State of Oregon
Oregon Department of Geology and Mineral Industries
Brad Avy, State Geologist

BASE FLOOD ELEVATION DETERMINATION BF-16-02

BASE FLOOD ELEVATION DETERMINATION FOR REACHES OF LAKE CREEK, DEADWOOD CREEK, AND NELSON CREEK NEAR DEADWOOD, LANE COUNTY, OREGON

by Jed T. Roberts[1] and Matt C. Williams[1]

2016

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DISCLAIMER

The Oregon Department of Geology and Mineral Industries is not liable for any claimed damage from the use of this information. The Federal Emergency Management Agency may, at any time in the future, revise the Base Flood Elevations for this study area. This study and Base Flood Elevation determination does not supersede any existing or future detailed analyses or determination performed by a licensed professional engineer. This analysis and mapping does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size.

Oregon Department of Geology and Mineral Industries Base Flood Elevation Determination BF-16-02
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This report was prepared by the Oregon Department of Geology and Mineral Industries for Johnson Broderick Engineering, in fulfillment of the Base Flood Elevation Determination Service Agreement made effective May 24, 2016.

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STUDY BACKGROUND

This study was conducted under a Base Flood Elevation Determination Service agreement dated May 24, 2016, between the Oregon Department of Geology and Mineral Industries (DOGAMI) and Johnson Broderick Engineering. The purpose of this study was to develop 1% annual chance (100-year) water surface elevations, also known as Base Flood Elevations (BFEs), for reaches of Lake Creek, Deadwood Creek, and Nelson Creek in Lane County, Oregon, near the unincorporated community of Deadwood.

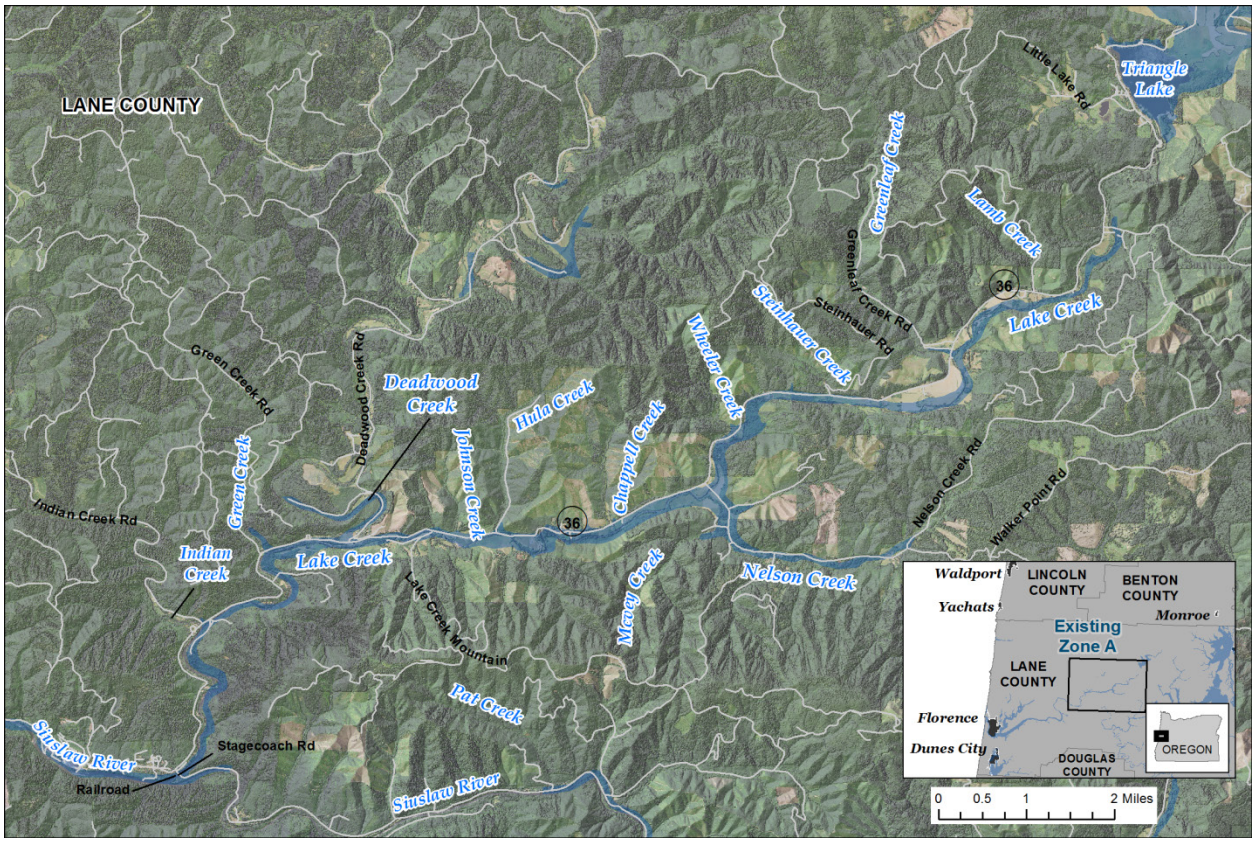
BFEs are determined primarily for administration of the National Flood Insurance Program (NFIP). The Federal Emergency Management Agency (FEMA) oversees the NFIP and issues Flood Insurance Rate Maps (FIRMs) that depict Special Flood Hazard Areas (SFHAs) within which flood insurance for structures is typically required. SFHAs are mapped by *detailed* or *approximate* methods:

