



September 16, 2015

TO: Flood Authority Members
FROM: Scott Boettcher, Staff
SUBJECT: Floodproofing Update

The purpose of this memo is to update Flood Authority members on floodproofing activities occurring since last Flood Authority meeting and associated with Bucoda flood openings pilot and French & Associates' local technical assistance work. We will discuss this at our 9/17/2015 meeting in Chehalis. Feel free to call or email if you have questions (360/4806600, scottb@sbgh-partners.com).

A. Bucoda Flood Openings Pilot

Activities occurring since last (7/16/2015) Flood Authority meeting:

1. **Bucoda Town Council Workshop** -- Met with the Town Council 7/28/2015 and outlined work done by Watershed Science and Engineering to update base flood elevations (BFEs) in the community. Discussed need for update to Towns Floodplain Development Ordinance to adopt WSE's work (as portions of Town had no established BFEs).
2. **Proposed Ordinance Amendment** – Worked with Town, Ecology, and French & Associates to develop proposed amendment to Town Floodplain Development Ordinance. Amendment has been prepared and will be adopted 9/22/2015. This will enable continuation of installation of foundation openings in the Town (previously slowed due to lack of BFEs for certain areas of Town). See Attachment A.

B. French & Associates Local Technical Assistance Work

Activities occurring since last (7/16/2015) Flood Authority meeting:

1. **Local Area Analyses** -- French & Associates has completed the field work for three areas in Thurston County covering a total of 49 buildings.
2. **Technical Assistance Presentations/Visits (CRS, CFM)** – French & Associates has provided following:
 - a. 7/20/2015 presentation to Grays Harbor County Commissioners.
 - b. 7/26/2015 follow-up visit with Grays Harbor County Staff.
 - c. 8/26/2015 presentation to Aberdeen City Council (here is link to Floodplain Management Assessment presented at meeting) - https://www.ezview.wa.gov/Portals/_1492/images/FPMgt%20Assessment%20Aberdeen%208-26-15.pdf.



3. **Model Effort** -- Met with City of Centralia on 8/26/2015 to discuss piloting a new program to facilitate funding of acquisition, relocation, elevation, and retrofitting projects in Basin communities.



Attachment A
Proposed Bucoda Floodplain Ordinance Amendment Language (9/15/2015)

ORDINANCE _____

An ordinance amending Town of Bucoda Ordinance No. 581 to make the provisions of Chapter 15.24, Flood Hazard Regulations consistent with the National Flood Insurance Program

WHEREAS, a portion of the 2012 FIRM for the Town of Bucoda was mapped with unnumbered A-Zones that lacked Base Flood Elevations; and

WHEREAS, Watershed Science & Engineering (WSE) was hired to develop Base Flood Elevation (BFE) data for the Town for the unnumbered A-Zone; and

WHEREAS, WSE updated the hydrologic analysis that was the basis of the 2012 FIRM as part of its mapping project based on high-water mark data from the 1996 flood-of-record and the more recent 2009 flood event; and

WHEREAS, by adopting WSE's recent study the Town of Bucoda further advances its efforts to update and modernize its floodplain development codes and regulations based on latest and best available science and in so doing further its effort to protect the citizens and property of the Town of Bucoda; and

WHEREAS, by additionally adopting WSE's recent study as best available science the Town of Bucoda further complies with State Growth Management Act policy.

NOW THEREFORE, the Town of Bucoda does ordain as follows:

Section 1: Section 15.24.050 is amended as follows:

A. This chapter shall apply to all areas of special flood hazard within the corporate limits of the Town including:

1. The areas of special flood hazard, including the floodway, identified by the Federal Insurance Administration in a scientific and engineering report entitled "The Flood Insurance Study for Thurston County, Washington and Incorporated Areas" dated October 16, 2012, and any revisions thereto, with accompanying Flood Insurance Rate Maps (FIRM) dated October 16, 2012, and any revisions thereto, is hereby adopted by reference and declared to be a part of this chapter. The Flood Insurance Study and the FIRM are on file at 110 N. Main Street, Bucoda, WA 98530.
2. The floodplain study and accompanying map and flood profiles, titled Floodplain Mapping Update, Town of Bucoda, Thurston County Washington, by Watershed Science & Engineering (WSE), dated 20 May 2015, for those areas of the Town where the flood elevations are higher than the FIS dated October 16, 2012, referenced in (1) above, except the floodway remains as depicted on the October 16, 2012 FIRM. The WSE map and profile are on file at 110 N. Main Street, Bucoda, WA 98530.

