

Woodland Creek Subdivision Zero-Rise Analysis

2308 Lewis River Road
Woodland, Washington

Prepared for:

Hinton Development LLC
14010-A NE 3rd Court, Suite A106
Vancouver, Washington 98685

July 27, 2021
PBS Project 71477.000



1180 NW MAPLE ST, SUITE 160
ISSAQUAH, WA 98027
425.654.8775 MAIN
866.727.0140 FAX
PBSUSA.COM

Table of Contents

1 INTRODUCTION	1
1.1 Project Site Description.....	1
2 EXISTING FEMA STUDY	2
2.1 Basin Overview.....	2
2.2 Existing Floodplain Insurance Maps.....	3
2.2.1 FEMA Flood Zones.....	3
2.2.2 Hydrology.....	4
3 HYDRAULICS	4
3.1 Model Description.....	5
3.1.1 Existing Conditions Model.....	5
3.1.2 Proposed Conditions Model.....	5
4 ZERO-RISE ANALYSIS RESULTS	5
REFERENCES	7

Supporting Data

TABLES

Table 1. Lewis River Peak Discharges

Table 2. Water Surface Elevations of the Lewis River

FIGURES

Figure 1. Woodland Creek Subdivision - Vicinity Map

Figure 2. Project Drainage Basin, USGS StreamStats

Figure 3. FIRMs Primary Zones

APPENDICES

Appendix A: FEMA Documents

Appendix B: Hydraulic Analysis

Appendix C: Design Plans

1 INTRODUCTION

Hinton Development, LLC is proposing to develop the Woodland Creek Subdivision (Project), a 150-lot subdivision, in the northeast corner of the City of Woodland, Washington (City). The Project is located within a Federal Emergency Management Agency (FEMA) defined floodplain with base flood elevations. It is ultimately desired that the 150-lot subdivision be exempt from the flood insurance requirement by using the FEMA Conditional Letter of Map Revision Based on Fill (CLOMR-F) and Letter of Map Revision Based on Fill (LOMR-F) process.

The CLOMR-F process entails performing hydraulic analysis, obtaining environmental and floodplain certifications, and coordination with the FEMA official from the City. A CLOMR-F application will be submitted after completion of the Project, with as-built conditions to determine if the Project meets all criteria. If approved, FEMA will proceed with the flood map revision.

PBS Engineering and Environmental Inc. (PBS) has been retained to provide floodplain analysis services. This task includes the preparation of a Hydrologic Engineering Center's River Analysis System (HEC-RAS) model that is based on the model created by FEMA. The HEC-RAS model will be used to determine the impact of the proposed Project to the floodplain. The results of this zero-rise analysis are presented in this document.

1.1 Project Site Description

The proposed Project (Figure 1) is an approximately 36.78-acres site occupying the SW ¼ of the NE ¼ of Section 7, Township 5 North, Range 1 East (Willamette Meridian) at 2308 Lewis River Road in the City of Woodland, Cowlitz County, Washington (Ecological Land Use, November 2020). The limits of grading are proposed to be approximately 28.3 acres (SGA Engineering and Design, 2013) with a net fill of approximately 5,600 cubic yards. The project is bordered by Lewis River Road and Lewis River to the east, single parcel lots to the north, a subdivision to the southwest, a school to the south, and industrial buildings to the southeast. Figure 1 shows the approximate grading limits for the proposed subdivision.

