you have a chance, and let me know if you or the name of someone else who could help us obtain this data.

Thank you,

~Todd

\*\*\*\*\*  
State Bridges Crossing the Snohomish River  
\*\*\*\*\*

\*\*\* US 2 (New construction here?) \*\*\*  
2/5S & 2/5N Snohomish River Bridge  
2/6T & 2/6N Ebey Island Viaduct  
2/6S & 2/7N Ebey Slough Bridge  
2/5T Future Snohomish R Br  
2/7A Ebey Slough

\*\*\* I-5 \*\*\*  
5/645E & 5/645W Snohomish R BN RR  
6/647E & 5/647W Union Slough  
5/648E & 5/648W Steamboat Slough  
5/650E & 5/650W Ebey Sl BN RY SR 529 OC

\*\*\* SR-9 \*\*\*

9/117 Snohomish R Overflow  
9/118 Snohomish R

\*\*\* SR-522 \*\*\*  
522/138 Snohomish R

\*\*\* SR-529 \*\*\*  
529/10E & 529/10W Snohomish R  
529/15E & 529/15W Union SI  
529/20W & 529/20E Steamboat SI

\*\*\*\*\*  
Todd H. Bennett  
WEST Consultants, Inc.  
12509 Bel-Red Road, Suite 100  
Bellevue, WA 98005-2535  
(425) 646-8806  
(425) 646-0570 Fax  
E-Mail: [tbennett@westconsultants.com](mailto:tbennett@westconsultants.com)  
Visit us at: [www.westconsultants.com](http://www.westconsultants.com)  
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**CR#44**

From: "Ray Walton" <[rwalton@westconsultants.com](mailto:rwalton@westconsultants.com)>  
To: <[tbennett@westconsultants.com](mailto:tbennett@westconsultants.com)>  
Subject: Fw: Snohomish FIS - Dec 89 FEQ input files  
Date: Wednesday, June 09, 1999 12:23 PM

-----Original Message-----

From: Vaughn.Collins@co.snohomish.wa.us <[Vaughn.Collins@co.snohomish.wa.us](mailto:Vaughn.Collins@co.snohomish.wa.us)>  
To: [rwalton@westconsultants.com](mailto:rwalton@westconsultants.com) <[rwalton@westconsultants.com](mailto:rwalton@westconsultants.com)>  
Date: Monday, June 07, 1999 12:58 PM  
Subject: Snohomish FIS - Dec 89 FEQ input files

>attached should be all files used in re-calibrated 1989 flood event.  
>Have paper, am looking for digital files on Snohomish @ Snohomish and  
>French Cr pump plant river stage time series data  
>Anything else?  
>Vaughn  
>  
>

---

**CR#45**

From: <[Vaughn.Collins@co.snohomish.wa.us](mailto:Vaughn.Collins@co.snohomish.wa.us)>

To: <rwalton@westconsultants.com>  
Subject: Snohomish R. Data  
Date: Tuesday, June 01, 1999 4:43 PM

Ray: attached files hyd\* are boundary condition hydrographs, \*xs.tab are cross section files for lower Skykomish and Snoqualmie. Sky XS are County 1991, Snoq XS are unverified, source unknown HEC-2 model via King County. Vaughn

---

**CR#46**

From: "Raymond Walton" <rwalton@westconsultants.com>  
To: "Jim Lencioni" <james.l.lencioni@usace.army.mil>  
Cc: <TBennett@westconsultants.com>  
Subject: Schedule and memo for Snohomish County Study  
Date: Monday, May 24, 1999 3:38 PM

Jim:

I have attached (1) an excel spreadsheet with a schedule for the Snohomish River FIS and (2) a memo discussion the types of information we are looking for and who (I think) is going to provide it. Please let me know if I have included some information (like existing flow and tidal hydrographs) that we should be trying to get.

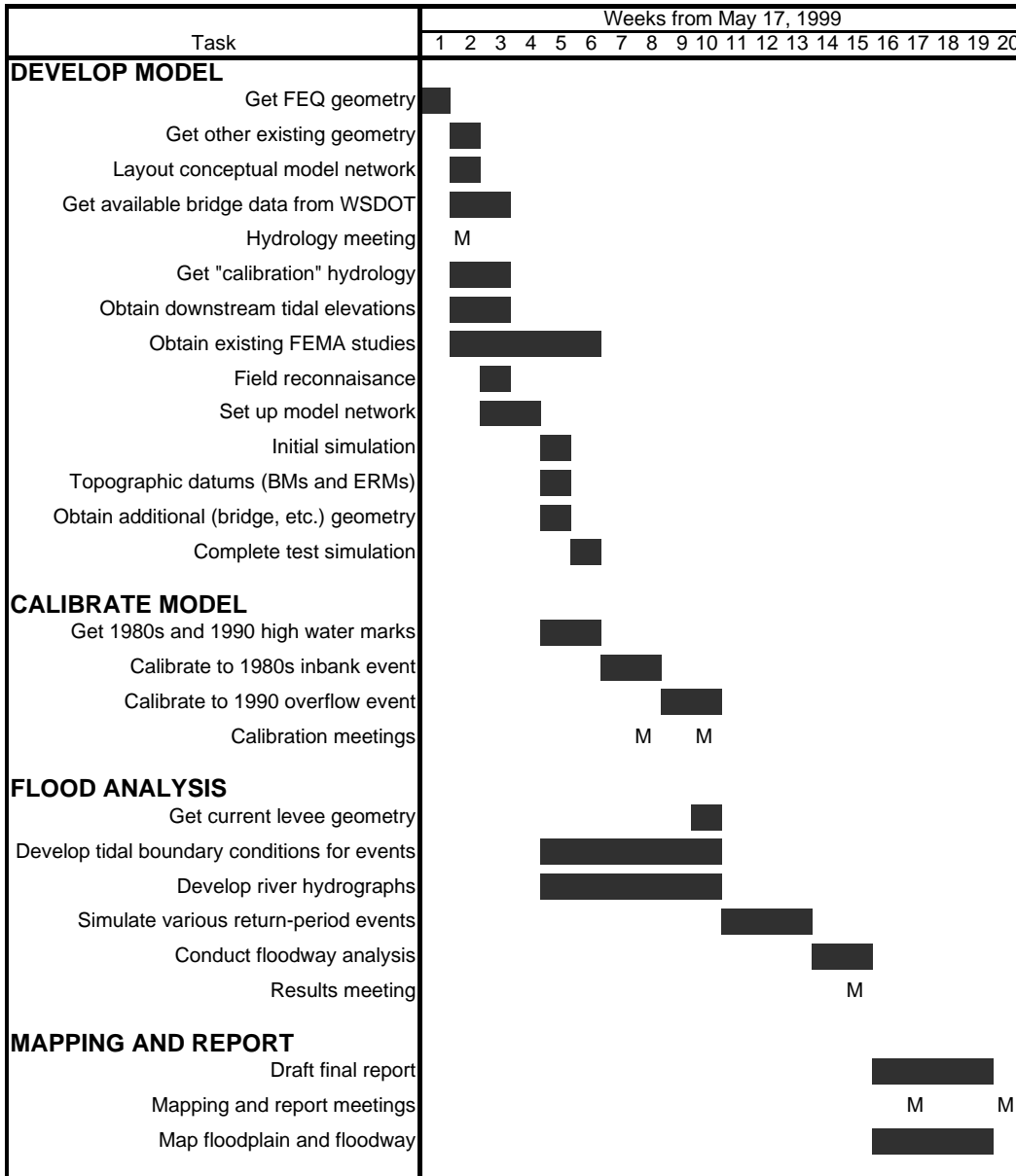
As you can see from the schedule, I have spread the study through the end of September. I think there is a little room to squeeze or delay the schedule (for the additional field information) but not much! I have also suggested that we should sit down and talk "hydrology" with dan Harvey pretty and also get out and take a look at the physical system (who from the District and County wants to come along).

I will call you tomorrow to discuss this further.

Regards

Ray Walton

**SCHEDULE FOR SNOHOMISH RIVER FIS**



# Memo

To: Jim Lencioni (Seattle District, Corps of Engineers)

From: Ray Walton

CC: Todd Bennett (WEST Consultants, Inc.)

Date: 5/24/99

Re: Initial Information Deliverables

---

After the meeting with WEST Consultants, the Seattle District, and Snohomish County, I thought I would try to summarize my understanding of the information I think we will receive from (1) the Seattle District and (2) Snohomish County. I would appreciate it if you would let me know which of the data below you expected WEST to obtain.

## **From the Seattle District**

1. The precise dates of the two model calibration events (1980s and 1990).
2. Flow hydrographs for the Snohomish, Skykomish and Snoqualmie Rivers for the two events in Item 1.
3. Tidal elevations for the two events in Item 1.
4. The FEMA models for the Snohomish, lower Skykomish and lower Snoqualmie Rivers.
5. High water elevations for the two events in Item 1.
6. The locations and details about levee failures during the events in Item 1.
7. A USGS map (from Joe Webber) showing storage and conveyance areas in the system to be modeled.
8. River flow and tidal hydrographs for the various return interval events to be simulated with the "calibrated" model.

9. Information on bench marks (BMs) and elevation reference marks (ERMs) that tie the various surveys together to a common datum used in the floodplain and floodway mapping.
10. Basemap in electronic form (AutoCAD). We are currently looking into whether the floodplain and floodway can be delineated electronically. Once we have determined the best approach, I will contact you (and Joe Webber) about the need to scan OR digitize the basemaps.

### **From Snohomish County**

1. Copies of the three reports referenced in the 1995 SWM report given to us.
2. Additional cross sections (other than in the FEQ model) available within the County - including sections taken for bridge scour studies.
3. Additional bridge sections (after grant money comes through).
4. New top-of-levee survey (after the grant money comes through).

**Meeting Minutes/Reports**

The purpose of this section to provide FEMA with a comprehensive chronology of written meeting/reports developed by the SC during the preparation of the FIS.

Study Contractor: WEST Consultants, Inc.

**Meeting Minutes/Report Index**

City of Everett, City of Marysville, City of Snohomish, and Unincorporated Snohomish County,  
Washington

FLOOD INSURANCE STUDY

<b>M#</b>	<b>Meetings/Report Date</b>	<b>Firm/Agency Contacted</b>	<b>Meeting Type</b>
1	October 14 <sup>th</sup> , 1999	Seattle Dist., USACE	General info
2	August 24 <sup>th</sup> , 1999	Snohomish County	Model info

**General Correspondence**

The purpose of this section to provide FEMA with a comprehensive chronology of written correspondence generated or received by the Contractor during the preparation of the FIS.

Study Contractor: WEST Consultants, Inc.			
<b>General Correspondence Index</b>			
City of Everett, City of Marysville, City of Snohomish, and Unincorporated Snohomish County, Washington			
FLOOD INSURANCE STUDY			
<b>GC#</b>	<b>Meetings/Report Date</b>	<b>Corresponding Firm/Agency</b>	<b>Topic</b>
1	December 29 <sup>th</sup> , 2000	FEMA	Floodway alternatives
2	November 13 <sup>th</sup> , 2000	Tetra Tech/KCM, Inc.	Preliminary results
3	September 13 <sup>th</sup> , 2000	FEMA	Scope of work for floodway alternatives
4	July 10 <sup>th</sup> , 2000	FEMA	Preliminary results
5	June 22 <sup>nd</sup> , 2000	Seattle Dist., USACE	Coincident tides
6	May 17 <sup>th</sup> , 2000	FEMA	Preliminary results
7	January 6 <sup>th</sup> , 2000	Seattle Dist., USACE	Highwater marks
8	September 20 <sup>th</sup> , 2000	Seattle Dist., USACE	Progress report
9	September 15 <sup>th</sup> , 1999	BNSF Railroad	Request for bridge data
10	February 22 <sup>nd</sup> , 1999	Seattle Dist., USACE	Scope of work

## **Section 2 - Engineering Analyses**

### **Hydrologic Analyses**

Study Contractor: WEST Consultants, Inc.

#### **Hydrologic Analyses Index**

City of Everett, City of Marysville, City of Snohomish, and Unincorporated Snohomish County,  
Washington

#### FLOOD INSURANCE STUDY

<b><i>Flooding Source/Stream Name</i></b>	<b><i>Hydrologic Method/Model Used</i></b>	<b><i>Method/Model Analysis Date</i></b>
Pilchuck River	Synthetic hydrograph	1982
Snohomish River	Synthetic hydrograph	2000

### **General**

Synthetic hydrographs for both the Pilchuck River and the Snohomish River are required for the unsteady flow model boundary conditions. Data for the Pilchuck River, a tributary located upstream of the City of Snohomish, was developed in 1982 by the US Army Corps of Engineers. WEST updated the Snohomish River hydrologic analysis and generated the synthetic hydrograph in 2000.

***Pilchuck River***

The Pilchuck River is a tributary to the Snohomish River and combines with the Snohomish just upstream of the City of Snohomish. WEST used the Pilchuck River inflow hydrographs generated in the prior FEMA Flood Insurance Study in the hydraulic model. WEST obtained these hydrograph data, shown in Figure 2-1, from the Seattle District, US Army Corps of Engineers, who conducted the original analysis. The peak of the Pilchuck River hydrograph was assumed to coincide with the peak of the Snohomish River hydrograph at the confluence for a more conservative analysis. The relative flow contribution from the Pilchuck is small (less than 10%) when compared to the Snohomish River inflow hydrograph.

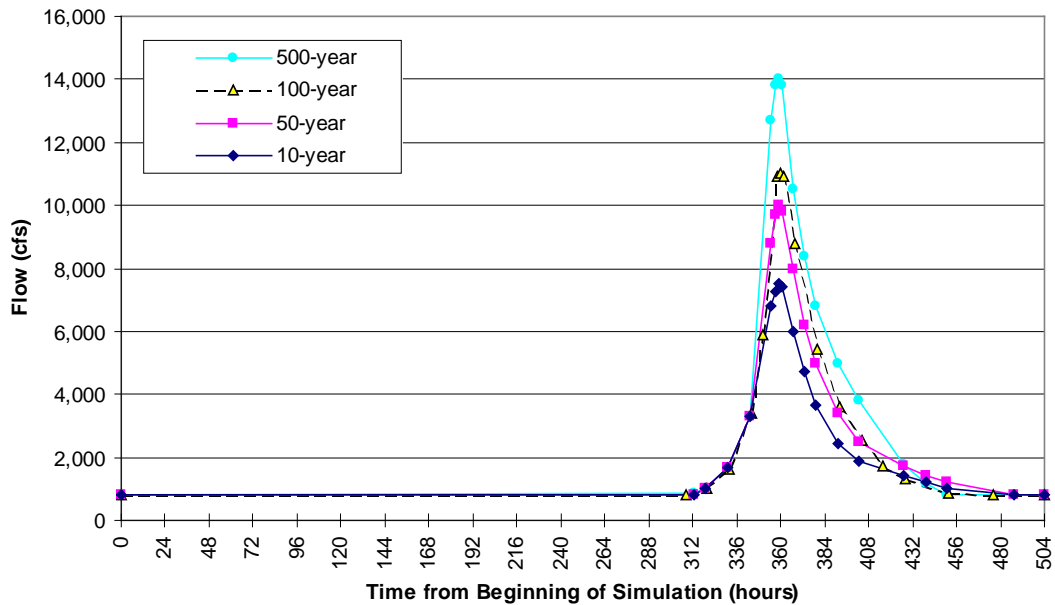


Figure 2-1. Inflow Hydrographs to the Snohomish River from the Pilchuck River

***Snohomish River***

Hydrographs were generated to simulate the hydraulic response of the 10-, 50-, 100- and 500-year flows as required by FEMA. However, for an unsteady flow model, the upstream flood hydrograph not only has to consider peak discharge but also volume. One method to develop an appropriate synthetic hydrograph is the “balanced hydrograph” approach. In this approach, flood frequency analyses (*USGS, 1982*) were conducted for instantaneous peak flows (Figure 2-2), and average 1-, 3-, 5-, and 7-day flows for the continuous period of record, after removing the hysteresis effect (discussed in the Hydraulic Analysis section) at the gage. Synthetic hydrographs

for the 10-, 50-, 100- and 500-year events were created by ensuring that the hydrograph ordinates preserved the peak discharge and the average 1-, 3-, 5-, and 7-day flows. Then, historical flood events were examined, and a skew specified that placed the flood peak at day 3 of the 7-day “event”.