Section 2: Section 15.24.110, Development permit required, is amended as follows:

15.24.110 Development permit required

A development permit shall be obtained before construction or development begins within any area of special flood hazard established in Section 15.24.050. The permit shall be for all structures including manufactured homes as set forth in the "Definitions" and for all development including fill and other activities also as set forth in the "Definitions."

Section 3: Section 15.24.120, Duties of the building official, is amended as follows:

15.24.120. Duties of the building official.

Duties of the building official shall include but not be limited to the following:

A. Permit review. The building official shall review all applications for flood improvement permits, for compliance with the requirements of this chapter, determine that all necessary permits have been obtained from those federal, state or local governmental agencies from which prior approval is required, determine if the proposed action will occur in the floodway, and if so, determine that all special provisions relating to actions in the floodway have been met, provided, it shall be the responsibility of the applicant to identify all federal, state or local agencies whose prior approval is required, and all risk of loss or damage for the failure to do so shall be borne solely by the applicant.

B. Use of other base flood data. When base flood elevation data has not been provided in accordance with BMC 15.24.050(B), the building official shall obtain, review and reasonably utilize any base flood elevation and floodway data available from a federal, state or other source, in order to administer the provisions of BMC 15.24.160, specific standards, and BMC 15.24.170, floodways.

C. Maintenance of information. The building official shall obtain, record, and maintain for public inspection the following information:

1. The actual (as-built) elevation in relation to mean sea level of the lowest floor (including basement) of all new or substantially improved structures, and whether or not the structure contains a basement; and
2. For all new or substantially improved floodproofed structures, verify and record the actual elevation in relation to mean sea level, and maintain the floodproofing certifications required by this chapter.

D. Alteration of watercourses.

1. Notify adjacent communities and the Department of Ecology prior to any alteration or relocation of a watercourse, and submit evidence of such notification to the Federal Insurance Administration.
2. Require that maintenance is provided within the altered or relocated portion of said watercourse so that the flood carrying capacity is not diminished.

E. Interpretation of FIRM boundaries. The building official shall make interpretations where needed as to the exact location of the boundaries of the areas of special flood hazards, for example, where there appears to be a conflict between a mapped area and actual field conditions. The person contesting the location of the boundary shall be given a reasonable opportunity to appeal the interpretation. Such appeals shall be granted when consistent with the standards of section 60.6 of the Rules and

Regulations of the National Flood Insurance Program (44 CFR 59-76) as the same now exist or may hereafter be amended.

F. Right of entry for inspection.

1. Whenever necessary to make an inspection to enforce any of the provisions of this chapter, or whenever the building official or his designee has reasonable cause to believe that there exists in any building or upon any lands any condition or violation of this chapter, the building official or his designee may enter such building or lands at all reasonable times to inspect the same or to perform any duty imposed on the building official by this chapter, provided, that if such building or lands be occupied, he shall first identify himself and request entry; and if such building or lands is unoccupied, he shall first make a reasonable effort to locate the owner or person having control of the building or lands and request entry. If such entry is refused, the building official or his designee shall have recourse to every remedy provided by law to secure entry.
2. No owner or occupant or any other person having charge, care or control of any building or lands shall fail or neglect, after proper request, to promptly permit entry by the building official for the purposes authorized in subsection F.1 of this section.

Section 4: Section 15.24.150, General standards, is amended as follows:

15.24.150. General standards.

A. Finished grade after construction.

1. After construction or other development, but prior to final building inspection, certificate of occupancy or other final approval, the applicant shall obtain and furnish to the Town a topographic survey, prepared by a licensed surveyor or engineer, with sufficient scale and contour to interval to adequately assess variation in ground surface and determine the average grade after construction or development, unless the requirement for a topographic survey was waived at the time of application.
2. The average finished grade of all lots, tracts or parcels after construction of a building or other development, excluding the area occupied by the above-grade building or other development, shall be no greater than the average grade of the lot prior to construction or development. After construction or other development but prior to final building inspection, the applicant shall furnish, together with the topographic survey, the written certification of the licensed surveyor or engineer preparing the topographic survey that the finished grade meets the requirement of this subsection. No building or other development shall be occupied or used if the requirements of this section are not met.
3. Any earth material that must be removed from a site in order to comply with the requirements of this chapter shall be transported to an approved disposal site at the applicant's or property owner's sole expense, and evidence of such disposal shall be furnished to the building official.