- *Detailed analyses* are performed for streams in urban or suburban settings, and SFHAs mapped with this approach are designated as Zone AE, Zone AO, or Zone AH. The analyses incorporate field survey and flood frequency data into a hydraulic model. The resulting BFEs are mapped onto best available topographic data.
- *Approximate analyses* are performed for streams in rural areas, and SFHAs mapped with this approach are designated as Zone A. Unlike detailed analyses, the approximate analysis does not produce BFEs. Instead, this latter method has historically involved engineering judgment of hydraulics and hydrology to map SFHAs onto U.S. Geological Survey (USGS) topographic sheets.

The approximate analysis approach was used to map SFHAs that are shown on the currently effective FIRM for Lake Creek, Deadwood Creek, and Nelson Creek (Figure 1).

DOGAMI has partnered with FEMA through its Cooperating Technical Partner program to improve FIRMs by introducing high-resolution lidar (light detection and ranging) topographic data. As part of this effort DOGAMI has developed a FEMA-approved computer model-based approach to produce BFEs using lidar in areas designated approximate, enabling the Zone A SFHAs to be revised and updated. This same approach was applied for the current study to produce BFEs in an area where FEMA has not yet funded a lidar-based FIRM revision.

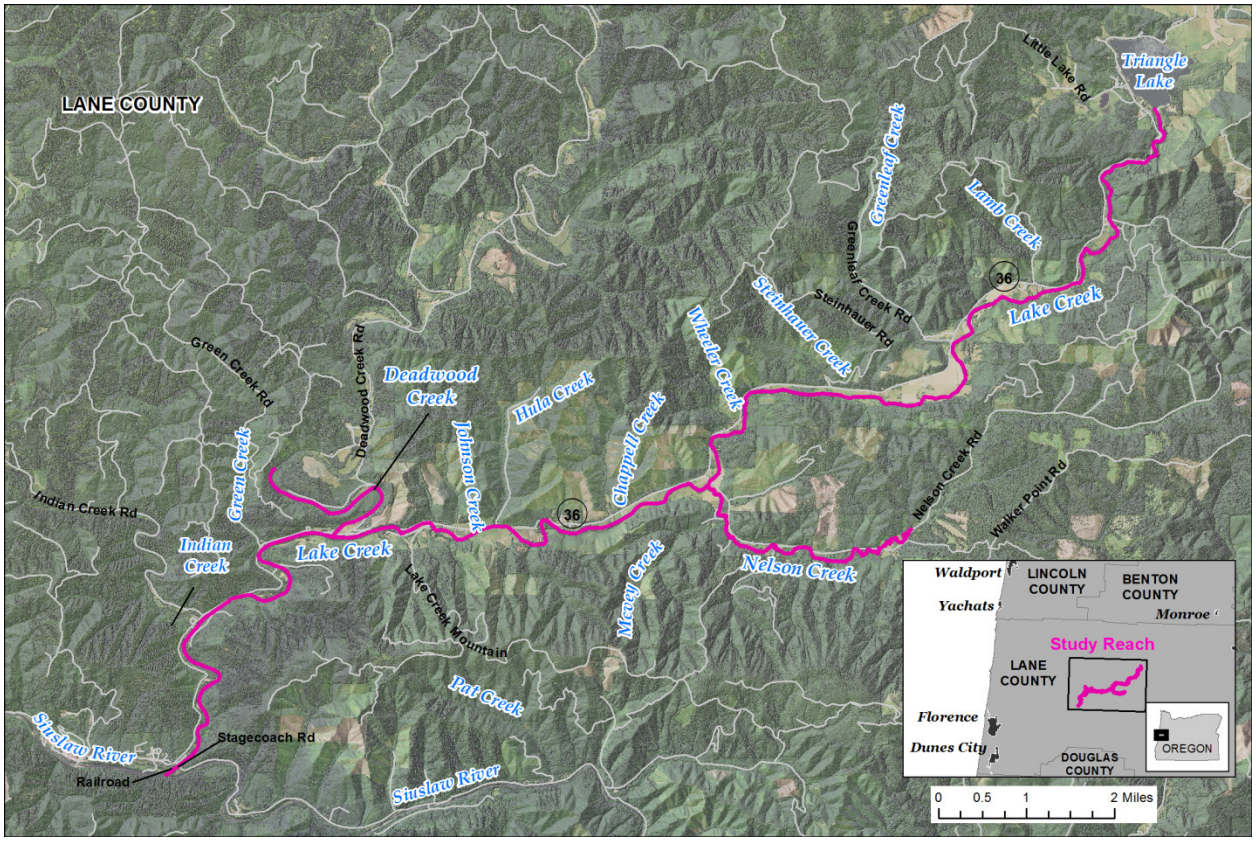
Figure 1. Zone A Special Flood Hazard Area published by FEMA in 1999.