Based on a flood frequency analysis from the record at the Monroe gage (1964 to 1999), the November 1990 peak flow would be about the 100-year event. However, numerous historic events, measured or inferred at nearby gages and streams, indicated that this event was exceeded several times since the late 1800s. When these flows, which were reported only as peak flows, were included in the analysis of peak values (Figure 2-3), the November 1990 peak flow was closer to the 30-year event, a finding that is consistent with nearby rivers with longer gage records. This information was used to increase the 1-day average flow (volume) of the synthetic hydrographs, by multiplying by the ratio of the peak with historical flows to the peak without historical flows, to account for not having historical volume data (Figure 2-4). Table 2-1 summarizes the hydrograph peaks and volumes from this analysis and Figure 2-5 shows the resulting hydrographs used in the UNET model. The 500-year peak was increased to the 500-year 1-day value in the synthetic hydrograph since that latter value was greater.

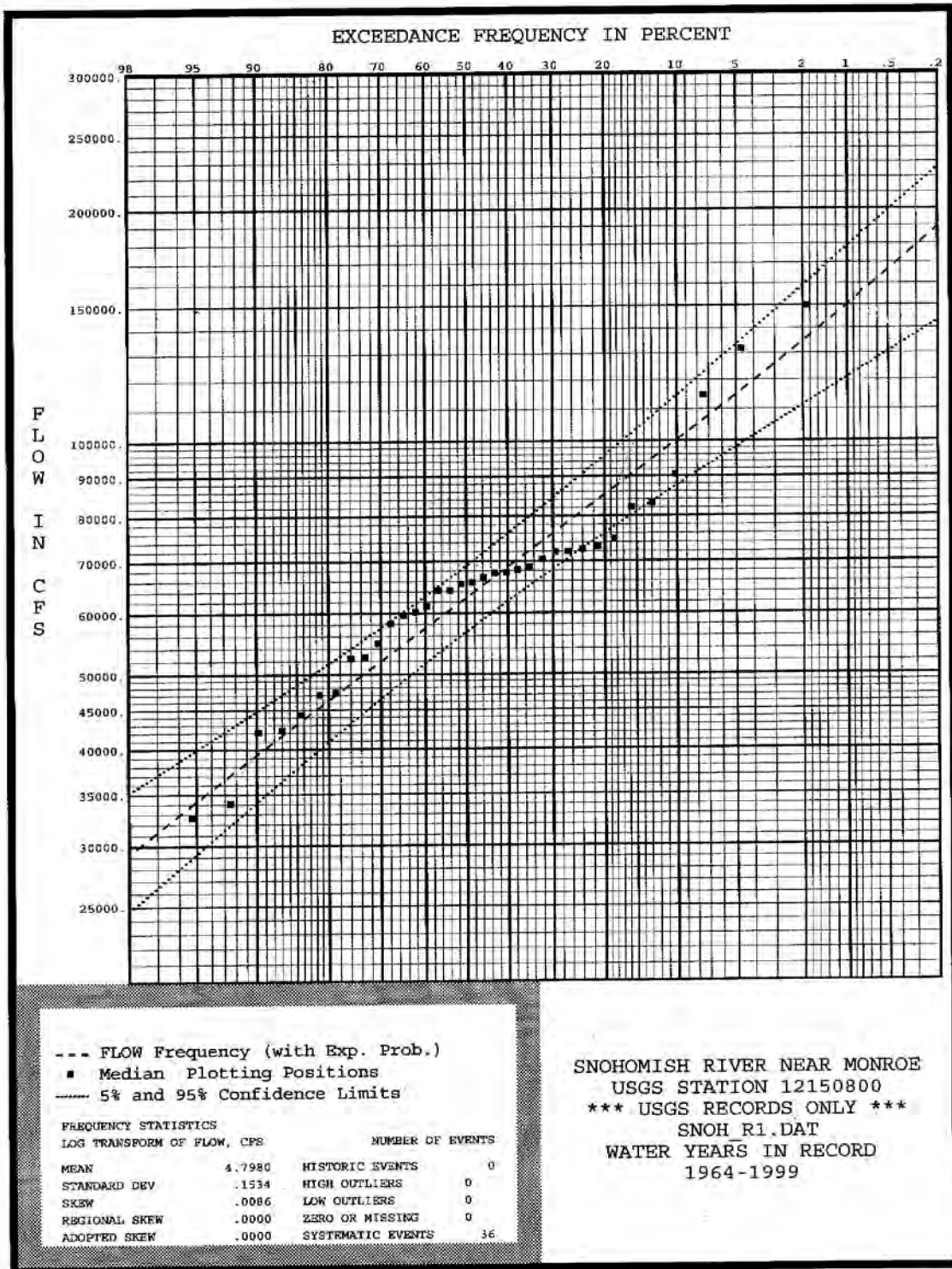


Figure 2-2. Exceedance frequency for the Snohomish River at Monroe without historical peaks.

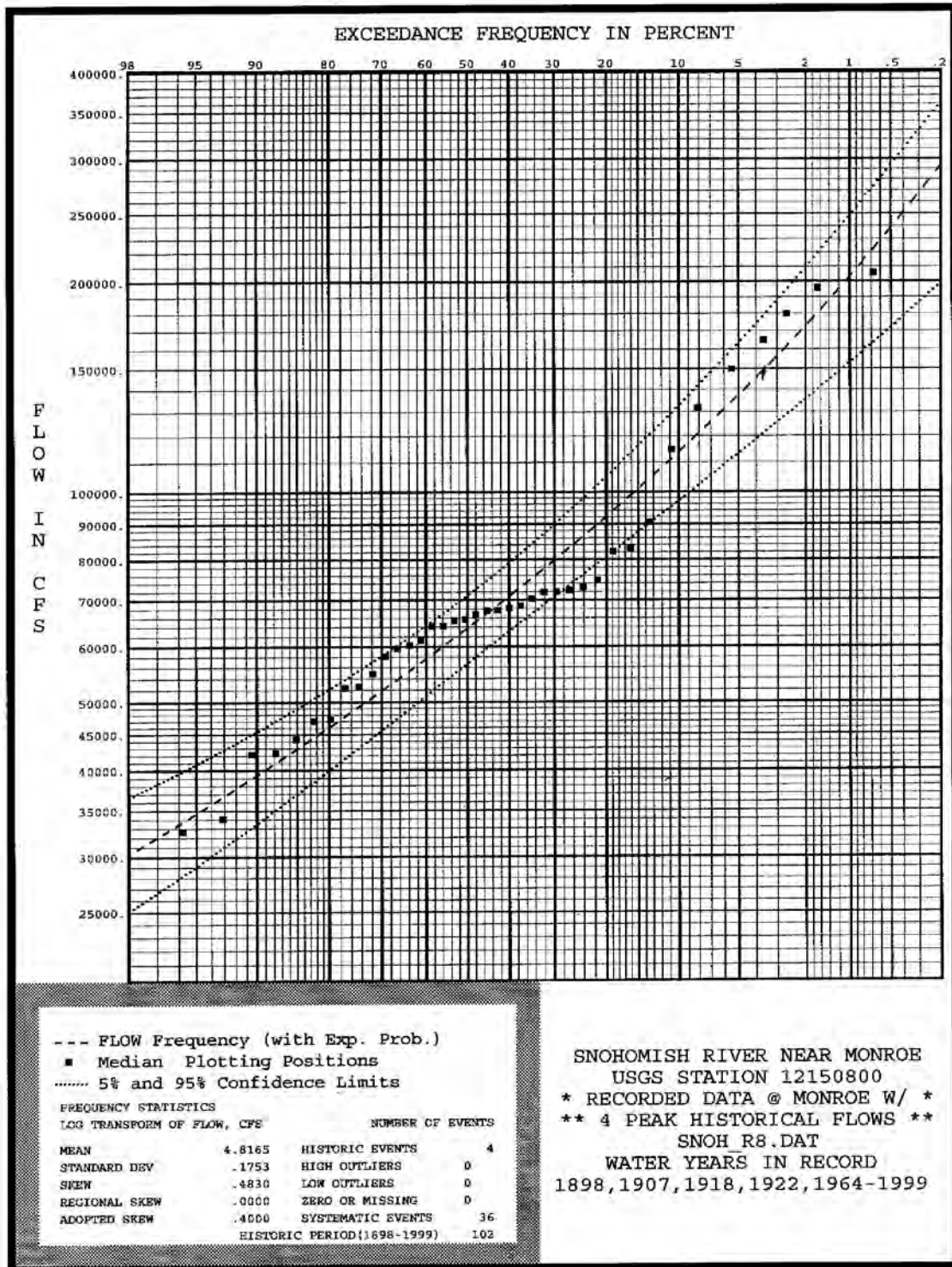
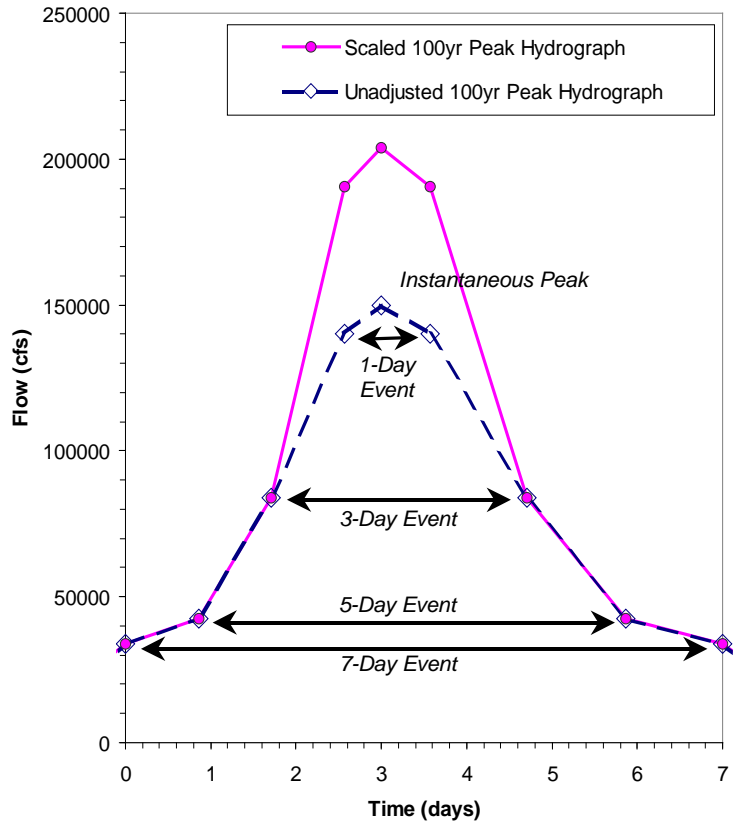


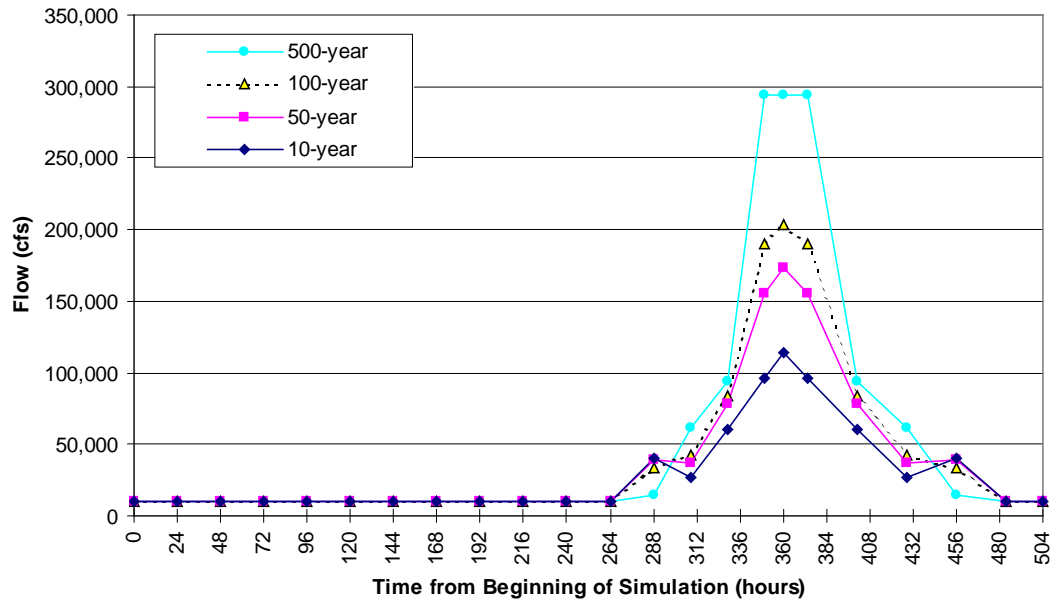
Figure 2-3. Exceedance frequency for the Snohomish River at Monroe with historical peaks.



**Figure 2-4. Example of scaling the 1-day average flow using the 100-year synthetic hydrograph**

**Table 2-1. Flood frequencies for peak, 1, 3, 5, and 7-day events.**

Recurrence Interval (years)	10	20	50	100	500
Exceedance Probability (%)	10%	5%	2%	1%	0.2%
Peak Values for Period of Record (cfs)	100000	115000	135000	150000	189000
Peak Values with Historic Events (cfs)	114000	137000	173000	204000	293000
Scaling Ratio	1.14	1.19	1.28	1.36	1.55
1-Day Average Daily Flow (cfs)	92100	107000	128000	145000	190000
1-Day Average Daily Flow (Scaled) (cfs)	104994	127470	164030	197200	294500
3-Day Average Daily Flow (cfs)	78900	91600	109000	123000	158000
5-Day Average Daily Flow (cfs)	64700	74700	88300	99100	126000
7-Day Average Daily Flow (cfs)	55700	63500	73800	81700	101000



**Figure 2-5. Synthetic Snohomish River Hydrographs used in the UNET model.**

## **Hydraulic Analyses**

Study Contractor: WEST Consultants, Inc.

### **Hydraulic Analyses Index**

City of Everett, City of Marysville, City of Snohomish, and Unincorporated Snohomish County,  
Washington

FLOOD INSURANCE STUDY

<b><i>Flooding Source/Stream Name</i></b>	<b><i>Hydraulic Method/Model Used</i></b>	<b><i>Method/Model Analysis Date</i></b>
Snohomish River	UNET	October 2000

### **General**

WEST Consultants, Inc. developed an unsteady flow model of the system using UNET Version 3.2(HEC, 1997), as part of a Flood Insurance Study for Federal Emergency Management Agency Region 10 (FEMA), and under contract to the Seattle District, US Army Corps of Engineers. Snohomish County and the Seattle District, US Army Corps of Engineers, contributed to the design of the model network. The UNET model consists of thirteen separate reaches with a total of nearly 270 cross-sections and twelve storage areas. The most significant overbank areas are Fryelands, which was modeled as a storage area, and Marshlands, which was modeled as a conveyance area as it is connected with the Snohomish River at the upstream and downstream ends. Figure 2-6 and Figure 2-7 depicts the interconnected reaches on the Snohomish River system and numerous storage areas. WEST modeled the 10, 50, 100, and 500-year events for this study.

