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February 12, 2016

Mr. Clint Loper
King County Department of Natural Resources and Parks
Water and Land Resources Division
201 South Jackson Street, Suite 600
Seattle, WA 98104

Re: Snoqualmie River Hydraulics Study
Independent Technical Review Report

Dear Mr. Loper:

This letter provides an overview and summary of my role as Independent Technical Reviewer for the Snoqualmie River Hydraulics Study (the "Study"). My comments address the draft report of the Study, dated January 28, 2016, as well as the supporting technical memoranda. I have also provided recommendations that I believe support the future sustainability of agriculture in the Snoqualmie Valley. I am pleased to have had the opportunity to participate in this important Study.

Introduction

The Snoqualmie River Hydraulics Study is more than 12 years past due. Over the last year, local hydrology experts have pieced together a hydraulic model of the Snoqualmie River that spans the system from reaches upstream of Snoqualmie Falls to the lower Snoqualmie Valley. The purpose of the model has been to evaluate the downstream flooding impacts of two large flood control projects (collectively, the "Projects"): the Snoqualmie Flood Damage Reduction Project (known as the "205 Project") and Puget Sound Energy's Snoqualmie Falls Project (the "PSE Project"). By reducing annual flood risk and flood damage, the two projects produced economic benefit to the city of Snoqualmie. PSE profits from their river project every day through increased efficiencies in power production.

The Projects were not without a downside to those downstream, however. The scale of the Projects' hydrologic significance is evident in the vast amount of flood storage that the Projects eliminated above the Falls—2,500 acre-feet, or about 13 percent of the previously available storage. Fortunately, the lower Valley's flood storage currently has the ability to absorb the brunt of the downstream impacts resulting from this loss of flood storage above the Falls.

The quantitative impacts of the Projects on downstream flooding have been a topic of debate since the 205 Project was constructed in 2004. Over the past five years I have worked with stakeholders in the Valley—most recently through the Snoqualmie Valley Preservation Alliance (SVPA)—helping them identify, understand, and address the

sources of flooding that impact their livelihoods. For those trying to make a living off land-based activities in the Snoqualmie River Valley, flooding makes life difficult.

The stakeholders have expressed a certain animosity toward the Projects, with valid reason. No flood impact studies were ever conducted prior to the construction of either the 205 Project or the PSE Project. The completion of the 205 Project was followed soon thereafter by damaging floods in November 2006, November 2008, and January 2009. Then, without any significant study of the 205 Project to alleviate concerns of downstream stakeholders, the PSE project began construction in 2010. The events left the Valley's stakeholders with many unanswered questions.

My Role as Independent Technical Reviewer

Recognizing the value of the resources in the Snoqualmie River Valley, King County stepped up and funded the Snoqualmie River Hydraulics Study. I was asked to provide independent technical review throughout the process. I was involved before the technical consultant team was assembled. The county asked me if I had any objections to the choice of consultants who ultimately prepared the study. Only a handful of local consultants have sufficient expertise to perform the tasks that would be required to complete the study, and the Herrera/Watershed Science & Engineering (WSE) consultant team certainly met the criteria.

I participated in developing the project scope. This process laid out the tasks to be accomplished over the following year. Defining project objectives was the starting point from which we developed the technical approach to the study. Aside from meeting project objectives, a major strategy of the technical approach was to get as much out of the project budget as possible. To that end, the WSE team made efficient use of past available studies and data in developing the hydraulic model that would be used to assess the flooding impacts of the Projects.

The Study was structured around three interim technical memoranda prepared by the WSE team. The memoranda both provided a foundation for the overall study and afforded logical milestones for independent review. I was not involved in the day-to-day activities of the technical study. I played no role in obtaining or reviewing the background data, nor was I involved in developing the hydraulic model. I did, however, review the underlying assumptions upon which the model was built, and I did comment on the interim results and data interpretation. I provided input to the process while there was still time to incorporate change, whether and when change would be determined to be necessary. Toward the end of the project I provided a review comment that strongly encouraged the simulation of a lower frequency flood among the other simulations. Addressing the comment caused a slight delay in project completion but, in my estimation, an analysis of a more frequently occurring flood would make the Study results more credible in the eyes of the stakeholders.

The project approach played out as anticipated. The consultant team prepared three interim memoranda and a preliminary draft report, which I reviewed. We discussed and resolved, with group consensus, the technical issues that developed along the way. The goal of my review was to represent the interests of the Valley's stakeholders and to ensure that sound science was used in the Study.

Credibility of the Study

The Study is based on the best-available science and was carried out by a competent team. The technical approach and basic interpretation of the Study's results were unbiased. I can attest to the fact that independent peer review was provided from the project's scoping phase through production of the draft final report. I made more than one hundred review comments and edits along the way. All were acknowledged, and many of the comments were incorporated. Those not incorporated were supported by reasonable explanations.