PHYSICAL SETTING

Lake Creek drains a 223 square mile watershed within the Siuslaw River basin in the Oregon Coast Range. It is a tributary to the Siuslaw River with its mouth located just upstream of river mile 29. Deadwood Creek and Nelson Creek are tributaries to Lake Creek; their mouths are near river mile 5 and 10, respectively. The watershed is characterized by steep forested uplands typical of the Coast Range. Timber harvests have moderately altered the watershed. Mean annual precipitation in the watershed ranges from approximately 50 to 70 inches per year. Flows do not appear to be regulated by dams or other hydraulic structures. This reach of Lake Creek drains from Triangle Lake, which is a natural lake formed by the constriction of Lake Creek, the result of an ancient landslide.

Figure 2. Location of study reaches.



HYDROLOGIC ANALYSIS METHODS

For this study, 34 discharge locations were identified: 26 on Lake Creek, 7 on Nelson Creek, and one at the mouth of Deadwood Creek. Locations were selected at the downstream terminus of each study reach and upstream based on a minimum drainage area reduction of 1 square mile (Figure 3).

100-year peak discharges were calculated using a regional regression equation developed by the Oregon Water Resource Department (OWRD) and the USGS (Cooper, 2005). OWRD and USGS divided western Oregon into three hydrologic regions with separate regression equations. The watersheds

upstream of the discharge locations fall completely within Region 1. For these ungaged locations the 100-year peak discharge is given by the equation:

$$Q_{100} = 0.003048\ Area^{0.9176}\ I24\text{-}2^{1.126}\ MxJanT^{2.325}\ SoilC^{-0.5701}\ SoilP^{-0.3319}$$

where

Q_{100} = 100-year (1% annual chance) peak discharge, in cubic feet per second,
Area = drainage area of the watershed, in square miles,
I24-2 = 2-year (50% annual chance) 24-hour precipitation intensity, in inches,
MxJanT = mean maximum January temperature, in degrees Fahrenheit,
SoilC = soil storage capacity, in inches, and,
SoilP = soil permeability, in inches.

Basin characteristics were determined using the USGS StreamStats for Oregon web tool (USGS, 2015). The resulting 100-year peak discharges are listed in Table 1.

Figure 3. Discharge locations.