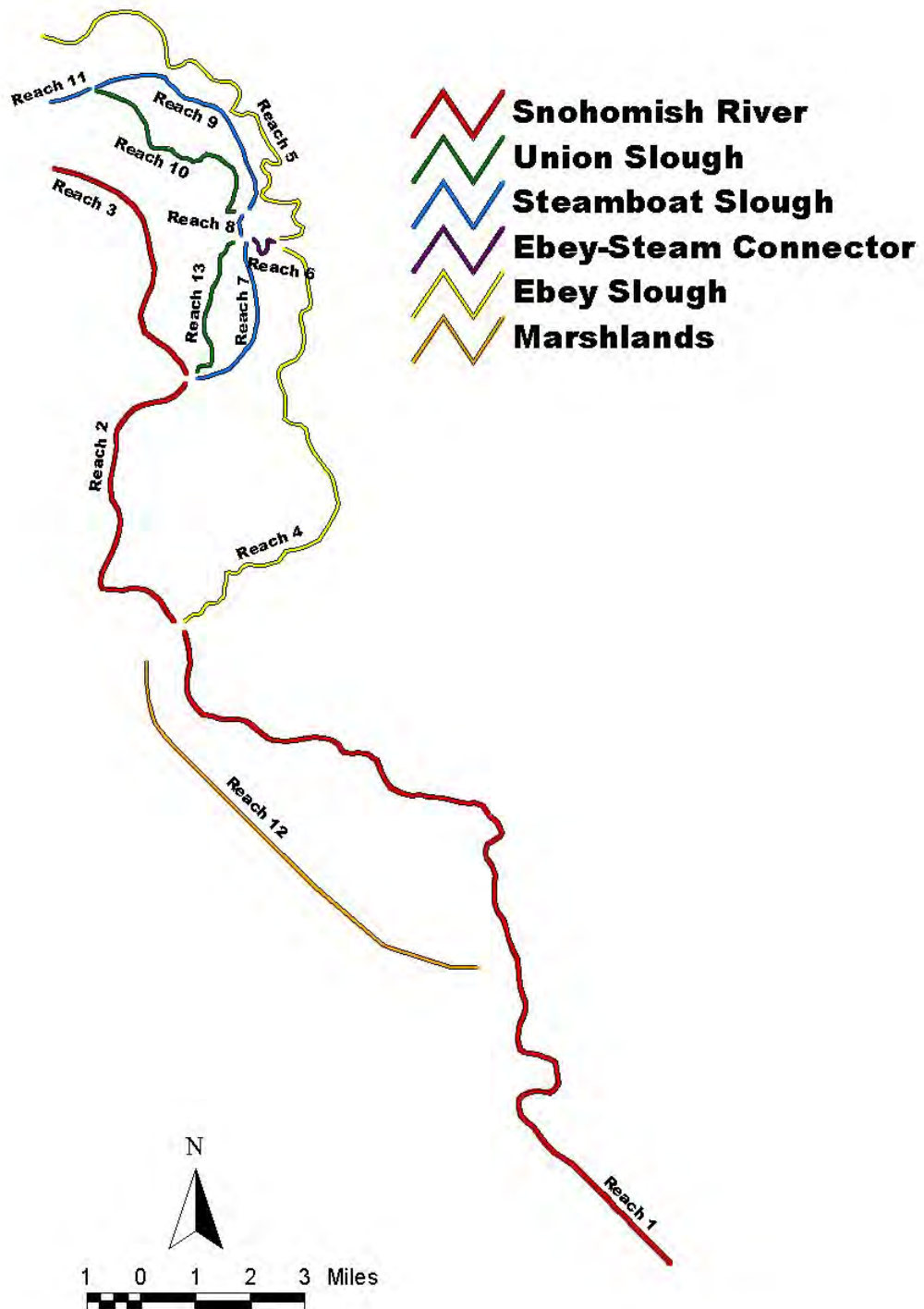
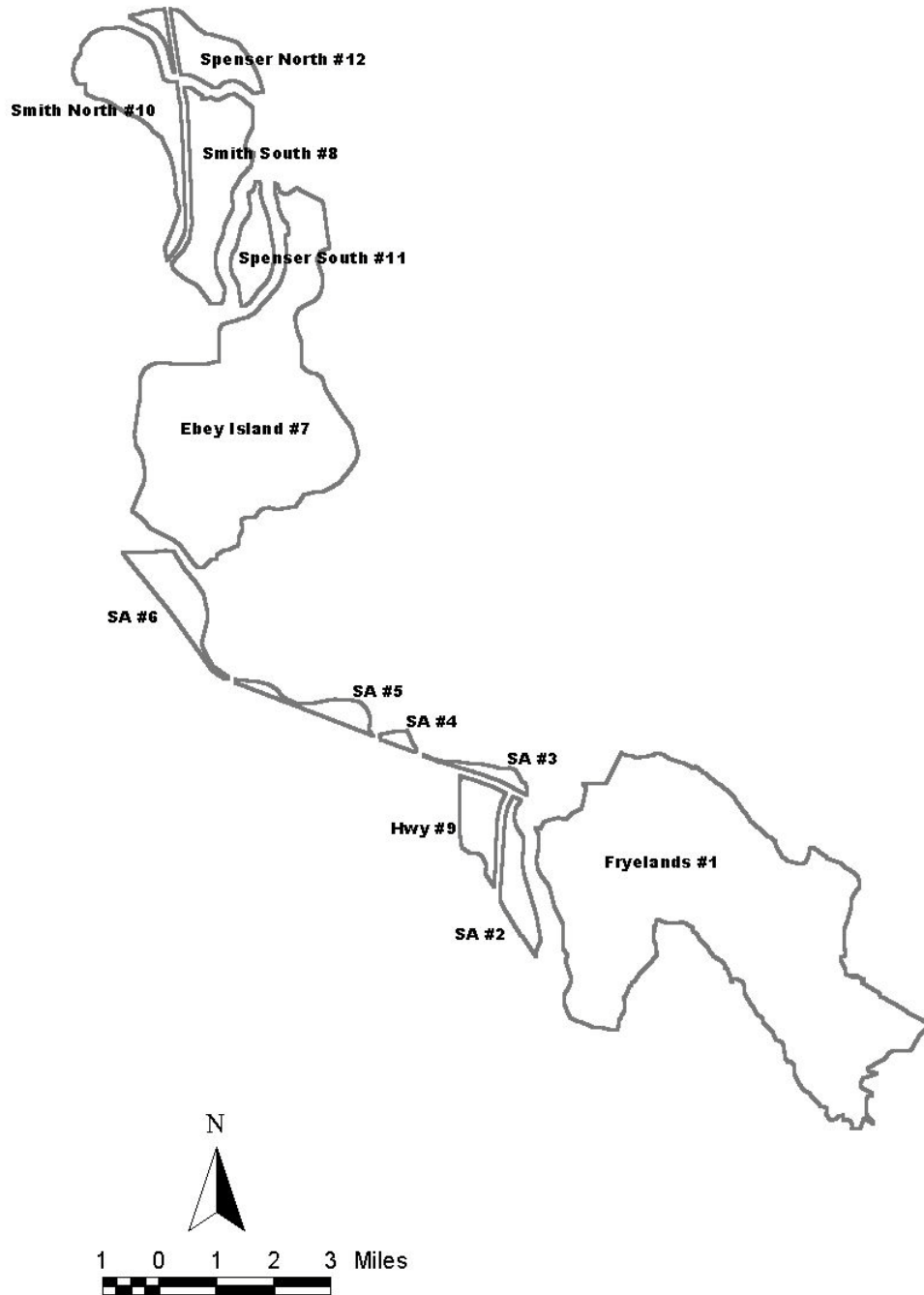


Figure 2-6. Reaches in the UNET model.

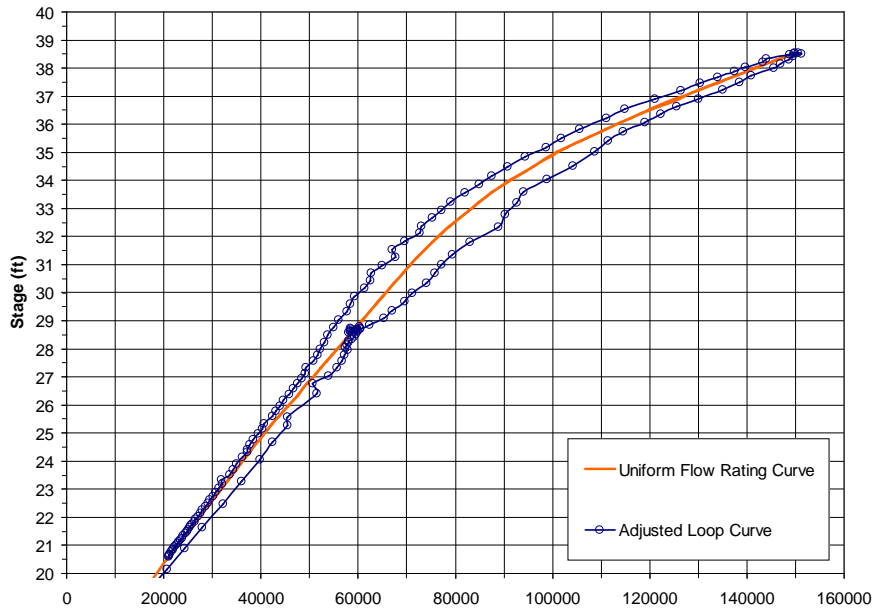


**Figure 2-7. Storage areas in the UNET model**

**Upstream Boundary Conditions**

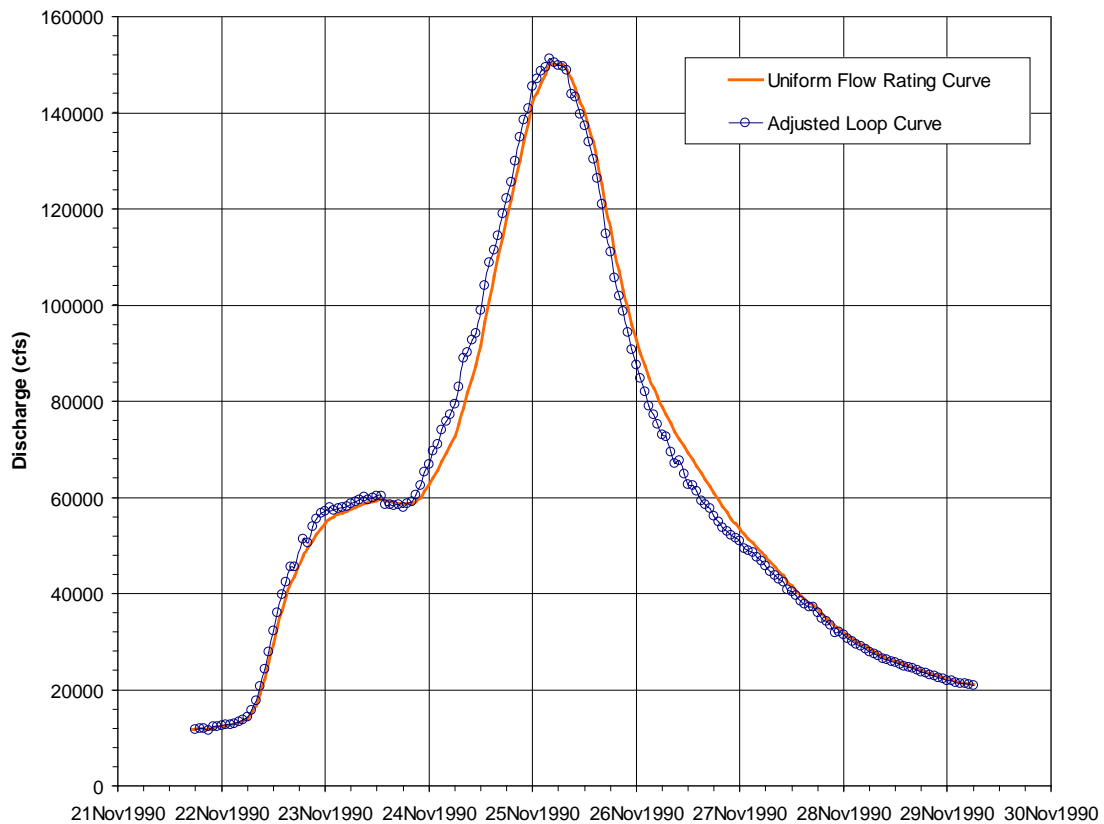
Upstream boundary conditions are usually developed from observations (e.g., a USGS streamflow gage), a hypothetical event, or from the output of another model (perhaps a rainfall-runoff model, such as HEC-HMS). In a steady flow model, these may be determined from a flood frequency analysis of historic recorded gage data, using peak event stages and a rating curve, or from regional regression analyses. Measured stage and a rating curve may also determine an observed hydrograph for an unsteady flow model. However, particularly in very flat rivers, hysteresis or the occurrence of a “loop-rating” may mask the “true” flow hydrograph.

There was concern that there might be a significant hysteresis affect in Snohomish River flows based on modeling studies conducted for the previous flood insurance study in the mid-1970’s. This was examined in two ways. First, the hourly flows and stages were obtained for the USGS streamflow gage near Monroe. These data were processed using the theoretical approach described in Henderson (1966). This approach uses an expanded version of the “Jones formula”, where a “loop-curve” is constructed based on the uniform flow rating curve. Additional slope terms are also added to account for subsidence, where the peak flow does not necessarily occur at the time of the peak stage. The analysis showed that hysteresis was present in the data, but that the data did not indicate significant subsidence (Figure 2-8).



**Figure 2-8. Uniform rating curve and looped rating curve at the USGS gage near Monroe, November 1990.**

A second concern was that the rating curve developed for the Monroe gage might be “biased” by observations taken only during the falling limb of floods. The data used to develop the rating curve at the Monroe gage were obtained from the USGS (USGS, 1999), and plotted against the hourly data to determine at what point flows were measured during events. It turned out that measurements occurred during all flow periods (rising, near-peak, and falling limb), and no biasing could be determined. Therefore, we concluded that not only was subsidence not an important factor in modifying the upstream hydrographs, but that the rating curve developed for the gage was as reasonable of an estimate of flows based on measured stages as any revised method. Figure 2-9 shows the flood event of 1990 (used for model calibration) before and after being modified by the loop-rating curve.



**Figure 2-9. Uniform and looped rating hydrographs at the USGS gage near Monroe, November 1990.**

***Downstream Boundary Conditions***

The downstream boundary condition in an unsteady flow model may be time dependent, whereas a normal depth condition or fixed stage is usually specified in a steady flow model. Puget Sound is tidal, and there are tide gages at Everett and Seattle with long periods of record. These data were used as downstream boundary conditions for model calibration.

A flood insurance study with a tidal downstream boundary usually considers both a river flood and a tidal surge in establishing flood elevations. However, as the joint occurrence of these events is extremely small, they may be considered to be independent events. A fixed downstream stage equal to mean higher high water (MHHW) plus one foot was used for the river flood stages based on prior studies (USACE, 2000b). The Seattle District, Corps of Engineers, had previously conducted a tidal surge analysis, and established tidal surge elevations at the mouth of the Snohomish River for the 10-, 50-, 100- and 500-year events (USACE, 2000a) as shown in Table 2-2. These tide elevations superseded any lower water surface elevations simulated in the UNET model and are accounted for in the profile plots.

**Table 2-2. Tidal Elevations at Everett, Washington.**

	<b>Tidal Elevation (feet) (NGVD)</b>
500-year	8.7
100-year	8.4
50-year	8.2
10-year	7.8
MHHW	5.2

***Cross-Sections***

Snohomish County provided cross-section data from their FEQ model of the system. We supplemented this with cross-section data from the original US Army Corps hydraulic model, bridge cross-sections from the Washington Department of Transportation and the Burlington Northern Sante Fe Railroad, and various additional surveys throughout the study area, to provide better channel definition where necessary. Listed in the “Key to Cross-Section Labeling” is the FEMA lettering assigned to each river station. Bridges piers were typically modeled as ground points unless the computed water surface elevation reached the bridge deck. As many of the downstream bridges had wing-walls or pier protection that extended beyond the bridge deck, we

added additional cross-sections upstream and downstream of the bridges to model adequately these structures.