As Independent Technical Reviewer, I believe that the report is based on sound science and the results have been appropriately interpreted. In my opinion, the Study has met its overall stated objectives and provides a defensible assessment of the Projects' effects on downstream flooding.

Results of the Study

At the heart of the Study is the question of how much of the loss of flow attenuation has been caused by the Projects' reduction in flood storage. The question commonly comes up in floodplain management. As a professional engineer, I have spent considerable time designing storage systems to attenuate runoff from urban watersheds. Based on my related experience and sense of the Projects' magnitude, I suspected that the Study would predict downstream flooding impacts that, in turn, explained much of the recent increase in flood frequency. However, the predicted downstream impacts were less than I had anticipated, thanks in part to the ability of flood storage in the lower Valley to lessen the Projects' effects.

The predicted increase in the river's 100-year flood peak elevation was approximately 1 in. near the city of Carnation. The Projects' impacts were predicted for floods for more frequently occurring flood as well. Of particular interest is the finding that the predicted increase in peak flood stage at locations below the Falls were similar in magnitude for both the 10-year flood and the 100-year flood. A rise in flood elevations of up to about ¾ in. was also predicted downstream from the Falls for floods with as small as a 2-year return interval.

To me it's significant that the predicted increase in flood elevations resulting from the Projects is present, in a similar magnitude no less, in storms having return intervals ranging from 2 to 100 years. The increase is persistent across the valley floor, from Fall City to Carnation. Although a 1-in. increase may not cause damage to existing structures

in the Valley, it is likely to have an adverse impact on agricultural production.[1] With a late spring flood, for instance, an extra inch of water spread across an agricultural field would come just when farmers are waiting for their fields to drain so that they can begin operations. The incremental time it takes for the additional floodwater to drain can reduce agricultural productivity.

Although the Study predicted a significant increase in peak flow rate of 1,260 cubic feet per second at the Falls, the downstream impacts were mitigated by compensating storage in the lower Valley. The Study predicted minor changes in the timing of the flood as well. An increase in peak flood flow rates of 1,200 cubic feet per second near Fall City and 1,000 cubic feet per second near Carnation for the 100-year flood were key model outcomes from the Study. The Study also clearly showed that, of the two flood-control Projects, the PSE Project had the more significant impacts on downstream flooding.

Conclusions

The Snoqualmie River Hydraulics Study has increased our understanding of the river system. Although I accept the Study's findings with respect to the Projects' impacts, the 2,500 acre-foot loss of flood storage is something that likely will never be replaced. The loss of flood storage, as such, will contribute to the cumulative effects of flooding in the Valley over the long term. As a hydrology professional who is accustomed to meeting zero-rise criteria when designing and evaluating flood-related projects, I interpret the Projects' predicted impacts on agriculture in the Valley as being significant, depending upon the site-specific characteristics of the farmland in question.

The factors that affect flooding in the Valley are moving flood high water marks in the wrong direction—that is, higher. We now know the magnitude of the Projects' contribution to downstream flooding. The impacts will be present in every flood in the future. Adding to that assessment are the anticipated impacts on flooding from climatic change over the next 10 to 50 years. Warmer and wetter weather in the region is expected to reduce mountain snowpack and increase flood flows to the Valley. Urban development, which has seen explosive growth in recent decades, is also thought to be an intensifying factor in flooding in the Valley. The total potential flooding impacts of the cumulative effects of these factors is yet to be seen. As essential elements of a scientific approach, these factors will be considered in the ongoing second phase of the Study, which will assess the issue of the Valley's changing hydrology.

Recommendations

The second phase of the Study will help build the tools necessary for evaluating flood-related countermeasures to make agriculture in the Valley sustainable. A program that is dedicated to addressing specific flood problems in the Snoqualmie Valley needs to be established to accomplish the following:

[1] The additional floodwater has a similar impact on operations such as the golf course in Fall City.

- Develop both basin-wide and field-scale, site-specific flood management strategies to improve the viability of local agriculture, under the assumption that flooding impacts will become greater over time.
- Identify data that will be needed for the assessment of future floods, and implement a program to collect the data.
- Implement selected basin-wide and field-scale flood management measures that have been prioritized.

The program should be administered jointly by SVPA and King County's Water and Land Resources Division. The city of Snoqualmie and PSE have benefited financially from the Projects. The benefits realized by the construction and operation of the Projects have come at the expense of downstream stakeholders. The city of Snoqualmie and, especially, PSE should seriously consider funding the program, described above, as deferred flood impact mitigation to their projects.

I believe that, with appropriately funded research, measures can be developed and implemented to offset flood impacts in the Snoqualmie Valley to protect the community's farms, businesses, and homes.

Sincerely,

Edward J. McCarthy

Edward McCarthy, Ph.D., P.E.
Hydrologist