B. Anchoring.

1. All new construction and substantial improvements shall be anchored so as to prevent flotation, collapse or lateral movement of the structure, pursuant to a design prepared by a registered professional engineer or architect licensed by the state of Washington.

2. All manufactured homes shall be anchored to prevent flotation, collapse or lateral movement, pursuant to a design prepared by a registered professional engineer or architect, and shall be installed using methods and practices that minimize the flood damage.

3. An alternative method of anchoring may involve a system designed to withstand a wind force of 85 miles per hour or greater. Certification must be provided to the building official that this standard has been met.

C. Construction materials and methods.

1. All new construction and substantial improvements shall be constructed with materials and utility equipment resistant to flood damage.

2. All new construction and substantial improvements shall be constructed using methods and practices that minimize flood damage.

3. Electrical, heating, ventilation, plumbing and air-conditioning equipment and other service facilities shall be designed and/or otherwise elevated or located so as to prevent water from entering or accumulating within the components during conditions of flooding.

D. Utilities.

1. All new and replacement water supply systems shall be designed to minimize or eliminate infiltration of floodwaters into the system.

2. New and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of floodwaters into the systems and discharge from the systems into floodwaters.

3. On-site waste disposal systems, if otherwise permitted, shall be located to avoid impairment to them or contamination from them during flooding.

E. Subdivision, short subdivision, binding site improvement plan and commercial and multifamily site plan approval proposals within areas of special flood hazard. All subdivision, short subdivision, binding site improvement plan and commercial and multifamily site plan proposals within areas of special flood hazard shall be subject to the provisions of BMC Title 18.

F. Subdivision, short subdivision and binding site plan proposals.

1. All subdivision proposals shall be consistent with the need to minimize flood damage;

2. All subdivision proposals shall have public utilities and facilities, such as sewer, gas, electrical, and water systems located and constructed to minimize or eliminate flood damage;

3. All subdivision proposals shall have adequate drainage provided to reduce exposure to flood damage;

4. Where base flood elevation data has not been provided or is not available from another authoritative

source, it shall be generated for subdivision proposals and other proposed developments which contain at least 50 lots or 5 acres (whichever is less).

G. Review of building permits.

Where elevation data is not available either through the Flood Insurance Study, FIRM or from another authoritative source (Section 15.24.1 20(8)), applications for building permits shall be reviewed to assure that proposed construction will be reasonably safe from flooding. The test of reasonableness is a local judgment and includes use of historical data, high water marks, photographs of past flooding, etc., where available. Failure to elevate at least two feet above the highest adjacent grade in these zones may result in higher insurance rates.

Signed: _____ Date: _____
 Alan Carr, Mayor

ATTEST: _____ Date: _____
 Clerk/Treasurer

Memorandum



110 Prefontaine Pl S, Suite 508
Seattle, WA 98104
Phone: 206-521-3000
www.watershedse.com

Date: June 4, 2015 Project No.: 13-019
From: Chris Frei and Larry Karpack
To: Scott Boettcher
Regarding: Skookumchuck River Floodplain Mapping in Bucoda

Scott;

The following technical memorandum documents the hydraulic investigation completed by Watershed Science and Engineering (WSE) to determine base flood elevations (BFEs) for the Skookumchuck River at Bucoda, WA. WSE produced new floodplain maps and water surface profiles using a recently developed HEC-RAS model and updated hydrologic data for the 100-year flood. Results of our analysis will be provided to the Town of Bucoda to supplement existing (effective) FEMA floodplain mapping and to support better floodplain management and the design of flood damage reduction projects.

Hydraulic Model

The base hydraulic model used for this analysis was an unsteady HEC-RAS model of the Skookumchuck River developed for the Chehalis River Basin Hydraulic Modeling and Analysis project completed by WSE for the Chehalis River Basin Flood Authority in 2012. That model was last updated in 2014 as part of the subsequent Chehalis River Basin Flood Hazards Alternatives Analysis Project.