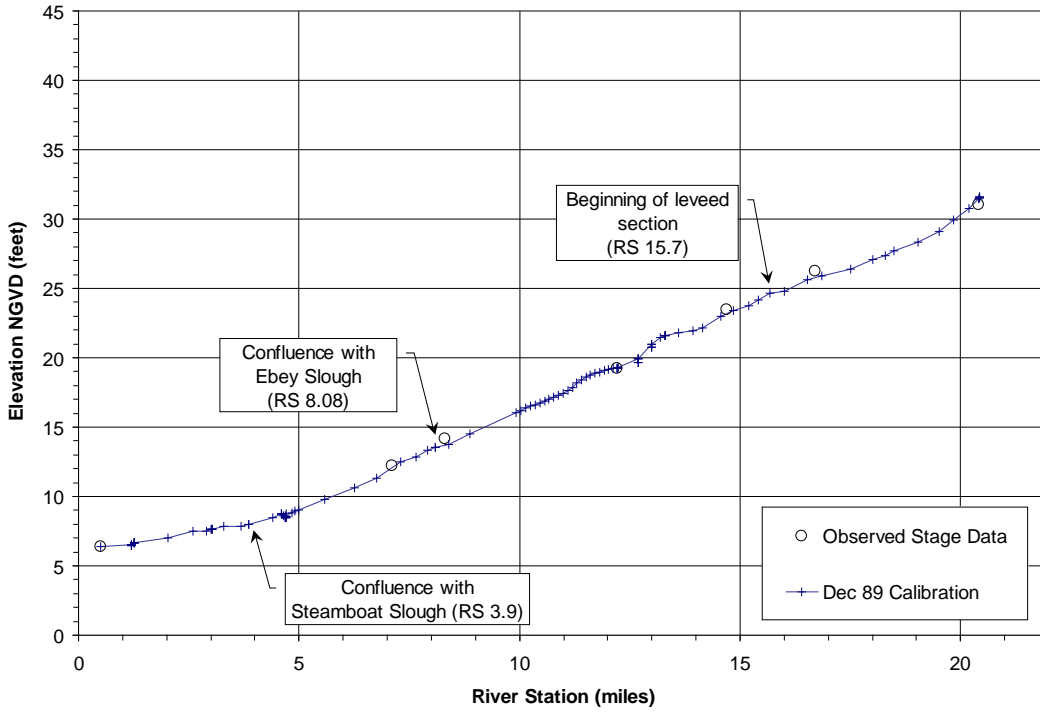
### ***Levees and Lateral Weir Flow***

Most of the river system downstream of river mile 15.7 is leveed, though none of these levees are certified to provide protection from the 100-year event. We have modeled lateral weir flow over the levees. In addition, lateral weirs connecting Ebey Slough and Steamboat Slough (between approximately I-5 and the Ebey – Steamboat bifurcation point) were used to maintain hydraulic connectivity in locations of shared overbanks. Lateral weirs also connect storage area #2 to storage area #9, storage area #9 to the Marshlands conveyance area, and storage area #8 to storage area #10.

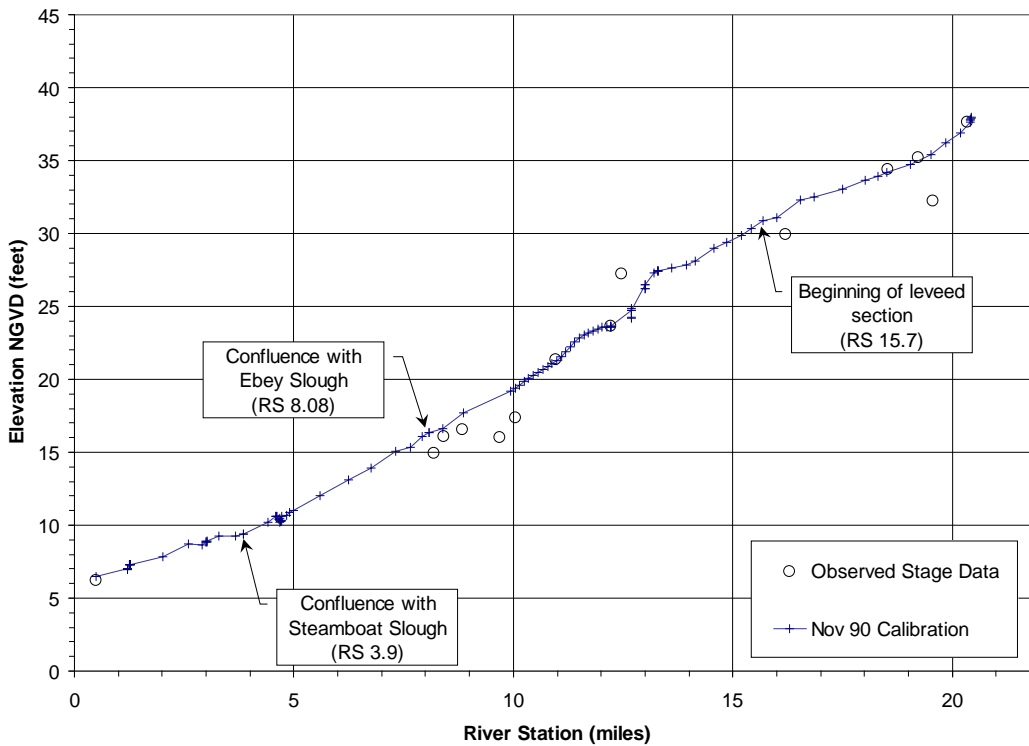
Snohomish County provided levee data in their Snohomish River Comprehensive Flood Control Management Plan (Snohomish County, 1991) as well from updated surveys (Snohomish County, 2000).

### ***Calibration***

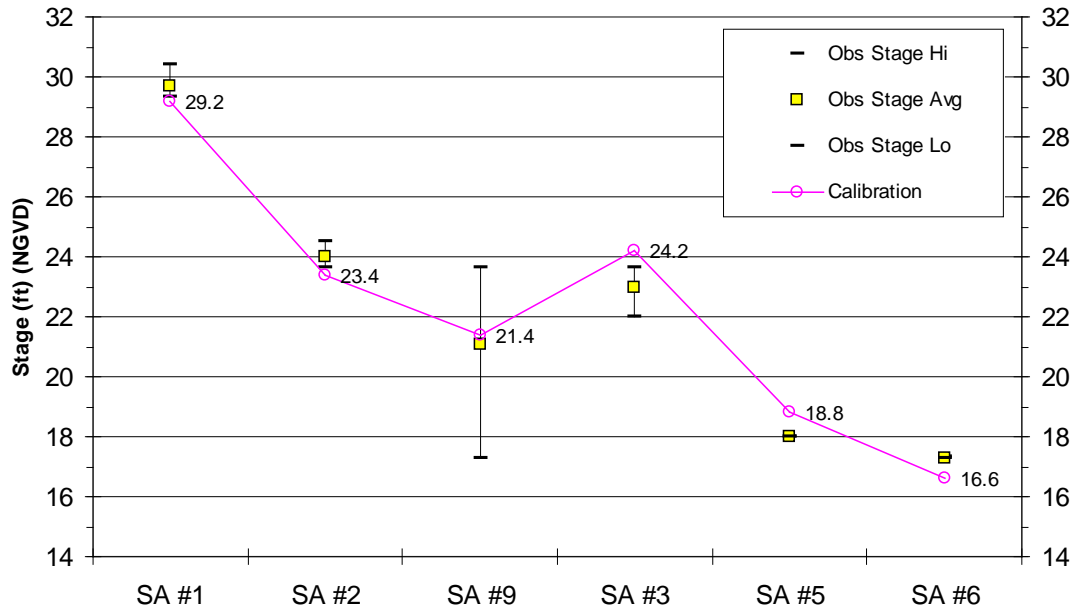
Fairly extensive sets of observations on the mainstem of the Snohomish River were available to calibrate the UNET model for the Floods of 1989 and 1990. The December 1989 event was essentially a bank-full event, and was used to calibrate Manning's  $n$  roughness values in the main channel (Figure 2-10). The November 1990 event caused significant overbank flooding, and numerous highwater marks were surveyed throughout the system, as well as continuous stages being recorded at the Monroe and Snohomish gages. We used the 1990 event, without changing the calibrated main channel  $n$  values, to calibrate the overbank (which includes storage areas and Marshlands) Manning's  $n$  roughness values (Figure 2-11 and Figure 2-12). Manning's  $n$  values in the sloughs were determined during calibration of the mainstem although calibration was limited due to the deficiency of observed water surface elevations in these areas. No further "validation" was conducted beyond these events because of the lack of data during other overbank flood events. The calibrated  $n$  values presented in Table 2-3 are consistent with typical ranges for channels and overbanks.



**Figure 2-10. Snohomish River calibration for the December 1989 bankfull event.**



**Figure 2-11. Snohomish River calibration for the November 1990 overbank event.**



**Figure 2-12. Maximum simulated stage and range of observed values in storage areas with observed data for the November 1990 overbank event.**

**Table 2-3. Range of calibrated Manning’s *n* values used in the UNET model**

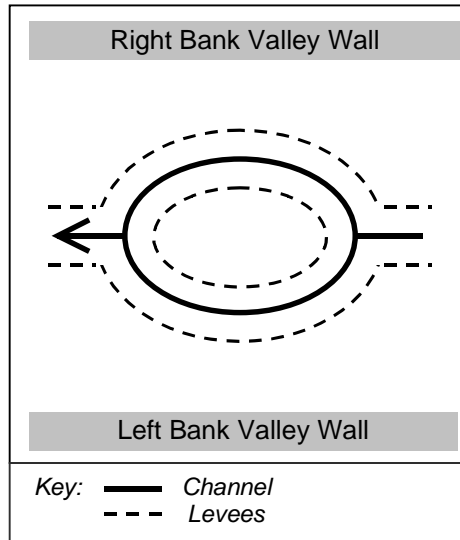
	<b>Channel <i>n</i></b>	<b>Overbank <i>n</i></b>
<b>Snohomish River</b>	0.035 – 0.045	0.050 – 0.070
<b>Sloughs and Marshlands</b>	0.036 – 0.070	0.050 – 0.070

**Base Flood Elevation**

The base flood elevation (BFE), the water surface elevation for the 1% chance (100-year) event, must be defined for FEMA Flood Insurance Studies (FEMA, 1995). The 1% chance hydrograph is routed through the model and the resulting water surface mapped. Following FEMA guidelines, a without-left-levee, a without-right-levee analysis, and a without both levees must also be simulated when levees are present. The final mapped BFE in the main channel and both of the overbanks is then the highest water surface of the four simulation runs.

Split-flow situations complicate the modeling considerably. How should the “with” and “without” levee analysis be performed in this case? Consider the simple case shown in Figure 7 with a ring levee in addition to levees on the valley wall sides of the channel. By FEMA’s definition, a “without” levee analyses could require five individual runs – without the left outside

levee, without the right outside levee, without the left ring wall levee, without the right ring wall levee, and without all levees. The complexity only increases with the number of reaches branching off each split-flow channel.



**Figure 2-13. Levees in a split reach.**

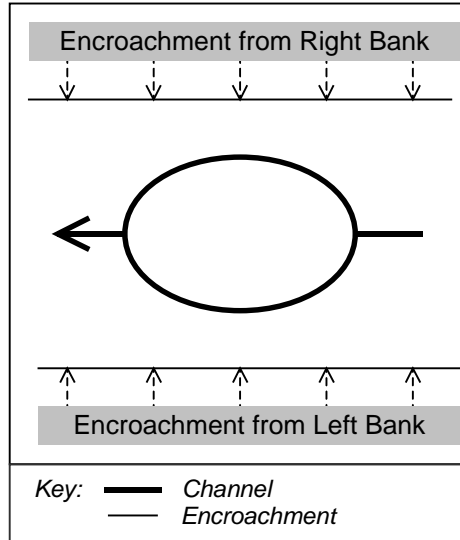
In the Snohomish River, there are multiple split flows along leveed channels. If the “without” levee analysis was performed in this manner, it would lead to many additional simulation runs. This situation was discussed with FEMA, and the approach adopted to simulate without levees (1) along the entire length of the left valley wall and (2) the entire length of the right valley wall.

### ***Floodway***

The regulatory floodway is defined as the portion of the river and adjacent land area that must remain unobstructed to ensure that the water surface elevation does not cumulatively increase more than one foot above the base flood elevation (BFE). Typically, an encroachment analysis is computed from both the left and right channel banks towards the river channel using an “equal conveyance reduction” method.

As for the “without” levees analysis, the floodway development becomes more complicated when multiple channels and split flows are involved when modeling in an unsteady flow model. Consider the case presented in Figure 2-14. The entire island between the channels would be within the floodway, disallowing development, if encroachment were made only from

the valley walls. In the Snohomish River, these areas are already developed with future build-out planned.



**Figure 2-14. Encroachment in a split reach.**

In addition, there are multiple channel bifurcations and junctions in the downstream reaches of the Snohomish network especially near the downstream sloughs, and major storage areas upstream. Performing an encroachment in such a system becomes extremely complex as each reach must be individually encroached upon, and changes between the reaches are dependent on one another, making determination of the 1-foot rise even more difficult.

Because of these complexities, a series of meetings were held with FEMA and the local communities to identify options and priorities for floodplain development. The downstream Cities of Everett and Marysville had specific encroachment goals in mind, whereas the upstream unincorporated County areas have an existing ordinance based on the density of development. The result was a floodway analysis where encroachment and storage-volume reduction were specified in locations of zoned development. This consensus among the local communities also removed the need for equal conveyance reduction.

The floodway fringe submitted in this FIS was defined in most locations by the existing Snohomish County fringe boundary (meeting February 7<sup>th</sup>, 2001, Everett, WA). We analyzed the floodway downstream of Snohomish River Station 15.7 (Section AX), including storage areas, with a density fringe criteria (15% conveyance reduction) based on existing Snohomish County

Code. We determined the floodway upstream of Snohomish River Station 15.7 starting with the floodway from the prior FIS and then reducing the encroachment as necessary to attain the maximum one-foot rise. There is no density fringe upstream of this location. The City of Everett requested additional floodway fringe near the downstream end of the river and a maximum fill of 3 feet on top of the existing grade in the zoned area near the downstream end of Marshlands and storage area #6. The City of Snohomish requested additional floodway fringe near their city limits.

***Water Surface Elevation Profiles***

Table 2-4 presents the simulated water surface elevations for the 10, 50, 100 and 500-year events. The “Condition” column in this table indicates which simulation, i.e., with levees (“With levee”), without the left levee (“Without LL”), or without the right levee (“Without RL”), yielded the highest water surface elevation. “No change” indicates that the water surface elevation was the same for all three simulations. Gutter lines on the Work Maps denote the separation of BFE’s for the with levee scenario, the without levees scenario, and storage areas

We removed “negative surcharges”, for example a drop in water surface as the water is “squeezed” passing though a bridge opening, as discussed in FEMA 37. Snohomish River stations 4.4 and 3.861 superseded by a higher downstream elevation from Steamboat Slough, is another example of this. The water surface elevation data, as well as the water surface elevations with “negative surcharges” intact, are provided digitally in the Excel file “Summary WSELEV – Snohomish River.XLS”. Tidal surge elevations are not reflected in the table below.

