

Engineering Geologic Risk Assessment

West Fork Sorts Timber Sale

October 23, 2024



Prepared for:

Trenton Baribault, Silviculture Forester
Department of Natural Resources
Northeast Region
North Cascades District

Prepared by:

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State Lands Geologist
Department of Natural Resources
Forest Resources Division

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1.0 INTRODUCTION

This report documents potentially unstable landforms for the proposed West Fork Sorts timber harvest to supplement the Forest Practices Application (FPA) to the Washington State Department of Natural Resources (DNR) (Figure 1). I provide this information to describe the slope stability risk assessment conducted for the proposed road construction of E404005E through an inner gorge. (Figure 4). This report is intended to satisfy the requirements of a Class-IV-Special FPA.

Washington's Forest Practices rules define potentially unstable landforms, commonly referred to as RILs,¹ for purposes of classifying and reviewing FPAs and regulating in those areas. The slope-stability trained forester identified and excluded rule-identified landforms (RILs) around other units. Refer to Appendix D of the FPA for more information.

2.0 SCOPE OF SERVICES

The scope of services included:

- Review of DNR GIS data including:
 - Digital orthophotographs: 1990-2000, 2003, 2004-2005, 2006, 2009, 2011, 2013, 2015, 2017, 2019, 2021-2022, 2023
 - Historic Aerial Photographs: 1946, 1953, 1958, 1965
 - 1-meter resolution 2016 light detection and ranging (LiDAR) derivatives
 - 1:100,000-scale geologic mapping (Figure 3)²
- Field reconnaissance on:
 - August 15th, 2023 – Greg Morrow, State Lands Geologist (LEG, QE) Trenton Baribault (Forester)
 - June 3rd, 2024 – Zach Click (LEG, QE), Trenton Baribault
 - June 7th, 2024 – Zach Click
- Preparation of this report

Zach Click prepared this report. Zach is a licensed engineering geologist (LEG #19110583) and a “qualified expert” (QE) for timberland slope stability evaluations, as designated by the DNR.

¹ WAC 222-16-050 (1)(d)(i)

² Joseph, Nancy L., compiler, 1990, Geologic map of the Colville 1:100,000 quadrangle, Washington-Idaho: Washington Division of Geology and Earth Resources Open File Report 90-13, 78 p., 1 plate.

3.0 SITE AND PROJECT DESCRIPTION

The proposed West Fork Sorts timber harvest is north of Northport within the Big Sheep Creek Watershed Administrative Unit (WAU) (Figure 1). The timber sale consists of five variable retention harvest (VRH) units, road pre-haul maintenance, reconstruction, and new construction. Privately owned timberlands surround the proposed harvest area and two units abut the Canada border. The nearest residential property is more than 1 mile south from the proposed harvest area.

New road construction is planned to cross an inner gorge between Units 4 and 5. Harvest and other management activities exclude other RILs.

4.0 GEOLOGIC AND GEOMORPHIC SETTING

I reviewed the Colville 1:100,000-scale geologic map by Joseph, 1990 (Figure 3). During the Pleistocene, the Okanogan lobe of the Cordilleran ice sheet scoured the local bedrock and deposited localized veneers of glacial sediment including glacial till, outwash, drift, and lacustrine deposits. The map indicates that the proposed harvest areas are underlain by Fraser-aged glacial till (Qgt) and Tertiary-aged intrusive rock known as Sheppard Granite (Eia_s). The Sheppard Granite is described by Joseph as “white or pink, medium- to fine-grained, equigranular granite and syenite.” Quaternary alluvium (Qa) and Tertiary metasedimentary rocks (T_{Rmm}) are mapped in the vicinity of the proposed timber harvest.

I reviewed the Washington Geology Survey (WGS) Landslide and Alluvial Fan inventory, Forest Practices landslide inventory (LSI) and hazard zonation (LHZ) databases to screen the sale area for published landslide information. There are no WGS, LSI, or LHZ data available for the proposed harvest area.

5.0 HISTORIC AERIAL IMAGERY

I reviewed historic aerial photographs and orthophotographs to assess past land use and evaluate landscape changes in the proposed harvest area. Figures 5 through 10 include a representative sample of the imagery I reviewed and are focused on the area of new road construction at the inner gorge crossing between Units 4 and 5.

I did not observe evidence of slope instability, landsliding or road failure in the reviewed imagery or in the field. The inner gorge topography appears consistent throughout the photo record. However, not all landslide activity can be detected in historical imagery due to image resolution, timing, and sun angle.

6.0 ROAD E404005E INNER GORGE CROSSING

Road E404005E was formally abandoned in 2007. To access Units 4 and 5, approximately 4,300 feet of new road construction is proposed along the abandoned road grade. The construction requires crossing a stream at station 22+57, between Units 4 and 5. Both stream banks at the crossing location have rule-identified, inner gorge topography.

The proposed inner gorge crossing construction includes the installation of a French drain at station 21+84 and a 60-inch by 80-foot culvert at station 22+57 along the type 4 stream. The road prism will be constructed in accordance with typical DNR road section details and will be approximately 14 feet wide through the stream crossing.

Observations at the proposed crossing include:

- Stream banks approximately 25 to 35 feet tall with areas of 70 to 90 percent slopes
- Portions of the stream banks immediately surrounding the abandoned road grade with 40 to 50 percent slopes
- A type 4 stream
- Glacial till in both stream banks and in the stream bed
- Approximately 15 percent stream gradient
- Upright, mature timber on the stream banks surrounding the abandoned grade
- Young alder and conifer, ferns, and grasses within the abandoned road grade

I did not observe evidence of landsliding on the inner gorge slopes or evidence of debris flows in the field or in the aerial photo record.

In my opinion, the proposed road construction will buttress the abandoned grade slopes and will therefore improve the stability of the inner gorge at the stream crossing. Therefore, it is my opinion that there is a low likelihood that the new road construction at this inner gorge crossing will cause or contribute to slope instability that will delivery sediment to the stream.



Image 1. The abandoned grade and inner gorge slopes west of the proposed stream crossing location. View facing south.



Image 2. The abandoned grade and inner gorge slopes at the proposed stream crossing location. View facing north.

7.0 FOREST PRACTICES RULE STATEMENTS

The following are the required Forest Practices Rule statements addressing WAC 222-10-030 (1) (a,b,c). These responses are based on the data and discussion presented above.

(a) The likelihood that the proposed forest practices will cause movement on the potentially unstable slopes or landforms, or contribute to further movement of a potentially unstable slope or landform.

In my opinion, the road construction has a low likelihood to cause movement on the inner gorge slopes. The engineered crossing will improve stability on this potentially unstable landform.

(b) The likelihood of delivery of sediment or debris to a public resource, or in a manner that would threaten public safety:

It is my opinion that this proposal will improve stability on the inner gorge slopes and therefore has a low likelihood of delivering sediment or debris to a public resource or in a manner that would threaten public safety.

(c) Any possible mitigation for the identified hazards and risks:

Road construction will utilize existing grades that appear to have been stable since their abandonment in aerial photos and field observations. In my opinion, this low-risk proposal requires no special mitigations beyond earthwork best management practices for erosion control.

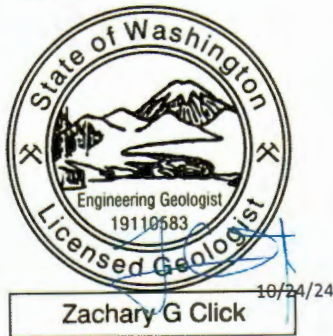
8.0 ASSESSMENT LIMITATIONS

This report documents potentially unstable landforms in and around the proposed West Fork Sorts timber sale to supplement the FPA to the Washington State Department of Natural Resources (DNR). I provide this information to describe the slope stability risk assessment conducted for this proposed harvest. This report is intended to satisfy the requirements of a Class IV-Special FPA. Mitigation recommendations presented in this report were developed collaboratively with DNR region staff. While forest management activities inherently involve risk, the mitigations presented in this report are intended to reduce adverse impacts to slope stability due to the proposed road construction and future scheduled road maintenance activities.

The conclusions presented in this report are based on professional judgement and do not guarantee slope stability or absolute absence of risk. In addition, conclusions were developed using office-based screening tools and surficial geologic observations at the locations visited, as they existed at the time of review. This review included shallow, hand-dug test pits and geologic exposures in the area reviewed but does not include deeper subsurface exploration such as borehole drilling. Actual geologic conditions may differ from those presented in this memorandum. Site conditions can change with time and additional relevant information may

become available. If this occurs, geologic interpretations and recommendations may require modification. It is not possible to fully define the geologic conditions of the site based on this limited investigation; however, the work was performed using accepted practices in the field of engineering geology in the region at the time of this memorandum. It is not possible to predict slope movement with certainty with the available scientific knowledge.

