OR DOT 18(2) OR-58: FIX-IT CORRIDOR CULVERTS

HYDRAULICS REPORT

Prepared for:

U.S. Department of Transportation
Federal Highway Administration

Oregon Department of Transportation

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1 INTRODUCTION

The OR DOT 18(2) OR-58: Fix-It Corridor Culverts Project (Project) is a partnership between the Western Federal Lands Highway Division (WFLHD) of the Federal Highway Administration (FHWA) and the Oregon Department of Transportation (ODOT). The Project proposes to repair or replace existing culverts on Oregon Route 58 (OR-58) beginning at approximate mile point (MP) 2.73 and ending at MP 84.97 that are rated as being in "Poor" or "Critical" condition in ODOT's Drainage Facility Management System (DFMS). ODOT has identified 102 culverts that are either in poor or critical condition. Culvert issues range from rusted out inverts, open joints, general barrel damage to complete collapse of the structure. ODOT has previously addressed condition issues of 5 culverts (D028003, D028017, D028027, D028029, and D034755) leaving 97 culverts to be addressed within the Project.

OR-58 is designated as an ODOT priority route. The purpose of the Project is to "harden" the corridor by repairing or replacing these culverts within an overall corridor allocation of funding. The goal of the Project is to manage these funds as efficiently as possible by targeting the most appropriate option for extending the useful life of each culvert and thereby stretching the funding to meet the need for correcting all poor or critical condition culverts in the corridor.

1.1 PROJECT LOCATION

The Project is located in Lane County and Klamath County, Oregon. The Project begins on OR-58 at approximately MP 2.73, Global Positioning System (GPS) coordinates 43° 58' 43.61" North, 122° 57' 42.46" West. The Project ends at approximately MP 84.97, GPS coordinates 43° 20' 46.34" North, 121° 46' 16.13" West. Figure 1 provides a Project location and vicinity map.

1.2 SCOPE OF WORK

WSP USA (WSP) was contracted to provide engineering and environmental services for the design of the repair or replacement of 97 culverts on OR-58. However, 43 culverts were removed from the scope of the work due to insufficient funding.. Thus, this final phase includes the design of total of 54 culverts.

Tasks for final phase includes:

- Updating hydrology and hydraulic (H&H) analysis from the intermediate phase and updating culvert and channel designs per ODOT design requirements
- Updating cost estimates
- Finalizing Area of Potential Effect (APE)
- Designing the culvert at MP 15.51 to meet Oregon Department of Fish and Wildlife (ODFW) fish passage requirements and ODOT hydraulic design requirements
- Summarizing known potential work zone traffic issues in the corridor during construction
- Updating this Hydraulics Report to incorporate final culverts and channel designs

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Figure 1: Project Location and Vicinity

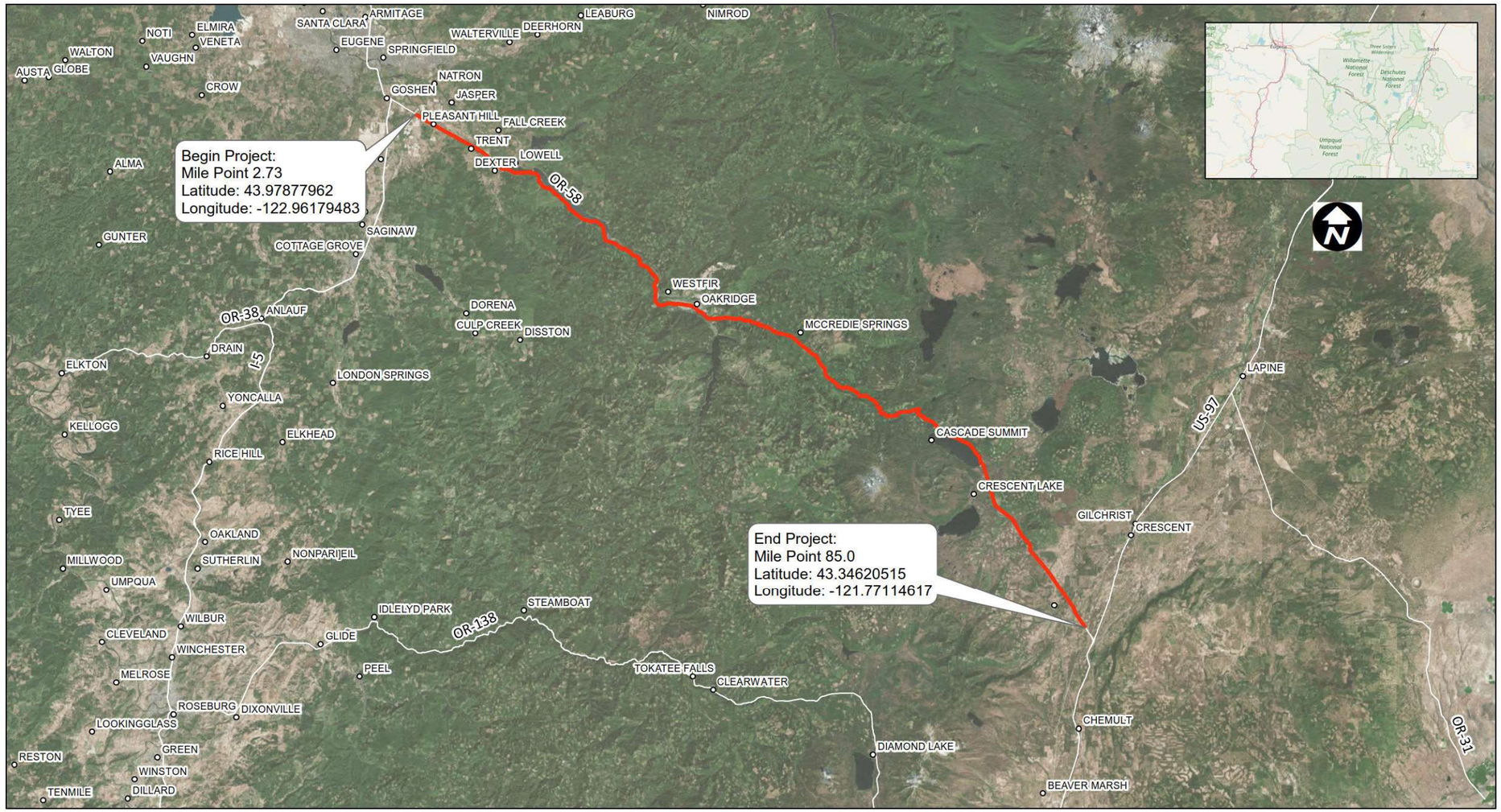

Figure 1: Project Location

Federal Highway Administration/
Western Federal Lands Division

Oregon Department of Transportation

OR-58 Fix-It Corridor Culverts

0 4 8 16 Miles

wsp

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2 PROJECT GOALS AND OBJECTIVES

The primary goals of the Project are as follows:

- "Harden" the corridor – increase resiliency by addressing culvert deficiencies because OR-58 provides a lifeline route between Interstate 5 and US 97
- Stretch the available funding to provide the most benefit to the most culverts as possible
- Be cognizant of and minimize mobility impacts associated with culvert replacement construction
- Address fish passage requirements outlined by the ODFW and included in the ODOT Culvert Repair Programmatic Agreement Pilot Project (Programmatic Agreement), dated December 8, 2017
- Coordinate timing of culvert repair or replacement with adjacent, separate projects, including a bridge project

2.1 PROJECT REQUIREMENTS

The Project will repair or replace existing culverts based upon the results of the field scoping effort conducted by WFLHD and WSP in November 2018, supplemented by ODOT's previous condition assessment efforts. The minimum allowable pipe diameter for replaced culverts is 18 inches.

The Programmatic Agreement between ODOT and ODFW applies when repair action constitute a "trigger event" under ODFW's Fish Passage Policy. Trigger events include (ODFW 2019):

- Creating a road which crosses a channel
- Widening the road footprint within a channel
- Filling or excavating at least 50 percent of the material directly above a culvert, unless this volume is exclusively composed of the top 1 foot of material
- Constructing of a new culvert, overflow pipe, apron, or wingwall, within the channel
- Widening/extending of a culvert, wingwall or apron
- Cumulatively through time making repairs or patches to over 50 percent of the culvert's linear length.
- Replacing any part of a culvert except for culvert ends that have become misaligned or eroded and which are replaced to their original configuration.
- Any reduction to the inside perimeter of the culvert
- Making any replacements, modifications, patches, repairs to the existing culvert that are different to the original configuration and which reduces the level of fish passage by native migratory fish

The Programmatic Agreement allows certain types of repair actions including:

- Strip lining
- Spot and localized repairs
- Spray on coatings
- Cured in place technologies
- Spiral wound lining
- Paving inverts
- Adding or extending end treatments
- Replacing one to three segments of the interior sections of a culvert
- Replacing road pavement and subbase above culverts.

Fish passage improvements include, but are not limited to, weirs, baffles, fish rocks, roughened channels, rock weirs, or other treatments within or outside the culvert that decrease water velocities, increase water depths, or reduce jump heights. Options

such as stream alignment changes, embankment repair and scour fixes cannot be standalone projects. These options are only eligible if structural repair is required at the culvert.

Any proposed culvert replacement within a fish stream requires full compliance with ODFW's fish passage policy.

2.2 DESIGN CRITERIA

The primary design manual for H&H design is the ODOT Hydraulics Manual (ODOT 2014). Additionally, the Programmatic Agreement was used to determine recommended fish passage design standards.

2.2.1 HYDROLOGIC METHODS

Three methods were used to determine peak flows from the drainage basins. The rational method was used to determine peak flows for non-stream drainage basins less than 200 acres. The United States Geologic Service (USGS) multiple regression equations were used for basins with stream or creek crossings. The Natural Resources Conservation Service (NRCS) TR-55 methodology was used for non-stream basins greater than 200 acres.

The Project is located within intensity-duration-recurrence interval (IDR) curves zones 3, 5, 8, 9 and 10. The 10-, 50-, and 100-year, 24-hour peak rainfall intensity was interpolated from the ODOT IDR curves in Chapter 7, Appendix A of the ODOT Hydraulics Manual.

For stream crossings, the 10-, 50-, and 100- year peak discharges were determined using the most recent USGS multiple regression equations.

2.2.2 HYDRAULICS

Culverts have been designed to safely pass the 50-year, 24-hour storm event and were checked for overtopping using the 100-year, 24-hour storm event. The selected culvert sizes should range in 6-inch increments from 18 to 120 inches in diameter.

The maximum allowable headwater-to-depth (Hw/D) ratio is 1.25 during the 50-year, 24-hour storm event. Higher Hw/D ratios may be allowed if the embankment is determined to be stable and existing conditions warrant a larger ratio (ODOT 2014) with no potential flooding of upstream properties. In these cases, a seepage collar should be considered. The maximum allowable Hw/D during the 100-year, 24-hour storm event should be limited to between 3.00 and 5.00. For new culverts, the maximum 50-year Hw elevation allowed is the bottom of the roadway aggregate base layer. The maximum allowed 50-year Hw elevation for existing culverts is the hinge point of the local roadway low point (i.e., no spread of stormwater onto the roadway is allowed).

The minimum allowable diameter for new culverts is 18 inches. For culverts used as cross-drains to carry away intermittent roadside ditch water, the minimum pipe slope should be 0.5 percent and whenever possible, it should not be flatter than 2 percent. Where practical, the pipe slope should equal or exceed the roadside ditch grade. The maximum slope should not exceed 10 percent for concrete pipe, or 25 percent for metal pipes, without using pipe anchors.

3 EXISTING CONDITIONS

3.1 CULVERT INSPECTION AND CONDITION ASSESSMENT

WSP, WFLHD, and SWCA Environmental Consultants (SWCA) conducted a condition visual assessment of the existing culverts in November 2018. No video inspections or measurement of wall thicknesses were completed during the visual assessment. The most frequent condition issues observed by the team were:

- Failing embankment or culvert covered with embankment due to scour
  - Scour

- Corrosion
- Deformation
- Joint displacement

A summary of the ODOT-provided condition assessment as well as WSP inspection notes are provided in Appendix A. Photographs from the inspection were provided in the file "OR58_FixIt_Culverts_Photolog.kmz". Two culverts (MP 46.75, MP 64.62) and the outlets of additional four culverts (MP 11.75, MP 61.71, MP 66.61, MP 84.97 were not located during the site reconnaissance.

3.2 TOPOGRAPHY

The Project is generally located within the Willamette Valley, Cascades, and Eastern Cascades Slopes and Foothills ecoregions. The Project is located within the following watersheds as delineated by the USGS National Hydrography Dataset (USGS 2019b):

- Lower Coast Fork Willamette River
- Pudding Creek – Middle Fork Willamette River
- Lookout Point Lake – Middle Fork Willamette River
- Hills Creek Lake – Middle Fork Willamette River
- Salt Creek
- Browns Creek – Deschutes River
- Crescent Creek

The topography varies throughout the Project limits ranging from flat areas generally on the west end of the Project with steeper rolling hills and mountains eastward to the Project limits. The roadway is constructed on both embankment and cut sections and is generally un-curbed with roadside ditches on either side.

The Dexter Lake and Lookout Point Reservoirs, U.S. Army of Corps of Engineers (USACE) flood reduction projects, are located north of the roadway alignment approximately between MPs 11.4 and 27.0. The dams at both these lakes impound the Middle Fork of the Willamette River. The USACE flood season is generally between November and March. The permanent pool elevation is restricted to 690 feet (USACE 2019) all year long.

3.3 DRAINAGE BASIN DELINEATION

The drainage basins of each of the Project culverts were delineated using two different sources of elevation and topographic data. The primary base data used in the analysis was Light Detection and Ranging (LiDAR). Sixty-three (63) of the 97 culverts were in locations where LiDAR data was available. The following 7.5-minute USGS quadrangle tiles with bare earth digital elevation models (DEM) were used in the analysis:

- Lane County (dated 2013-2014)
- Deschutes County (dated 2009-2010)
- Cascade Volcano Observatory (CVO) Newberry study area (dated 2011)
- United States Army Corps of Engineers Fall Creek (dated 2011)

LiDAR data was not available between MPs 41.2 and 60.8. The USGS topographic datasets in 40-foot elevation contours were used to delineate drainage basin boundaries for the culverts within these mile points. The USGS contours did not capture the road elevation along OR-58 nor were all drainage basin divides confidently determined from the dataset. This was especially true for cross culverts located close to each other.

The available LiDAR- and USGS-based basin maps were further refined using the following information:

- The USGS National Hydrography Dataset (USGS 2019b)
- WSP-digitized culvert locations, outside of the Project culverts, from the ODOT TransGIS website (ODOT 2019c).

The information obtained from topographic survey was used to refine basin boundaries to better reflect the available data and the field visit. Drainage basin maps are provided in Appendix B and a summary of drainage basin areas are provided in the respective hydrology results.

3.4 SOILS DATA

Soils data was obtained from the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Soil Survey. The NRCS Soil Survey dataset includes spatial delineations for various soil classifications, in addition to characteristics and properties for each soil classification. The available data for the Project indicated that soils are Hydrologic Soil Group (HSG) C, or soils with low to moderate infiltration rates and high runoff rates.

Data was available for non-forest land in Lane County (MPs 2–18 and 30–38); soil data was not available for the remaining portions of the Project corridor (MPs 18–30 and 38–85) that are located within Deschutes and Willamette National Forests. Based on review of available data for MPs 2 to 18 and 30 to 38, four culverts are located in mapped hydric soils (D028052, D028053, D028044, and D028041) and one culvert is located in soils mapped as prime farmland (, and D034723).Table 3-1 lists the general soil types that occur at culverts between MPs 2.0 and 18 and 30 and 38. Soil maps are provided in Appendix C.

Table 3-1: NRCS Soil Map Units

SOIL MAP UNITS	
Briedwell cobbly loam, 0 to 7 percent slopes	Hazelair silty clay loam, 7 to 20 percent slopes
Chehalis silty clay loam, occasionally flooded	Peavine silty clay loam, 30 to 60 percent slopes
Cumley silty clay loam, 2 to 20 percent slopes	Ritner cobbly silty clay loam, 30 to 60 percent slopes
Dupee silt loam, 3 to 20 percent slopes	Rock outcrop-Witzel complex, 10 to 70 percent slopes
Fluvents, nearly level	Salem-Urban land complex
Hazelair silty clay loam, 2 to 7 percent slopes	Salkum silty clay loam, 2 to 8 percent slopes

3.5 GENERALIZED LAND USE

Generalized existing land use were assigned based upon available 2016 aerial imagery and land use maps are provided as Appendix D. The selected generalized land use types used on the Project are summarized in Table 3-2.

Table 3-2: Selected Generalized Land Use Types

LAND USE
Gravel road
Improved land, 30% impervious
Improved land, 50% impervious
Open grass/swale
Open pasture
Paved road
Wetlands

Table 3-2: Selected Generalized Land Use Types

LAND USE
Woods – dense
Woods – light

3.6 RUNOFF COEFFICIENTS

ArcGIS was used to intersect the drainage basins with generalized land use to develop sub-basin hydrologic response units. Each hydrologic response unit was assigned a runoff coefficient based on the land use type. Area-weighted runoff coefficients were determined for each drainage basin using the response unit areas and assigned runoff coefficients.

Runoff coefficients used in hydrology analyses are summarized in Table 3-3 and were assigned using the general land use and the values summarized in Chapter 7, Appendix F, Table 1, of the ODOT Hydraulic Manual. Weighted runoff coefficients were calculated based upon basin area and are summarized in the appropriate hydrology section.

Table 3-3: Land Use and Runoff Coefficient

LAND USE	RUNOFF COEFFICIENT
Gravel roads	0.90
Improved land, 30% impervious	0.41
Improved land, 50% impervious	0.55
Open grass/swale	0.20
Open pasture	0.20
Paved road	0.90
Wetlands	0.90
Woods – dense	0.20
Woods – light	0.20

3.7 CURVE NUMBERS

ArcGIS was used to intersect the drainage basins, land use and NRCS soils datasets to develop sub-basin hydrologic response units. Each hydrologic response unit was assigned a curve number based on the land use type and hydrologic soil group classification combination. Area-weighted curve numbers were determined for each drainage basin using the response unit areas and assigned curve numbers.

Curve numbers used in hydrology analyses are summarized in Table 3-4 and were assigned using the general land use and the values summarized in the NRCS Technical Release 55 Urban Hydrology for Small Watersheds, Tables 2-2a, 2-2b, and 2-2c (NRCS, 1986). Weighted curve numbers were calculated based upon basin area and are summarized in the appropriate hydrology section. Curve numbers were assigned on existing land use and did not account for increasing imperviousness resulting from potential future development. Ten culverts were identified near existing private properties that have potential for future development and are subject to increased flow. All of them have Hw/D ratio less than or equal to 0.8, while five of them are flowing at less than half of the capacity.

Table 3-4: Land Use and Curve Numbers

LAND USE	HYDROLOGIC SOIL GROUP			
	A	B	C	D
Gravel road	98	98	98	98
Improved land, 30% impervious	57	72	81	86
Improved land, 50% impervious	69	80	86	89
Open grass/swale	39	61	74	80
Open pasture	39	61	74	80
Paved road	98	98	98	98
Wetlands	98	98	98	98
Woods – dense	30	55	70	77
Woods – light	36	60	73	79

4 HYDROLOGY ANALYSIS

WSP completed hydrology calculations using topographic survey data.

4.1 TIME OF CONCENTRATION

Due to the rural nature of the Project area, WSP used the NRCS Watershed Lag Method to estimate time of concentration. The Lag Method uses the average flow length, average watershed land slope and the curve number to calculate a travel time using the following equation:

$$L = 0.6T_c$$

where:
L = lag, h
T_c = time of concentration, h

$$L = \frac{\ell^{0.8}(S+1)^{0.7}}{1{,}900Y^{0.5}}$$ $L=0.6T_c$, yields:

$$T_c = \frac{\ell^{0.8}(S+1)^{0.7}}{1{,}140Y^{0.5}}$$

where:
L = lag, h
T_c = time of concentration, h
ℓ = flow length, ft
Y = average watershed land slope, %
S = maximum potential retention, in

$$= \frac{1{,}000}{cn'} - 10$$

where:
cn′ = the retardance factor

A summary of time of concentration calculations are provided in Appendix E.

4.2 BYPASS FLOW

Drainage basin boundaries are based upon readily available topography data in 10 to 40-foot contours as described in Section 3.3. Additionally, other, non-Project, culverts are located within the Project limits and their drainage areas were not specifically delineated nor were their hydraulic properties modeled. Bypass flow from these non-Project culverts was not quantified.

4.3 RATIONAL METHOD

The rational method was used to estimate the 10-year, 50-year and 100-year, 24-hour peak runoff rates from non-stream drainage areas less than 200 acres. A summary of the rational method results is provided in Appendix F.

4.4 REGRESSION EQUATION

West of MP 65.0 at stream crossings, the regression equations in the USGS Estimation of Peak Discharges for Rural, Unregulated Streams in Western Oregon (USGS 2005) was used. The Region 2A regression equations included in Table 11 in the USGS document (USGS 2005) were used for locations with mean elevations greater than 3,000 feet and the Region 2B regression equations included in Table 12 (USGS 2005) for locations less than 3,000 feet. Area and slope were determined using ArcGIS and LiDAR data as described in Section 3. The mean minimum and mean maximum January temperatures were determined using Figure 16 and Figure 17 in the USGS document (USGS 2005). The 2-year, 24-hour rainfall depth was determined using the Oregon 24-hour Precipitation Maps (ODOT 2019a). WSP estimated the 10-year, 50-year, and 100-year, 24-hour peak flow rates.

East of MP 65.0, WSP used the regression equations in the USGS Magnitude and Frequency of Floods in Eastern Oregon (USGS 1983). Channel length was determined using ArcGIS and LiDAR as described in Section 3. Mean annual precipitation was determined from Figure 2 of the USGS Magnitude and Frequency of Floods in Eastern Oregon (USGS 1983).

A summary of the regression equation results is provided in Appendix G.

4.5 NRCS TR-55 METHOD

The TR-55 Method, using the equations within HydroCAD, was used to determine the 10-year, 50-year, and 100-year peak runoff rates from culvert crossings with drainage areas larger than 200 acres. Basin areas were determined using ArcGIS and refined based on topographic survey data. Area-weighted curve numbers were assigned as described in Section 3.7. Time of concentration values were determined using the NRCS watershed lag method as described in Section 4.1. Type 1 and Type 1A Soil Conservation Service rainfall distributions were applied based on the NRCS Oregon Engineering Handbook, Appendix B (NRCS 1987). A summary of the TR-55 results is provided in Appendix H.

A summary of the peak runoff flow of all 54 culverts is provided in Appendix I.

5 HYDRAULIC ANALYSIS

Hydraulic calculations were completed using topographic survey data. HY-8, version 7.50 was used to estimate the Hw/D ratio during the 50-year and 100-year, 24-hour storm events for the existing pipe diameters. Pipe elevations and slopes were estimated using the topographic survey (refer to Section 3.3). WSP typically modeled trapezoidal channels to define the tailwater condition for each culvert crossing. Channel properties including bottom width, side slopes, and channel slope were estimated based upon survey data. Manning's n roughness of the downstream channel was selected based on land use and expedite hydraulic modeling using the values from the ODOT Hydraulic Manual. Table 5-1 provides a summary of the assigned Manning's n.

Table 5-1: Manning's Roughness Coefficient

CULVERT ID	CHANNEL MANNING'S N	CHANNEL DESCRIPTION
D028100	0.024	Downstream CMP pipe
D027990	0.024	CMP culvert cut in half
D034723,	0.100	Highway channel, grass, fair stand, length about 12 inches
D027832, D027833, D027842, D034741, D027992, D028041, D028044, D028045, D028050, D028052, D028086, D028090, D028091, D028094, D028095, D028137, D028159, D028160, D028161	0.050	Minor mountain streams, trees and branches along banks, bottom cobbles and few boulders
D028033, D028053, , D028071, D028074, D034765, D028076, D028077, D028078, D028082, D028107, D028108, D028109, D028124, D028128, D028142, D028163, D02186, D028238,	0.150	Streams on plain, very weedy reaches, floodways with heavy stand of timber and underbrush
D028051, D034764, D028088, D028127, D028130, D028131, D028132, D028139, D028158, , , D028273	0.200	Floodplain, trees, dense willows, summer, straight

D027828, D028047,	0.200	Natural channels and floodplains with dense, straight willows
D027825	Constant tail water elevation, Dexter Reservoir	

The initial hydraulic analysis assumed that the existing pipe was functional. WSP did not reduce the pipe capacity based upon existing conditions such as sedimentation, blockages, deformation or corrosion nor were initial culvert lining repair strategies modeled. Each result was compared to the maximum allowable design storm Hw/D. A second hydraulic model was run assuming the inlet and outlet were mitered end sections with paved end slopes per ODOT Standard Drawing RD320 if the existing culvert diameter had sufficient capacity (Hw/D < 1.25) and if it was not overtopping during the check storm. Culvert diameters were increased and remodeled in HY-8 to meet the maximum criteria allowed, also assuming mitered, paved end sections.

A summary of the existing and proposed hydraulic analysis is included as Appendix J.

6 WATER MANAGEMENT

During the in-water construction period of low flow summer and fall months (July through August), flows through culverts (creeks/ditches) will be bypassed around the work area. It is recommended that work occur during June through October within the streams identified as potentially fish bearing or waterways identified (field delineated) as streams by the wetland/waters ecologist working on the Project. Temporary water management is the control of flow and sediment from surface water and groundwater seepage during construction activities to be performed within bodies of water such as streams, creeks, rivers, wetlands, estuaries, or lakes. The plan for temporary water management (TWM) is to construct one or more temporary dams across the creek/ditch upstream from the work area. One or more pumps will pump flows into a bypass pipe or hose that is run over the construction area over the existing road pavement to an area in the existing channel downstream from the construction area. There, the water will be released back to its natural channel. A temporary dam will be constructed if needed, on the downstream side of the construction area. This dam will prevent fish from entering the construction site. Fish passage will be blocked throughout the construction period. The natural discharge estimates for the culverts that require TWM are obtained from USGS streamflow statistics and spatial analysis tools (available at: https://streamstats.usgs.gov/ss/) and are reported in Table 6-1.

Table 6-1 Temporary Water Management Discharge Table for Required Culverts

No.	DFI No.	Mile Post	AVERAGE DAILY DISCHARGE IN GALLONS PER MINUTE					
			JULY			AUGUST		
			1	2	3	1	2	3
1	D027828	MP 13.56	5.1	3.1	2.3	3.1	1.7	1.1
2	D027842	MP 15.51	26.9	16.2	11.9	16.1	8.7	5.8
3	D027853	MP 17.67	140.5	81.9	59.9	95.2	46.0	35.7
4	D028076	MP 41.91	112.6	65.7	48.1	76.3	36.9	28.6
5	D028078	MP 42.12	247.4	144.3	105.6	167.7	81.0	62.8
6	D028095	MP 44.06	58.8	34.3	25.1	39.9	19.3	14.9
7	D028102	MP 44.54	102.8	60.0	43.9	69.7	33.7	26.1
8	D028128	MP 47.07	26.7	15.6	11.4	18.1	8.7	6.8

9	D028132	MP 47.80	38.0	22.2	16.2	25.7	12.4	9.6
10	D028142	MP 50.30	80.5	47.0	34.3	54.6	26.3	20.4
11	D028160	MP 53.76	1497.1	1109.0	838.2	1053.5	812.2	613.2
12	D028189	MP 58.02	14093.9	10439.9	7891.4	9917.9	7645.7	5772.7
13	D028190	MP 58.16	990.9	734.0	554.8	697.3	537.6	405.9
4	D028238	MP 64.27	16757.5	12412.9	9382.7	11792.3	9090.6	6863.6
15	D028239	MP 64.60	936.5	693.7	524.4	659.0	508.0	383.6
16	D028240	MP 64.62	125.8	93.2	70.4	88.5	68.2	51.5
17	D028256	MP 66.61	51.8	38.3	29.0	36.4	28.1	21.2

Table 6-1 (continued)

No.	DFI No.	Mile Post	AVERAGE DAILY DISCHARGE IN GALLONS PER MINUTE					
			SEPTEMBER			OCTOBER		
			1	2	3	1	2	3
1	D027828	MP 13.56	4.2	1.7	0.9	13.1	2.4	1.0
2	D027842	MP 15.51	21.9	8.9	4.7	68.9	12.6	5.2
3	D027853	MP 17.67	74.5	49.2	35.7	176.4	102.2	59.4
4	D028076	MP 41.91	59.7	39.4	28.7	141.4	82.0	47.6
5	D028078	MP 42.12	131.1	86.6	62.9	310.6	180.0	104.6
6	D028095	MP 44.06	31.2	20.6	15.0	73.9	42.8	24.9
7	D028102	MP 44.54	54.5	36.0	26.2	129.1	74.8	43.5
8	D028128	MP 47.07	14.1	9.3	6.8	33.5	19.4	11.3
9	D028132	MP 47.80	20.1	13.3	9.7	47.7	27.6	16.1
10	D028142	MP 50.30	42.7	28.2	20.5	101.1	58.6	34.0
11	D028160	MP 53.76	812.2	574.1	427.3	854.6	642.5	492.5
12	D028189	MP 58.02	7645.7	5404.2	4022.4	8044.9	6049.0	4636.6
13	D028190	MP 58.16	537.6	380.0	282.8	565.6	425.3	326.0
14	D028238	MP 64.27	9090.6	6425.5	4782.6	9565.3	7192.2	5512.8
15	D028239	MP 64.60	508.0	359.1	267.3	534.6	401.9	308.1
16	D028240	MP 64.62	68.2	48.2	35.9	71.8	54.0	41.4
17	D028256	MP 66.61	28.1	19.9	14.8	29.6	22.2	17.0

1) 5 Percent Exceedance Discharge (Average daily discharge expected to be exceeded 2 days each month.)

2) 25 Percent Exceedance Discharge (Average daily discharge expected to be exceeded 8 days each month.)

3) 50 Percent Exceedance Discharge (Average daily discharge expected to be exceeded 16 days each month.)

In- water work period extends from 1 July through 31 October

Listed discharges are surface water from the upstream watershed. The estimated discharges are based on StreamStats. Discharges in the subject watershed may differ.

7 WATER QUALITY

Structural excavation and fill for culvert replacements will reconstruct the roadway from the subgrade. Per chapter 14 of the ODOT Hydraulics Manual (ODOT 2014), this is a water quality treatment trigger. Appendix K presents the reconstructed impervious areas for 29 culverts that impact wetland or water features.

OR-58 within the project limits is mostly uncurbed and surrounded by the Willamette, Deschutes and Umpqua national forests. The dense forests treat stormwater runoff by maintaining sheet flow and allowing dispersion, filtration and infiltration downstream of the culverts before reaching the receiving water bodies. Riprap at culvert outlets dissipate energy and spread the flow from culverts. Additional natural treatments are provided by vegetated roadside embankments and ditches.

A desktop study was performed to evaluate natural treatment in the project. Google Earth, photos from scoping site visit, and the project plan sets were used in the evaluation. Treatment downstream of a culvert is possible when sheet flow conditions occur (i.e., the road sheet flows to the outlet or the road slopes to the inlet but the culvert is not a stream culvert). Downstream treatment is not feasible when the road slopes to the inlet and the culvert is a stream culvert, because flow is confined to the channel. Treatment by upstream ditches is, therefore, evaluated for stream culverts that receive flow from the road. Ditches leading to culverts D028159 (MP 53.69) is partially vegetated and soil amendment is proposed to promote treatment. The amendment is 12 inches deep and done in areas 4 feet wide by 100 feet long. Summary of the visual evaluation, site photos, reconstructed pavement areas and locations of the natural treatment for each culvert are included in Appendix K. Totally, 0.25 acres of pavement is reconstructed, all of which is treated by natural dispersion, infiltration and filtration. Appendix K summarizes the geometry of the natural treatment areas, the receiving water bodies and length to the water body.

8 FISH PASSAGE DESIGN

Six culverts were identified as possible fish passage culverts. ODFW was consulted to determine current and historical fish presence and which of the culverts would require fish approval. Based on ODFW's determination, D027842 (MP 15.51) requires fish passage design. Culvert D028160 (MP 53.76) do not trigger the fish passage design requirements while MP 44.54 and MP 64.27 were exempt. Waivers were issued with mitigation required for D027828 and D028132.

The existing culvert D027842 (MP 15.51) is a 36-inch CMP for approximately 85 feet of the culvert length and changes to 48-inch CMP for the remaining half of the length. The outlet is perched above the ground line more than 2 feet and a large scour hole was observed on the downstream end. The outlet is deformed with significant damage to corrosion protection, rust and pitting. The culvert is, therefore, proposed to be replaced and designed for fish passage. ODOT Hydraulics Manual, HEC-26, and ODFW fish passage criteria were consulted for the fish passage design.

Besides the peak flow, fish passage designs incorporate minimum and maximum discharges for passage. The high passage flow (Q_H) and the low passage flow (Q_L) are taken as the 5% and 95% exceedance discharges, respectively. In-water work period for the project extends from July through October. The 5% discharge is needed for January, the wettest month. The 95% discharge is needed for October, the driest month outside of the in-water work period.

StreamStats (2021) was used to estimate the 5% and 95% exceedance discharges. The drainage area of 0.12 square miles is lower than the minimum recommended for the StreamStats regression equations. Therefore, discharges were obtained for a nearby Minnow Creek (within 0.5 miles of MP 15.51) and scaled down with the drainage area ratio. Q_H and Q_L for MP 15.51 are 2.79 cfs and 0.0 cfs, respectively. HY8 (v. 7.60) is used for the fish passage design and a value of 0.10 cfs is used for Q_L.

ODFW's preferred fish passage design method is the Stream Simulation method. In this method, fish passages should maintain average water depth and velocities that simulate the surrounding stream channel. The structures should have beds that are at least equal to the active stream channel width and composed of material gradation that maintains the bed structure.

The fish passage design elements are as follows:

- culvert basin area is 0.12 square miles,

- peak runoffs computed using USGS regression equations are 11.7 cfs, 20.0 cfs, 27.20 cfs, and 30.20 cfs for the 2-year, 10-year, 50-year and 100-year events,
- Q_L and Q_H are 0.10 cfs and 2.79 cfs, respectively
- the active channel width is approximately 7.0 ft.,
- the proposed culvert is an 8-foot diameter, 191-foot long CMP culvert with riprap headwall ,
- the culvert is on a 7.2% slope, similar to the natural stream channel,
- the invert would be buried 3.0 feet into the stream bottom,
- a series of sediment retention baffles inside the culvert, and
- the culvert is filled with 1 foot of streambed material and 2 feet of oversized bed layer to mimic the natural bed and to provide stability against bed mobility during peak flows.

The natural streambed is mainly composed of small cobbles and silt. D_{95} is approximately 5" for small cobble and the Fuller-Thompson method was used to estimate the stream bed gradation (HEC-26). Per HEC-26, the oversized bed layer is at least $1.5D_{95}$ resulting in D_{95} of 1.33 ft. D_5 should be no larger than 2 mm to limit interstitial flow. The oversized bed gradation was estimated using the Lagasse equation (HEC-26).

HY8 input and output data and details of the fish passage culvert are included in Appendix L.

A 0.5-foot triangular channel is provided within the stream bed to attain the minimum depth during Q_L. Depth of flow at Q_L is 0.52 ft and velocity at Q_H is 1.46 fps. These values are acceptable when compared to simulated existing values within the stream.

9 DESIGN SUMMARY AND NEXT STEPS

Hydrology and hydraulic analysis of all culverts is included in this report. The detailed plan and profile of each repair/replacement culvert along with summary of quantities can be found in construction drawings submitted in the final package. Improvement strategies for each culvert is summarized in Appendix J. The following is a list of recommendations for proposed culvert repair or replacement:

- Thirty-Eight (38) culverts are proposed for open-trench replacement because the existing pipe condition is critical, the capacity is insufficient for the hydrology estimates, and the depth of cover is less than 10 to 15 feet. However, only sections of the twenty (20) culverts will be replaced, outside the edge of pavement and the culvert will be lined. Only one (1) culvert is proposed for trenchless replacement.
- The inlets and outlets of replaced culverts will be improved with mitered, paved end slopes and riprap.
- Fifteen (15) culverts are proposed for repairs. Repairs include: adding inlet and outlet protection (e.g., paved end slopes and riprap); lining, either full or paving the invert; excavating and resetting pipe sections; grouting displaced joints; adding corrosion protection; scour repair; inlet ditch realignment, and improving the inlet and outlet with mitered, paved end sections and riprap.

- One (1) culvert was designed to meet ODFW fish passage requirements and ODOT hydraulic design requirements. Detailed fish passage design is included in Appendix L.
- Fifteen (15) culverts were TV inspected during this design in December 2020. This additional TV inspection, outside of the TV pre- and post-repair TV inspections completed during construction were summarized in a separate memo and submitted under independent cover.

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APPENDIX

A CONDITION ASSESSMENT

DFI	Culvert Condition	Mile Point	Inspection Date	Stream Name	Inlet Side	Orientation	Facility Usage	Inlet End Type	Outlet End Type	Inlet Ht. of Cover (ft.)	Outlet Ht. of Cover (ft.)	Culvert A Span (in)	Culvert A Rise (in)	Culvert A Length (ft.)	Culvert A Shape	Culvert A Material	Culvert B Span (in)	Culvert B Rise (in)	Culvert B Length (ft.)	Culvert B Shape	Culvert B Material	Inlet Bank Protection Material	Outlet Bank Protection Material	ODOT Inspector Comments
D034723	Poor	2.73	05/06/14		Right	Cross	Roadside Drainage	Drop Inlet	Mitered	2.2	3.5	12	12	77	Circular	HDPE Smooth Wall						Roadway Fill	Riprap	Pipe appears to be punched by guard rail post, see pic L.
D027793	Poor	6.92	05/07/14		Right	Cross	Roadside Drainage	Mitered Slope Paved	Mitered Slope Paved	4	6	18	18	92	Circular	Concrete						Roadway Fill	Rip Rap	Pipe appears to be punched by guard rail post, see pic L.
D034732	Poor	8.22	06/27/16		Left	Cross	Roadside Drainage	Drop Inlet	Catch Basin	2.4	2.4	12	12	95	Circular	Conc Pipe						Roadway Fill	RDF	Outlet of 8.2200 flows into catch basin at 8.2300.
D034733	Poor	8.23	05/07/14		Right	Pipe Right	Roadside Drainage	Drop Inlet	Mitered Slope Paved	2.6	5	12	12	37	Circular	Conc Pipe						Roadway Fill	Roadway Fill	Inlet of 8.2300 is outlet of 8.2200.
D027817	Poor	11.13	05/08/14		Right	Cross	Roadside Drainage	Projecting	Projecting	4	5	18	18	72	Circular	Concrete						Roadway Fill	Roadway Fill	Inlet of 8.2210 is outlet of 8.2200.
D027819	Poor	11.42	05/08/14		Right	Public Approach Rt	Roadside Drainage	Projecting	Projecting	0.0	2.0	18.0	18.0	60.0	Circular	Concrete						Roadway Fill	Roadway Fill	
D027821	Critical	11.75	06/16/14		Right	Pipe Left	Roadside Drainage	Projecting	No Data	0.0	2.0	12.0	12.0	175.0	Circular	HDPE Corrugated						Roadway Fill	Roadway Fill	CNL outlet, estimated ht. of cover & length, ratings done from inlet end only.6/16/14 no outlet found
D027825	Poor	13.07	06/27/16		Right	Cross	Roadside Drainage	Projecting	Projecting	2.5	5.0	24.0	24.0	76.0	Circular	Corrugated Metal Pipe						Roadway Fill	Riprap	Inlet end smashed, but not completely closed.
D027828	Poor	13.56	06/27/16		Right	Cross	Stream	Projecting	Projecting	3.9	7.0	18.0	18.0	78.0	Circular	Conc Pipe						Roadway Fill	Roadway Fill	Outlet end piece starting to separate with others from rest of culvert.
D027832	Poor	13.93	06/16/14		Right	Cross	Roadside Drainage	Projecting	Projecting	3.8	5.8	18.0	18.0	53.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill	Inlet end has rip in the crown.
D027833	Poor	14.03	06/16/14		Right	Cross	Roadside Drainage	Projecting	Projecting	4.2	5.2	18.0	18.0	54.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill	
D027842	Poor	15.51	06/17/14		Right	Cross	Stream	Projecting	Projecting	7.1	14.2	36.0	36.0	173.0	Circular	Corrugated Metal Pipe						Rip Rap	Roadway Fill	36" CMP at inlet, 48" CMP (approx. 60 - 80' long) at outlet.
D027844	Poor	15.67	06/28/16		Right	Cross	Stream	Projecting	Projecting	29.0	35.6	36.0	36.0	219.0	Circular	Corrugated Metal Pipe						Riprap	Roadway Fill	Tree roots at outlet and a log laying on the inlet. Minor damage to crown/Joint at outlet end.
D027848	Poor	16.87	06/28/16		Right	Cross	Roadside Drainage	Projecting	Projecting	16.9	43.0	36.0	36.0	258.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill	Blockage is at the outlet end.
D034741	Critical	17.29	06/28/16		Right	Pipe Right	Roadside Drainage	Mitered Slope Paved	Mitered	1.7	2.3	12.0	12.0	146.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill	Joint seam pinched in as seen from outlet inside photo. Blockage is both structural & sediment.
D027853	Poor	17.67	06/17/14	DISGUST CREEK	Right	Cross	Stream	Projecting	Projecting	13.2	29.0	54.0	54.0	175.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill	Blockage at outlet end.
D027987	Poor	25.73	06/18/14		Right	Cross	Roadside Drainage	Projecting	Projecting	4.1	6.3	36.0	36.0	76.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill	Invert on both ends is starting to deteriorate.
D027990	Poor	26.27	06/18/14		Right	Cross	Roadside Drainage	Projecting	Projecting	3.8	5.6	24.0	24.0	64.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill	Half pipe continues down slope for 75'.6/16/14 half pipe down hill 75 ft.
D027992	Poor	26.6	06/18/14		Right	Cross	Roadside Drainage	Projecting	Projecting	3.2	9.0	18.0	18.0	97.0	Circular	Concrete						Roadway Fill	Roadway Fill	Both ends have started to separate from the rest of the culvert.
D027996	Poor	27.03	06/18/14		Right	Cross	Roadside Drainage	Projecting	Projecting	3.8	18.9	18.0	18.0	89.0	Circular	Concrete						Roadway Fill	Roadway Fill	Inlet end section is starting to separate from the rest of the culvert.
D027998	Poor	27.36	06/18/14		Right	Cross	Roadside Drainage	Projecting	Projecting	4.3	5.3	18.0	18.0	60.0	Circular	Concrete						Roadway Fill	Roadway Fill	Outlet end section is starting to separate from the rest of the culvert.
D028003	Poor	27.92	06/28/16		Right	Cross	Stream	Projecting	Projecting	5.0	19.0	18.0	18.0	75.0	Circular	Conc Pipe						Roadway Fill	Roadway Fill	Inlet/outlet end sections are both starting to separated from rest of culvert.
D028017	Poor	29.57	06/29/16		Right	Cross	Roadside Drainage	Projecting	Projecting	3.2	6.3	18.0	18.0	56.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill	Plugged at inlet about 1/3 full with mostly rock. Crown/joint damaged slightly at inlet also.
D028027	Critical	30.61	06/06/17		Right	Cross	Roadside Drainage	Projecting	Projecting	4.5	3.5	18.0	18.0	69.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill	Guardrail post into crown of outlet side. Pipe is located on super, outlet is located on lower end of super.
D028029	Critical	30.91	06/19/14		Right	Cross	Roadside Drainage	Projecting	Projecting	9.1	11.3	24.0	24.0	75.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill	Holes in side of center of pipe (rust) 4" to 6".
D034755	Critical	31.08	06/29/16		Right	Public Approach Left	Roadside Drainage	Projecting	Projecting	5.0	6.7	18.0	18.0	74.0	Circular	Conc Pipe						Roadway Fill	Roadway Fill	Crosses under Westridge Ave. Joint at end treatment is starting to separate. Reported replaced in 2017.

DFI	Pavement Cracks / Patches	Roadway / Guardrail Sag	Embankment Voids / Popouts	Channel Alignment	Inlet Bank Protection	Outlet Bank Protection	Inlet Scour	Outlet Scour	End Treatment	Culvert A General Barrel Condition	Structural Blockage	Sediment Blockage	Cracking	Invert	Open Joints	Distortion	Settlement	Piping	Drift	Vegetation Obstruction
D034723	Good	Good	Good	Good	Good	Good	Good	Good	Good	Critical	Poor (Good)	Critical (Good)	Good	Good	Good	Good	Good	Good	Good	Good
D027793	Good	Good	Good	Good	Good	Good	Good	Good	Good	Critical		Poor	Good	Good	Good	Good	Good	Good	Good	Good
D034732	Good	Good	Good	Good	Good	Good	Good	Good	Good	Poor	Poor	No Data (Poor)	Good	No Data	Good	Good	Good	Good	Good	Good (Poor)
D034733	Good	Good	Good	Good	Good	Good	Good	Good	Good	Poor	Poor	Critical	Good	Good	Good	Good	Good	Good	Good	Good
D027817	Good	Good	Good	Good	Good	Good	Good	Good	Good	Poor		Poor	Good	Good	Good	Good	Good	Good	Good	Good
D027819	Good	Good	Good	Good	Good	Good	Good	Good	Good	Poor		Poor	Good	Good	Good	Good	Good	Good	Fair	Fair
D027821	Good	Good	Good	Good	Good	Good	Good	Good	Good	Critical	Critical	Critical	Good	Good	Good	Good	Good	Good	Good	Fair
D027825	Good	Good	Good	Fair	Good	Good	Good	Good	Critical	Poor	Good	No Data	Good	Poor	Good	Good	Good	Good	Good	Good
D027828	Good	Good	Good	Good	Good	Good	Fair	Fair	Fair	Poor	Fair	No Data	Good	Good	Fair	Good	Fair	Poor	Good	Good
D027832	Good	Good	Good	Good	Good	Good	Good	Good	Poor	Poor	Poor	Critical	Good	Good	Good	Good	Good	Good	Good	Good
D027833	Good	Good	Good	Critical	Good	Good	Good	Fair	Good	Poor	Poor	Critical	Good	Good	Good	Good	Good	Good	Fair	Good
D027842	Good	Good	Good	Good	Good	Good	Good	Poor	Good	Poor		Good	Fair	Fair	Poor	Poor	Good	Poor	Good	Good
D027844	Good	Good	Good	Good	Good	Good	Fair	Good	Good	Poor	Poor	No Data	Good	Fair	Good	Good	Good	Good	Fair	Good
D027848	Good	Good	Good	Fair	Good	Good	Good	Fair	Fair	Poor	Poor	No Data	Good	Good	Fair	Good	Fair	Good	Good	Good
D034741	Good	Good	Good	Good	Good	Good	Good	Good	Fair	Critical	Critical	No Data	Good	Fair	Good	Good	Good	Good	Fair	Good
D027853	Good	Good	Good	Good	Good	Good	Good	Good	Good	Poor	Poor	Critical	Good	Fair	Fair	Good	Good	Fair	Good	Good
D027987	Good	Good	Good	Fair	Good	Good	Fair	Fair	Fair	Poor		Good	Good	Poor	Fair	Good	Good	Fair	Good	Fair
D027990	Good	Good	Good	Good	Good	Good	Fair	Good	Good	Poor		Good	Good	Fair	Poor	Good	Fair	Good	Good	Good
D027992	Good	Good	Good	Poor	Good	Good	Good	Poor	Critical	Poor		Good	Good	Good	Poor	Good	Poor	Good	Poor	Poor
D027996	Good	Good	Good	Good	Good	Good	Good	Fair	Poor	Poor		Good	Fair	Good	Poor	Good	Poor	Good	Good	Good
D027998	Good	Good	Good	Poor	Good	Good	Good	Good	Poor	Poor		Good	Good	Good	Poor	Good	Fair	Good	Good	Good
D028003	Good	Good	Good	Good	Good	Good	Good	Poor	Poor	Critical	Good	No Data	Good	Fair	Good	Good	Fair	Critical	Good	Good
D028017	Good	Good	Good	Good	Good	Good	Good	Good	Good	Poor	Poor	No Data	Good	Fair	Good	Good	Good	Good	Good	Good
D028027	Good	Good	Good	Critical	Good	Good	Good	Good	Good	Critical	Critical	Good	Good	Good	Good	Good	Good	Good	Good	Good
D028029	Fair	Good	Good	Good	Good	Good	Good	Good	Good	Critical		Fair	Critical	Critical	Critical	Poor	Poor	Good	Fair	Good
D034755	Good	Good	Good	Critical	Good	Good	Good	Good	Fair	Critical	Critical	No Data	Good	Good	Good	Good	Fair	Good	Good	Fair

DFI	WSP USA November 2018 Inspection Notes	WSP USA February 2022 Inspection Notes
D034723	Existing riprap (D50=12") apron on outlet appears stable. G2 Inlet on end panel, not against curb. Miter end section. Guardrail may have penetrated the pipe. Inlet appears to be in good condition.	
D027793	Joints on both ends have separated at the paved end sections. Large trapezoidal ditch on east side. Some aggregate exposure on joints. Staining on bottom fifth of invert. Paved inlet and outlet appear stable. May be stream, flows to north onto private property?	
D034732	Inlet at end of mountable curb. Lots of debris on grate top. Downstream inlet is filled with sediment. Unable to tell pipe diameter but appears to be larger than 12". Outlet from second CB is a paved end section with some riprap.	
D034733	D034732 drains to this pipe. It was completely full of sediment	
D027817	Joints have separated. Outlet has exposed rebar and is projecting. Some spalling at the end section is occurring.	
D027819	End section is spalling with little cover. Joints have separated/ subsided approximately 1 inch. Some spalling at the joints. Abrasion on the bottom of the pipe. Vegetation at inlet indicates that some backwater may be occurring. Appears there may be a bend or deflection in the pipe alignment.	
D027821	Could not located outlet. Pipe is 3/4 full of sediment. Erosion into roadway embankment has occurred.	
D027825	Inlet is deformed with hydraulic capacity compromised by at least 70%. Bottom 1/3 of pipe is rusted with pitting. Some corrugations appear to be completely rusted through. May be some deformation of the barrel. Outlet projects into the reservoir. Appears invert may have been paved in the past. Class 2000 riprap along bank. May need barge to access outlet.	Outlet is round and straight and can see through the culvert. Inlet is crushed, potentially hit by car.
D027828	This drains a steep slope/draw. Minor join separation on inlet. Bottom 1/3 of pipe is filled with sediment/rocks. Some abrasion / pitting on invert. Outlet is perched at least 2 feet above ground line. Outlet has separated/settled at least 3 inches. Some backfill can be seen at the separation. Some minor pitting on downstream end. More sediment on the upstream end may mean a blockage some where along the barrel is causing backwater. Private access is west of this culvert.	No signs of overtopping. No signs of scour. ?Can see through the cuvlert from the outlet. 1" to 2" joint separation at the outlet (3 joints in). Deflection at 30 ft from the outlet? Recommend CCTV to see if any cracks or crushing at non-visible joints. Separation at second joint from outfall and joint settled. Culvert is clean with no immediate or visible breaks at outfall.
D027832	Inlet is in depression. Some old riprap around the inlet. Pipe is deformed/crushed with a split on the top of the pipe. Gravel/sediment is on the bottom 1/4 of the pipe. Some sediment residue on top of pipe indicates it might flow full. Abrasion is present on the bottom half of the invert. Pipe discharges at top of steep bank. Some erosion at outlet	Damage is only at inlet and outlet
D027833	Inlet and outlet is damaged/deformed. Scour hole on downstream. Some joint separation. Downstream end is higher than upstream end and may be causing backwater. Sediment in the pipe approximate 1/4 of invert. Some sediment residue on top of pipe indicates it might flow full.	Outlet looks new with minor damage compared to MP 13.93. Lots of sediment. Inlet has some deflection
D027842	Could not locate inlet as it was covered by blackberries. Outlet is 48" CMP. Outlet is perched above the ground line at least 3 ft. Large scour hole on downstream end. Large erosional hole around outlet back towards inlet, approximately 6.5 feet long. Water is piping around the culvert. Outlet is deformed with significant damage to corrosion protection, rust and pitting. Outside of pipe is rusted and pitted. Not a lot of flow in pipe.	
D027844	Inlet is down a very steep bank to safely access. Outlet is deformed with flowing water almost to spring line. Sediment has accumulated to at least 1/4 height. Large trees are growing around and into the outlet. Appears this may have been asphalt paved/lined in the past. Channel downstream is showing signs of a erosion and is incised.	
D027848	Could not locate outlet. Inlet has 2 channels coming into it from the west and north. No channel erosion. Culvert has been lined in the past. No deformation of the pipe. Water mark up to the spring line. Some damage to the lining.	
D034741	Paved inlet is damaged and corroded. Pipe is flowing full. Outlet is in a depression. Communication pedestal is located east of the culvert on mound. Pipe has corrosion around nearly 3/4 of the invert (above spring line)	
D027853	Large debris cage has been installed on the inlet. Debris and logs are in the channel upstream of the culvert. Inlet has minor rust on bottom 1/4 of invert. Outlet appears higher than inlet . Some joint displacement on the upstream end. Outlet was submerged and could not be inspected. Can see approximately 1/4 of outlet from inlet end. Bedrock was evident at the railroad crossing.	
D027987	Inlet is deformed. Pipe may have had a previous corrosion coating. Some rust / pitting on bottom 1/4 of invert at the inlet. Small holes in bottom of pipe are present. May be some joint settling/separation. May be some slight deformation in middle of pipe. Pipe is upstream of a railroad culvert. Outlet has significant rust and section loss as well as holes. Joints are separated. Slight deflection in alignment.	
D027990	Inlet is deformed but doesn't appear to have reduced opening significantly. Joint at inlet is damaged/slightly offset. Some rust on bottom 1/3 of invert but no section loss. Pipe has been previously coated. Outlet has a bend in it (22.5?) with asphalt paved / coated outlet. Some damage to the coating (chipping with rust). No section loss. Half round pipe chute from outlet down the bank likely means bank erosion has been a problem in the past. Could not verify the condition of the bank. Some cracking of pavement at the edge near the guardrail on outlet (bank stability?).	Something intruding into culvert at approximately roadway centerline. Minor overtopping. Bedrock at the end of the flume
D027992	At least 2 joints have separated at least 3 inches on outlet. Minor pitting in concrete at invert. No water was entering the inlet however water was coming out of the pipe (possible I&I?). Lane Electrical Co-Op junction box and transformer located at the outlet. There was at least a 6 inch drop from the outlet to a riprap pad.	
D027996	Joints have separated at least 2 inches at the inlet. Same for the outlet. Slight skew on the first stick of inlet pipe, likely not designed. Some abrasion and visible aggregate on the top of the pipe. Crack in right side of the inlet from the bottom of the pipe to nearly the top.	
D027998	REPAIRED OR REPLACED BY ODOT. NOT INSPECTED BY WSP.	
D028003	REPAIRED OR REPLACED BY ODOT. NOT INSPECTED BY WSP.	
D028017	REPAIRED OR REPLACED BY ODOT. NOT INSPECTED BY WSP.	
D028027	REPAIRED OR REPLACED BY ODOT. NOT INSPECTED BY WSP.	
D028029	REPAIRED OR REPLACED BY ODOT. NOT INSPECTED BY WSP.	
D034755	REPAIRED OR REPLACED BY ODOT. NOT INSPECTED BY WSP.	

OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
CONDITION ASSESSMENT

DFI	Culvert Condition	Mile Point	Inspection Date	Stream Name	Inlet Side	Orientation	Facility Usage	Inlet End Type	Outlet End Type	Inlet Ht. of Cover (ft.)	Outlet Ht. of Cover (ft.)	Span (in)	Rise (in)	Length (ft.)	Shape	Material	Span (in)	Rise (in)	Length (ft.)	Shape	Material	Inlet Bank Protection Material	Outlet Bank Protection Material	ODOT Inspector Comments	Pavement Cracks / Patches	Roadway / Guardrail Sag	Embankment Voids / Popouts	Channel Alignment	Inlet Bank Protection	Outlet Bank Protection	Inlet Scour	Outlet Scour	Bed Treatment	General Barrel Condition	Structural Blockage	Sediment Blockage	Cracking	Invert	Open Joints	Distortion	Settlement	Piping	Drift	Vegetation Obstruction	WSP USA November 2018 Inspection Notes	WSP USA February 2022 Inspection Notes
D028033	Critical	31.47	10/31/16		Right	Cross	Roadside Drainage	Projecting	Projecting	4.0	4.0	18.0	18.0	83.0	Circular	Conc Pipe						Roadway Fill	Roadway Fill	Flow now goes through pipe at 34.4710. 10/31/16 cnl inlet, buried	Good	Good	Good	Critical	Good	Good	Good	Good	Good	Critical	Critical	Critical	Good	Good	Poor	Good	Fair	Good	Good	Joint are separating and the inlet is partially buried (at least 70%). Some spalling and chipping on inlet pipe. Outlet is partially block with sediment.	Both pipes are RCP and the pipe doesn't look officially abandoned
D028041	Critical	33.54	06/23/14		Left	Cross	Roadside Drainage	Projecting	Projecting	5.0	6.0	18.0	18.0	63.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill	CMP extensions on both ends, main pipe under road is bad.	Good	Good	Good	Good	Good	Good	Good	Fair	Fair	Critical		Good	Good	Critical	Fair	Good	Good	Fair	Good	Good	Outlet is perched above the ground without protection. Erosion/depression at outlet. May have been cleaned recently? May be in 100 year flood plain? Appears to have an asphalt lining on the invert. Damage to CMP at outlet.	Pokehole damage at inlet. Bottom rusted starting at the end of the bitumen, as observed from the outlet. Seeming low-flow culvert with no evidence of overtopping.
D028044	Critical	33.65	06/06/17		Left	Cross	Roadside Drainage	Projecting	Projecting	4.5	4.7	18.0	18.0	64.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill	No invert in section of pipe.	Good	Good	Good	Critical	Good	Good	Good	Poor	Fair	Critical	Good	Good	Good	Critical	Good	Good	Fair	Critical	Fair	Good	Inlet end section is damaged with a hole and has some stacked river rock around it. Pipe appears to have been previously asphalt paved. Asphalt lining is chipped/cracked with damage due to abrasion along the pipe invert, approximately 6 inches wide only on the left 1/4 (looking downstream). The damaged lining shows rust. Exterior of pipe also has an aspahltic coating which is failing. Inlet is perched above the ground line by approximately 6 inches.	
D028045	Critical	33.79	06/06/17		Left	Cross	Roadside Drainage	Projecting	Projecting	3.4	7.1	18.0	18.0	72.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill	Pipe is falling in, ext. on both ends. Middle section invert is gone. Blockage is structural problem.	Good	Good	Good	Critical	Good	Good	Good	Good	Fair	Critical	Critical	Good	Good	Critical	Critical	Good	Good	Good	Good	Good	The inlet has bedrock along its south side and was partially filled (at least 1/2) with dirt and debris. The inlet was squashed with at least 30% reduction in opening. Pipe has been previously asphalt lined/coated. The outlet has some stacked river rock around. Outlet has extensive rust and pitting on the bottom 10 inches of the invert. The end section is slighlty skewed from the barrier and the joint has separated. The end section does not have a coating, maybe dissimilar pipes. End section is slightly deformed but it doesn't appear to have compromised the capacity. Some gravel in the bottom of the culvert.	
D034760	Poor	36.56	05/21/14		Left	Pipe Left	Roadside Drainage	Manhole	Projecting	4.5	1.0	12.0	12.0	206.0	Circular	Concrete						Roadway Fill	Roadway Fill	MH is outlet for inlet at 36.5800. X's under Industrial Park Wy. Has sewage smell.	Fair	Good	Good	Good	Good	Good	Good	Good	Good	Poor			Good	Good	Good	Poor	Good	Poor	Good	Good	Good	INSPECTED WRONG SECTION OF PIPE. THIS IS THE INLET TO THE MANHOLE. ASSUME SAME CONDITION AS INSPECTION. The inlet is in a deep ditch and is at least 1/2 buried with sediment. Some spalling of the concrete on the inlet. Sediment reduces the capacity by at least 1/2 and could not inspect the invert. Some of the joints have separated less than 2 inches on the outlet end. Given the sewage odors, TV inspection for illicit connections to this system is warranted.	
D028047	Poor	36.73	06/29/16		Left	Cross	Roadside Drainage	Projecting	Projecting	2.5	4.0	24.0	24.0	55.0	Circular	Conc Pipe						Roadway Fill	Roadway Fill	Last two joints of outlet starting to separate from rest of pipe.	Good	Good	Good	Poor	Good	Fair	Good	Poor	Poor	Poor	Good	No Data	Good	Good	Fair	Good	Poor	Good	Good	Good	Inlet is projecting and perched above ground line at least 6 inches. Joints have separated at least 2 inches at outlet. Concrete is damaged. Outlet is onto a steep slope with no riprap protection.	Inlet looks good. Replace four 3-foot sections at the outlet. It is approximately 12' from the outlet to the fog line, therefore the sections are not under the road. Riprap at outlet can be keyed-in by overexcavation adding base for structural riprap. Cover verified > 24"
D028050	Poor	37.31	06/29/16		Left	Cross	Roadside Drainage	Projecting	Projecting	8.0	11.5	18.0	18.0	68.0	Circular	Conc Pipe						Roadway Fill	Roadway Fill	Last two sections of outlet starting to separate from rest of pipe.	Good	Good	Good	Poor	Good	Good	Good	Good	Fair	Poor	Fair	No Data	Good	Good	Fair	Good	Poor	Good	Fair	Good	Inlet is at least 1/3 buried with sediment. First section of pipe has settled at least 1 inch and sediment is accumulating on it. Concrete appears to be in good condition. Some minor abrasion along walls to the spring line. Minor spalling of the end section with some rebar exposure. outlet has more sediment in it. A joint has settled approximately 20 feet from end of barrel (2 sections back). No inlet or outlet protection. Outlet is perpendicular to the stream.	
D028051	Poor	37.56	06/29/16		Left	Cross	Roadside Drainage	Projecting	Projecting	3.0	11.0	18.0	18.0	52.0	Circular	Conc Pipe						Roadway Fill	Roadway Fill	Inlet pipe has separated at joint due to cracking, material has fallen into pipe, rebar is exposed.	Good	Good	Good	Critical	Fair	Good	Good	Good	Fair	Poor	Good	No Data	Poor	Good	Fair	Good	Fair	Good	Good	Good	Inlet is approximately 1/4 buried with sediment. Joints have separated more than 2 inches and soil can be seen in the separation. Overall the concrete condition is good. No inlet or outlet protection.	
D028052	Poor	37.68	06/29/16		Left	Cross	Roadside Drainage	Projecting	Projecting	5.0	8.0	18.0	18.0	51.0	Circular	Conc Pipe						Roadway Fill	Roadway Fill	WB - EB, outlet has 3' depth of scour. Inlet has joint separation at first pipe.	Good	Good	Good	Poor	Fair	Poor	Fair	Fair	Poor	Poor	Good	No Data	Good	Good	Poor	Good	Poor	Good	Good	Good	Joints have separated on both ends at least 1 to 2 inches. Some abrasion with exposed aggregate on the invert. Some cracks in the invert on the outlet end. Downstream end appears stable with riprap. Possibly discharges to creek.	
D028053	Poor	37.89	06/06/17		Left	Cross	Roadside Drainage	Projecting	Projecting	2.5	4.5	18.0	18.0	65.0	Circular	Corrugated Metal Pipe						Roadway Fill	Riprap	Invert bad in middle of pipe. Joint damage near inlet end, causing infiltration of fill material.	Good	Good	Good	Critical	Poor	Good	Good	Fair	Fair	Poor	Fair	Good	Good	Poor	Fair	Good	Good	Good	Good	Good	Inlet is damaged and both the exterior and interior are heavily corroded with rust. Corrosion protection coating has failed. It looks like it was abraded off.	
D028071	Critical	40.92	06/06/17		Right	Cross	Stream	Projecting	Projecting	3.0	5.5	30.0	30.0	64.0	Circular	Corrugated Metal Pipe						Riprap	Roadway Fill	Damage has occurred to a couple of joints.	Good	Good	Good	Good	Good	Good	Good	Poor	Fair	Poor	Fair	Poor	Good	No Data	Good	Good	Good	Good	Good	Good	Inlet is damaged. Flow appears to be high velocity from steep slope upstream of culvert. Flow has displaced rock towards the inlet. Both the inlet and outlet are almost 1/2 full with sediment. Corrosion can be seen from the invert up to the spring line. Some pitting on the crown. Abrasion may be an issue.	Agree with double barrel due to shallow cover. Existing culvert is 24" and 30". Satisfactory energy dissipation in the field.
D028074	Poor	41.5	06/30/16		Right	Cross	Roadside Drainage	Projecting	Projecting	3.0	6.0	18.0	18.0	55.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill	Inlet end smashed almost completely.	Good	Good	Good	Good	Good	Fair	Good	Good	Critical	Poor	Fair	No Data	Good	Poor	Good	Good	Good	Good	Good	Good	The inlet is deformed with less than 10% cross-sectional area. Corrosion up to the spring line at the inlet. Sedimentation approximately 1/3 capacity. Outlets is almost completely corroded.	Existing culvert is 15", Upsize pipe as proposed and no additional riprap needed
D034764	Poor	41.58	06/30/16		Right	Cross	Roadside Drainage	Projecting	Projecting	10.0	11.5	24.0	24.0	79.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill	Pipe separated about 15' in from outlet end, deformation of invert in same area.	Good	Good	Good	Poor	Good	Good	Good	Good	Fair	Poor	Fair	No Data	Good	Fair	Poor	Good	Poor	Good	Good	Good	The invert is rusted and pitted up to the spring line. The Inlet has sediment accumulation and standing water in it. The outlet has separated from the barrel and invert is deformed. The invert is rusted and pitted for the bottom 1/3. No water at the outlet.	
D034765	Poor	41.811	06/30/16		Left	Pipe Right	Roadside Drainage	Mitered	Mitered	0.0	0.0	12.0	12.0	20.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill	Center of culvert has been bent by guard rail post = poor structural blockage.	Good	Good	Good	Good	Good	Good	Good	Fair	Good	Poor	Poor	No Data	Good	Fair	Good	Good	Good	Good	Good	Good	The pipe has been deformed by the guardrail post. The invert is rusted and pitted to past the spring line. There is standing water in the pipe. The outlet has a mitered end section.	
D028076	Poor	41.91	05/28/14		Right	Cross	Stream	Projecting	Projecting	4.0	5.0	24.0	24.0	70.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill		Good	Good	Fair	Critical	Fair	Good	Fair	Good	Fair	Poor		Good	Good	Poor	Fair	Good	Good	Good	Good	Good	Inlet is slightly deformed although it doesn't appear to have compromised the cross-section. It has also separated from the barrel. The inlet has rust up to the spring line. Outlet has rust only on the 1/3 of the invert.	
D028077	Poor	42.01	06/30/16		Right	Cross	Roadside Drainage	Projecting	Projecting	5.0	4.0	18.0	18.0	55.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill	Conc. extensions on inlet/outlet. Critical open joints at concrete inlet/outlet end treatment\ CMP pipe connections.	Good	Good	Good	Good	Fair	Fair	Good	Good	Critical	Poor	Fair	No Data	Good	Fair	Poor	Good	Good	Good	Good	Good	Concrete pipe was used to extend the inlet and outlet and connects to CMP. CMP had holes in the crown and soil is coming through them. Outlet end is full of sediment. Concrete extensions have separated from the CMP section.	
D028078	Poor	42.12	06/06/17		Right	Cross	Roadside Drainage	Projecting	Projecting	3.0	6.0	24.0	24.0	58.0	Circular	Corrugated Metal Pipe						Roadway Fill	Riprap	Concrete extension on inlet, there is a gap in the inlet end treatment joint. 6/6/17. End treatment critical due to invert at outlet.	Good	Good	Good	Critical	Good	Fair	Good	Fair	Critical	Poor	Good	Poor	Good	Fair	Good	Good	Good	Good	Good	Good	Concrete pipe was used to extend the inlet and connects to CMP. Concrete section has exposed rebar and has separated from the CMP section. Soil is settling into the pipe at the separation. CMP outlet is corroded and erosion is occurring at the outlet. Outlet is less than 30 feet from stream.	Existing culvert is concrete on the inlet and CMP at the outlet. Rusted out at the outlet.Inlet is approximately 1/4th full of running water. No extending the culvert at the outlet, the embankment can be excavated back to be out of the OHW
D028082	Critical	42.5	06/07/17		Right	Cross	Roadside Drainage	Projecting	Projecting	3.5	4.0	18.0	18.0	77.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill	Culvert in good condition except for the invert. End treatment critical for outlet invert.	Good	Good	Good	Fair	Good	Good	Good	Good	Critical	Critical	Good	Good	Good	Critical	Fair	Good	Fair	Good	Good	Good	Some corrosion on the inlet invert. Outlet pipe has completely corroded and fallen off.	
D028086	Critical	43.26	06/07/17		Left	Cross	Roadside Drainage	Projecting	Projecting	3.0	5.0	18.0	18.0	46.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill	Dug out inlet, needs ditched. Pipe unable to function properly.	Good	Good	Good	Critical	Good	Good	Good	Poor	Critical	Critical	Critical	Poor	Good	Critical	Good	Good	Good	Poor	Good	Good	Inlet is damaged/deformed with corrosion past the spring line. The crown has some pitting. It is also full of sediment. Likely needs protected ditch upstream of it. Outlet is completely rusted with significant section loss. It has holes through crown and invert. Outlet is perched above the ground line at last 1 foot with no riprap protection.	
D028088	Critical	43.43	06/07/17		Left	Cross	Roadside Drainage	Projecting	Projecting	10.0	13.0	18.0	18.0	63.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill	Invert is rusted through, blockage at outlet end.	Good	Good	Good	Good	Good	Good	Good	Good	Critical	Critical	Good	Fair	Good	Critical	Good	Good	Fair	Good	Fair	Fair	Corrosion has completely compromised the inlet invert. Anti-corrosion coating failed along the invert. Outlet is nearly 1/2 full of sediment and is blocked on the outlet. This is causing backwater. May need to construct ditches to control water.	
D028090	Critical	43.54	06/07/17		Left	Cross	Roadside Drainage	Projecting	Projecting	6.0	6.5	18.0	18.0	51.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill	invert is rusted through. End treatment critical for inlet/outlet.	Good	Good	Good	Poor	Fair	Good	Good	Poor	Critical	Critical	Good	Fair	Fair	Critical	Good	Good	Good	Critical	Good	Good	Inlet and outlet invert is corroded with significant section loss and holes. Outlet is in a depression. Pipe is full of sediment on the downstream end. Some scour is occurring.	This is not a stream and doesn't need to be in the JPA. No evidence of scour at inlet or outlet. Wetland is delineated at the outlet
D028091	Critical	43.74	06/07/17		Left	Cross	Roadside Drainage	Projecting	Projecting	4.5	12.0	18.0	18.0	71.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill	Inlet crown has been partly crushed. End treatment poor for inlet.	Good	Good	Good	Poor	Good	Good	Good	Poor	Poor	Critical	Good	Good	Good	Critical	Fair	Fair	Fair	Fair	Good	Fair	Galvanized CMP. Inlet is damaged / partially crushed and the invert is corroded with rust and pitting on the bottom 1/2 of the invert. Outlet is also rusted and pitted with less extents. Water was flowing in the culvert. Otherwise the pipe appears in good condition.	
D028094	Critical	43.99	06/07/17		Left	Cross	Roadside Drainage	Drop Inlet	Projecting	3.6	6.4	18.0	18.0	88.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill	IT has no grate. Inlet/outlet ends rusted through. Two pipes come into IT from hillside.	Good	Good	Good	Good	Good	Critical	Good	Poor	Critical	Critical	Good	Good	Fair	Critical	Good	Good	Fair	Critical	Fair	Good	Drop inlet has no grate. Inlet structure has two pipes coming into it from hill side and is almost completely filled with dirt and debris. Need to do further locating/as-built review to determine where these pipes come from. Inlet is rusted through on the invert with pitting on the crown also. Outlet is also rusted through with holes and soil coming through it. Outlet is perched at least 2 feet above ground and there is a scour hole downstream from this.	
D028095	Critical	44.06	05/28/14		Left	Cross	Stream	Projecting	Projecting	4.0	5.0	24.0	24.0	88.0	Circular	Concrete						Roadway Fill	Roadway Fill	Outlet end sec. is separating from rest of pipe, critical scour/embankment issues at outlet.	Fair	Good	Good	Good	Good	Critical	Fair	Critical	Fair	Critical		Good	Good	Good	Poor	Good	Poor	Critical	Good	Fair	A narrow, well defined channel drains to the inlet. Less than 1 inch of joint separation on the inlet. Invert has some abrasion with minor aggregate exposure. The outlet section is separating from the barrel which can also be seen from the outside. Outlet projects past the embankment. Scour is occurring downstream and channel is incised.	
D028100	Critical	44.36	05/28/14		Left	Cross	Roadside Drainage	Drop Inlet	Projecting	8.0	9.0	24.0	24.0	55.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill	Inlet submerged, 36" vertical shaft under CB grate, 8' drop to water. Ratings from outlet only.	Good	Good	Good	Good	Good	Good	Good	Fair	Good	Critical		Poor	Critical	Critical	Good	Good	Fair	Good	Good	Good	Circular shaft, 36" diameter, with grate flush to ground (good condition). Inlet pipe submerged in structure. Channel downstream of outlet pipe is well defined. Outlet pipe has some deformation but does not compromise capacity. The outlet had standing water, at least 12 inches deep, in it. Interior of pipe has corrosion with rust above the spring line. Could not inspect the invert because of the standing water. There was some embankment erosion.	This is in the landslide area and the inlet may have settled. That is probably why there is always water in the inlet. Survey pole identified a 24" (upstream end appears modified by a 30") pipe from RR with invert at 8 ft bst. Outgoing pipe invert is at 9 ft bst. This is not a stream. Flat ground at the outlet without evidence of scour.
D028102	Critical	44.54	06/07/17		Left	Cross	Stream	Projecting	Projecting	3.0	4.8	18.0	18.0	58.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill	Invert is gone. Heavy scour at outlet end.	Good	Good	Good	Poor	Good	Good	Fair	Critical	Critical	Critical	Fair	Good	Good	Critical	Poor	Good	Fair	Critical	Good	Good	Inlet is completely corroded through and the crown is squashed. Exterior of pipe is also rusted. Rust was up to the spring line. The outlet is perched at least 4 feet above the ground and is also badly corroded with holes. Water was flowing through the holes. Channel is incised with defined banks. Scour is occurring.	
D028103	Critical	44.58	06/07/17		Left	Cross	Roadside Drainage	Projecting	Projecting	3.0	6.0	24.0	24.0	45.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill	Invert rusted through in culvert. Retake GPS point	Good	Good	Good	Critical	Fair	Good	Good	Good	Critical	Critical	Good	Good	Good	Critical	Good	Good	Good	Critical	Good	Good	The inlet is deformed with 20% reduction in cross-section. Invert has some rust and pitting along the bottom 1/3. The bank around the inlet is eroding. Outlet has minor corrosion along its invert as well as some soil erosion.	
D028107	Critical	44.96	06/07/17		Left	Cross	Roadside Drainage	Projecting	Projecting	9.0	10.0	24.0	24.0	67.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill	Invert is rusted through. Inlet/outlet are both in critical condition.	Good	Good	Good	Good	Good	Fair	Good	Good	Critical	Critical	Good	Good	Good	Critical	Good	Good	Good	Good	Good	Good	Inlet and outlet invert is corroded with significant section loss and holes. Rust goes almost to the spring line.	
D028108	Critical	45.03	06/07/17		Left	Cross	Roadside Drainage	Projecting	Projecting	3.7	2.7	18.0	18.0	47.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill	Invert is rusted through. Inlet/outlet are both in critical condition.	Good	Good	Good	Fair	Fair	Good	Good	Good	Critical	Critical	Good	Good	Good	Critical	Good	Good	Good	Good	Fair	Good	Inlet and outlet invert is corroded with significant section loss and holes. Rust goes almost to the spring line. A fiber optic line is close to the culvert. The outlet has a defined channel. Some erosion is occurring.	No defined channel but pockets of landslide depressions. Strong flow from uphill seems to bubble out at the ditch by McCredie Rd. No evidence of overtopping and excess flow can flow to the next culvert before overtopping the road. General consensus on fish is that flows do not seem to be high enough for fish passage.
D028109	Poor	45.35	07/05/16		Left	Cross	Roadside Drainage	Projecting	Projecting	2.0	7.0	18.0	18.0	52.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill	Inlet end treatment smashed and ripped.	Good	Good	Good	Good	Fair	Good	Good	Fair	Poor	Poor	Good	No Data	Good	Poor	Good	Good	Good	Good	Good	Good	Inlet is damaged and ripped. The outlet invert is corroded for the bottom 1/3. Some sedimentation is occurring.	8 CY of riprap is too large for the space available at the culvert outlet.

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CONDITION ASSESSMENT

DFI	Culvert Condition	Milla Point	Inspection Date	Stream Name	Inlet Side	Orientation	Facility Usage	Inlet End Type	Outlet End Type	Inlet Ht. of Cover (ft.)	Outlet Ht. of Cover (ft.)	Span (in)	Rise (in)	Length (ft.)	Shape	Material	Span (in)	Rise (in)	Length (ft.)	Shape	Material	Inlet Bank Protection Material	Outlet Bank Protection Material	ODOT Inspector Comments	Pavement Cracks / Patches	Roadway / Guardrail Sag	Embankment Voids / Popouts	Channel Alignment	Inlet Bank Protection	Outlet Bank Protection	Inlet Scour	Outlet Scour	Flat Treatment	General Barrel Condition	Structural Blockage	Sediment Blockage	Cracking	Invert	Open Joints	Distortion	Settlement	Piping	Drift	Vegetation Obstruction	WSP USA November 2018 Inspection Notes	WSP USA February 2022 Inspection Notes
D028124	Critical	46.75	06/07/17		Left	Cross	Roadside Drainage	Projecting	Projecting	3.0	3.0	18.0	18.0	65.0	Circular	Corrugated Metal Pipe						Roadway Fill	Riprap	CNL inlet, old slide covers inlet. Water flow moved up M.P. to 46.76. Abandoned? - pipe filled.	Good	Good	Good	Fair	Good	Good	Good	Good	Poor	Critical	Critical	Good	Good	Critical	Good	Good	Good	Good	Good	Good	Could not be located	The right pipe (looking downstream) is abandoned. Do not touch the left pipe which was replaced for fish passage.
D028127	Poor	46.89	07/06/16		Left	Cross	Roadside Drainage	Projecting	Projecting	4.0	4.0	18.0	18.0	47.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill	Joint damage in crown looking from inlet end. Blockage is past the joint damage towards the outlet end.	Good	Good	Good	Good	Fair	Good	Good	Good	Good	Poor	Fair	No Data	Good	Poor	Good	Good	Good	Good	Good	Good	Inlet has some pitting on the crown. Culvert is approximately 1/3 full of debris. Invert is rusted and pitted up to the spring line.	Ditch looks stable and in good condition.
D028128	Critical	47.07	06/07/17		Left	Cross	Roadside Drainage	Projecting	Projecting	4.0	3.0	18.0	18.0	43.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill	Outlet end has been crushed slightly water flowing from bottom of pipe. Tear on side on inlet pipe.	Good	Good	Good	Good	Good	Good	Good	Fair	Critical	Critical	Fair	Good	Good	Critical	Good	Fair	Good	Fair	Good	Good	The inlet was half buried with sediment. The invert has corrosion on the bottom 1/3 and the inlet has a tear in it. Outlet is partially crushed.	
D028130	Poor	47.46	07/06/16		Left	Cross	Stream	Projecting	Projecting	5.0	5.0	30.0	30.0	50.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill	Both end have been damaged/inlet is the worst.	Good	Good	Good	Fair	Good	Good	Good	Good	Poor	Poor	Poor	No Data	Good	Poor	Good	Good	Good	Good	Fair	Fair	Inlet has some damage at the end section and rust on the invert. Outlet does not have a lot of rust on it and is slightly deformed at the crown.	
D028131	Critical	47.57	06/07/17		Left	Cross	Roadside Drainage	Projecting	Projecting	4.0	4.0	30.0	30.0	48.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill	invert completely rusted through and pushing up from bottom. Retake GPS point	Good	Good	Good	Fair	Good	Fair	Good	Good	Critical	Critical	Good	Good	Good	Critical	Good	Good	Good	Good	Good	Good	The inlet has some pitting on it and is slightly deformed at the crown. There are abrasion and rust marks nearly up to the spring line. Some sedimentation has occurred.	
D028132	Critical	47.8	05/21/14	CREEK	Left	Cross	Stream	Headwall Non Engr	Projecting	7.0	8.0	18.0	18.0	98.0	Circular	Corrugated Metal Pipe	18.0	18.0	98.0	Circular	Corrugated Metal Pipe	Roadway Fill	Roadway Fill	CNL inlet A, appears to be buried.	Fair	Good	Good	Good	Good	Good	Good	Good	Good	Critical		Critical	Good	Poor	Fair	Good	Good	Good	Poor	Good	This is double barrel culvert. The inlets are almost completely buried in the dirt with most of the flow going through the right barrel, looking downstream. This barrel is flowing at 90% capacity. The embankment has stacked river rock headwall that is almost vertical. The inlet end sections have rust on the interior and exterior. The two barrels are not at the same elevation on the downstream side. Both pipes are perched at least 4 feet above the ground. Some flow is coming out of the left hand culver (looking downstream). The invert has abrasion marks and rust on the bottom 8 inches. The anti-corrosion coating has failed. These culvert discharge into Salt Creek.	
D028137	Poor	49.41	05/21/14		Left	Cross	Roadside Drainage	Projecting	Projecting	16.0	24.0	24.0	24.0	99.0	Circular	Concrete						Roadway Fill	Roadway Fill	Water coming thru joints, end section of outlet loose. GPS point moved to inlet.	Good	Good	Good	Critical	Good	Good	Good	Critical	Fair	Poor		Good	Good	Poor	Poor	Good	Fair	Good	Good	Good	Several joints have settled/separated on the inlet at least 2 inches. The outlet is projecting from the embankment and has erosion around the outlet. Some rebar can be seen on the projecting end.	Good candidate for lining (from the inlet). Scouring just 3 ft from the outlet. Getting riprap to the steep slope would be difficult.Approximately 20-ft drop at 1:1 or less to outlet. 4-ft drop at outfall. Water not observed at the inlet but comes out the outlet. Potentially spotted owl habitat
D028139	Critical	49.99	05/21/14		Left	Cross	Roadside Drainage	Projecting	Projecting	9.0	11.0	18.0	18.0	74.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill		Good	Good	Good	Critical	Good	Good	Good	Good	Good	Critical		Fair	Good	Critical	Good	Good	Good	Good	Good	Good	Inlet is dented and has rust on the invert. The outlet has rust, pitting and abrasion up to the spring line.	
D028142	Critical	50.3	06/07/17		Left	Cross	Roadside Drainage	Projecting	Projecting	6.0	10.0	30.0	30.0	108.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill	Structural blockage at outlet end in crown.	Good	Good	Good	Poor	Good	Good	Good	Good	Good	Critical	Fair	Good	Good	Critical	Good	Good	Good	Good	Good	Fair	Invert at inlet has corrosion on the bottom 6 inches to water line. Outlet has more standing water and rust up to the spring line. The crown is deformed on the top right hand side approximately 10 feet from the outlet. Pipe is punctured near the inlet.	
D028158	Critical	53.56	06/07/17		Left	Cross	Roadside Drainage	Projecting	Projecting	3.0	5.2	18.0	18.0	51.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill	Crown is bent up badly causing blockage, inlet buried.	Good	Good	Good	Good	Good	Good	Good	Good	Good	Critical	Fair	Fair	Fair	Fair	Critical	Critical	Good	Good	Good	Good	Good	The inlet has been excavated out with a wide flat bottom ditch. The crown of the inlet is dented and has deformed the cross-section. The pipe has corroded along its invert.	
D028159	Critical	53.69	05/21/14		Left	Cross	Roadside Drainage	Mitered	Projecting	2.0	7.0	36.0	36.0	381.0	Circular	Concrete						Roadway Fill	Roadway Fill	Outlet end section starting to separate from rest of culvert.	Good	Good	Good	Poor	Good	Good	Good	Poor	Fair	Critical		Good	Good	Good	Poor	Good	Critical	Good	Good	Good	The inlet and outlet has some abrasion on the invert, approximately 8 inches wide. There is buried power and a transformer along the end of the road on the inlet side. The last 2 pipe sections on the outlet are separating from the barrel. The last section has settled at least 2 inches.	
D028160	Critical	53.76	06/07/17		Left	Cross	Stream	Projecting	Projecting	3.0	12.5	24.0	24.0	82.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill		Good	Good	Good	Good	Good	Fair	Good	Good	Good	Critical	Good	Good	Good	Good	Critical	Good	Good	Good	Fair	Good	Good	The outlet is projecting and is at least 2 feet above the ground line. The invert is rusted with holes through which water is coming through. Only rust in the bottom 1/4 of the pipe diameter.	
D028161	Poor	53.83	05/21/14		Left	Cross	Roadside Drainage	Mitered	Projecting	2.0	25.0	30.0	30.0	130.0	Circular	Concrete						Roadway Fill	Roadway Fill	A 20' extension of larger CMP was added to the outlet, creating a joint issue.	Good	Good	Good	Good	Good	Good	Good	Good	Fair	Poor		Good	Good	Good	Poor	Good	Fair	Good	Good	Good	ODOT data indicates this a roadside culvert. However it appears to be a stream based upon flow and channel configuration. The inlet is a Mitered end section that has separated from the barrel. The next section has also settled. There are some cracks in the pavement along the guardrail posts. Outlet is a CMP with extensive rust and pitting up past the spring line. There is scaling on the top 1/4 right of crown.	
D028163	Critical	53.95	07/06/16		Right	Pipe Left	Roadside Drainage	Mitered	Projecting	4.0	2.0	24.0	24.0	160.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill	Outlet end has been crushed.	Good	Good	Good	Good	Good	Fair	Good	Good	Critical	Critical	Critical	No Data	No Data	No Data	No Data	No Data	No Data	No Data	Good	Fair	Inlet is a Mitered end section that has separated from the barrel. It is 50% blocked with sediment. The outlet is crushed.	
D028186	Critical	57.77	06/07/17		Left	Cross	Roadside Drainage	Mitered	Projecting	2.0	5.0	24.0	24.0	77.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill	Crown of first joint at inlet is dented (structural blockage). Sediment blockage at inlet end.	Good	Good	Good	Fair	Good	Good	Good	Good	Fair	Critical	Fair	Poor	Good	Critical	Good	Good	Good	Good	Good	Good	Inlet is a Mitered end section that is almost completely full of standing water. The pipe is crushed and the end section has separated from the barrel. The joint projects into the cross-section. No interior or exterior corrosion on the inlet. Outlet is projecting and has less water coming out that going into the culvert. Downstream end has abrasion up to the spring line.	Culvert not visited due to being in the snow zone. ODOT recommended approach: remove riprap, replace inlet end section (confirm during construction). Add section of pipe at outlet to stabilize slope
D028188	Poor	57.96	05/20/14		Left	Cross	Roadside Drainage	Drop Inlet	Projecting	8.0	13.0	24.0	24.0	98.0	Circular	Corrugated Metal Pipe						Roadway Fill	Rip Rap		Good	Good	Good	Good	Good	Good	Good	Good	Good	Poor		Fair	Fair	Poor	Good	Good	Good	Good	Good	Good	Inlet is an at-grade drop inlet. Culvert discharges into Salt Creek. Outlet is partially buried and the embankment above it has deep rilling behind the guardrail. It has not compromised the bank or guardrail but will eventually.	
D028189	Poor	58.02	05/20/14	JENNY CREEK	Left	Cross	Stream	Projecting	Projecting	8.0	11.0	48.0	48.0	107.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill		Good	Good	Good	Good	Good	Fair	Good	Poor	Good	Poor		Fair	Good	Poor	Fair	Good	Fair	Good	Good	Good	The interior of the pipe appears in good condition. There may be a deflection in the alignment in the middle of the barrel. It appears that more water is leaving the pipe than is coming in (possible broken joint with infiltration or piping?). Some minor damage to the coating on the top right. Slight deformation of the crown at the inlet end. The outlet has water up to the spring line with moss growing on the crown. Channel down stream is wider and flatter gradient than stream coming into it.	
D028190	Poor	58.16	05/20/14		Left	Cross	Stream	Mitered	Mitered	4.0	7.0	36.0	36.0	104.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill	20' CMP extensions on both ends, connected to old pipe.	Good	Good	Good	Poor	Good	Good	Good	Good	Good	Poor		Good	Good	Fair	Poor	Fair	Fair	Good	Good	Good	Inlet and outlet are CMP mitered end sections. Neither has rust or corrosion on it. Inlet headwall is protected with riprap. Some joint separation on the downstream end.	
D028237	Poor	64.06	05/21/14		Left	Cross	Roadside Drainage	Mitered	Projecting	1.9	5.0	18.0	18.0	66.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill		Good	Good	Good	Critical	Fair	Good	Good	Good	Fair	Poor	Poor	No Data	Good	Fair	Fair	Good	Good	Good	Good	Good	Spiral wound CMP. Inlet is a mitered end section with rust and pitting over almost all of the end treatment. The interior has rust along the bottom 1/4. Outlet is 90% blocked with sediment. End section has some rust and pitting.	
D028238	Poor	64.27	05/21/14	ROSARY CREEK	Left	Cross	Stream	Projecting	Projecting	10.7	13.6	36.0	36.0	89.0	Circular	Corrugated Metal Pipe	36.0	36.0	89.0	Circular	Corrugated Metal Pipe	Roadway Fill	Roadway Fill	Blockage at barrel A, inlet side, embankment pushed down covering end treatment at A.	Good	Good	Good	Good	Fair	Critical	Fair	Good	Good	Poor	Poor	No Data	Good	Fair	Good	Good	Good	Good	Fair	Poor	This is a double barrel culvert however only one barrel was located on the upstream end but two can be seen on the downstream. Culvert B has abrasion up to the spring line with associated rust to nearly the same location. The pipe has sediment in the bottom (approximately 3 inches). Rock was in the culvert and it looks like there is a large alignment deflection near the outlet end.	
D028239	Critical	64.6	06/08/17	ALDER CREEK	Left	Cross	Stream	Projecting	Projecting	7.2	8.6	24.0	24.0	69.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill	Outlet is buried w/water flowing out. 6/8/17 Inlet has a large rotten log very close to inlet. Ratings taken from inlet only. Retake GPS point	Good	Good	Good	Good	Good	Good	Good	Good	Good	Critical	No Data	Critical	Good	Good	Good	Good	Good	Good	Critical	Good	Outlet is buried with a log across it and approximately 50% blocked. Water is flowing out of the culvert. Inlet has some abrasion to almost the spring line and the bottom 1/4 of the pipe has some rust.	
D028240	Poor	64.62	05/21/14		Left	Cross	Roadside Drainage	Projecting	Projecting	6.2	7.4	18.0	18.0	63.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill		Good	Good	Good	Good	Good	Good	Good	Good	Good	Poor	Poor	Critical	Good	Fair	Good	Good	Good	Good	Good	Good	DID NOT LOCATE.	
D028256	Critical	66.47	06/13/17		Left	Cross	Roadside Drainage	Projecting	Projecting	5.9	6.3	18.0	18.0	67.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill	No ratings were done due to limited viewing distance.	Good	Good	Good	Critical	Fair	Good	Good	Good	Fair	Poor	No Data	Poor	No Data	No Data	No Data	No Data	No Data	No Data	No Data	Good	Fair	Inlet has sediment along its left radius. It is corroded on the bottom 1/3. The outlet is in a depression that has been excavated around it. Water was ponding at the outlet. The end of the pipe was damaged.	
D028257	Critical	66.61	05/21/14	NO SEE EM CREEK	Left	Cross	Stream	Projecting	No Data	3.1		18.0	18.0	63.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill	CNL outlet, all prior estimates changed to no rating.	Good	Good	Good	Good	Good	No Rating	Good	No Rating	Good	Critical		Critical	No Rating	No Rating	Poor	No Rating	No Rating	No Rating	Good	Good	Pipe is deformed at the inlet and 1/4 buried with sediment. Both the interior and exterior has rust and pitting on it.	
D028267	Critical	70.83	06/13/17		Left	Cross	Roadside Drainage	Stand Pipe	Projecting	0.5	7.5	18.0	18.0	111.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill	Input from Diamond Peaks housing development. Culvert material becomes conc. at center to outlet. Needs investigated for other pipes entering and leaving the MH.	Good	Good	Good	Good	Good	Good	Good	Good	Fair	Poor	No Data	Poor	No Data	No Data	No Data	No Data	No Data	No Data	Good	Good	The surface structure is a CMP standpipe from Diamond Peaks development that is protected by stacked riprap. The standpipe is approximately 2 feet above grade. A MH is located in the roadway, which was not opened for inspection. The outlet is south of the highway and is concrete. An 18" CMP with mitered end section is NW of the stand pipe and has a 45 degree bend in it. It either goes to the standpipe or to the MH. This needs more investigation/locating.	
D034770	Poor	71.31	05/21/14		Left	Cross	Roadside Drainage	Projecting	Projecting	3.3	5.9	24.0	24.0	105.0	Circular	Conc Pipe						Roadway Fill	Roadway Fill	Inlet end has a CMP extension that is damaged.	Good	Good	Good	Critical	Fair	Good	Good	Good	Fair	Poor	Poor	Critical	Good	Good	Fair	Good	Fair	Good	Good	Good	Inlet is a crushed CMP and is also full sediment. The embankment is eroding above it from roadway runoff. The outlet is 3/4 full of sediment.	
D028269	Poor	72.36	07/13/16		Left	Cross	Roadside Drainage	Projecting	Projecting	7.1	8.5	24.0	24.0	146.0	Circular	Corrugated Metal Pipe						Roadway Fill	Roadway Fill	Culvert material changes from CMP to CDN near center to outlet.	Good	Good	Good	Fair	Good	Good	Good	Good	Good	Poor	Poor	No Data	Good	Fair	Fair	Good	Fair	Good	Good	Good	Inlet is a 24" CMP pipe and outlet is a 18" concrete pipe. Inlet is corroded and full of sediment up to the spring line. Outlet is approximately 1/4 full of sediment. Several of the joints have settled. The pipe has water marks and light abrasion up to the spring line.	
D028273	Critical	84.68	06/13/17		Right	Cross	Roadside Drainage	Projecting	Projecting	16.8	21.5	24.0	24.0	101.0	Circular	Conc Pipe						Roadway Fill	Roadway Fill	From inlet end about 10 sections in the crown is cracking/buckling on a section. Outlet end treatment fair due to joint.	Good	Good	Good	Good	Good	Good	Good	Good	Fair	Critical	Critical	Fair	Critical	Good	Good	Critical	Good	Good	Good	Good	Inlet is approximate 1/2 full of sediment. The crown is buckling approximately 10 sections downstream. Sediment has accumulated in the pipe. Another joint closer to the inlet, has separated at least 2 inches. The outlet has a couple of the sections that have separated and abrasion at the joint has occurred.	

APPENDIX

B DRAINAGE BASIN MAPS

Culvert DFI No.	Location (MP)	Sheet Number
D034723	2.73	B-2
D027825	13.07	B-3
D027828	13.56	B-3
D027832	13.93	B-4
D027833	14.03	B-4
D027842	15.51	B-5
D034741	17.29	B-6
D027990	26.27	B-7
D027992	26.6	B-7
D028033	31.47	B-9
D028041	33.54	B-10
D028044	33.65	B-10
D028045	33.79	B-10
D028047	36.73	B-11

Culvert DFI No.	Location (MP)	Sheet Number
D028050	37.31	B-12
D028051	37.56	B-12
D028052	37.68	B-12
D028053	37.89	B-12
D028071	40.92	B-13
D028074	41.5	B-14
D034764	41.58	B-14
D034765	41.811	B-14
D028076	41.91	B-13
D028077	42.01	B-14
D028078	42.12	B-13
D028082	42.5	B-13
D028086	43.26	B-15
D028088	43.43	B-15

Culvert DFI No.	Location (MP)	Sheet Number
D028090	43.54	B-15
D028091	43.74	B-16
D028094	43.99	B-15
D028095	44.06	B-16
D028100	44.36	B-16
D028107	44.96	B-17
D028108	45.03	B-17
D028109	45.35	B-17
D028124	46.75	B-18
D028127	46.89	B-18
D028128	47.07	B-18
D028130	47.46	B-18
D028131	47.57	B-18
D028132	47.8	B-18

Culvert DFI No.	Location (MP)	Sheet Number
D028137	49.41	B-19
D028139	49.99	B-19
D028142	50.3	B-19
D028158	53.56	B-20
D028159	53.69	B-20
D028160	53.76	B-20
D028161	53.83	B-20
D028163	53.95	B-20
D028186	57.77	B-21
D028188	57.96	B-21
D028238	64.27	B-22
D028273	84.68	B-23

Appendix B: Drainage Basins (Key)

Appendix B: Drainage Basins

Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR DOT 18(2) OR-58 Fix-It Corridor Culverts

0 25 50 100 150 200 Feet

wsp

Appendix B: Drainage Basins

Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR DOT 18(2) OR-58 Fix-It Corridor Culverts

0 125 250 500 750 1,000 Feet

wsp

Appendix B: Drainage Basins

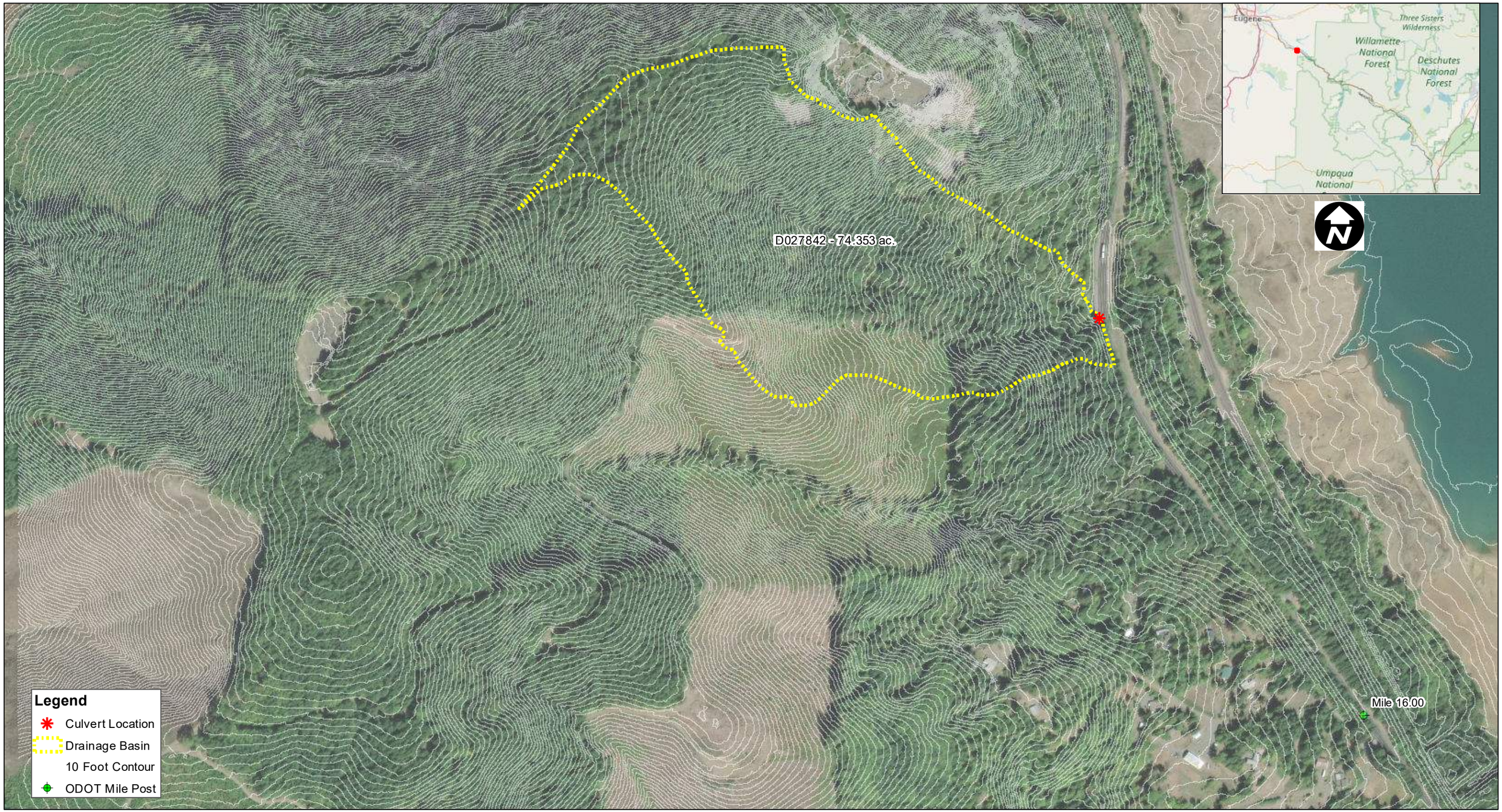
Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR DOT 18(2) OR-58 Fix-It Corridor Culverts

0 100 200 400 600 800 Feet

wsp



Appendix B: Drainage Basins

Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR DOT 18(2) OR-58 Fix-It Corridor Culverts

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

wsp

Appendix B: Drainage Basins

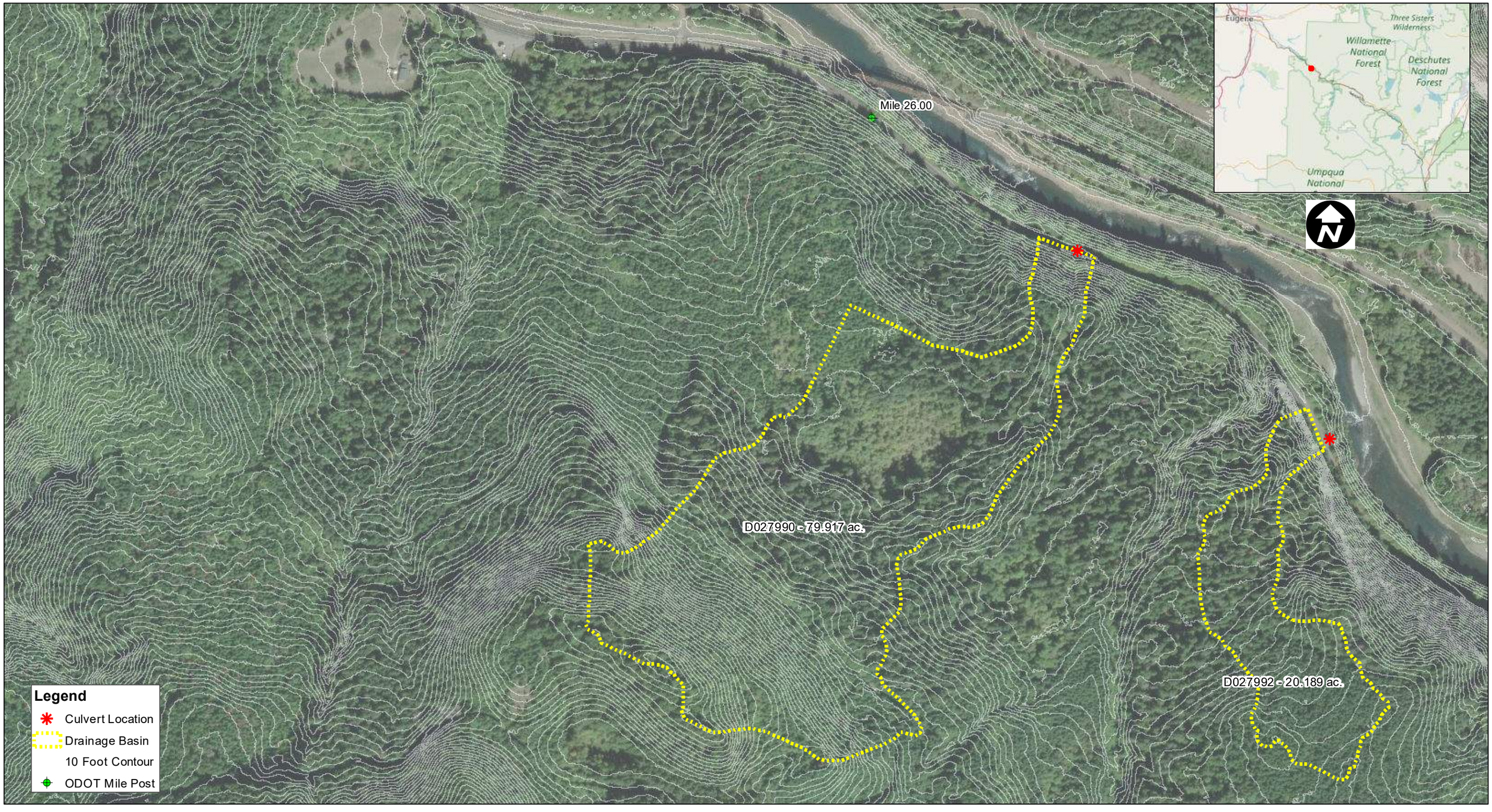
Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR DOT 18(2) OR-58 Fix-It Corridor Culverts

0 150 300 600 900 1,200 Feet

wsp



Appendix B: Drainage Basins

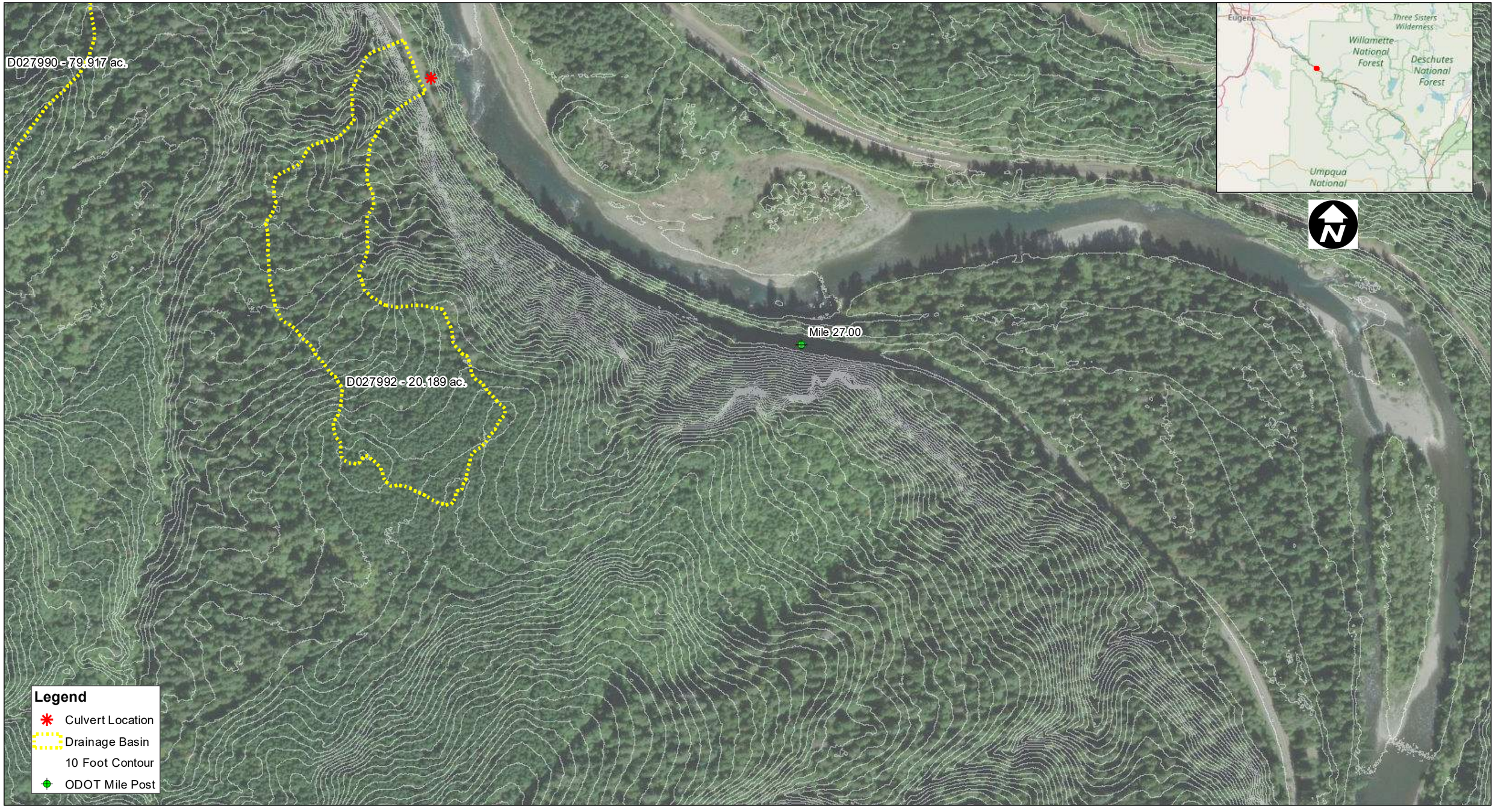
Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR DOT 18(2) OR-58 Fix-It Corridor Culverts

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

wsp



Appendix B: Drainage Basins

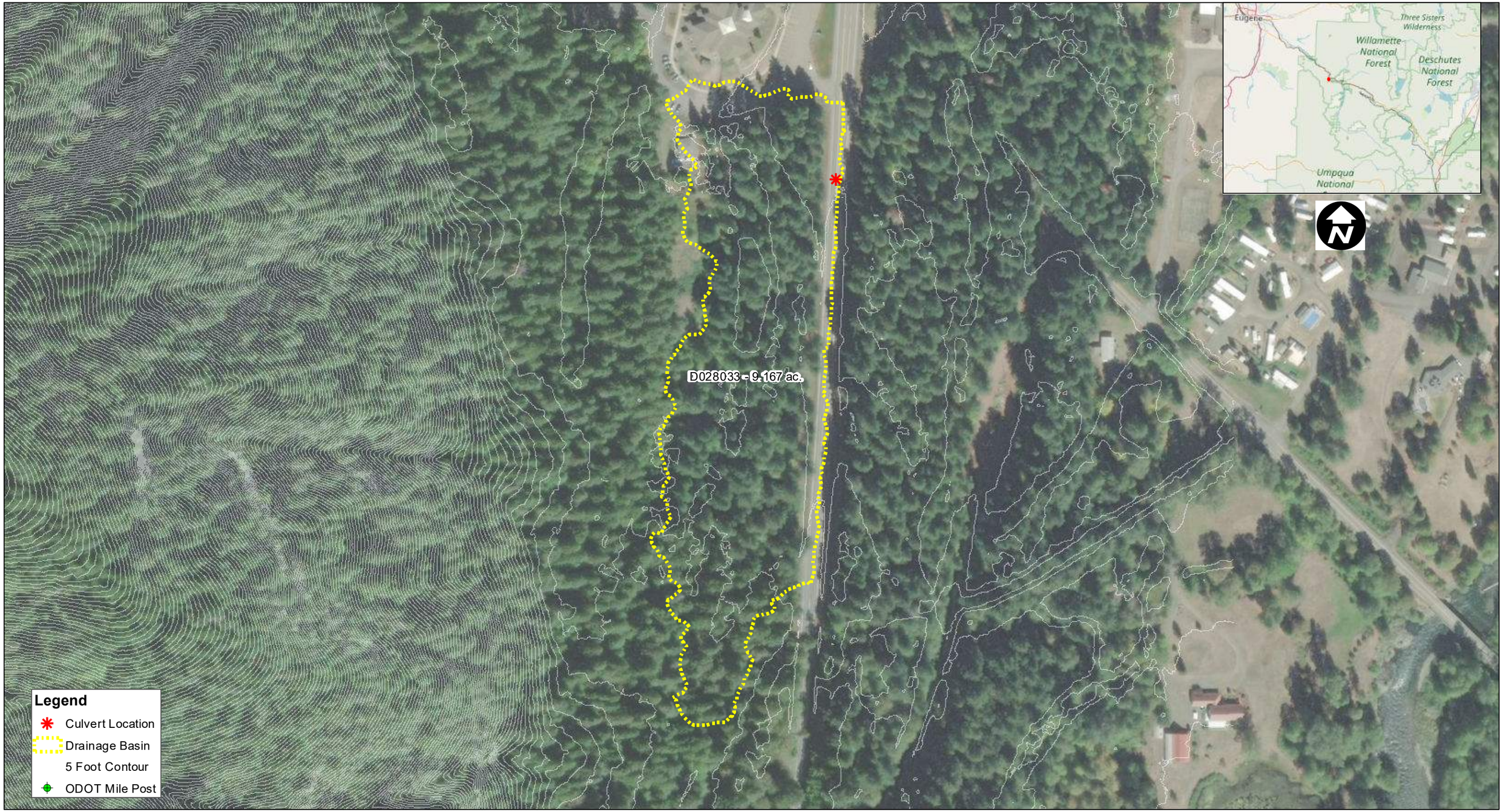
Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR DOT 18(2) OR-58 Fix-It Corridor Culverts

0 200 400 800 1,200 1,600 Feet

wsp



Appendix B: Drainage Basins

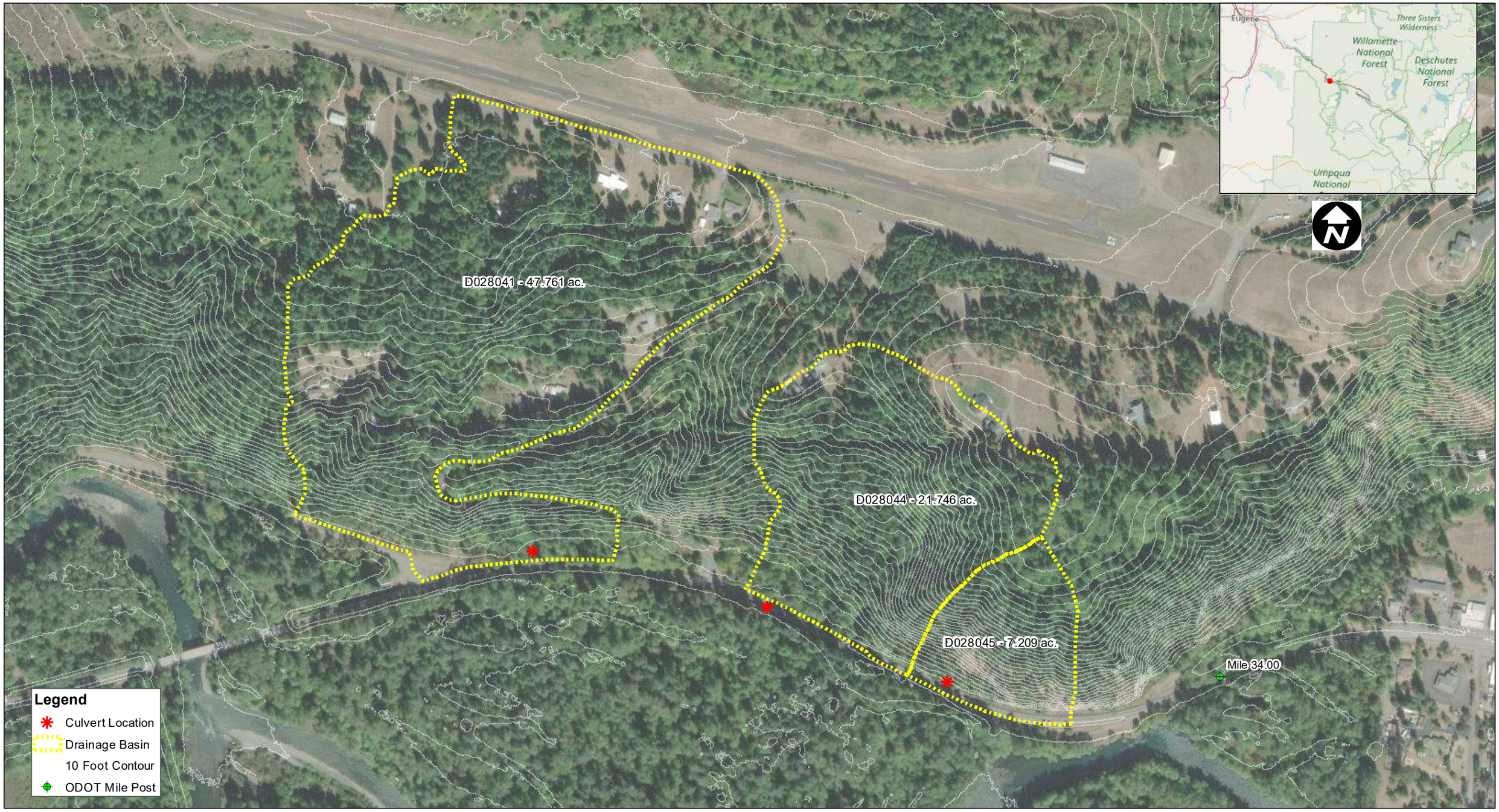
Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR DOT 18(2) OR-58 Fix-It Corridor Culverts

0 100 200 400 600 800 Feet

wsp



Appendix B: Drainage Basins

Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR DOT 18(2) OR-58 Fix-It Corridor Culverts

0 175 350 700 1,050 1,400 Feet

wsp

Appendix B: Drainage Basins

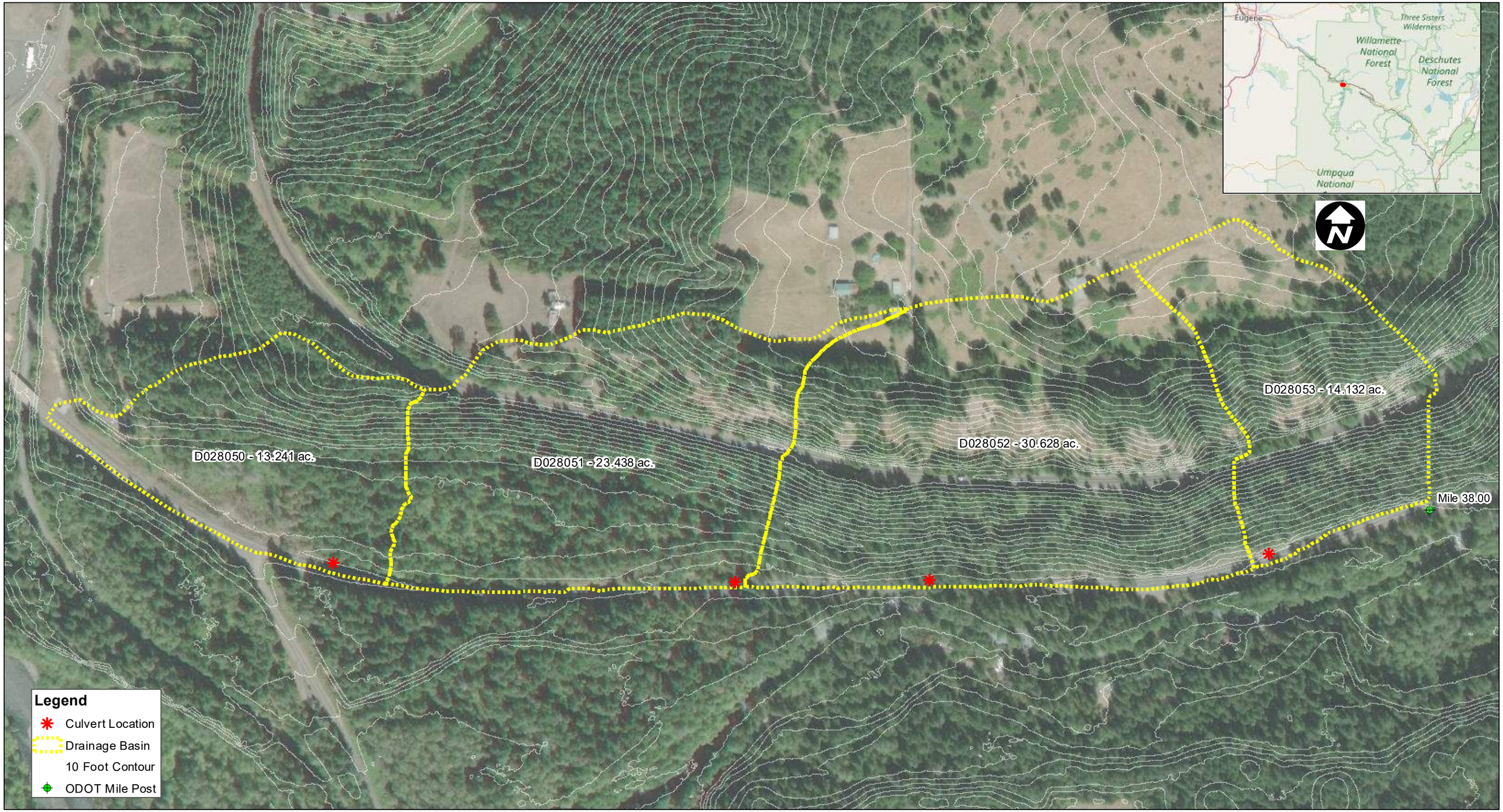
Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR DOT 18(2) OR-58 Fix-It Corridor Culverts

0 100 200 400 600 800 Feet

wsp



Appendix B: Drainage Basins

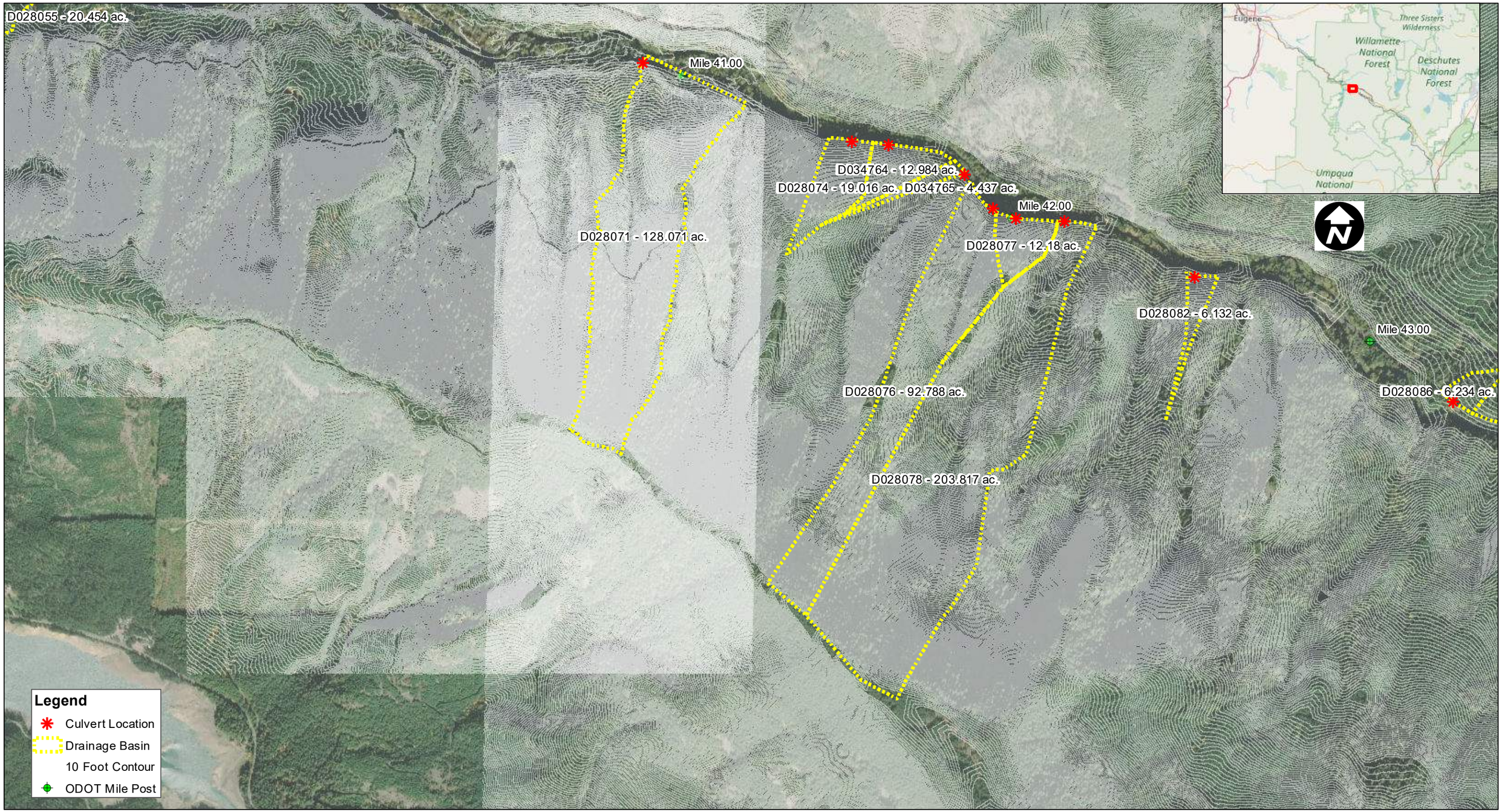
Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR DOT 18(2) OR-58 Fix-It Corridor Culverts