**Table 2-4. Water surface elevations for the 10, 50, 100, and 500-year events.**

<b>River Station</b>	<b>10-Year WSELEV (ft) (NGVD)</b>	<b>50-Year WSELEV (ft) (NGVD)</b>	<b>BFE (ft) (NGVD)</b>	<b>Condition</b>	<b>500-Year WSELEV (ft) (NGVD)</b>	<b>Condition</b>
<b>Snohomish River</b>						
20.438	35.72	39.16	40.68	With levee	44.42	With levee
20.437	35.68	39.07	40.56	With levee	44.24	With levee
20.421	35.6	38.96	40.55	With levee	44.24	With levee
20.42	35.65	39.05	40.55	With levee	44.24	With levee
20.4	35.49	38.83	40.3	With levee	43.92	With levee
20.18	34.8	38.01	39.44	With levee	42.95	With levee

19.85	34.17	37.32	38.73	With levee	42.24	With levee
19.51	33.5	36.5	37.84	With levee	41.14	With levee
19.04	32.92	35.76	37.03	With levee	40.15	With levee
18.5	32.45	35.16	36.37	With levee	39.34	With levee
18.3	32.27	34.95	36.13	With levee	39.05	With levee
18.02	32.06	34.67	35.81	With levee	38.64	With levee
17.5	31.6	34.02	35.06	With levee	37.63	With levee
16.86	31.24	33.49	34.44	With levee	36.75	With levee
16.53	31.05	33.2	34.09	With levee	36.22	With levee
16.01	30.24	32.05	32.76	With levee	34.46	With levee
15.68	30.07	31.89	32.59	With levee	34.24	With levee
15.42	29.68	31.48	32.11	With levee	33.55	With levee
15.2	29.33	31.15	31.71	With levee	32.96	With levee
14.85	28.94	30.83	31.4	With levee	32.71	With levee
14.57	28.53	30.43	30.95	With levee	32.05	No change
14.15	27.62	29.94	30.57	Without RL	31.81	Without LL
13.94	27.42	29.59	30.19	Without RL	31.31	Without LL
13.6	27.26	29.25	29.74	With levee	30.75	With levee
13.303	26.98	28.94	29.44	With levee	30.49	With levee
13.302	26.92	28.8	29.41	With levee	30.47	With levee
13.301	26.91	28.78	29.41	With levee	30.47	With levee
13.3	26.97	28.92	29.41	With levee	30.47	With levee
13.2	26.83	28.77	29.27	With levee	30.33	With levee
13.003	26.14	27.99	28.49	With levee	29.59	With levee
13.002	25.92	27.73	28.47	With levee	29.57	With levee
13.001	25.9	27.71	28.47	With levee	29.57	With levee
13	26.12	27.97	28.47	With levee	29.57	With levee
12.703	24.62	26.34	27.01	With levee	28.39	With levee
12.702	24.18	25.81	27.01	With levee	28.39	With levee
12.701	24.21	25.85	27.01	With levee	28.39	With levee
12.7	24.7	26.43	27.01	With levee	28.39	With levee
12.69	24.61	26.32	26.91	With levee	28.29	With levee
12.23	23.67	24.87	25.26	With levee	26.15	With levee
12.229	23.62	24.79	25.26	With levee	26.15	With levee
12.223	23.59	24.77	25.26	With levee	26.15	With levee
12.222	23.66	24.86	25.26	With levee	26.15	With levee
12.119	23.57	24.86	25.26	With levee	26.15	With levee
12.017	23.46	24.83	25.24	With levee	26.15	With levee
11.915	23.34	24.78	25.2	With levee	26.12	With levee
11.813	23.2	24.66	25.09	With levee	26.01	With levee

11.711	23.05	24.54	24.98	With levee	25.91	With levee
11.608	22.87	24.37	24.83	With levee	25.77	With levee
11.506	22.68	24.18	24.64	With levee	25.58	With levee
11.404	22.45	23.92	24.39	With levee	25.34	With levee
11.302	22.16	23.51	23.99	With levee	24.96	With levee
11.208	21.85	23.04	23.46	With levee	24.34	With levee
11.114	21.55	22.67	23.07	With levee	23.93	With levee
11.02	21.22	22.29	22.71	With levee	23.67	With levee
10.988	21.18	22.24	22.66	With levee	23.65	With levee
10.882	20.91	21.96	22.4	With levee	23.52	With levee
10.776	20.65	21.66	22.12	With levee	23.34	With levee
10.67	20.42	21.44	21.92	With levee	23.21	With levee
10.565	20.21	21.28	21.81	With levee	23.14	With levee
10.459	20.02	21.15	21.74	With levee	23.07	With levee
10.353	19.82	21	21.63	With levee	22.96	With levee
10.247	19.61	20.86	21.54	With levee	22.89	With levee
10.141	19.39	20.66	21.4	With levee	22.78	With levee
10.035	19.19	20.51	21.27	With levee	22.67	With levee
9.93	19	20.4	21.17	With levee	22.58	With levee
8.87	17.44	19.03	19.95	With levee	21.56	With levee
8.4	16.38	18.38	19.32	With levee	20.92	With levee
8.081	16.08	18.23	19.13	With levee	20.58	With levee
8.08	16.08	18.23	19.13	With levee	20.58	With levee
7.92	15.83	18.15	19.06	With levee	20.5	With levee
7.66	15.15	17.91	18.87	With levee	20.37	With levee
7.31	14.84	17.7	18.64	With levee	20.13	With levee
6.77	13.68	16.21	17.17	Without LL	18.36	Without RL
6.25	12.88	15.35	16.17	Without LL	17.36	Without RL
5.59	11.79	13.93	14.56	Without LL	16.12	Without RL
5	10.71	12.89	13.65	Without LL	15.32	With levee
4.91	10.59	12.77	13.54	Without LL	15.2	With levee
4.84	10.39	12.56	13.35	Without LL	14.96	With levee
4.717	10.26	12.47	13.27	Without LL	14.92	With levee
4.716	9.98	12.2	13.27	Without LL	14.92	With levee
4.701	9.9	12.13	13.27	Without LL	14.92	With levee
4.7	9.89	12.1	13.27	Without LL	14.92	With levee
4.693	9.86	12.07	13.27	Without LL	14.92	With levee
4.692	9.87	12.09	13.27	Without LL	14.92	With levee
4.682	9.81	12.04	13.27	Without LL	14.92	With levee
4.681	10.11	12.31	13.27	Without LL	14.92	With levee

4.65	10.1	12.3	13.27	Without LL	14.92	With levee
4.601	10.24	12.46	13.27	Without LL	14.92	With levee
4.6	10.22	12.43	13.26	Without LL	14.91	With levee
4.593	10.21	12.42	13.26	Without LL	14.91	With levee
4.592	10.23	12.45	13.26	Without LL	14.91	With levee
4.4	9.82	12.03	12.95	With Levee**	14.57	With levee
3.861	9.03	11.11	12.95	With Levee**	13.75	Without RL
3.86	9.03	11.11	11.97	Without LL	13.75	Without RL
3.68	8.88	10.81	11.72	Without LL	13.48	With levee
3.3	8.92	10.91	11.72	Without LL	13.48	With levee
3.017	8.56	10.29	11	Without LL	12.53	With levee
3.016	8.54	10.25	10.95	Without LL	12.46	With levee
2.998	8.51	10.2	10.94	Without LL	12.46	With levee
2.997	8.54	10.24	10.94	Without LL	12.46	With levee
2.9	8.3	9.79	10.59	Without LL	12.04	With levee
2.6	8.35	9.93	10.59	Without LL	12.04	With levee
2.02	7.47	8.42	8.95	Without LL	10.09	With levee
1.272	6.96	7.64	8.11	Without LL	9.21	With levee
1.271	6.94	7.61	8.1	Without LL	9.21	With levee
1.269	6.93	7.6	8.1	Without LL	9.21	With levee
1.268	6.95	7.64	8.1	Without LL	9.21	With levee
1.26	6.95	7.62	8.09	Without LL	9.19	With levee
1.259	6.93	7.59	8.08	No change	9.19	With levee
1.256	6.92	7.59	8.08	No change	9.19	With levee
1.255	6.94	7.62	8.08	No change	9.19	With levee
1.201	6.7	7.24	7.65	Without LL	8.72	With levee
1.2	6.61	7.08	7.63	Without LL	8.69	With levee
1.199	6.6	7.06	7.63	Without LL	8.69	With levee
1.198	6.69	7.22	7.63	Without LL	8.69	With levee
0.5	6.2	6.2	6.2	No change	6.2	No change
<b>Ebey Slough</b>						
13.17	16.08	18.23	19.13	With levee	20.58	With levee
13.08	16.03	18.17	19.05	With levee	20.47	With levee
12.386	15.19	16.98	17.65	With levee	18.67	Without LL
12.385	15.15	16.95	17.65	With levee	18.67	Without LL
12.381	15.14	16.93	17.65	With levee	18.66	Without LL
12.38	15.2	16.99	17.65	With levee	18.65	No change
11.46	14.33	15.85	16.4	Without RL	17.56	Without LL
10.95	13.51	14.51	15.16	Without RL	16.55	Without LL

9.4	11.04	11.98	13.19	Without RL	15.47	With levee
9.38	11.19	12.15	13.19	Without RL	15.47	With levee
9.35	10.98	11.97	13.19	Without RL	15.47	With levee
9.32	11	12.12	13.19	Without RL	15.47	With levee
9.244	11.07	12.15	13.19	Without RL	15.47	With levee
9.243	11.07	12.15	13.19	Without RL	15.47	With levee
9.231	11.06	12.15	13.19	Without RL	15.47	With levee
9.23	11.05	12.14	13.19	Without RL	15.47	With levee
9.226	11.05	12.14	13.19	Without RL	15.47	With levee
9.225	11.05	12.15	13.19	Without RL	15.47	With levee
9.221	11.05	12.15	13.18	Without RL	15.47	With levee
9.22	11.04	12.14	13.18	Without RL	15.47	With levee
9.217	11.08	12.15	13.18	Without RL	15.47	With levee
9.216	11.04	12.15	13.18	Without RL	15.47	With levee
9.211	11.04	12.15	13.18	Without RL	15.47	With levee
9.21	11.03	12.14	13.18	Without RL	15.47	With levee
9.17	10.9	12.12	13.16	Without RL	15.46	With levee
9.12	10.82	12.02	13.16	Without RL	15.46	With levee
8.75	10.39	11.83	13.03	With levee	15.44	With levee
7.37	8.8	11.15	12.51	With levee	14.88	With levee
6.85	8.58	11.05	12.4	With levee	14.72	With levee
6.801	8.58	11.04	12.39	With levee	14.71	With levee
6.8	8.58	11.04	12.39	With levee	14.71	With levee
6.72	8.54	11.01	12.36	With levee	14.68	With levee
6.21	8.24	10.68	11.97	With levee	14.22	With levee
5.54	7.87	10.01	11.59	Without RL	13.77	Without LL
4.24	7.25	8.87	10.33	Without RL	12.48	No change
3.19	6.8	7.9	8.98	Without RL	11.28	With levee
2.87	6.71	7.68	8.76	Without RL	10.96	With levee
2.4	6.61	7.4	8.58	Without RL	10.73	Without LL
1.894	6.52	7.15	8.21	Without RL	10.01	Without LL
1.893	6.51	7.14	8.17	Without RL	9.94	Without LL
1.866	6.51	7.12	8.13	Without RL	9.84	Without LL
1.861	6.51	7.11	8.12	Without RL	9.81	Without LL
1.856	6.51	7.11	8.12	Without RL	9.81	Without LL
1.855	6.51	7.11	8.12	Without RL	9.81	Without LL
1.829	6.5	7.1	8.11	Without RL	9.78	Without LL
1.828	6.51	7.11	8.11	Without RL	9.78	Without LL
1.734	6.5	7.09	8.06	Without RL	9.67	Without LL
1.733	6.49	7.07	8.05	Without RL	9.65	Without LL

1.73	6.49	7.07	8.05	Without RL	9.65	Without LL
1.729	6.5	7.08	8.05	Without RL	9.65	Without LL
1.646	6.49	7.07	8.01	Without RL	9.6	Without LL
1.645	6.49	7.07	8.01	Without RL	9.59	Without LL
1.634	6.49	7.06	8.01	Without RL	9.59	Without LL
1.633	6.49	7.06	8.01	Without RL	9.59	Without LL
1.629	6.49	7.07	8.01	Without RL	9.59	Without LL
1.628	6.49	7.06	8	Without RL	9.56	Without LL
1.619	6.49	7.06	8	Without RL	9.56	Without LL
1.618	6.49	7.06	8	Without RL	9.56	Without LL
1.6	6.45	6.95	7.77	Without RL	9.18	Without LL
0.48	6.2	6.2	6.2	No change	6.2	No change
<b>Ebey- Steamboat Connection</b>						
0.6	8.58	11.04	12.39	With levee	14.71	With levee
0.25	8.39	10.82	12.14	With levee	14.36	With levee
0	8.26	10.61	11.84	With levee	13.89	With levee
<b>Marshland</b>						
6.689	6.46	21.39	23.06	Without LL	26.28	With levee
6.688	6.46	21.08	23.06	Without LL	26.13	Without RL
6.687	6.46	21.1	23.06	Without LL	26.13	Without RL
6.29	6.46	18.7	22.71	Without LL	25.74	Without RL
5.85	6.46	18.65	22.36	Without LL	25.36	Without RL
5.326	6.46	18.55	22.02	Without LL	25	Without RL
4.71	6.46	18.47	21.75	Without LL	24.72	Without RL
4.307	6.46	18.45	21.67	Without LL	24.61	Without RL
3.82	6.46	18.43	21.57	Without LL	24.47	Without RL
3.345	6.46	18.41	21.51	Without LL	24.37	Without RL
2.722	6.46	18.4	21.41	Without LL	24.21	Without RL
2.309	6.46	18.38	21.32	Without LL	24.05	Without RL
1.418	6.46	18.25	20.54	Without LL	22.76	Without RL
0.671	6.46	18.19	20.23	Without LL	22.27	Without RL
0.67	6.46	18.18	20.23	Without LL	22.27	Without RL
0.669	6.46	18.19	20.23	Without LL	22.27	Without RL
<b>Steamboat Slough</b>						
6.23	9.03	11.11	12.95	With levee	15.32	With levee
5.7	8.9	11.23	12.95	With levee	15.32	With levee
4.96	8.63	11.49	12.95	With levee	15.32	With levee

4.2	8.3	10.9	12.33	With levee	14.6	With levee
4.041	8.26	10.61	11.84	With levee	13.89	With levee
4.04	8.26	10.61	11.84	With levee	13.89	With levee
3.761	8.08	10.4	11.63	With levee	13.71	With levee
3.76	8.08	10.4	11.63	With levee	13.71	With levee
3.3	7.81	9.93	11.27	Without RL	13.22	With levee
2.6	7.2	8.74	10.06	Without RL	12.25	With levee
2.15	6.92	8.12	9.36	Without RL	11.85	With levee
1.72	6.67	7.59	8.65	Without RL	10.91	Without LL
1.62	6.6	7.42	8.39	Without RL	10.48	Without LL
1.49	6.59	7.4	8.32	Without RL	10.3	Without LL
1.432	6.58	7.36	8.24	Without RL	10.15	Without LL
1.431	6.57	7.33	8.2	Without RL	10.07	Without LL
1.421	6.56	7.32	8.18	Without RL	10.04	Without LL
1.42	6.56	7.31	8.16	Without RL	10.01	Without LL
1.4	6.55	7.28	8.16	Without RL	10.01	Without LL
1.399	6.55	7.29	8.16	Without RL	10.01	Without LL
1.389	6.55	7.28	8.16	Without RL	10.01	Without LL
1.388	6.56	7.31	8.16	Without RL	10.01	Without LL
1.302	6.55	7.28	8.12	Without RL	9.95	Without LL
1.301	6.54	7.26	8.09	Without RL	9.9	Without LL
1.276	6.53	7.24	8.06	Without RL	9.85	Without LL
1.275	6.52	7.2	8.05	Without RL	9.83	Without LL
1.268	6.52	7.2	8.05	Without RL	9.83	Without LL
1.267	6.53	7.24	8.05	Without RL	9.83	Without LL
1.242	6.52	7.22	8.02	Without RL	9.79	Without LL
1.241	6.53	7.22	8.02	Without RL	9.79	Without LL
1.215	6.52	7.21	8	Without RL	9.75	Without LL
1.214	6.5	7.17	7.99	Without RL	9.73	Without LL
1.211	6.5	7.16	7.99	Without RL	9.73	Without LL
1.21	6.52	7.2	7.99	Without RL	9.73	Without LL
1.184	6.51	7.19	7.99	Without RL	9.73	Without LL
1.183	6.52	7.2	7.99	Without RL	9.73	Without LL
1.162	6.51	7.18	7.96	Without RL	9.69	Without LL
1.161	6.5	7.17	7.94	Without RL	9.65	Without LL
1.144	6.5	7.16	7.92	Without RL	9.62	Without LL
1.143	6.49	7.13	7.91	Without RL	9.6	Without LL
1.142	6.49	7.13	7.91	Without RL	9.6	Without LL
1.141	6.5	7.15	7.91	Without RL	9.6	Without LL
1.122	6.49	7.14	7.91	Without RL	9.6	Without LL