Do not rely on the interpretations or conclusions presented in this report for any activities other than those evaluated for the proposed West Fork Sorts timber sale. If any changes in the proposed timber sale or road plan are formulated or carried out differently in the field than what was evaluated, the conclusions and recommendations shall not be considered valid unless those changes are reviewed in writing by the author. No one other than the DNR, other departments with regulatory authority over this FPA, or tribal partners should rely on this report.



Zach Click, LEG #19110583
State Lands Geologist

Appendix A

Geologist Qualifications

Zach Click has a Bachelor of Science Degree (2013) in environmental geology from Western Washington University in Bellingham, Washington. He conducted site characterizations, geotechnical engineering and slope stability assessments for public agencies and private entities from 2014 to 2023. Mr. Click has been employed by the Washington State Department of Natural Resources since September 2023. He is a Washington State Licensed Engineering Geologist (LEG #19110583) and meet the definition of a "qualified expert" as outlined in WAC 222-10-030(5).

UNITED STATES - CANADA BORDER














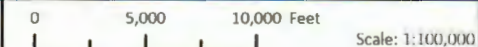
	West Fork Sorts Harvest Boundary		DNR-Managed Lands
	Watershed Administrative Unit (WAU)		Granted Trust Lands
	Major Stream		Survey - Township Lines
	Open Freshwater		Survey - Section Lines
	State Highway		City Limits (Census 2010)
	Summits		



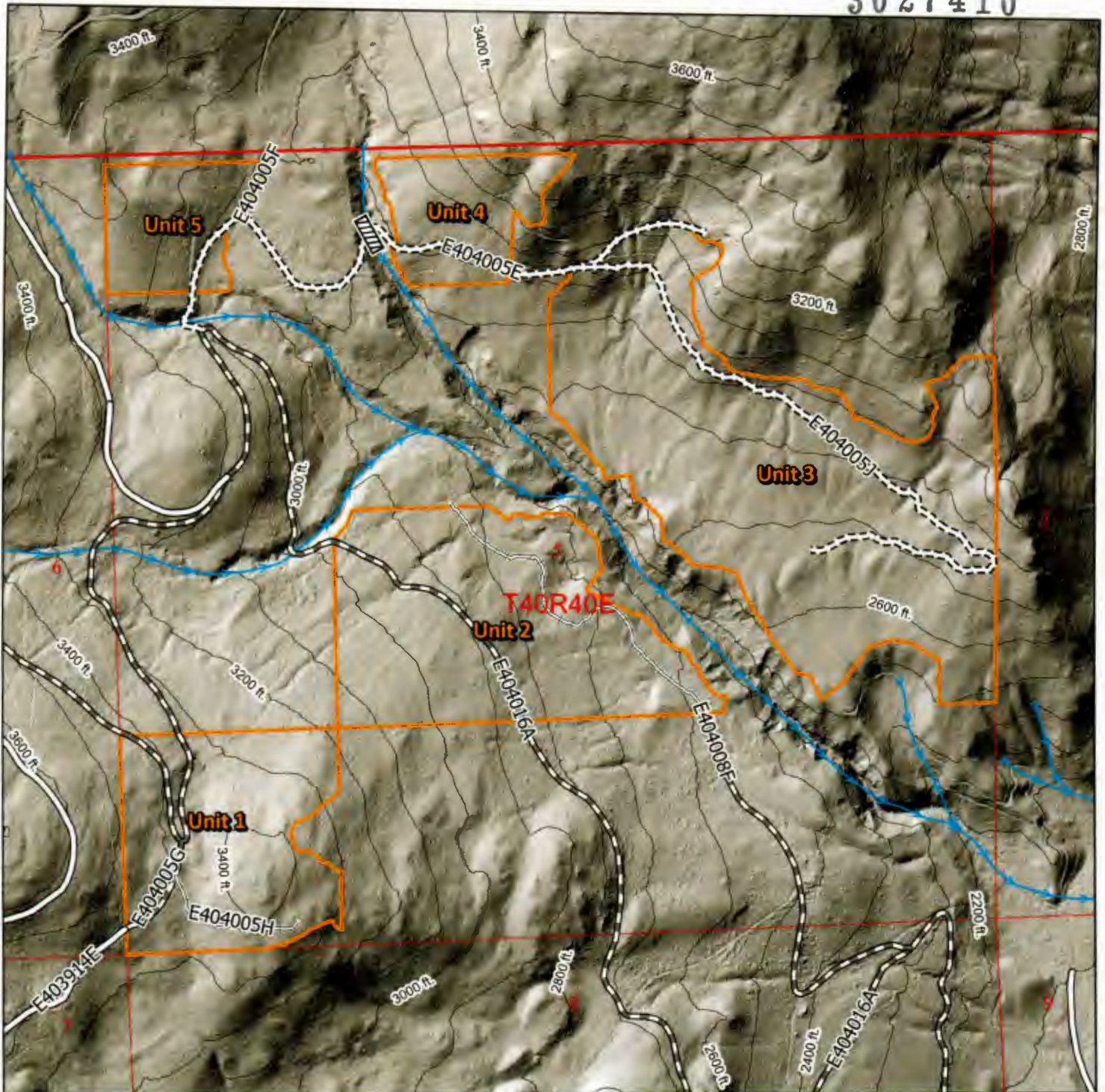
Fig. 1

VICINITY MAP
West Fork Sorts Timber Sale



Washington State Department of Natural Resources





- West Fork Sorts Harvest Boundary
- Typed Streams
- Road Construction Types**
- New Construction
- Reconstruction
- Required Pre-Haul Maintenance Easement Needed
- Existing Roads
- Culvert at IG Crossing
- Survey - Township Lines
- Survey - Section Lines

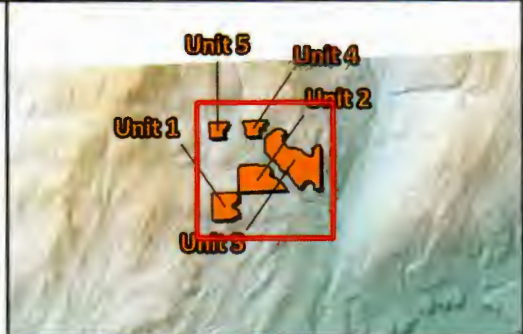
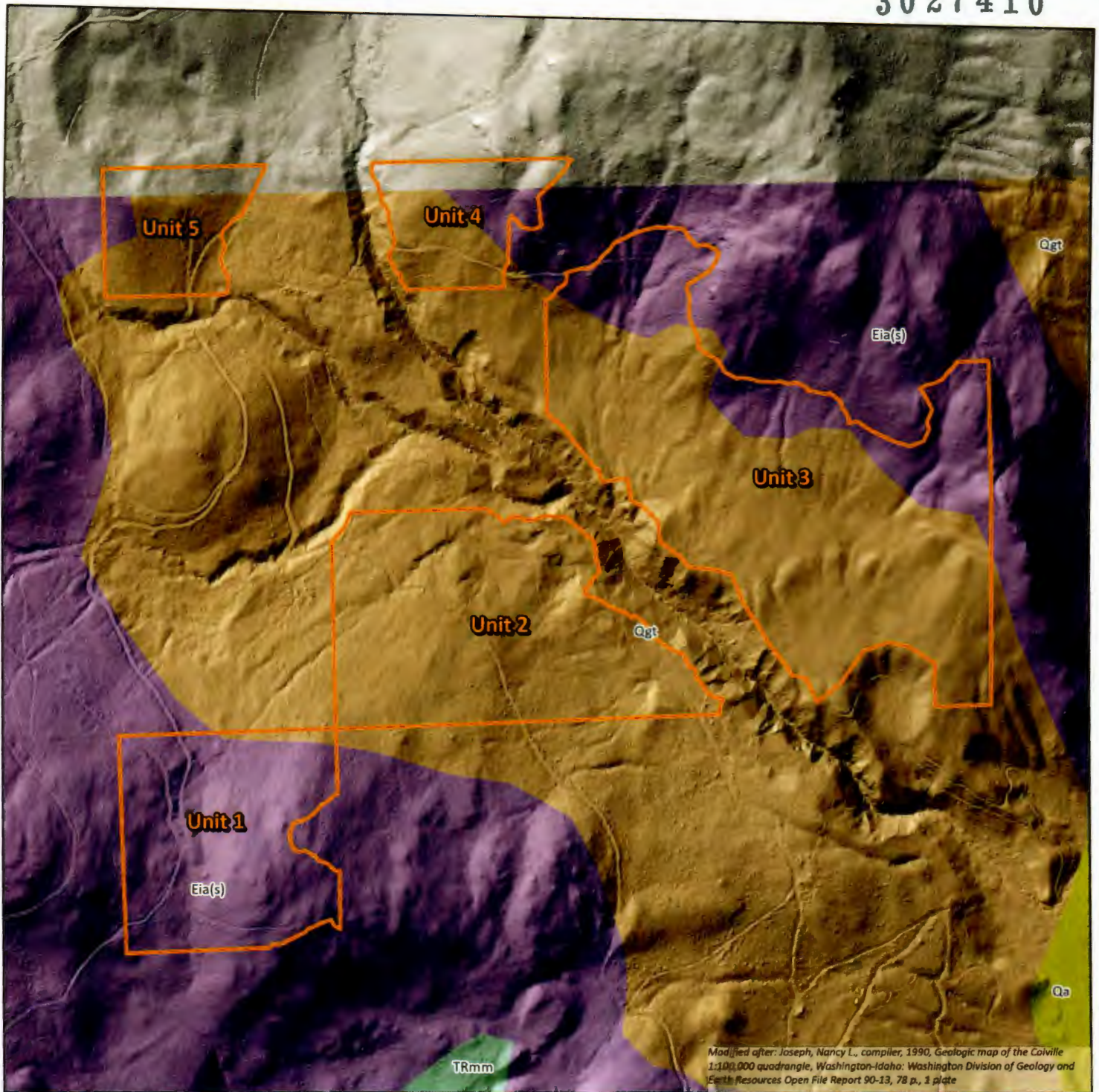