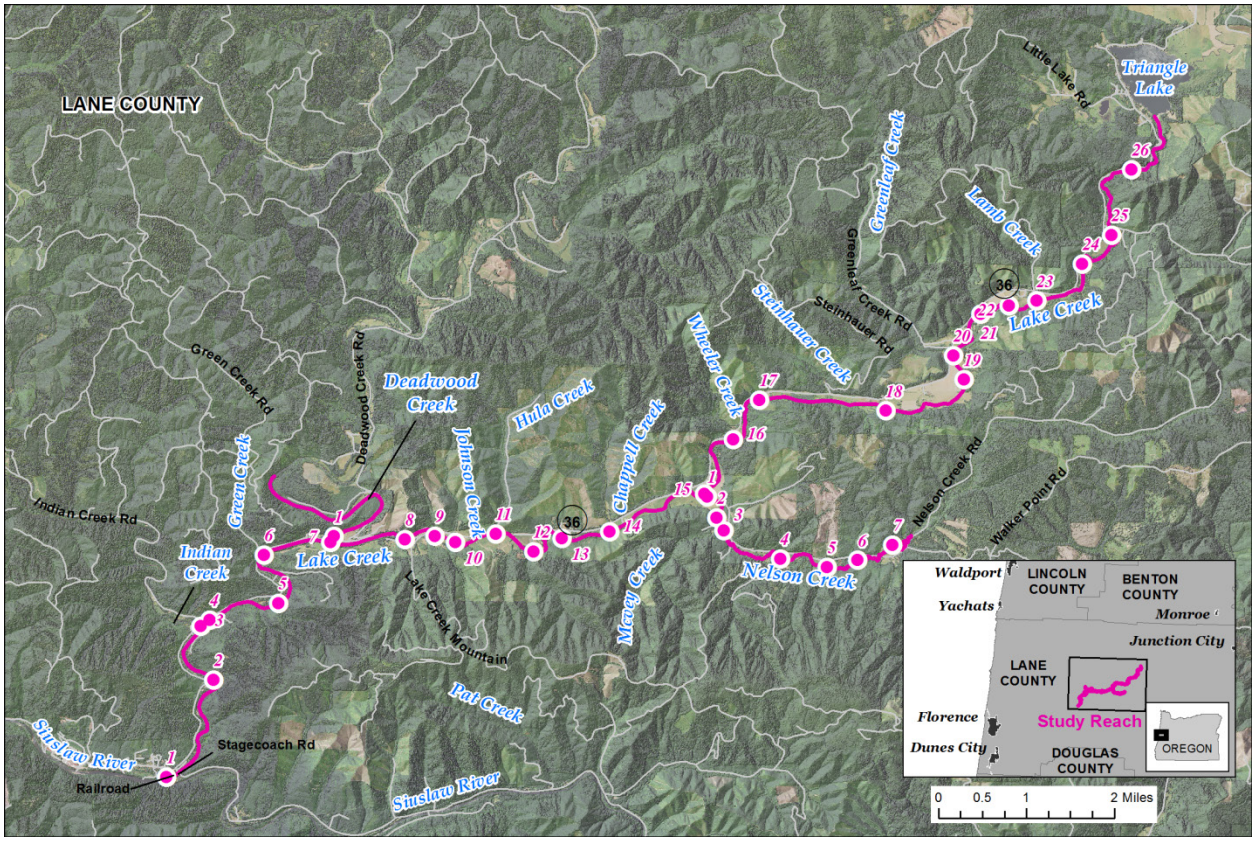


Table 1. Summary of 100-year flood discharges.