0 150 300 600 900 1,200 Feet

wsp



Appendix B: Drainage Basins

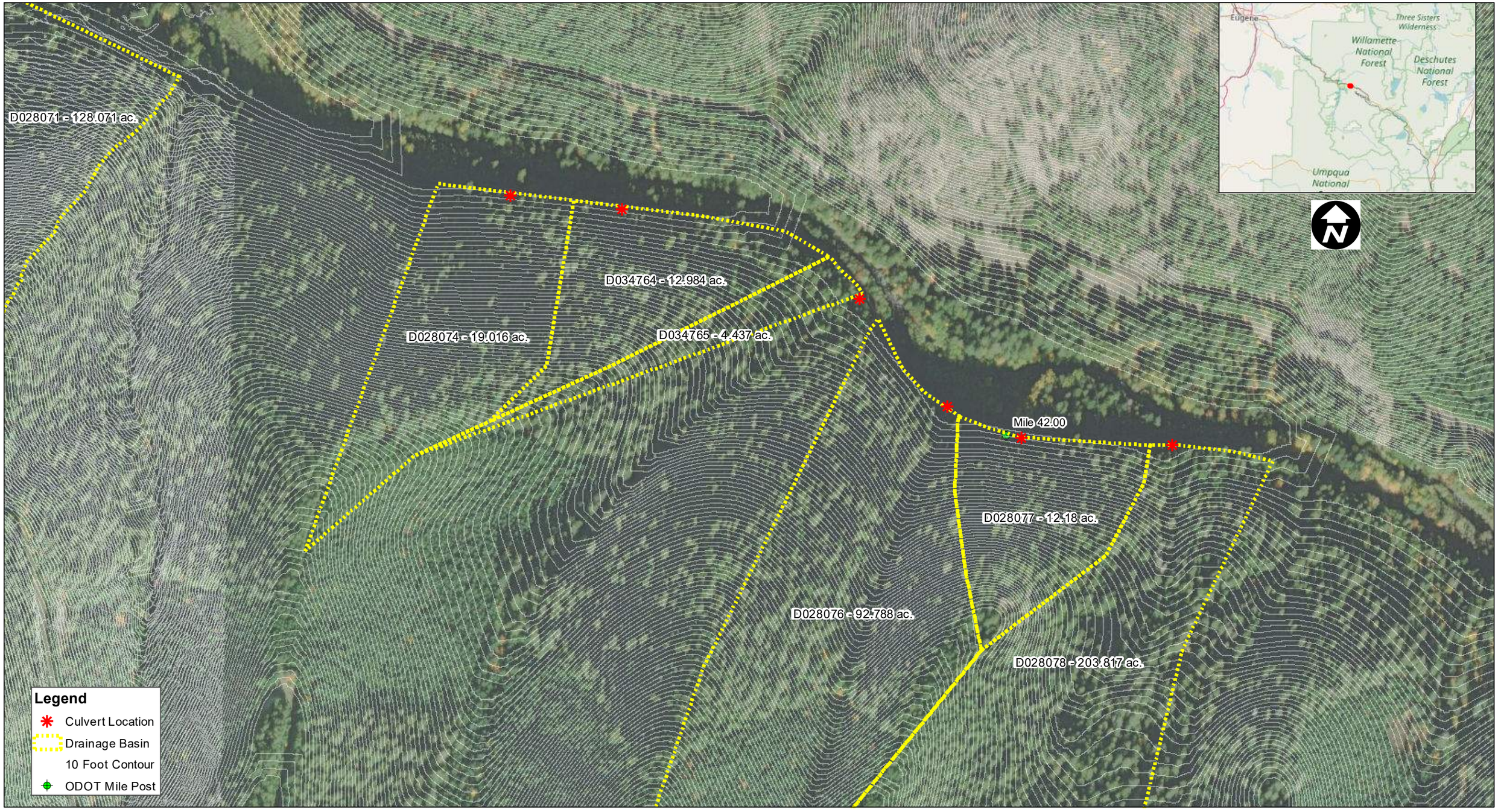
Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR DOT 18(2) OR-58 Fix-It Corridor Culverts

0 625 1,250 2,500 3,750 5,000 Feet

wsp



Appendix B: Drainage Basins

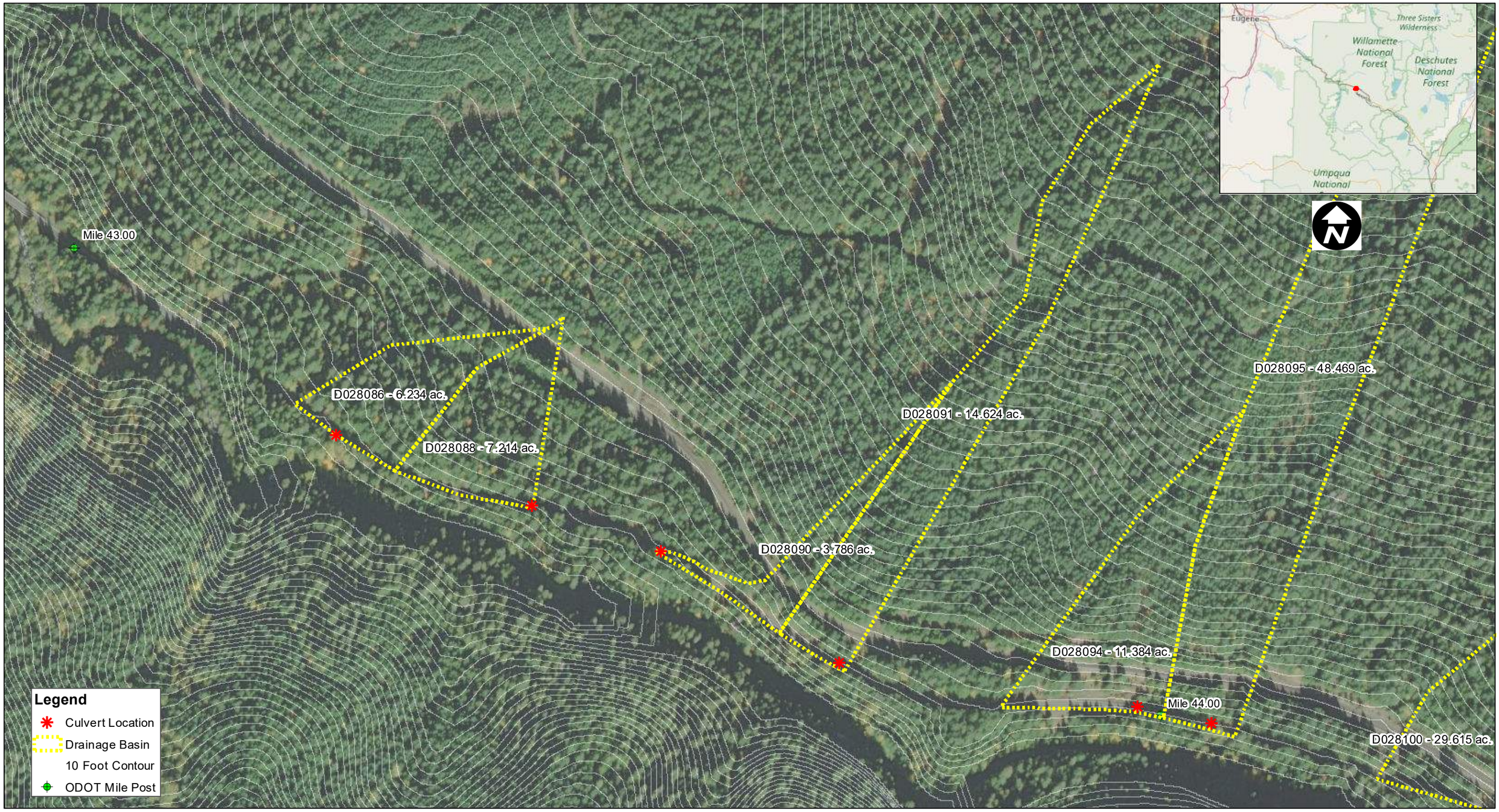
Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR DOT 18(2) OR-58 Fix-It Corridor Culverts

0 200 400 800 1,200 1,600 Feet

wsp



Appendix B: Drainage Basins

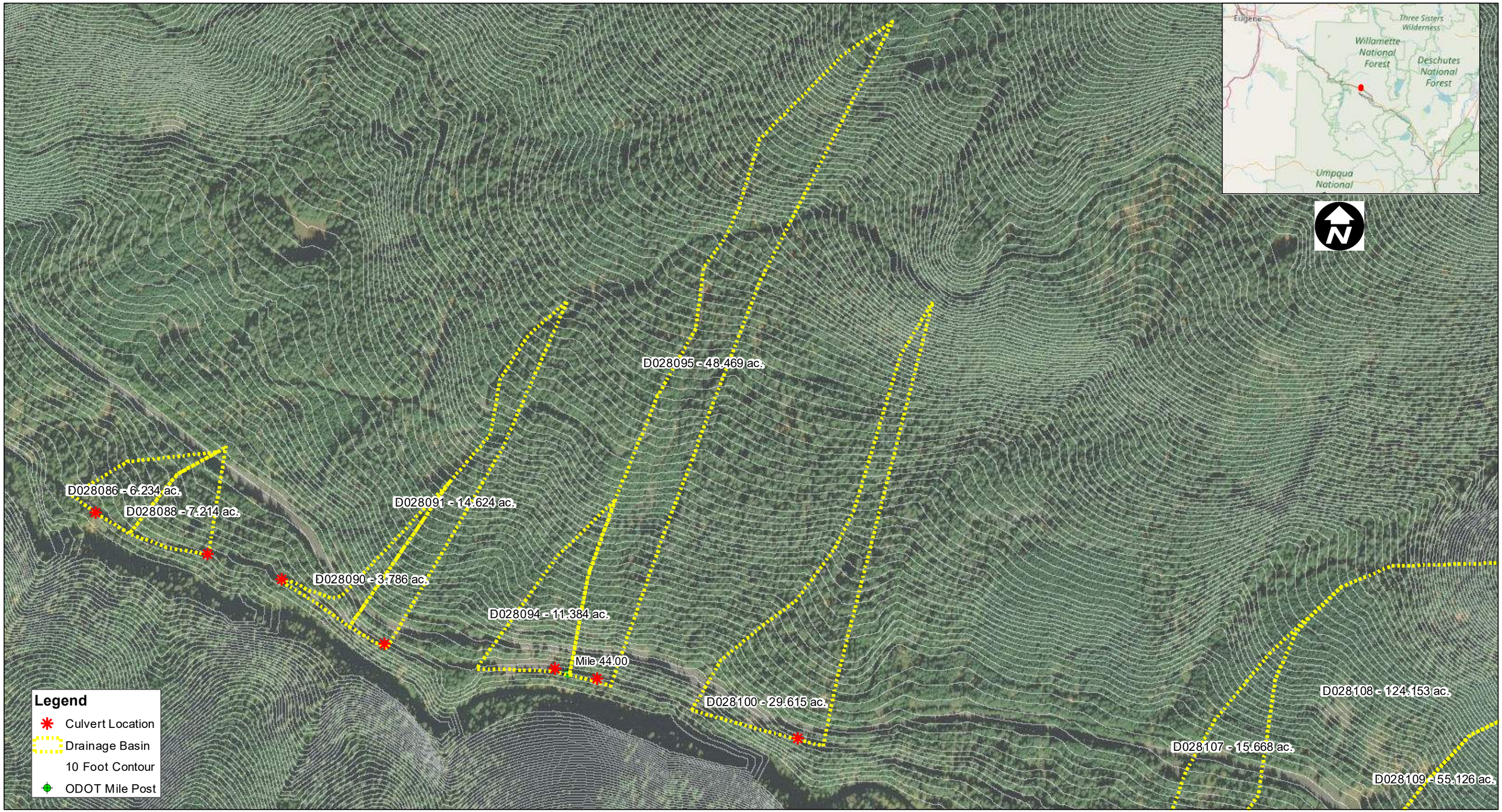
Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR DOT 18(2) OR-58 Fix-It Corridor Culverts

0 200 400 800 1,200 1,600 Feet

wsp



Appendix B: Drainage Basins

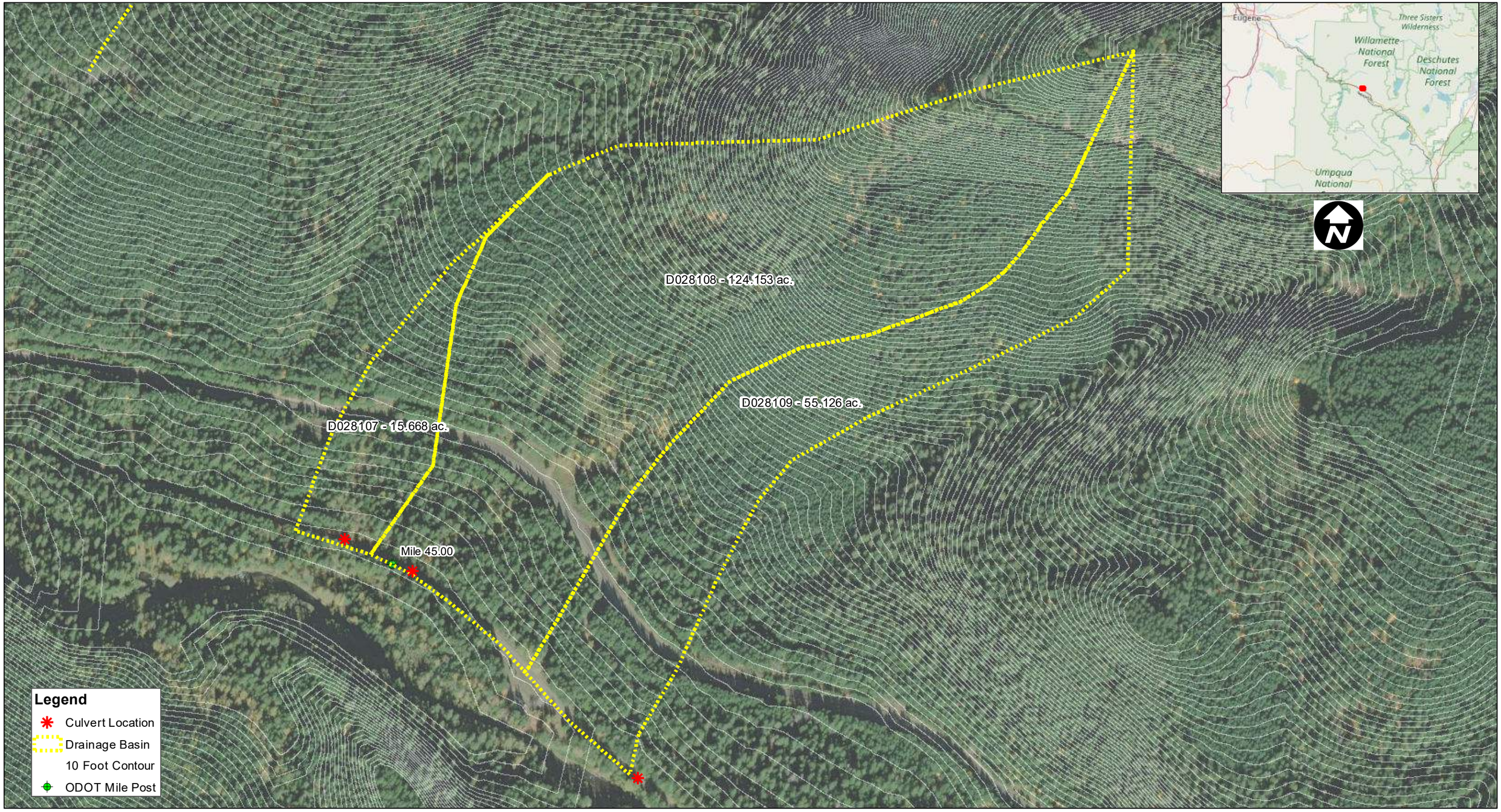
Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR DOT 18(2) OR-58 Fix-It Corridor Culverts

0 350 700 1,400 2,100 2,800 Feet

wsp



Appendix B: Drainage Basins

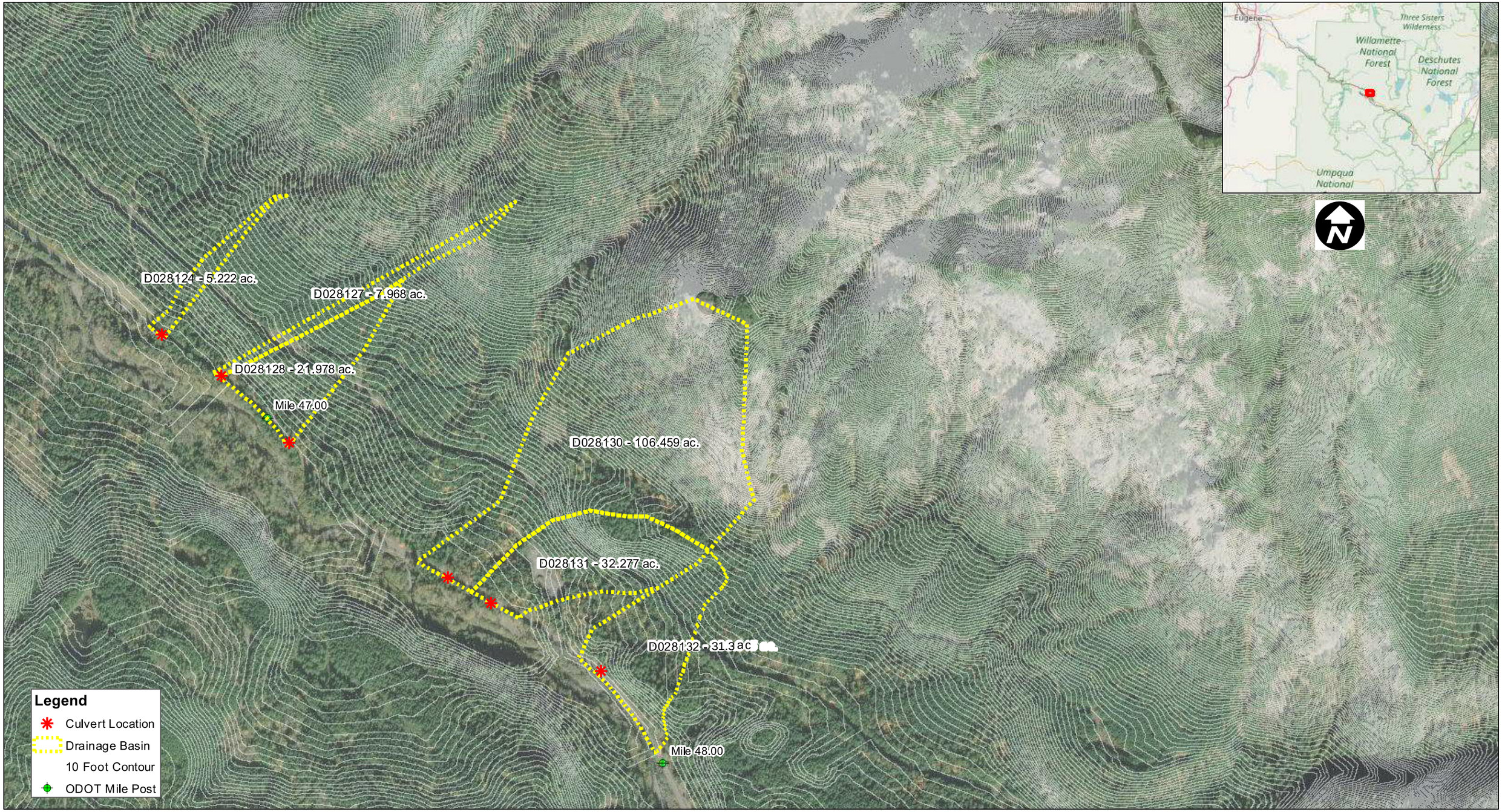
Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR DOT 18(2) OR-58 Fix-It Corridor Culverts

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

wsp



Appendix B: Drainage Basins

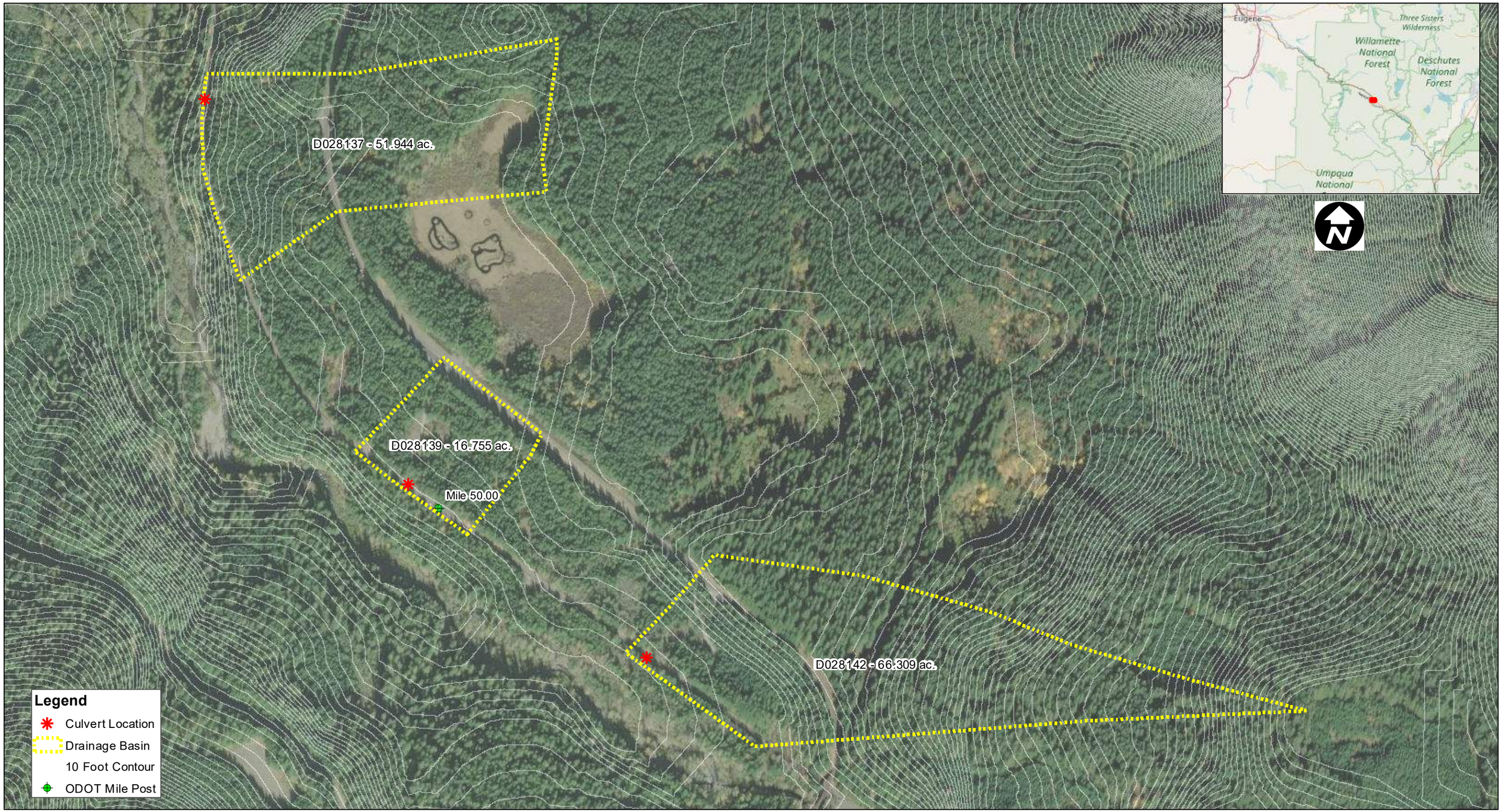
Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR DOT 18(2) OR-58 Fix-It Corridor Culverts

0 450 900 1,800 2,700 3,600 Feet

wsp



Appendix B: Drainage Basins

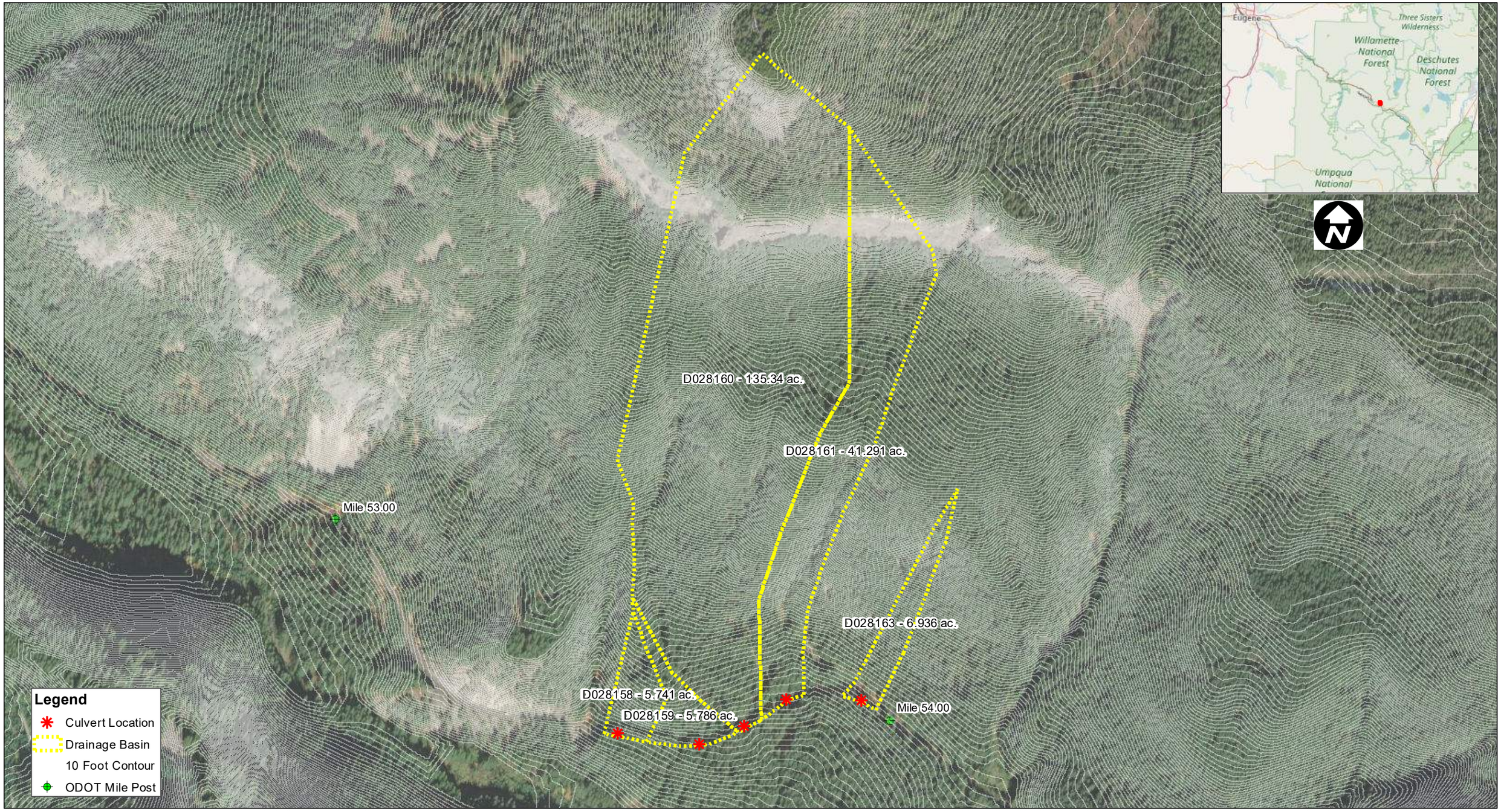
Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR DOT 18(2) OR-58 Fix-It Corridor Culverts

0 300 600 1,200 1,800 2,400 Feet

wsp



Appendix B: Drainage Basins

Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR DOT 18(2) OR-58 Fix-It Corridor Culverts

0 350 700 1,400 2,100 2,800 Feet

wsp

Appendix B: Drainage Basins

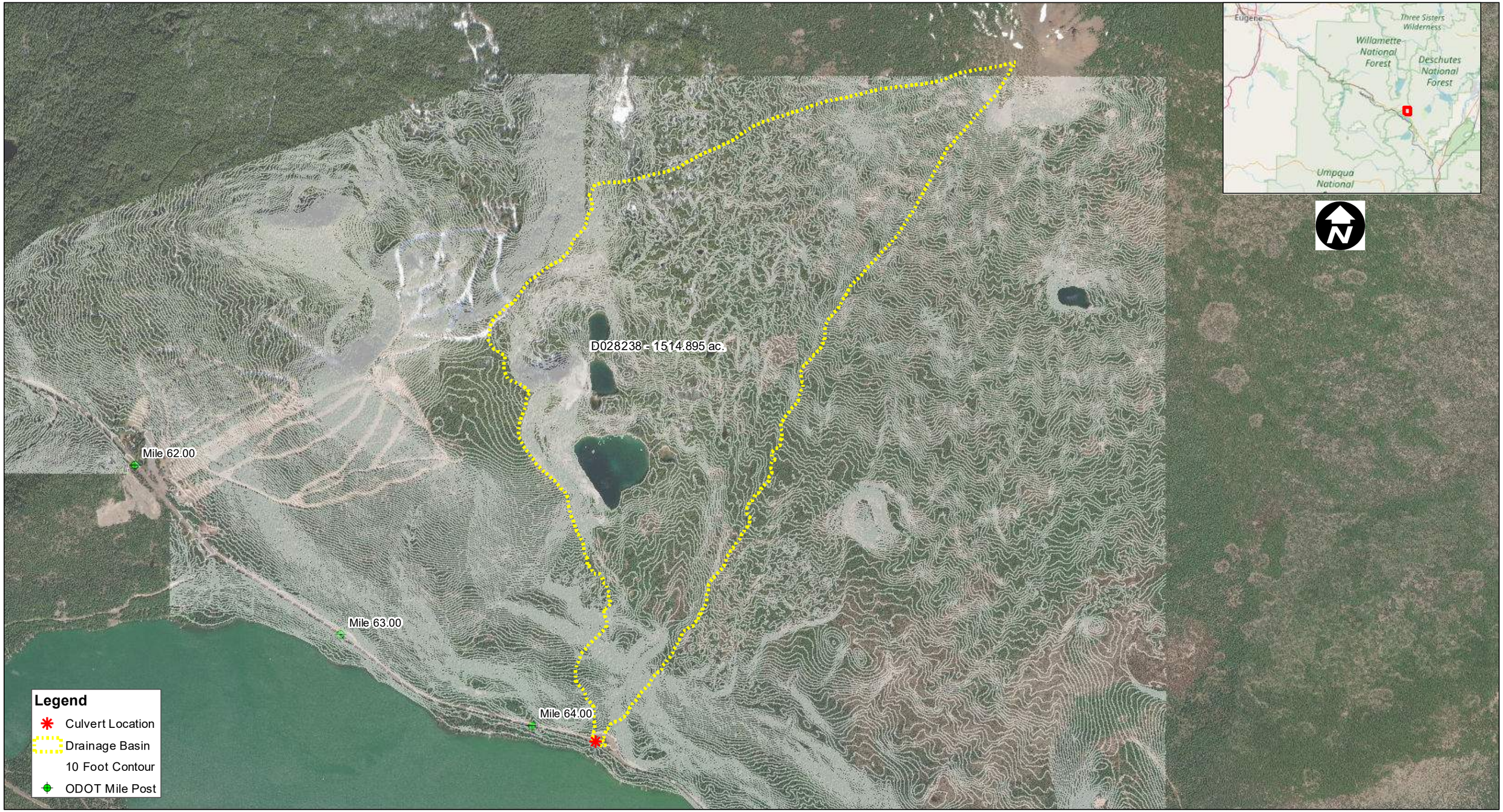
Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR DOT 18(2) OR-58 Fix-It Corridor Culverts

0 75 150 300 450 600 Feet

wsp



Appendix B: Drainage Basins

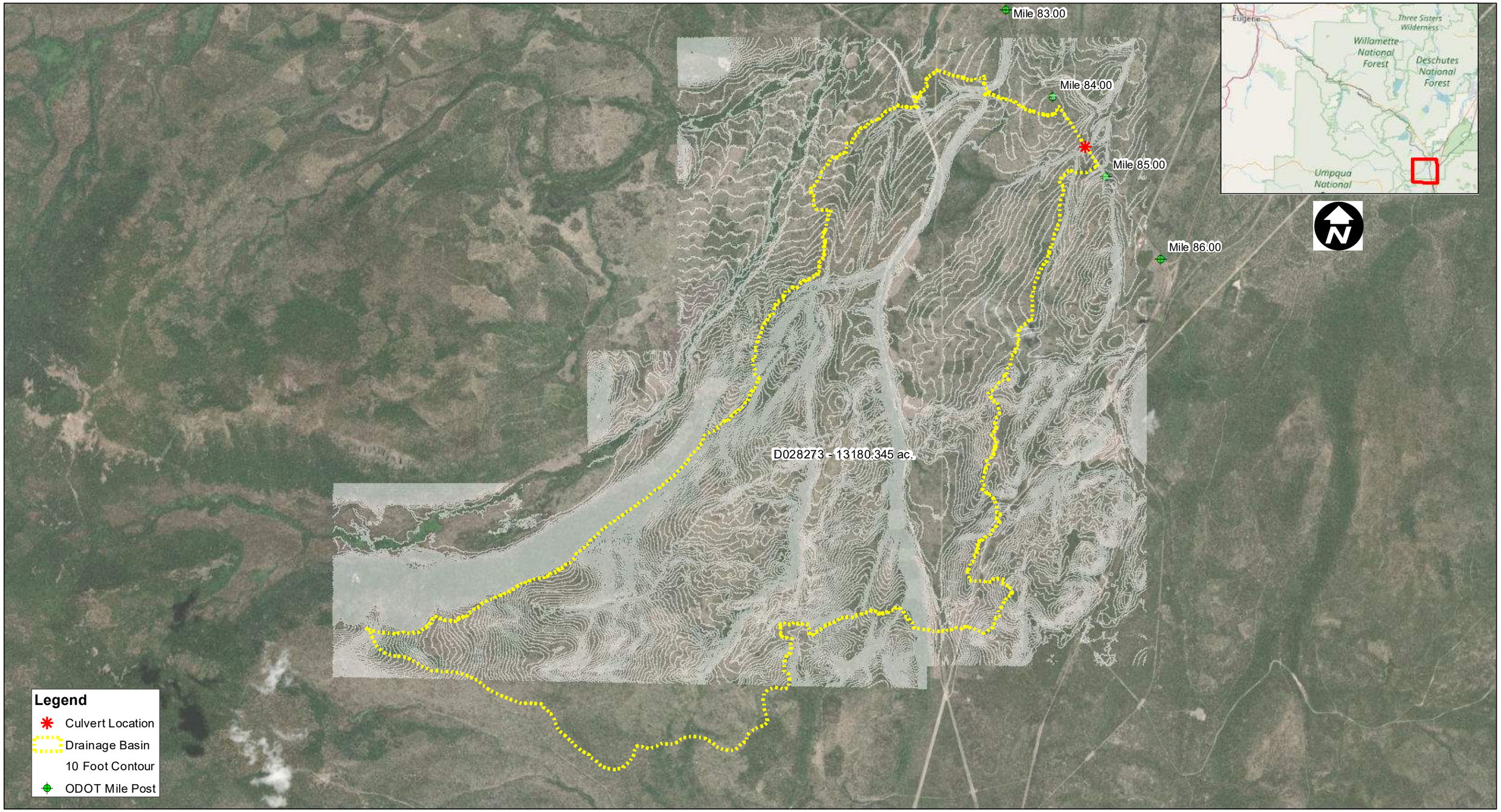
Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR DOT 18(2) OR-58 Fix-It Corridor Culverts

0 1,000 2,000 4,000 6,000 8,000 Feet

wsp



Appendix B: Drainage Basins

Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR DOT 18(2) OR-58 Fix-It Corridor Culverts

0 2,500 5,000 10,000 15,000 20,000 Feet

wsp

APPENDIX

C SOILS MAPS

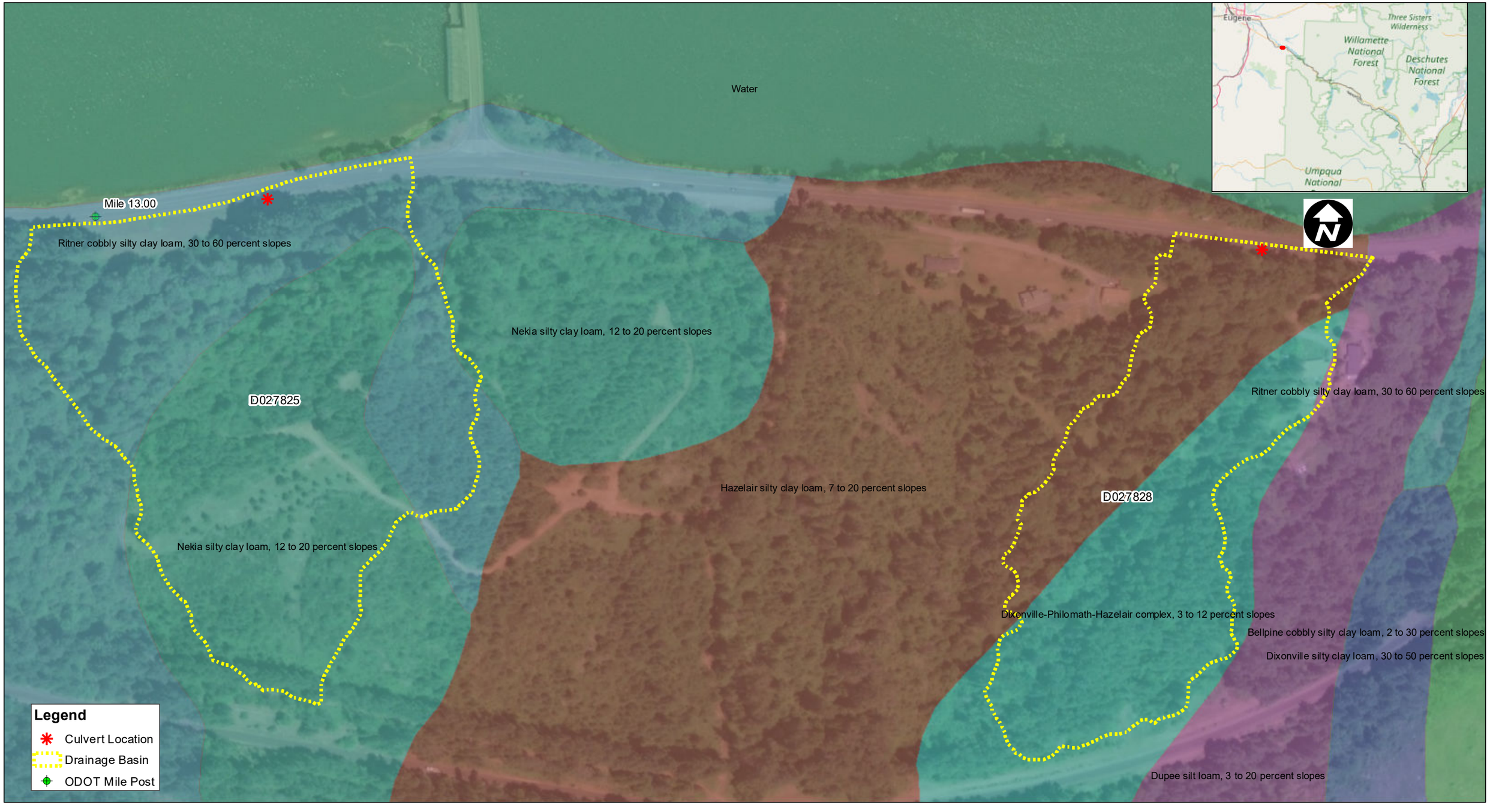
Appendix C: Soils Map

OR-58 Fix-It Corridor Culverts

0 15 30 60 90 120 Feet

Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation



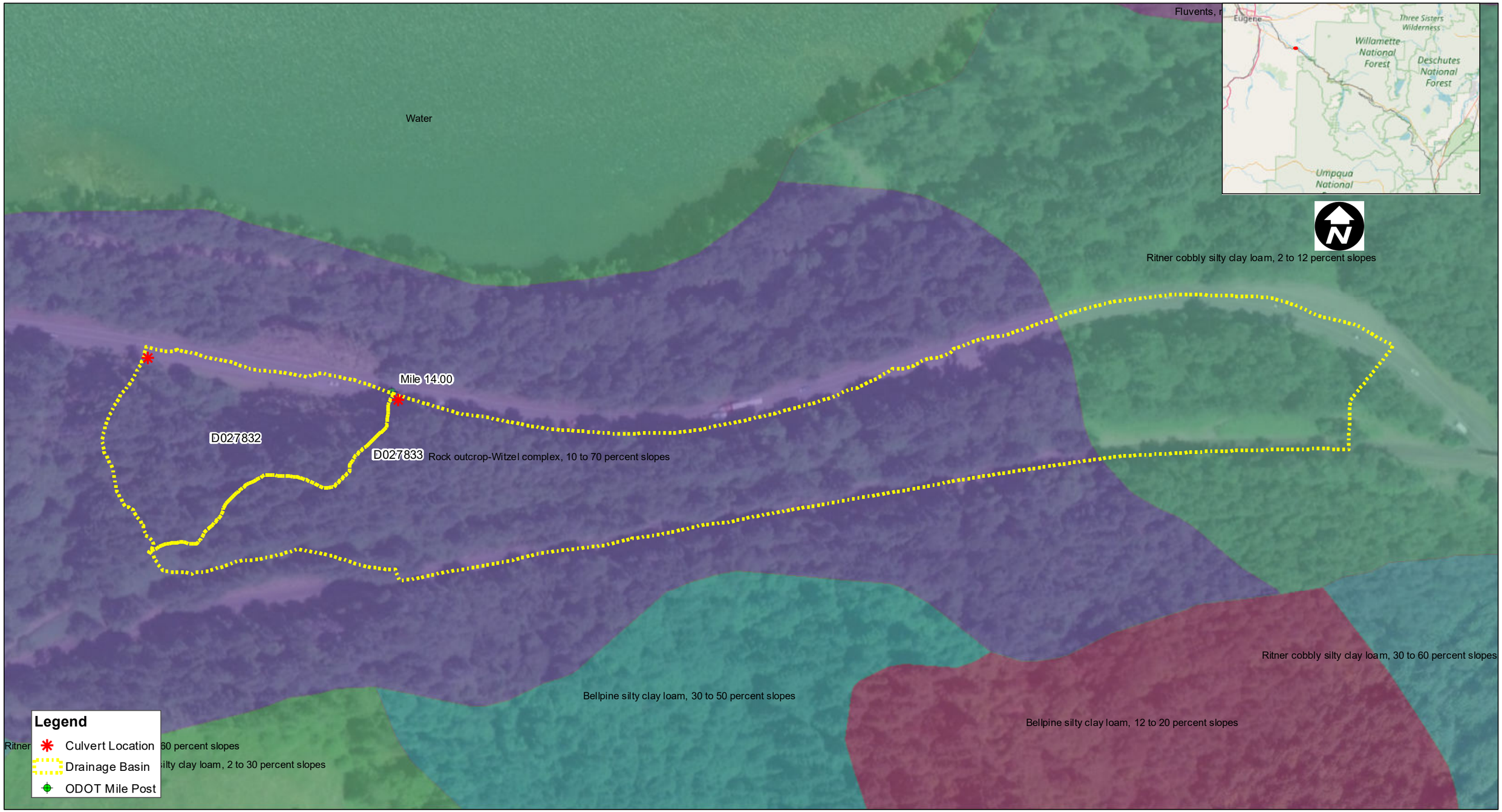
Appendix C: Soils Map

Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR-58 Fix-It Corridor Culverts

0 112.5 225 450 675 900 Feet



Appendix C: Soils Map

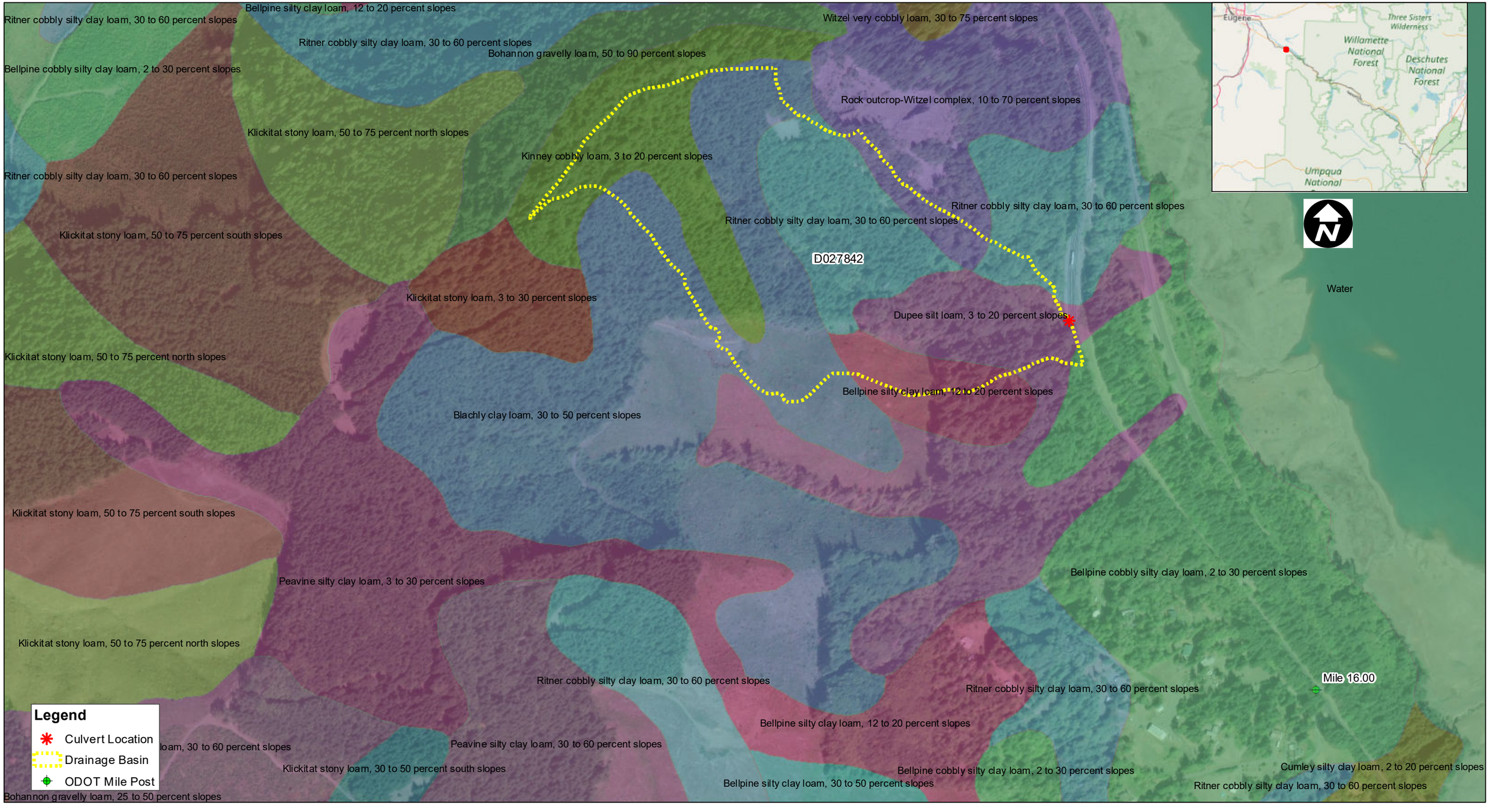
Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR-58 Fix-It Corridor Culverts

0 85 170 340 510 680 Feet

wsp



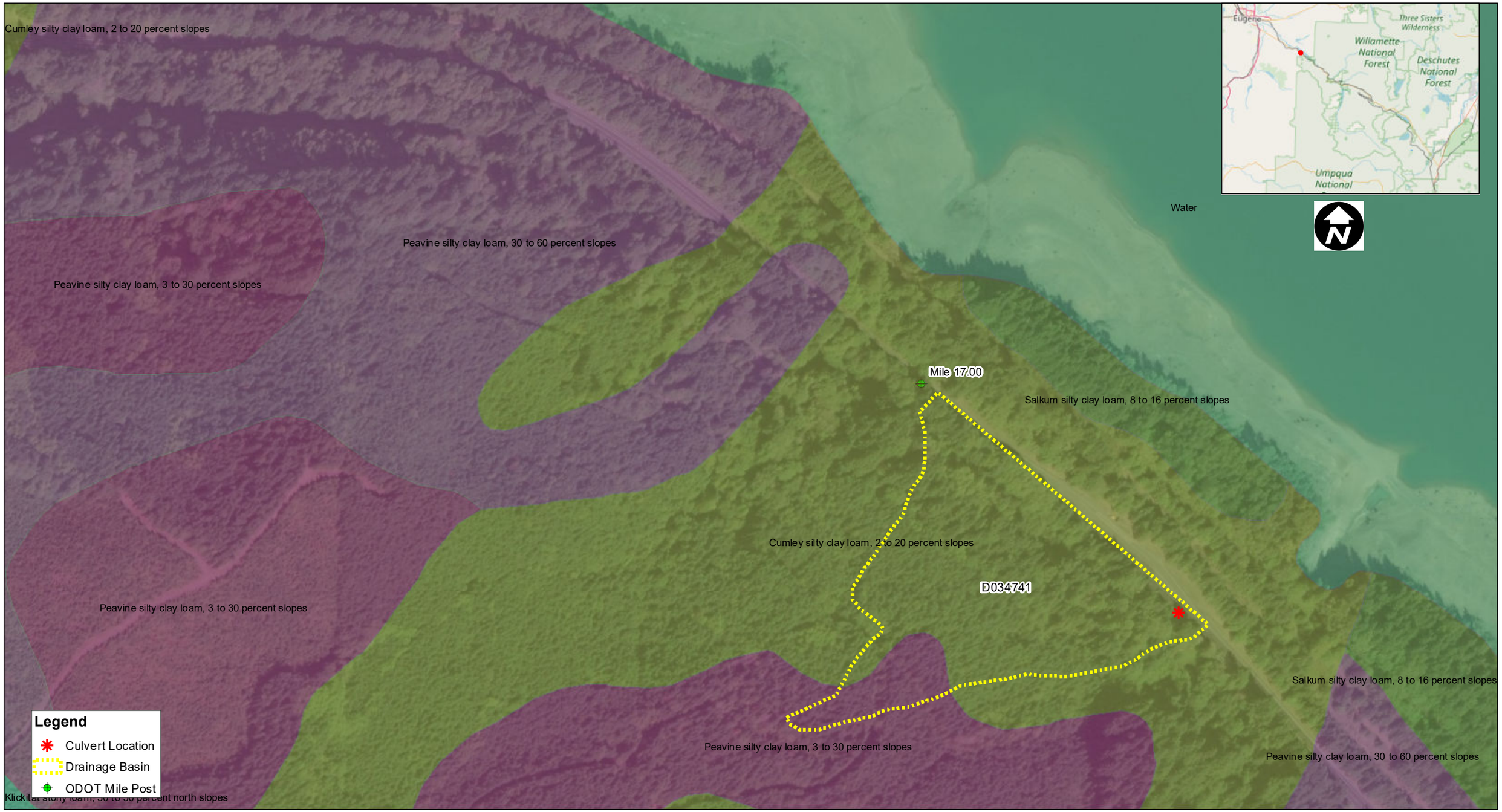
Appendix C: Soils Map

Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR-58 Fix-It Corridor Culverts

0 270 540 1,080 1,620 2,160 Feet



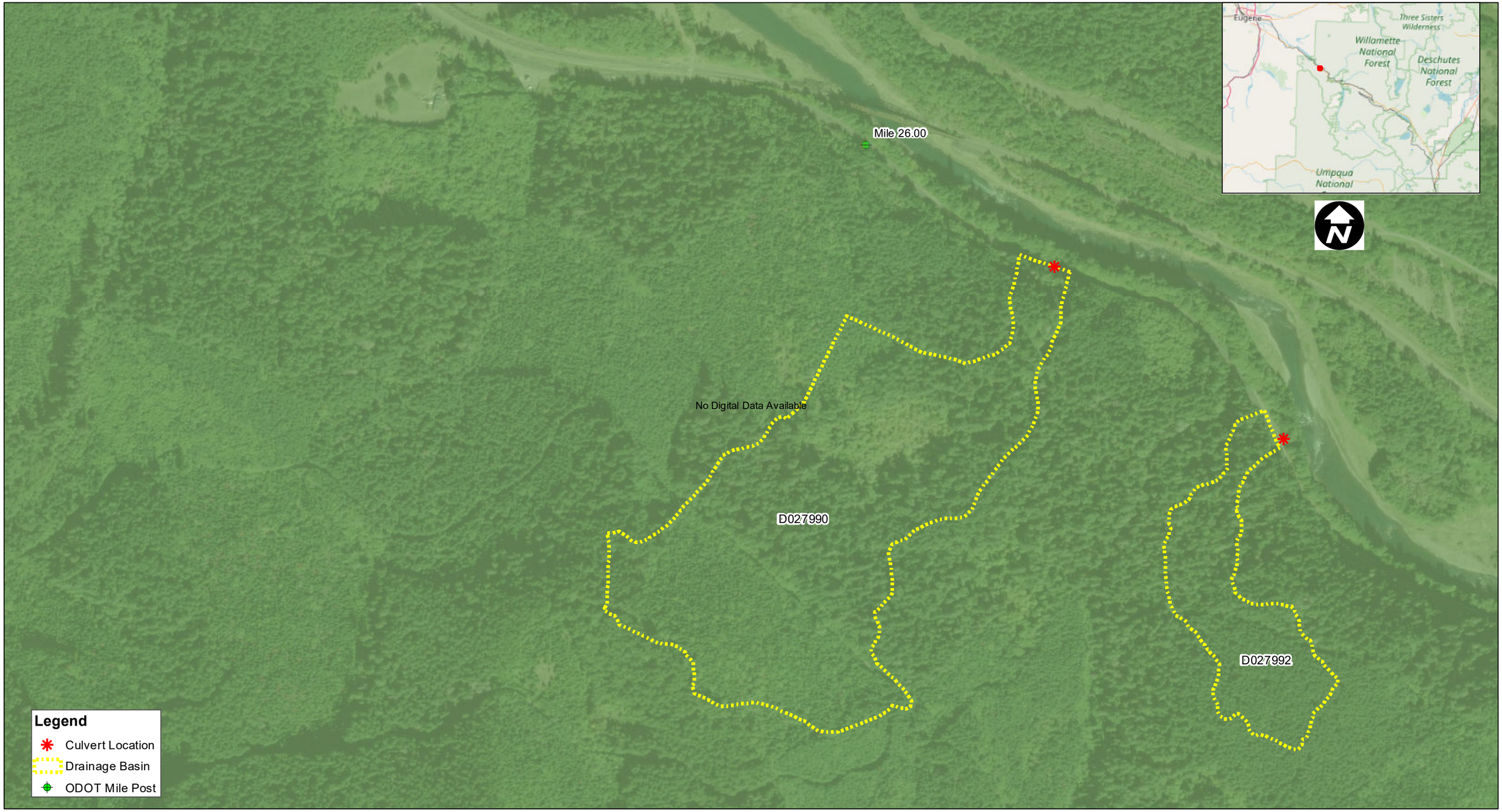
Appendix C: Soils Map

Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR-58 Fix-It Corridor Culverts

0 150 300 600 900 1,200 Feet



Appendix C: Soils Map

Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR-58 Fix-It Corridor Culverts

0 275 550 1,100 1,650 2,200 Feet

WSP

Appendix C: Soils Map

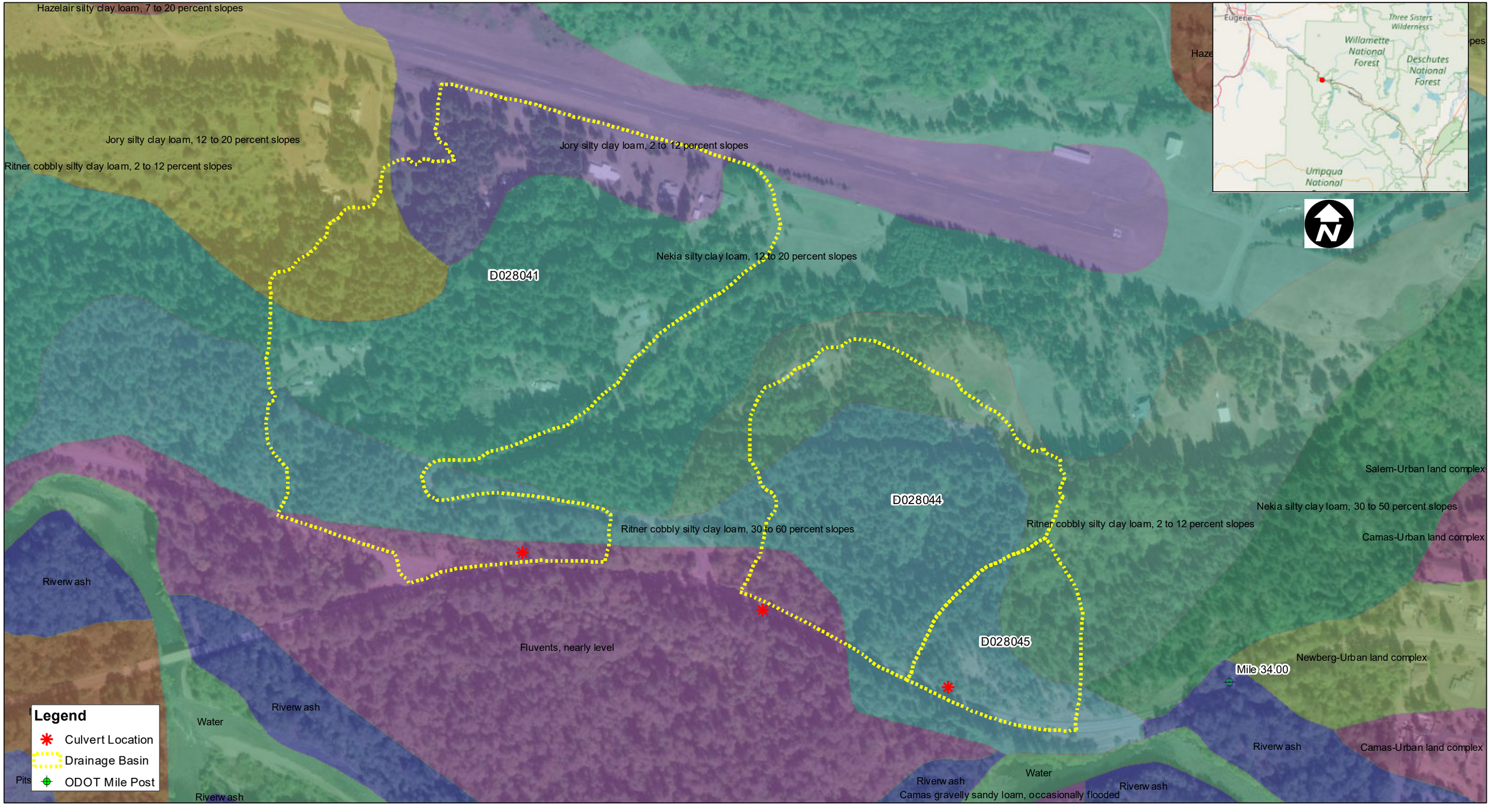
Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR-58 Fix-It Corridor Culverts

0 95 190 380 570 760 Feet

wsp



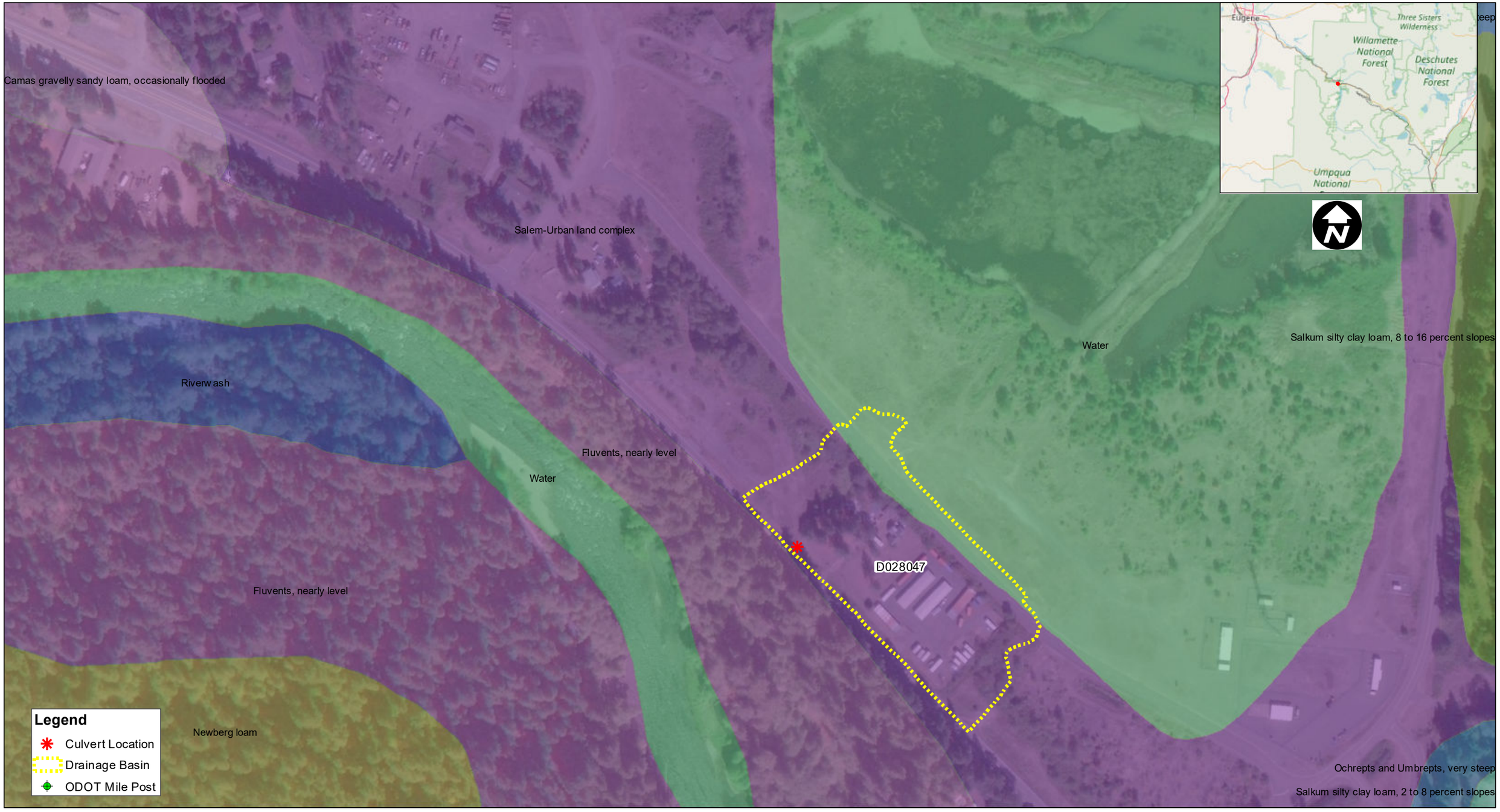
Appendix C: Soils Map

Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR-58 Fix-It Corridor Culverts