1.121	6.5	7.15	7.91	Without RL	9.6	Without LL
0.8	6.33	6.72	7.21	Without RL	8.43	Without LL
0.799	6.33	6.72	7.21	Without RL	8.43	Without LL
0.16	6.2	6.2	6.2	No change	6.2	No change
<b>Union Slough</b>						
4.64	9.03	11.11	11.97	Without LL	13.89	With levee
3.93	8.61	10.56	11.84	With levee	13.89	With levee
3.38	8.37	10.48	11.84	With levee	13.89	With levee
3.05	8.26	10.51	11.84	With levee	13.89	With levee
2.98	8.26	10.61	11.84	With levee	13.89	With levee
2.68	8.08	10.4	11.63	With levee	13.71	With levee
2.61	8.02	10.37	11.5	With levee	13.4	With levee
1.47	6.92	9.14	10.67	No change	12.39	With levee
1.2	6.76	8.66	10.07	No change	12.39	With levee
1.045	6.62	8.07	8.9	Without LL	10.21	With levee
1.044	6.62	8.05	8.85	Without LL	10.12	With levee
1.036	6.6	8	8.81	Without LL	10.06	With levee
1.035	6.61	8.02	8.81	Without LL	10.06	With levee
1.034	6.61	8.01	8.79	Without LL	10.03	With levee
1.033	6.6	7.99	8.77	No change	9.98	With levee
1.025	6.59	7.94	8.77	No change	9.98	With levee
1.024	6.59	7.96	8.77	No change	9.98	With levee
0.88	6.61	8.01	8.77	No change	9.98	With levee
0.38	6.47	7.48	8.11	Without LL	9.3	With levee
0.358	6.47	7.46	8.09	Without LL	9.28	With levee
0.357	6.47	7.45	8.08	Without LL	9.27	With levee
0.352	6.47	7.44	8.08	Without LL	9.27	With levee
0.351	6.47	7.45	8.08	Without LL	9.27	With levee
0.306	6.46	7.42	8.04	Without LL	9.24	With levee
0.305	6.46	7.4	8.03	Without LL	9.23	With levee
0.301	6.46	7.4	8.03	Without LL	9.23	With levee
0.3	6.46	7.41	8.03	Without LL	9.23	With levee
0.238	6.41	7.18	7.77	Without RL/LL	9.04	With levee
0.237	6.4	7.14	7.75	Without RL	9.02	With levee
0.234	6.39	7.12	7.75	Without RL	9.02	With levee
0.233	6.4	7.16	7.75	Without RL	9.02	With levee
0	6.33	6.72	7.21	Without RL	8.43	Without LL

\*\*These elevations are superseded by a higher downstream water surface elevation on Steamboat Slough.

**Table 2-5. 100-year storage area elevations.**

Storage Area Number	Elevation (ft) (NGVD)		
	With Levees	Without Left Levee	Without Right Levee
1	31.6	16.1	31.3
2	22.8	N/A	22.6
3	26.4	N/A	26.2
4	24.7	N/A	24.5
5	21.0	N/A	19.5
6	19.3	N/A	18.5
7	12.9	12.9	12.8
8	11.1	11.1	11.1
9	21.3	22.8	21.1
10	8.2	8.3	8.2
11	12.5	12.5	12.3
12	10.5	10.5	10.5

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**Key to Cross-Section Labeling**

<b>Key to Cross-Section Labeling</b>				
FLOOD INSURANCE STUDY				
<b>Prepared by:</b>		<b>Community Name:</b>		
SC: WEST Consultants, Inc. TC:		City of Everett, City of Marysville, City of Snohomish, and Unincorporated Snohomish County		
<b>Date Prepared:</b>		<b>State:</b> Washington		
SC: April 2001 TC:		<b>FEMA CID:</b>		
		<b>Stream Name:</b> Snohomish River		
		<b>Run Date:</b>		
<i>STUDY CONTRACTOR</i>			<i>TECHNICAL EVALUATION CONTRACTOR</i>	
<i>Field Survey Section No.</i>	<i>Cross-Section Draft FIS</i>	<i>Computer Stationing</i>	<i>EPA Reach No.</i>	<i>Cross-Section Final FIS</i>
Snohomish River				
0.5	A	0		
1.198	B	3685		
1.199		3686		
1.2		3704		
1.201	C	3705		
1.255	D	3995		
1.256		3996		
1.259		4024		
1.26		4025		
1.268		4061		
1.269		4062		
1.271		4086		
1.272	E	4087		
2.02	F	8037		
2.6	G	11099		
2.9	H	12683		

2.997	I	13200		
2.998		13201		
3.016		13307		
3.017	J	13308		
3.3	K	14808		
3.68	L	16814		
3.86	M	17764		
3.861		17765		
4.4	N	20616		
4.592	O	21630		
4.593		21631		
4.6		21667		
4.601	P	21668		
4.65	Q	21932		
4.681	R	22096		
4.682		22097		
4.692		22157		
4.693		22158		
4.7		22194		
4.701		22195		
4.716		22285		
4.717	S	22286		
4.84	T	22935		
4.91	U	23305		
5	V	23780		
5.59	W	26895		
6.25	X	30380		
6.77	Y	33125		
7.31	Z	35976		
7.66	AA	37824		
7.92	AB	39198		
8.08	AC	40043		
8.081		40044		
8.4	AD	41734		
8.87	AE	44215		
9.93	AF	49812		
10.035		50370.8		
10.141		50929.6		

10.247		51488.4		
10.353		52047.2		
10.459		52606		
10.565		53164.8		
10.67		53723.61		
10.776		54282.41		
10.882		54841.21		
10.988		55400.01		
11.02	AG	55568.91		
11.114		56065.21		
11.208		56561.51		
11.302		57057.81		
11.404		57597.91		
11.506		58138.01		
11.608		58678.11		
11.711		59218.21		
11.813		59758.32		
11.915		60298.42		
12.017		60838.52		
12.119		61378.62		
12.222	AH	61918.72		
12.223		61919.72		
12.229		61951.72		
12.23	AI	61952.72		
12.69		64381.72		
12.7	AJ	64431.72		
12.701		64432.72		
12.702		64478.72		
12.703	AK	64479.72		
13	AL	66063.72		
13.001		66064.72		
13.002		66080.72		
13.003	AM	66081.72		
13.2	AN	67126.72		
13.3	AO	67654.72		
13.301		67655.72		
13.302		67674.22		
13.303	AP	67675.22		

13.6	AQ	69248.22		
13.94	AR	71043.22		
14.15	AS	72152.22		
14.57	AT	74370.22		
14.85	AU	75848.22		
15.2	AV	77696.22		
15.42	AW	78859.22		
15.68	AX	80232.22		
16.01	AY	81974.22		
16.53	AZ	84720.22		
16.86	BA	86462.22		
17.5	BB	89841.12		
18.02	BC	92587.02		
18.3	BD	94064.91		
18.5	BE	95120.91		
19.04	BF	97971.91		
19.51	BG	100453.9		
19.85	BH	102248.9		
20.18	BI	103990.9		
20.4	BJ	105152.9		
20.42		105258.9		
20.421		105259.9		
20.437		105343.9		
20.438	BK	105344.9		
<b>Ebey Slough</b>				
0.48	A	0		
1.6	B	5914		
1.618	C	6009		
1.619		6010		
1.628		6066		
1.629		6067		
1.633		6090		
1.634		6091		
1.645		6151		
1.646	D	6152		
1.729	E	6590		
1.73		6591		
1.733		6608		

1.734	F	6609		
1.828	G	7105		
1.829		7106		
1.855		7246		
1.856		7247		
1.861		7277		
1.866		7278		
1.893		7418		
1.894	H	7419		
2.4	I	10091		
2.87	J	12573		
3.19	K	14263		
4.24	L	19807		
5.54	M	26671		
6.21	N	30209		
6.72	O	32902		
6.8		33324		
6.801		33325		
6.85	P	33584		
7.37	Q	36329		
8.75	R	43615		
9.12	S	45569		
9.17	T	45833		
9.21	U	46044		
9.211		46045		
9.216		46079		
9.217		46080		
9.22		46094		
9.221		46095		
9.225		46129		
9.226		46130		
9.23		46160		
9.231		46161		
9.243		46231		
9.244	V	46232		
9.32	W	46633		
9.35	X	46791		
9.38	Y	46949		

9.4	Z	47055		
10.95	AA	55239		
11.46	AB	57932		
12.38	AC	62789		
12.381		62790		
12.385		62820		
12.386	AD	62821		
13.08	AE	66485		
13.17	AF	66960		
<b>Ebey-Steamboat Connection</b>				
0	A	0		
0.25	B	1320		
0.6	C	3168		
<b>Marshland</b>				
0.669	A	0		
0.67		20		
0.671		40		
1.418	B	3990		
2.309	C	8690		
2.722	D	10870		
3.345	E	14160		
3.82	F	16670		
4.307	G	19240		
4.71	H	21370		
5.326	I	24620		
5.85	J	27390		
6.29	K	29710		
6.687		31810		
6.688		31830		
6.689	L	31850		
<b>Steamboat Slough</b>				
0.16	A	0		
0.799	B	3374		
0.8		3375		
1.121	C	5070		
1.122	D	5071		
1.141		5171		
1.142		5172		

1.143		5189		
1.144		5190		
1.161		5290		
1.162	E	5291		
1.183	F	5402		
1.184		5403		
1.21		5540		
1.211		5541		
1.214		5565		
1.215		5566		
1.241		5703		
1.242	G	5704		
1.267	H	5836		
1.268		5837		
1.275		5873		
1.276		5874		
1.301		6006		
1.302	I	6007		
1.388	J	6461		
1.389		6462		
1.399		6524		
1.4		6525		
1.42		6631		
1.421		6632		
1.431		6694		
1.432	K	6695		
1.49	L	7001		
1.62	M	7687		
1.72	N	8215		
2.15	O	10485		
2.6	P	12861		
3.3	Q	16557		
3.76		18986		
3.761	R	18987		
4.04	S	20460		
4.041		20461		
4.2	T	21301		
4.96	U	25314		

5.7	V	29221		
6.23	W	32019		
<b>Union Slough</b>				
0	A	0		
0.233	B	1235.5		
0.234		1236.5		
0.237		1251.5		
0.238	C	1252.5		
0.3	D	1584		
0.301		1585		
0.305		1611		
0.306	E	1612		
0.351	F	1855		
0.352		1856		
0.357		1888		
0.358	G	1889		
0.38		2005		
0.88	H	4645		
1.024	I	4769		
1.025		4770		
1.033		4819.5		
1.034		4820.5		
1.035		4825		
1.036		4826		
1.044		4875.5		
1.045	J	4876.5		
1.2	K	5696.5		
1.47	L	7121.5		
2.61	M	13141.5		
2.68	N	13511.5		
2.98	O	14986.5		
3.05	P	15356.5		
3.38	Q	17098.5		
3.93	R	20002.5		
4.64	S	23751.5		

**Hydraulic Model Files Index**

Study Contractor: WEST Consultants, Inc.		
<p><b>Hydraulic Model Files Index</b> City of Everett, City of Marysville, City of Snohomish, and Unincorporated Snohomish County, Washington FLOOD INSURANCE STUDY</p>		
<b>Flooding Source /Stream Name</b>	<b>File Description</b>	<b>File Name</b>
Snohomish River	With levee geometry	SNO_XSEC.CS
Snohomish River	With levee geometry without left levee	REMOVEDL.CS
Snohomish River	With levee geometry without right levee	REMOVEDR.CS
Snohomish River	Floodway geometry	SNO_ALT8.CS
Snohomish River	Floodway geometry without left levee	ALT8NOLL.CS
Snohomish River	Floodway geometry without right levee	ALT8NORL.CS
Snohomish River	10-year boundary condition	SNO10YR.BC
Snohomish River	50-year boundary condition	SNO50YR.BC
Snohomish River	100-year boundary condition file for with levees and without right levee	SNO100YR.BC
Snohomish River	500-year boundary condition file for with levees and without right levee	SNO500YR.BC
Snohomish River	100-year boundary condition file for without left levee and for floodway without left levee	REMOVEDL.BC
Snohomish River	Floodway 100-year boundary condition file for with levees and without right levee	SNO_ALT8.BC
Snohomish River	500-year boundary condition file for without left levee	NOLL500Y.BC

*(Files are contained in the "UNET" subdirectory on Disk #1)*

## **Section 3 - Draft FIS Report Text**

### FLOOD INSURANCE STUDY REPORT DATA CHECKLIST

#### FLOOD INSURANCE STUDY SNOHOMISH COUNTY, WASHINGTON

#### 1.0 INTRODUCTION

##### 1.1 Purpose of Study

Community Name: Snohomish County  
County: Snohomish  
State: Washington

##### 1.2 Authority and Acknowledgments

Study Contractor: WEST Consultants, Inc.  
Subcontractor (if applicable): N/A  
Inter-Agency Agreement No.: \_\_\_\_\_  
or Contract No.: DACW67-97-D-1016, Delivery Order #6, Seattle District, US  
Army Corps of Engineers, 4735 East Marginal Way South, Seattle WA 98124  
Completion Date (month and year): April 2001

Provider/Agency of Base Map & Address: Seattle District, US Army Corps of  
Engineers,

Base Map Compilation Source: US Army Corps of Engineers  
Base Map Compilation Scale: 1" = 400'  
Base Map Compilation Date: September 1981

Coordinate System, Projection, Datum:  
(See prior *Snohomish County, Washington, Unincorporated Areas, Flood  
Insurance Study, Revised: September 30, 1992*)

Has base map source been modified? No  
If so, how and where? N/A

Any restrictions on release of base map data? No  
If yes, what restrictions apply? N/A

##### 1.3 Coordination

Initial Consultation and Coordination Officer's (CCO) meeting date:

List attendees and agencies represented at the initial CCO meeting:

Intermediate CCO meeting data and attendees (if applicable):

List contacts made for purposes of acquiring information:

## 2.0 AREA STUDIED

### 2.1 Scope of Study

Note areas excluded from study, as well as areas of extraterritorial jurisdiction:

List the flooding sources studied in detail (detailed study streams should be listed in the same order as they appear in the profiles). If they are also partially studied by approximate methods, provide the limits of detailed study:

Snohomish River and connected side channels including Ebey Slough, Ebey-Steamboat Connection, Steamboat Slough, and Union Slough  
Excluded areas include the Pilchuck River, Quilceda Creek, Allen Creek, a miscellaneous creek near the City of Snohomish treatment plant (west of the city), and Anderson Creek

List the flooding sources studied by approximate methods:

N/A

If applicable, discuss streams on which study was terminated where the 100-year floodplain permanently narrowed to less than 200 feet wide or for which detailed study was ended where the drainage area was less than 1 square mile:

N/A

### 2.2 Community Description

Provide a general description of the community's location within the county and state:

(See prior *Snohomish County, Washington, Unincorporated Areas, Flood Insurance Study, Revised: September 30, 1992*)

List surrounding communities and their locations with respect to the subject community:

(See prior *Snohomish County, Washington, Unincorporated Areas, Flood Insurance Study, Revised: September 30, 1992*)

List other nearby large cities and their locations:

(See prior *Snohomish County, Washington, Unincorporated Areas, Flood Insurance Study, Revised: September 30, 1992*)

Briefly describe the community. This description may include patterns of residential and commercial development; the extent and nature of floodplain development; natural features that affect flood hazards in the community; and sufficient description of climatic, physiographic, and land use factors to support the discussion of flood problems that follows (Section 2.3).

