MFR
SKAGIT BASIN HYDROLOGY TECHNICAL DISCUSSION
17 JUNE 2009
SEATTLE DISTRICT – USACE
1000-1600

ATTENDEES
Albert Liou (Pacific International Engineering, Inc.), Chal Martin (Public Works Director, City of Burlington), Lorna Ellestad (Public Works, Skagit County), Dan Berentson (Natural Resources Director, Skagit County), Malcolm Leytham (NW Hydraulic Consultants), Adam LeMieux (Congressman Larsen), Amy Gibbons (USACE, Project Management), Doug Knapp (USACE, Hydrology & Hydraulics – 1st 30 minutes of meeting only), Mona Thomason (USACE, Chief of Planning), Dan Katz (USACE, Chief of Hydrology & Hydraulics), Karl Eriksen (USACE, Hydrology & Hydraulics), Kristen Kerns (USACE, Plan Formulation), Nola Leyde (USACE, PAO), Martin Hudson (USACE, Division, Office of Planning), Jerry Webb (USACE, Headquarters Principle Hydrology & Hydraulics)

PURPOSE
The purpose of this meeting is to review information that Skagit County and the City of Burlington, and their consultants, have developed on the peak discharges for the four historic (1897, 1909, 1917 and 1921) floods on the Skagit River.

OVERVIEW
Chal Martin (CM) presented a brief Skagit Basin overview for the benefit of those not familiar with the basin. Skagit basin 3,100 square miles. 2 flood control dams – Ross and Upper Baker. Lower Baker dam also in basin. 60% of the basin is unregulated (Sauk River Basin primarily). In 2003, Sauk discharge was 106,000 cfs. Albert Liou (AL) pointed out the location of Concrete. Malcolm Leytham (ML) indicated that much of the discussion at the meeting would focus on the area around Concrete.

USACE SEATTLE DISTRICT
Karl Eriksen (KE) presented on behalf of the USACE Seattle District. History of discharges on the Skagit River. 1952 studies mention the historic floods in report but not used in the analysis. Change in use of historic peak discharge estimate data over time. In 1963, USACE made the decision to use the historic flood discharge peak discharge estimates generated by USGS and that data has been used by the Corps ever since. USGS updated flood peak discharge estimates in 2007. Data was incorporated into current analysis. Review by H&H Engineering Center, FEMA, USGS HQ, PSE.

KE also discussed flood events throughout the northwest in the late 1800s and early 1900s. Higher discharges are unusual but the Columbia (gauge at Dalles) and Willamette (gauge at Salem) rivers match this unusual trend recorded on the Skagit. No studies to date focus on long term climate change impacts.1815 and 1856 flood events are not used in the hydrologic analysis, but should be able to get more information from archeological analysis. USGS notes that there is potential for inaccuracy for these

floods. Data from USGS is accepted by the Corps without corps reproducing the same data.

CM questioned whether a mix of gauged data and discharge estimates on the Columbia and Willamette Rivers in different years from the Skagit events could be correlated in any way to the Skagit historic events. ML also noted the Columbia events were spring floods. ML stated that doesn't indicate magnitude and KE agreed.

CM stated with regard to the 1856 and 1815 flood events, it has been suggested that more could be learned through paleo-studies. He noted that in his experience studying the more recent floods of 1897 forward, he has seen that the fog of time makes trying to reconstruct events of more than 100 years ago, very difficult. He believes the more recent floods around the turn of the last century are as far back as we can reasonably go. He indicated that the older Skagit data (1815 and 1856) is too uncertain and shouldn't be used on the slide being shown to infer any correlation with other large flood events in the Columbia River and Willamette River basins.

ML stated that he would like more specificity on the type of review conducted by the Corps for the historic floods in question. KE responded that USGS looked at Stewart in the 1950's. In 2004 and 2007 USGS did two more confirmation studies. Best estimates have been established, but not without question.

ML asked what has the Corps done? Is it relying on USGS? KE responded yes.

AL stated that Stewart's estimated historical flood discharges had been known since 1923. In 1954 the Corps questioned Stewart's estimates and concluded the estimates should not be used. Given that 1954 conclusion, and notwithstanding the publication of WSP 1527, what is the specific logic trail that caused the Corps to change its mind and use the USGS data now? KE responded that there is no dialog or text defining the Corps reasoning. Once USGS publishes data, USACE accepts it. The decision since the 1970s has been to include the historic flood data and that decision has been maintained since then.