Fig. 2

SITE MAP
West Fork Sorts Timber Sale

0 520 1,000 Feet Scale: 1:10,000

Washington State Department of Natural Resources



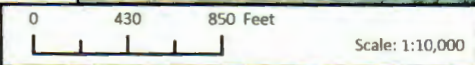
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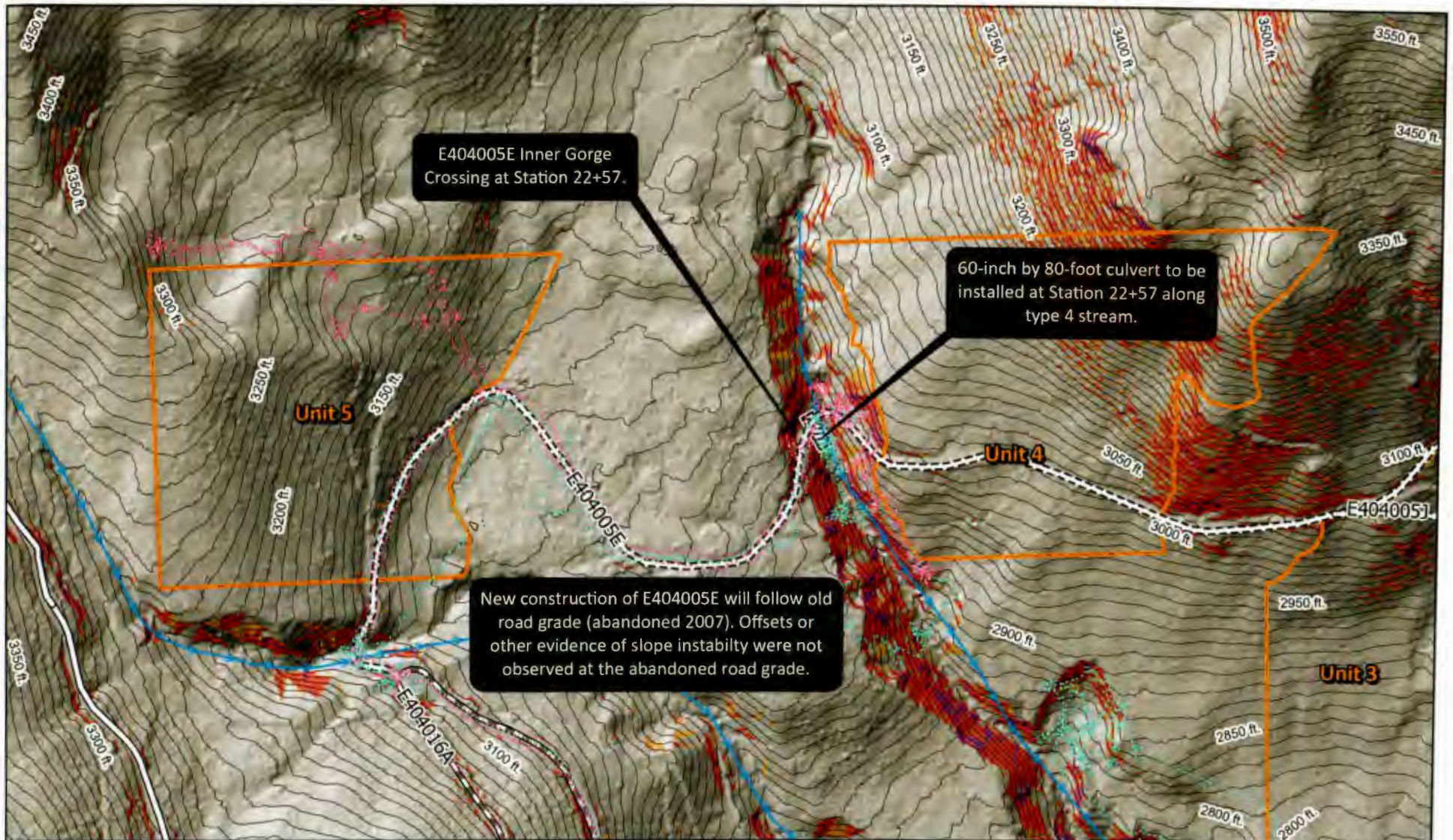
- West Fork Sorts Harvest Boundary
- 1:100,000 Geologic Units**
- Eia(s), acidic (felsic) intrusive rocks
- Qa, alluvium
- Qgt, continental glacial till, Fraser-age
- TRmm, marine metasedimentary rocks



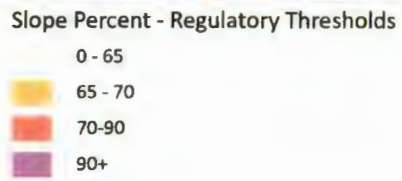
Fig. 3

1:100,000 GEOLOGIC MAP
West Fork Sorts Timber Sale





- West Fork Sorts Harvest Boundary
- Y Typed Streams
- Y Geologist Tracks - Zach Click
- Y Geologist Tracks - Greg Morrow
- New Construction
- Pre-Haul Maintenance
- Existing Roads
- Culvert