As a component of the 2012 project, WSE completed a flood hazard assessment for the town of Bucoda that included updating the Skookumchuck River hydraulic model using new surveyed channel cross sections and 2002 LiDAR data. A "Bucoda Bypass" reach was added to the model to allow a more accurate representation of the split-flow flooding that occurs through the town of Bucoda, and the model was calibrated to high water marks from the January 2009 flood event.

As part of the current investigation, WSE refined model calibration to the 2009 flood event. The model was run to simulate the January 2009 flood, and Manning's n roughness values were adjusted to better match observed high water marks, including one additional high water mark not considered in the 2012 analysis. Following calibration, WSE trimmed the Skookumchuck River reach at a location near the USGS Bucoda gage (River Mile 6.4), and input a stage-discharge rating curve as the downstream model boundary. The model was then run to simulate an updated 100-

year flood event with a peak discharge of 12,600 cubic feet per second (cfs), WSE’s revised estimate of the 100-year flow at Bucoda.

Hydrology

WSE computed an updated 100-year instantaneous peak flow of 12,600 cfs based on the USGS gage on the Skookumchuck River near Bucoda (located downstream of Bucoda near the Highway 507 crossing). The updated 100-year flood is approximately 40% higher than the FEMA 100-year flood of 9060 cfs - primarily because the current analysis is based on a longer gage record that accounts for a number of flood events that occurred after the FEMA study was completed in 1979 (see Table 1).

Table 1. Skookumchuck River Peak Flow at USGS Bucoda Gage

Event	Peak Flow (cfs)
Updated 100-Year	12,600
Feb 1996*	11,300
January 2009*	10,500
FEMA 100-Year	9,060

*USGS Observed Flow

WSE then developed a 100-year flood hydrograph by scaling the hydrograph from the February 1996 flood of record such that the peak flow in that hydrograph matched the 100-year peak flow of 12,600 cfs. This hydrograph was routed through the updated hydraulic model to determine peak water surface elevations for the updated 100-year flood.

Hydraulic Modeling Results

Hydraulic model results, including updated 100-year Base Flood Elevations (BFEs) and water surface extents, are shown in Figure 1. Water surface extents are based on a comparison of peak water surface elevation to a 2012 Thurston County LiDAR ground surface. Water surface profiles for the Skookumchuck River and the Bucoda Bypass Reach are provided in Figures 2 through 4, and a GIS grid containing 100-year water surface elevation results is included with this report.

Comparison to the effective FEMA mapping reveals that the updated 100-year BFEs are lower than FEMA BFEs in most areas upstream of the Tono Road bridge (see Figure 5). This is in spite of the fact that the effective study is based on a smaller peak flow of 9,060 cfs. The updated model contains a number of improvements on previous modeling including updated topography based on survey and LiDAR, improved model representation of the Bucoda flow split, and calibration to an observed high flow event (Jan 2009). This new study represents the “best available data”; however, Bucoda may still need to regulate to the effective FEMA BFEs in areas where FEMA maps are more conservative. For this reason, WSE created a composite water surface grid representing