(See prior *Snohomish County, Washington, Unincorporated Areas, Flood Insurance Study, Revised: September 30, 1992*)

### 2.3 Principal Flood Problems

Include the discharges and recurrence intervals of major floods:

***Snohomish River - November 1990 Flood Event*** The Thanksgiving weekend flood of November 1990, was preceded by a rain-on-snow-event, a common denominator with most large floods in the west Cascade rivers. Two large cold fronts led to three feet of snow in the Cascade Mountains during the week preceding the flood, then two large back-to-back warm fronts generated 25 inches of rain melting the snow. The coincident flood peaks of the upstream Skykomish and Snoqualmie Rivers also contributed to the Snohomish River flooding (Snohomish County, 1991). Peak flow for this event was estimated at 150,000 cfs.

(Also see prior *Snohomish County, Washington, Unincorporated Areas, Flood Insurance Study, Revised: September 30, 1992*)

Give the locations (city and state) of all stream gages for studied streams:

(See prior *Snohomish County, Washington, Unincorporated Areas, Flood Insurance Study, Revised: September 30, 1992*)

Note any factors that aggravate flood problems:

(See prior *Snohomish County, Washington, Unincorporated Areas, Flood Insurance Study, Revised: September 30, 1992*)

Provide photos of flooding, flood control structures, etc. (with location of photo noted):

(See prior *Snohomish County, Washington, Unincorporated Areas, Flood Insurance Study, Revised: September 30, 1992*)

#### 2.4 Flood Protection Measures

Describe all flood protection structures and floodplain management measures used to reduce potential flood damage:

(See prior *Snohomish County, Washington, Unincorporated Areas, Flood Insurance Study, Revised: September 30, 1992*)

Mention all dams, including those affecting the community that lie outside the community:

(See prior *Snohomish County, Washington, Unincorporated Areas, Flood Insurance Study, Revised: September 30, 1992*)

Mention dams within the community used for purposes other than flood control:

(See prior *Snohomish County, Washington, Unincorporated Areas, Flood Insurance Study, Revised: September 30, 1992*)

If levees are mentioned, state whether the levees meet or fail to meet the FEMA 3-foot freeboard requirement.

None of the mentioned levees protect against the 100-year event

### 3.0 ENGINEERING METHODS (Note any digital methodologies used)

#### 3.1 Hydrologic Analyses

Describe the hydrologic analyses for all flooding sources studied in detail:

Hydrographs were generated to simulate the hydraulic response of the 10-, 50-, 100- and 500-year flows as required by FEMA. However, for an unsteady flow model, the upstream flood hydrograph not only has to consider peak discharge but also volume. One method to develop an appropriate synthetic hydrograph is the “balanced hydrograph” approach. In this approach, flood frequency analyses (USGS, 1982) were conducted for instantaneous peak flows, and average 1-, 3-, 5-, and 7-day flows for the continuous period of record, after removing the hysteresis effect at the gage. Synthetic hydrographs for the 10-, 50-, 100- and 500-year events were created by ensuring that the hydrograph ordinates preserved the peak discharge and the average 1-,

3-, 5-, and 7-day flows. Then, historical flood events were examined, and a skew specified that placed the flood peak at day 3 of the 7-day “event”.

Based on a flood frequency analysis from the record at the Monroe gage (1964 to 1999), the November 1990 peak flow would be about the 100-year event. However, numerous historic events, measured or inferred at nearby gages and streams, indicated that this event was exceeded several times since the late 1800s. When these flows, which were reported only as peak flows, were included in the analysis of peak values, the November 1990 peak flow was closer to the 30-year event, a finding that is consistent with nearby rivers with longer gage records. This information was used to increase the 1-day average flow (volume) of the synthetic hydrographs, by multiplying by the ratio of the peak with historical flows to the peak without historical flows, to account for not having historical volume data. .

In a Summary of Discharges table, provide a summary of drainage area-peak discharge relationships for the streams studied by detailed methods. Discharges and drainage areas for each stream should be listed in descending order. Streams should be listed in the same order as flood profiles:

	Drainage Area (Square Miles)**	Peak Discharges (cfs)			
		10-Year	50-Year	100-Year	500-Year
Snohomish River near Monroe	1537	114000	173000	204000	293000

\*\*From FEMA, 1992

If applicable, discuss methods used to determine stillwater elevations and reference the Summary of Stillwater Elevations table:

N/A

### 3.2 Hydraulic Analyses

State how cross sections were developed for all streams studied by detailed methods:

Snohomish County provided cross-section data from their FEQ model of the system. We supplemented this with cross-section data from the original US Army Corps hydraulic model, bridge cross-sections from the Washington Department of Transportation and Burlington Northern Sante Fe Railroad, and various additional surveys throughout the study area, to provide better channel definition where necessary.

Describe how the dimensions of hydraulic structures were determined:

Snohomish County, the Washington Department of Transportation, and Burlington Northern Sante Fe Railroad provided various construction information for defining bridge structures.

Explain how channel roughness factors (Manning's "n") were assigned. The "n" values for ALL streams studied by detailed methods (channel and overbank areas) should be given:

Fairly extensive sets of observations on the mainstem of the Snohomish River were available to calibrate the UNET model for the Floods of 1989 and 1990. The December 1989 event was essentially a bank-full event, and was used to calibrate Manning's n roughness values in the main channel (Figure 2-8). The November 1990 event caused significant overbank flooding, and numerous highwater marks were surveyed throughout the system, as well as continuous stages being recorded at the Monroe and Snohomish gages. We used the 1990 event, without changing the calibrated main channel n values, to calibrate the overbank (which includes storage areas and Marshlands) Manning's n roughness values (Figure 2-9 and Figure 2-10). Manning's n values in the sloughs were determined during calibration of the mainstem although calibration was limited due to the deficiency of observed water surface elevations in these areas. No further "validation" was conducted beyond these events because of the lack of data during other overbank flood events. The calibrated n values presented in Table 2-3 are consistent with typical ranges for channels and overbanks.

	<b>Channel <i>n</i></b>	<b>Overbank <i>n</i></b>
<b>Snohomish River</b>	0.035 – 0.045	0.050 – 0.070
<b>Sloughs and Marshlands</b>	0.036 – 0.070	0.050 – 0.070

State how water-surface elevations were obtained for all streams studied by detailed methods:

WEST Consultants, Inc. developed an unsteady flow model of the system using UNET Version 3.2 (HEC, 1997). The UNET model consists of thirteen separate reaches with a total of nearly 270 cross-sections and twelve storage areas. The most significant overbank areas are Fryelands, which was modeled as a storage area, and Marshlands, which was modeled as a conveyance area as it is connected with the Snohomish River at the upstream and downstream ends.

State how starting water-surface elevations were obtained for all streams studied by detailed methods:

The downstream boundary condition in an unsteady flow model may be time dependent, whereas a normal depth condition or fixed stage is usually specified in a steady flow model. Puget Sound is tidal, and there are tide gages at Everett and Seattle with long periods of record. These data were used as downstream boundary conditions for model calibration.

A flood insurance study with a tidal downstream boundary usually considers both a river flood and a tidal surge in establishing flood elevations. However, as the joint occurrence of these events is extremely small, they may be considered to be independent events. A fixed downstream stage equal to mean higher high water (MHHW) plus one foot was used for the river flood stages based on prior studies (USACE, 2000b). The Seattle District, Corps of Engineers, had previously conducted a tidal surge analysis, and established tidal surge elevations at the mouth of the Snohomish River for the 10-, 50-, 100- and 500-year events (USACE, 2000a).

Describe the methodology for wave height/runup, lacustrine, ice jam, alluvial fan flooding, and shallow flooding areas (where applicable):

N/A

If applicable, reference the Transect Descriptions which should include: transect number, location, 100-year stillwater elevation, and maximum 100-year wave elevation.

N/A

If performed, describe the hydraulic analyses for the approximate flooding sources:

N/A

If applicable, reference the Transect Data Table which should include: Flooding Source (with the affected transects), 10-, 50-, 100-, and 500-year stillwater elevation, zone designation and Base Flood Elevation.

N/A

If applicable, reference the Transect Location Map.

N/A

Standard paragraphs in this section include paragraphs for cross sections, NGVD, and unobstructed flow.

Specify whether elevations are referenced to NGVD or NAVD or other datum, and give releveling dates, if any.

NGVD

#### 4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

##### 4.1 Floodplain Boundaries

Identify all maps used. Include the scale, contour interval, and type of map (topographic, compiled from aerial photographs, etc.):

Base maps from the original FIS (see prior *Snohomish County, Washington, Unincorporated Areas, Flood Insurance Study, Revised: September 30, 1992*) were used to delineate cross-sections, floodplains, and floodways. Work maps were generated by projecting this information on to USGS quad maps.

Identify and reference all maps or methods used to delineate floodplain boundaries for approximate flooding sources:

N/A

4.2 Floodways

List streams, if any, for which floodway widths extend beyond the corporate limits:  
N/A

List streams affected by backwater:  
N/A

Provide method used for floodway computations:

The regulatory floodway is defined as the portion of the river and adjacent land area that must remain unobstructed to ensure that the water surface elevation does not cumulatively increase more than one foot above the base flood elevation (BFE). Typically, an encroachment analysis is computed from both the left and right channel banks towards the river channel using an “equal conveyance reduction” method. The floodway development becomes more complicated when multiple channels and split flows are involved when modeling in an unsteady flow model.

There are multiple channel bifurcations and junctions in the downstream reaches of the Snohomish network especially near the downstream sloughs, and major storage areas upstream. Performing an encroachment in such a system becomes extremely complex as each reach must be individually encroached upon, and changes between the reaches are dependent on one another, making determination of the 1-foot rise even more difficult.

Because of these complexities, a series of meetings were held with FEMA and the local communities to identify options and priorities for floodplain development. The downstream Cities of Everett and Marysville had specific encroachment goals in mind, whereas the upstream unincorporated County areas have an existing ordinance based on the density of development. The result was a floodway analysis where encroachment and storage-volume reduction were specified in locations of zoned development. This consensus among the local communities also removed the need for equal conveyance reduction.

The floodway fringe submitted in this FIS was defined in most locations by the existing Snohomish County fringe boundary. We analyzed the floodway downstream of Snohomish River Station 15.7 (Section AX), including storage areas, with a density fringe criteria (15% conveyance reduction) based on existing Snohomish County Code. We determined the floodway upstream of Snohomish River Station 15.7 starting with the floodway from the prior FIS and then reducing the encroachment as necessary to attain the maximum one-foot rise. There is no density fringe upstream of this location. The City of Everett requested additional floodway fringe near the downstream end of the river and a maximum fill of 3 feet on top of the existing grade in the zoned area near the downstream end of Marshlands and storage area #6. The City of Snohomish requested additional floodway fringe near their city limits.

Give reason or reasons why no floodway was delineated for streams or portions of streams:  
N/A

Identify any abnormal procedures (such as state-imposed surcharges of less than 1.0 foot) for floodway delineations:

N/A

## 7.0 OTHER STUDIES

Identify and reference all other FISs for contiguous communities and any other published reports or available data dealing with related flooding sources. All disagreements and discrepancies must be noted and resolved:

The Snohomish River system abuts the Pilchuck River, the Skykomish River, and the Snoqualmie River detailed study area, in addition to the Quilceda Creek and French Creek approximate study areas. The Snohomish River water surface elevations are approximately XX feet higher in these locations. Not only has the hydrology changed since the original study, but also the modeling technique. The UNET model of the system now represents both storage areas and multiple reaches.

## 9.0 BIBLIOGRAPHY AND REFERENCES

List references with complete information, including date, place of publication, and scale (as applicable):

Federal Emergency Management Agency (FEMA) (1992), *Flood Insurance Study Snohomish County Washington, Unincorporated Areas*, Revised September 1992.

Federal Emergency Management Agency (FEMA) (1995), *Flood Insurance Study Guidelines and Specifications for Study Contractors*, FEMA 37.

Hydrologic Engineering Center (HEC) (1997), *UNET One-Dimensional Unsteady Flow Through a Full Network of Open Channels, User's Manual*, US Army Corps of Engineers, Davis, CA.

Snohomish County Public Works Department (1991), *Snohomish River Comprehensive Flood Control Management Plan*, Surface Water Management, December 1991.

United States Army Corps of Engineers (USACE) (2000a), *Personal communication*, Joe Weber, Program Manager, Flood Plain Management Services, Seattle District, February 2000.

United States Army Corps of Engineers (USACE) (2000b), *Personal communication*, Wayne Wagner, Chief, Hydrology and Hydraulics Section, Seattle District, June 2000.

United States Geological Society (USGS) (1982), *Guidelines for Determining Flood Flow Frequency*, Bulletin #17B, March 1982.

**Water Surface Profiles Index**

Study Contractor: WEST Consultants, Inc.

**Water Surface Profiles Index**

City of Everett, City of Marysville, City of Snohomish, and Unincorporated Snohomish County,  
Washington

FLOOD INSURANCE STUDY

<b><i>Flooding Source /Stream Name</i></b>	<b><i>Number of Profile Sheets</i></b>	<b><i>Sub- directory</i></b>	<b><i>Disk Number</i></b>	<b><i>File Name (*.MDB and *.DXF extensions)</i></b>
Snohomish River	9	\RASPLOT	Disk #1	SNOHOMISH
Ebey Slough	6	\RASPLOT	Disk #1	EBEY
Ebey-Steamboat Connection	1	\RASPLOT	Disk #1	CONNECTION
Marshlands	3	\RASPLOT	Disk #1	MARSHLAND
Steamboat Slough	3	\RASPLOT	Disk #1	STEAMBOAT
Union Slough	2	\RASPLOT	Disk #1	UNION

*(Files are contained in the "RASPLOT" subdirectory on Disk #1)*

**Floodway Tables**

Velocities listed are the maximum of with levee, without left levee, and without right levee scenarios for the simulation period and do not necessary correspond to the time step with the maximum increase in stage. The provided top widths take into account the 15% density fringe, in addition to the floodway fringe, where appropriate.