Road Construction Types

- New Construction



Fig. 4

GEOMORPHOLOGY MAP
West Fork Sorts Timber Sale



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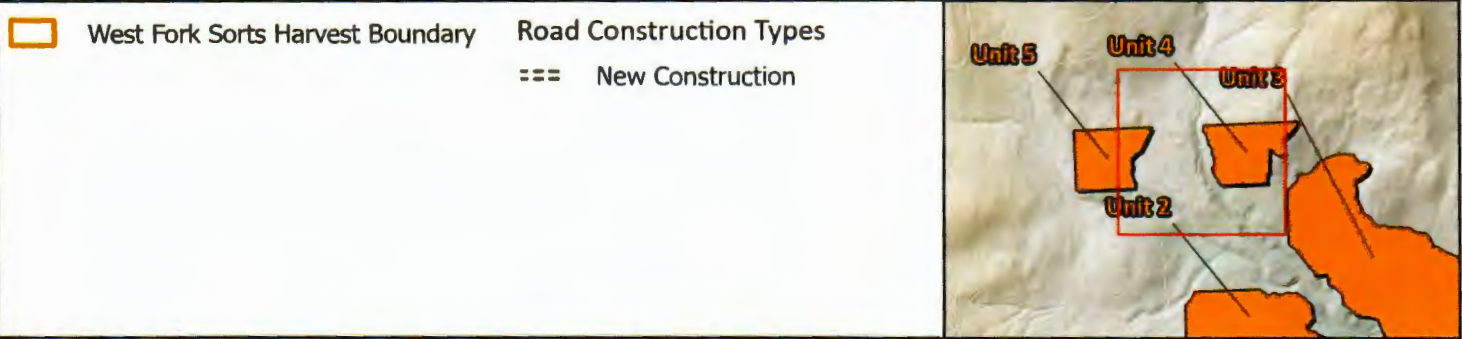
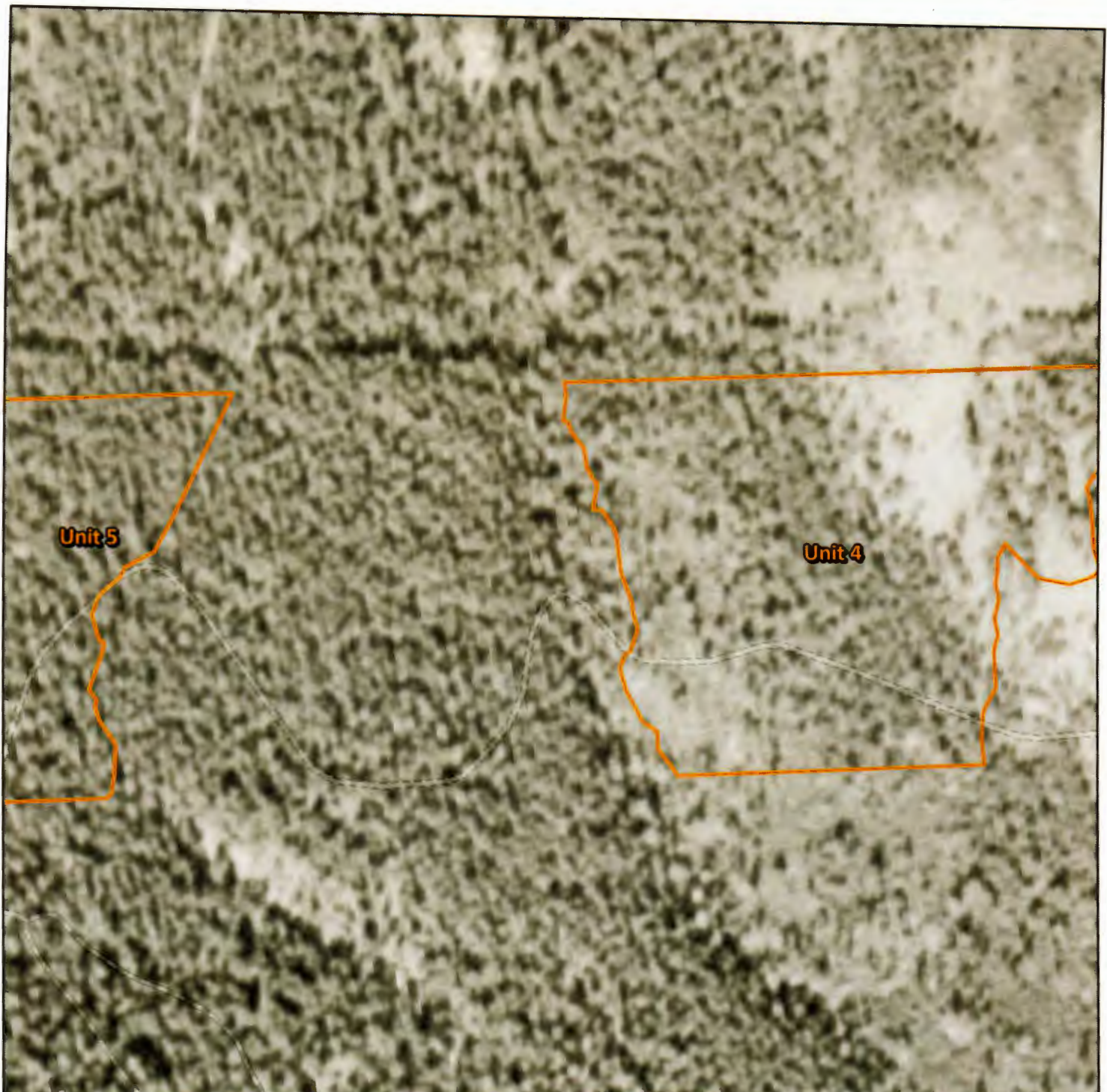
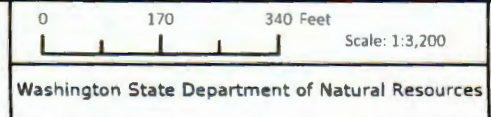
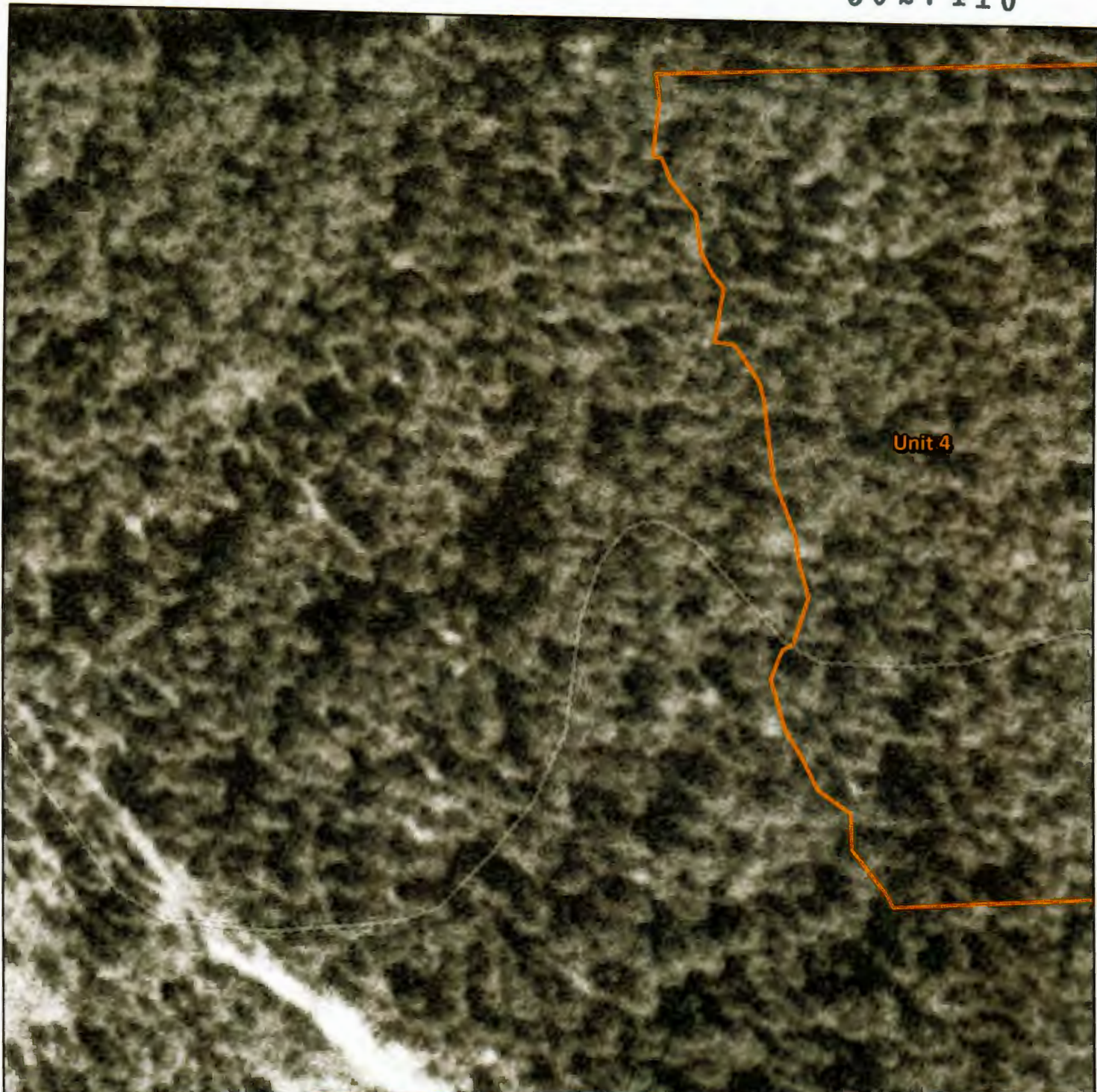