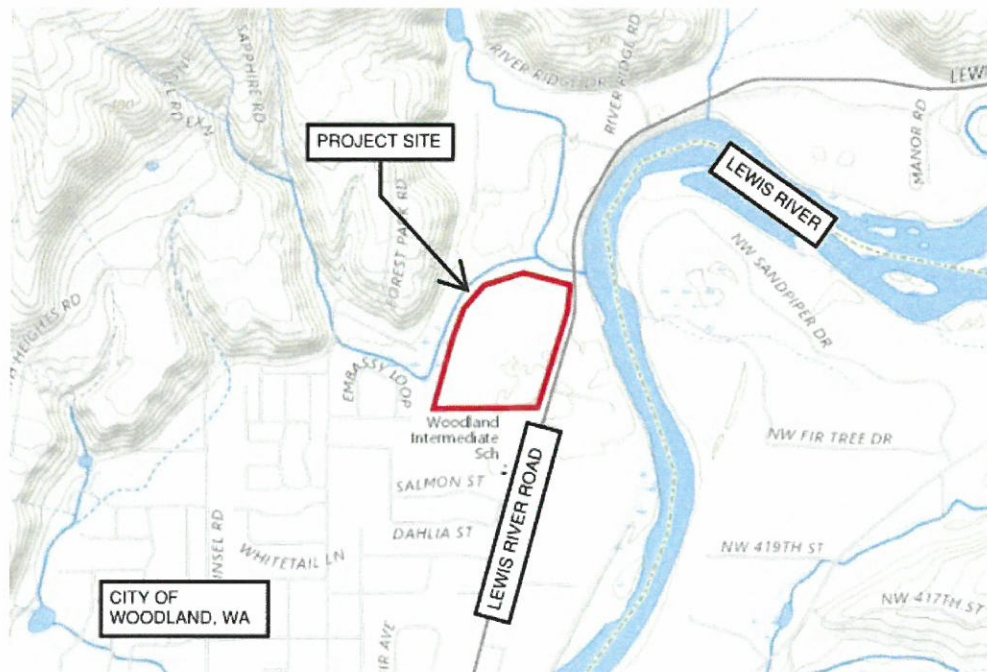


Figure 1. Woodland Creek Subdivision - Vicinity Map

1.2 Zero-Rise Analysis

As the project site is within the 100-year floodplain of the Lewis River, a zero-rise analysis is needed to determine impacts of the proposed Project to the existing 100-year flood elevations. A zero-rise analysis entails that a hydraulic analysis must be performed with standard engineering practices, and a “no-rise certification” (this document) must be provided to ensure the Project does not increase flood levels past regulation standards. The zero-rise process requires FEMA to generate an effective model for the pre-developed Project site area. This model will be duplicated by PBS, verified for accuracy, corrected if necessary; and used as the existing conditions model. The engineer will then generate a post-conditions model and compare the results of the 100-year flood elevations to make a no-rise analysis determination.

2 EXISTING FEMA STUDY

2.1 Basin Overview

The Project site is located west of the Lewis River between river mile (RM) stations 8.61 and 9.20. The Lewis River originates in the Cascade Mountain Range and ultimately discharges into the Columbia River. The basin is mountainous with high benches of comparatively level land in the middle and lower sections of the basin (see Figure 2). In the 20-mile segment between the mouth of the river and Lake Merwin Dam (RM 20), the Lewis River has an average fall of 2 feet per mile (0.04% slope), and an average valley width of 1 mile. The average annual runoff is approximately 90 inches. Reservoirs have been created along the main stem of the Lewis River by dams located approximately at RM 20 (Merwin Lake), RM 34 (Yale Lake), and RM 47 (Swift Reservoir) (FIS, 2015).