Discharge Location	Drainage Area (sq. mi.)	2-Year 24-Hour Precipitation Intensity (in.)	Mean Maximum January Temperature (°F)	Soil Storage Capacity (in.)	Soil Permeability (in.)	100-Year Peak Discharge (cfs)
Lake Creek #1	223.0	3.29	46.6	0.14	2.52	30,900
Lake Creek #2	222.0	3.29	46.6	0.14	2.52	30,600
Lake Creek #3	174.0	3.27	46.4	0.14	2.48	23,900
Lake Creek #4	173.0	3.27	46.4	0.14	2.48	23,700
Lake Creek #5	172.0	3.27	46.4	0.14	2.48	23,500
Lake Creek #6	167.0	3.27	46.4	0.14	2.47	22,900
Lake Creek #7	108.0	3.22	46.0	0.14	2.36	15,000
Lake Creek #8	107.0	3.21	46.0	0.14	2.36	14,800
Lake Creek #9	106.0	3.21	46.0	0.14	2.36	14,600
Lake Creek #10	105.0	3.21	45.9	0.14	2.35	14,500
Lake Creek #11	103.0	3.20	45.9	0.14	2.35	14,200
Lake Creek #12	102.0	3.20	45.9	0.14	2.34	14,100
Lake Creek #13	101.0	3.20	45.9	0.14	2.34	14,000
Lake Creek #14	99.4	3.20	45.9	0.14	2.33	13,800
Lake Creek #15	83.7	3.24	45.7	0.14	2.28	12,000
Lake Creek #16	82.0	3.25	45.7	0.14	2.27	11,800
Lake Creek #17	81.4	3.25	45.7	0.14	2.27	11,700
Lake Creek #18	79.5	3.26	45.7	0.14	2.26	11,500
Lake Creek #19	78.9	3.27	45.7	0.14	2.25	11,400
Lake Creek #20	78.1	3.27	45.6	0.14	2.25	11,400
Lake Creek #21	66.5	3.29	45.6	0.14	2.29	9,810
Lake Creek #22	65.8	3.30	45.6	0.14	2.28	9,770
Lake Creek #23	65.2	3.30	45.6	0.14	2.28	9,680
Lake Creek #24	63.9	3.31	45.6	0.14	2.28	9,540
Lake Creek #25	62.9	3.32	45.6	0.14	2.27	9,450
Lake Creek #26	53.8	3.35	45.5	0.15	2.20	7,990
Nelson Creek #1	15.0	2.94	46.6	0.13	2.62	2,280
Nelson Creek #2	14.0	2.94	46.6	0.13	2.62	2,140
Nelson Creek #3	12.1	2.91	46.6	0.13	2.62	1,840
Nelson Creek #4	10.6	2.89	46.5	0.13	2.63	1,610
Nelson Creek #5	9.8	2.88	47.3	0.13	2.63	1,490
Nelson Creek #6	9.0	2.88	47.3	0.13	2.63	1,360
Nelson Creek #7	6.3	2.86	47.2	0.13	2.68	962
Deadwood Creek	58.8	3.36	47.2	0.13	2.68	9,520

HYDRAULIC ANALYSIS METHODS

To produce simulated water surface elevations of the 100-year peak discharge, a three steady flow hydraulic models – one for each creek – were developed using the Hydrologic Engineering Center River Analysis System (HEC-RAS 5.0) produced by the U.S. Army Corps of Engineers (Brunner, 2016). Geometric input data were developed using the Esri ArcGIS© for Desktop Advanced 10.2.2 software package, the Esri 3D Analyst™ and Spatial Analyst™ extensions, and the HEC-GeoRAS 10.2 add-on produced by USACE (Ackerman, 2011).