Fig. 5

1953 AERIAL PHOTO
West Fork Sorts Timber Sale





Unit 4

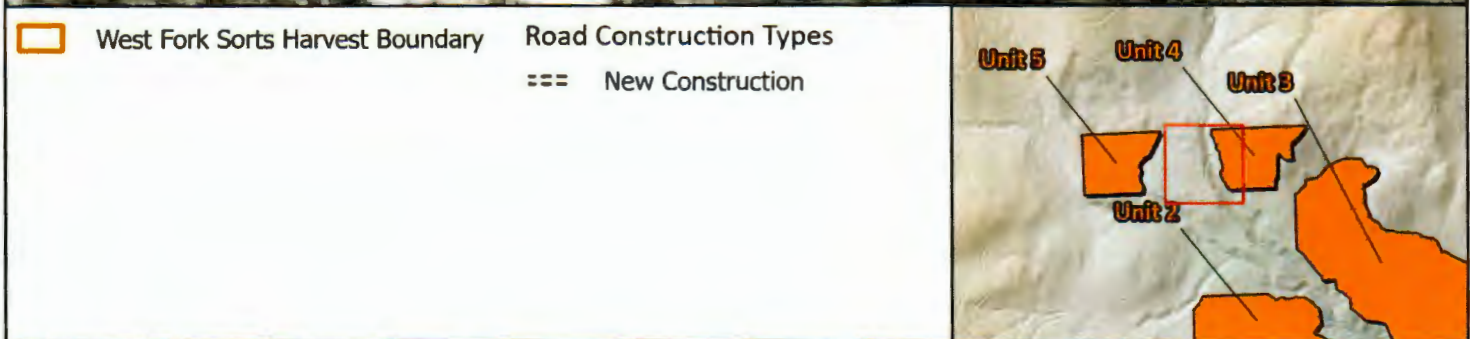
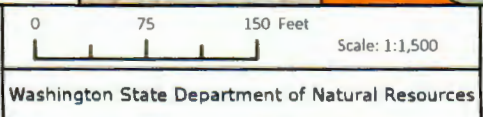
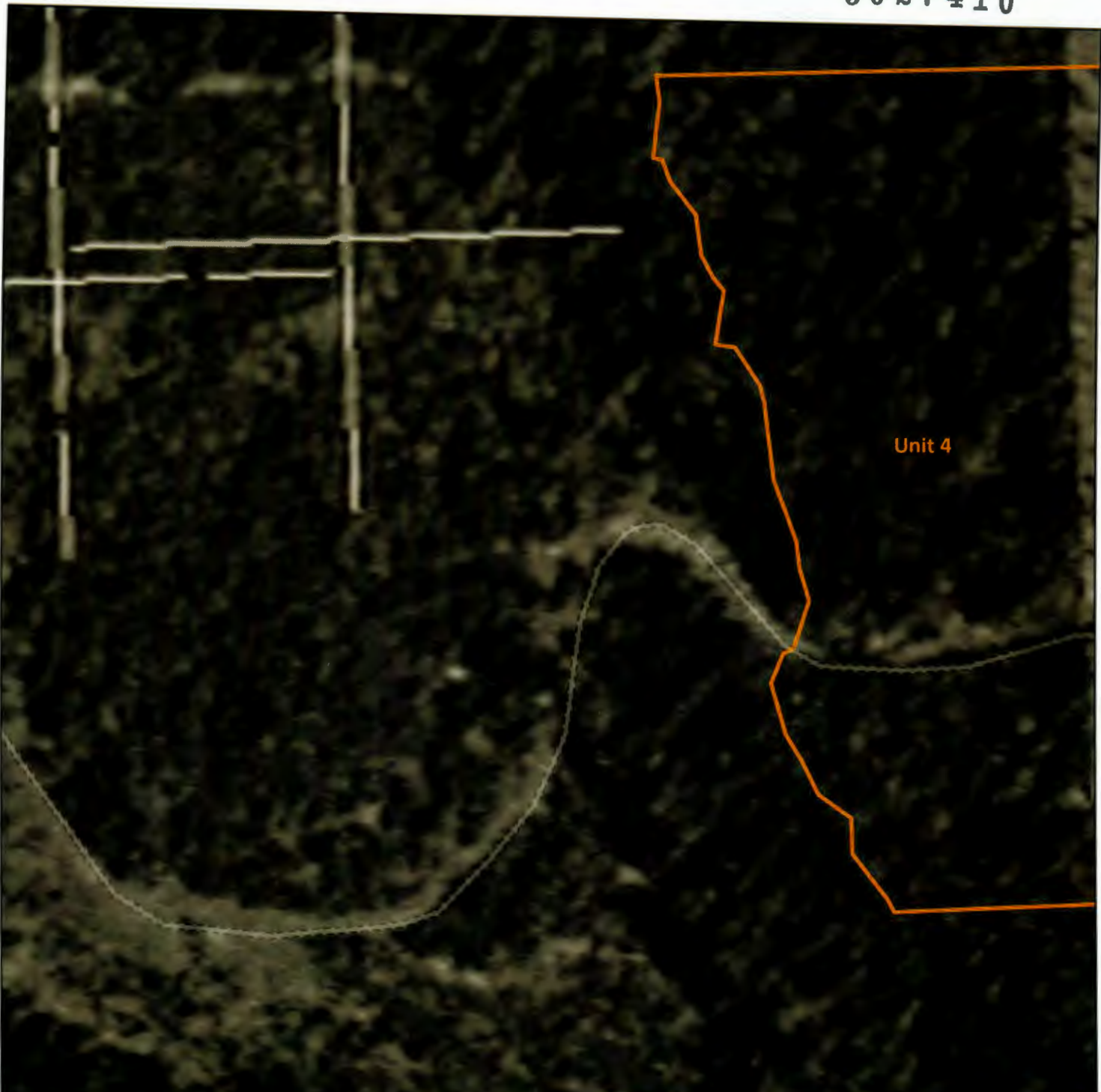


Fig. 6

1965 AERIAL PHOTO
West Fork Sorts Timber Sale






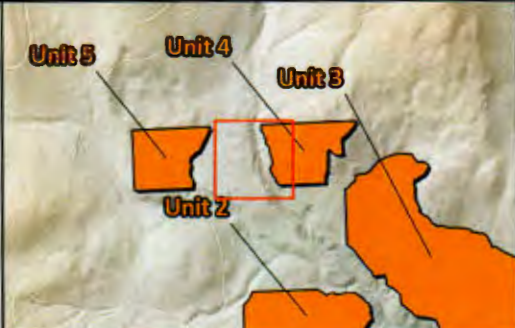
<p> West Fork Sorts Harvest Boundary</p>	<p>Road Construction Types --- New Construction</p>	
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Fig. 7