0 170 340 680 1,020 1,360 Feet



Appendix C: Soils Map

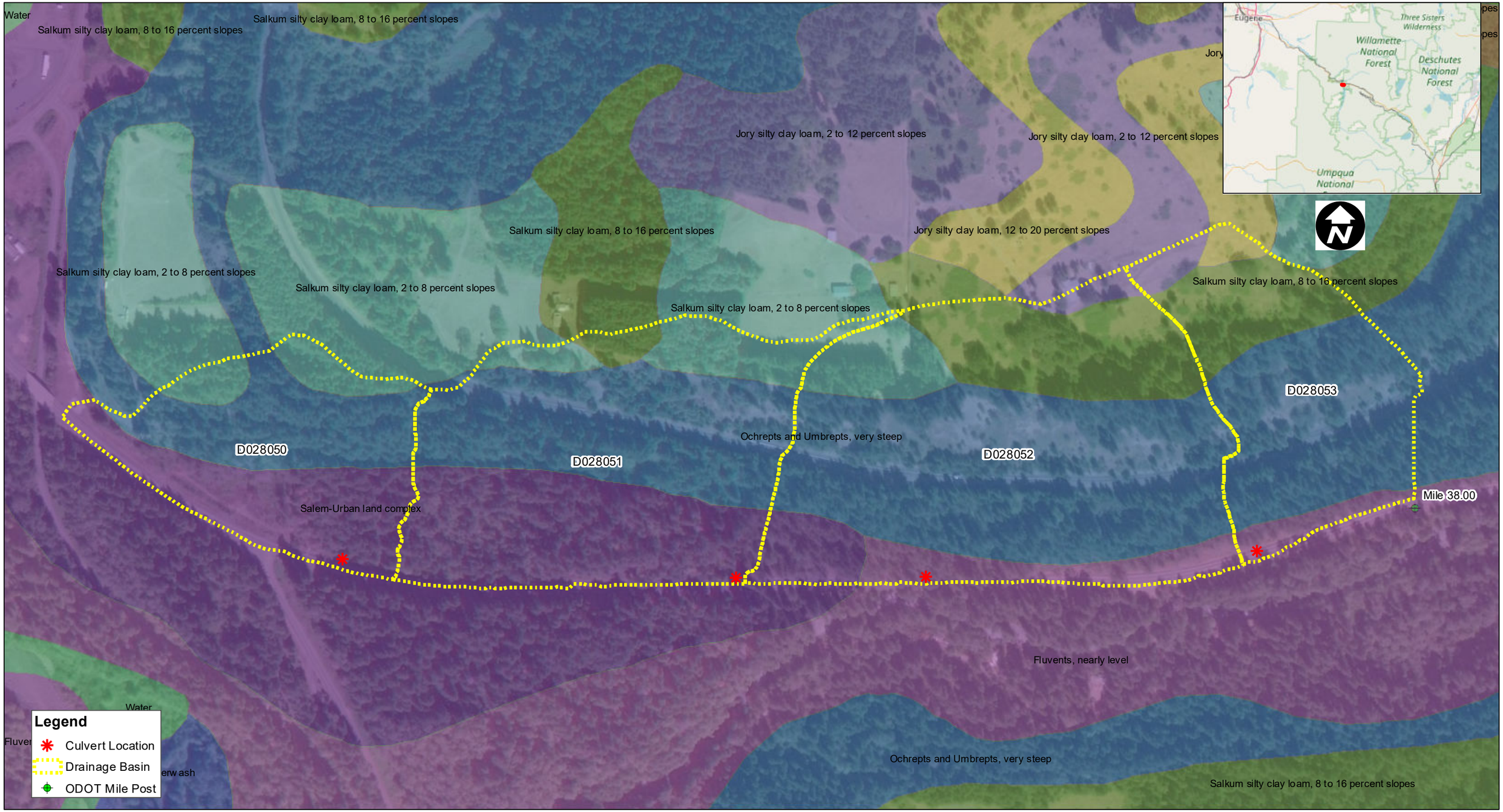
Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR-58 Fix-It Corridor Culverts

0 100 200 400 600 800 Feet

wsp



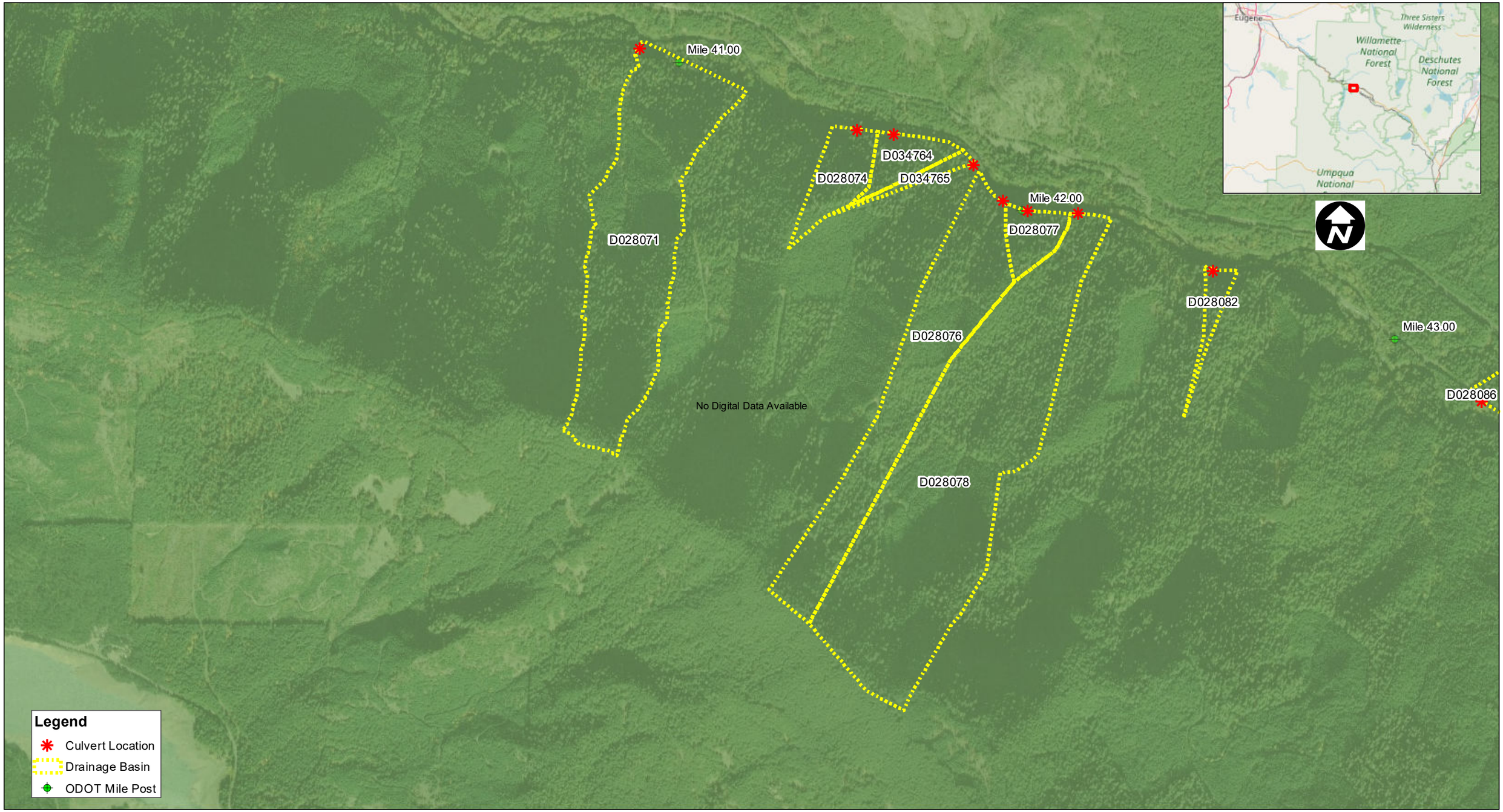
Appendix C: Soils Map

Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR-58 Fix-It Corridor Culverts

0 155 310 620 930 1,240 Feet



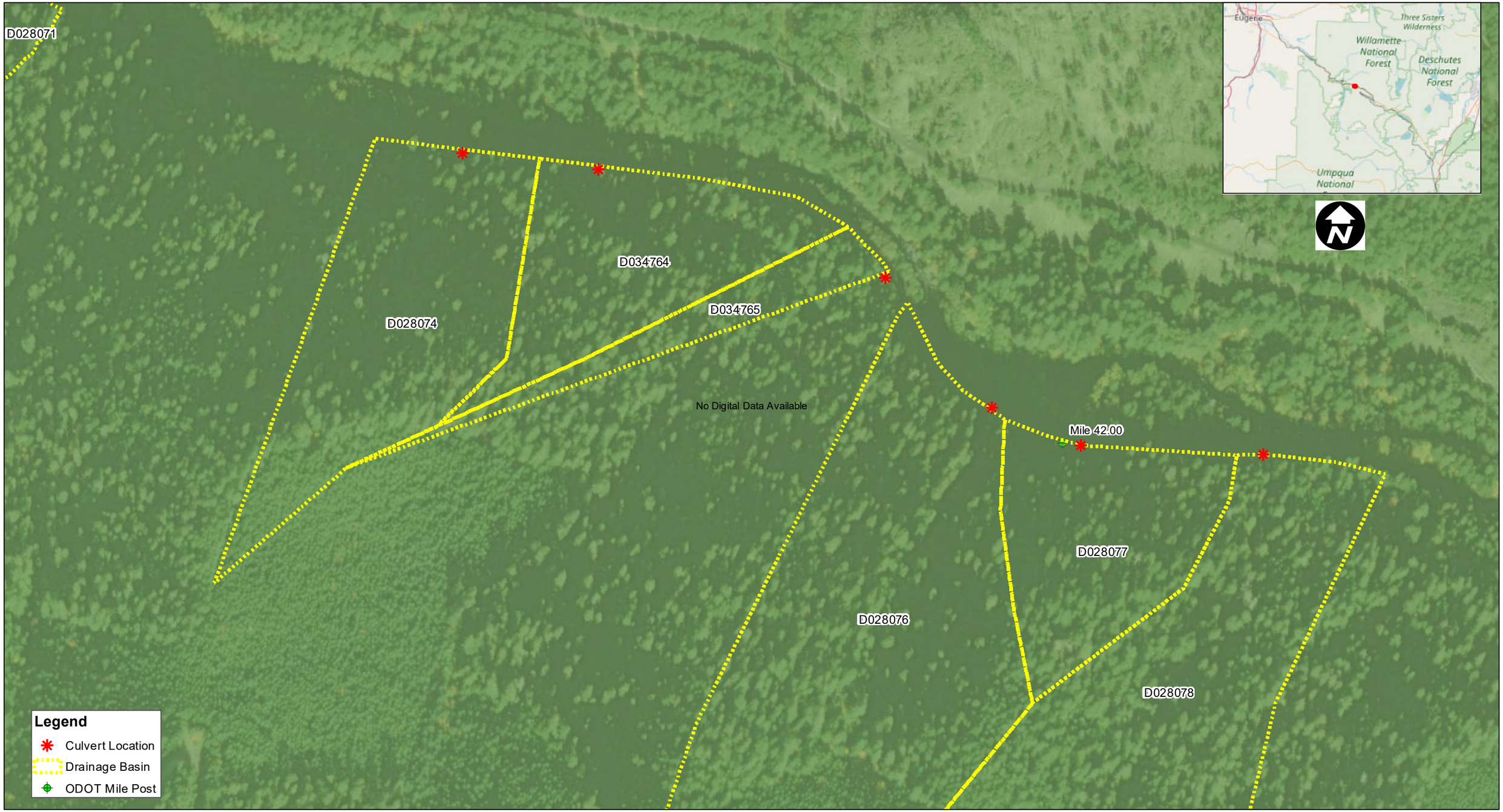
Appendix C: Soils Map

Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR-58 Fix-It Corridor Culverts

0 600 1,200 2,400 3,600 4,800 Feet



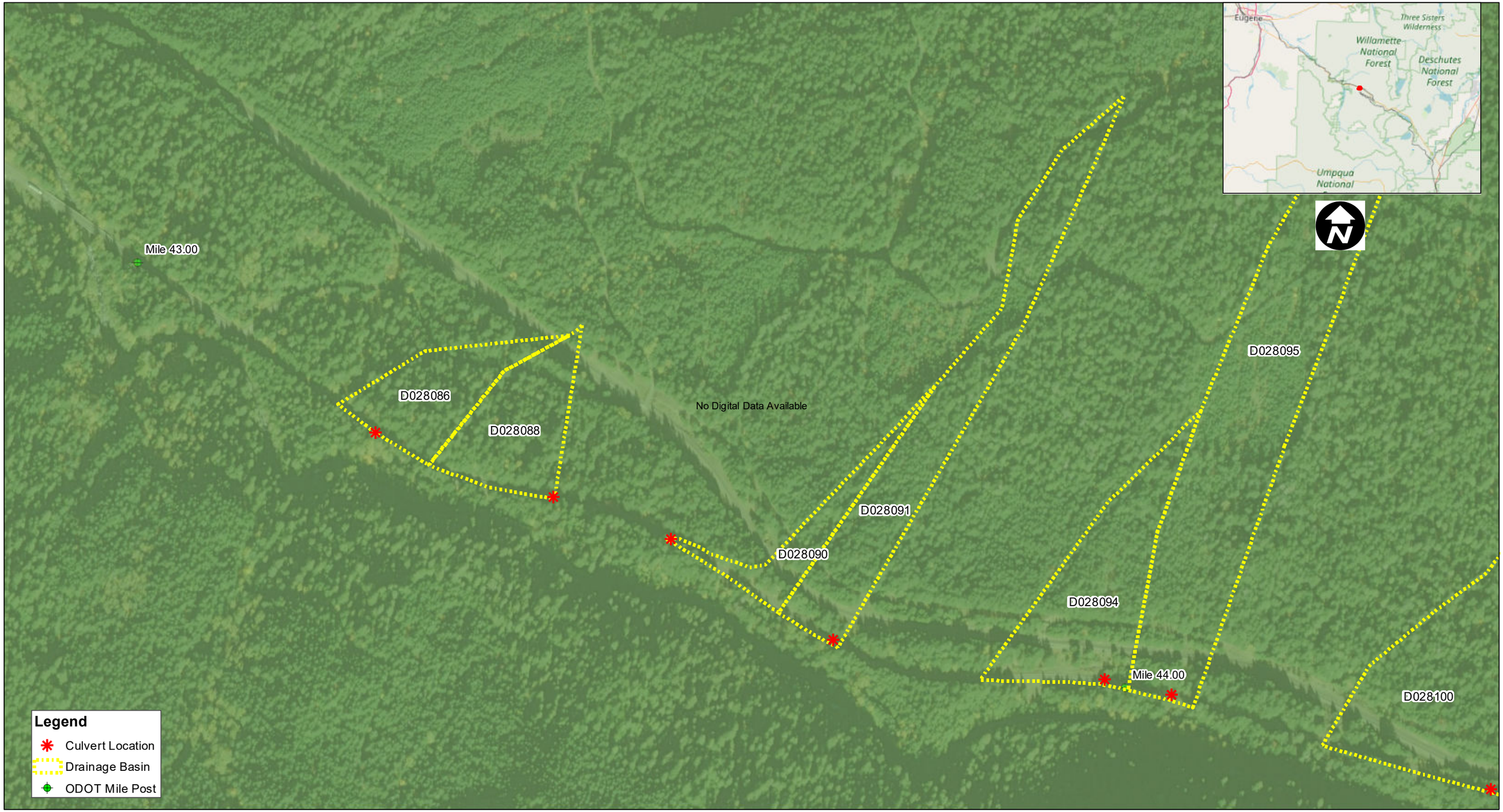
Appendix C: Soils Map

Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR-58 Fix-It Corridor Culverts

0 165 330 660 990 1,320 Feet



Appendix C: Soils Map

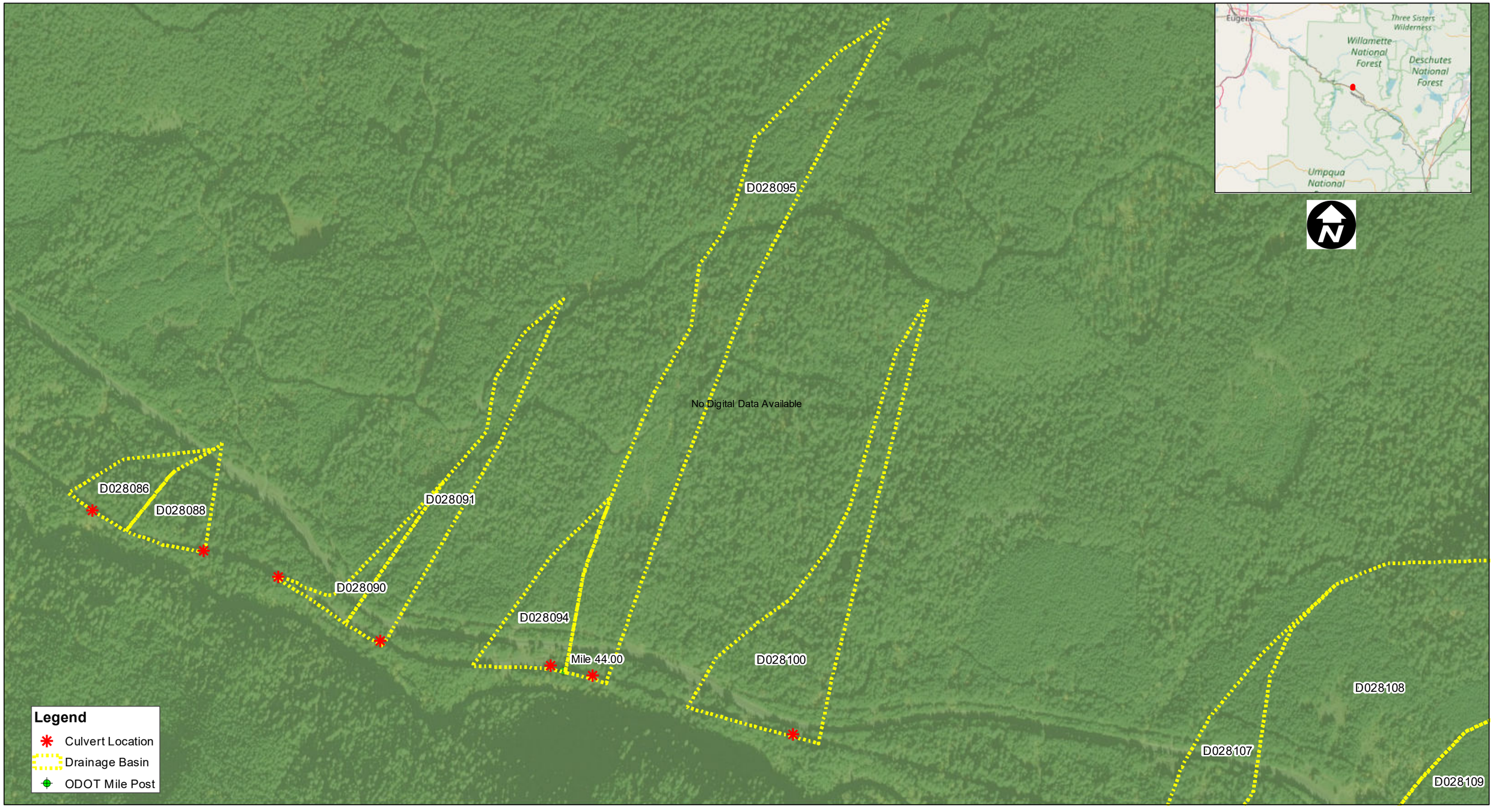
Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR-58 Fix-It Corridor Culverts

0 220 440 880 1,320 1,760 Feet

WSP



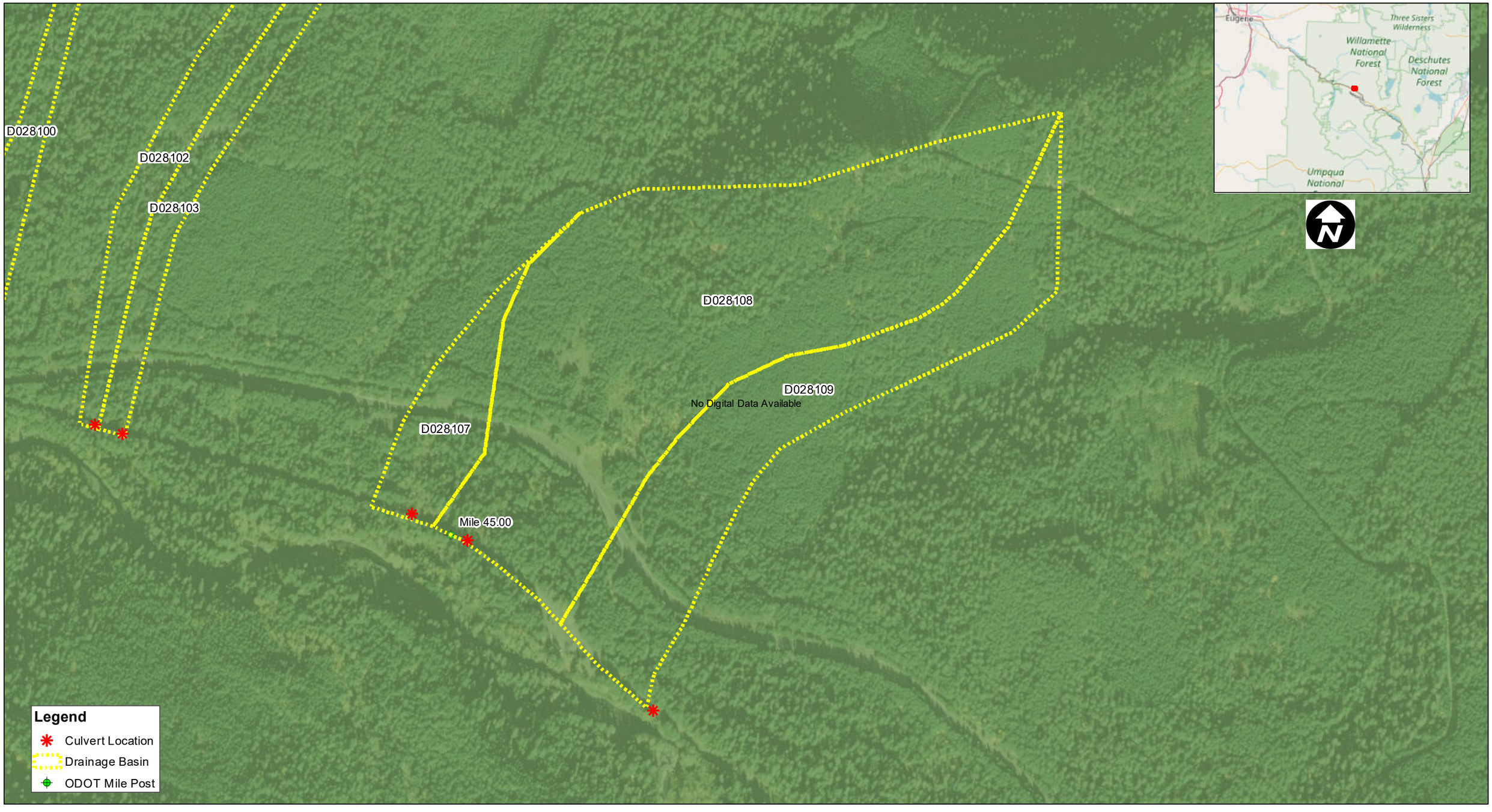
Appendix C: Soils Map

Federal Highway Administration/
Western Federal Lands Division

Oregon Department of Transportation

OR-58 Fix-It Corridor Culverts

0 350 700 1,400 2,100 2,800 Feet



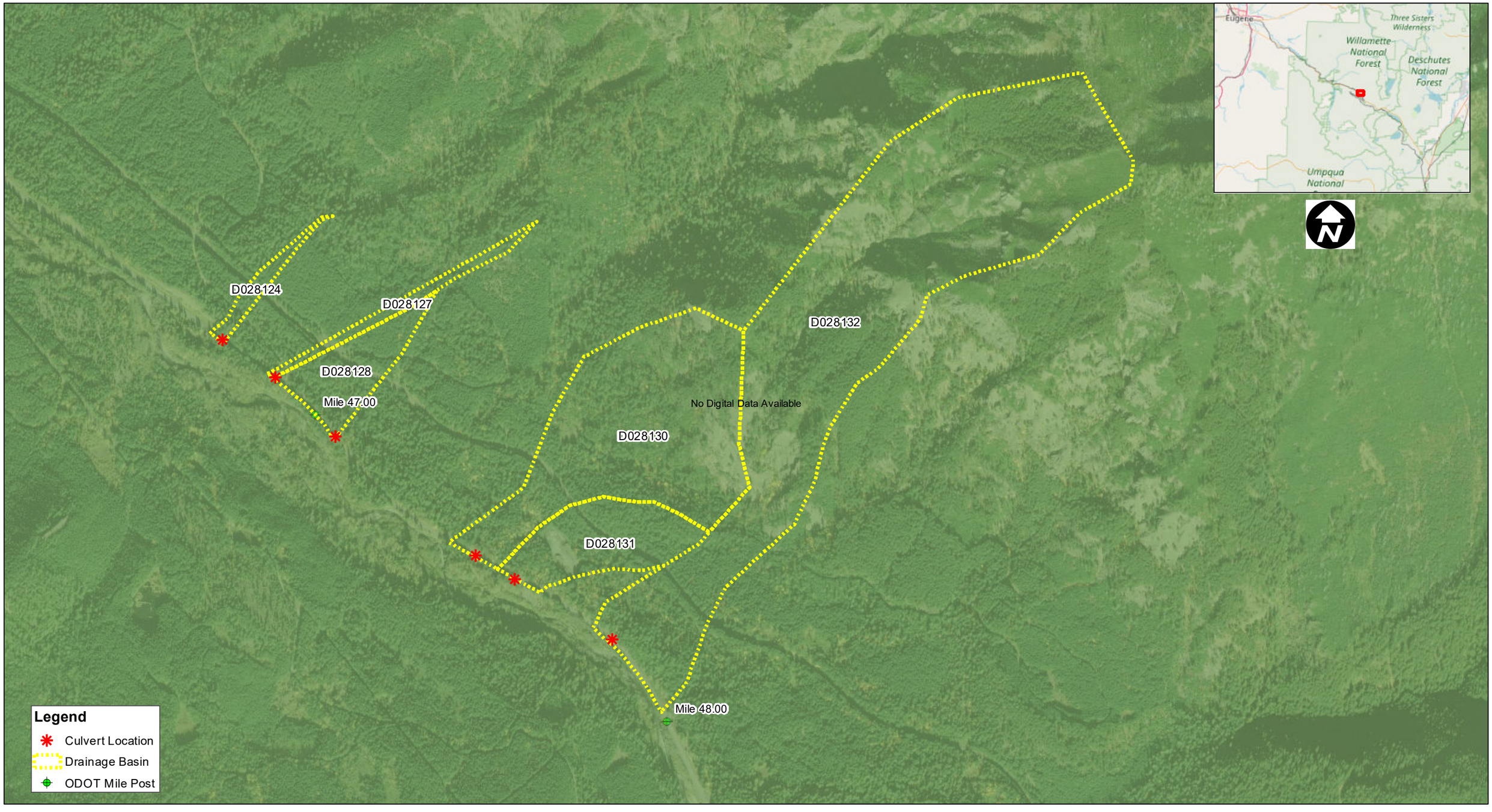
Appendix C: Soils Map

Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR-58 Fix-It Corridor Culverts

0 305 610 1,220 1,830 2,440 Feet



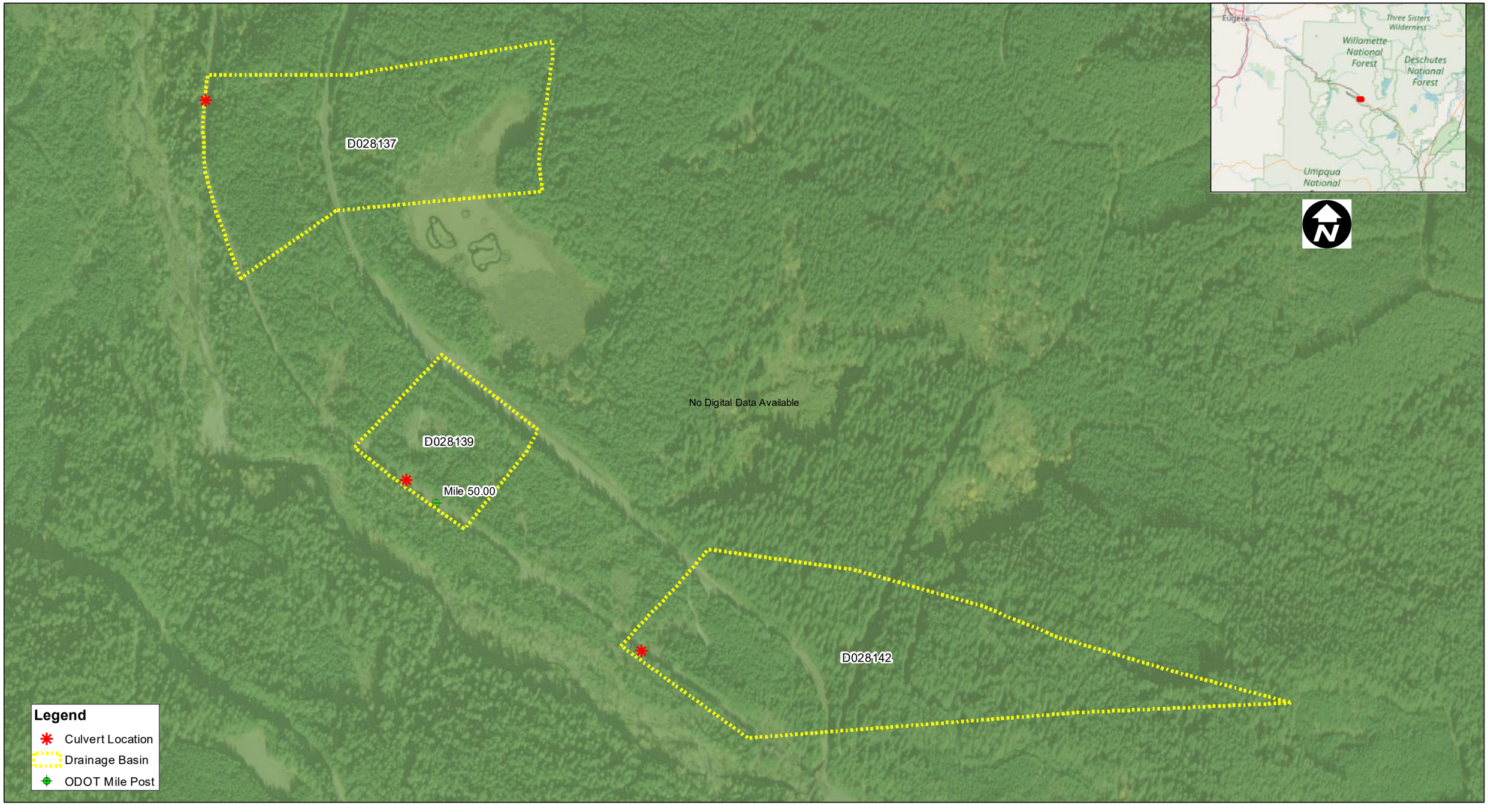
Appendix C: Soils Map

Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR-58 Fix-It Corridor Culverts

0 500 1,000 2,000 3,000 4,000 Feet



Appendix C: Soils Map

Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR-58 Fix-It Corridor Culverts

0 305 610 1,220 1,830 2,440 Feet

Appendix C: Soils Map

Federal Highway Administration/
Western Federal Lands Division

Oregon Department of Transportation

OR-58 Fix-It Corridor Culverts

0 345 690 1,380 2,070 2,760
Feet

WSP

Appendix C: Soils Map

Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR-58 Fix-It Corridor Culverts

0 120 240 480 720 960 Feet

wsp

Appendix C: Soils Map

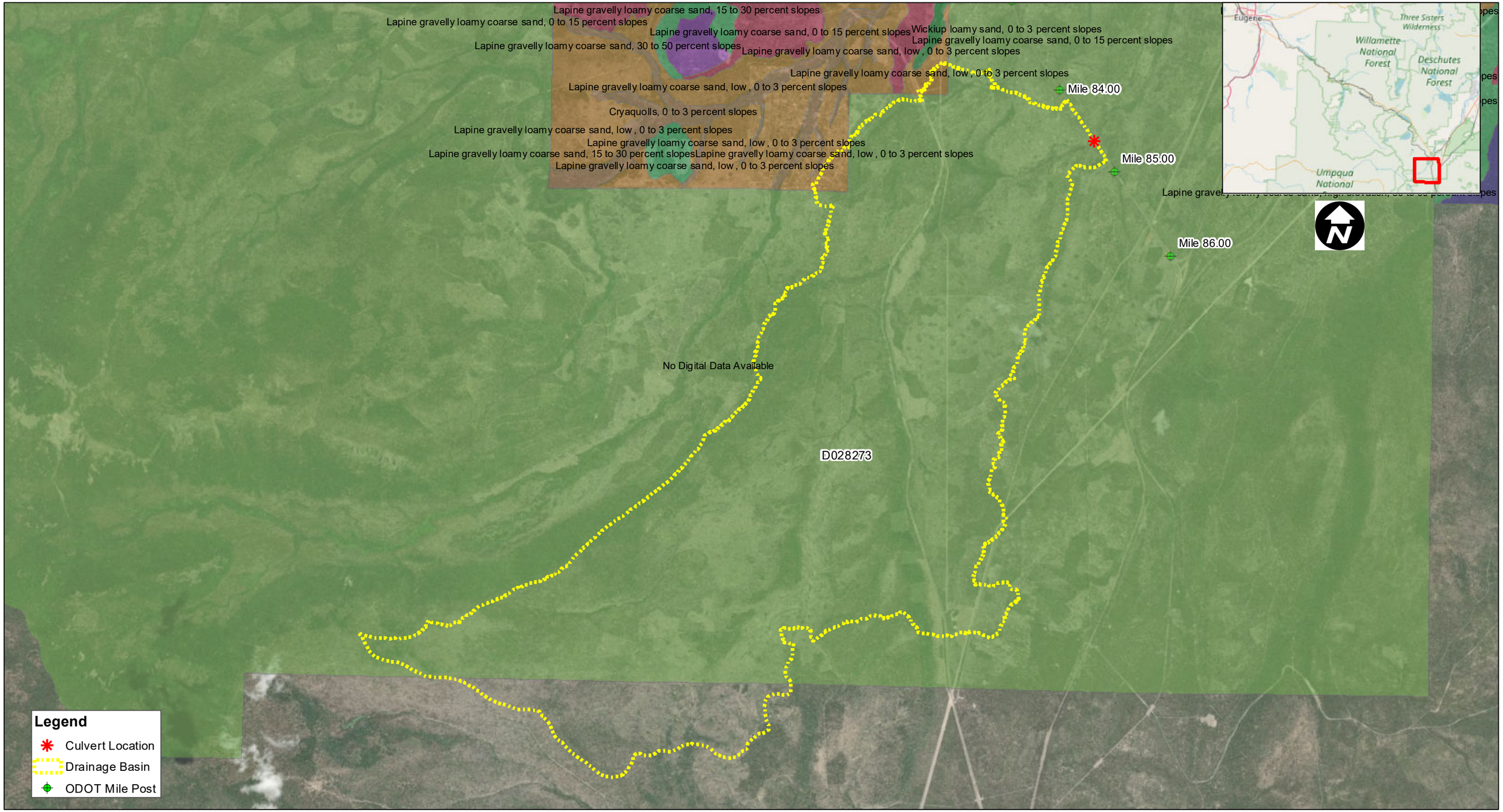
Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR-58 Fix-It Corridor Culverts

0 650 1,300 2,600 3,900 5,200 Feet

WSP



Appendix C: Soils Map

Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR-58 Fix-It Corridor Culverts

0 2,450 4,900 9,800 14,700 19,600 Feet

APPENDIX

D GENERALIZED LAND USE

Appendix D: Generalized Land Use

Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR-58 Fix-It Corridor Culverts

0 15 30 60 90 120 Feet

wsp

Appendix D: Generalized Land Use

Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR-58 Fix-It Corridor Culverts

0 112.5 225 450 675 900 Feet

WSP

Appendix D: Generalized Land Use

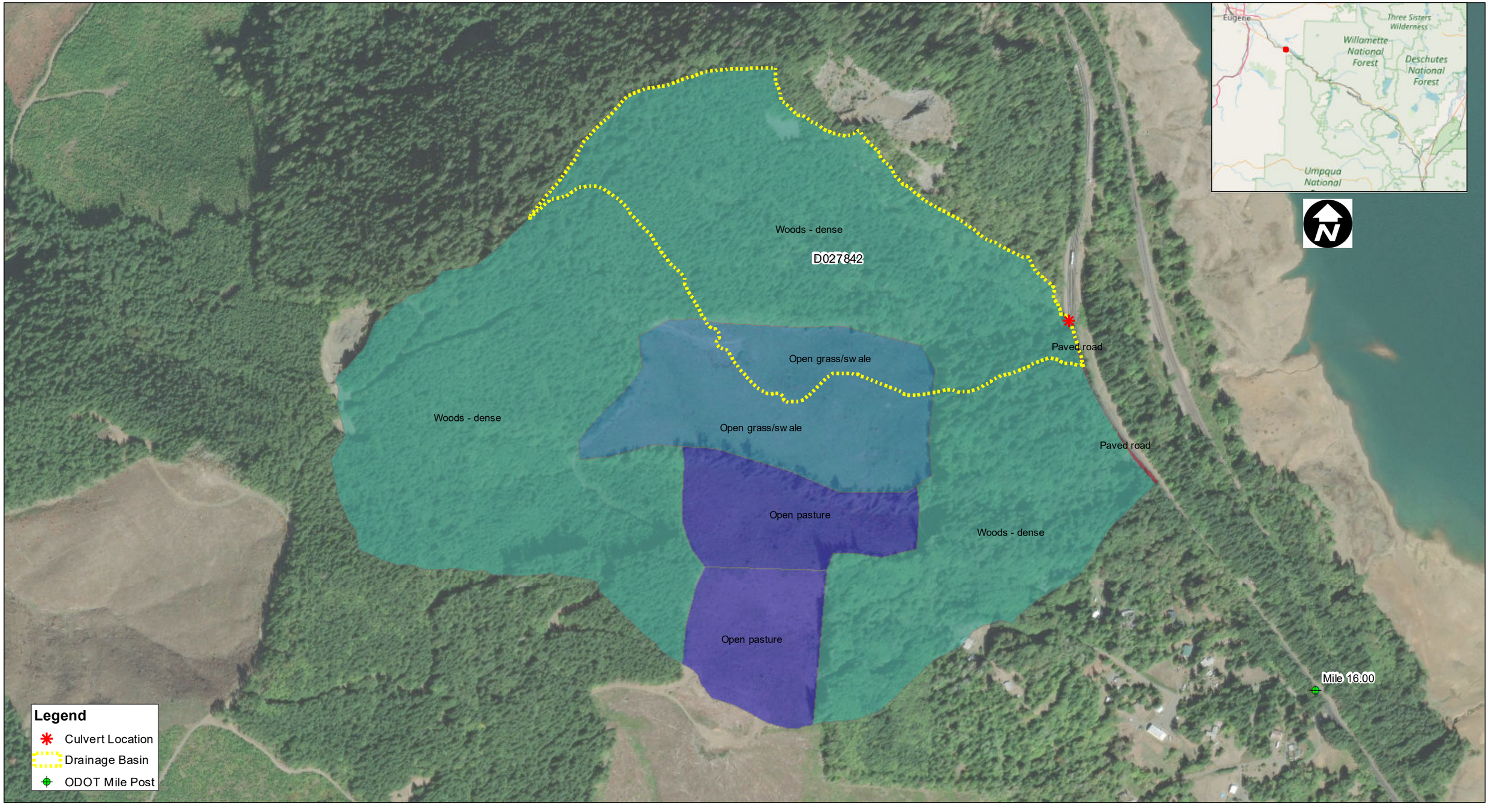
Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR-58 Fix-It Corridor Culverts

0 85 170 340 510 680 Feet

wsp



Appendix D: Generalized Land Use

Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR-58 Fix-It Corridor Culverts

0 270 540 1,080 1,620 2,160 Feet

Appendix D: Generalized Land Use

Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR-58 Fix-It Corridor Culverts

0 150 300 600 900 1,200 Feet

WSP

Appendix D: Generalized Land Use

Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR-58 Fix-It Corridor Culverts

0 275 550 1,100 1,650 2,200 Feet

WSP

Appendix D: Generalized Land Use

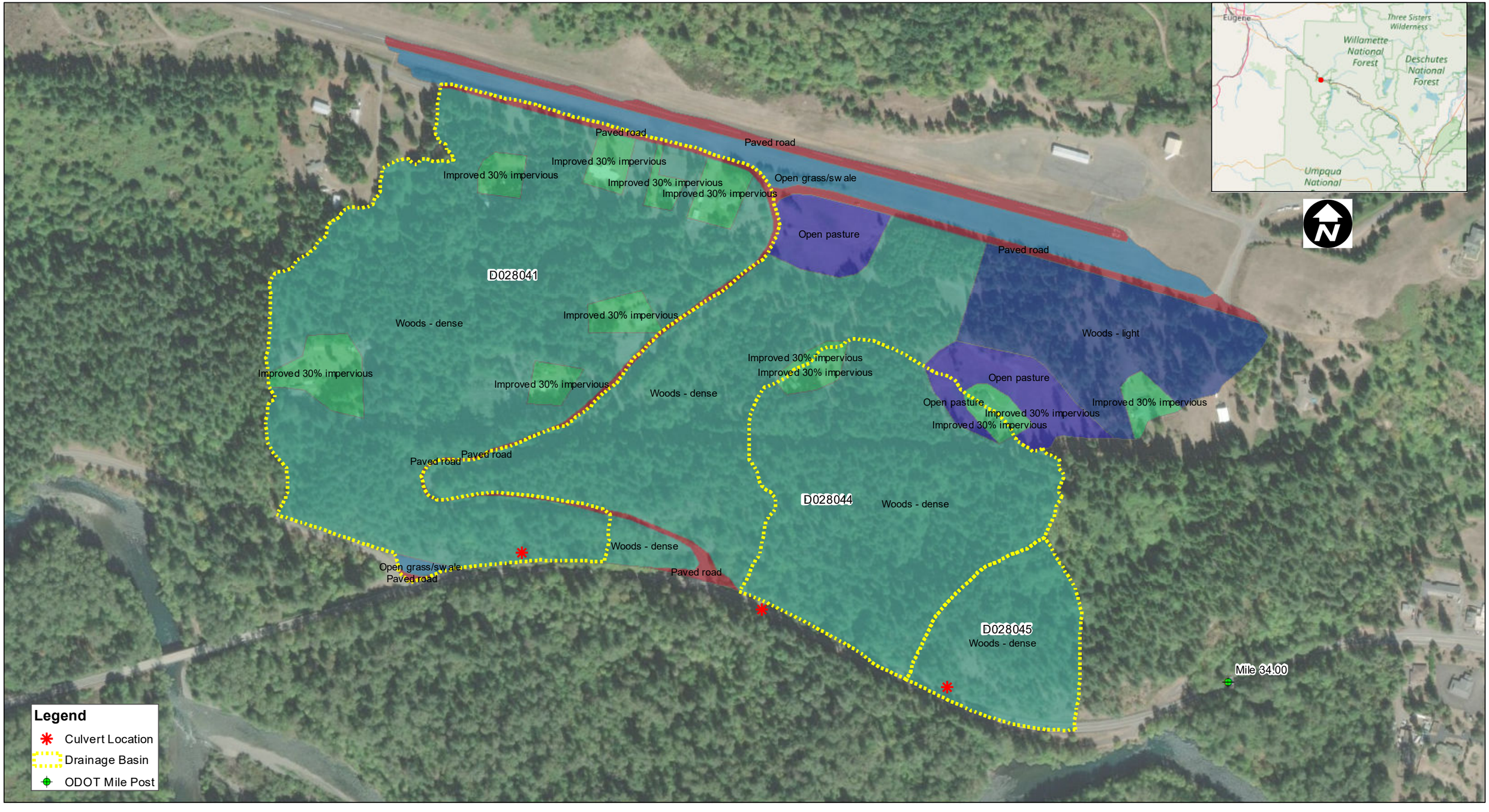
Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR-58 Fix-It Corridor Culverts

0 95 190 380 570 760 Feet

WSP



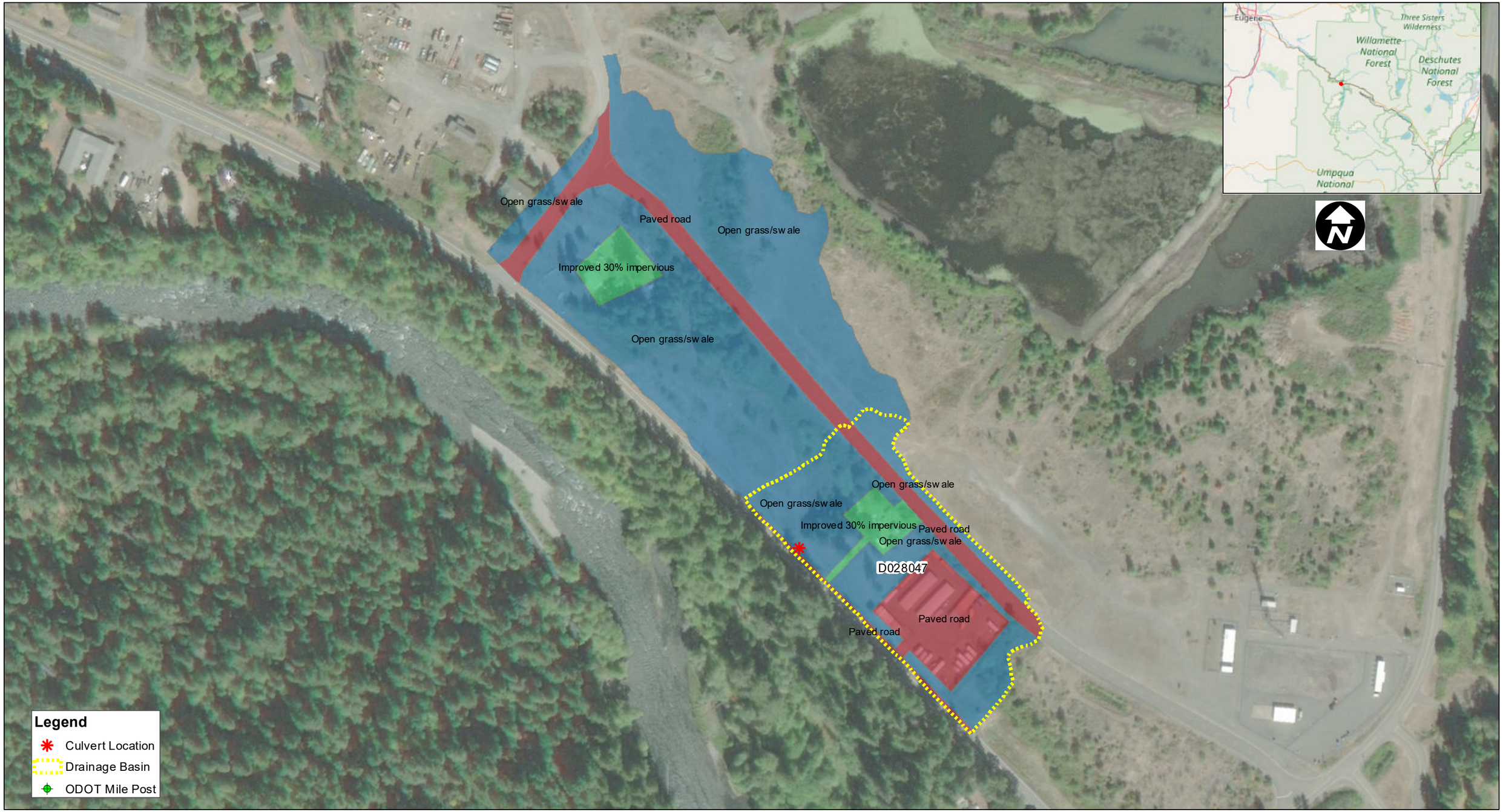
Appendix D: Generalized Land Use

Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR-58 Fix-It Corridor Culverts

0 170 340 680 1,020 1,360 Feet



Appendix D: Generalized Land Use

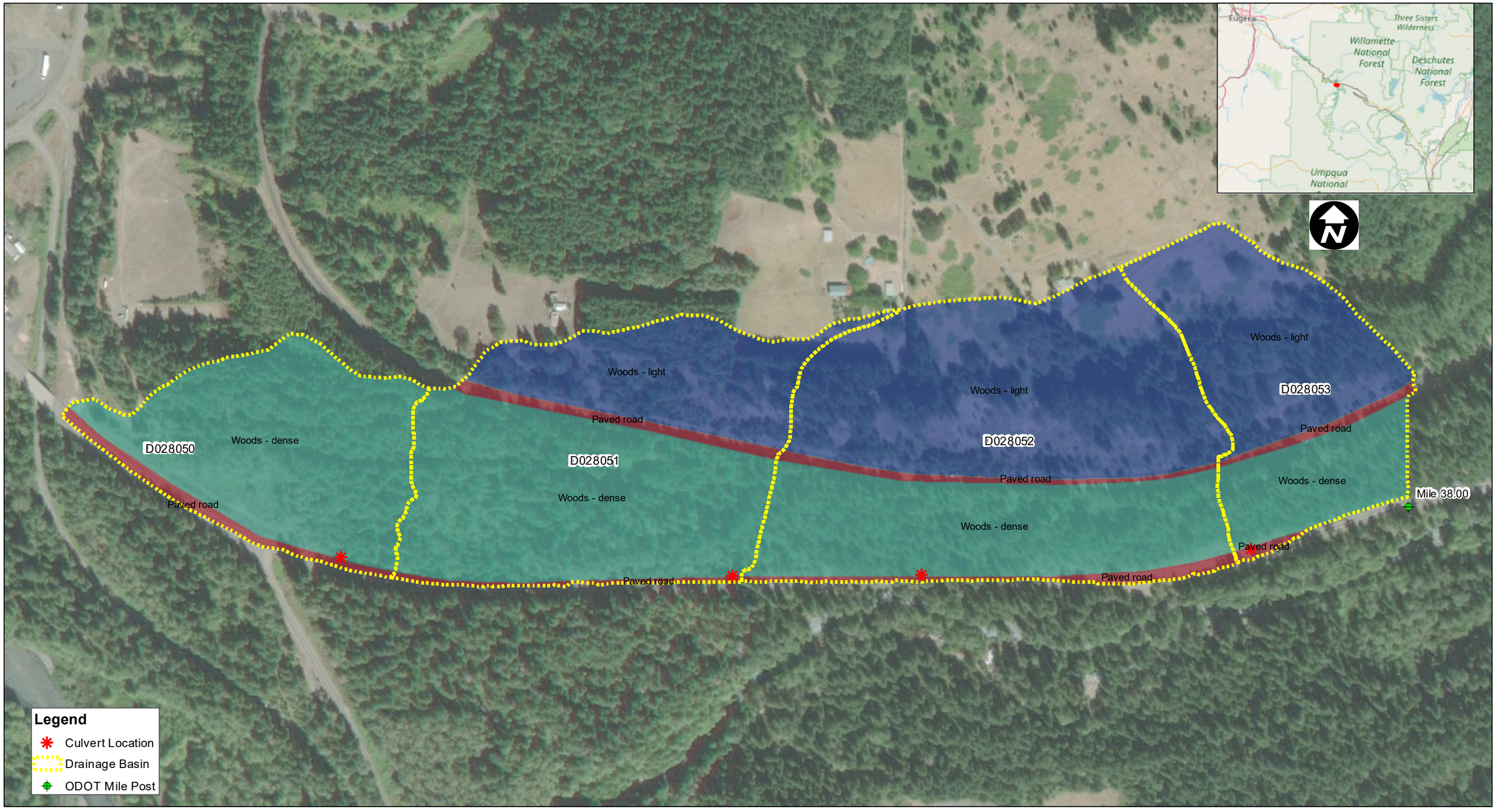
Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR-58 Fix-It Corridor Culverts

0 100 200 400 600 800 Feet

wsp



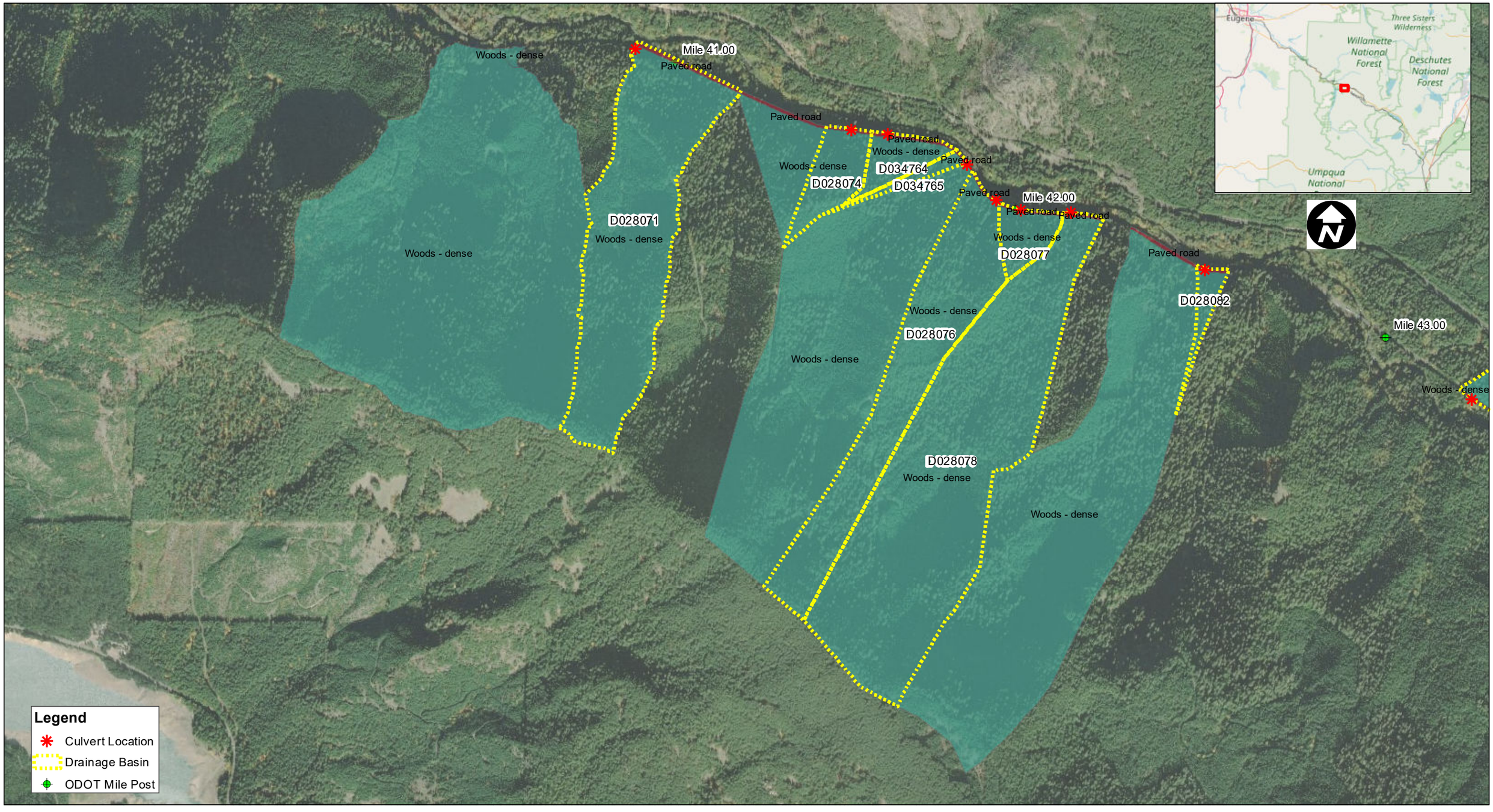
Appendix D: Generalized Land Use

Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR-58 Fix-It Corridor Culverts

0 155 310 620 930 1,240 Feet



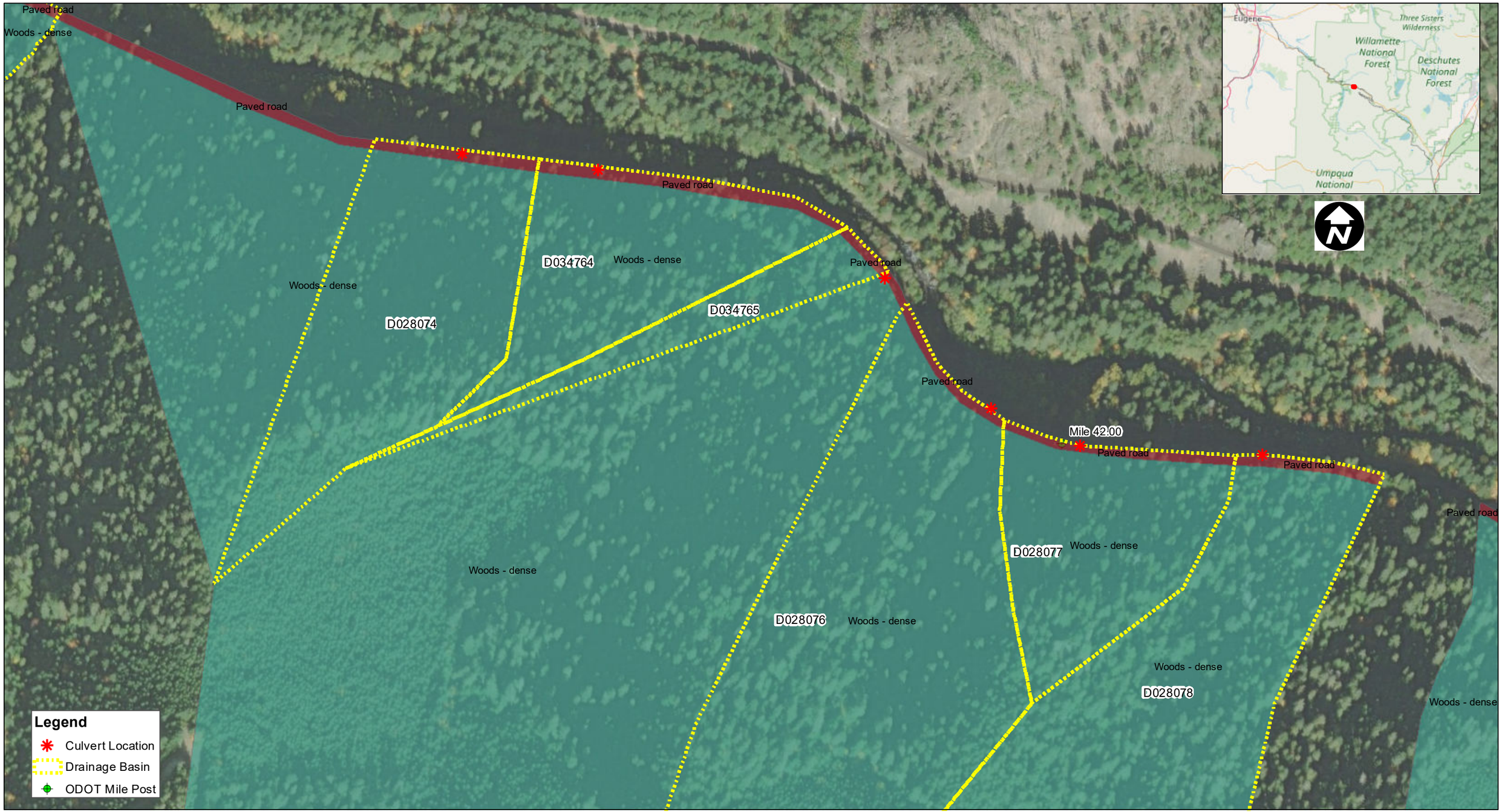
Appendix D: Generalized Land Use

Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR-58 Fix-It Corridor Culverts