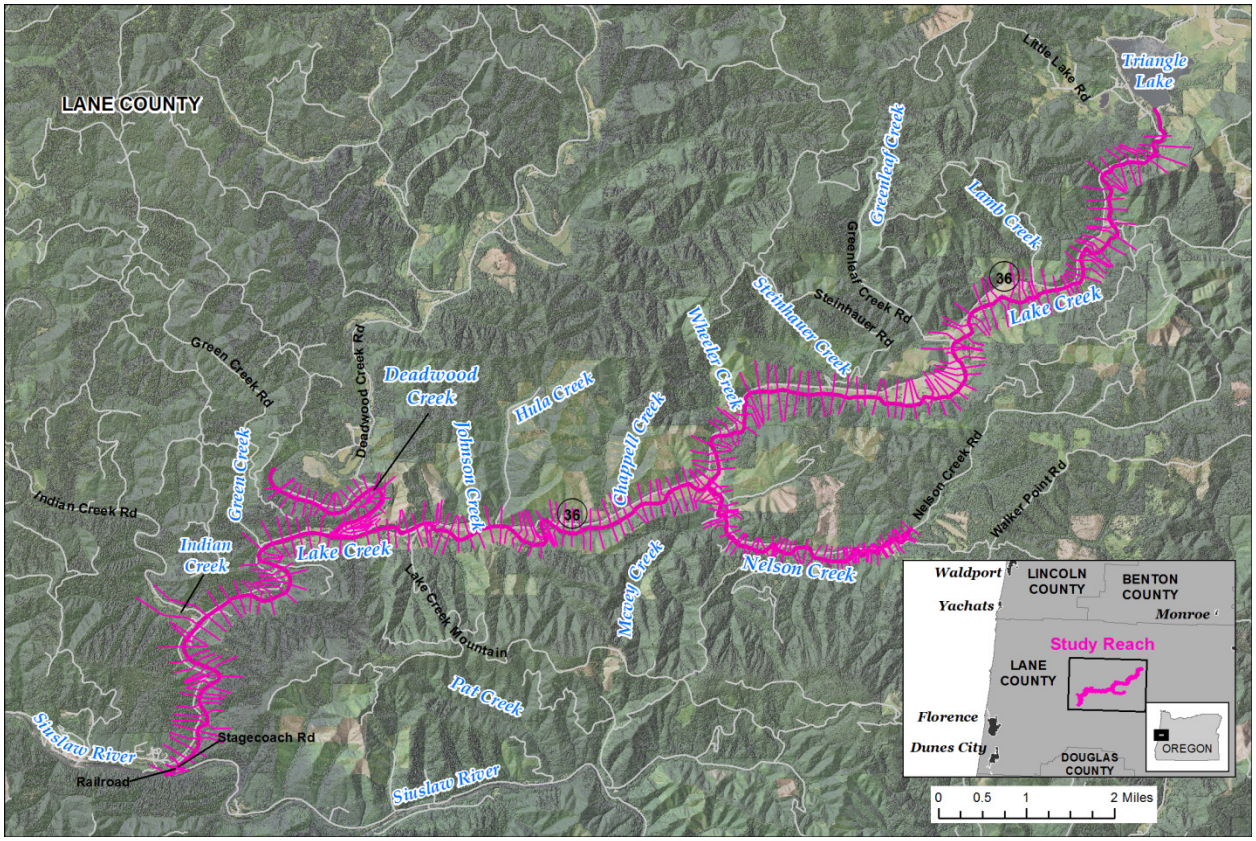
Geometric data layers, including stream centerline, flowpaths, bank stations, and cross-sections, were digitized from a hillshade raster derived from a 3-foot resolution lidar digital elevation model (DEM). The lidar DEM was derived from ground classified points with an average density of 0.05 per square foot. The vertical accuracy for the lidar acquisition area is ± 0.22 ft on flat surfaces. Lidar acquisition for the study area took place in June and July 2014 (QSI, 2015).

To model the in-channel and overbank terrain, 251 cross-sections were cut from the lidar DEM, placed perpendicular to the stream centerline with 178 on Lake Creek, 47 along Nelson Creek, and 26 on Deadwood Creek (Figure 4). The downstream reach boundary condition was defined with a normal depth slope; 0.006 for Lake Creek, 0.005 for Nelson Creek, and 0.002 for Deadwood Creek.

Fifteen bridges were incorporated in the model; 12 on Lake Creek, 2 on Nelson Creek, and one on Deadwood Creek. The bridge opening width was inferred from the lidar DEM. An assumed deck thickness of 3.5 ft was applied. The bridge top deck elevation was taken from the highest hit lidar DEM.

Manning's roughness coefficients were determined for the study area overbank areas using the 2011 National Land Cover Dataset (Jin, 2013). Land cover types were assigned a coefficient from land descriptions provided in Chow (1959). Overbank coefficients were found to range from 0.03 to 0.15 throughout the study area. Channel coefficients for Lake Creek and Deadwood Creek were determined by inspecting orthoimagery and are fairly consistent, ranging from 0.04 to 0.05 depending on whether large boulders are visible. Due to thick vegetation cover the channel was not visible for most of the Nelson Creek reach and roughness was defined by the land cover dataset. Ineffective flow areas were applied in several areas of shallow, off-channel flooding.

Figure 4. Location of cross-sections used for hydraulic analysis.



SUMMARY OF RESULTS

The results of hydraulic modeling show that BFEs range from 117.0 ft (NAVD88) at the downstream terminus of the study area to 690.8 ft (NAVD88) at the upstream terminus. Table 2 shows BFEs at cross-sections selected approximately every 1 mile (Appendix A) throughout the study reaches.

Table 2. Summary of 100-year flood elevations.