1990-2000 ORTHOPHOTOGRAPH
West Fork Sorts Timber Sale

0 75 150 Feet Scale: 1:1,500

Washington State Department of Natural Resources



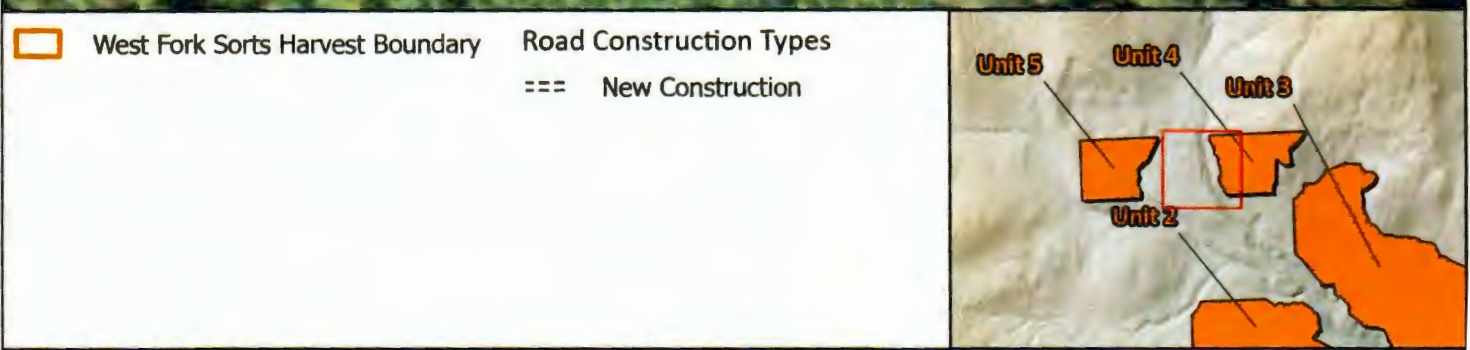


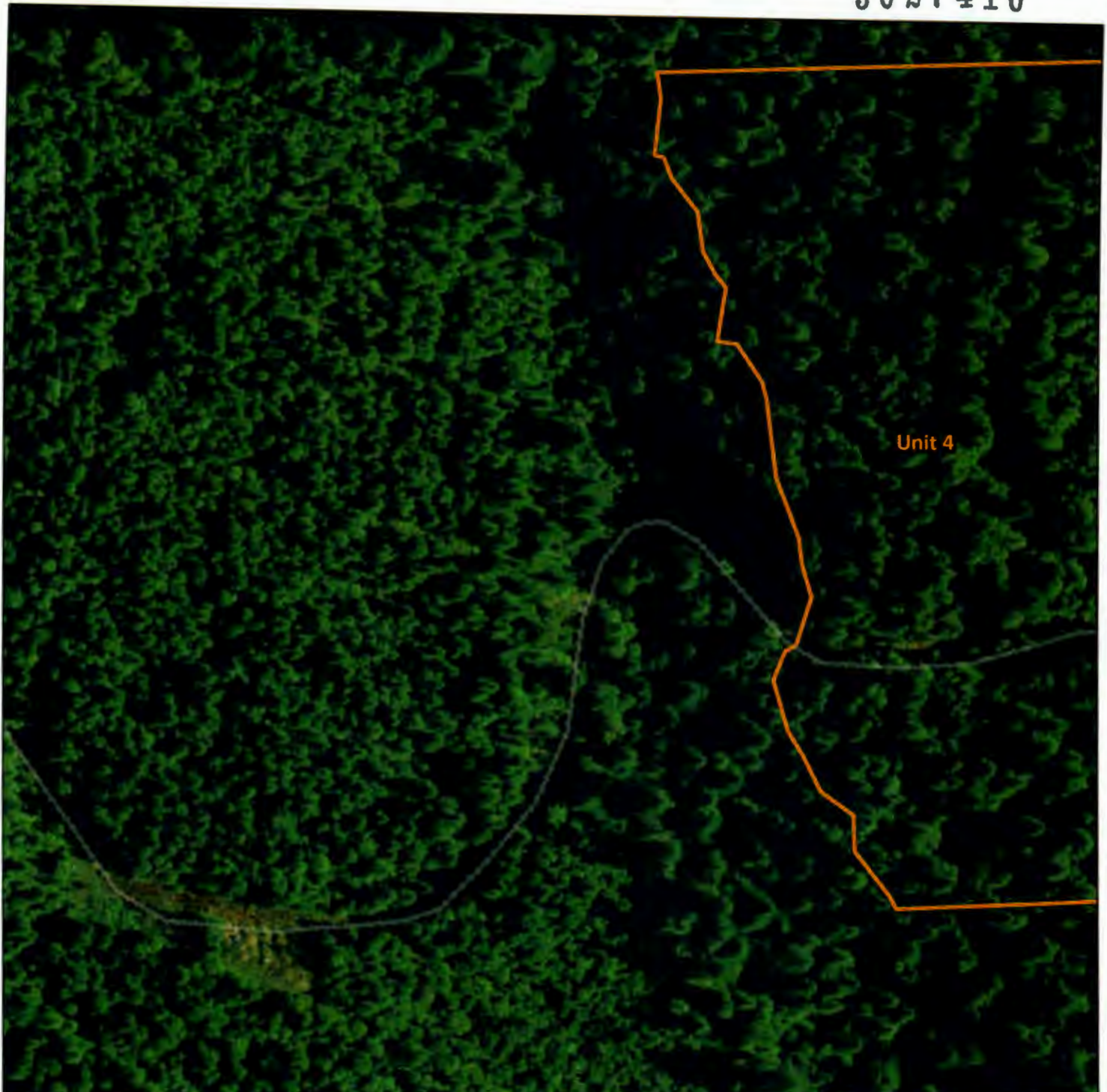
Fig. 8

2006 ORTHOPHOTOGRAPH
West Fork Sorts Timber Sale

0 75 150 Feet Scale: 1:1,500

Washington State Department of Natural Resources






 West Fork Sorts Harvest Boundary Road Construction Types
=== New Construction



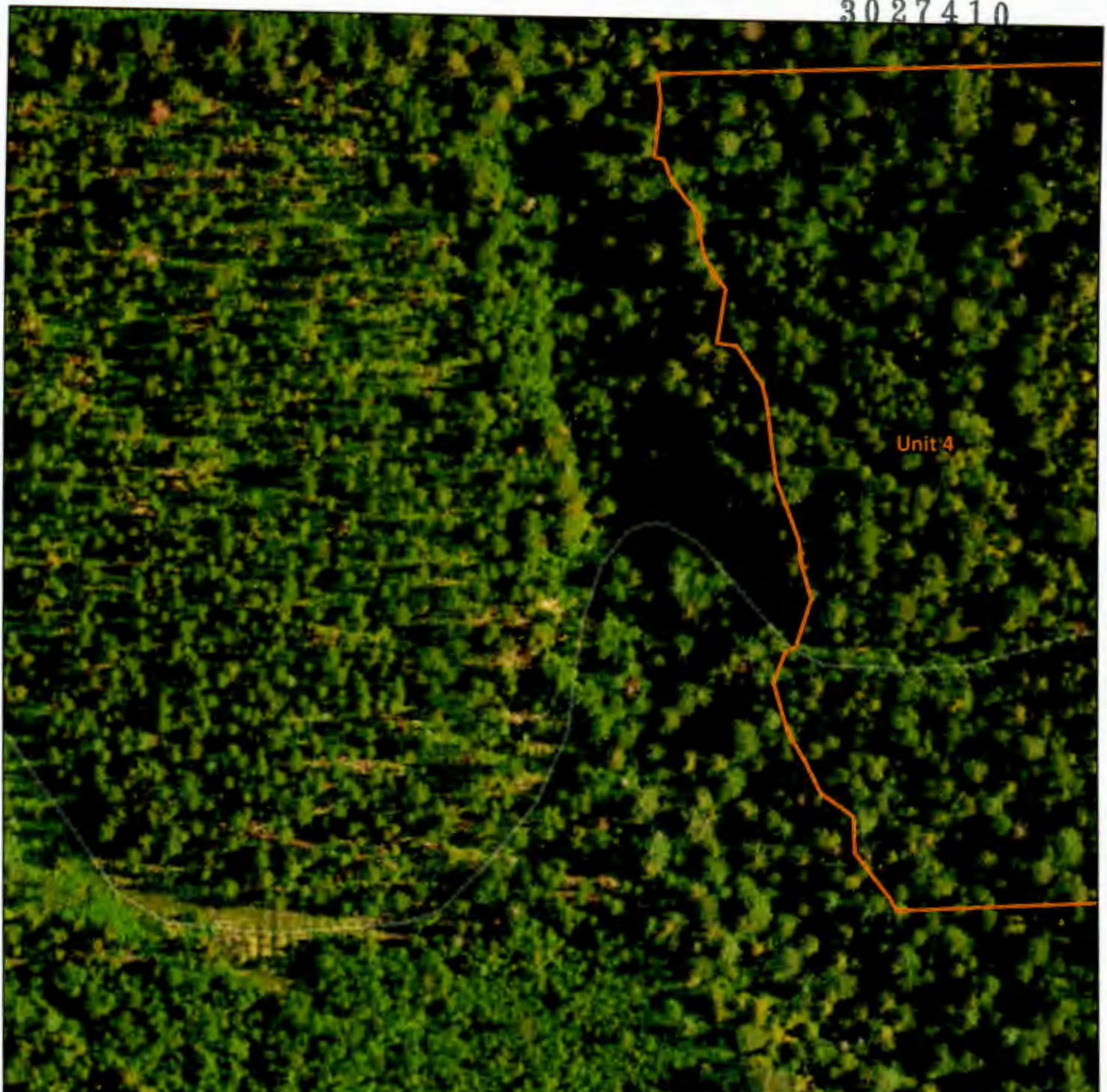
Fig. 9

2015 ORTHOPHOTOGRAPH
West Fork Sorts Timber Sale

0 75 150 Feet Scale: 1:1,500

Washington State Department of Natural Resources





West Fork Sorts Harvest Boundary
 Road Construction Types
 New Construction

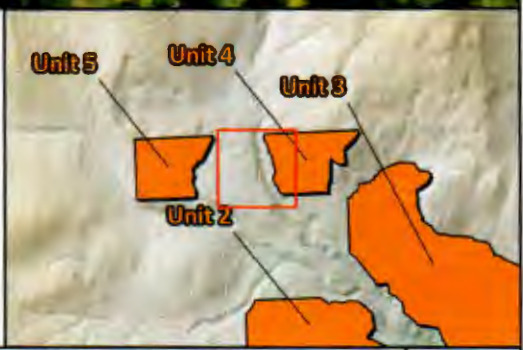
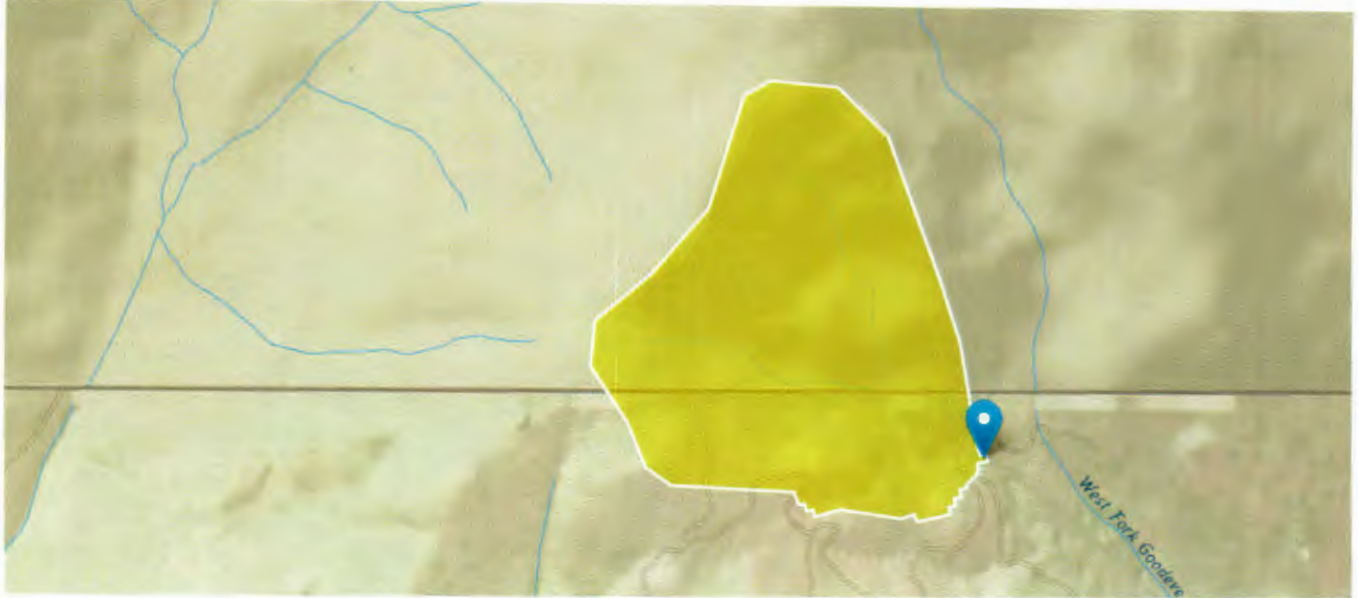