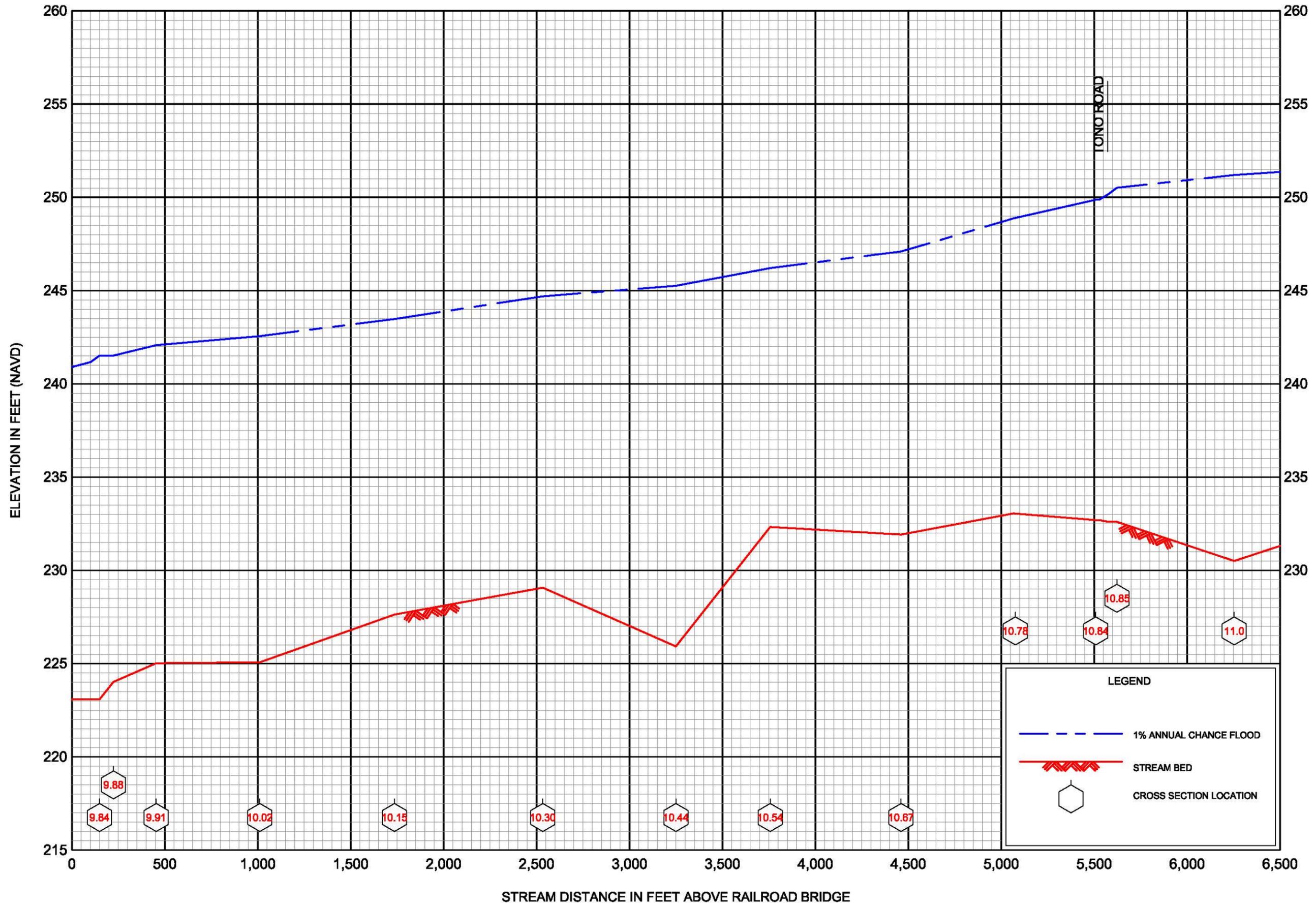
the greater of the effective FEMA water surface and the updated 100-year water surface elevations. WSE delineated the FEMA water surface grid based on the Effective FEMA BFEs at each FEMA cross section and the 2012 Thurston County LiDAR surface. Because the current work used the newer and more detailed topographic surface the floodplain extents may vary slightly from the effective FEMA mapping which was based on an older topographic surface.

Future Work

The work described herein was intended to supplement available FEMA floodplain mapping data and, in particular, to fill in gaps in the FEMA floodplain BFEs. This work was not intended to replace the FEMA study and WSE has not prepared all of the necessary supporting technical documentation that would be required for submittal to FEMA to request a Letter of Map Revision (LOMR). Updating the FEMA maps would require review and comparison to the effective FEMA model (which WSE does not have), delineation of a FEMA floodway, and additional map and profile formatting to conform to FEMA guidelines and specifications. FEMA would also require that the hydrologic analysis be evaluated to determine if any adjustments are required to account for flow reduction due to flood storage at the upstream Skookumchuck Dam.