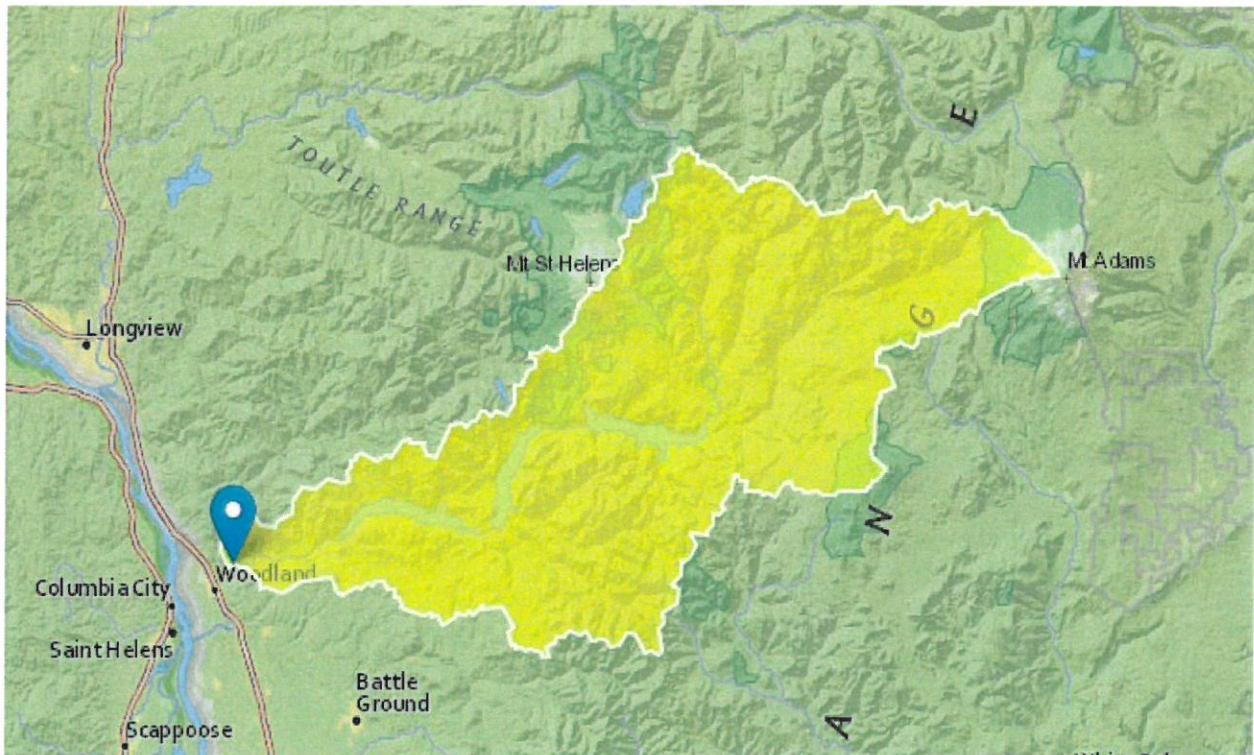


Figure 2. Project Drainage Basin, USGS StreamStats

2.2 Existing Floodplain Insurance Maps

The FEMA Flood Insurance Study (FIS) provides information on the existence and severity of flood hazards in the geographic area of Cowlitz County, including the City of Woodland. Hydrologic and hydraulic analyses for the Lewis River were completed for FEMA by U.S. Geological Survey (USGS) in 1976 and updated in 1978 by the United States Army Corps of Engineers (USACE) to reflect 70,000 acre-feet of available flood control storage on the Lewis River at Merwin Dam (FIS, 2015).

The FIS states that the Lewis River was last studied in detail in 1989 and is effective countywide as of December 16, 2015. Flood Insurance Rate Maps (FIRMs) that outline the boundaries for 100-year and 500-year flood events are provided in Appendix A.

Historical aerial images do not appear to show signs of major residential or industrial development activities since 1990 (Google Earth, April 2021) and the floodplain or pre-project conditions have not changed over the last 30 years. Historical aerial images dating back to 1990 show that a few buildings (that is, houses and barns) have been removed from the project area. Additionally, an electrical substation that appears to be at least 30 years old is present on the property.

2.2.1 FEMA Flood Zones

The FIRMs designate defined zones that represent the chance of a flood event occurring. The primary zones of the Project site are listed below and shown in Figure 3:

- Special Flood Hazard Areas subject to inundation by the 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year.
- Floodway Areas in Zone AE: The floodway is the channel of the stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.
- Other Flood Areas: Areas of 0.2% (500-year flood) annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