0 600 1,200 2,400 3,600 4,800 Feet



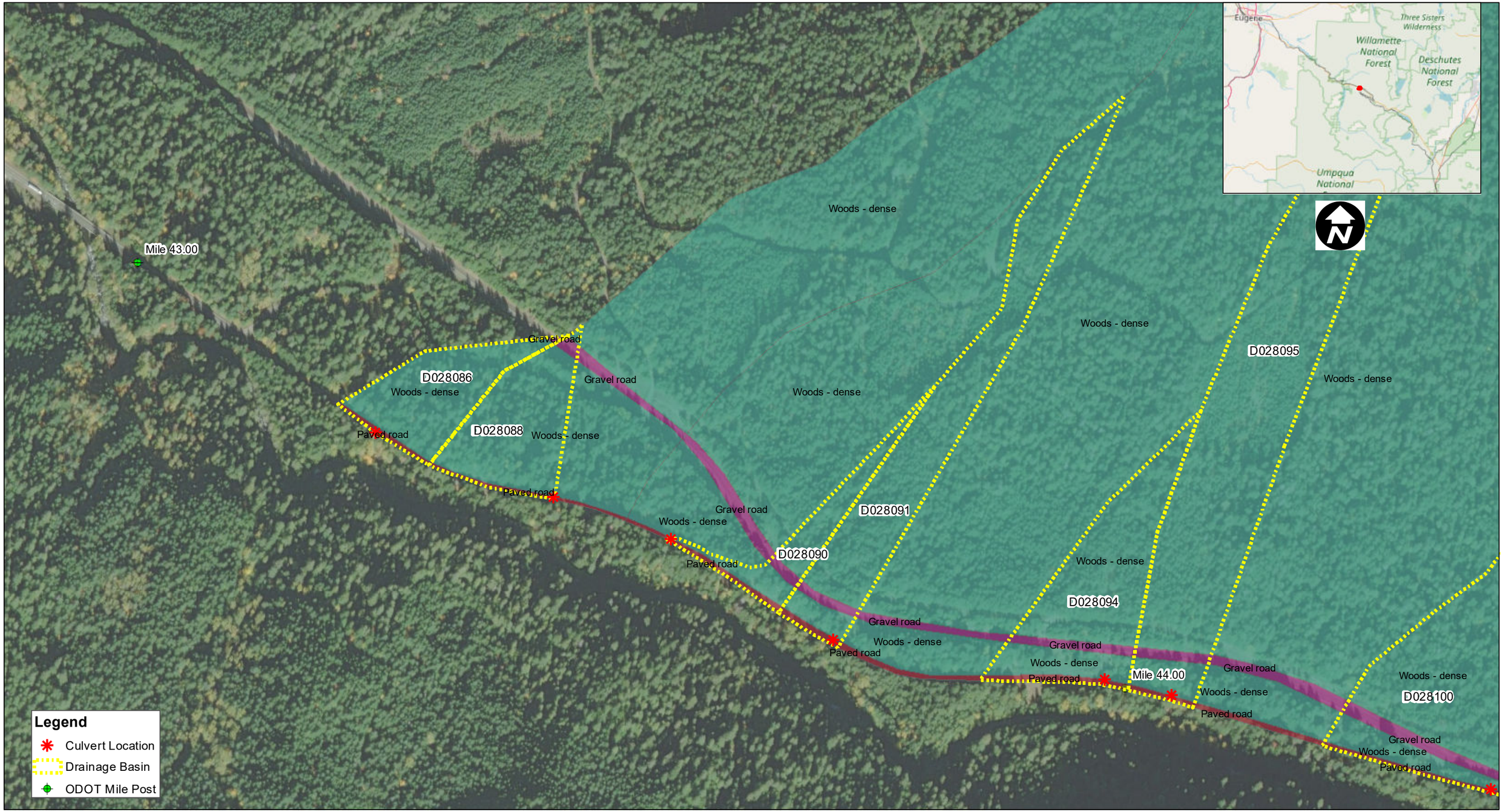
Appendix D: Generalized Land Use

Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR-58 Fix-It Corridor Culverts

0 165 330 660 990 1,320 Feet



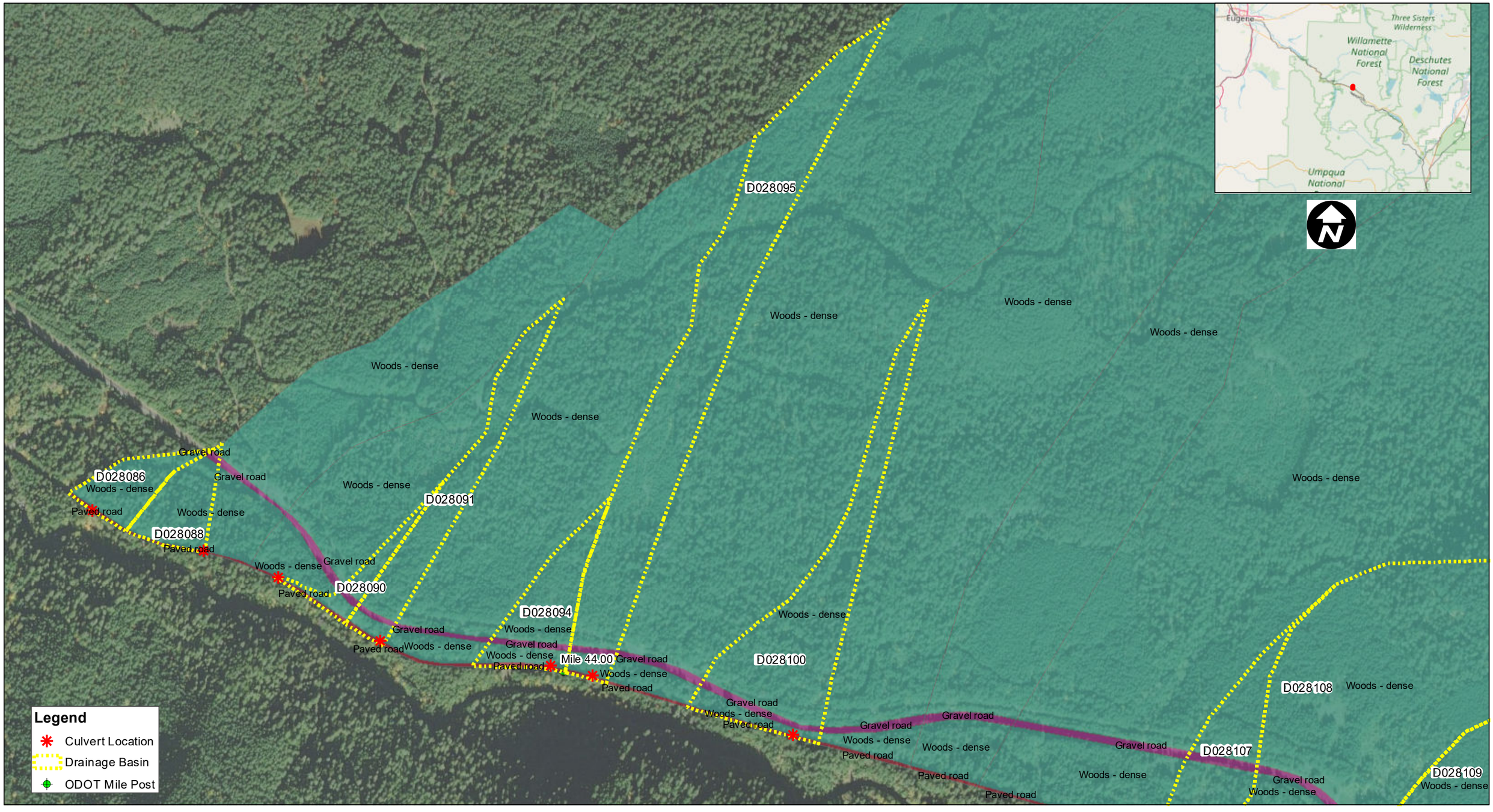
Appendix D: Generalized Land Use

Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR-58 Fix-It Corridor Culverts

0 220 440 880 1,320 1,760 Feet



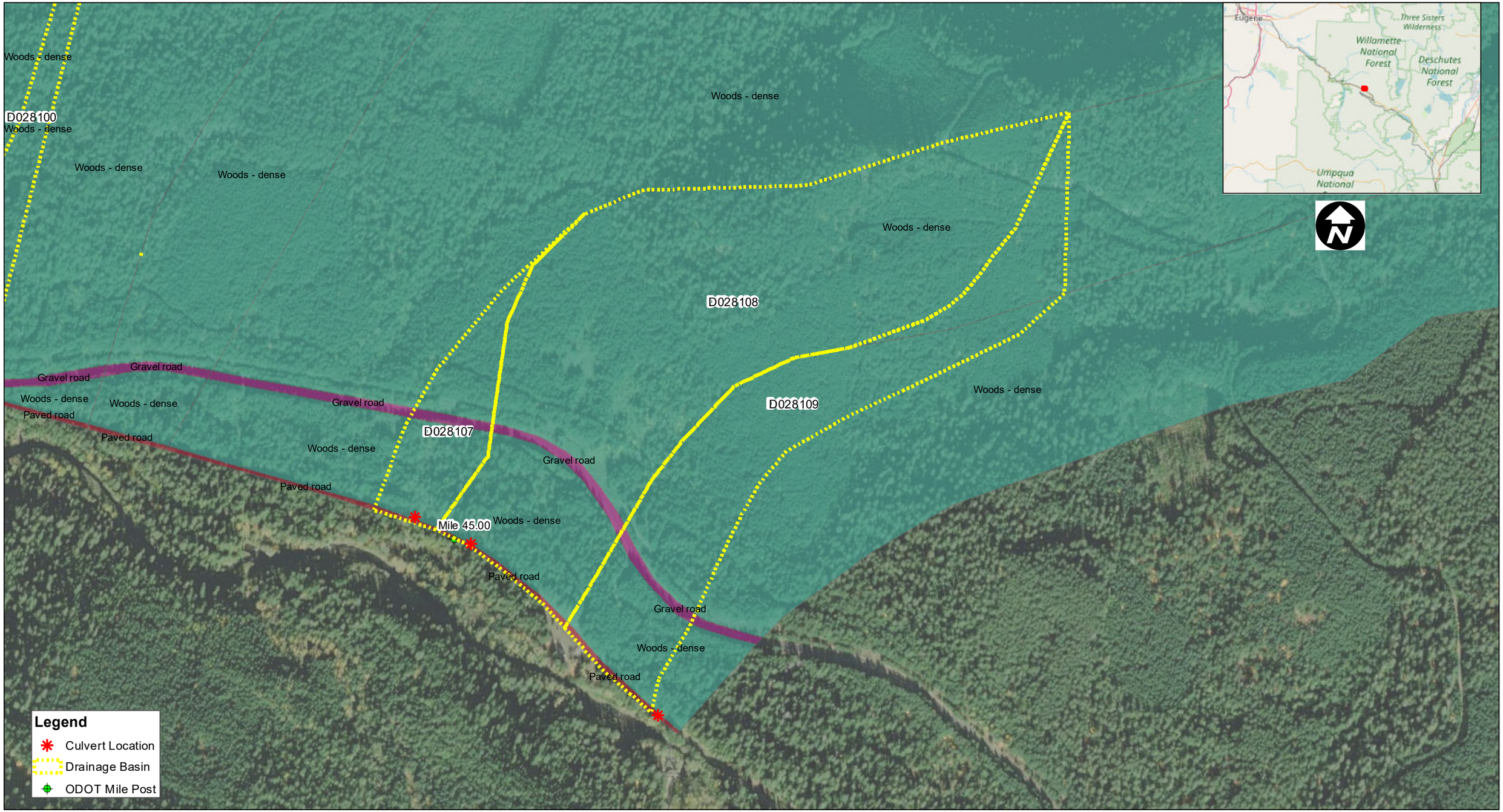
Appendix D: Generalized Land Use

Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR-58 Fix-It Corridor Culverts

0 350 700 1,400 2,100 2,800 Feet



Appendix D: Generalized Land Use

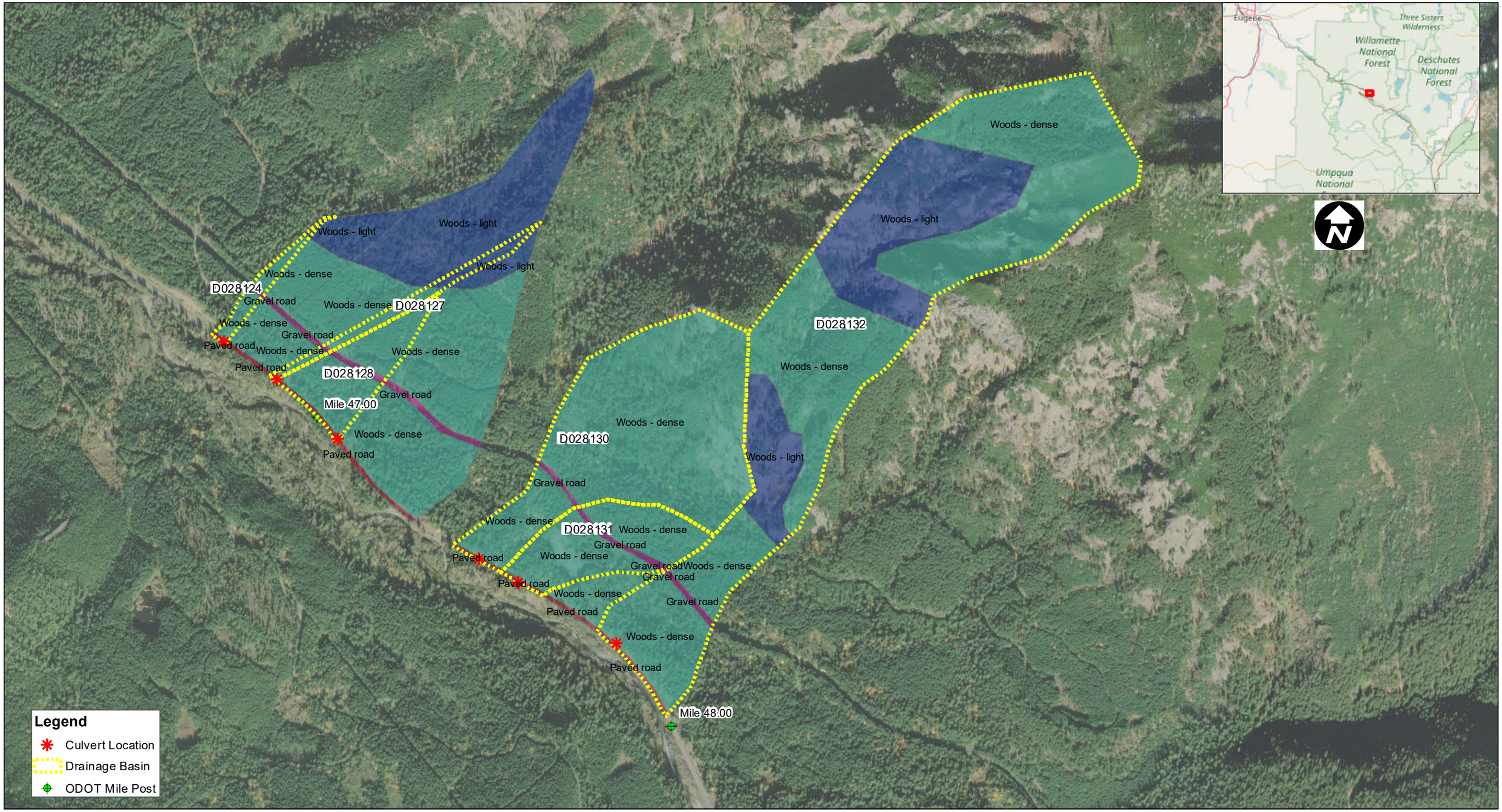
Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR-58 Fix-It Corridor Culverts

0 305 610 1,220 1,830 2,440 Feet

WSP



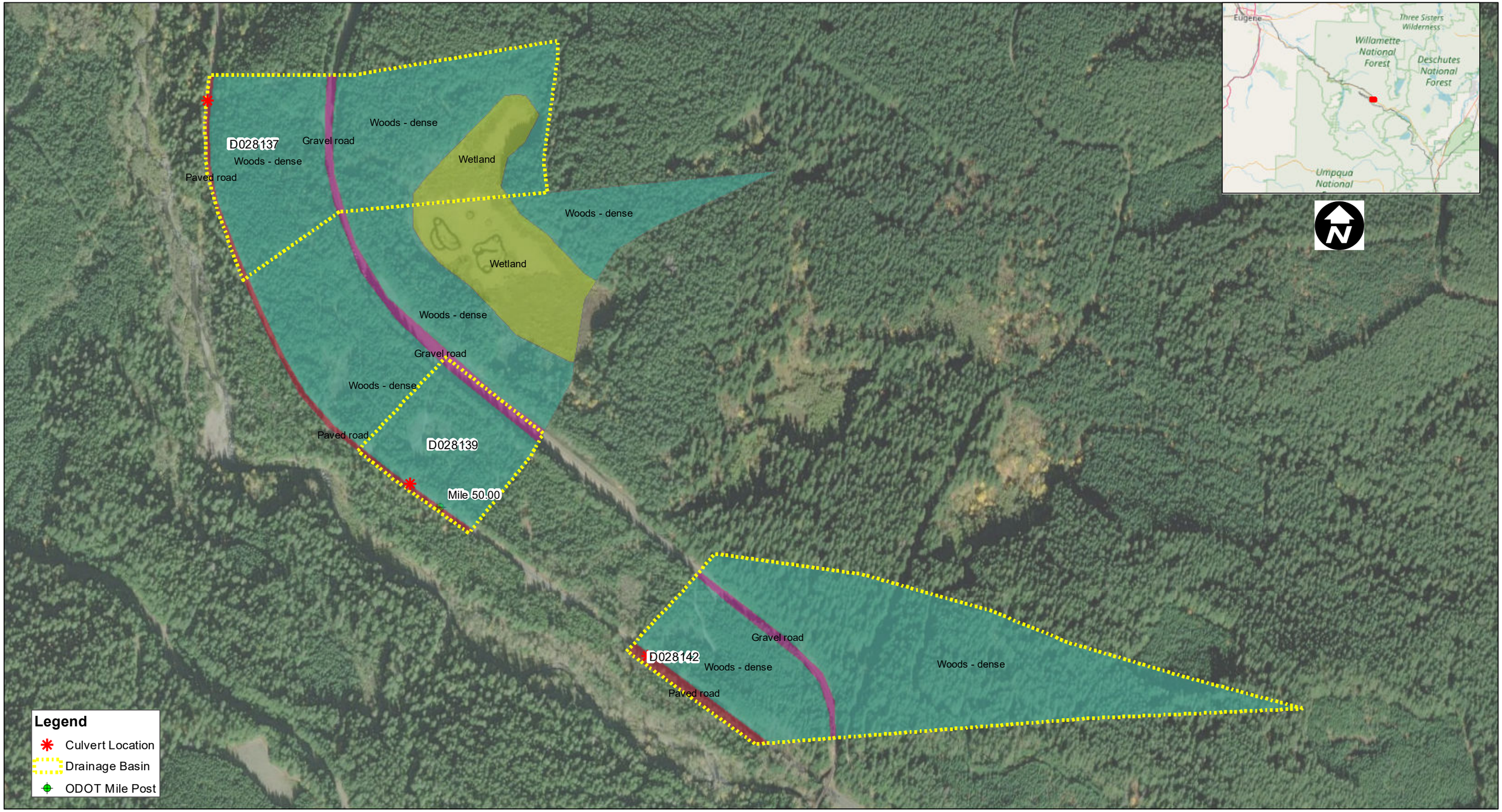
Appendix D: Generalized Land Use

Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR-58 Fix-It Corridor Culverts

0 500 1,000 2,000 3,000 4,000 Feet



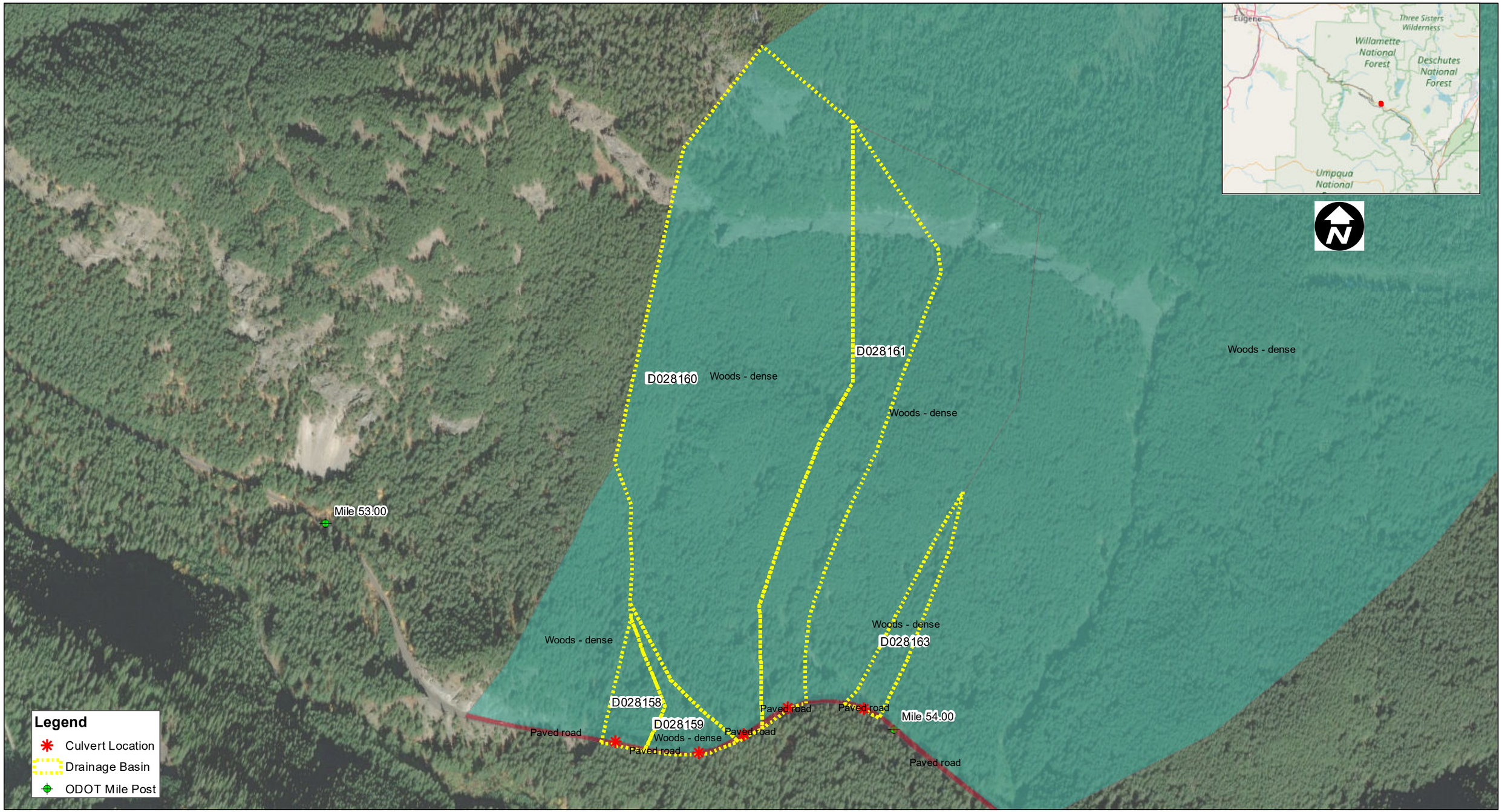
Appendix D: Generalized Land Use

Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR-58 Fix-It Corridor Culverts

0 305 610 1,220 1,830 2,440 Feet



Appendix D: Generalized Land Use

Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR-58 Fix-It Corridor Culverts

0 345 690 1,380 2,070 2,760 Feet

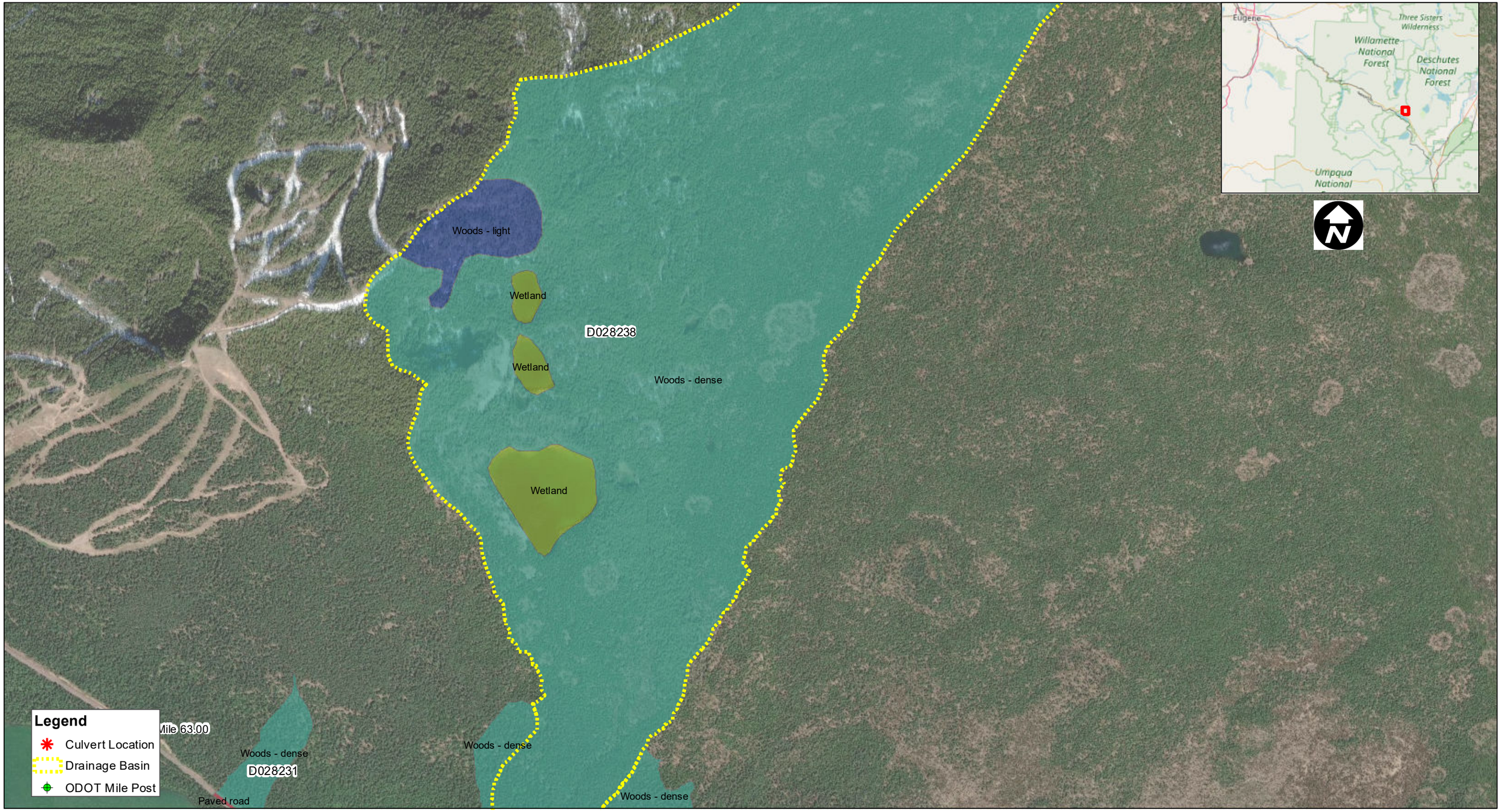
Appendix D: Generalized Land Use

Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR-58 Fix-It Corridor Culverts

0 120 240 480 720 960 Feet



Appendix D: Generalized Land Use

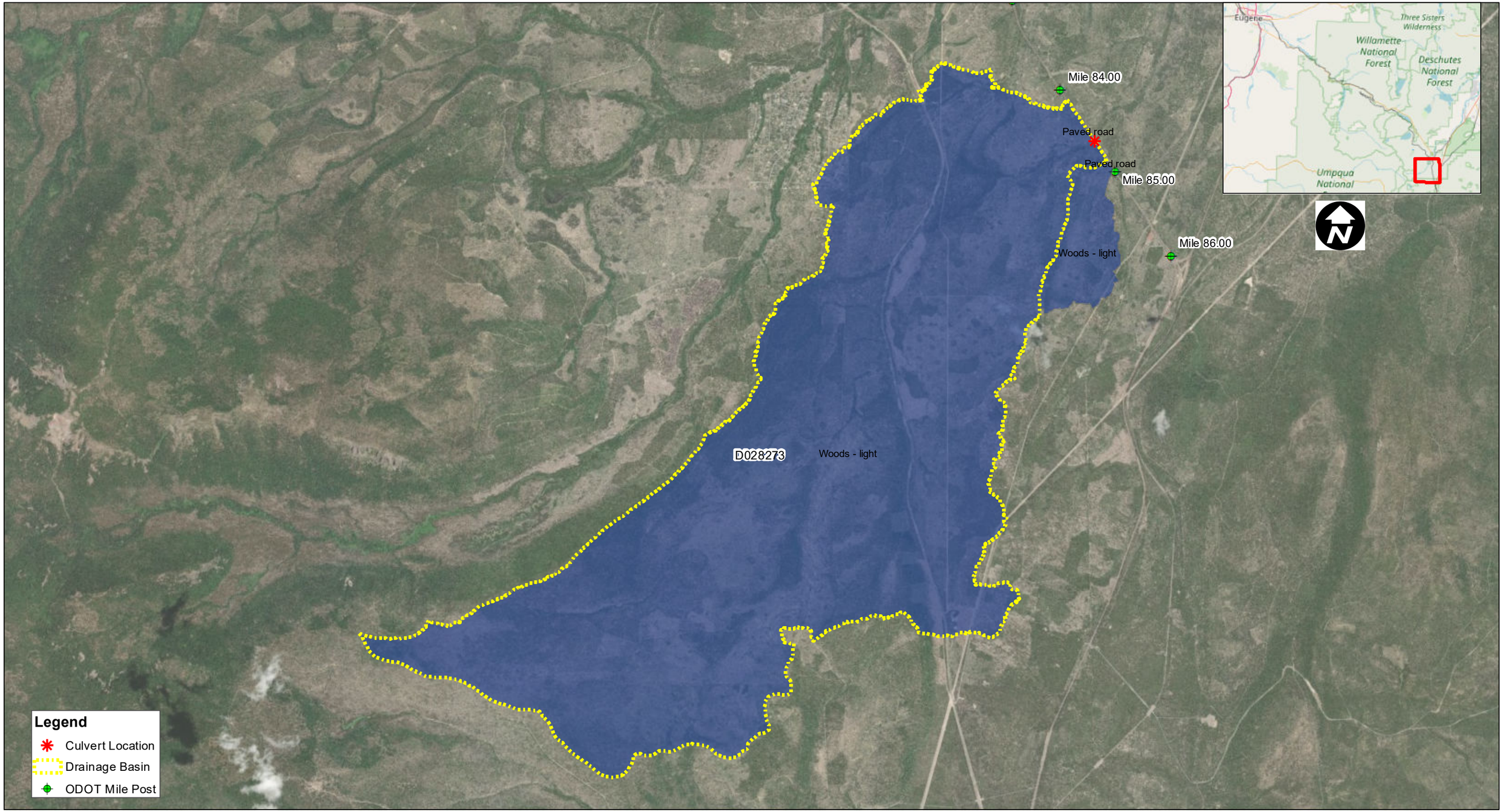
Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR-58 Fix-It Corridor Culverts

0 650 1,300 2,600 3,900 5,200 Feet

wsp



Appendix D: Generalized Land Use

Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR-58 Fix-It Corridor Culverts

0 2,450 4,900 9,800 14,700 19,600 Feet

WSP

APPENDIX

E TIME OF CONCENTRATION

OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF CURVE NUMBERS AND TIME OF CONCENTRATION

DFI NUMBER	MILE POINT	BASIN AREA (ac)	WEIGHTED CURVE NUMBER (CN)	MAXIMUM POTENTIAL RETENTION S, (inches)	AVERAGE WATERSHED LAND SLOPE, Y (%)	MAXIMUM FLOW LENGTH (feet)	TIME OF CONCENTRATION, Tc (hour)	Tc (Minutes)	Final Tc (Minutes)
D034723	2.73	0.39	98	0.00	1.00	184	0.06	3.40	5.00
D027825	13.07	21.84	72	3.89	14.0	1,731	0.28	17.00	17.00
D027828	13.56	14.16	78	2.82	12.0	1,598	0.24	14.00	14.00
D027832	13.93	2.80	60	6.67	38.0	454	0.08	4.70	5.00
D027833	14.03	11.60	64	5.63	7.00	1,923	0.53	32.00	32.00
D027842	15.51	74.35	67	4.93	31.0	3,422	0.37	22.00	22.00
D034741	17.29	14.69	72	3.89	22.0	1,394	0.19	11.00	11.00
D027990	26.27	79.92	70	4.29	18.0	4,000	0.50	30.00	30.00
D027992	26.60	20.19	70	4.29	16.0	2,379	0.35	21.00	21.00
D028033	31.47	9.17	60	6.67	1.00	1,245	1.09	66.00	66.00
D028041	33.54	47.76	72	3.89	15.0	2,137	0.32	19.00	19.00
D028044	33.65	21.75	71	4.08	24.0	1,399	0.18	11.00	11.00
D028045	33.79	7.21	70	4.29	46.0	724	0.08	4.80	5.00
D028047	36.73	4.88	77	2.99	2.00	683	0.30	18.00	18.00
D028050	37.31	13.24	64	5.63	13.0	1,216	0.27	16.00	16.00
D028051	37.56	23.44	65	5.38	15.0	1,519	0.29	17.00	17.00
D028052	37.68	30.63	69	4.49	27.0	1,584	0.20	12.00	12.00
D028053	37.89	14.13	70	4.29	37.0	1,117	0.13	7.60	7.60
D028071	40.92	128.07	70	4.29	41.0	5,500	0.43	26.00	26.00
D028074	41.50	19.02	71	4.08	49.0	1,775	0.16	9.30	9.30
D034764	41.58	12.98	72	3.89	54.0	884	0.08	5.00	5.00
D034765	41.81	4.44	71	4.08	31.0	1,989	0.21	13.00	13.00
D028076	41.91	92.79	70	4.29	42.0	5,974	0.46	27.00	27.00
D028077	42.01	12.18	71	4.08	63.0	883	0.08	4.70	5.00
D028078	42.12	203.82	70	4.29	36.0	7,265	0.58	35.00	35.00
D028082	42.50	6.13	72	3.89	23.0	1,961	0.24	14.00	14.00
D028086	43.26	6.23	71	4.08	11.0	997	0.21	12.00	12.00
D028088	43.43	7.21	72	3.89	12.0	838	0.17	10.00	10.00
D028090	43.54	3.79	75	3.33	15.0	1,734	0.25	15.00	15.00
D028091	43.74	14.62	71	4.08	15.0	2,972	0.42	25.00	25.00
D028094	43.99	11.38	73	3.70	21.0	1,383	0.18	11.00	11.00
D028095	44.06	48.47	70	4.29	17.0	5,573	0.68	41.00	41.00
D028100	44.36	29.62	72	3.89	18.0	3,379	0.42	25.00	25.00
D028107	44.96	15.67	72	3.89	15.0	2,119	0.32	19.00	19.00
D028108	45.03	86.00	71	4.08	16.0	3,700	0.49	29.00	29.00
D028109	45.35	55.13	71	4.08	25.0	5,017	0.50	30.00	30.00
D028124	46.75	5.22	72	3.89	18.0	1,851	0.26	15.00	15.00
D028127	46.89	7.97	72	3.89	24.0	3,345	0.36	22.00	22.00
D028128	47.07	21.98	72	3.89	19.0	1,883	0.25	15.00	15.00
D028130	47.46	106.46	70	4.29	29.0	3,811	0.38	23.00	23.00
D028131	47.57	32.28	72	3.89	15.0	2,083	0.31	19.00	19.00
D028132	47.80	31.30	71	4.08	7.4	1,883	0.42	25.00	25.00
D028137	49.41	51.94	73	3.70	6.00	2,286	0.51	31.00	31.00
D028139	49.99	16.76	73	3.70	4.00	804	0.27	16.00	16.00
D028142	50.30	66.31	72	3.89	15.0	3,956	0.52	31.00	31.00
D028158	53.56	5.74	71	4.08	32.0	991	0.12	7.20	7.20
D028159	53.69	5.79	72	3.89	27.0	1,179	0.15	8.80	8.80
D028160	53.76	135.34	70	4.29	51.0	5,507	0.39	23.00	23.00
D028161	53.83	41.29	70	4.29	53.0	4,589	0.33	20.00	20.00
D028163	53.95	6.94	71	4.08	55.0	1,743	0.14	8.70	8.70
D028186	57.77	18.76	72	3.89	12.0	1,112	0.21	13.00	13.00
D028188	57.96	0.78	98	0.00	1.00	407	0.11	6.40	6.40

OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF CURVE NUMBERS AND TIME OF CONCENTRATION

DFI NUMBER	MILE POINT	BASIN AREA (ac)	WEIGHTED CURVE NUMBER (CN)	MAXIMUM POTENTIAL RETENTION S, (inches)	AVERAGE WATERSHED LAND SLOPE, Y (%)	MAXIMUM FLOW LENGTH (feet)	TIME OF CONCENTRATION, Tc (hour)	Tc (Minutes)	Final Tc (Minutes)
D028238	64.27	1514.90	23	33.48	15.0	18,396	6.97	418.00	418.00
D028273	84.68	13180.35	36	17.78	3.00	54,504	24.28	1457.00	1457.00

APPENDIX

F RATIONAL METHOD RESULTS

OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF RATIONAL METHOD CALCULATIONS

BASIN INFORMATION						RUNOFF COEFFICIENT CORRECTION FACTOR			RAINFALL INTENSITY (IN/HOUR)			PEAK RUNOFF (CFS)		
DFI NUMBER	MILE POINT	BASIN AREA (Ac)	WEIGHTED RUNOFF COEFFICIENT	TIME OF CONCENTRATION (MINUTE)	IDF RAINFALL ZONE	10 YEAR, 24 HOUR	50 YEAR, 24 HOUR	100 YEAR, 24 HOUR	10 YEAR, 24 HOUR	50 YEAR, 24 HOUR	100 YEAR, 24 HOUR	10 YEAR, 24 HOUR	50 YEAR, 24 HOUR	100 YEAR, 24 HOUR
D034723	2.73	0.39	0.90	5.00	Zone 8	1.00	1.20	1.25	2.27	3.01	3.36	0.79	1.26	1.47
D027825	13.07	21.84	0.22	17.00	Zone 5	1.00	1.20	1.25	1.55	2.04	2.27	7.46	11.78	13.65
D027828	13.56	14.16	0.23	14.00	Zone 5	1.00	1.20	1.25	1.70	2.24	2.49	5.54	8.74	10.15
D027832	13.93	2.80	0.29	5.00	Zone 5	1.00	1.20	1.25	2.52	3.31	3.70	2.04	3.22	3.75
D027833	14.03	11.60	0.29	32.00	Zone 5	1.00	1.20	1.25	1.10	1.44	1.61	3.71	5.82	6.75
D034741	17.29	14.69	0.24	11.00	Zone 5	1.00	1.20	1.25	1.88	2.48	2.76	6.63	10.47	12.17
D027990	26.27	79.92	0.20	30.00	Zone 5	1.00	1.20	1.25	1.15	1.50	1.67	18.34	28.79	33.44
D027992	26.60	20.19	0.21	21.00	Zone 5	1.00	1.20	1.25	1.39	1.83	2.04	5.90	9.33	10.79
D028033	31.47	9.17	0.28	66.00	Zone 5	1.00	1.20	1.25	0.69	0.91	1.02	1.77	2.80	3.26
D028041	33.54	47.76	0.24	19.00	Zone 5	1.00	1.20	1.25	1.47	1.92	2.15	16.88	26.44	30.86
D028044	33.65	21.75	0.21	11.00	Zone 5	1.00	1.20	1.25	1.88	2.48	2.76	8.59	13.57	15.77
D028045	33.79	7.21	0.20	5.00	Zone 5	1.00	1.20	1.25	2.52	3.31	3.70	3.63	5.72	6.66
D028047	36.73	4.88	0.47	18.00	Zone 5	1.00	1.20	1.25	1.51	1.98	2.21	3.47	5.45	6.34
D028050	37.31	13.24	0.25	16.00	Zone 5	1.00	1.20	1.25	1.59	2.10	2.34	5.28	8.35	9.69
D028051	37.56	23.44	0.24	17.00	Zone 5	1.00	1.20	1.25	1.55	2.04	2.27	8.74	13.79	15.98
D028052	37.68	30.63	0.24	12.00	Zone 5	1.00	1.20	1.25	1.81	2.38	2.67	13.30	21.02	24.52
D028053	37.89	14.13	0.23	7.60	Zone 5	1.00	1.20	1.25	2.17	2.85	3.18	7.06	11.11	12.91
D028074	41.50	19.02	0.22	9.30	Zone 5	1.00	1.20	1.25	2.01	2.64	2.96	8.41	13.25	15.46
D034764	41.58	12.98	0.26	5.00	Zone 5	1.00	1.20	1.25	2.52	3.31	3.70	8.50	13.40	15.59
D034765	41.81	4.44	0.23	13.00	Zone 5	1.00	1.20	1.25	1.75	2.31	2.58	1.79	2.83	3.29
D028077	42.01	12.18	0.24	5.00	Zone 5	1.00	1.20	1.25	2.52	3.31	3.70	7.36	11.61	13.50
D028082	42.50	6.13	0.24	14.00	Zone 5	1.00	1.20	1.25	1.70	2.24	2.49	2.50	3.95	4.59
D028086	43.26	6.23	0.24	12.00	Zone 3	1.00	1.20	1.25	1.89	2.43	2.70	2.83	4.37	5.05
D028088	43.43	7.21	0.24	10.00	Zone 3	1.00	1.20	1.25	2.04	2.62	2.90	3.52	5.44	6.28
D028090	43.54	3.79	0.32	15.00	Zone 3	1.00	1.20	1.25	1.72	2.20	2.45	2.08	3.20	3.71
D028091	43.74	14.62	0.23	25.00	Zone 3	1.00	1.20	1.25	1.33	1.71	1.90	4.46	6.90	7.98
D028094	43.99	11.38	0.27	11.00	Zone 3	1.00	1.20	1.25	1.96	2.52	2.80	6.04	9.30	10.76
D028095	44.06	48.47	0.21	41.00	Zone 3	1.00	1.20	1.25	0.97	1.26	1.38	9.87	15.36	17.59
D028100	44.36	29.62	0.24	25.00	Zone 3	1.00	1.20	1.25	1.33	1.71	1.90	9.42	14.59	16.85
D028107	44.96	15.67	0.25	19.00	Zone 3	1.00	1.20	1.25	1.54	1.96	2.19	6.01	9.23	10.73
D028108	45.03	86.00	0.21	29.00	Zone 3	1.00	1.20	1.25	1.22	1.57	1.74	21.98	34.11	39.24
D028109	45.35	55.13	0.22	30.00	Zone 3	1.00	1.20	1.25	1.19	1.55	1.70	14.47	22.50	25.85
D028124	46.75	5.22	0.26	15.00	Zone 3	1.00	1.20	1.25	1.72	2.20	2.45	2.33	3.58	4.15
D028127	46.89	7.97	0.22	22.00	Zone 3	1.00	1.20	1.25	1.42	1.82	2.03	2.48	3.83	4.44
D028128	47.07	21.98	0.26	15.00	Zone 3	1.00	1.20	1.25	1.72	2.20	2.45	9.81	15.08	17.48
D028131	47.57	32.28	0.25	19.00	Zone 3	1.00	1.20	1.25	1.54	1.96	2.19	12.39	19.01	22.11

OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF RATIONAL METHOD CALCULATIONS

D028137	49.41	51.94	0.32	31.00	Zone 3	1.00	1.20	1.25	1.17	1.52	1.67	19.45	30.27	34.73
D028139	49.99	16.76	0.28	16.00	Zone 3	1.00	1.20	1.25	1.67	2.14	2.38	7.83	12.03	13.96
D028158	53.56	5.74	0.23	7.20	Zone 3	1.00	1.20	1.25	2.30	2.96	3.29	3.04	4.70	5.43
D028159	53.69	5.79	0.26	8.80	Zone 3	1.00	1.20	1.25	2.14	2.75	3.06	3.22	4.96	5.75
D028161	53.83	41.29	0.21	20.00	Zone 3	1.00	1.20	1.25	1.50	1.92	2.14	12.97	19.94	23.16
D028163	53.95	6.94	0.22	8.70	Zone 3	1.00	1.20	1.25	2.15	2.76	3.07	3.28	5.05	5.86
D028186	57.77	18.76	0.24	13.00	Zone 3	1.00	1.20	1.25	1.83	2.34	2.61	8.26	12.65	14.69
D028188	57.96	0.78	0.90	6.40	Zone 3	1.00	1.20	1.25	2.40	3.09	3.43	1.69	2.61	3.02

APPENDIX

G REGRESSION EQUATION RESULTS

OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF USGS REGRESSION EQUATION RESULTS - WEST OF THE CASCADES (2A)

BASIN INFORMATION							PEAK RUNOFF (CFS)		
DFI NUMBER	BASIN AREA (ac)	BASIN AREA (sq. mile)	2-YEAR, 24-HOUR RAINFALL DEPTH (inches)	CHANNEL SLOPE (degrees)	MINIMUM JANUARY TEMPERATURE (^{O}F)[1]	MAXIMUM JANUARY TEMPERATURE (^{O}F)[1]	10 YEAR, 24 HOUR	50 YEAR, 24 HOUR	100 YEAR, 24 HOUR
D028132	31.30	0.05	2.32	7.37	30.50	43.90	1.19	1.69	1.91
D028160	135.34	0.21	3.67	27.15	28.00	42.00	29.09	40.78	46.03
D028238	1514.90	2.37	3.61	7.06	22.00	36.00	53.94	72.31	80.94

Table 11. Prediction equations for estimating peak discharges for ungaged watersheds in Region 2A, western interior watersheds with mean elevations greater than 3,000 feet.

[Variables: Q(n), discharge in cubic feet per second for the n-year recurrence interval; Area, drainage area, in square miles; Slope, mean watershed slope, in degrees; I24-2, 2-year 24-hour precipitation intensity, in inches; Mn Jan T, mean minimum January temperature, in degrees Fahrenheit; Mx Jan T, mean maximum January temperature, in degrees Fahrenheit]

Prediction equation	Percent standard error of the model, in percent	Average standard error of sampling, in percent	Average prediction error, in percent	Average equivalent years of record
$Q(2) = 0.003119 Area^{1.021} Slope^{0.8124} I24\text{-}2^{2.050} MnJanT^{3.541} MxJanT^{-1.867}$	37.1	10.5	38.7	2.2
$Q(5) = 0.007824 Area^{1.020} Slope^{0.9022} I24\text{-}2^{1.649} MnJanT^{3.611} MxJanT^{-2.017}$	32.0	10.2	33.8	4.2
$Q(10) = 0.01546 Area^{1.021} Slope^{0.9506} I24\text{-}2^{1.471} MnJanT^{3.620} MxJanT^{-2.137}$	30.6	10.6	32.5	6.1
$Q(25) = 0.03353 Area^{1.021} Slope^{0.9930} I24\text{-}2^{1.321} MnJanT^{3.624} MxJanT^{-2.278}$	30.2	11.4	32.5	8.6
$Q(50) = 0.05501 Area^{1.022} Slope^{1.014} I24\text{-}2^{1.243} MnJanT^{3.624} MxJanT^{-2.366}$	30.7	12.2	33.2	10.3
$Q(100) = 0.08492 Area^{1.022} Slope^{1.030} I24\text{-}2^{1.182} MnJanT^{3.621} MxJanT^{-2.440}$	31.6	12.9	34.4	11.6
$Q(500) = 0.1974 Area^{1.023} Slope^{1.053} I24\text{-}2^{1.079} MnJanT^{3.601} MxJanT^{-2.566}$	34.6	14.7	37.9	13.6

OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS

SUMMARY OF USGS REGRESSION EQUATION RESULTS - WEST OF THE CASCADES (2A)

BASIN INFORMATION					PEAK RUNOFF (CFS)					
DFI NUMBER	BASIN AREA (ac)	BASIN AREA (sq. mile)	2-YEAR, 24-HOUR RAINFALL DEPTH (inches)	CHANNEL SLOPE (degrees)	Q2	Q5	10 YEAR, 24 HOUR	Q25	50 YEAR, 24 HOUR	100 YEAR, 24 HOUR
D027842	74.35	0.12	2.71	17.34	11.69	16.69	19.99	24.11	27.16	30.16
D028071	128.07	0.20	2.57	22.32	20.54	29.57	35.50	42.89	48.33	53.66
D028076	92.79	0.14	2.60	22.70	15.64	22.47	26.94	32.50	36.59	40.60
D028078	259.46	0.41	2.61	19.97	37.29	53.73	64.59	78.17	88.20	98.07
D028130	106.46	0.17	2.95	16.38	16.90	23.92	28.58	34.41	38.73	42.99
D028142	66.31	0.10	3.03	8.56	8.32	11.69	13.98	16.88	19.05	21.20

Table 12. Prediction equations for estimating peak discharges for ungaged watersheds in Region 2B, western interior watersheds with mean elevations less than 3,000 feet.

[Variables: Q(n), discharge in cubic feet per second for the n-year recurrence interval; Area, drainage area, in square miles; Slope, mean watershed slope, in degrees; I24-2, 2-year 24-hour precipitation intensity, in inches]

Prediction Equation	Percent standard error of the model, in percent	Average standard error of sampling, in percent	Average prediction error, in percent	Average equivalent years of record
$Q(2) = 9.136\ Area^{0.9004} Slope^{0.4695}\ I24\text{-}2^{0.8481}$	31.9	6.53	32.6	2.0
$Q(5) = 14.54\ Area^{0.9042}\ Slope^{0.4735}\ I24\text{-}2^{0.7355}$	31.6	6.85	32.4	2.8
$Q(10) = 18.49\ Area^{0.9064}\ Slope^{0.4688}\ I24\text{-}2^{0.6937}$	32.0	7.28	33.0	3.6
$Q(25) = 23.72\ Area^{0.9086}\ Slope^{0.4615}\ I24\text{-}2^{0.6578}$	33.0	7.90	34.1	4.8
$Q(50) = 27.75\ Area^{0.9101}\ Slope^{0.4559}\ I24\text{-}2^{0.6390}$	34.0	8.37	35.1	5.5
$Q(100) = 31.85\ Area^{0.9114}\ Slope^{0.4501}\ I24\text{-}2^{0.6252}$	35.0	8.83	36.2	6.2
$Q(500) = 41.72\ Area^{0.9141}\ Slope^{0.4365}\ I24\text{-}2^{0.6059}$	37.7	9.87	39.1	7.5

APPENDIX

H TR-55 RESULTS

OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF TR-55 RESULTS

BASIN INFORMATION					RAINFALL DEPTH (inches)			PEAK RUNOFF (CFS)[1]		
DFI NUMBER	MILE POINT	BASIN AREA (ac)	WEIGHTED CURVE NUMBER (CN)	TIME OF CONCENTRATION, Tc (minute)	10-YEAR, 24-HOUR	50-YEAR, 24-HOUR	100-YEAR, 24-HOUR	10 YEAR, 24 HOUR	50 YEAR, 24 HOUR	100 YEAR, 24 HOUR
D028273	84.68	13,180.35	36	1,457	3.16	4.28	4.79	0.00	16.84	46.72

1: Values from HYDROCAD

APPENDIX

PEAK RUNOFF SUMMARY

OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF HYDROLOGY RESULTS

BASIN INFORMATION				PEAK RUNOFF (CFS)		
DFI NUMBER	MILE POINT	BASIN AREA (ac)	HYDROLOGY METHOD	10 YEAR, 24 HOUR	50 YEAR, 24 HOUR	100 YEAR, 24 HOUR
D034723	2.73	0.39	Rational Method	0.79	1.26	1.47
D027825	13.07	21.84	Rational Method	7.46	11.78	13.65
D027828	13.56	14.16	Rational Method	5.54	8.74	10.15
D027832	13.93	2.80	Rational Method	2.04	3.22	3.75
D027833	14.03	11.60	Rational Method	3.71	5.82	6.75
D027842	15.51	74.35	USGS WEST 2B	19.99	27.16	30.16
D034741	17.29	14.69	Rational Method	6.63	10.47	12.17
D027990	26.27	79.92	Rational Method	18.34	28.79	33.44
D027992	26.60	20.19	Rational Method	5.90	9.33	10.79
D028033	31.47	9.17	Rational Method	1.77	2.80	3.26
D028041	33.54	47.76	Rational Method	16.88	26.44	30.86
D028044	33.65	21.75	Rational Method	8.59	13.57	15.77
D028045	33.79	7.21	Rational Method	3.63	5.72	6.66
D028047	36.73	4.88	Rational Method	3.47	5.45	6.34
D028050	37.31	13.24	Rational Method	5.28	8.35	9.69
D028051	37.56	23.44	Rational Method	8.74	13.79	15.98
D028052	37.68	30.63	Rational Method	13.30	21.02	24.52
D028053	37.89	14.13	Rational Method	7.06	11.11	12.91
D028071	40.92	128.07	USGS WEST 2B	35.50	48.33	53.66
D028074	41.50	19.02	Rational Method	9.25	14.58	17.01
D034764	41.58	12.98	Rational Method	8.50	13.40	15.59
D034765	41.81	4.44	Rational Method	1.97	3.11	3.62
D028076	41.91	92.79	USGS WEST 2B	26.94	36.59	40.60
D028077	42.01	12.18	Rational Method	7.36	11.61	13.50
D028078	42.12	203.82	USGS WEST 2B	51.90	70.81	78.70
D028082	42.50	6.13	Rational Method	2.75	4.34	5.05
D028086	43.26	6.23	Rational Method	2.83	4.37	5.05
D028088	43.43	7.21	Rational Method	3.88	5.98	6.91
D028090	43.54	3.79	Rational Method	2.29	3.52	4.08
D028091	43.74	14.62	Rational Method	4.90	7.60	8.77
D028094	43.99	11.38	Rational Method	6.04	9.30	10.76
D028095	44.06	48.47	Rational Method	10.85	16.90	19.35

OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF HYDROLOGY RESULTS

BASIN INFORMATION				PEAK RUNOFF (CFS)		
DFI NUMBER	MILE POINT	BASIN AREA (ac)	HYDROLOGY METHOD	10 YEAR, 24 HOUR	50 YEAR, 24 HOUR	100 YEAR, 24 HOUR
D028100	44.36	29.62	Rational Method	9.42	14.59	16.85
D028107	44.96	15.67	Rational Method	6.62	10.15	11.81
D028108	45.03	124.15	Rational Method	21.98	34.11	39.24
D028109	45.35	55.13	Rational Method	15.92	24.75	28.43
D028124	46.75	5.22	Rational Method	2.57	3.94	4.57
D028127	46.89	7.97	Rational Method	2.73	4.22	4.88
D028128	47.07	21.98	Rational Method	10.80	16.59	19.22
D028130	47.46	106.46	USGS WEST 2B	28.58	38.73	42.99
D028131	47.57	32.28	Rational Method	12.39	19.01	22.11
D028132	47.80	31.30	USGS WEST 2A	1.19	1.69	1.91
D028137	49.41	51.94	Rational Method	19.45	30.27	34.73
D028139	49.99	16.76	Rational Method	8.62	13.23	15.36
D028142	50.30	66.31	USGS WEST 2B	13.98	19.05	21.20
D028158	53.56	5.74	Rational Method	3.34	5.17	5.97
D028159	53.69	5.79	Rational Method	3.22	4.96	5.75
D028160	53.76	135.34	USGS WEST 2A	29.09	40.78	46.03
D028161	53.83	41.29	Rational Method	14.27	21.93	25.47
D028163	53.95	6.94	Rational Method	3.28	5.05	5.86
D028186	57.77	18.76	Rational Method	8.26	12.65	14.69
D028188	57.96	0.78	Rational Method	1.69	2.61	3.02
D028238	64.27	403.51	USGS WEST 2A	53.94	72.31	80.94
D028273	84.68	13180.35	TR-55	0.00	16.84	46.72