References

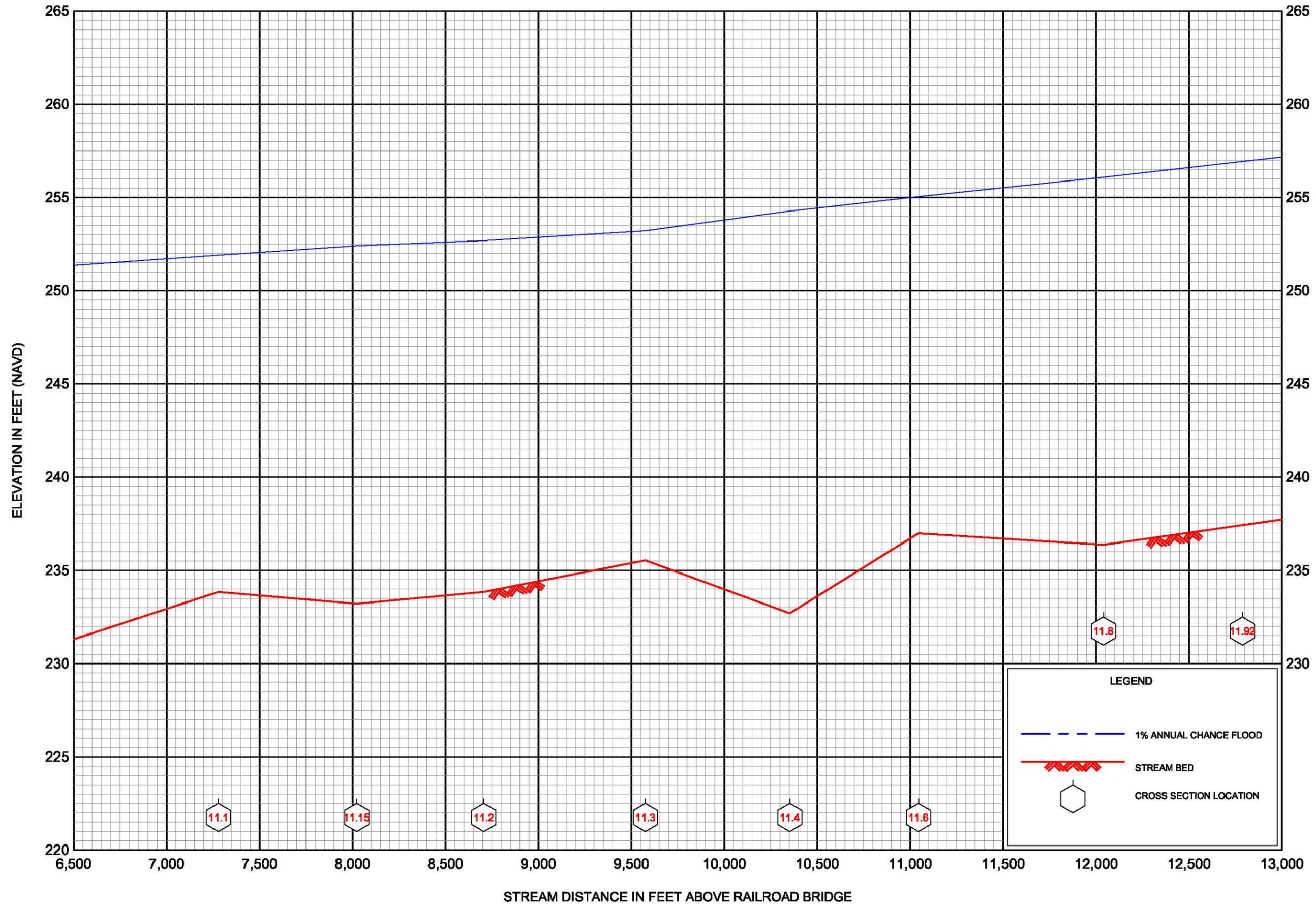
- Federal Emergency Management Agency (2012), *"Flood Insurance Study, Thurston County Washington and Incorporated Areas"*, FIS No 5367CV00A, Effective Date October 16, 2012.
- Watershed Science & Engineering (2012), *"Chehalis River Hydraulic Model Development Project"* Draft Report. July 23, 2012.
- Watershed Science & Engineering, Science & Engineering (2014), *"Chehalis Basin Strategy: Reducing Flood Damage and Enhancing Aquatic Species - Development and Calibration of Hydraulic Model"* Technical Memorandum. July 22, 2014.