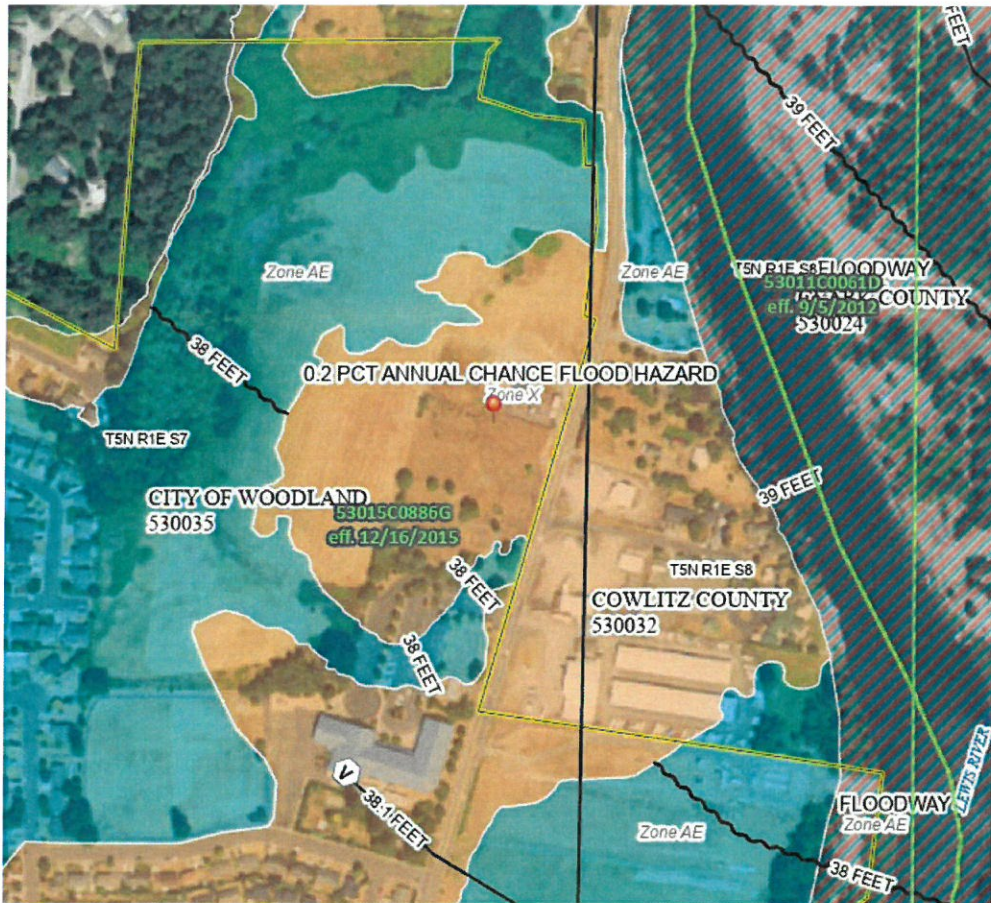


Figure 3. FIRMs Primary Zones

2.2.2 Hydrology

The design flows used for the floodplain analysis were obtained using the Cowlitz County, Washington, and Incorporated Areas FIS, Volume 1 of 3 (see Appendix A). The design flows are presented in Table 1.

Table 1. Lewis River Peak Discharges

Recurrence Interval	Peak Discharge (CFS)
10% Annual Chance	54,400
2% Annual Chance	86,600
1% Annual Chance	102,000
0.2% Annual Chance	142,000

Longitudinal profiles showing water surface elevations for the various peak discharges from the river mouth (RM 0.0) up to Merwin Lake (RM 20.0) are provided in Appendix A.

3 HYDRAULICS

Hydraulic information for the FIS was obtained from FEMA on April 28, 2021, which contained the following information:

1. 1989 HEC-2 modeling PDF

- a. Cross sections A-AG
- 2. 01-10-247P
 - a. Revises near cross section S
 - b. HEC2 digital modeling
 - c. Workmaps
 - d. Letter of determination

3.1 Model Description

The HEC-RAS model for the Lewis River was modeled using a HEC-2 flood study provided by the FEMA. Electronic data provided by FEMA was imported into HEC-RAS model to replicate the FEMA study. After importing the data, the HEC-RAS model was reviewed against the 1989 HEC-2 modeling results PDF for geometric accuracy.

3.1.1 Existing Conditions Model

Once the Lewis River cross-sectional geometry and flow inputs were entered, the HEC-RAS model produced water surface 100-year elevations that matched those of the FEMA HEC-2 study. In order to get a better understanding of how the proposed conditions would impact the floodplain, the existing conditions model would have to be adjusted to account for the Project site. To make the adjustments to the existing model, FEMA cross sections were extended and three cross sections between FEMA cross sections V and W were interpolated. Surface elevation data for the extended and interpolated cross sections that modeled the project site were obtained by creating a combined surface of GIS elevation data and existing ground survey elevation data of the project site. This additional elevation was used to calibrate the existing HEC-RAS model to better interpret proposed results of the project area.