Fig. 10	2023 ORTHOPHOTOGRAPH West Fork Sorts Timber Sale	0 75 150 Feet Scale: 1:1,500	N
Washington State Department of Natural Resources			

StreamStats Report

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 Workspace ID: WA20241002212846062000
 Clicked Point (Latitude, Longitude): 48.99797, -117.75202
 Time: 2024-10-02 14:29:24 -0700



+ Collapse All

> Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
CANOPY_PCT	Percentage of drainage area covered by canopy as described in OK SIR 2009_5267	57.1	percent
DRNAREA	Area that drains to a point on a stream	0.79	square miles
PRECPRI10	Basin average mean annual precipitation for 1981 to 2010 from PRISM	34.5	inches

General Disclaimers

This watershed has been edited, computed flows and basin characteristics may not apply. For more information, submit a support request from the 'Help' button in the upper-right of the screen, attach a pdf of this report and request assistance from your local StreamStats regional representative.

> Peak-Flow Statistics

Peak-Flow Statistics Parameters [Peak Region 2 2016 5118]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.79	square miles	0.42	1330

REGION 2

Page 2 of 7

E404005E Sta. 0+75 Road Np Stream Culvert install

USGS Regression Equations - Washington State Region 2

SR: Date: 10/2/2024

Project: **west fork goodeve creek crossing E404005E station 0.75**

Made By: Gene Gibbs

Legend

Q = Flow (cfs)

A = Drainage Basin Area (miles²)

MAP = Mean Annual Precipitation (inches)

Limits(0.08 miles² ≤ A ≤ 1,540 miles²)

(23 in ≤ MAP ≤ 170 in)

Input Values Into Columns With Red Headings

Description of Area	Return Frequency	A	MAP	Q (cfs)	Qmetric (cms)
	2	0.79	34.5	15	0.43
	10	0.79	34.5	27	0.77
	25	0.79	34.5	33	0.94
	50	0.79	34.5	38	1.07
	100	0.79	34.5	42	1.18

Equations:

$$Q_{2yr} = 0.067 \times A^{0.866} \times (MAP)^{1.59} \quad (\text{Standard Error} = 61\%)$$

$$Q_{10yr} = 0.107 \times A^{0.861} \times (MAP)^{1.62} \quad (\text{Standard Error} = 58\%)$$

$$Q_{25yr} = 0.126 \times A^{0.859} \times (MAP)^{1.63} \quad (\text{Standard Error} = 58\%)$$

$$Q_{50yr} = 0.139 \times A^{0.857} \times (MAP)^{1.64} \quad (\text{Standard Error} = 59\%)$$

$$Q_{100yr} = 0.153 \times A^{0.856} \times (MAP)^{1.64} \quad (\text{Standard Error} = 60\%)$$

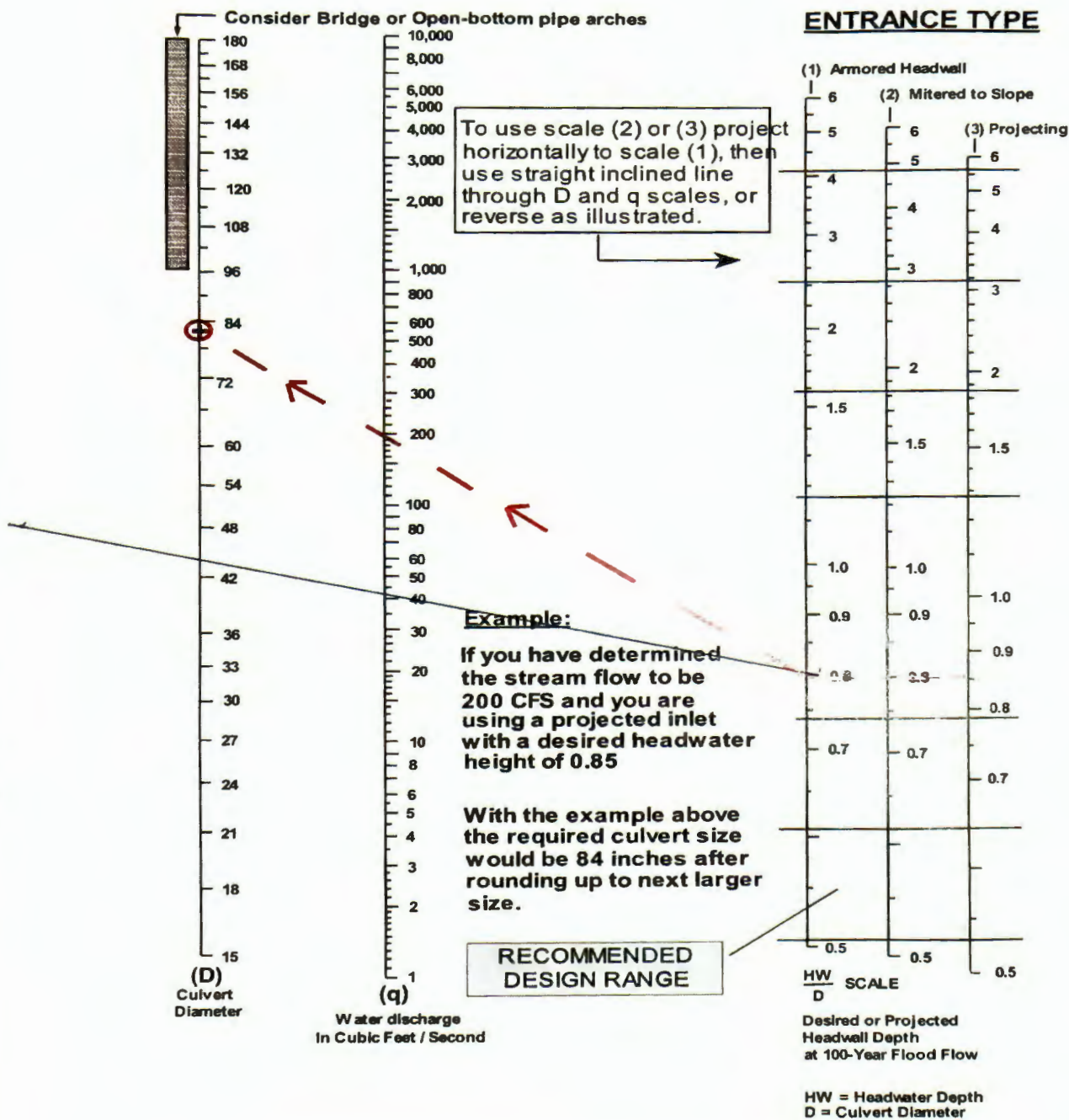
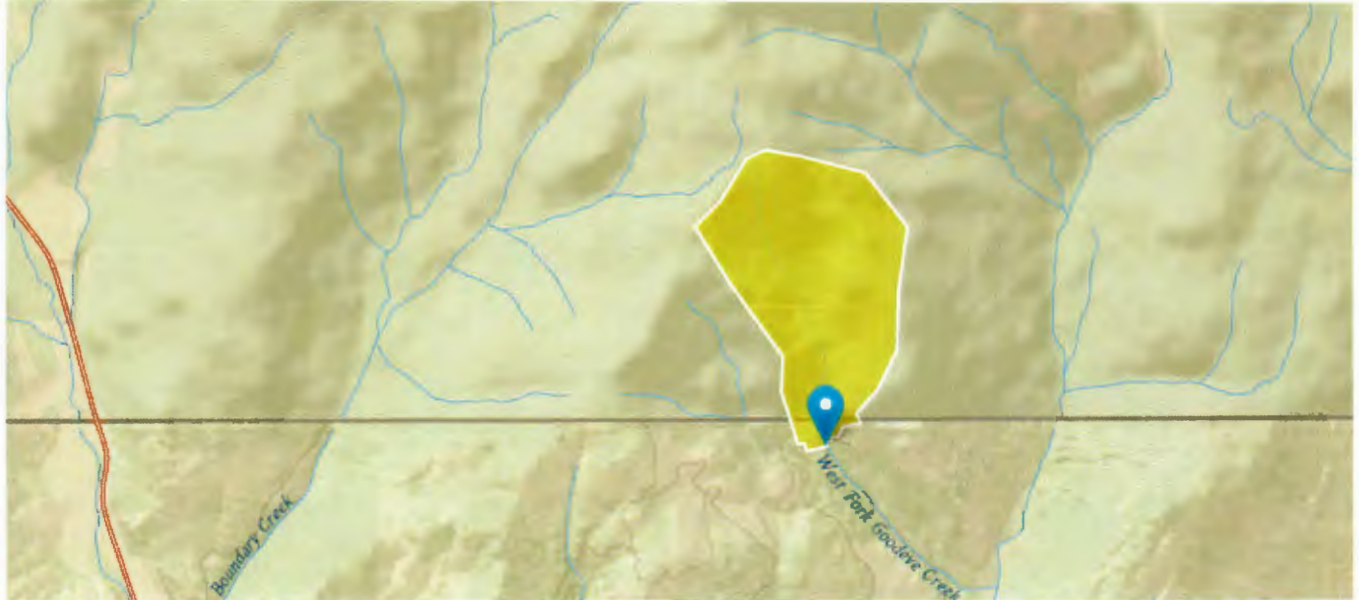