CITY BURLINGTON – PUBLIC WORKS

Chal Martin (CM) presented on behalf of the City of Burlington. County hired Pacific International Engineering (PIE) to supplement GI efforts in 2002. NW Hydraulic Consultants (NHC) brought on in 2006 by the County. Burlington and others continued to work with PIE. A consortium of Mount Vernon, Burlington, Dike District 1 and Dike District 12 brought PIE on in early 2007. Dalles bridge gauge installed in 1924 and has provided good readings for USGS. Good data from 1924 to present. USGS has revised historic floods downward slightly. Forensic evidence of houses was incorporated into hydraulic modeling by PIE – first in Hamilton, then Concrete in accordance with Stewart's documented survey notes. Stewart, RR, and 1995 and 2003 high water marks were collected and incorporated into modeling. Extensive information collected for Hamilton area on Smith house and cigar store. Smith house (built in 1908) has survived multiple floods. House is not tied down to foundation. Flood of 95 lifted the house

slightly and repairs made after that. Forensic evidence of Smith house interior walls shows no evidence of silt marks. Exterior walls have significant markings. Based on this evidence, hydraulic analysis indicated maximum discharge since 1908 would be 188,000 cfs. Based on Stewart's survey work in Hamilton, floods appeared to be smaller. The Hamilton work led to additional forensic and hydraulic modeling study of the Crofoot's Addition to Concrete. Old Wolfe residence in Crofoot (Concrete) is approximate location of additional Stewart's high water mark in Concrete, which Stewart surveyed twice in 1922. Jenkins house at 7752 South Dillard in Concrete, gives good high water mark for 2003 flood event. Forensic studies at the Jenkins and Ripple houses indicated previous flooding was likely not much above first floor level of the Crofoot's houses, consistent with the results obtained from extending the hydraulic model upstream from the known stage/discharge information from the Dalles gauge, at the Crofoot's Addition. Jenkins house photo provided valuable information for accurately calibrating the HEC-RAS hydraulic model because of the clear high water mark for the 2003 flood event, and the time indication on the picture. The hydraulic model, based on discharges for the 2003 flood event, starts with the known stage/discharge information at the Dalles gauge, and extends the stage/discharge curve upstream to the Crofoot's Addition based on substantive and plentiful information from a variety of sources. Consortium of Burlington, Mount Vernon, Dike District 1 and Dike District 12 believe the 1921 peak discharge was 169,700 cfs at Concrete.

SKAGIT COUNTY – NORTHWEST HYDRAULIC CONSULTANTS (NHC)
Malcolm Leytham (ML) presented on behalf of Skagit County. Work by NHC has been mostly independent of work by PIE, but has shared information regarding forensic investigations and interpretation of Stewart's work. No one has investigated or considered reliability of 1921 high water marks. There has not been an assessment of the full body of information. Lack of attention to historic high water marks. Reliable slope area measurements require good high water marks. There are unexplained inconsistencies between the field notes and the slope area measurements calculated by the USGS. Tremendous difficulty in identifying in field high water marks after the fact. Should not accept 1921 water marks as unquestioned values. Estimation of the 1921 high water marks between Dalles and Concrete comes from the Concrete Herald and Stewart's work from 1923. This was then incorporated into HEC-RAS. Un-reconciled discrepancy of gauge reading for high water mark at the upper Dalles gauge. Modeling in the Dalles is complex 3-D flow conditions, no reliable data on head loss through the Dalles. NHC's approach was to brackets the range of hydraulic conditions by using two alternate model runs, within the low and high value range, for the head loss through the Dalles. We know stage elevation at the Dalles and Crofoot during 2003 flood event. So when you calibrate the model you have to make the elevations match. What difference does it make-the expansion and roughness coefficient-when you are trying to figure out 1921 discharge? –Velocity and head loss through the Dalles are affected. Rating data show February 1932 and October 2003 overlay. The current 228,000 for Dec 1921 peak is too high and is inconsistent with the available high water date at Concrete.

CM asked what difference do these coefficients make? ML responded that they impact discharge going into the Crofoot Addition. (CM note after meeting: it should be

emphasized that this minor uncertainty does not substantively impact the stage/discharge results provided by the hydraulic model for the Crofoot's location at Concrete). The primary sources of uncertainty in the published slope-area estimate is the high water data derived from field survey. USACE does not have a recognized technique for incorporating measurement uncertainty in modeling.

Amy Gibbons (AG) asked if this data was presented to USGS. CM answered that it was presented to USGS. USGS was surprised by large discrepancy in results but is sticking to their 2007 report because USGS cannot use outside data. The official USGS position is that they were staying with the existing publication.

IDENTIFICATION AND DISCUSSION OF ISSUES

It was stated that Burlington wants to find best estimates. Skagit County doesn't want to be biased toward conservatism.

<u>Best estimate vs. Conservatism</u>

Jerry Webb (JW) stated that from a USACE standpoint, we need to recognize that there are different means of developing and analyzing data.

AG stated for the GI this is not an academic exercise and we are concerned with producing products. The next step is the FSM which serves as upward reporting and establishes without project conditions.

CM stated the 'what if' issue always gets wrapped around historic flows. The issue is not what happens after we utilize the flows but rather what the values should be.

One of the issues has always been that the USACE has the mechanism to address uncertainty and risk in HEC-FDA. Need to come up with the best defensible data and agree on a resolution.