3.1.2 Proposed Conditions Model

Since the Project site is in the floodplain and the FEMA models did not extend out into the floodplain where the Project is located, existing FEMA cross sections were extended to capture what was happening in the floodplain at the project site. The geometry of these extended cross sections was taken and adjusted from a combination of available survey data and GIS data. Once the existing conditions model had been adjusted and calibrated to include the area of interest, the proposed conditions HEC-RAS model was developed by using the existing model and simply modifying the cross-sectional geometry to match that of the proposed surface at selected points along the extended cross sections.

4 ZERO-RISE ANALYSIS RESULTS

The results of the model show that the proposed subdivision did not have any impact to the 100-year flood elevations on the downstream region of the floodplain; however, the results of the model showed a 0.04 foot increase upstream of the Project site. This results in backwater flows in the upstream portion of the floodplain. It is recommended that the project site include compensatory storage to account for the 0.04 foot upstream rise. Table 2 summarizes the results, including the floodway of the zero-rise analysis, comparing proposed conditions to the existing conditions. The elevation results are provided in a NAVD27 datum for comparison. See Appendix B for the full HEC-RAS results.

Table 2. Water Surface Elevations of the Lewis River

Cross Section (River Mile)	Existing Water Surface Elevation (feet)	Proposed Water Surface Elevation (feet)	Difference in Water Surface Elevation (feet)
7.13	32.51	32.51	0
7.69	33.54	33.54	0
8.13	34.17	34.17	0

Cross Section (River Mile)	Existing Water Surface Elevation (feet)	Proposed Water Surface Elevation (feet)	Difference in Water Surface Elevation (feet)
8.39	34.6	34.6	0
8.61	34.83	34.81	-0.02
8.95	34.92	34.92	0
9.03	36.03	36.01	-0.02
9.2	36.31	36.35	0.04
9.85	37.21	37.24	0.03
10.69	38.11	38.14	0.03

According to Guidance for Flood Risk Analysis and Mapping for Floodway Analysis and Mapping provided by FEMA, since the proposed conditions are directly changing the floodplain and not the floodway, it meets requirement section 60.3(c)(10) of NFIP regulations, which requires that the floodplain does not increase base flood levels by more than 1 foot. With an upstream rise of only 0.04 foot in the floodplain, the proposed surface complies. The 1-foot window provides the leeway necessary to meet requirements since the proposed surface is not the floodway, which requires stricter 0.00 rise parameters.

After a detailed hydraulic analysis, it has been determined that the proposed subdivision will not have an impact on the proposed 100-year flood elevations of the Lewis River, because it is in the floodplain.

REFERENCES

Federal Insurance Administration. "The Flood Insurance Study for Cowlitz County and Incorporated Areas,"
December 16, 2015.

Ecological Land Services. Critical Areas Report. Woodland Creek Delineation, Woodland, Washington.
November 1, 2020.

USGS. 2021. United States Geological Survey StreamStats Application. Available online at:
<https://streamstats.usgs.gov/ss/>. Accessed June 2021.