Figure 3.4 Nomograph for calculating sizes for round corrugated metal culvert pipe on Type N Waters.

E404005E 0+75

StreamStats Report

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 Workspace ID: WA20241002195337111000
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 Time: 2024-10-02 12:54:22 -0700



Collapse All

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	1.05	square miles

General Disclaimers

This watershed has been edited, computed flows and basin characteristics may not apply. For more information, submit a support request from the 'Help' button in the upper-right of the screen, attach a pdf of this report and request assistance from your local StreamStats regional representative.

Maximum Probable Flood Statistics

Maximum Probable Flood Statistics Parameters [4.0 Percent (0.0368 square miles) Crippen Bue Region 13]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	1.05	square miles	0.1	10000

Maximum Probable Flood Statistics Disclaimers [4.0 Percent (0.0368 square miles) Crippen Bue Region 13]

Weighted flows were not calculated. Users should be careful to evaluate the applicability of the provided estimates. Percentage of area falls outside where region is undefined. Whole estimates have been provided using available regional equations.

Maximum Probable Flood Statistics Flow Report [4.0 Percent (0.0368 square miles) Crippen Bue Region 13]

Statistic	Value	Unit
Maximum Flood Crippen Bue Regional	6090	ft^3/s

Maximum Probable Flood Statistics Citations

Crippen, J.R. and Bue, Conrad D.1977, Maximum Floodflows in the Conterminous United States, Geological Survey Water-Supply Paper 1887, 52p. (<https://pubs.usgs.gov/wsp/1887/report.pdf>)

USGS Data Disclaimer: Unless otherwise stated, all data, metadata and related materials are considered to satisfy the quality standards relative to the purpose for which the data were collected. Although these data and associated metadata have been reviewed for accuracy and completeness and approved for release by the U.S. Geological Survey (USGS), no warranty expressed or implied is made regarding the display or utility of the data for other purposes, nor on all computer systems, nor shall the act of distribution constitute any such warranty.

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Application Version: 4.24.0

StreamStats Services Version: 1.2.22

NSS Services Version: 2.2.1

REGION 2

E404005E Sta. 22+57 Road Np Stream Culvert install

SR: Date: 10/2/2024

Project: **west fork goodeve creek crossing E404005E station 22.57**
 Made By: Gene Gibbs

Legend

Limits

Q = Flow (cfs)

A = Drainage Basin Area (miles²)

MAP = Mean Annual Precipitation (inches)

(0.08 miles² ≤ A ≤ 1,540 miles²)

(23 in ≤ MAP ≤ 170 in)

Input Values Into Columns With Red Headings

Description of Area	Return Frequency	A	MAP	Q (cfs)	Qmetric (cms)
	2	1.05	33	18	0.51
	10	1.05	33	32	0.91
	25	1.05	33	39	1.11
	50	1.05	33	45	1.27
	100	1.05	33	49	1.40

Equations:

$$Q_{2yr} = 0.067 \times A^{0.866} \times (MAP)^{1.59} \quad (\text{Standard Error} = 61\%)$$

$$Q_{10yr} = 0.107 \times A^{0.861} \times (MAP)^{1.62} \quad (\text{Standard Error} = 58\%)$$

$$Q_{25yr} = 0.126 \times A^{0.859} \times (MAP)^{1.63} \quad (\text{Standard Error} = 58\%)$$

$$Q_{50yr} = 0.139 \times A^{0.857} \times (MAP)^{1.64} \quad (\text{Standard Error} = 59\%)$$

$$Q_{100yr} = 0.153 \times A^{0.856} \times (MAP)^{1.64} \quad (\text{Standard Error} = 60\%)$$

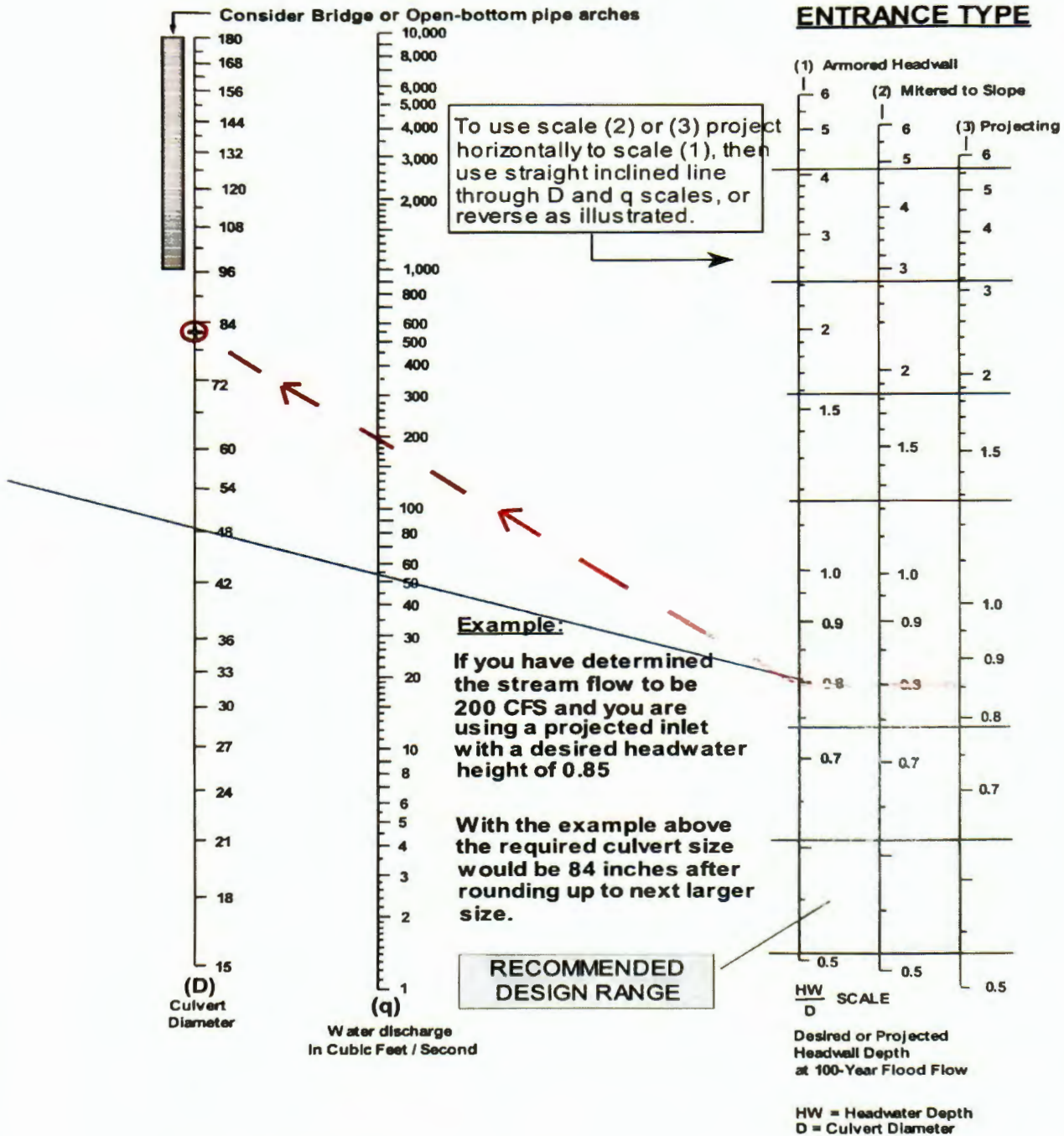


Figure 3.4 Nomograph for calculating sizes for round corrugated metal culvert pipe on Type N Waters.

E404005E 22+57