FLOOD PROFILES

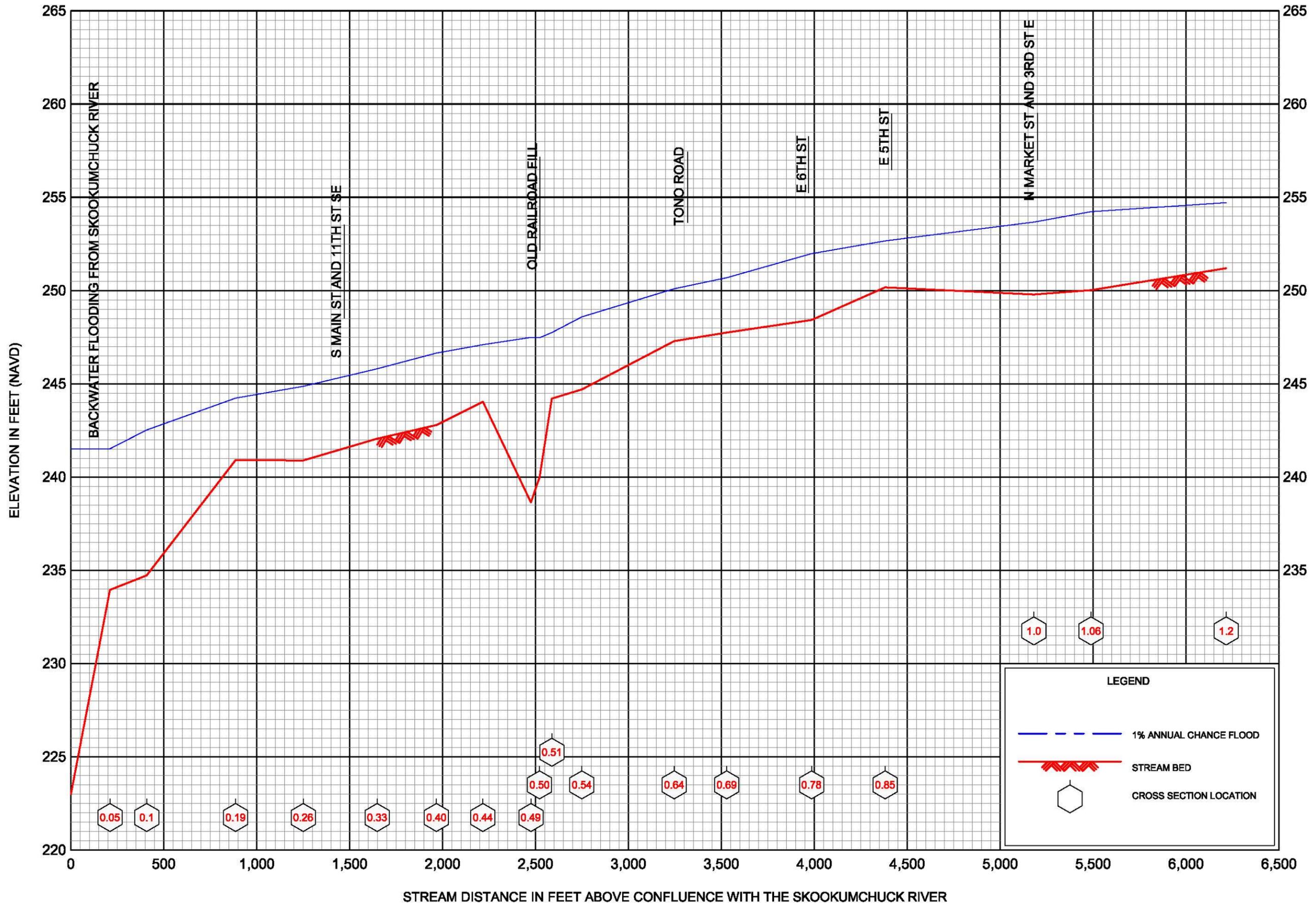
SKOOKUMCHUCK RIVER AT BUCODA

TOWN OF BUCDOA
 THURSTON COUNTY, WA



FLOOD PROFILES
SKOOKUMCHUCK RIVER AT BUCODA

TOWN OF BUCDOA
THURSTON COUNTY, WA
AND INCORPORATED AREAS



FLOOD PROFILES

SKOOKUMCHUCK RIVER BUCODA BYPASS REACH

TOWN OF BUCDOA
THURSTON COUNTY, WA

C:\Users\GIS\Documents\WSE\Projects\13-018 Chehalis River Basin Flood Hazard Mitigation\GIS\WXD\Bucoda Mapping Figure 5.mxd 5/20/2015 9:05:46 AM