APPENDIX

J HYDRAULIC RESULTS AND RECOMMENDATIONS

OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

DFI NUMBER	MILE POINT	CROSSING TYPE	Inlet Ht. of Cover (ft.)[2]	Outlet Ht. of Cover (ft.)[2]	EXISTING CONDITIONS										INITIAL IMPROVEMENT STRATEGY BASED UPON CONDITION ASSESSMENT[3]			STRATEGY BASED UPON PRELIMINARY HYDRAULICS	STRATEGY BASED ON ODOT COMMENTS (NOV. 2021) AND FIELD VISIT (FEB. 2022)[3]	NOTES	SELECTED REPAIR OR REPLACEMENT STRATEGY[4]	PROSPOSED CONDITIONS								POSSIBLE FISH PRESENT?	WETLAND / WATER DELINEATOIN	CLEAN/ TV INSPECTION FOR FURTHER DESIGN	PROPOSED PRE-DESIGN TV INSPECTION LEGNTH (ft)
					D (ft.)	DOUBLE BARREL?	Hw/D			OVERTOPPING @ Q100?					REPLACE (OPEN CUT)	REPLACE (TRENCHLESS)	REPAIR					D (ft.)	Hw/D			OVERTOPPING @ Q100?							
							Q10	Q50	Hw/D < 1.25 at Q50?	Roadway Elevation (ft.)	Headwater Elev. (ft.)	Freeboard (ft.)											Q10	Q50	Hw/D < 1.25 at Q50?	Roadway Elevation (ft.)	Headwater Elev. (ft.)	Freeboard (ft.)							
D034723	2.73	Roadside Drainage	0.18	1.74	1.00		0.58	0.74	PASS	498.92	496.65	2.27	PASS	X			REPAIR	REPAIR	Scope is REPAIR based upon condition.	REPAIR	-	-	-	-	-	-	-	-		X		
D027825	13.07	Roadside Drainage	0.44	3.22	2.00		0.75	1.02	PASS	704.74	702.60	2.14	PASS	X			REPAIR	REPAIR	Scope is REPAIR based upon condition.	REPAIR	-	-	-	-	-	-	-	-		X		
D027828	13.56	Stream	1.60	1.99	1.50		0.87	1.20	PASS	714.49	711.20	3.29	PASS	X			REPAIR	REPAIR	ODOT will perform CCTV inspection. Lining recommended	REPAIR	-	-	-	-	-	-	-	-		X		
D027832	13.93	Roadside Drainage	1.53	3.87	1.50		0.52	0.69	PASS	775.32	771.42	3.90	PASS	X			REPAIR	REPAIR	Scope is REPAIR based upon condition.	REPAIR	-	-	-	-	-	-	-	-				
D027833	14.03	Roadside Drainage	2.11	3.26	1.50		0.75	1.03	PASS	799.29	795.43	3.86	PASS	X			REPAIR	REPAIR	Scope is REPAIR based upon condition.	REPAIR	-	-	-	-	-	-	-	-				
D027842	15.51	Stream	2.41	14.33	3.00		0.71	0.87	PASS	1,014.23	1,007.64	6.59	PASS	X			REPLACEMENT	REPLACEMENT	Scope is REPLACE based upon condition.	REPLACE (OPEN CUT)	8.00	0.48	0.51	PASS	1,014.23	1,006.00	8.23	PASS	YES	X		
D034741	17.29	Roadside Drainage	-2.44	-0.78	1.00		1.72	1.75	FAIL	986.98	987.09	-0.11	OVERTOP	X			REPLACEMENT	REPLACEMENT	Scope is REPLACE based upon condition and hydraulic capacity.	REPLACE (OPEN CUT)	1.50	1.13	1.15	PASS	986.98	987.06	-0.08	OVERTOP		X		
D027990	26.27	Roadside Drainage	0.64	1.73	2.00		1.54	2.89	FAIL	991.49	991.55	-0.06	OVERTOP	X			REPLACEMENT	REPLACEMENT		REPLACE (OPEN CUT)	3.00	0.70	0.91	PASS	991.49	988.03	3.46	PASS		X		
D027992	26.6	Roadside Drainage	0.68	3.69	1.50		0.89	1.25	FAIL	978.63	975.03	3.60	PASS	X			REPLACEMENT	REPLACEMENT		REPLACE (OPEN CUT)	2.50	0.49	0.62	PASS	978.63	974.54	4.09	PASS		X		
D028033	31.47	Roadside Drainage	-0.39	0.78	1.5		0.50	0.68	PASS	1,039.02	1,036.95	2.07	PASS	X			REPLACEMENT	REPLACEMENT	Scope is REPLACE based upon condition.	REPLACE (OPEN CUT)	1.50	0.53	0.71	PASS	1,039.02	1,037.00	2.02	PASS				
D028041	33.54	Roadside Drainage	2.81	5.84	1.5		3.75	3.81	FAIL	1,095.09	1,095.22	-0.13	OVERTOP	X			REPAIR	REPAIR		REPAIR	-	-	-	-	-	-	-	-				
D028044	33.65	Roadside Drainage	2.15	4.44	1.5		1.47	2.97	FAIL	1,098.95	1,098.96	-0.01	OVERTOP	X			REPLACEMENT	REPLACEMENT		REPLACE (OPEN CUT)	2.50	0.62	0.78	PASS	1,098.95	1,095.13	3.82	PASS		X		
D028045	33.79	Roadside Drainage	1.49	5.44	1.5		0.73	1.01	PASS	1,103.37	1,100.04	3.33	PASS	X			REPLACEMENT	REPLACEMENT	Scope is REPLACE based upon condition.	REPLACE (OPEN CUT)	2.00	0.50	0.65	PASS	1,103.37	1,099.74	3.63	PASS				
D028047	36.73	Roadside Drainage	0.29	2.63	2.0		0.43	0.55	PASS	1,274.70	1,271.38	3.32	PASS			X	REPAIR	REPAIR	Minimum cover is not attained. Per ODOT direction, only replace last four joints of outlet section as the sections are not under the road and don't require minimum cover.	REPAIR	-	-	-	-	-	-	-	-		X		
D028050	37.31	Roadside Drainage	6.62	9.89	1.5		0.85	1.15	PASS	1,281.05	1,272.65	8.40	PASS			X	REPAIR	REPAIR	CCTV shows 'good' longitudinal crack at 63.8 ft and culvert 10% full of sediments. REPAIR: clean culvert and replace three sections at outlet.	REPAIR	-	-	-	-	-	-	-	-		X	X	68
D028051	37.56	Roadside Drainage	0.84	9.18	1.5		1.14	1.91	FAIL	1,265.59	1,264.54	1.05	PASS	X			REPAIR	REPAIR	Scope is REPAIR based upon condition.	REPAIR	-	-	-	-	-	-	-	-			X	52
D028052	37.68	Roadside Drainage	3.41	6.88	1.5		1.85	3.71	FAIL	1,257.42	1,257.43	-0.01	OVERTOP			X	REPAIR	REPAIR	Scope is REPAIR based upon condition.	REPAIR	-	-	-	-	-	-	-	-		X	X	
D028053	37.89	Roadside Drainage	0.09	2.65	1.5		1.27	2.33	FAIL	1,270.53	1,270.56	-0.03	OVERTOP	X			REPAIR	REPAIR	Scope is REPAIR based upon condition.	REPAIR	-	-	-	-	-	-	-	-		X		
D028071	40.92	Stream	-0.70	3.60	2.0		2.51	2.55	FAIL	1,539.02	1,539.22	-0.20	OVERTOP			X	REPLACEMENT	REPLACEMENT	Scope is REPAIR based upon condition. Existing HW/D > 1.25 and will overtop the roadway at Q50 and Q100. Replace and upsize pipe.	REPLACE (OPEN CUT)	2.50	0.91	1.16	PASS	1,539.02	1,538.11	0.91	PASS			X	
D028074	41.5	Roadside Drainage	1.04	2.59	1.3		3.95	5.22	FAIL	1,586.09	1,586.17	-0.08	OVERTOP	X			REPLACEMENT	REPLACEMENT		REPLACE (OPEN CUT)	2.50	0.36	0.54	PASS	1,586.09	1,581.78	4.31	PASS		X		
D034764	41.58	Roadside Drainage	7.99	9.49	2.0		0.81	1.20	PASS	1,594.17	1,584.50	9.67	PASS	X			REPAIR	REPAIR	Scope is REPAIR based upon condition.	REPAIR	-	-	-	-	-	-	-	-		X		
D034765	41.811	Roadside Drainage	-1.85	-0.93	1.0		0.95	1.43	FAIL	1,615.92	1,615.69	0.23	PASS	X			REPLACEMENT	REPLACEMENT		REPLACE (OPEN CUT)	1.50	0.53	0.69	PASS	1,615.92	1,615.09	0.83	PASS		X		
D028076	41.91	Stream	0.92	4.06	2.0		2.58	2.66	FAIL	1,630.74	1,630.86	-0.12	OVERTOP	X			REPAIR	REPAIR	Scope is REPAIR based upon condition.	REPAIR	-	-	-	-	-	-	-	-		X		
D028077	42.01	Roadside Drainage	0.46	0.39	1.5		1.03	1.57	FAIL	1,637.55	1,635.16	2.39	PASS	X			REPLACEMENT	REPLACEMENT		REPLACE (OPEN CUT)	2.00	0.75	0.99	PASS	1,637.55	1,635.00	2.55	PASS		X		
D028078	42.12	Roadside Drainage	-0.50	1.63	2.0		2.48	2.52	FAIL	1,647.22	1,647.51	-0.29	OVERTOP	X			REPLACEMENT	REPLACEMENT		REPLACE (OPEN CUT)	3.00	0.82	1.00	PASS	1,647.22	1,645.67	1.55	PASS	YES	X		
D028082	42.5	Roadside Drainage	0.96	3.22	1.5		0.59	0.80	PASS	1,697.21	1,694.20	3.01	PASS	X			REPLACEMENT	REPLACEMENT		REPLACE (OPEN CUT)	1.50	0.67	0.85	PASS	1,697.21	1,693.60	3.61	PASS		X		
D028086	43.26	Roadside Drainage	0.56	2.97	1.5		0.63	0.84	PASS	1,825.15	1,822.48	2.67	PASS	X			REPLACEMENT	REPLACEMENT	Scope is REPLACE based upon condition.	REPLACE (OPEN CUT)	1.50	0.64	0.82	PASS	1,825.15	1,822.43	2.72	PASS		X		
D028088	43.43	Roadside Drainage	6.72	11.92	1.5		0.75	1.03	PASS	1,857.32	1,848.84	8.48	PASS		X		REPAIR	REPAIR	Scope is REPAIR based upon condition.	REPAIR	-	-	-	-	-	-	-	-		X		
D028090	43.54	Roadside Drainage	4.89	6.62	1.5		0.55	0.72	PASS	1,878.22	1,871.02	7.20	PASS	X			REPLACEMENT	REPLACEMENT	Scope is REPLACE based upon condition.	REPLACE (OPEN CUT)	1.50	0.59	0.74	PASS	1,878.22	1,871.04	7.18	PASS		X		
D028091	43.74	Roadside Drainage	3.02	7.96	1.5		0.90	1.29	FAIL	1,907.25	1,902.98	4.27	PASS	X			REPAIR	REPAIR	Scope is REPAIR based upon condition.	REPAIR	-	-	-	-	-	-	-	-			X	71
D028094	43.99	Roadside Drainage	1.89	4.65	1.5		0.95	1.37	FAIL	1,922.21	1,919.23	2.98	PASS	X			REPLACEMENT	REPLACEMENT	Scope is REPLACE based on video inspection. Existing Hw/D > 1.25 but less than 3. No overtopping at Q100. REPLACE culvert.	REPLACE (OPEN CUT)	2.00	0.84	1.02	PASS	1,922.21	1,918.53	3.68	PASS			X	
D028095	44.06	Stream	1.28	3.35	2.0		0.84	1.13	PASS	1,928.43	1,925.45	2.98	PASS	X			REPAIR	REPAIR	Scope is REPAIR based upon condition.	REPAIR	-	-	-	-	-	-	-	-		X	X	88
D028100	44.36	Roadside Drainage	4.75	5.65	2.0		0.74	1.02	PASS	1,998.75	1,992.23	6.52	PASS			X	REPLACEMENT	REPLACEMENT	Scope is REPLACE to correct negative culvert slope (i.e., existing culvert slopes towards the drop inlet).	REPLACE (OPEN CUT)	2.00	0.74	1.02	PASS	1,998.75	1,992.23	6.52	PASS		X	X	55
D028107	44.96	Roadside Drainage	9.36	8.87	2.0		0.70	0.91	PASS	1,971.64	1,960.33	11.31	PASS	X			REPLACEMENT	REPLACEMENT	Scope is REPLACE based upon condition.	REPLACE (OPEN CUT)	2.00	0.68	0.88	PASS	1,971.64	1,960.23	11.41	PASS		X		
D028108	45.03	Roadside Drainage	1.83	1.00	1.5		3.63	3.68	FAIL	1,969.31	1,969.52	-0.21	OVERTOP	X			REPAIR	REPAIR		REPAIR	-	-	-	-	-	-	-	-		X		
D028109	45.35	Roadside Drainage	1.94	4.16	1.5		2.39	2.43	FAIL	1,993.19	1,993.34	-0.15	OVERTOP			X	REPLACEMENT	REPLACEMENT	Scope is REPAIR based upon condition. Existing HW/D > 1.25 and will overtop the roadway at Q50 and Q100. Replace and upsize pipe.	REPLACE (OPEN CUT)	3.00	0.64	0.82	PASS	1,993.19	1,988.70	4.49	PASS		X	X	
D028124	46.75	Roadside Drainage	-0.04	1.68	1.5		0.59	0.77	PASS	2,094.99	2,093.82	1.17	PASS	X					Culvert is abandoned	ABANDON	-	-	-	-	-	-	-	-		X		
D028127	46.89	Roadside Drainage	1.37	1.40	1.5		0.63	0.82	PASS	2,108.98	2,104.96	4.02	PASS	X			REPLACEMENT	REPLACEMENT	Scope is REPLACE based on video inspection.	REPLACE (OPEN CUT)	1.50	0.71	0.90	PASS	2,108.98	2,105.58	3.40	PASS		X	X	47
D028128	47.07	Roadside Drainage	-0.24	-0.01	1.5		2.89	3.35	FAIL	2,123.58	2,124.79	-1.21	OVERTOP			X	REPLACEMENT	REPLACEMENT	Scope is REPLACE based upon hydraulic capacity. Existing HW/D > 3.0 and will overtop the roadway at Q100. Replace and upsize pipe. Remove from CCTV list.	REPLACE (OPEN CUT)	2.50	0.76	1.00	PASS	2,123.58	2,122.09	1.49	PASS		X	X	
D028130	47.46	Stream	3.32	3.42	2.5		1.91	2.69	FAIL	2,159.87	2,159.71	0.16	PASS			X	REPAIR	REPAIR	Scope is REPAIR based upon video inspection. Existing HW/D > 1.25 but less than 3.00. It will not overtop the roadway at Q100. Consider adding seepage collar and NOT up-size pipe. Clean culvert.	REPAIR	-	-	-	-	-	-	-	-		X	X	50
D028131	47.57	Roadside Drainage	1.65	2.18	2.5		1.02	1.46	FAIL	2,168.38	2,165.92	2.46	PASS			X	REPLACEMENT	REPLACEMENT	Scope is REPLACE based on video inspection.	REPLACE (OPEN CUT)	3.00	0.78	1.06	PASS	2,168.38	2,165.28	3.10	PASS		X	X	48

OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

DFI NUMBER	MILE POINT	CROSSING TYPE	Inlet Ht. of Cover (ft.)[2]	Outlet Ht. of Cover (ft.)[2]	EXISTING CONDITIONS										INITIAL IMPROVEMENT STRATEGY BASED UPON CONDITION ASSESSMENT[3]			STRATEGY BASED UPON PRELIMINARY HYDRAULICS	STRATEGY BASED ON ODOT COMMENTS (NOV. 2021) AND FIELD VISIT (FEB. 2022)[3]	NOTES	SELECTED REPAIR OR REPLACEMENT STRATEGY[1]	PROSPOSED CONDITIONS								POSSIBLE FISH PRESENT?	WETLAND / WATER DELINEATOIN	CLEAN/ TV INSPECTION FOR FURTHER DESIGN	PROPOSED PRE-DESIGN TV INSPECTION LEGNTH (ft)
					D (ft.)	DOUBLE BARREL?	Hw/D Q10	Hw/D Q50	Hw/D < 1.25 at Q50?	OVERTOPPING @ Q100? Roadway Elevation (ft.)	OVERTOPPING @ Q100? Headwater Elev. (ft.)	OVERTOPPING @ Q100? Freeboard (ft.)			REPLACE (OPEN CUT)	REPLACE (TRENCHLESS)	REPAIR					D (ft.)	Hw/D Q10	Hw/D Q50	Hw/D < 1.25 at Q50?	OVERTOPPING @ Q100? Roadway Elevation (ft.)	OVERTOPPING @ Q100? Headwater Elev. (ft.)	OVERTOPPING @ Q100? Freeboard (ft.)					
D028132	47.8	Stream	3.39	10.04	1.5	X	0.42	0.47	PASS	2,197.63	2,189.71	7.92	PASS				X	REPLACEMENT	REPLACEMENT	Existing is 2 ,18-inch-diameter culverts with a non-engineered headwall. Scope is REPAIR based upon condition and hydraulics. The scope is REPLACE with a single barrel per ODOT maintenance request due to observed bedload movement and sedimentation. This is AOP culvert and offsite fish passage mitigation to be provided.	REPLACE (OPEN CUT)	4.00	0.12	0.14	PASS	2,197.63	2,188.57	9.06	PASS	YES	X	X	
D028137	49.41	Roadside Drainage	13.26	23.68	2.0		1.25	2.12	FAIL	2,419.48	2,407.14	12.34	PASS		X			REPAIR	REPAIR	Scope is REPAIR based upon condition.	REPAIR	-	-	-	-	-	-	-	-			X	
D028139	49.99	Roadside Drainage	7.63	9.28	1.5		2.69	7.03	FAIL	2,524.51	2,524.55	-0.04	OVERTOP				X	REPAIR	REPAIR	Scope is REPAIR based upon condition.	REPAIR	-	-	-	-	-	-	-	-		X	X	
D028142	50.3	Roadside Drainage	4.76	8.24	2.5		0.77	0.96	PASS	2,535.93	2,529.27	6.66	PASS				X	REPAIR	REPAIR		REPAIR	-	-	-	-	-	-	-	-	YES	X	X	108
D028158	53.56	Roadside Drainage	1.83	2.94	1.5		2.45	2.49	FAIL	3,292.51	3,291.64	0.87	PASS	X				REPLACEMENT	REPLACEMENT		REPLACE (OPEN CUT)	2.50	0.75	1.00	PASS	3,292.51	3,288.80	3.71	PASS				
D028159	53.69	Roadside Drainage	-0.07	5.53	2.7		0.32	0.41	PASS	3,328.04	3,324.16	3.88	PASS	X			X	REPAIR	REPAIR	Scope is REPAIR based upon condition.	REPAIR	-	-	-	-	-	-	-	-		X	X	381
D028160	53.76	Stream	2.40	10.64	2.0		2.69	2.75	FAIL	3,346.89	3,347.04	-0.15	OVERTOP	X				REPAIR	REPAIR	Scope is REPAIR based upon condition.	REPAIR	-	-	-	-	-	-	-	-		X		
D028161	53.83	Roadside Drainage	4.21	28.21	2.5		2.78	3.03	FAIL	3,368.00	3,366.78	1.22	PASS	X				REPAIR	REPAIR	Scope is REPAIR based upon condition.	REPAIR	-	-	-	-	-	-	-	-				
D028163	53.95	Roadside Drainage	1.45	4.79	2.0		0.46	0.59	PASS	3,396.36	3,391.99	4.37	PASS	X				REPAIR	REPAIR	Scope is REPAIR based upon condition.	REPAIR	-	-	-	-	-	-	-	-		X		
D028186	57.77	Roadside Drainage	0.52	3.80	2.0		0.84	1.08	PASS	4,326.44	4,324.32	2.12	PASS	X				REPAIR	REPAIR	Scope is REPAIR based upon condition.	REPAIR	-	-	-	-	-	-	-	-		X		
D028188	57.96	Roadside Drainage	7.67	11.39	2.0		0.29	0.36	PASS	4,338.28	4,327.30	10.98	PASS				X	REPAIR	REPAIR		REPAIR	-	-	-	-	-	-	-	-		X	X	98
D028238	64.27	Stream	8.80	13.36	3.0	X	0.56	0.68	PASS	4,845.40	4,833.69	11.71	PASS				X	REPAIR	REPAIR	Existing is 2, 30-inch diameter culverts. Scope is REPAIR pending CCTV condition assessment.	REPAIR	-	-	-	-	-	-	-	-	YES	X	X	89
D028273	84.68	Roadside Drainage	13.97	14.50	2.00		0.00	1.16	PASS	4,603.73	4,594.39	9.34	PASS		X			REPAIR	REPAIR	Scope is REPAIR based upon condition.	REPAIR	-	-	-	-	-	-	-	-		X		
																					REPAIR	↑ 29											
																					REPLACE (OPEN CUT)	↓ 24								5	42	20	45

1: Values in ITALICS are culverts with cover between 10 and 15 feet. Open trench or trenchless replacement are both viable strategies.

2: Height of cover is measured from the subgrade to the pipe crown

3: See Appendix A of the Hydraulic Report for field condition assessments.

USGS Flow Types

Flow Control	Length Full	Flow Type		Flow Profiles	Outlet		Outlet Depth
		HW>D	HW<D		TW>D	TW<D	
Inlet	none	5	1	S2		n	Normal
Inlet	none	5	1	S1		t	Tailwater (TW)
Inlet	none	5	1	JS1		t	Jump, S1, TW
Inlet	none	5	1	M3, S3, H3, A3		t	Tailwater
Inlet	none	5	1	H3J, A3J		t	H3, Jump, TW
Inlet	part	5	1	S1	f		Full
Inlet	part	5	1	S1	f		Full
Inlet	part	5	1	JS1	f		Jump, S1, Full
Inlet	part	5	1	H3J, A3J	f		H3, Jump, Full
Outlet	none		2	M2, H2, A2		c	Critical
Outlet	none		3	M2, H2, A2		t	Tailwater
Outlet	none		3	M1		t	Tailwater
Outlet	part		3	M1	f		Full
Outlet	all	4		FF	f		Full
Outlet	most	6		FF		t	Tailwater
Outlet	most	6		FF		c	Critical
Outlet	part	7		M1		t	Tailwater
Outlet	part	7		M2, H2, A2		t	Tailwater
Outlet	part	7		M2, H2, A2		c	Critical

REPLACEMENT

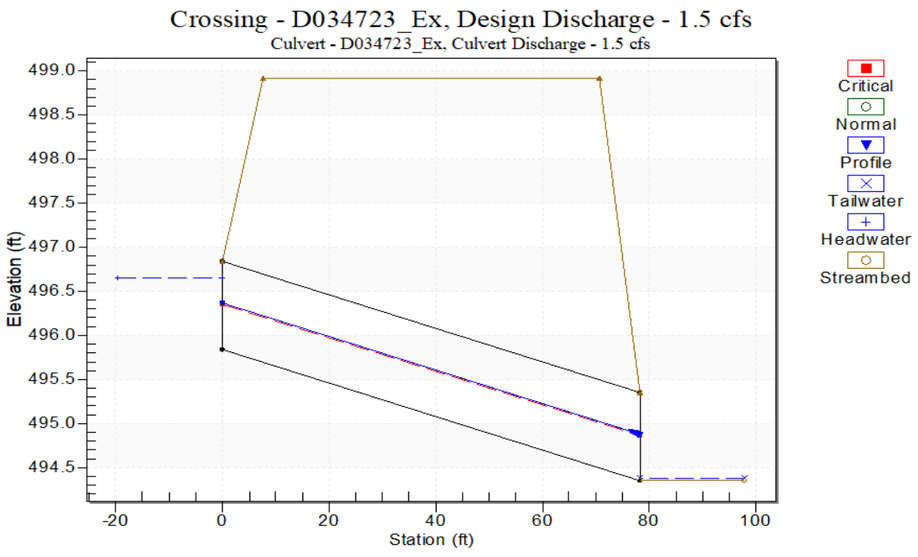
OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

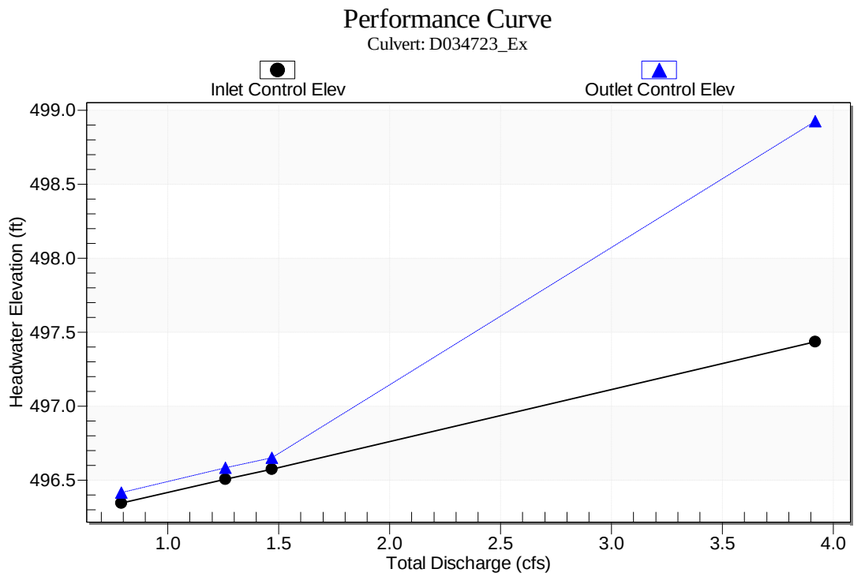
REPAIR

Culvert Name D034723 MP 2.73
Modeled By YH
Date 10/22/2020

Note: Pipe cover measured from top of pipe to bottom of sub-base

	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Existing Pipe	1.0	HDPE Corrugated	78	Drop Inlet	Mitered	495.84	494.35	1.91%	498.92	498.99	0.2	1.7	Q10	0.79	0.79	496.42	0.51	0.58	2-M2c	0.37	0.37	0.37	0.02	2.97	0.7	0.58	PASS	PASS	PASS	FAIL	PASS
													Q50	1.26	1.26	496.58	0.67	0.74	2-M2c	0.48	0.47	0.47	0.03	3.44	0.84	0.74	PASS	PASS	PASS	FAIL	PASS
													Q100	1.47	1.47	496.65	0.74	0.81	2-M2c	0.53	0.51	0.51	0.03	3.62	0.89	0.81	PASS	PASS	PASS	FAIL	PASS





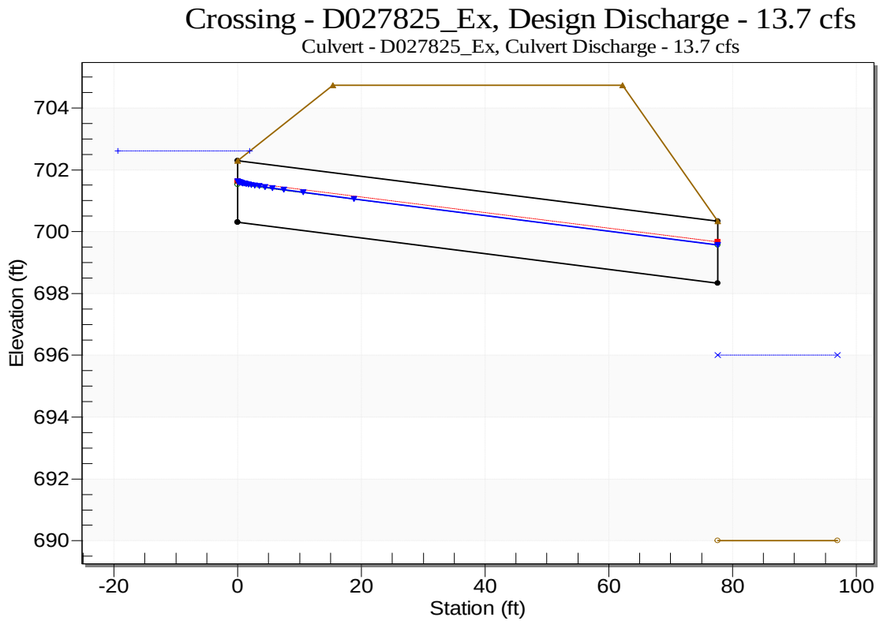
OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

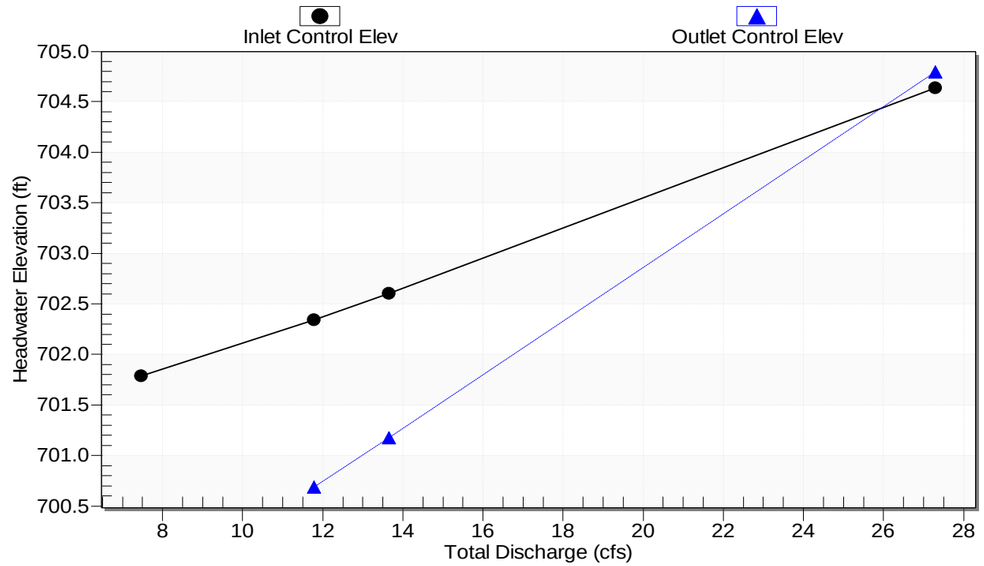
REPAIR

Culvert Name D027825 MP 13.07
Modeled By Yhabtemihcael
Date 9/10/2020

Note: Pipe cover measured from top of pipe to bottom of sub-base

	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverChec k Outlet
Existing Pipe	2.00	CMP	77.60	Project	Project	700.30	698.33	0.025	704.74	705.55	0.44	3.22	Q10	7.46	7.46	701.79	1.49	-0.55	1-S2n	0.86	0.97	0.86	6	5.81	0	0.75	PASS	PASS	PASS	FAIL	PASS
													Q50	11.78	11.78	702.34	2.04	0.39	5-S2n	1.12	1.23	1.12	6	6.51	0	1.02	PASS	PASS	PASS	FAIL	PASS
													Q100	13.65	13.65	702.6	2.3	0.87	5-S2n	1.23	1.33	1.23	6	6.73	0	1.15	PASS	PASS	PASS	FAIL	PASS





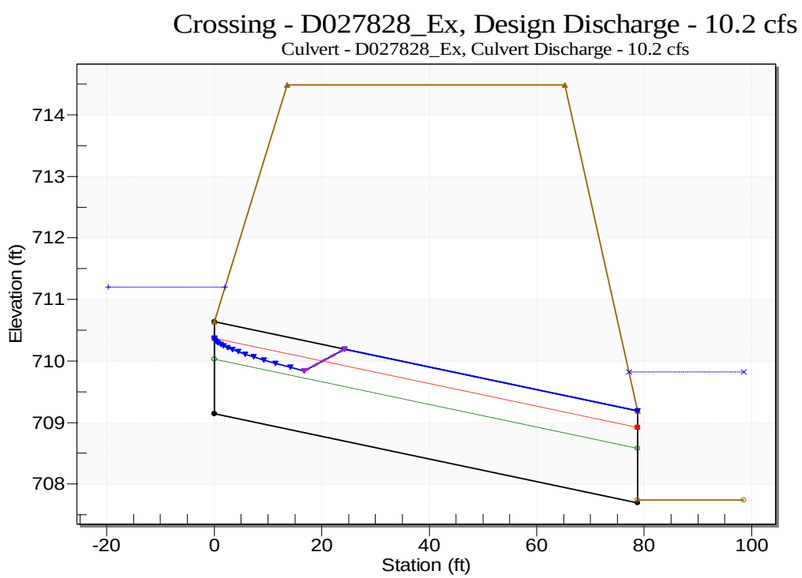
OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

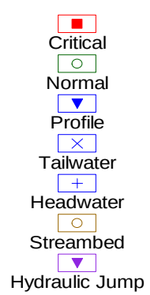
REPAIR

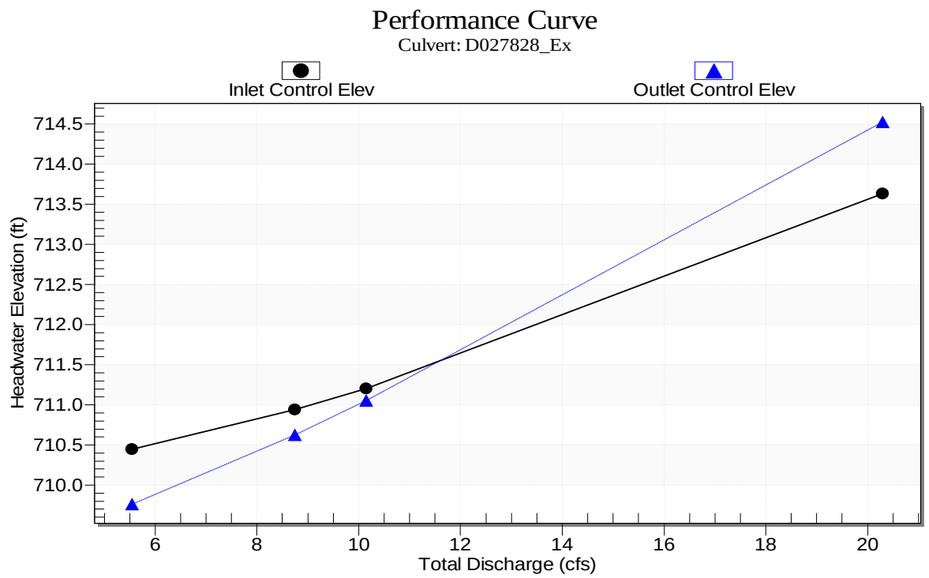
Culvert Name D027828 MP 13.56
Modeled By Yhabtemichael
Date 9/10/2020

Note: Pipe cover measured from top of pipe to bottom of sub-base

	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Existing Pipe	1.50	Conc	78.80	Project	Project	709.14	707.69	0.018	714.49	713.43	1.60	1.99	Q10	5.54	5.54	710.45	1.31	0.62	1-JS1f	0.62	0.91	1.5	1.66	3.13	3.37	0.87	PASS	PASS	PASS	PASS	PASS
													Q50	8.74	8.74	710.94	1.8	1.48	5-JS1f	0.81	1.14	1.5	1.97	4.95	3.77	1.20	PASS	PASS	PASS	PASS	PASS
													Q100	10.15	10.15	711.2	2.06	1.92	5-JS1f	0.89	1.23	1.5	2.08	5.74	3.92	1.37	PASS	PASS	PASS	PASS	PASS







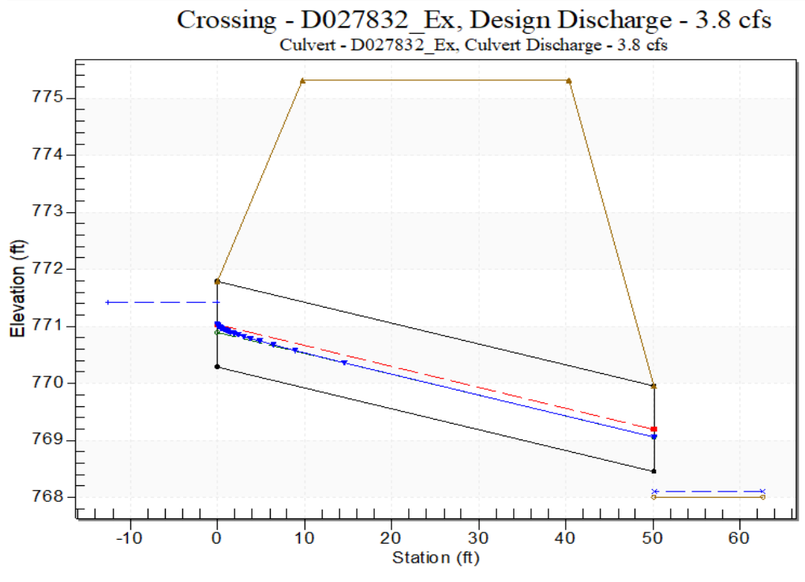
OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

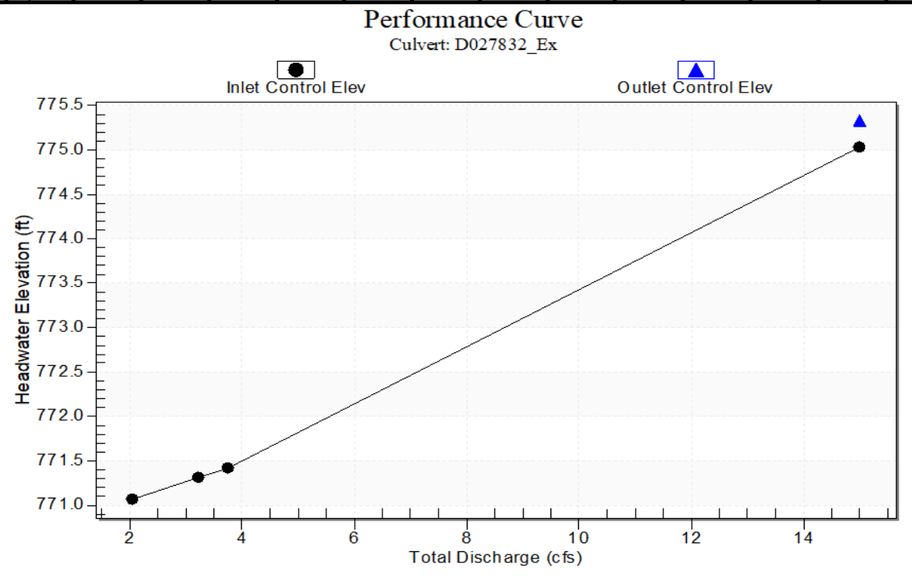
REPAIR

Culvert Name D027832 MP13.93
Modeled By YH
Date 10/22/2020

Note: Pipe cover measured from top of pipe to bottom of sub-base

	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Existing Pipe	1.50	CMP	50.13	Project	Project	770.29	768.45	0.037	775.32	775.82	1.53	3.87	Q10	2.04	2.04	771.07	0.78	-1.2	1-S2n	0.44	0.54	0.44	0.07	4.74	4.21	0.52	PASS	PASS	PASS	PASS	PASS
													Q50	3.22	3.22	771.32	1.03	-0.9	1-S2n	0.56	0.68	0.56	0.09	5.38	5.02	0.69	PASS	PASS	PASS	PASS	PASS
													Q100	3.75	3.75	771.42	1.13	-0.75	1-S2n	0.61	0.74	0.61	0.1	5.61	5.33	0.75	PASS	PASS	PASS	PASS	PASS





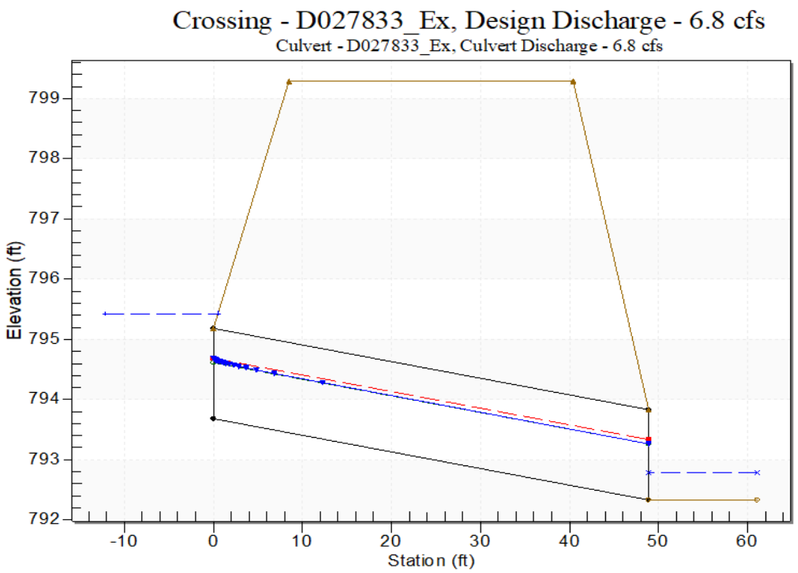
OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

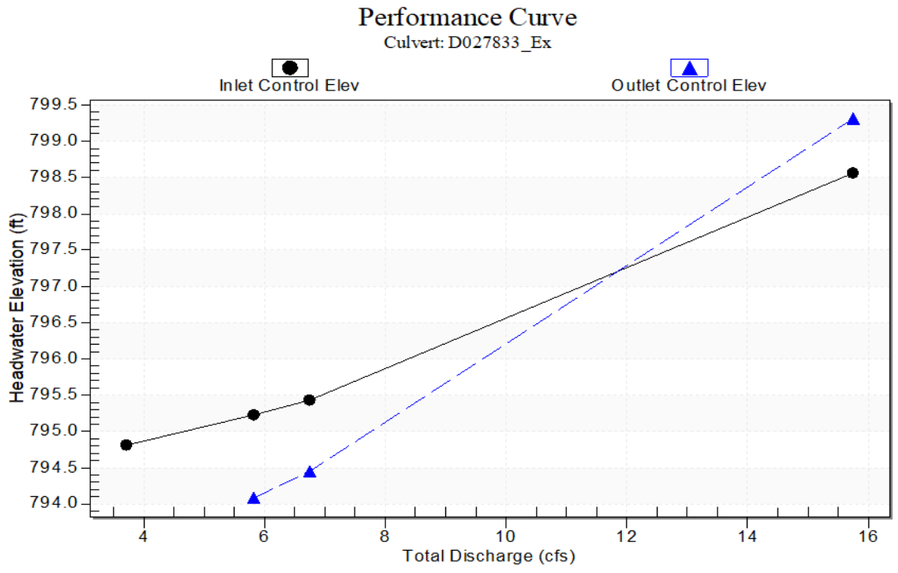
REPAIR

Culvert Name D027833 MP 14.03
Modeled By YH
Date 10/22/2020

Note: Pipe cover measured from top of pipe to bottom of sub-base

	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Existing Pipe	1.50	CMP	48.88	Project	Project	793.68	792.33	0.03	799.29	799.09	2.11	3.26	Q10	3.71	3.71	794.81	1.13	-0.28	1-S2n	0.65	0.74	0.65	0.33	5.03	4.36	0.75	PASS	PASS	PASS	PASS	PASS
													Q50	5.82	5.82	795.23	1.55	0.41	5-S2n	0.85	0.93	0.85	0.42	5.61	5.01	1.03	PASS	PASS	PASS	PASS	PASS
													Q100	6.75	6.75	795.43	1.75	0.77	5-S2n	0.94	1.01	0.94	0.46	5.82	5.24	1.17	PASS	PASS	PASS	PASS	PASS





OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

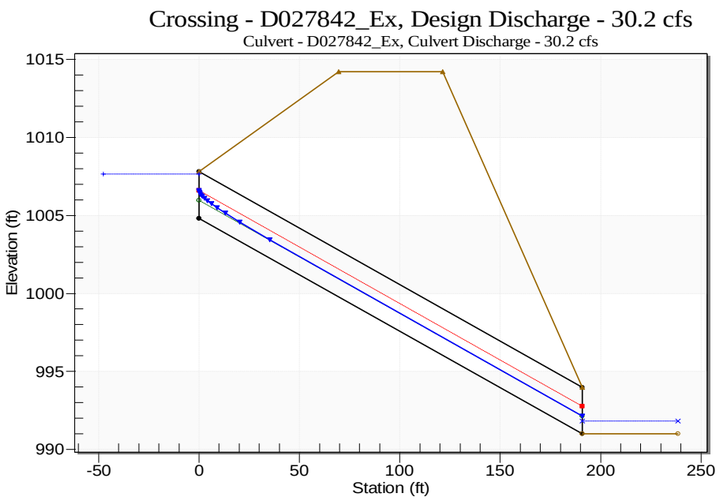
REPLACEMENT

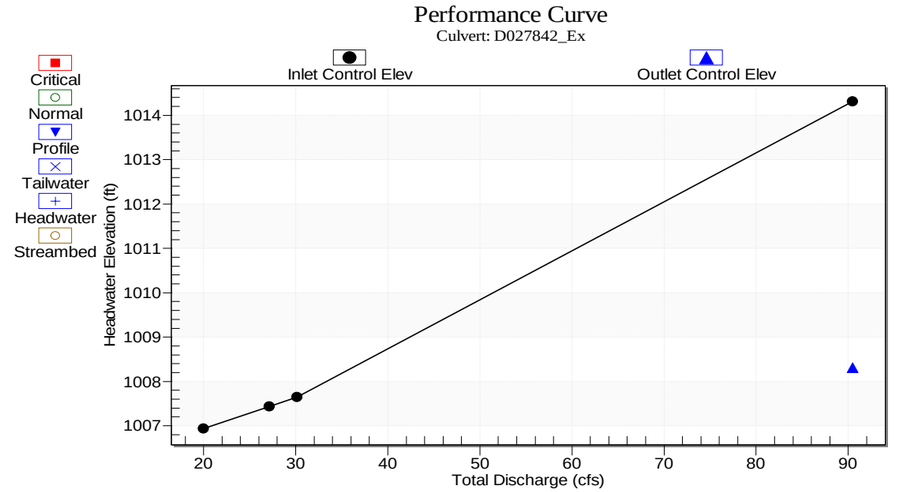
Culvert Name D027842 MP 15.51
Modeled By YH
Date 10/22/2020

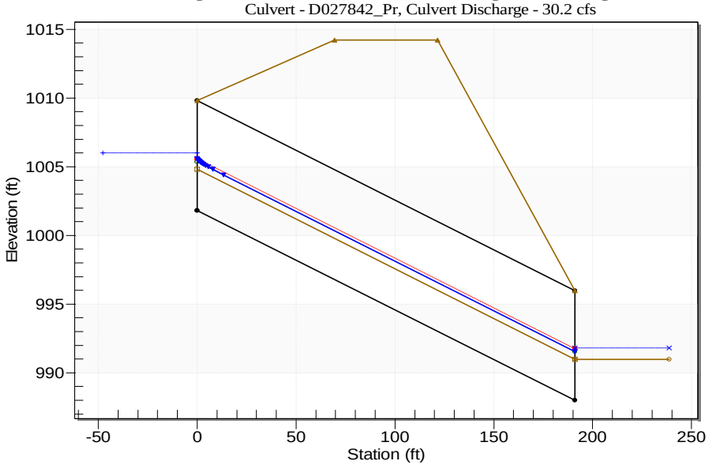
Note: Pipe cover measured from top of pipe to bottom of sub-base

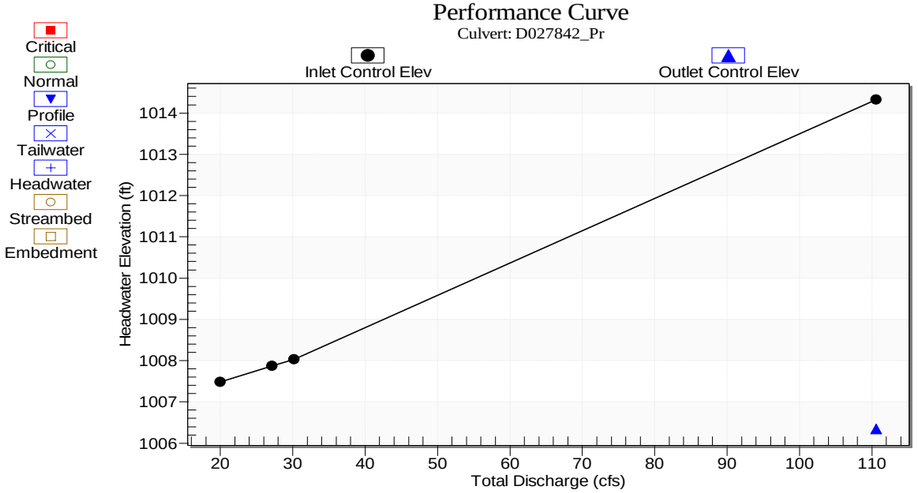
	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Existing Pipe	3.00	CMP	190.90	Project	Project	1,004.82	990.99	0.07	1,014.23	1,012.32	4.41	16.33	Q10	19.99	19.99	1006.94	2.12	-11.58	1-S2n	0.92	1.43	0.92	0.65	10.84	4.15	0.71	PASS	PASS	PASS	PASS	PASS
													Q50	27.16	27.16	1007.43	2.61	-10.63	1-S2n	1.08	1.68	1.08	0.78	11.81	4.62	0.87	PASS	PASS	PASS	PASS	PASS
													Q100	30.16	30.16	1007.64	2.82	-10.19	1-S2n	1.15	1.78	1.13	0.83	12.36	4.79	0.94	PASS	PASS	PASS	PASS	PASS

	Pipe Size (ft)*	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Proposed	8.00	CMP	191.00	Mitered	Mitered	1,001.82	987.99	0.07	1,014.23	1,012.32	2.41	14.33	Q10	19.99	19.99	1005.69	0.87	-13.15	1-S2n	0.42	0.59	0.42	0.65	6.12	4.15	0.48	PASS	PASS	PASS	PASS	PASS
													Q50	27.16	27.16	1005.91	1.09	-12.99	1-S2n	0.51	0.72	0.51	0.78	6.83	4.62	0.51	PASS	PASS	PASS	PASS	PASS
													Q100	30.16	30.16	1006	1.18	-12.93	1-S2n	0.54	0.78	0.54	0.83	7.12	4.79	0.52	PASS	PASS	PASS	PASS	PASS









OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

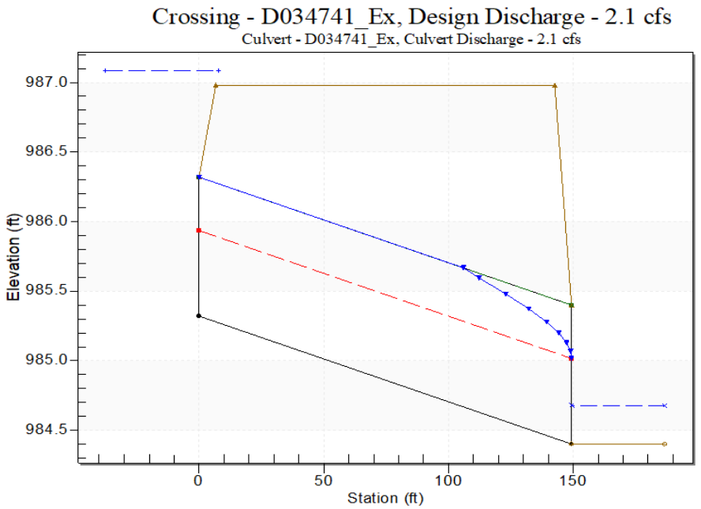
REPLACEMENT

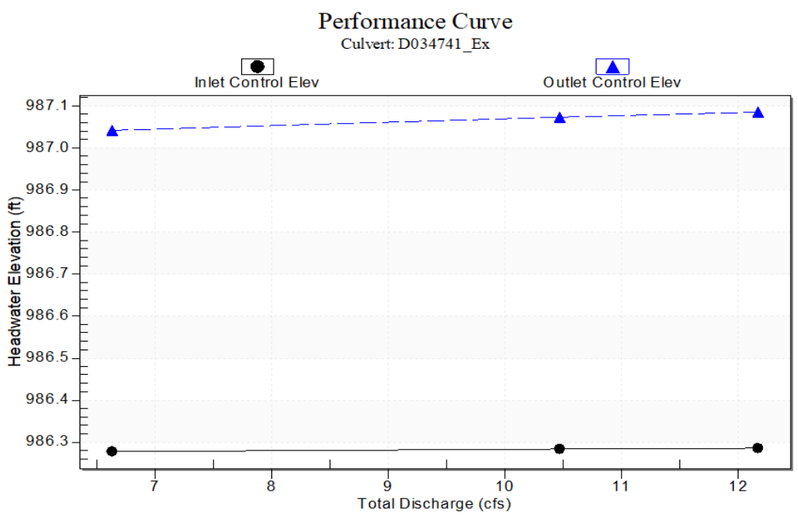
Culvert Name D034741 MP 17.29
Modeled By YH
Date 10/22/2020

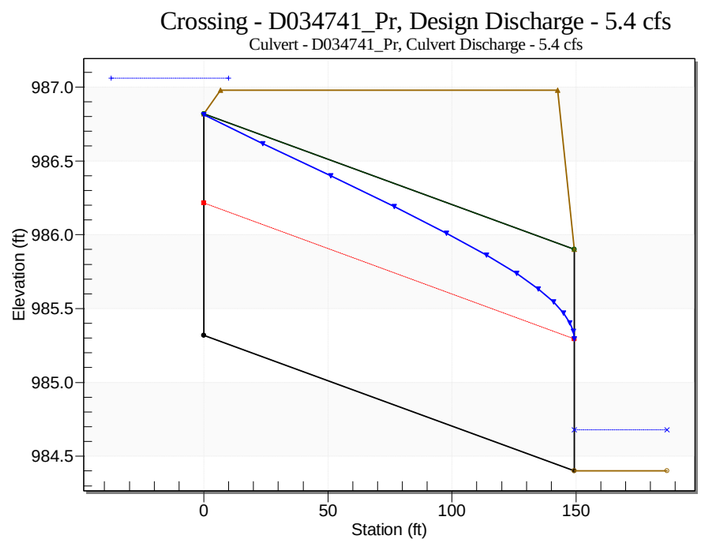
Note: Pipe cover measured from top of pipe to bottom of sub-base

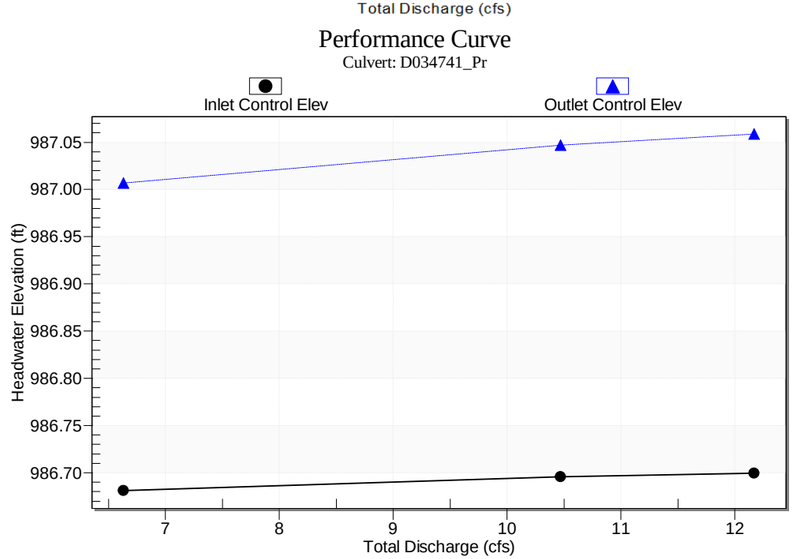
	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverChec k Outlet
Existing Pipe	1.00	CMP	149.28	Mitered	Mitered	985.32	984.40	0.01	986.98	987.72	-1.94	-0.28	Q10	6.63	2.06	987.04	0.96	1.72	7-M2c	1	0.61	0.61	0.19	4.09	3.68	1.72	FAIL	OVERTOP	PASS	FAIL	FAIL
													Q50	10.47	2.08	987.07	0.96	1.75	7-M2c	1	0.62	0.62	0.25	4.1	4.36	1.75	FAIL	OVERTOP	PASS	FAIL	FAIL
													Q100	12.17	2.09	987.09	0.97	1.76	7-M2c	1	0.62	0.62	0.28	4.1	4.61	1.77	FAIL	OVERTOP	PASS	FAIL	FAIL

	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverChec k Outlet
Proposed	1.50	DIP	150.00	Mitered	Mitered	985.32	984.40	0.01	986.98	987.72	-2.44	-0.78	Q10	6.63	5.28	987.01	1.36	1.69	7-M2c	1.5	0.88	0.88	0.19	4.87	3.68	1.13	PASS	OVERTOP	PASS	FAIL	FAIL
													Q50	10.47	5.36	987.05	1.38	1.73	7-M2c	1.5	0.89	0.89	0.25	4.89	4.36	1.15	PASS	OVERTOP	PASS	FAIL	FAIL
													Q100	12.17	5.38	987.06	1.38	1.74	7-M2c	1.5		0.89	0.28	4.9	4.61	1.16	PASS	OVERTOP	PASS	FAIL	FAIL









OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

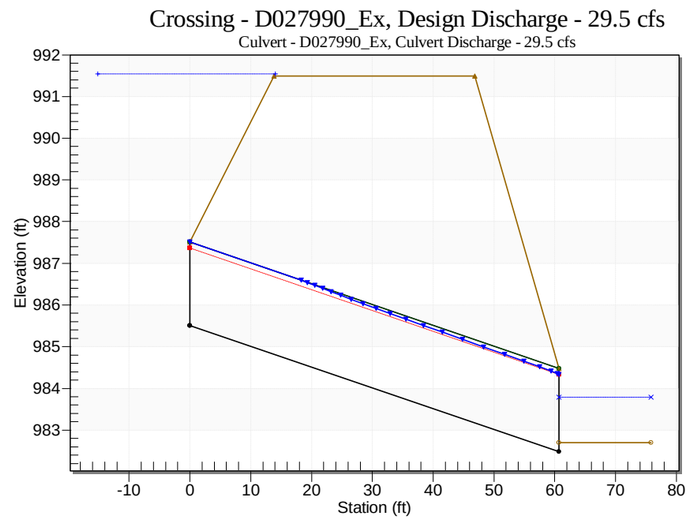
REPLACEMENT

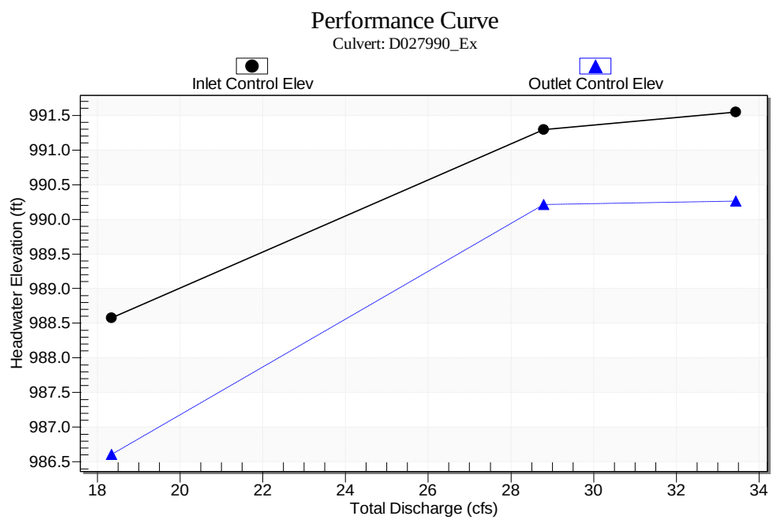
Culvert Name D027990 MP 26.27
Modeled By YH
Date 10/22/2020

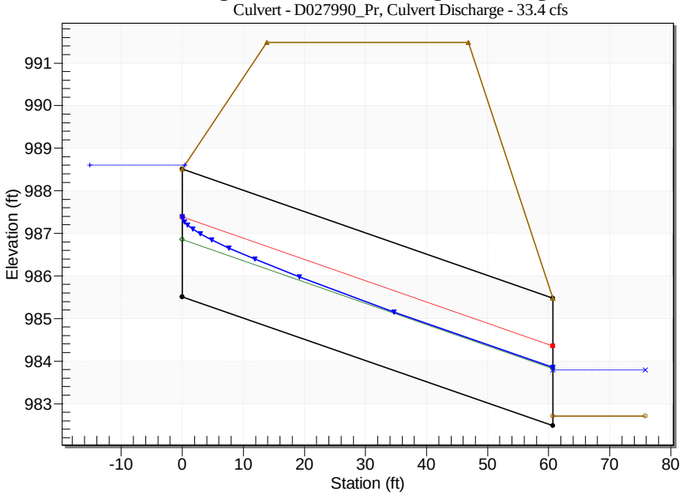
Note: Pipe cover measured from top of pipe to bottom of sub-base

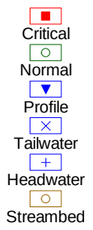
	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Existing Pipe	2.00	CMP	60.68	Project	Project	985.51	982.48	0.05	991.49	990.06	1.38	2.98	Q10	18.34	18.34	988.58	3.07	1.1	5-S2n	1.2	1.54	1.2	0.87	9.36	24.46	1.54	FAIL	PASS	PASS	PASS	PASS
													Q50	28.79	28.79	991.29	5.78	4.7	5-S2n	1.75	1.84	1.75	1.03	9.89	27.37	2.89	FAIL	PASS	PASS	PASS	PASS
													Q100	33.44	29.54	991.55	6.03~	4.75	7-M2c	2	1.86	1.86	1.08	9.72	28.42	3.02	FAIL	OVERTOP	PASS	PASS	PASS

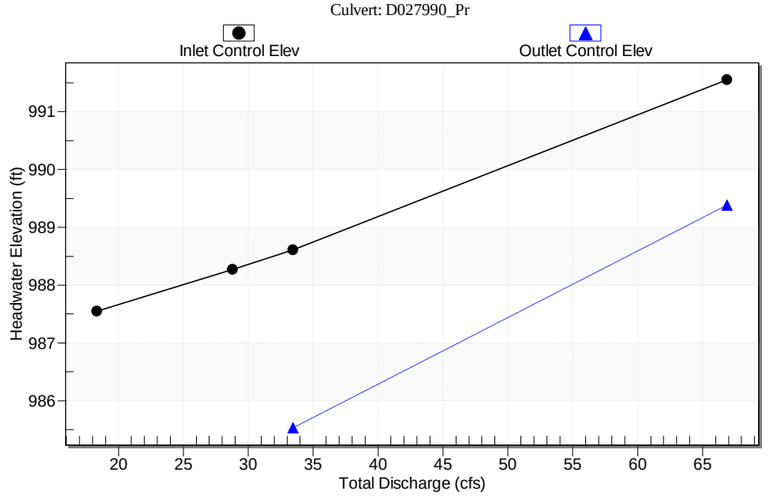
	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Proposed	3.00	CONC	61.00	Mitered	Mitered	985.00	982.48	0.04	991.49	990.06	0.64	1.73	Q10	18.34	18.34	987.1	2.1	-0.81	1-S2n	1.02	1.37	1.02	0.87	8.65	24.46	0.70	PASS	PASS	PASS	FAIL	PASS
													Q50	28.79	28.79	987.73	2.73	0.04	1-S2n	1.3	1.74	1.33	1.03	9.55	27.37	0.91	PASS	PASS	PASS	FAIL	PASS
													Q100	33.44	33.44	988.03	3.03	0.47	5-S2n	1.42	1.88	1.42	1.08	10.16	28.42	1.01	PASS	PASS	PASS	FAIL	PASS











OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

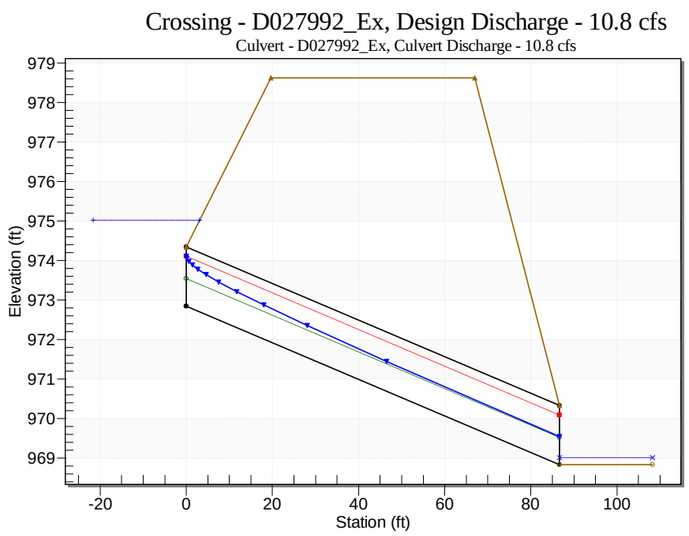
REPLACEMENT

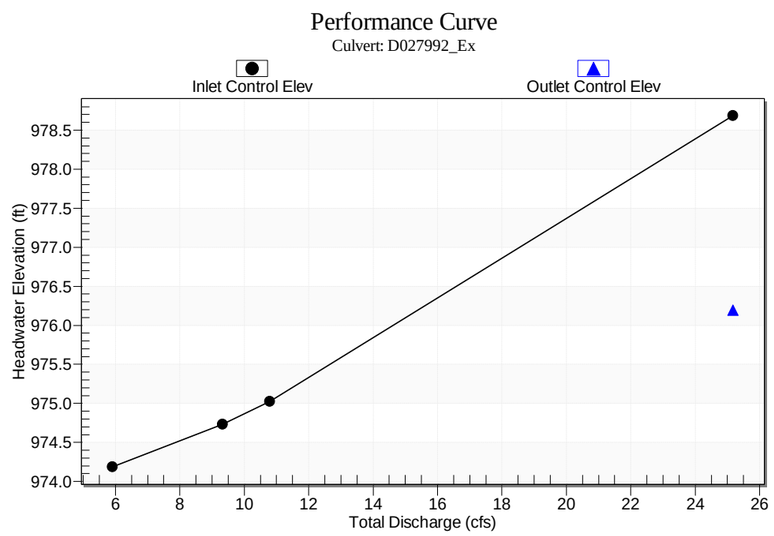
Culvert Name D027992 MP 26.6
Modeled By YH
Date 10/22/2020

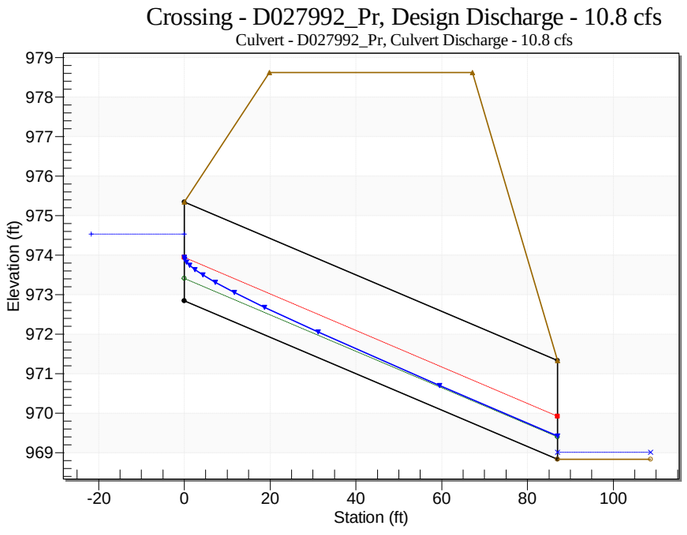
Note: Pipe cover measured from top of pipe to bottom of sub-base

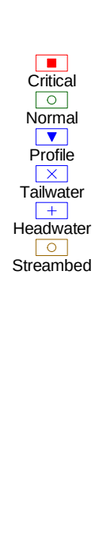
	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Existing Pipe	1.50	Conc	86.63	Project	Project	972.85	968.83	0.05	978.63	977.62	1.43	4.44	Q10	5.9	5.9	974.19	1.34	-2.64	1-S2n	0.5	0.94	0.52	0.13	10.77	7.32	0.89	PASS	PASS	PASS	PASS	PASS
													Q50	9.33	9.33	974.73	1.88	-1.58	5-S2n	0.64	1.18	0.67	0.17	12.2	8.73	1.25	FAIL	PASS	PASS	PASS	PASS
													Q100	10.79	10.79	975.03	2.18	-1.17	5-S2n	0.7	1.26	0.72	0.19	12.87	9.23	1.45	FAIL	PASS	PASS	PASS	PASS

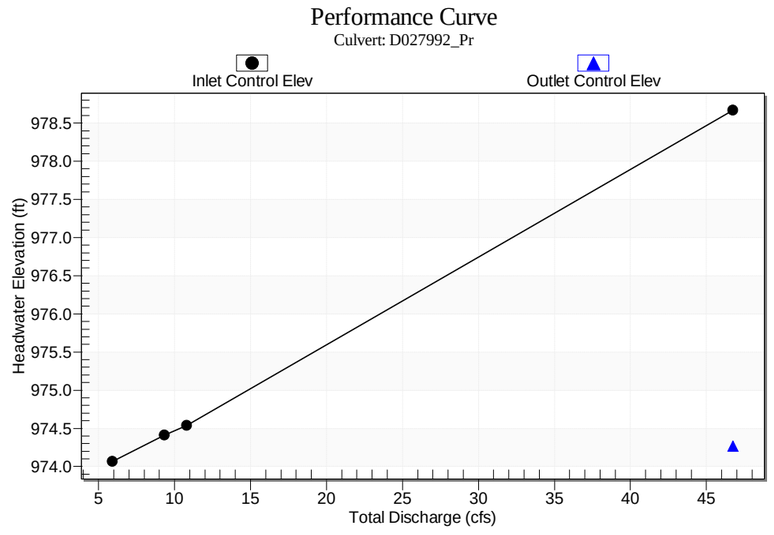
	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Proposed	2.50	DIP	87.00	Mitered	Mitered	972.85	968.83	0.05	978.63	977.62	0.68	3.69	Q10	5.9	5.9	974.07	1.22	-3.16	1-S2n	0.42	0.8	0.43	0.13	10.59	7.32	0.49	PASS	PASS	PASS	FAIL	PASS
													Q50	9.33	9.33	974.41	1.56	-2.87	1-S2n	0.53	1.02	0.55	0.17	11.6	8.73	0.62	PASS	PASS	PASS	FAIL	PASS
													Q100	10.79	10.79	974.54	1.69	-2.74	1-S2n	0.57	1.1	0.6	0.19	12.02	9.23	0.68	PASS	PASS	PASS	FAIL	PASS











OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

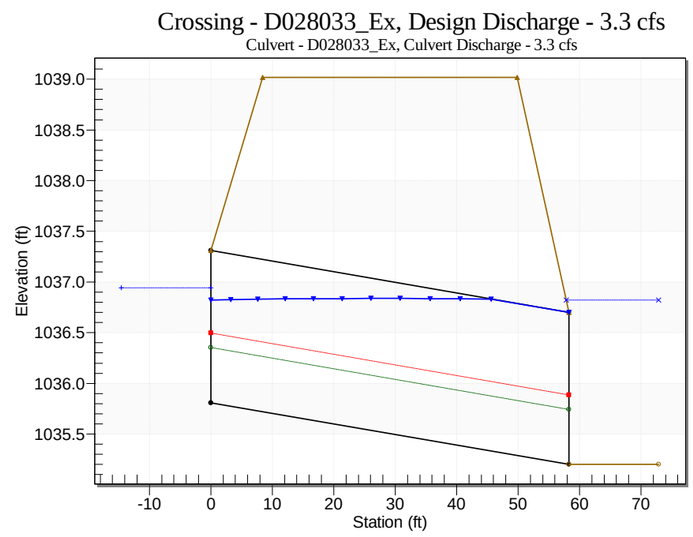
REPLACEMENT

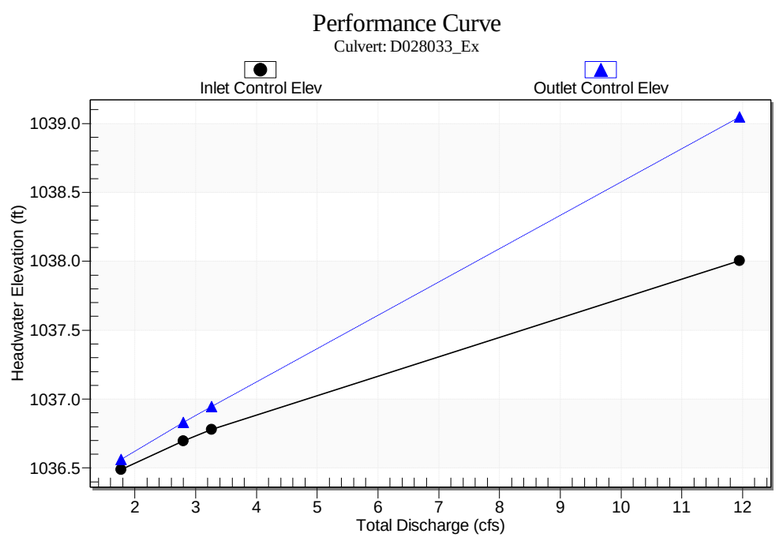
Culvert Name D028033 MP 31.47
Modeled By YH
Date 10/22/2020

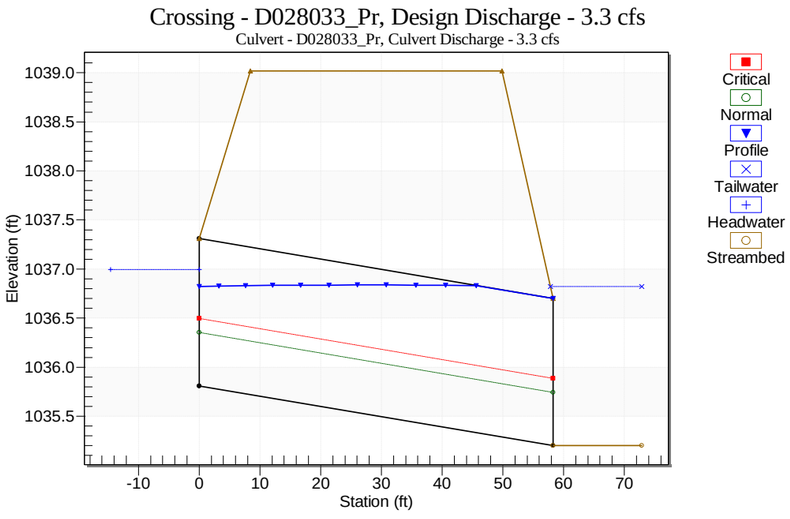
Note: Pipe cover measured from top of pipe to bottom of sub-base

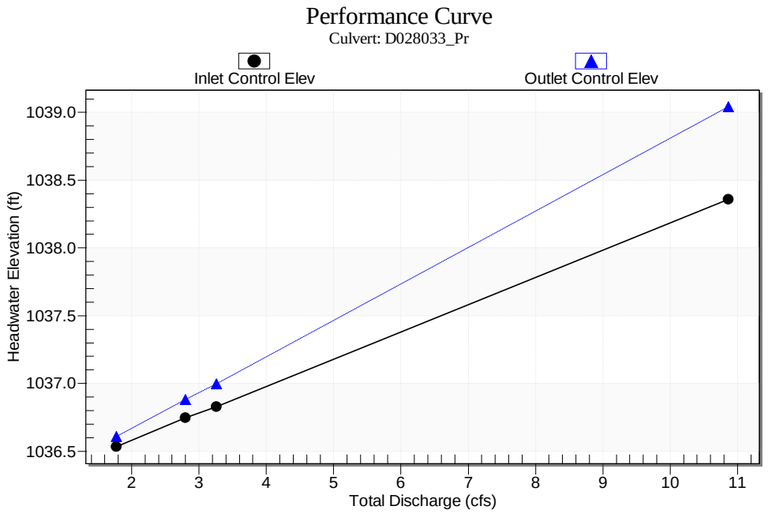
	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverChec k Outlet
Existing Pipe	1.50	Conc	58.28	Project	Project	1,035.81	1,035.20	1.05%	1,039.02	1,039.58	-0.64	0.53	Q10	1.77	1.77	1036.56	0.68	0.75	1-S1t	0.39	0.5	1.29	1.29	1.1	0.53	0.50	PASS	PASS	PASS	FAIL	FAIL
													Q50	2.8	2.8	1036.83	0.89	1.02	1-S1f	0.5	0.64	1.5	1.53	1.58	0.6	0.68	PASS	PASS	PASS	FAIL	FAIL
													Q100	3.26	3.26	1036.95	0.97	1.14	1-S1f	0.54	0.69	1.5	1.62	1.84	0.62	0.76	PASS	PASS	PASS	FAIL	FAIL

	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverChec k Outlet
Proposed	1.50	DIP	58.28	Mitered	Mitered	1,035.81	1,035.20	1.05%	1,039.02	1,039.58	-0.39	0.78	Q10	1.77	1.77	1036.61	0.72	0.8	1-S1t	0.39	0.5	1.29	1.29	1.1	0.53	0.53	PASS	PASS	PASS	FAIL	FAIL
													Q50	2.8	2.8	1036.88	0.94	1.07	1-S1f	0.5	0.64	1.5	1.53	1.58	0.6	0.71	PASS	PASS	PASS	FAIL	FAIL
													Q100	3.26	3.26	1037	1.02	1.19	1-S1f	0.54	0.69	1.5	1.62	1.84	0.62	0.79	PASS	PASS	PASS	FAIL	FAIL









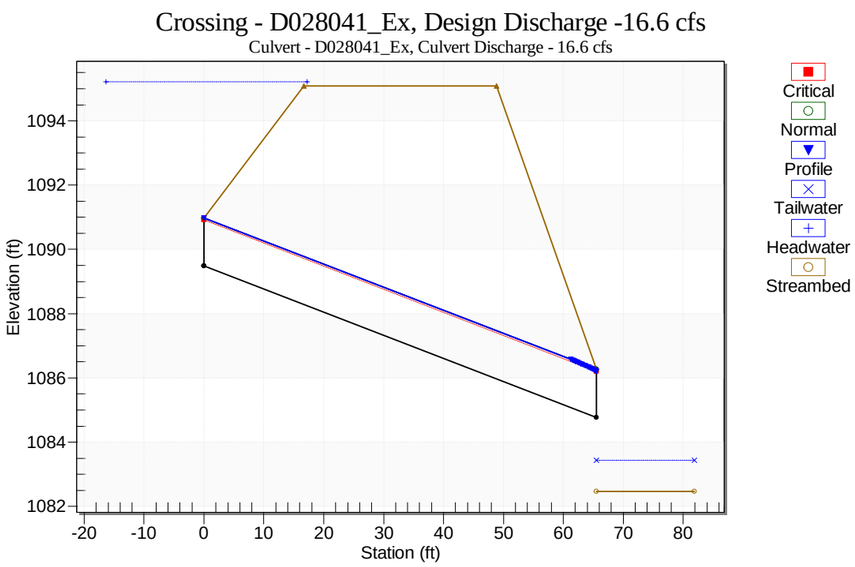
OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

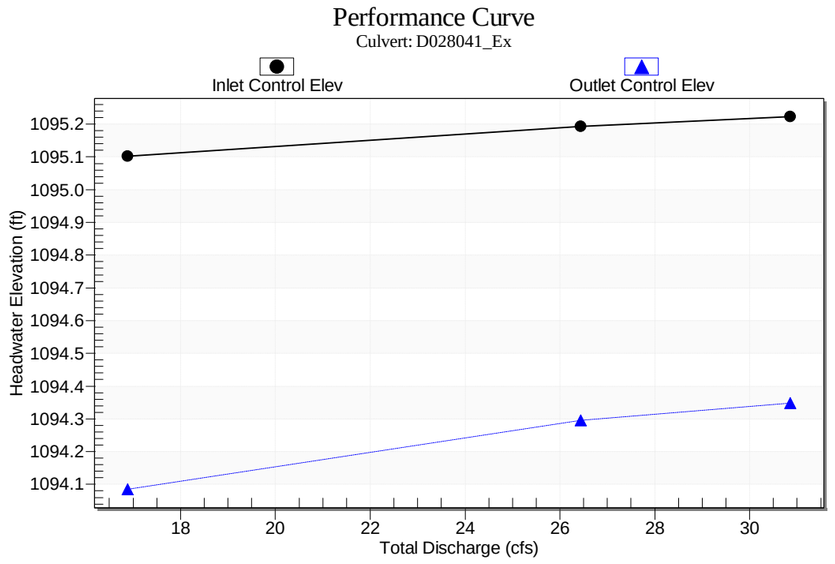
REPAIR

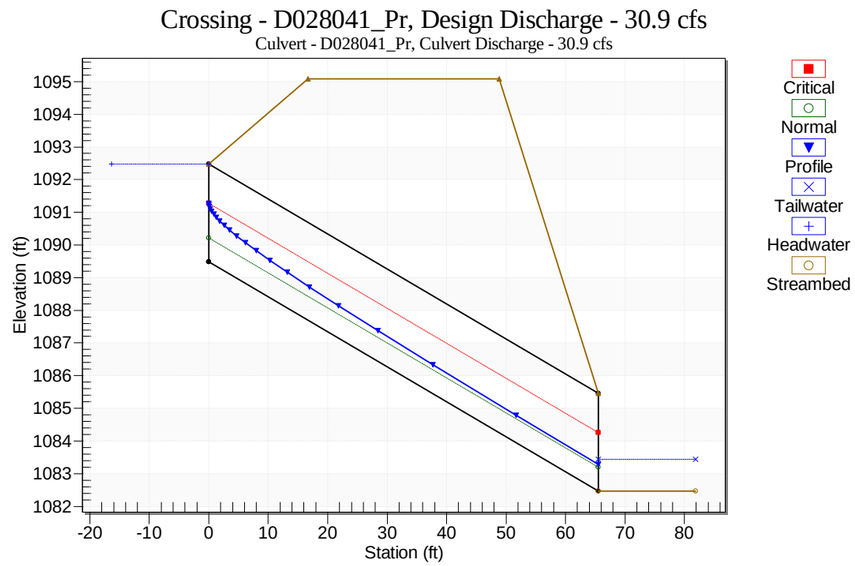
Culvert Name D028041 MP 33.54
Modeled By YH
Date 10/22/2020

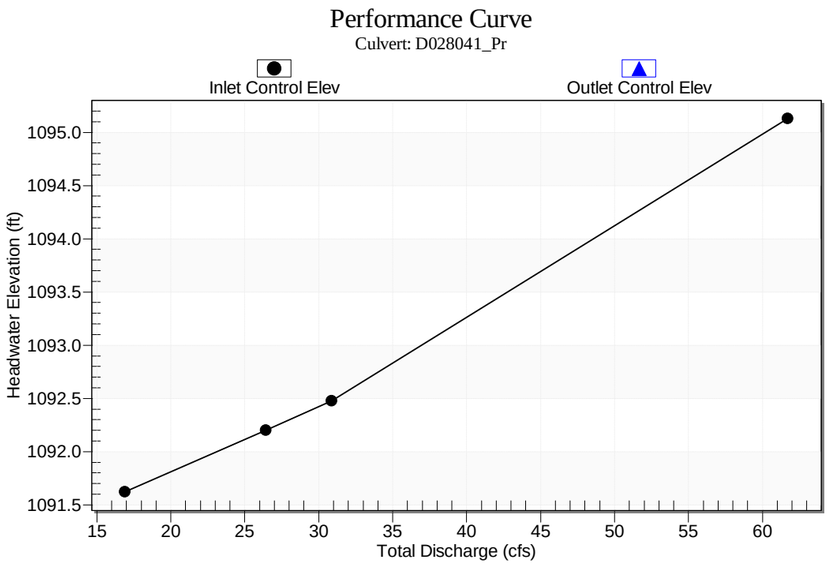
Note: Pipe cover measured from top of pipe to bottom of sub-base

	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverChec k Outlet
Existing Pipe	1.50	CMP	65.53	Project	Project	1,089.48	1,084.77	0.07	1,095.09	1,093.41	2.81	5.84	Q10	16.88	16.38	1095.1	5.62~	4.61	7-M2c	1.5	1.43	1.43	0.68	9.43	5.46	3.75	FAIL	OVERTOP	PASS	PASS	PASS
													Q50	26.44	16.53	1095.19	5.71~	4.82	7-M2c	1.5	1.43	1.43	0.89	9.51	6.29	3.81	FAIL	OVERTOP	PASS	PASS	PASS
													Q100	30.86	16.58	1095.22	5.74~	4.87	7-M2c	1.5	1.43	1.43	0.98	9.53	6.6	3.83	FAIL	OVERTOP	PASS	PASS	PASS









OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

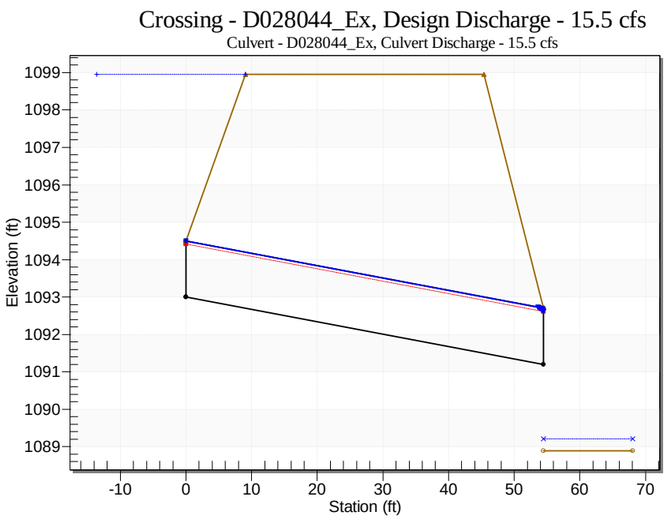
REPLACEMENT

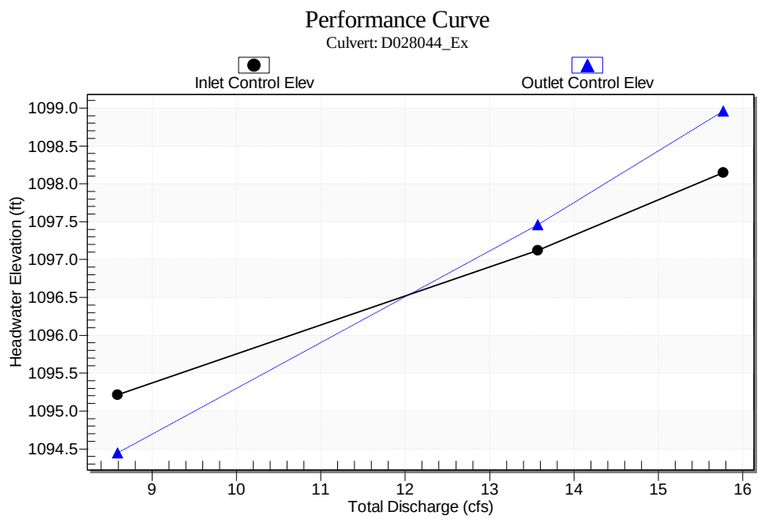
Culvert Name D028044 MP 33.65
Modeled By YH
Date 10/22/2020

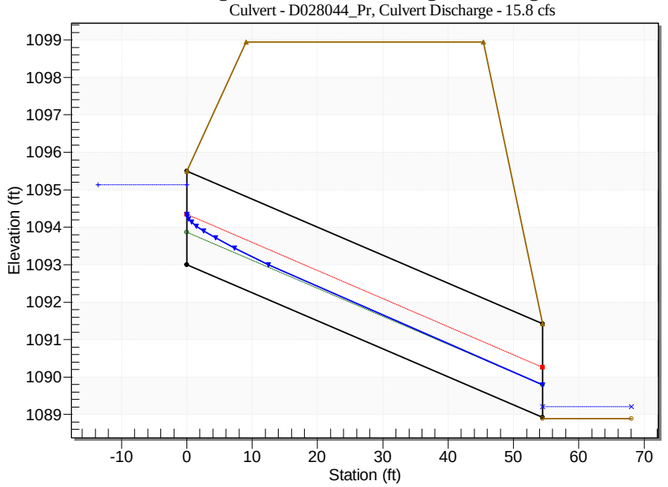
Note: Pipe cover measured from top of pipe to bottom of sub-base

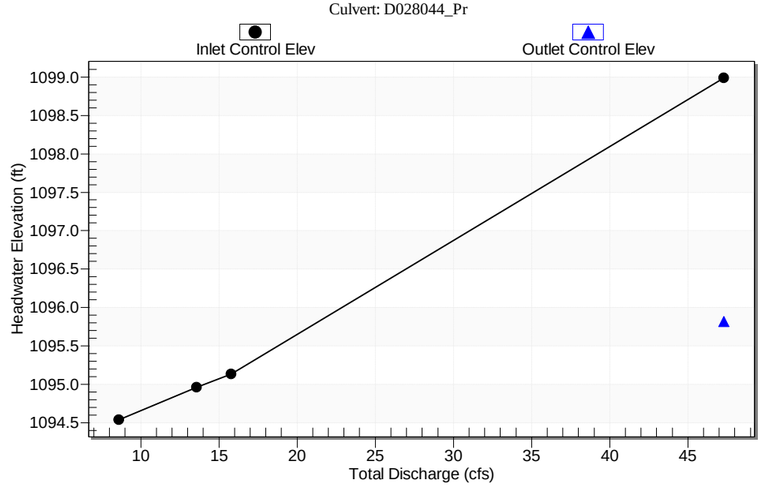
	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Existing Pipe	1.50	CMP	54.46	Project	Project	1,093.00	1,090.21	0.05	1,098.95	1,097.16	3.15	4.15	Q10	8.59	8.59	1095.21	2.21	1.45	5-S2n	1.04	1.13	1.04	0.22	6.56	3.38	1.47	FAIL	PASS	PASS	PASS	PASS
													Q50	13.57	13.57	1097.46	4.12	4.46	7-M2c	1.5	1.37	1.37	0.29	8.02	4.03	2.97	FAIL	PASS	PASS	PASS	PASS
													Q100	15.77	15.5	1098.96	5.15	5.96	7-M2c	1.5	1.42	1.42	0.32	8.97	4.27	3.97	FAIL	OVERTOP	PASS	PASS	PASS

	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Proposed	2.50	CMP	54.46	Mitered	Mitered	1,093.00	1,088.92	0.07	1,098.95	1,097.16	2.15	4.44	Q10	8.59	8.59	1094.54	1.54	-2.94	1-S2n	0.63	0.98	0.63	0.22	8.77	3.38	0.62	PASS	PASS	PASS	PASS	PASS
													Q50	13.57	13.57	1094.96	1.96	-2.44	1-S2n	0.8	1.24	0.81	0.29	9.87	4.03	0.78	PASS	PASS	PASS	PASS	PASS
													Q100	15.77	15.77	1095.13	2.13	-2.19	1-S2n	0.87	1.34	0.87	0.32	10.42	4.27	0.85	PASS	PASS	PASS	PASS	PASS









OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

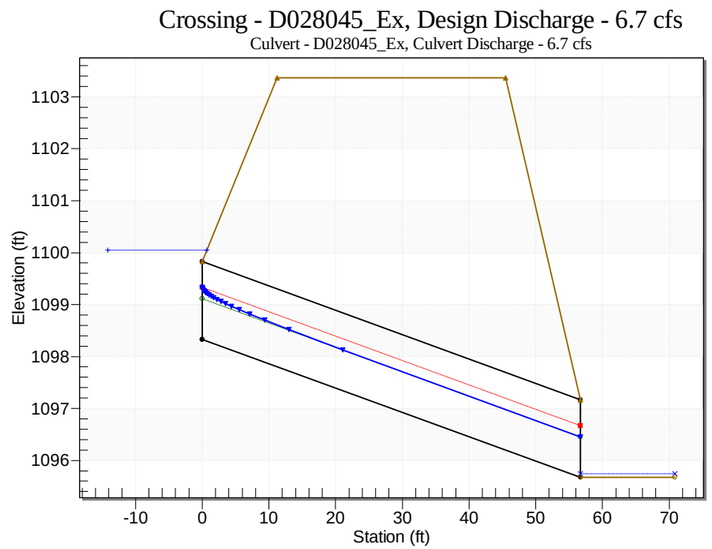
REPLACEMENT

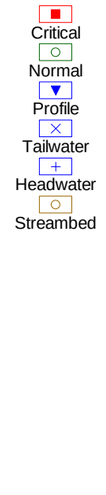
Culvert Name D028045 MP 33.79
Modeled By YH
Date 10/22/2020

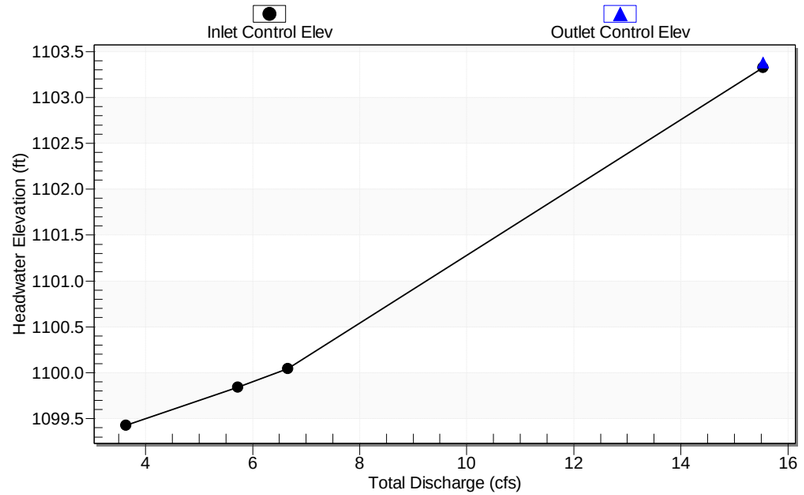
Note: Pipe cover measured from top of pipe to bottom of sub-base

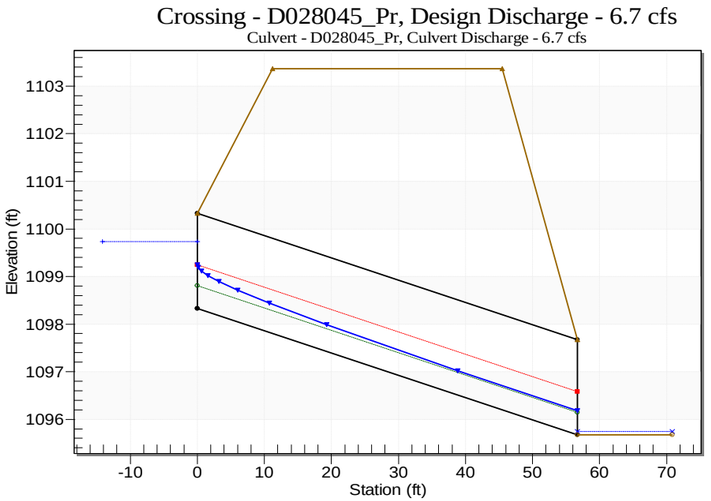
	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)		Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverChec k Outlet
Existing Pipe	1.50	CMP	56.69	Project	Project	1,098.33	1,095.67	0.05	1,103.37	1,104.66	2.24	6.19	Q10	3.63	3.63	1099.43	1.1	-1.58	1-S2n	0.56	0.73	0.56	0.05	6.08	1.51	0.73	PASS	PASS	PASS	PASS	PASS
													Q50	5.72	5.72	1099.84	1.51	-0.86	5-S2n	0.72	0.92	0.72	0.07	6.86	1.81	1.01	PASS	PASS	PASS	PASS	PASS
													Q100	6.66	6.66	1100.04	1.71	-0.47	5-S2n	0.78	1	0.78	0.07	7.12	1.92	1.14	PASS	PASS	PASS	PASS	PASS

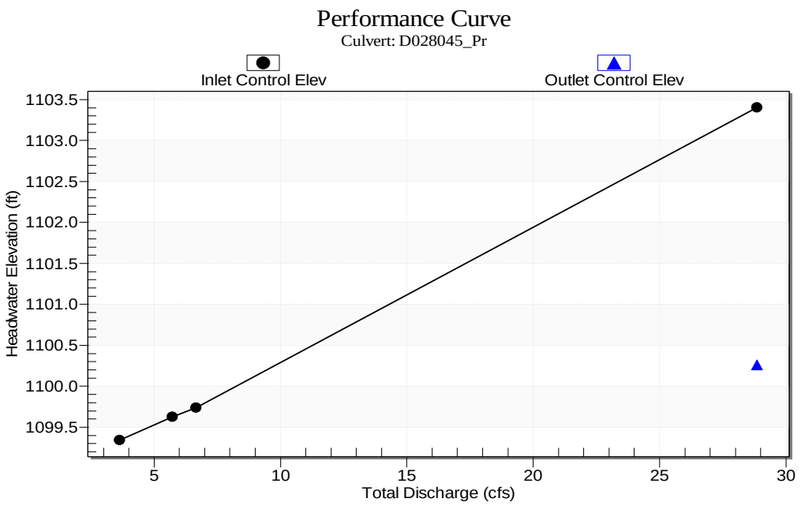
	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverChec k Outlet
Proposed	2.00	Conc	56.69	Mitered	Mitered	1,098.33	1,095.67	0.05	1,103.37	1,104.66	1.49	5.44	Q10	3.63	3.63	1099.34	1.01	-1.95	1-S2n	0.35	0.67	0.35	0.05	9.68	1.51	0.50	PASS	PASS	PASS	PASS	PASS
													Q50	5.72	5.72	1099.63	1.3	-1.7	1-S2n	0.44	0.84	0.46	0.07	10.55	1.81	0.65	PASS	PASS	PASS	PASS	PASS
													Q100	6.66	6.66	1099.74	1.41	-1.59	1-S2n	0.48	0.91	0.51	0.07	10.56	1.92	0.71	PASS	PASS	PASS	PASS	PASS











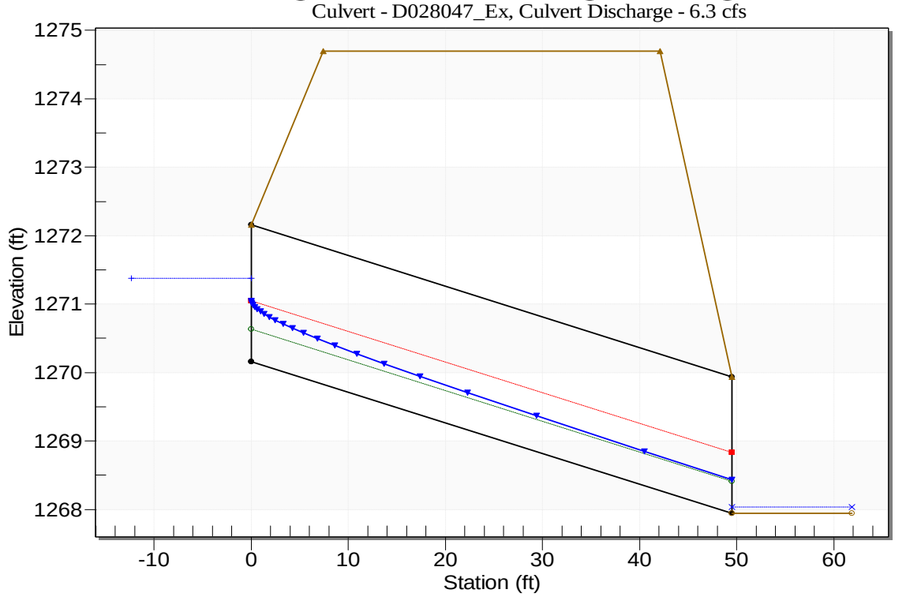
OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

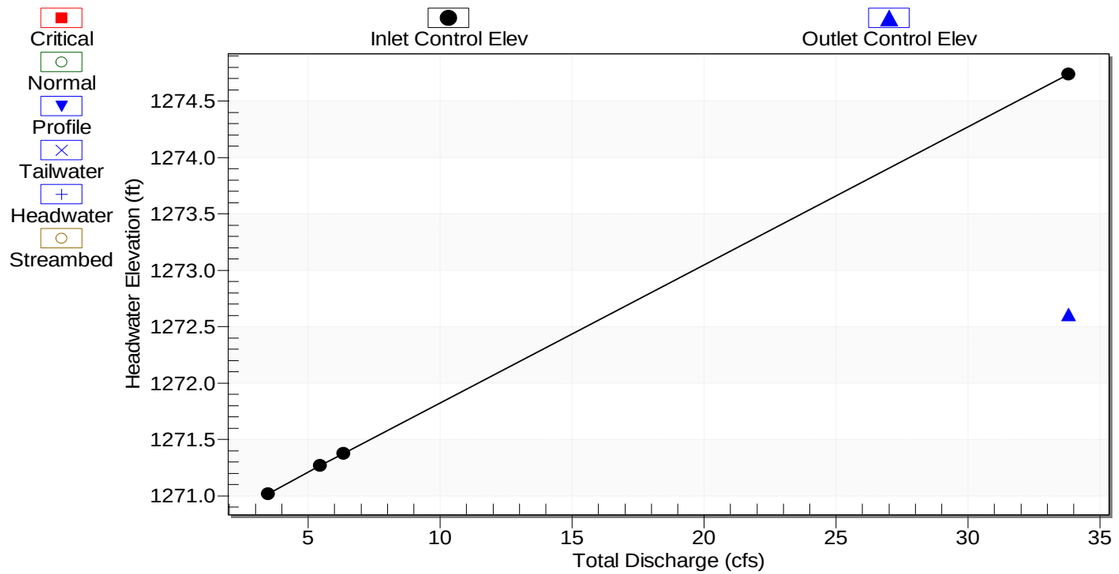
REPAIR

Culvert Name D028047
Modeled By Yhabtemichael
Date 9/10/2020

Note: Pipe cover measured from top of pipe to bottom of sub-base

	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Existing Pipe	2.00	CONC	49.50	Project	Project	1,270.16	1,267.94	0.045	1,274.70	1,274.82	0.29	2.63	Q10	3.47	3.47	1271.02	0.86	-1.54	1-S2n	0.35	0.65	0.36	0.07	9.02	1.22	0.43	PASS	PASS	PASS	FAIL	PASS
													Q50	5.45	5.45	1271.27	1.11	-1.32	1-S2n	0.44	0.82	0.46	0.09	10.08	1.45	0.55	PASS	PASS	PASS	FAIL	PASS
													Q100	6.34	6.34	1271.38	1.22	-1.22	1-S2n	0.47	0.89	0.5	0.1	10.41	1.54	0.61	PASS	PASS	PASS	FAIL	PASS





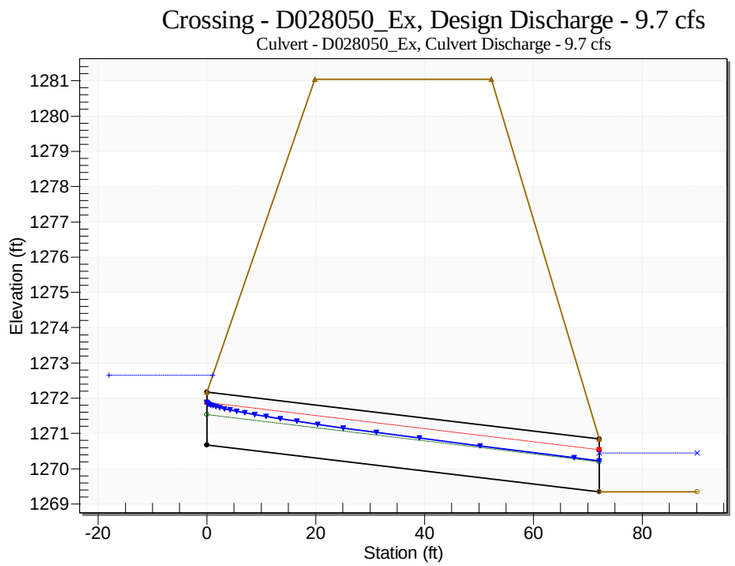
OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

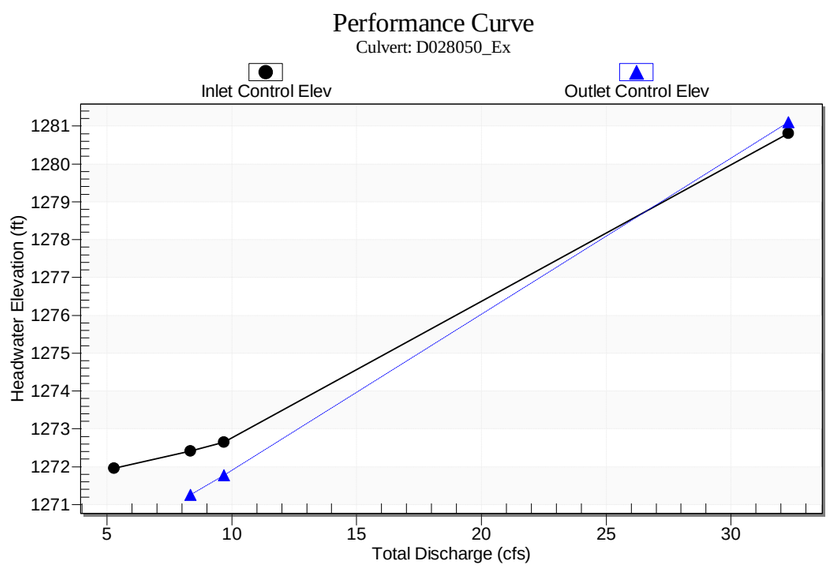
REPAIR

Culvert Name D028050 MP 37.31
Modeled By YH
Date 10/22/2020

Note: Pipe cover measured from top of pipe to bottom of sub-base

	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Existing Pipe	1.50	CONC	72.13	Project	Project	1,270.68	1,269.34	0.02	1,281.05	1,282.98	6.62	9.89	Q10	5.28	5.28	1271.95	1.27	-0.13	1-S2n	0.6	0.89	0.61	0.81	7.79	2.38	0.85	PASS	PASS	PASS	PASS	PASS
													Q50	8.35	8.35	1272.41	1.73	0.58	5-S2n	0.78	1.12	0.8	1.02	8.67	2.69	1.15	PASS	PASS	PASS	PASS	PASS
													Q100	9.69	9.69	1272.65	1.97	1.09	5-S2n	0.86	1.2	0.88	1.1	8.98	2.8	1.31	FAIL	PASS	PASS	PASS	PASS





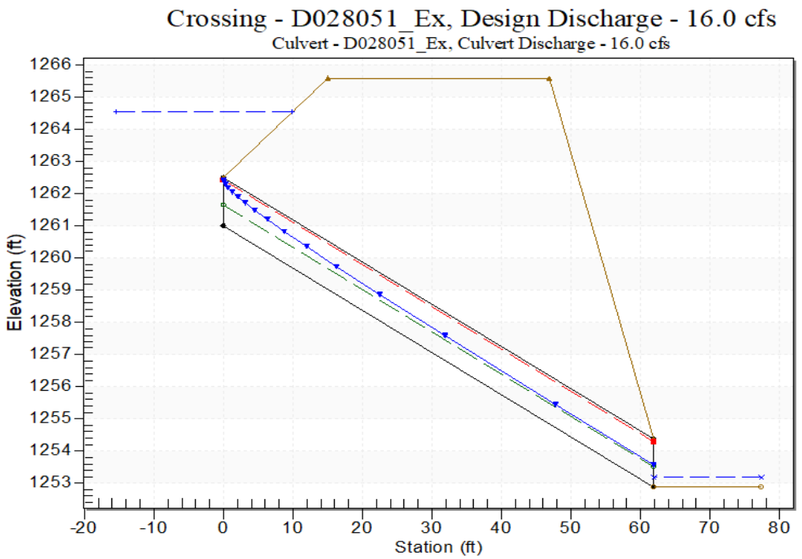
OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

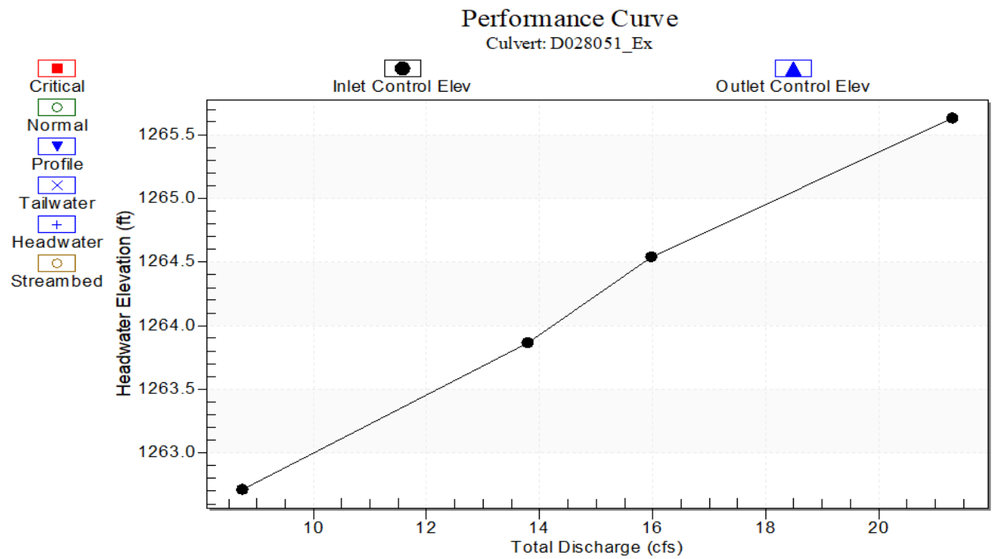
REPAIR

Culvert Name D028051 MP 37.56
Modeled By YH
Date 10/22/2020

Note: Pipe cover measured from top of pipe to bottom of sub-base

	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverChec k Outlet
Existing Pipe	1.50	Conc	61.86	Project	Project	1,261.00	1,252.87	0.13	1,265.59	1,265.80	0.84	9.18	Q10	8.74	8.74	1262.71	1.71	-5.99	5-S2n	0.47	1.14	0.47	0.22	18.54	0.68	1.14	PASS	PASS	PASS	FAIL	PASS
													Q50	13.79	13.79	1263.87	2.87	-4.64	5-S2n	0.6	1.38	0.64	0.28	19.05	0.81	1.91	FAIL	PASS	PASS	FAIL	PASS
													Q100	15.98	15.98	1264.54	3.54	-3.92	5-S2n	0.65	1.42	0.71	0.31	19.58	0.86	2.36	FAIL	PASS	PASS	FAIL	PASS





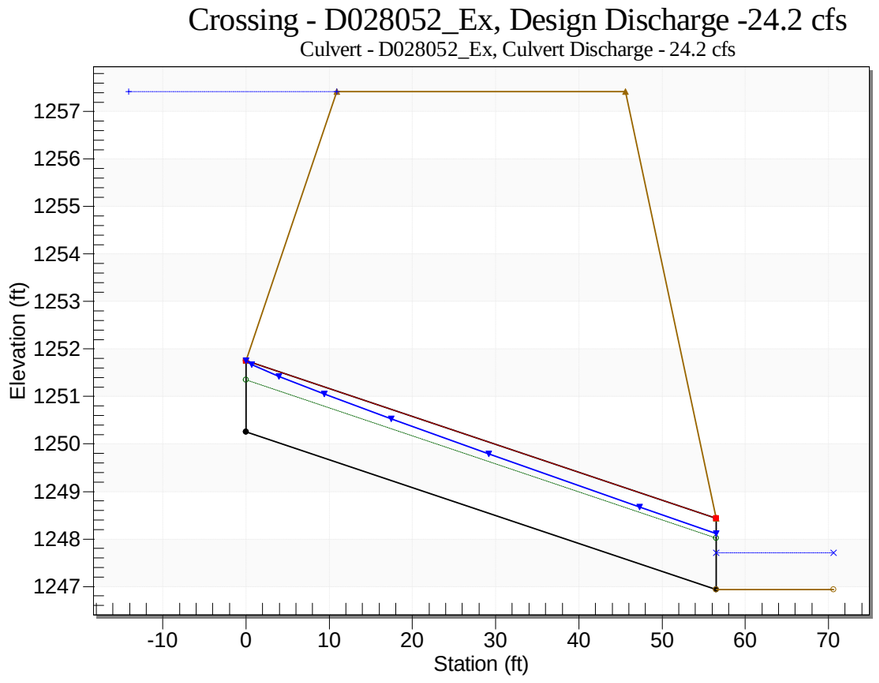
OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

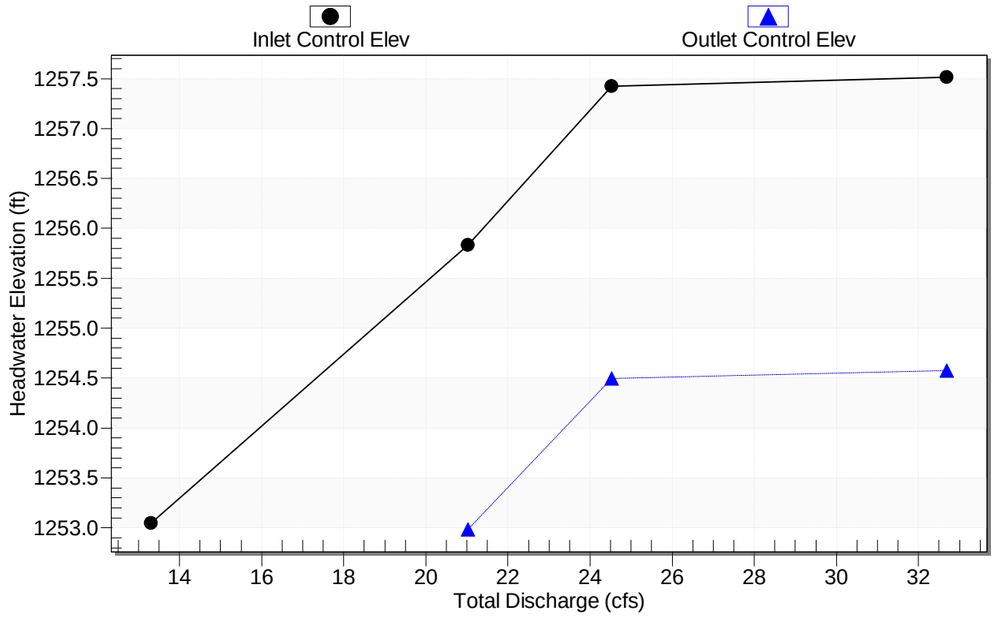
REPAIR

Culvert Name D028052 MP 37.68
Modeled By YH
Date 10/22/2020

Note: Pipe cover measured from top of pipe to bottom of sub-base

	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)		Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Existing Pipe	1.50	CONC	56.51	Project	Project	1,250.26	1,246.93	0.06	1,257.42	1,257.56	3.41	6.88	Q10	13.3	13.3	1253.04	2.78	-0.08	5-S2n	0.73	1.36	0.8	0.55	13.9	9.07	1.85	FAIL	PASS	PASS	PASS	PASS
													Q50	21.02	21.02	1255.83	5.57	2.73	5-S2n	0.98	1.5	1.08	0.71	15.46	10.39	3.71	FAIL	PASS	PASS	PASS	PASS
													Q100	24.52	24.25	1257.43	7.17	4.23	5-S2n	1.09	1.5	1.19	0.77	16.19	10.86	4.78	FAIL	OVERTOP	PASS	PASS	PASS





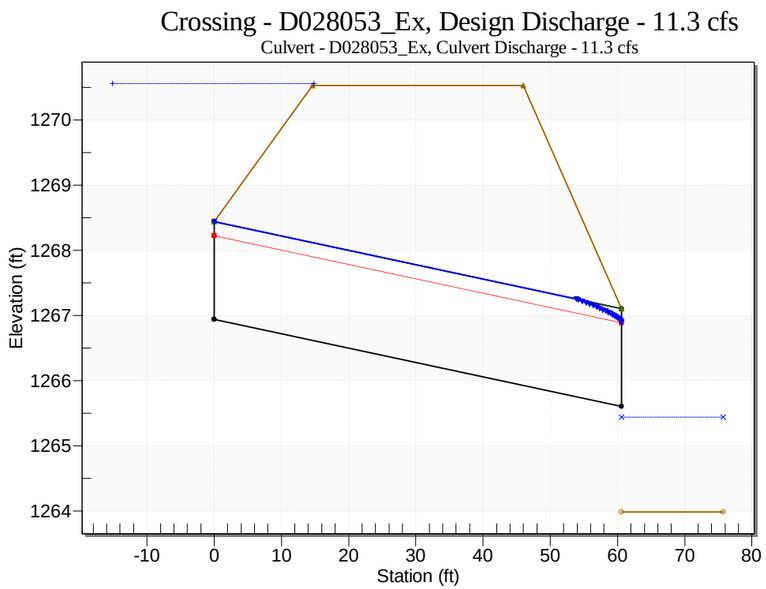
OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

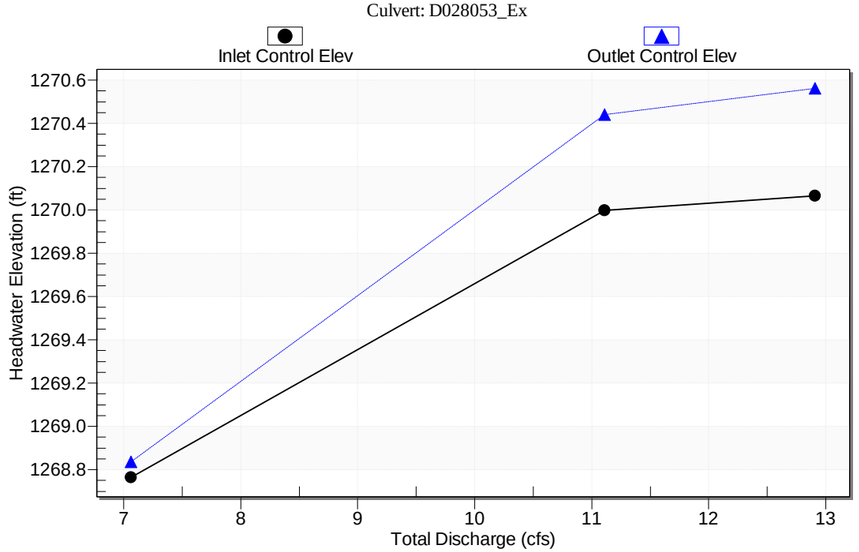
REPAIR

Culvert Name D028053 MP 37.89
Modeled By YH
Date 10/22/2020

Note: Pipe cover measured from top of pipe to bottom of sub-base

	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Existing Pipe	1.50	CMP	60.60	Project	Project	1,266.94	1,265.60	0.02	1,270.53	1,271.75	0.09	2.65	Q10	7.06	7.06	1268.84	1.83	1.9	7-M2c	1.05	1.03	1.03	1.04	5.47	0.63	1.27	FAIL	PASS	PASS	FAIL	PASS
													Q50	11.11	11.11	1270.44	3.06	3.5	7-M2c	1.5	1.28	1.28	1.34	6.94	0.72	2.33	FAIL	PASS	PASS	FAIL	PASS
													Q100	12.91	11.29	1270.56	3.13	3.62	7-M2c	1.5	1.28	1.28	1.46	7.01	0.76	2.41	FAIL	OVERTOP	PASS	FAIL	PASS





OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

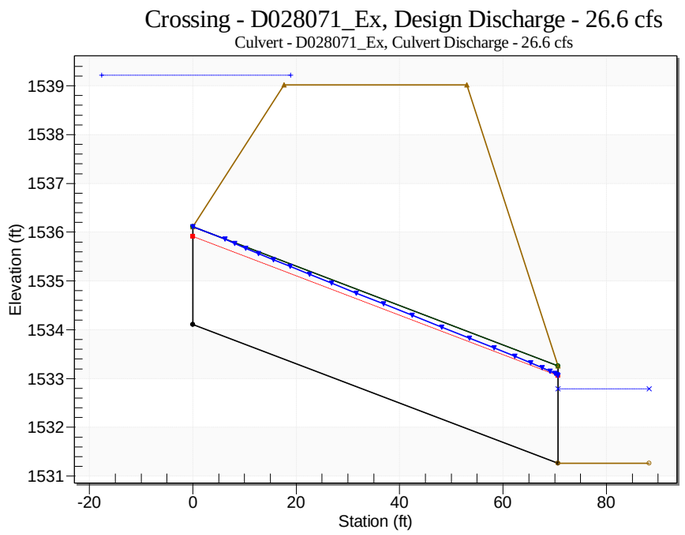
REPLACEMENT

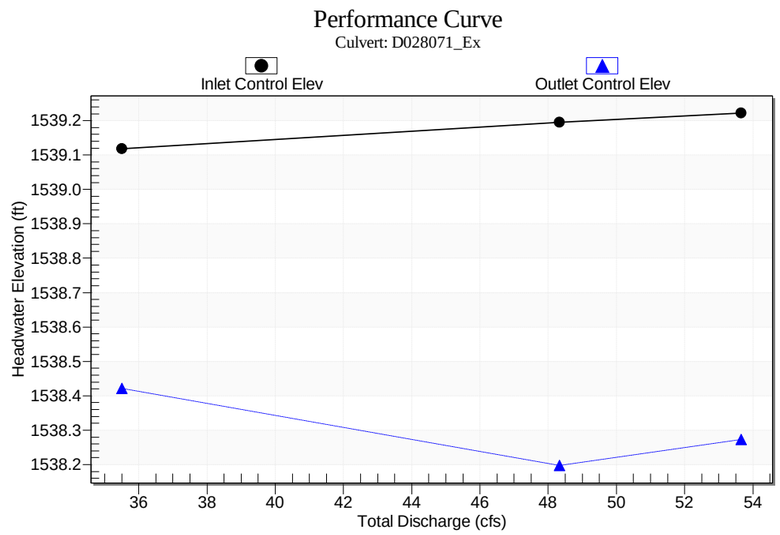
Culvert Name D028071 MP 40.92
Modeled By YH
Date 10/22/2020

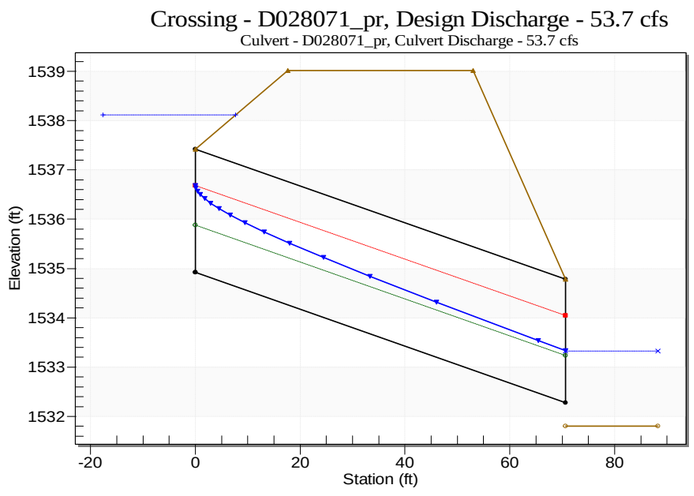
Note: Pipe cover measured from top of pipe to bottom of sub-base

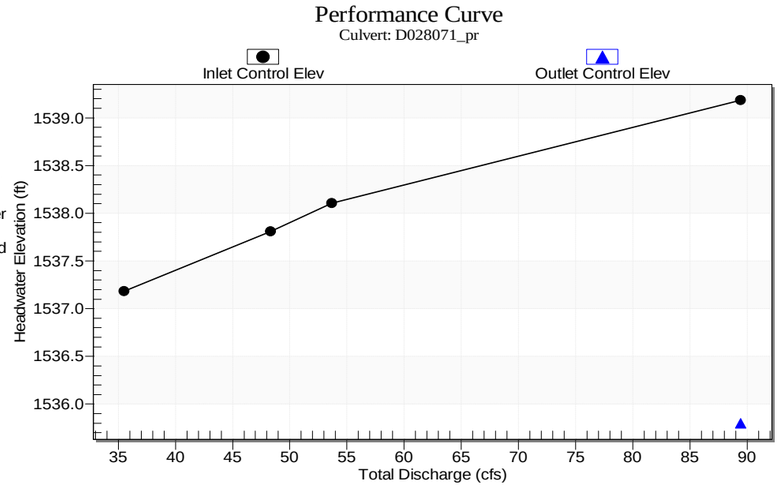
	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Existing Pipe	2.00	CMP	70.64	Project	Project	1,534.11	1,531.26	0.040	1,539.02	1,540.68	0.61	5.12	Q10	35.5	26.29	1539.12	5.01~	4.31	7-M2c	2	1.79	1.79	1.19	8.86	2.37	2.51	FAIL	OVERTOP	PASS	FAIL	PASS
													Q50	48.33	26.55	1539.2	5.08~	4.09	7-M2c	2	1.8	1.8	1.43	8.92	2.64	2.55	FAIL	OVERTOP	PASS	FAIL	PASS
													Q100	53.66	26.64	1539.22	5.11~	4.16	7-M2c	2	1.8	1.8	1.53	8.94	2.73	2.56	FAIL	OVERTOP	PASS	FAIL	PASS

	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Proposed (double barrel)	2.50	DIP	70.64	Mitered	Mitered	1,534.92	1,532.28	0.037	1,539.02	1,540.68	-0.70	3.60	Q10	35.5	35.5	1537.19	2.27	-0.72	1-S2n	0.77	1.43	0.83	1.19	12.54	2.37	0.91	PASS	PASS	PASS	FAIL	PASS
													Q50	48.33	48.33	1537.82	2.9	-0.04	5-S2n	0.91	1.67	1	1	13.27	2.64	1.16	PASS	PASS	PASS	FAIL	PASS
													Q100	53.66	53.66	1538.11	3.19	0.26	5-S2n	0.96	1.77	1.06	1.53	13.57	2.73	1.28	FAIL	PASS	PASS	FAIL	PASS









OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

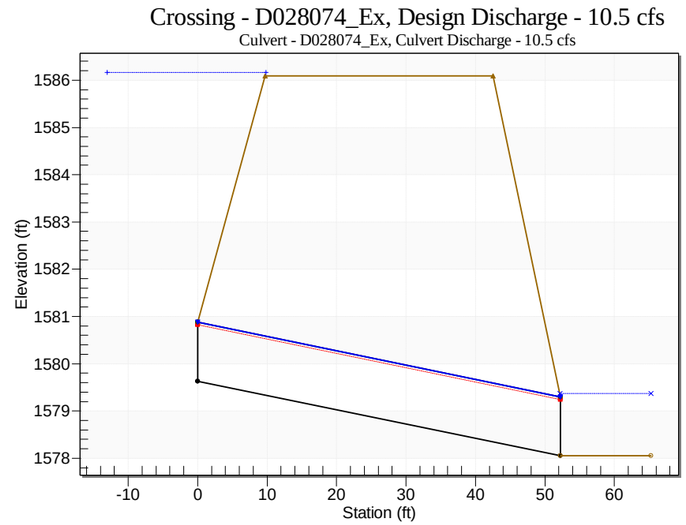
REPLACEMENT

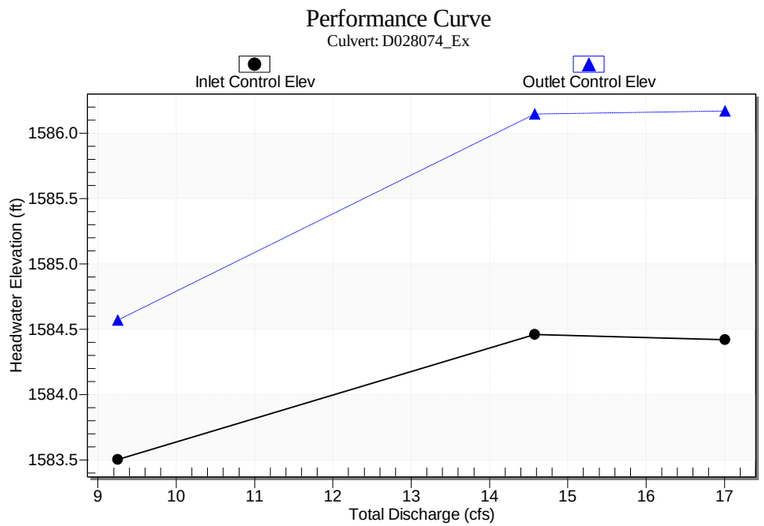
Culvert Name D028074 MP 41.50
Modeled By YH
Date 10/22/2020

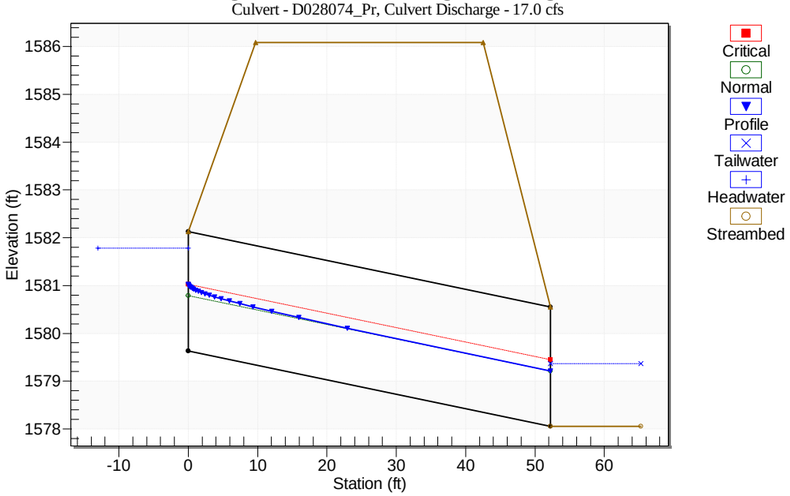
Note: Pipe cover measured from top of pipe to bottom of sub-base

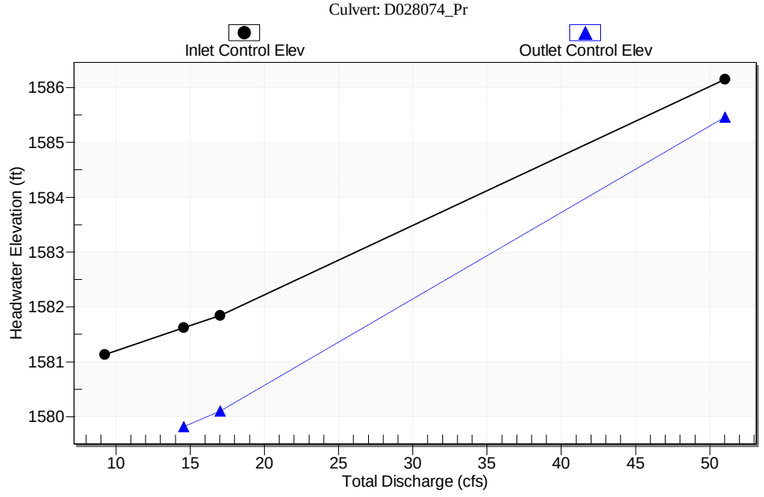
	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Existing Pipe	1.3	CMP	52.23	Projecting	Projecting	1579.63	1578.05	3.03%	1586.09	1585.88	2.9	4.3	Q10	9.25	9.25	1584.57	3.87	4.94	7-M2c	1.25	1.16	1.16	0.96	7.77	2.22	3.95	FAIL	PASS	PASS	PASS	PASS
													Q50	14.58	10.52	1586.15	4.83	6.52	7-M2t	1.25	1.19	1.22	1.22	8.63	2.52	5.22	FAIL	OVERTOP	PASS	PASS	PASS
													Q100	17.01	10.47	1586.17	4.79	6.54	4-FF1	1.25	1.19	1.25	1.32	8.53	2.63	5.23	FAIL	OVERTOP	PASS	PASS	PASS

	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Proposed	2.5	CMP	52.23	Mitered	Mitered	1580.25	1578.49	3.37%	1586.09	1585.88	1.0	2.6	Q10	9.25	9.25	1581.16	1.53	-0.38	1-S2n	0.83	1.01	0.83	0.96	6.47	2.22	0.36	PASS	PASS	PASS	PASS	PASS
													Q50	14.58	14.58	1581.59	1.96	0.16	1-S2n	1.06	1.29	1.06	1.22	7.33	2.52	0.54	PASS	PASS	PASS	PASS	PASS
													Q100	17.01	17.01	1581.78	2.15	0.44	1-S2n	1.16	1.39	1.16	1.32	7.63	2.63	0.61	PASS	PASS	PASS	PASS	PASS