Reference Cross-Section[1]	Location Description	BFE (ft. NAVD88[2])
LC-1	mouth of Lake Creek	117.0
LC-2	About a mile upstream of the Stagecoach Road bridge	161.2
LC-3	400 ft upstream of the confluence with Indian Creek	195.8
LC-4	About a mile upstream of the confluence with Indian Creek	217.7
LC-5	1,300 ft downstream of confluence with Deadwood Creek	241.2
LC-6	4,200 ft upstream of confluence with Deadwood Creek	261.2
LC-7	3,300 ft upstream of Lake Creek Mountain Road bridge	279.8
LC-8	1,000 ft upstream of private bridge	313.9
LC-9	1.1 miles downstream of confluence with Nelson Creek	325.5
LC-10	1,900 ft downstream of confluence with Nelson Creek	333.2
LC-11	1,900 ft upstream of the Nelson Mountain Road bridge	344.9
LC-12	1.3 miles upstream of the Nelson Mountain Road bridge	357.2
LC-13	2,000 ft downstream of private bridge	366.4
LC-14	2,100 ft downstream of private bridge	370.2
LC-15	2,400 ft downstream of Greenleaf Creek	375.3
LC-16	2,700 ft upstream of Greenleaf Creek	384.7
LC-17	300 ft upstream of private foot bridge	396.1
LC-18	3,900 ft downstream of Fish Creek Road bridge	408.8
LC-19	1,300 ft upstream of Fish Creek Road bridge	424.0
LC-20	just downstream of Triangle Lake	690.8
NC-1	mouth of Nelson Creek	332.9
NC-2	2,800 ft downstream of forest service road 17-8-16-2 bridge	359.5
NC-3	1,900 ft upstream of forest service road 17-8-16-2 bridge	391.3
NC-4	1,700 ft downstream of Nelson Mountain Road bridge	412.7
NC-5	3,500 ft upstream of Nelson Mountain Road bridge	433.8
DWC-1	mouth of Deadwood Creek	243.3
DWC-2	4,100 ft upstream of mouth of Deadwood Creek	254.8
DWC-3	1.5 miles upstream of mouth of Deadwood Creek	267.3
DWC-4	2.1 miles upstream of mouth of Deadwood Creek	273.2

[1]See Appendix A for map of reference cross-sections.

[2]North American Vertical Datum of 1988.

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APPENDIX A: MAP OF HYDRAULIC ANALYSIS RESULTS

Attached to this report are maps depicting the hydraulic analysis results of the 100-year peak discharge for the study reaches of Lake Creek, Deadwood Creek, and Nelson Creek.

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Reaches of Lake Creek, Deadwood Creek, and Nelson Creek, Lane County, Oregon (Map 1 of 3)

By Jed T. Roberts and Matt C. Williams
(See accompanying report.)

N

Upstream Limit of Study
Deadwood Creek Rd
Deadwood Creek
Johnson Creek
Hula Creek
Green Creek
DWC4
273.2
267.3
254.8
DWC2
DWC3
LC5
LC6
LC7
LC8
243.3
DWC1
36
241.2
261.2
279.8
313.9
Indian Creek
LC4
LC3
Lake Creek
Indian Creek Rd
217.7
Lake Creek Mountain Rd
LANE COUNTY
195.8
Cleveland Creek Rd
LC2
161.2
Lake Creek
Downstream Limit of Study
Stagecoach Rd
LC1
Siuslaw River
117
Railroad

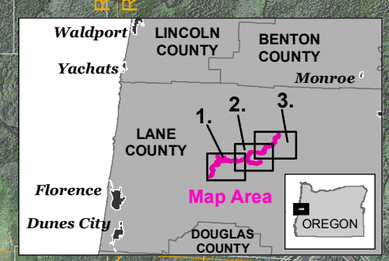
Modeled 1% Chance Flood Depths

- 0–2 feet
- 2–4 feet
- 4–6 feet
- 6–8 feet
- 8 feet and above

117.0 LC1 — Reference Cross-Section with Water Surface Elevation in Feet (NAVD88)

- Study Reach
- Road
- Public Land Survey System
- Township and Range Boundary
- Taxlot Boundary

Range 9 West
Range 8 West



0 0.25 0.5 1 Miles

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BASE FLOOD ELEVATION DETERMINATION REPORT BF-16-02

Reaches of Lake Creek, Deadwood Creek, and Nelson Creek, Lane County, Oregon (Map 2 of 3)

By Jed T. Roberts and Matt C. Williams

(See accompanying report.)