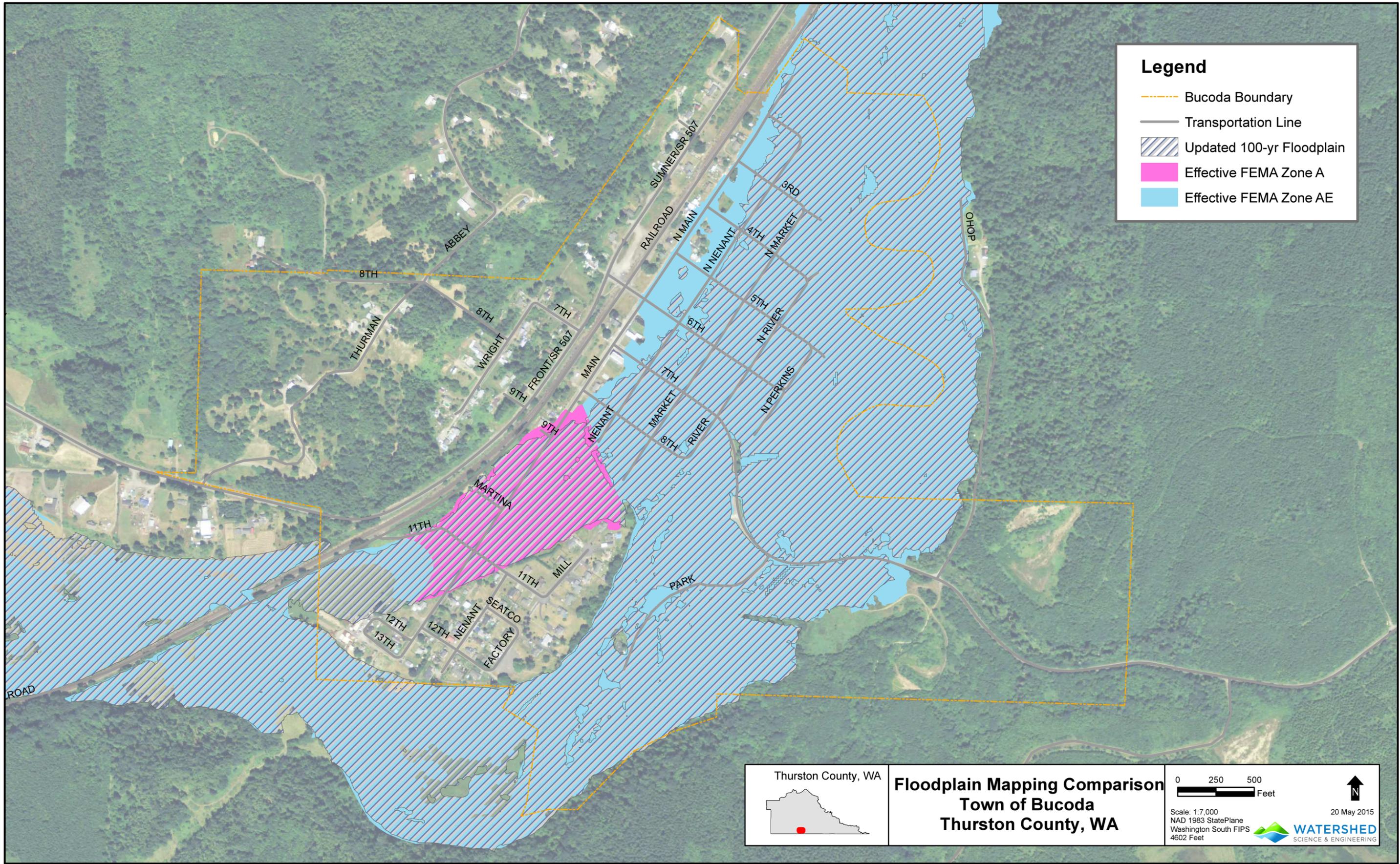


Figure 5