Appendix A

FEMA Documents

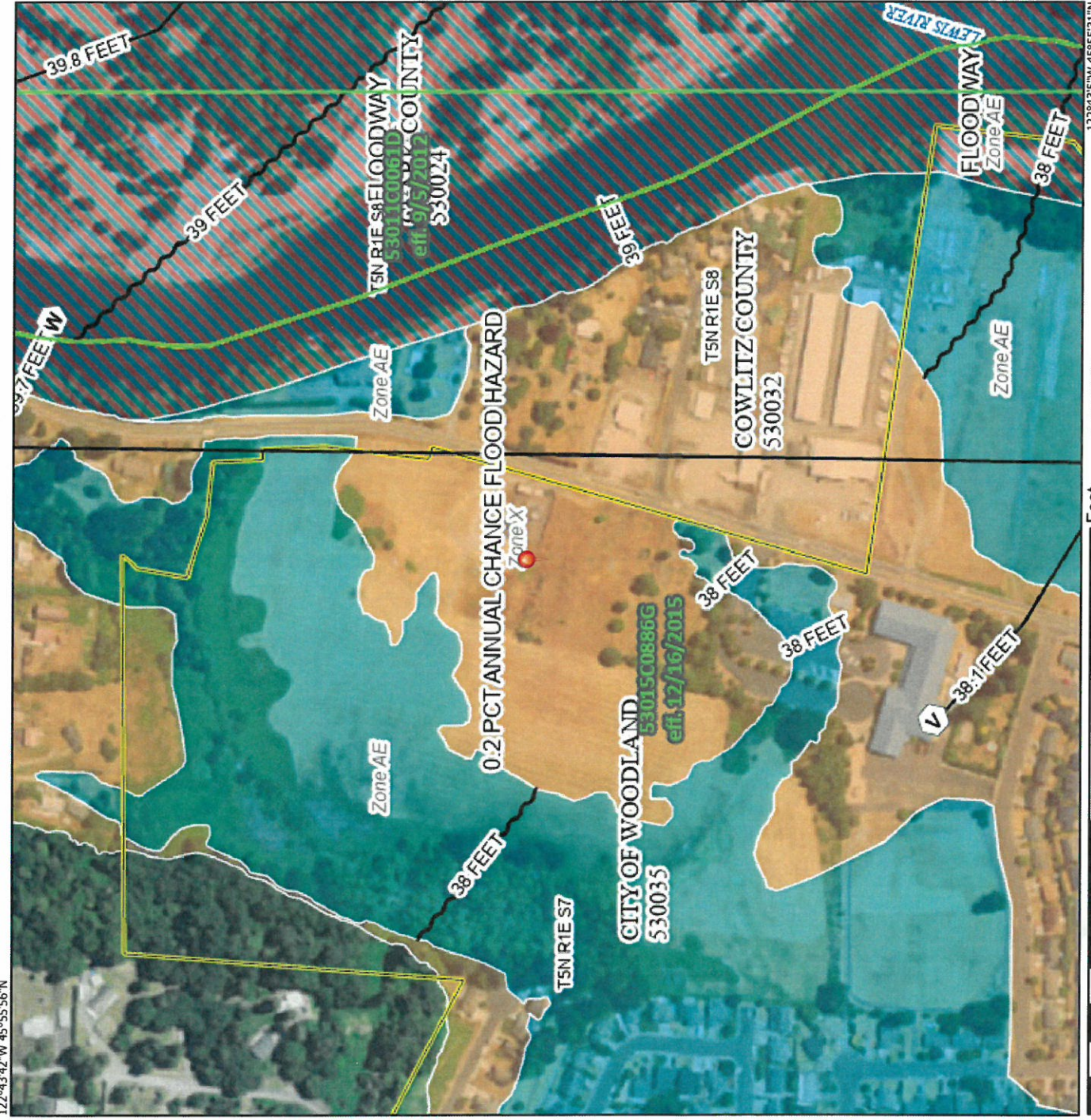
Flood Insurance Rate Maps (FIRMs)

Flood Insurance Studies (FIS)

National Flood Hazard Layer FIRMette



122°43'42"W 45°55'56"N



0 250 500 1,000 1,500 2,000 Feet

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS

- Without Base Flood Elevation (BFE) Zone A, V, AG9
- With BFE or Depth Zone AE, AO, AH, VE, AR
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD

- 0.2% Annual Chance Flood Hazard. Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
- Future Conditions 1% Annual Chance Flood Hazard Zone X
- Area with Reduced Flood Risk due to Levee. See Notes. Zone X
- Area with Flood Risk due to Levee Zone D

OTHER AREAS

- NO SCREEN
- Area of Minimal Flood Hazard Zone X
- Effective LOMRs
- Area of Undetermined Flood Hazard Zone D

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- Cross Sections with 1% Annual Chance Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS

- Digital Data Available
- No Digital Data Available
- Unmapped

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards.

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 7/20/2021 at 2:48 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and undetermined areas cannot be used for regulatory purposes.