N

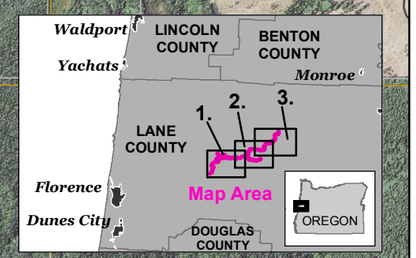
Greenleaf Creek Rd
LC16
Steinhauer Creek
Greenleaf Creek
LC15
LC12
Steinhauer Rd
LC13
LC14
36
Hula Creek
Chappell Creek
LANE COUNTY
Wheeler Creek
Johnson Creek
LC11
357.2
366.4
370.2
Lake Creek
344.9
LC10
332.9
LC9
LC8
LC7
NC1
Nelson Mountain Rd
Nelson Creek
Upstream Limit of Study
433.8
NC5
LC6
36
333.2
359.5
391.3
412.7
325.5
261.2
279.8
313.9
NC2
NC3
NC4
Lake Creek
McVey Creek
Lake Creek Mountain Rd
Range 9 West
Range 8 West

Modeled 1% Chance Flood Depths

- 0–2 feet
- 2–4 feet
- 4–6 feet
- 6–8 feet
- 8 feet and above

117.0 LC1 — Reference Cross-Section with Water Surface Elevation in Feet (NAVD88)

- Study Reach
- Road
- Public Land Survey System
- Township and Range Boundary
- Taxlot Boundary



0 0.25 0.5 1 Miles

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Reaches of Lake Creek, Deadwood Creek, and Nelson Creek, Lane County, Oregon (Map 3 of 3)

By Jed T. Roberts and Matt C. Williams

(See accompanying report.)

N

LANE COUNTY

Little Lake Rd

Triangle Lake

LC20

690.8

Upstream Limit of Study

Range 8 West
Range 7 West

LC19

424

LC18

36

Lake Creek

408.8

LC17

396.1

LC16

384.7

Greenleaf Creek

Lamb Creek

Greenleaf Creek Rd

Steinhauer Creek

Wheeler Creek

LC12

Steinhauer Rd

LC13

LC14

LC15

375.3

370.2

366.4

357.2

LC11

344.9

Township 16 South
Township 17 South

Modeled 1% Chance Flood Depths

- 0–2 feet
- 2–4 feet
- 4–6 feet
- 6–8 feet
- 8 feet and above

117.0 LC1 — Reference Cross-Section with Water Surface Elevation in Feet (NAVD88)

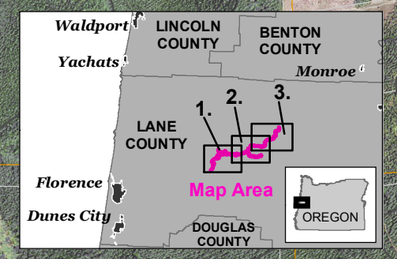
Study Reach

Road

Public Land Survey System

Township and Range Boundary

Taxlot Boundary



0 0.25 0.5 1 Miles

APPENDIX B: HYDRAULIC ANALYSIS DATA PACKAGE

Attached to this report is a GIS data package containing the input and output datasets used to perform this study.

The data package includes a folder for each reach:

- DeadwoodCreek_Reach
- LakeCreek_Reach
- NelsonCreek_Reach

Within each reach folder are:

- HEC-RAS 4.1 model (HECRAS folder)
- HEC-GeoRAS 10.2 input geometry data in GIS format (HECGeoRAS_Input_Geometry folder)
    - Cross-sections (XSCutLines)
    - Stream centerlines (River)
    - Flowpaths
    - Bridges
- HEC-GeoRAS 10.1 output data in GIS format (HECGeoRAS_Output folder)
    - Model output 100-year flood zone (bp002)
    - 100-year water surface elevation grid (wsgridp002)
    - 100-year depth grid (dp002)
    - Cross-sections with computed 100-year water surface elevations (XSCutlines)
- Hydrologic data table (*-Hydrology Sheet.xlsx) and supplementary shapefiles (HydroPoint*, Subbasin*)

The “Composite Reach” folder includes data for combined reaches:

- 100-year flood zone
- 100-year water surface elevation grid
- 100-year depth grid