**Table 3-1. Floodway table.**

	Cross Section	Distance (feet)	Width (feet)	Section Area (square fee)	Mean Velocity (foot per second)	Without Floodway (ft) (NGVD)	With Floodway (ft) (NGVD)	Increase (ft)
Snohomish River								
0.5	A	0	1166	18260	4.92	6.2	6.2	0.0
1.198	B	3685	985	14456	7.4	7.63	7.63	0.0
1.201	C	3705	985	14475	7.39	7.65	7.65	0.0
1.255	D	3995	1082	23388	3.82	8.08	8.2	0.1
1.272	E	4087	1081	24205	3.69	8.11	8.23	0.1
2.02	F	8037	733	12298	7.27	8.95	9.3	0.4
2.6	G	11099	1093	21123	4.23	10.59	11.16	0.6
2.9	H	12683	377	10504	8.52	10.59	11.16	0.6
2.997	I	13200	489	12869	6.95	10.94	11.52	0.6
3.017	J	13308	486	12899	6.93	11	11.58	0.6
3.3	K	14808	720	22351	4	11.72	12.37	0.6
3.68	L	16814	356	11748	7.61	11.72	12.37	0.6
3.86	M	17764	356	11890	7.54	11.97	12.55	0.6
4.4	N	20616	820	15115	6.82	12.85	13.3	0.5
4.592	O	21630	1438	18663	5.28	13.26	13.64	0.4
4.601	P	21668	1438	18672	5.28	13.27	13.64	0.4
4.65	Q	21932	1000	14690	6.96	13.27	13.64	0.4
4.681	R	22096	1000	14397	7.32	13.27	13.64	0.4
4.717	S	22286	1000	14493	7.25	13.27	13.64	0.4
4.84	T	22935	443	11220	7.81	13.35	13.67	0.3

4.91	U	23305	442	12014	7.23	13.54	13.84	0.3
5	V	23780	443	11669	7.44	13.65	13.92	0.3
5.59	W	26895	601	13088	7.1	14.56	14.64	0.1
6.25	X	30380	460	11654	8.27	16.17	15.94	0.0
6.77	Y	33125	1383	19236	7.7	17.17	17.62	0.4
7.31	Z	35976	1668	20540	5.59	18.64	18.99	0.3
7.66	AA	37824	479	11799	7.7	18.87	19.21	0.3
7.92	AB	39198	603	14029	6.55	19.06	19.41	0.4
8.08	AC	40043	603	14071	6.68	19.13	19.48	0.4
8.4	AD	41734	2110	36660	8.82	19.32	19.69	0.4
8.87	AE	44215	3043	52800	7.57	19.95	20.37	0.4
9.93	AF	49812	1366	24582	8.47	21.17	21.76	0.6
11.02	AG	55568.91	837	16252	8.74	22.71	23.01	0.3
12.222	AH	61918.72	445	14850	9.26	25.26	25.38	0.1
12.23	AI	61952.72	445	14725	9.33	25.26	25.38	0.1
12.7	AJ	64431.72	386	12558	10.49	27.01	27.08	0.1
12.703	AK	64479.72	371	11878	11.1	27.01	27.08	0.1
13	AL	66063.72	611	16589	8.36	28.47	28.48	0.0
13.003	AM	66081.72	611	16601	8.35	28.49	28.5	0.0
13.2	AN	67126.72	1021	24748	6.35	29.27	29.28	0.0
13.3	AO	67654.72	2041	37146	5.81	29.41	29.49	0.1
13.303	AP	67675.22	2041	37177	5.81	29.44	29.51	0.1
13.6	AQ	69248.22	1380	34423	4.95	29.74	29.8	0.1
13.94	AR	71043.22	644	19306	6.27	30.19	30.21	0.0
14.15	AS	72152.22	540	16619	7.5	30.57	30.59	0.0
14.57	AT	74370.22	917	22475	6.67	30.95	30.97	0.0
14.85	AU	75848.22	983	25096	7.21	31.4	31.42	0.0
15.2	AV	77696.22	1165	27087	6.81	31.71	31.73	0.0
15.42	AW	78859.22	1352	29115	8.27	32.11	32.12	0.0
15.68	AX	80232.22	1364	39661	5.45	32.59	32.61	0.0
16.01	AY	81974.22	2194	38784	8.66	32.76	32.78	0.0
16.53	AZ	84720.22	2887	50117	4.85	34.09	34.14	0.0
16.86	BA	86462.22	3541	78612	3.4	34.44	34.69	0.3
17.5	BB	89841.12	3680	59694	6.49	35.06	35.43	0.4
18.02	BC	92587.02	4080	78959	4.5	35.81	36.33	0.5

18.3	BD	94064.91	4570	71600	4.87	36.13	36.64	0.5
18.5	BE	95120.91	4350	68399	4.94	36.37	36.91	0.5
19.04	BF	97971.91	3022	56603	5.04	37.03	37.66	0.6
19.51	BG	100453.9	2690	47711	6.37	37.84	38.53	0.7
19.85	BH	102248.9	3180	54899	5.21	38.73	39.41	0.7
20.18	BI	103990.9	1150	24324	9.83	39.44	40.02	0.6
20.4	BJ	105152.9	1045	23931	10.87	40.3	41.17	0.9
20.438	BK	105344.9	1030	25015	10.1	40.68	41.56	0.9
<b>Ebey Slough</b>								
0.48	A	0	3065	17959	1.1	6.2	6.2	0.0
1.6	B	5914	284	4137	4.93	7.77	7.79	0.0
1.618	C	6009	467	7594	2.69	8	8.07	0.1
1.646	D	6152	422	6973	2.92	8.01	8.09	0.1
1.729	E	6590	431	6660	3.15	8.05	8.14	0.1
1.734	F	6609	431	6664	3.15	8.06	8.15	0.1
1.828	G	7105	373	5928	3.58	8.11	8.21	0.1
1.894	H	7419	373	5965	3.56	8.21	8.31	0.1
2.4	I	10091	420	6488	3.15	8.58	8.89	0.3
2.87	J	12573	1214	9589	3.74	8.76	9.42	0.7
3.19	K	14263	5113	29486	3.4	8.98	9.85	0.9
4.24	L	19807	900	7861	3.52	10.33	10.89	0.6
5.54	M	26671	2055	21310	3.48	11.59	12.03	0.4
6.21	N	30209	2256	17790	3.89	11.97	12.49	0.5
6.72	O	32902	3080	33618	2.7	12.36	12.89	0.5
6.85	P	33584	2916	36389	2.59	12.4	12.93	0.5
7.37	Q	36329	345	7971	4.24	12.51	13.09	0.6
8.75	R	43615	1454	19353	4.35	13.03	13.59	0.6
9.12	S	45569	1082	15311	4.58	13.16	13.59	0.4
9.17	T	45833	1138	15192	4.68	13.16	13.6	0.4
9.21	U	46044	1280	16540	4.33	13.18	13.6	0.4
9.244	V	46232	1280	16540	4.35	13.19	13.6	0.4
9.32	W	46633	1218	15282	4.99	13.19	13.6	0.4
9.35	X	46791	1166	14566	5.22	13.19	13.6	0.4
9.38	Y	46949	1186	14708	5.22	13.19	13.6	0.4
9.4	Z	47055	1083	14007	5.25	13.19	13.6	0.4

10.95	AA	55239	1648	21971	7.31	15.16	15.17	0.0
11.46	AB	57932	1750	27045	6.01	16.4	16.51	0.1
12.38	AC	62789	1789	30312	7.37	17.65	17.76	0.1
12.386	AD	62821	1789	30294	7.52	17.65	17.76	0.1
13.08	AE	66485	2377	35749	5.57	19.05	19.39	0.3
13.17	AF	66960	2377	35963	5.58	19.13	19.48	0.4
<b>Ebey-Steamboat Connection</b>								
0	A	0	407	5237	4.12	11.84	12.41	0.6
0.25	B	1320	250	5157	3.5	12.14	12.69	0.5
0.6	C	3168	272	5205	3.25	12.39	12.92	0.5
<b>Marshlands</b>								
0.669	A	0	8540	19109	1.03	20.23	20.47	0.2
1.418	B	3990	3314	46938	3.12	20.54	20.87	0.3
2.309	C	8690	4690	91868	1.45	21.32	21.86	0.5
2.722	D	10870	6340	130368	0.97	21.41	21.97	0.6
3.345	E	14160	6910	135254	0.98	21.51	22.07	0.6
3.82	F	16670	7487	126411	1.52	21.57	22.15	0.6
4.307	G	19240	7565	114236	2.34	21.67	22.28	0.6
4.71	H	21370	9145	131146	2.64	21.75	22.39	0.6
5.326	I	24620	5050	47238	3.85	22.02	22.75	0.7
5.85	J	27390	3960	40187	2.13	22.36	23.26	0.9
6.29	K	29710	3050	30009	2.7	22.71	23.72	1.0
6.689	L	31850	2040	3835	7.04	23.06	24.09	1.0
<b>Steamboat Slough</b>								
0.16	A	0	2917	30510	3.89	6.2	6.2	0.0
0.799	B	3374	1353	21730	4.65	7.21	7.22	0.0
1.121	C	5070	2889	17842	4.37	7.91	8.19	0.3
1.122	D	5071	919	17039	4.58	7.91	8.19	0.3
1.162	E	5291	949	17900	4.36	7.96	8.26	0.3
1.183	F	5402	814	18302	4.17	7.99	8.3	0.3
1.242	G	5704	835	17201	4.48	8.02	8.34	0.3
1.267	H	5836	835	17226	4.48	8.05	8.37	0.3
1.302	I	6007	879	18492	4.17	8.12	8.47	0.4
1.388	J	6461	792	16862	4.48	8.16	8.52	0.4
1.432	K	6695	793	16949	4.46	8.24	8.63	0.4

1.49	L	7001	1368	19526	5.33	8.32	8.63	0.3
1.62	M	7687	596	12265	5.86	8.39	8.91	0.5
1.72	N	8215	626	12730	5.11	8.65	9.23	0.6
2.15	O	10485	1309	17342	4.79	9.36	10.11	0.8
2.6	P	12861	1148	13451	5.63	10.06	10.77	0.7
3.3	Q	16557	1150	16315	4.47	11.27	11.75	0.5
3.761	R	18987	2145	22823	4.45	11.63	12.19	0.6
4.04	S	20460	2772	26253	4.88	11.84	12.41	0.6
4.2	T	21301	350	6490	3.45	12.33	12.9	0.6
4.96	U	25314	349	5844	2.85	12.95	13.52	0.6
5.7	V	29221	240	4566	3.35	12.95	13.52	0.6
6.23	W	32019	742	10093	1.64	12.95	13.52	0.6
Union Slough								
0	A	0	610	7084	3.6	7.21	7.22	0.0
0.233	B	1235.5	505	4798	5.27	7.75	7.86	0.1
0.238	C	1252.5	505	4823	5.24	7.77	7.91	0.1
0.3	D	1584	588	7698	3.28	8.03	8.36	0.3
0.306	E	1612	588	7703	3.28	8.04	8.37	0.3
0.351	F	1855	588	7745	3.26	8.08	8.44	0.4
0.358	G	1889	588	7756	3.25	8.09	8.46	0.4
0.88	H	4645	278	4356	5.79	8.77	9.46	0.7
1.024	I	4769	328	4006	7.5	8.77	9.46	0.7
1.045	J	4876.5	328	4034	7.01	8.9	9.6	0.7
1.2	K	5696.5	382	4948	3.82	10.07	11.06	1.0
1.47	L	7121.5	207	3281	4.87	10.67	11.33	0.7
2.61	M	13141.5	309	4189	4.51	11.5	12.03	0.5
2.68	N	13511.5	309	4239	4.48	11.63	12.19	0.6
2.98	O	14986.5	558	5405	1.7	11.84	12.41	0.6
3.05	P	15356.5	260	3250	2.08	11.84	12.41	0.6
3.38	Q	17098.5	259	3086	2.14	11.84	12.41	0.6
3.93	R	20002.5	272	2925	2.73	11.84	12.41	0.6
4.64	S	23751.5	364	3413	2.24	11.97	12.55	0.6

## **Section 4 - Mapping Information**

### ***Base maps***

The Seattle District, US Army Corps of Engineers provided the base maps in both paper and digital form. WEST located and then digitized cross-section locations on these maps. We interpolated between these cross-sections and using the 5' contours to delineate the 100 and 500-year floodplain boundaries. Only the 100-year floodplain is shown where the 100 and 500-year boundaries overlap.

### ***Work maps***

Work maps could not be generated using the digital versions of the base maps provided by the Seattle District, US Army Corps of Engineers for various reasons. Therefore, all data was projected onto USGS quad maps for presentation.

Study Contractor: WEST Consultants, Inc.			
<p><b>Mapping Index</b> City of Everett, City of Marysville, City of Snohomish, and Unincorporated Snohomish County, Washington FLOOD INSURANCE STUDY</p>			
<b><i>File/Exhibit Name</i></b>	<b><i>Description</i></b>	<b><i>Subdirectory</i></b>	<b><i>Disk # or Exhibit #</i></b>
Base map – Index Sheet			Exhibit #5
Base map – Sheet 1			Exhibit #6
Base map – Sheet 2			Exhibit #7
Base map – Sheet 3			Exhibit #8
Base map – Sheet 4			Exhibit #9
Base map – Sheet 5			Exhibit #10
Base map – Sheet 6			Exhibit #11
Base map – Sheet 7			Exhibit #12
Base map – Sheet 8			Exhibit #13
Base map – Sheet 9			Exhibit #14
Base map – Sheet 10			Exhibit #15

Base map – Sheet 11			Exhibit #16
Base map – Sheet 12			Exhibit #17
Base map – Sheet 13			Exhibit #18
Base map – Sheet 14			Exhibit #19
Base map – Sheet 15			Exhibit #20
*-500.shp (e.g. 15-500.shp)	500-year floodplain	\\Base map files 4-29-01	Disk #1
Break.shp	Gutter lines	\\Base map files 4-29-01	Disk #1
Fp*.shp (e.g. fp1.shp)	100-year floodplain	\\Base map files 4-29-01	Disk #1
Fr*t.shp (e.g. Fr8t.shp)	Floodway fringe (polygon theme)	\\Base map files 4-29-01	Disk #1
Fr*tL.shp (e.g. Fr8tL.shp)	Floodway fringe (line theme)	\\Base map files 4-29-01	Disk #1
Line*.shp (e.g. Line2.shp)	Cross-sections and water surface elevations	\\Base map files 4-29-01	Disk #1
Rm.shp	River mile point theme	\\Base map files 4-29-01	Disk #1
Zone X.shp	Zone X	\\Base map files 4-29-01	Disk #1
new_20001026_00**.img	Base map sheets #1 - 8		Disk #2
new_20001026_00**.img	Base map sheets #8 - 12		Disk #3
new_20001026_00**.img	Base map sheets #13 - 15		Disk #4
Draft Work Map – Panel A			Exhibit #1
Draft Work Map – Panel B			Exhibit #2
Draft Work Map – Panel C			Exhibit #3
Draft Work Map – Panel D			Exhibit #4
100-year.shp	100-year floodplain	\\Work map files 4-29-01	Disk #1
500-year floodplain.shp	500-year floodplain	\\Work map files 4-29-01	Disk #1
Area not included.shp	Area not included boundary	\\Work map files 4-29-01	Disk #1
Bounds.shp	Study limit boundaries	\\Work map files 4-29-01	Disk #1
Cross section.shp	Cross-sections	\\Work map files 4-29-01	Disk #1
Everett ugs.shp	“Special” zone area	\\Work map files 4-29-01	Disk #1
Fringe zone end.shp	Upstream density fringe boundary	\\Work map files 4-29-01	Disk #1
Fringe3.shp	Floodway fringe	\\Work map files 4-29-01	Disk #1
Profile breaks.shp	Gutter lines	\\Work map files 4-29-01	Disk #1
River mile.shp	River mile point theme	\\Work map files 4-29-01	Disk #1
Water surface elevation.shp	BFE lines	\\Work map files 4-29-01	Disk #1
Zone X.shp	Zone X polygon theme	\\Work map files 4-29-01	Disk #1
Zone X line theme.shp	Zone X line theme	\\Work map files 4-29-01	Disk #1

*Elevation Reference Marks*

Refer to the prior FIS for information on the elevation reference marks (ERM). No additional elevation reference marks were identified during this study. As per the regional PO, neither the ERM nor the community boundaries have not been included in the this TSDN (Larry Basich, *personal communication*, April 26<sup>th</sup>, 2001)

## **Section 5 - Miscellaneous Reference Materials**

There are no additional miscellaneous reference materials for this study.

## **Section 6 - Certification**

This is to certify that all work accomplished in the conduct of this FIS was done in accordance with the Statement of Work and General Provisions of Contract, DACW67-97-D-1016, Delivery Order #6, with the Seattle District, US Army Corps of Engineers, and all amendments thereto, together with all such modifications, either written or oral, as the Regional PO and/or the Contracting Officer of their representatives have directed, as such modifications affect this contract, and that all such work has been accomplished in accordance with sound and accepted engineering practice within the contract provisions for respective phases of the work.

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Raymond Walton  
Vice-President  
WEST Consultants, Inc.