JW/Martin Hudson (MH) stated that the regulations that governs USACE requires risk assessment over full range of project loading conditions. Sponsors are indicating there is a fairly significant uncertainty for extreme loads. In reality what USACE does is incorporate risk analysis into the entire full range of conditions. USACE cannot get by with the simplicity of this statement because a full range of risk is evaluated and accounted for in the risk assessment. The USGS, Weather Service, and USACE are all governed under multiple federal regulations and must utilize common data to the extent practicable. USGS is responsible for historical flows and since these discharges are published as official data significant and compelling reasoning will be required to justify changes in the data for use in the GI. This is analogous to the Weather Service being responsible for official river forecasts. USACE must recognize USGS as the official record. When it comes to public safety, when in doubt, must be conservative as part of a public service organization. USGS uses a totally different methodology when evaluating historic flows that have been verified twice. USGS published data is very difficult to counter and calibration is outside of scope of USACE methodology. USACE

Office of Counsel had provided the guidance that while USACE may generate data, USGS is the official data of record and USACE will not conflict that record unless there is compelling reasons to do so.

JW stated in a post-Katrina environment, when in doubt, USACE will proceed with caution when it comes to public safety. MH stated that this is incorporated into USACE methods as the Nation Economic Development plan will address what happens when design levels are exceeded. The GI will discuss with the Planning Excellence Center on how the risk analysis will be conducted.

JW stated that, while the information presented is interesting, he does not think it meets the level of compelling enough to change the methodologies used by the GI.

Sponsor and Burlington argue that their information has enough scientific validity to warrant a reevaluation of USGS information. KE responded that the participants presentations were scientific but that their information has strengths and weaknesses. Using other than USGS data needs to be for compelling reasons.

ML asked if the appropriate venue was USGS. JW stated that we have to consult with USGS. JW asks if USGS has seen this data. JW stated that USGS needs to maintain quality and consistency.

JW stated that this is the first time he has had a local government argue for a lower standard of protection. ML asked how you reflect that bias in the analysis. JW responded that he doesn't think of it as bias. USACE's risk assessment is quantified within a band. MH stated that USACE used to incorporate this risk into the design via freeboard.

ML asked if you are incorporating a conservative design on top of conservative data? JW responded that USACE doesn't incorporate freeboard anymore because of the use of incorporating uncertainty in risk bands. ML states the data is biased but USACE considers the data to be the official data of record.

CM objected to JW's statement that by insisting the hydrology be corrected, the consortium of local governments was arguing for increased risk. He stated that incorrect hydrology would drive larger and higher levee structures through the GI process and that from Burlington's perspective; the larger structures posed more risk of catastrophic failure than lower structures designed for overtopping. Burlington wants overtopping so everyone gets wet provided there is ample time to move people and animals out of harms way. 100-year protection for Burlington, as likely defined by a Corps project based on overstated hydrology, increases the risk downstream.

NHC presentation asks: does USACE have independent authority to decide what data to use? JW responded that USACE does have flexibility/authority in ungaged basins but is more limited when official gage sites are available. . USACE has a sister agency whose primary responsibility is to establish discharges and provide official publications

of records. USACE doesn't have liberty to just decide to use different data without compelling evidence. CM stated we have significant and compelling data. How high is the bar? The studies are independent and present a large body of data.

LE asked if KE can itemize his issues with the reports presented? AG responded that KE can move forward with putting together a list of issues with the studies presented.

CM stated we need to settle this issue and that the studies provided by the County and the Cities/Dike Districts are significant and compelling.

JW stated that USGS needs to be involved in further discussions. He indicated that this shouldn't uphold progress of the feasibility study. How this data would impact the study is unknown but to not use the USGS data opens the GI up to challenge.

AL stated that the USGS-published 1921 flood stage elevation at the Dalles gage has no scientific support (the USGS looked for, but could not find, any evidence to support the published elevation), and noted that given his substantial first-hand analysis of the hydrology issue, it is his responsibility as a Professional Engineer to develop the best engineering report based on his professional engineering judgment.

MH stated that there is no USACE policy with regard to a local agency disagreeing with USGS published data that stops the GI from moving forward.

JW stated that if the H&H does change, the model can be rerun to incorporate the changes and make adjustments. He stated that he doesn't see compelling evidence to go against standards.

TASKS
KE will provide a list of concerns relating to the studies presented for delivery to Burlington and the Sponsor no later than the last day of July 2009 (preferably sooner).

AG stated the project will move forward. LE stated we need to get a handle on water discharged into the system and that the GI needs to be cognizant of how changes will impact the project. (LE note after the meeting: One of the major concerns was the ability to accurately evaluate the environmental impact of proposed measures. The concern wasn't just on the 100 year discharge but the impact to the full range of the hydrograph i.e. the increased discharge associated with more frequent 25 to 50 year events. MH/JW responded that based on their experience, USACE process will address LEs concerns.

Mona Thomason stated that USACE can develop a sensitivity analysis plan to test the outcome sensitivity to discharges of 195,000 cfs vs 228,000 cfs. CM stated the sensitivity analysis should not be limited to 195,000 cfs, noting that NHC internally documented its conservative approach and pointing out that the Cities/Dike Districts have concluded a 1921 peak discharge of 169,700 cfs is the best estimate.

USACE will not adopt the new data at this time. USACE will participate in meeting with Burlington, the Sponsor and USGS to discuss the data but the ultimate decision will be up to USGS.

Corps will commit to the end of July to provide H&H status update.