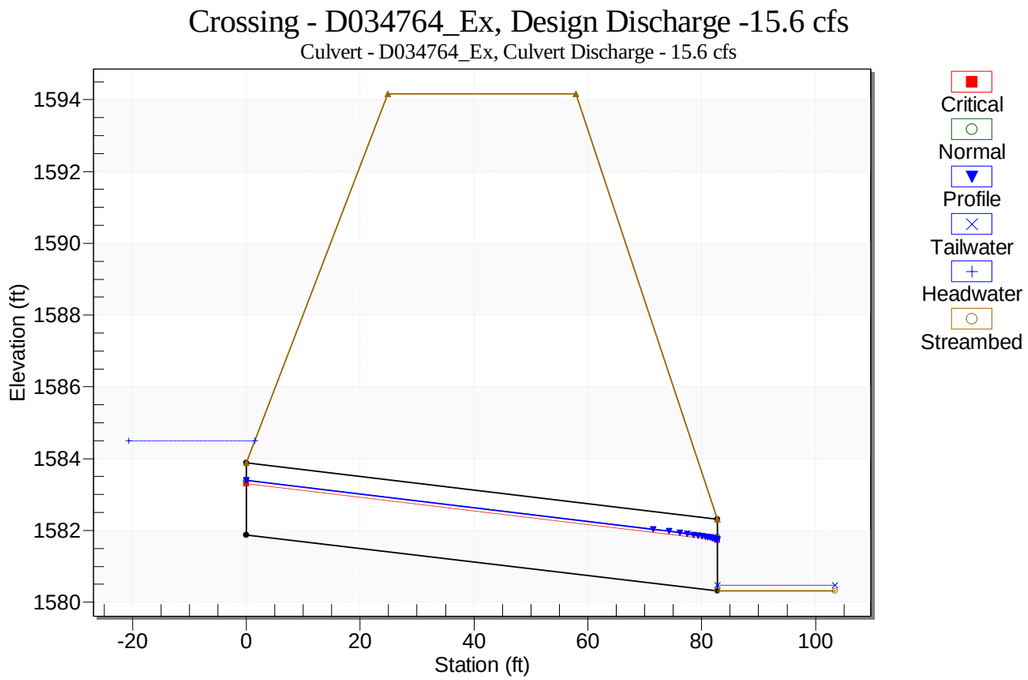
OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

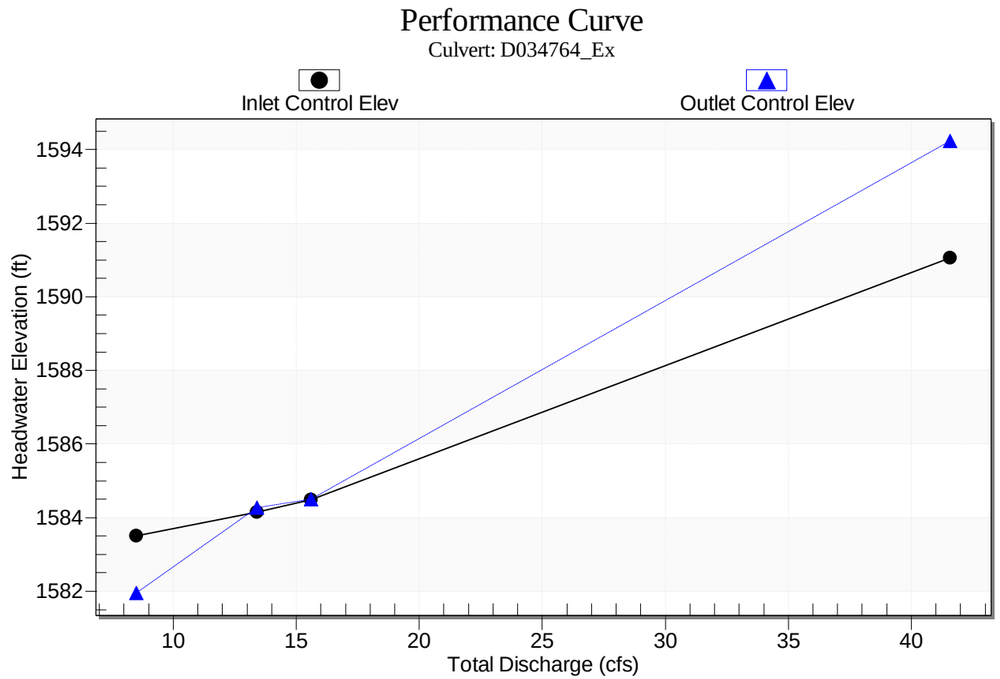
REPAIR

Culvert Name D034764 MP 41.58
Modeled By YH,PD
Date 10/22/2020

Note: Pipe cover measured from top of pipe to bottom of sub-base

	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Existing Pipe	2.0	CMP	82.77	Projecting	Projecting	1581.88	1580.31	1.90%	1594.17	1594.1	8.0	9.5	Q10	8.5	8.5	1583.5	1.62	0.08	1-S2n	1	1.04	1	0.11	5.39	1.35	0.81	PASS	PASS	PASS	PASS	PASS
													Q50	13.4	13.4	1584.28	2.27	2.4	7-M2c	1.34	1.32	1.32	0.14	6.11	1.62	1.20	PASS	PASS	PASS	PASS	PASS
													Q100	15.59	15.59	1584.5	2.61	2.62	7-M2c	1.51	1.42	1.42	0.16	6.52	1.72	1.31	FAIL	PASS	PASS	PASS	PASS





OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

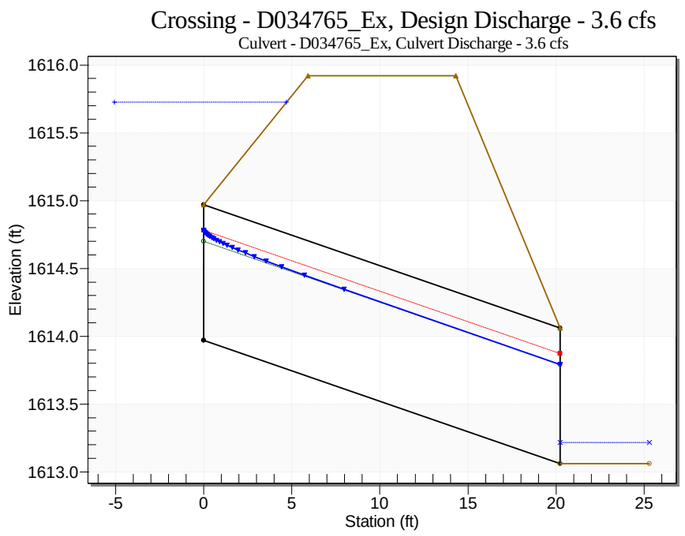
REPLACEMENT

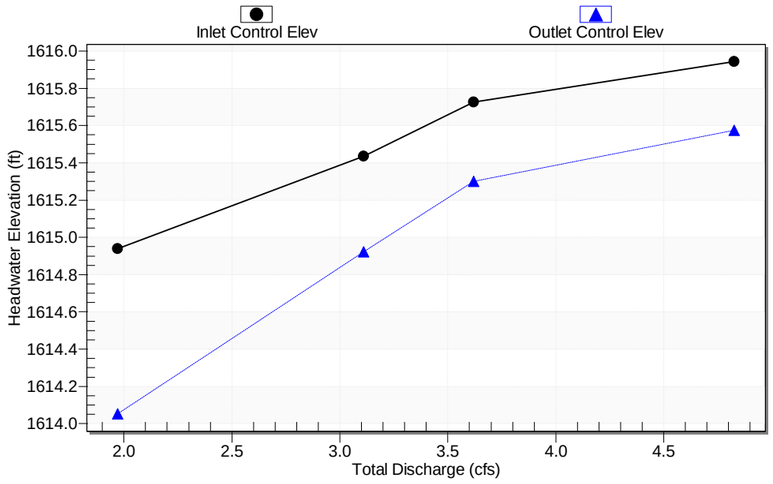
Culvert Name D034765 MP 41.811
Modeled By YH,PD
Date 10/22/2020

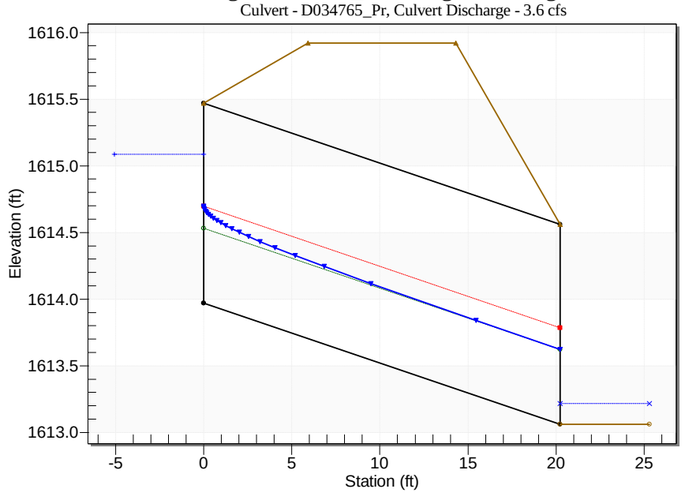
Note: Pipe cover measured from top of pipe to bottom of sub-base

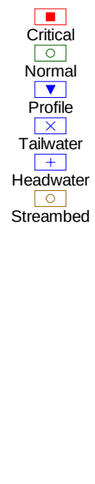
	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Existing Pipe	1.0	CMP	20.23	Miltered	Miltered	1613.97	1613.06	4.50%	1615.922	1615.927	-1.3	-0.4	Q10	1.97	1.97	1614.92	0.95	0.06	1-S2n	0.49	0.6	0.49	0.11	5.17	0.36	0.95	PASS	PASS	PASS	FAIL	FAIL
													Q50	3.11	3.11	1615.4	1.43	0.9	5-S2n	0.65	0.76	0.65	0.14	5.74	0.43	1.43	FAIL	PASS	PASS	FAIL	FAIL
													Q100	3.62	3.62	1615.69	1.72	1.27	5-S2n	0.73	0.81	0.73	0.16	5.89	0.45	1.72	FAIL	PASS	PASS	FAIL	FAIL

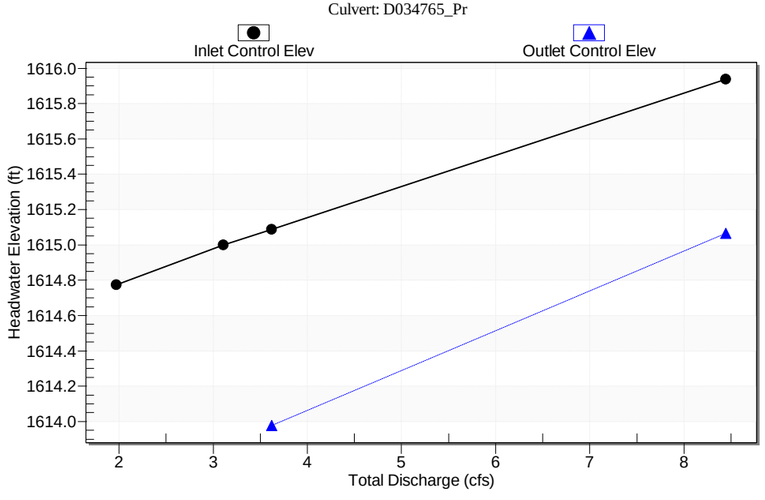
	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Proposed	1.5	DIP	20.23	Mitered	Mitered	1613.97	1613.06	4.50%	1615.922	1615.927	-1.8	-0.9	Q10	1.97	1.97	1614.77	0.8	-0.32	1-S2n	0.41	0.53	0.41	0.11	5.04	0.36	0.53	PASS	PASS	PASS	FAIL	FAIL
													Q50	3.11	3.11	1615	1.03	-0.1	1-S2n	0.52	0.67	0.52	0.14	5.74	0.43	0.69	PASS	PASS	PASS	FAIL	FAIL
													Q100	3.62	3.62	1615.09	1.12	0.01	1-S2n	0.56	0.73	0.56	0.16	5.98	0.45	0.75	PASS	PASS	PASS	FAIL	FAIL











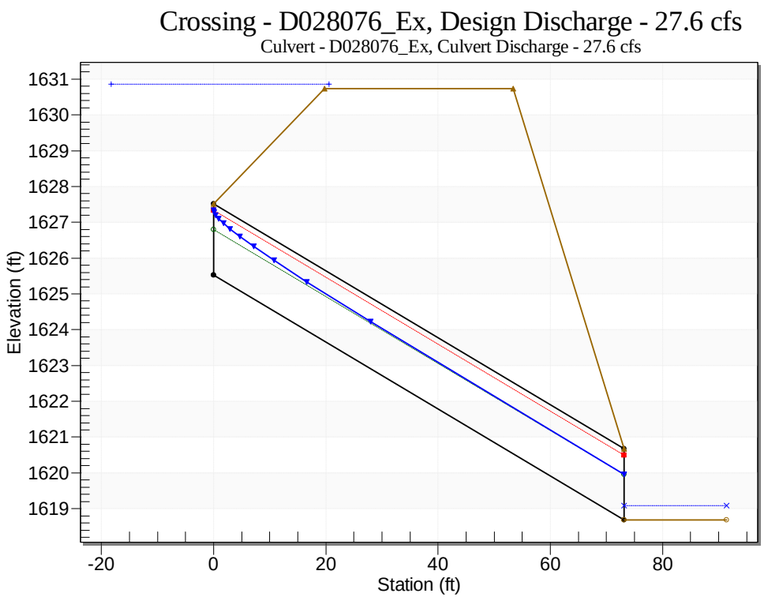
OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

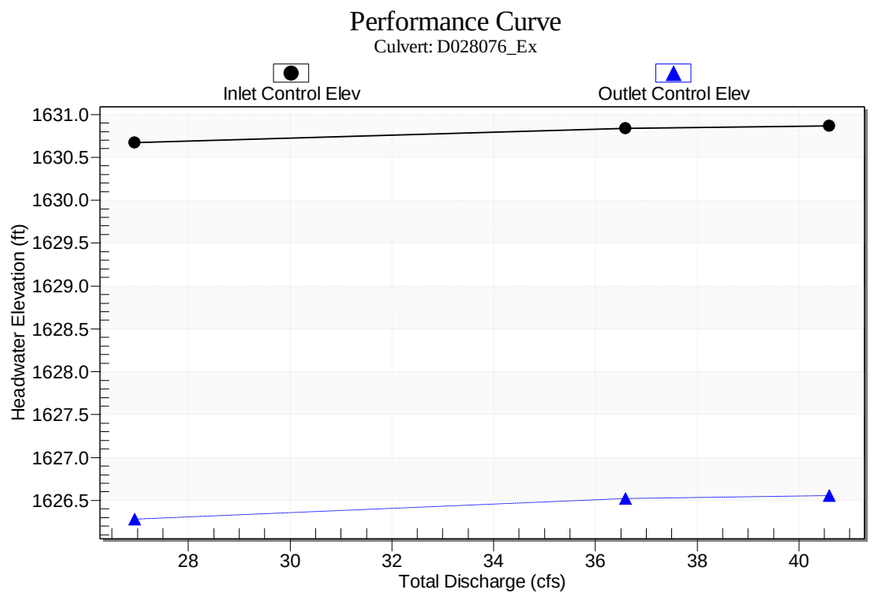
REPAIR

Culvert Name D028076 MP 41.91
Modeled By YH,PD
Date 10/22/2020

Note: Pipe cover measured from top of pipe to bottom of sub-base

	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Existing Pipe	2.0	CMP	73.17	Projecting	Projecting	1625.52	1618.68	9.35%	1630.74	1627.04	0.9	4.1	Q10	26.94	26.94	1630.67	5.15	0.76	5-S2n	1.25	1.81	1.25	0.32	13	2.04	2.58	FAIL	PASS	PASS	FAIL	PASS
													Q50	36.59	27.48	1630.84	5.32	1	5-S2n	1.27	1.82	1.27	0.39	13.05	2.3	2.66	FAIL	OVERTOP	PASS	FAIL	PASS
													Q100	40.6	27.57	1630.86	5.34	1.04	5-S2n	1.27	1.82	1.27	0.41	13.08	2.4	2.67	FAIL	OVERTOP	PASS	FAIL	PASS





OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

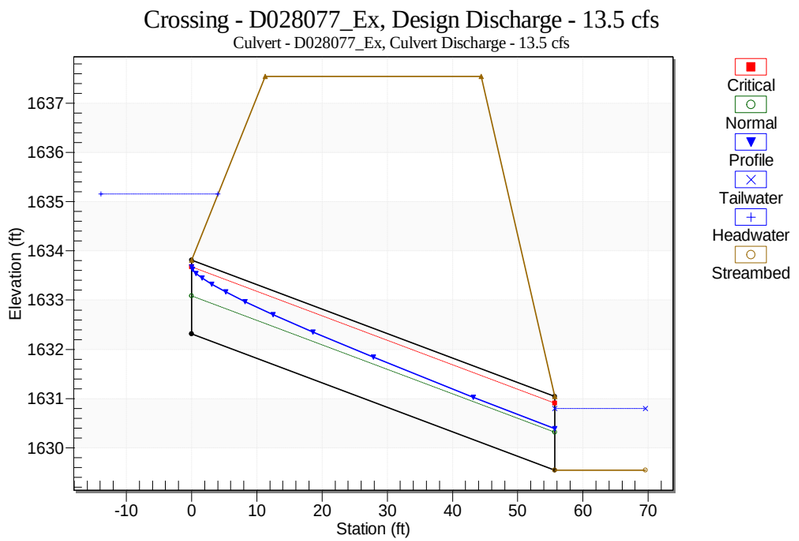
REPLACEMENT

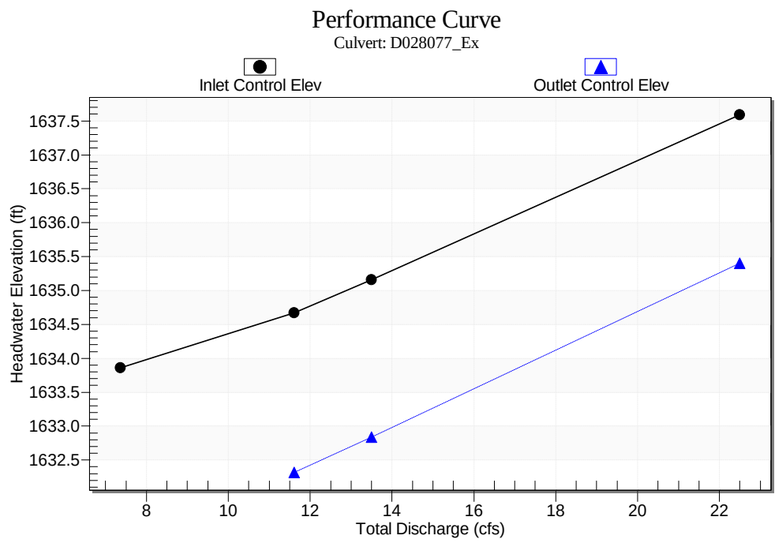
Culvert Name D028077 MP 42.01
Modeled By YH,PD
Date 10/22/2020

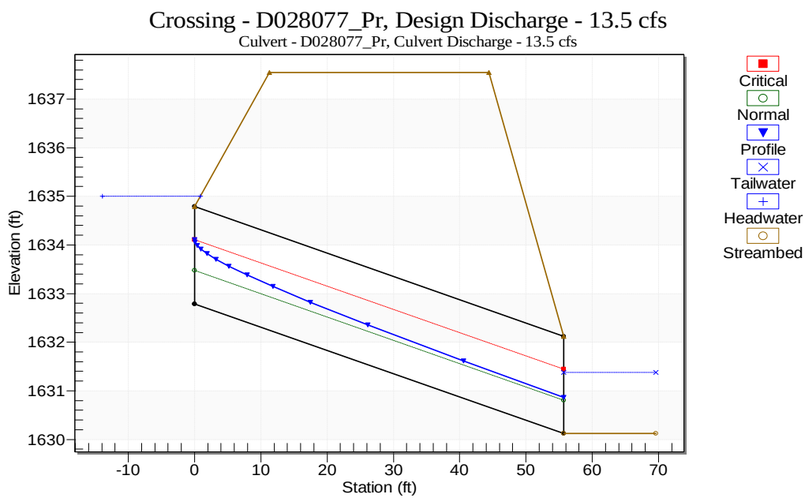
Note: Pipe cover measured from top of pipe to bottom of sub-base

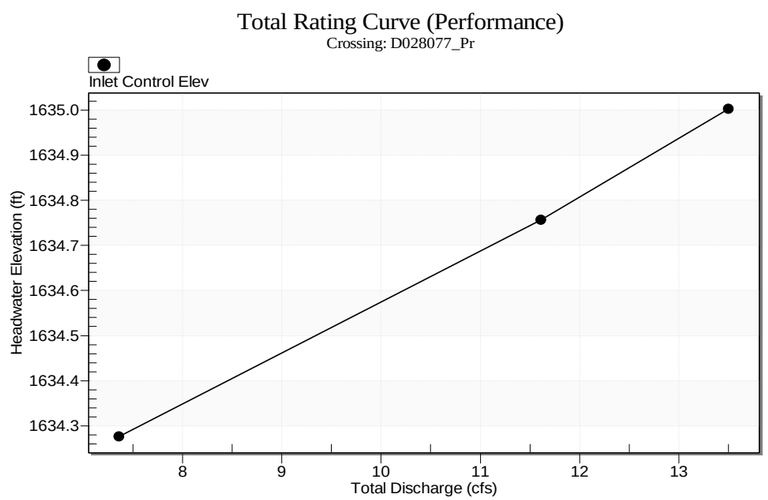
	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Existing Pipe	1.5	Conc	55.68	Projecting	Projecting	1632.31	1629.54	4.98%	1637.55	1634.81	1.2	1.2	Q10	7.36	7.36	1633.86	1.55	-1.16	5-S2n	0.55	1.05	0.59	0.92	11.4	2.51	1.03	PASS	PASS	PASS	PASS	PASS
													Q50	11.61	11.61	1634.67	2.36	0.01	5-S2n	0.71	1.3	0.77	1.17	12.7	2.84	1.57	FAIL	PASS	PASS	PASS	PASS
													Q100	13.5	13.5	1635.16	2.85	0.53	5-S2n	0.78	1.37	0.85	1.26	13.12	2.95	1.90	FAIL	PASS	PASS	PASS	PASS

	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Proposed	2.0	DIP	55.70	Mitered	Mitered	1632.79	1630.12	4.79%	1637.55	1634.81	0.5	0.4	Q10	7.36	7.36	1634.28	1.49	-1.51	1-S2n	0.5	0.96	0.53	0.92	11.11	2.51	0.75	PASS	PASS	PASS	FAIL	FAIL
													Q50	11.61	11.61	1634.76	1.97	-0.96	1-S2n	0.63	1.22	0.68	1.17	12.3	2.84	0.99	PASS	PASS	PASS	FAIL	FAIL
													Q100	13.5	13.5	1635	2.21	-0.69	5-S2n	0.68	1.32	0.75	1.26	12.6	2.95	1.11	PASS	PASS	PASS	FAIL	FAIL









OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

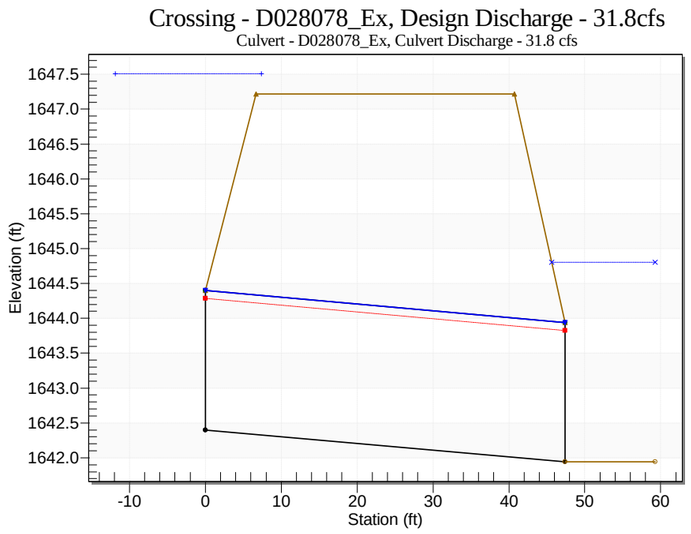
REPLACEMENT

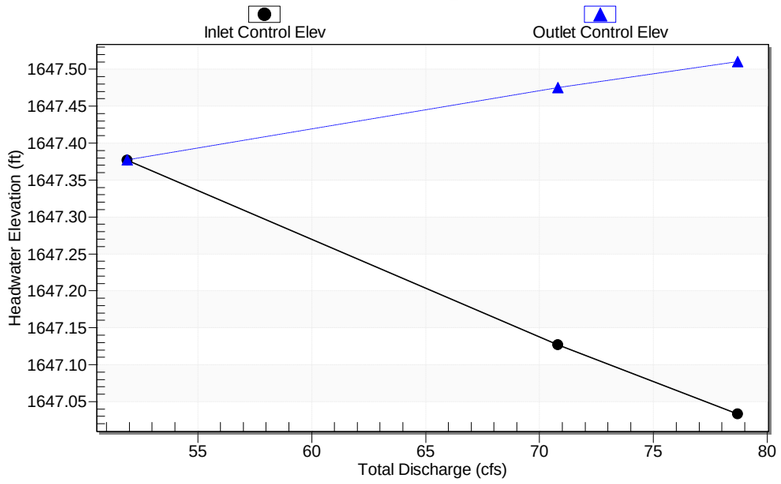
Culvert Name D028078 MP 42.12
Modeled By YH,PD
Date 10/22/2020

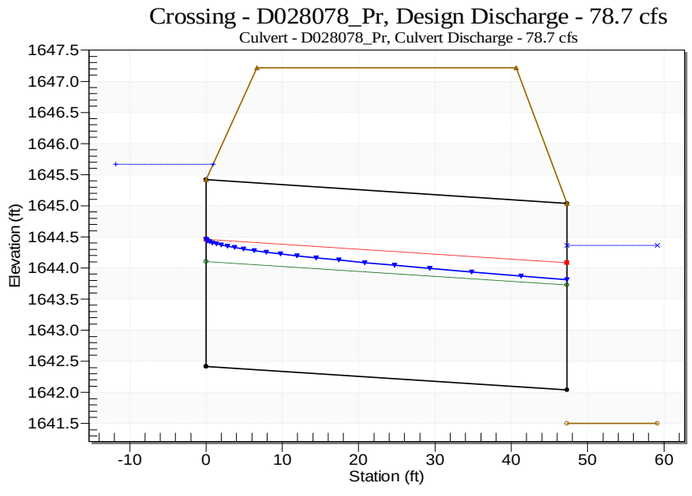
Note: Pipe cover measured from top of pipe to bottom of sub-base

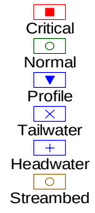
	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Existing Pipe	2.0	Conc	47.41	Projecting	Projecting	1642.43	1641.94	1.03%	1647.22	1648.97	0.2	2.5	Q10	51.9	33.42	1647.38	4.98	4.98	4-FFf	2	1.91	2	2.45	10.64	5.08	2.48	FAIL	OVERTOP	PASS	FAIL	PASS
													Q50	70.81	32.25	1647.48	4.73	5.07	4-FFf	2	1.89	2	2.75	10.27	5.5	2.52	FAIL	OVERTOP	PASS	FAIL	PASS
													Q100	78.7	31.81	1647.51	4.63	5.11	4-FFf	2	1.89	2	2.86	10.13	5.64	2.54	FAIL	OVERTOP	PASS	FAIL	PASS

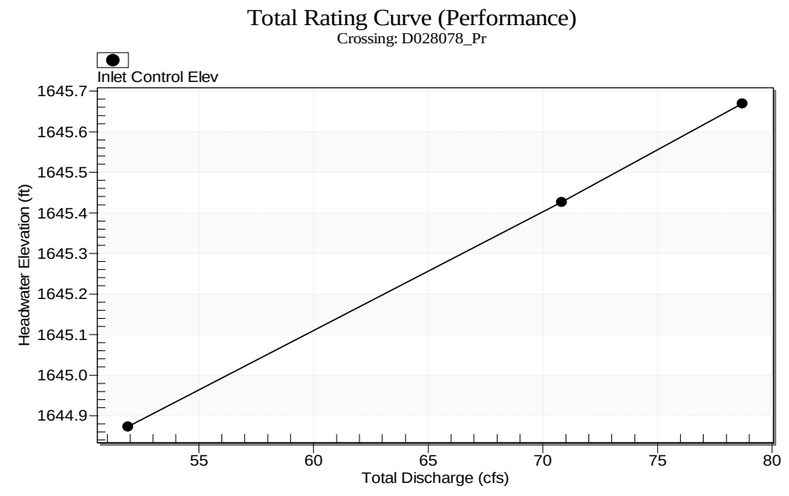
	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Proposed (double barrel)	3.0	DIP	47.30	Mitered	Mitered	1642.42	1642.04	0.80%	1647.22	1648.97	-0.5	1.6	Q10	51.9	51.9	1644.87	2.45	1.9	1-S2n	1.32	1.64	1.39	2.45	8.12	5.08	0.82	PASS	PASS	PASS	FAIL	PASS
													Q50	70.81	70.81	1645.43	3.01	2.53	5-S2n	1.58	1.93	1.66	2.75	8.8	5.5	1.00	PASS	PASS	PASS	FAIL	PASS
													Q100	78.7	78.7	1645.67	3.25	2.81	5-S2n	1.69	2.04	1.77	2.86	9.05	5.64	1.08	PASS	PASS	PASS	FAIL	PASS











OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

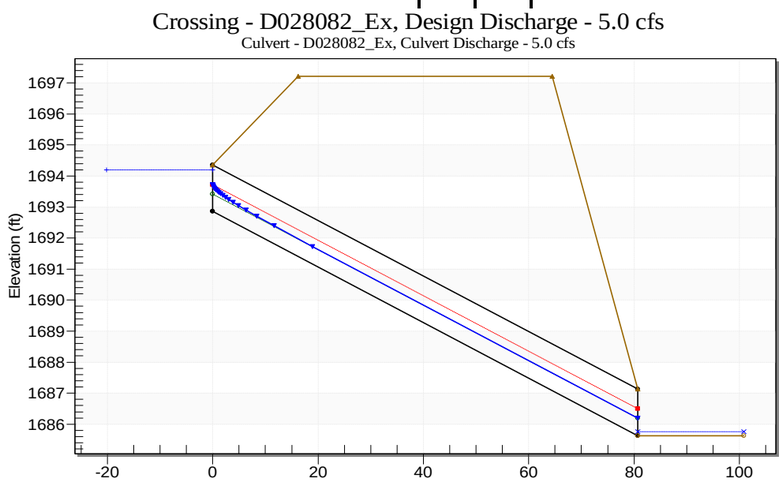
REPLACEMENT

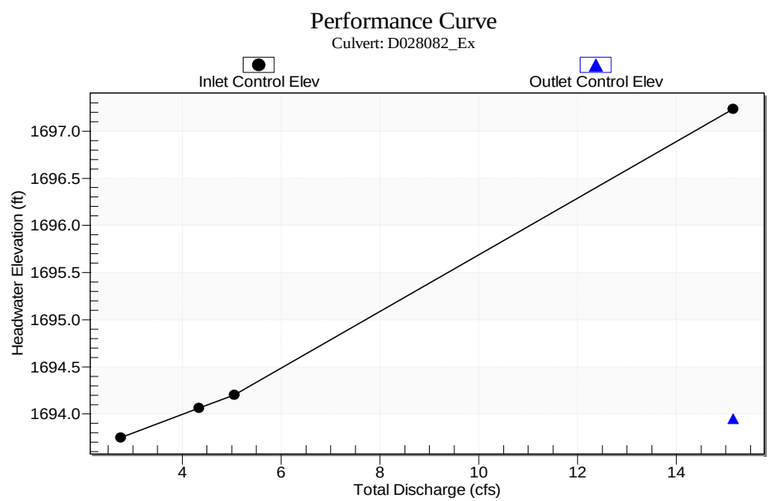
Culvert Name D028082 MP 42.5
Modeled By YH,PD
Date 10/22/2020

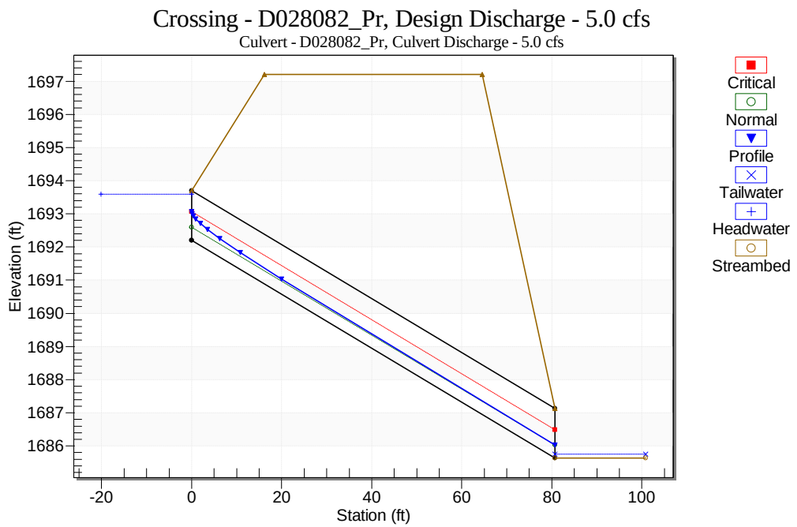
Note: Pipe cover measured from top of pipe to bottom of sub-base

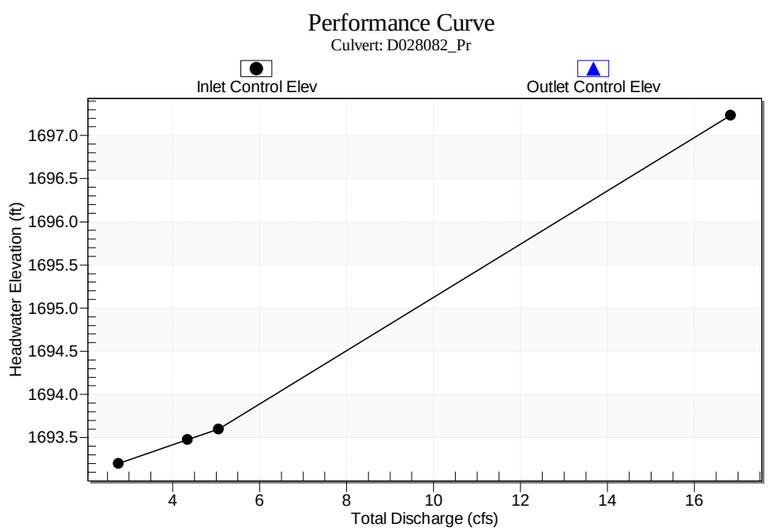
	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Existing Pipe	1.5	CMP	80.68	Projecting	Projecting	1692.86	1685.63	8.96%	1697.21	1692.9	0.6	3.5	Q10	2.75	2.75	1693.75	0.89	-6.34	1-S2n	0.41	0.63	0.41	0.09	7.1	0.75	0.59	PASS	PASS	PASS	FAIL	PASS
													Q50	4.34	4.34	1694.06	1.2	-5.78	1-S2n	0.52	0.8	0.52	0.12	8.07	0.89	0.80	PASS	PASS	PASS	FAIL	PASS
													Q100	5.05	5.05	1694.2	1.34	-5.49	1-S2n	0.56	0.86	0.56	0.13	8.41	0.95	0.89	PASS	PASS	PASS	FAIL	PASS

	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Proposed	1.5	Conc	80.68	Mitered	Mitered	1692.20	1685.63	8.14%	1697.21	1692.9	1.0	3.2	Q10	2.75	2.75	1693.2	1	-5.83	1-S2n	0.29	0.63	0.3	0.09	10.91	0.75	0.67	PASS	PASS	PASS	FAIL	PASS
													Q50	4.34	4.34	1693.48	1.28	-5.49	1-S2n	0.37	0.8	0.37	0.12	12.81	0.89	0.85	PASS	PASS	PASS	FAIL	PASS
													Q100	5.05	5.05	1693.6	1.4	-5.33	1-S2n	0.4	0.86	0.4	0.13	13.38	0.95	0.93	PASS	PASS	PASS	FAIL	PASS









OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

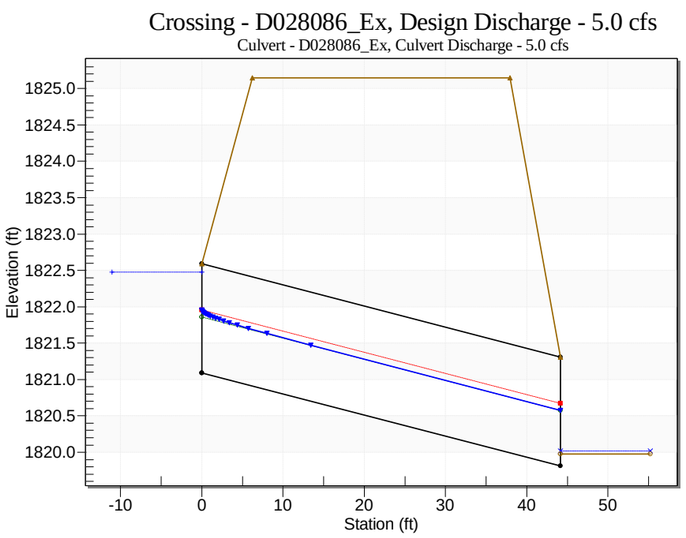
REPLACEMENT

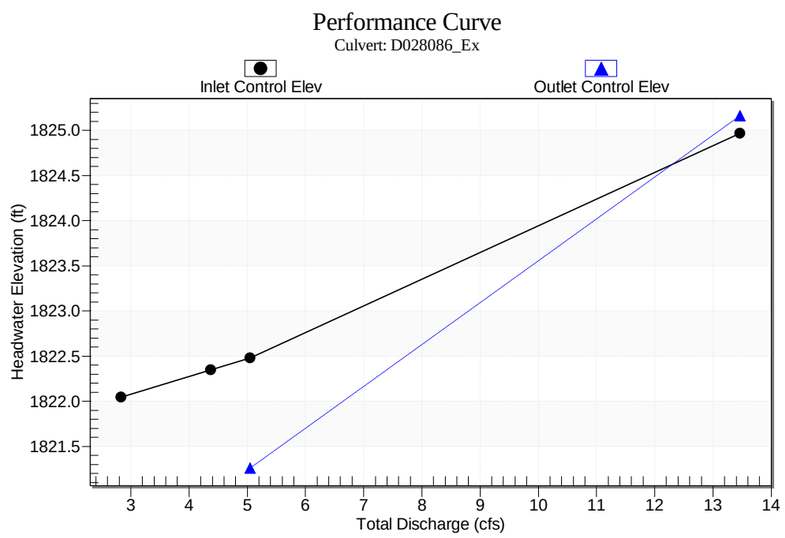
Culvert Name D028086 MP 43.26
Modeled By YH,PD
Date 10/22/2020

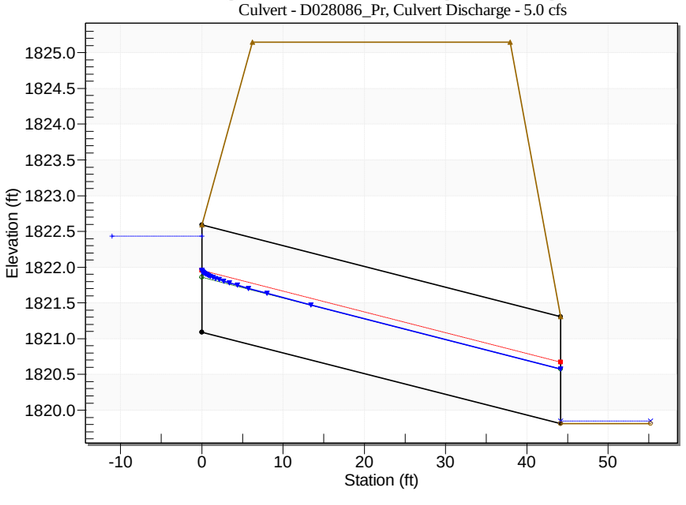
Note: Pipe cover measured from top of pipe to bottom of sub-base

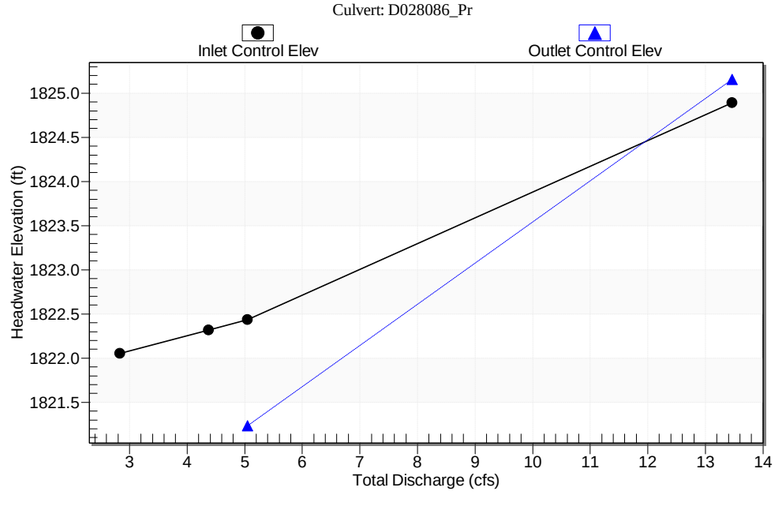
	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Existing Pipe	1.5	CMP	44.16	Projecting	Projecting	1821.09	1819.81	2.90%	1825.15	1826.28	0.6	3.0	Q10	2.83	2.83	1822.04	0.95	-0.46	1-S2n	0.55	0.64	0.55	0.03	4.77	2.02	0.63	PASS	PASS	PASS	FAIL	PASS
													Q50	4.37	4.37	1822.35	1.26	-0.04	1-S2n	0.71	0.8	0.71	0.04	5.35	2.4	0.84	PASS	PASS	PASS	FAIL	PASS
													Q100	5.05	5.05	1822.48	1.39	0.17	1-S2n	0.77	0.86	0.77	0.04	5.55	2.55	0.93	PASS	PASS	PASS	FAIL	PASS

	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Proposed	1.5	Class V conc	44.16	Miltered	Miltered	1821.09	1819.81	2.90%	1825.15	1826.28	0.6	3.0	Q10	2.83	2.83	1822.05	0.96	-0.46	1-S2n	0.55	0.64	0.55	0.03	4.77	2.02	0.64	PASS	PASS	PASS	FAIL	PASS
													Q50	4.37	4.37	1822.32	1.23	-0.06	1-S2n	0.71	0.8	0.71	0.04	5.35	2.4	0.82	PASS	PASS	PASS	FAIL	PASS
													Q100	5.05	5.05	1822.43	1.34	0.15	1-S2n	0.77	0.86	0.77	0.04	5.55	2.55	0.89	PASS	PASS	PASS	FAIL	PASS









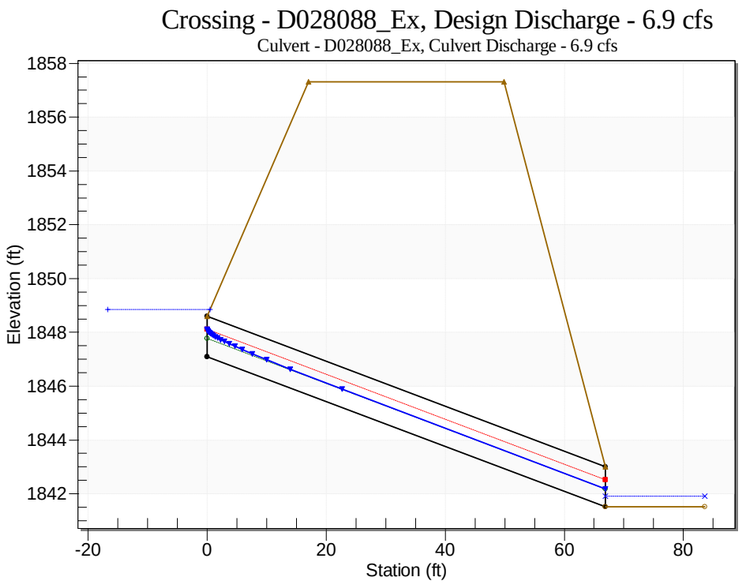
OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

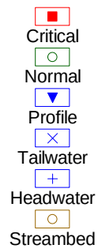
REPAIR

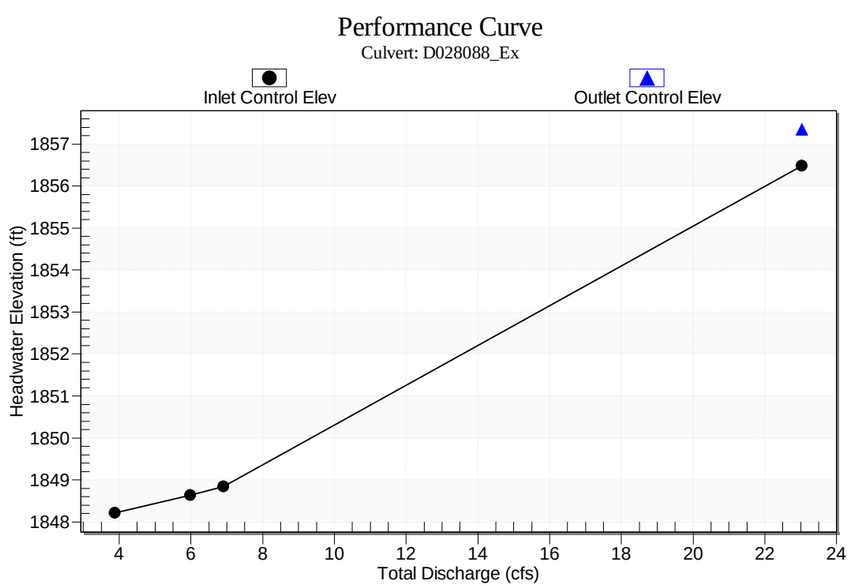
Culvert Name D028088 MP 43.43
Modeled By YH,PD
Date 10/22/2020

Note: Pipe cover measured from top of pipe to bottom of sub-base

	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Existing Pipe	1.5	CMP	66.90	Projecting	Projecting	1847.10	1841.51	8.36%	1857.32	1856.93	6.7	11.9	Q10	3.88	3.88	1848.22	1.12	-4.38	1-S2n	0.5	0.75	0.5	0.29	7.63	1.08	0.75	PASS	PASS	PASS	PASS	PASS
													Q50	5.98	5.98	1848.64	1.54	-3.57	5-S2n	0.62	0.94	0.62	0.37	8.58	1.24	1.03	PASS	PASS	PASS	PASS	PASS
													Q100	6.91	6.91	1848.84	1.74	-3.14	5-S2n	0.68	1.02	0.68	0.4	8.92	1.3	1.16	PASS	PASS	PASS	PASS	PASS







OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

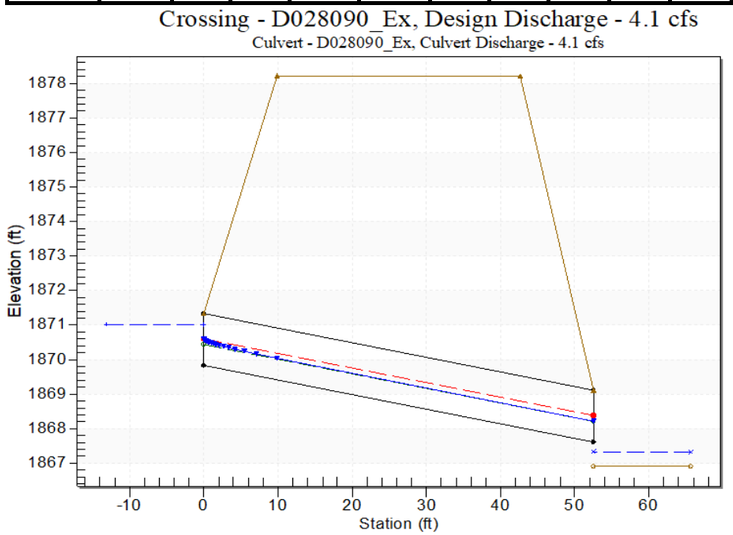
REPLACEMENT

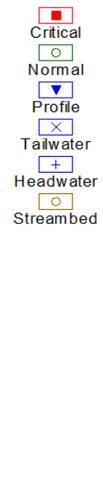
Culvert Name D028090 MP 43.54
Modeled By YH,PD
Date 10/22/2020

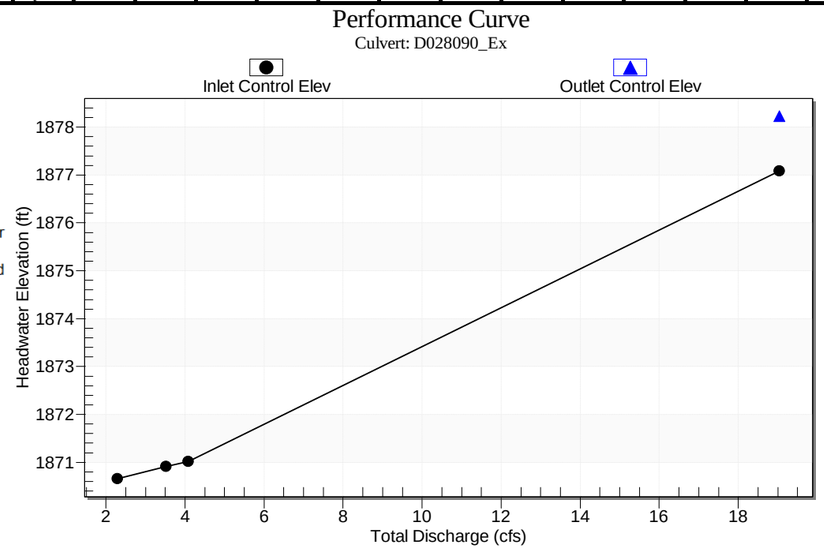
Note: Pipe cover measured from top of pipe to bottom of sub-base

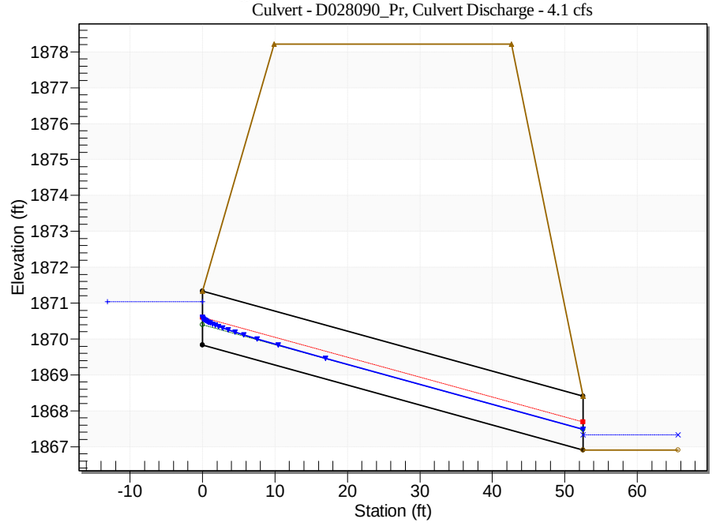
	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Existing Pipe	1.5	CMP	52.52	Projecting	Projecting	1869.83	1867.61	4.23%	1878.22	1877.03	4.9	5.9	Q10	2.29	2.29	1870.66	0.83	-1.51	1-S2n	0.45	0.57	0.45	0.3	5.15	1.9	0.55	PASS	PASS	PASS	PASS	PASS
													Q50	3.52	3.52	1870.91	1.08	-1.19	1-S2n	0.56	0.72	0.56	0.39	5.8	2.21	0.72	PASS	PASS	PASS	PASS	PASS
													Q100	4.08	4.08	1871.02	1.19	-1.02	1-S2n	0.61	0.77	0.61	0.42	6.04	2.33	0.79	PASS	PASS	PASS	PASS	PASS

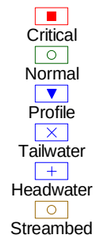
	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Proposed	1.5	CMP	52.52	Mitered	Mitered	1869.83	1866.91	5.56%	1878.22	1877.03	4.9	6.6	Q10	2.29	2.29	1870.71	0.88	-2.22	1-S2n	0.42	0.57	0.42	0.3	5.68	1.9	0.59	PASS	PASS	PASS	PASS	PASS
													Q50	3.52	3.52	1870.94	1.11	-1.9	1-S2n	0.52	0.72	0.52	0.39	6.41	2.21	0.74	PASS	PASS	PASS	PASS	PASS
													Q100	4.08	4.08	1871.04	1.21	-1.74	1-S2n	0.57	0.77	0.57	0.42	6.67	2.33	0.81	PASS	PASS	PASS	PASS	PASS

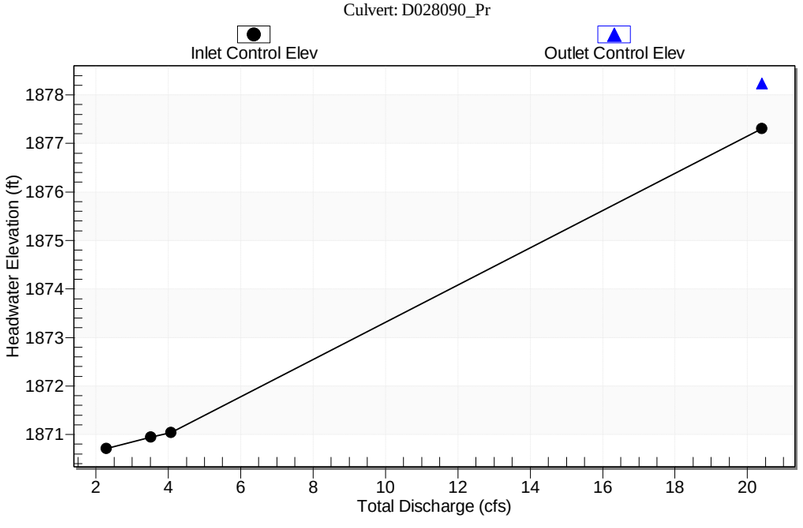












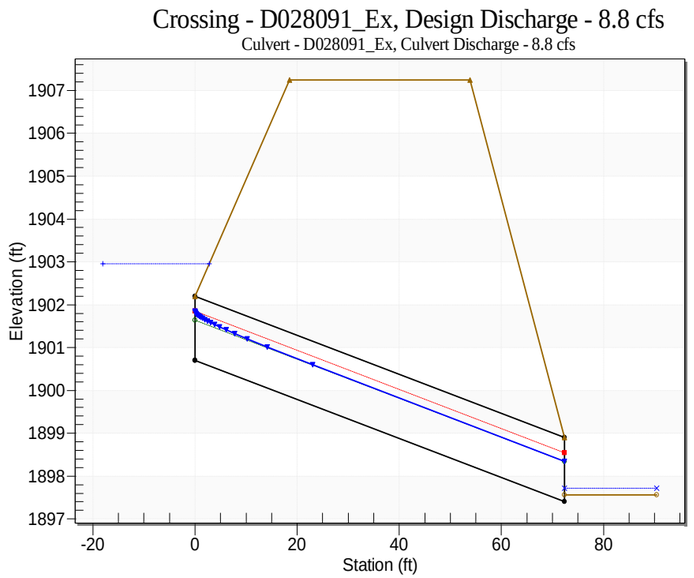
OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

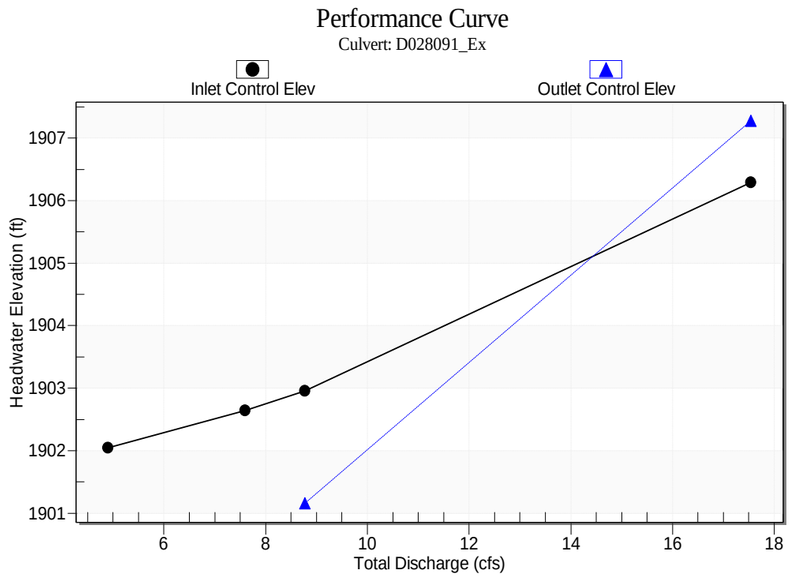
REPAIR

Culvert Name D028091 MP 43.74
Modeled By YH,PD
Date 10/22/2020

Note: Pipe cover measured from top of pipe to bottom of sub-base

	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Existing Pipe	1.5	CMP	72.36	Projecting	Projecting	1900.73	1897.35	4.67%	1907.25	1908.81	3.0	8.0	Q10	4.9	4.9	1902.08	1.35	-1.77	1-S2n	0.66	0.85	0.66	0.11	6.57	3.95	0.90	PASS	PASS	PASS	PASS	PASS
													Q50	7.6	7.6	1902.67	1.94	-0.48	5-S2n	0.85	1.07	0.85	0.14	7.34	4.67	1.29	FAIL	PASS	PASS	PASS	PASS
													Q100	8.77	8.77	1902.98	2.25	0.38	5-S2n	0.94	1.15	0.94	0.15	7.57	4.94	1.50	FAIL	PASS	PASS	PASS	PASS





OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

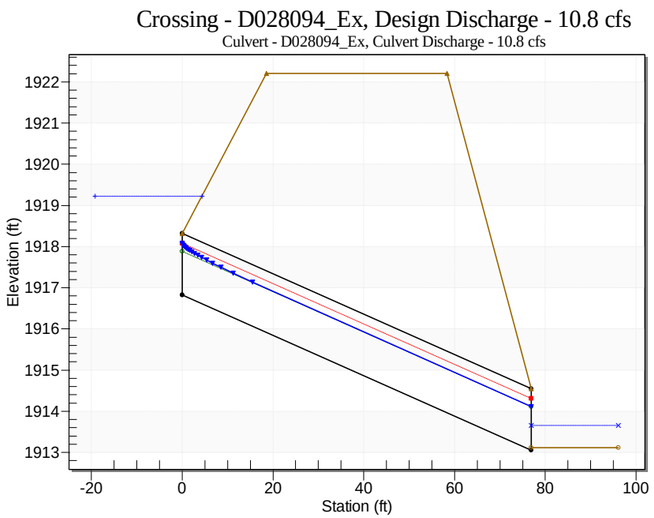
REPLACEMENT

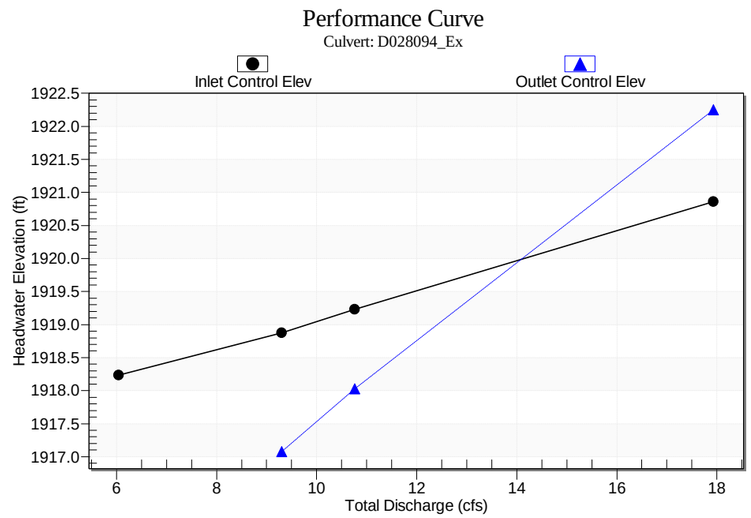
Culvert Name D028094 MP 43.99
Modeled By YH,PD
Date 10/22/2020

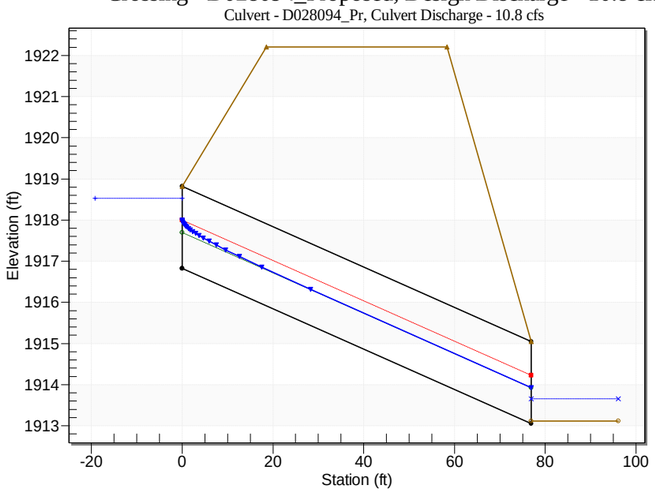
Note: Pipe cover measured from top of pipe to bottom of sub-base

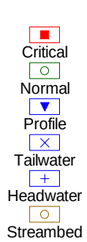
	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Existing Pipe	1.5	CMP	76.90	Drop Inlet	Projecting	1916.82	1913.05	4.90%	1922.21	1921.7	1.9	5.2	Q10	6.04	6.04	1918.24	1.42	-1.69	1-S2n	0.73	0.95	0.73	0.39	7.06	8.89	0.95	PASS	PASS	PASS	PASS	PASS
													Q50	9.3	9.3	1918.87	2.05	0.26	5-S2n	0.96	1.18	0.96	0.5	7.81	10.01	1.37	FAIL	PASS	PASS	PASS	PASS
													Q100	10.76	10.76	1919.23	2.41	1.21	5-S2n	1.06	1.26	1.06	0.53	8.02	10.41	1.61	FAIL	PASS	PASS	PASS	PASS

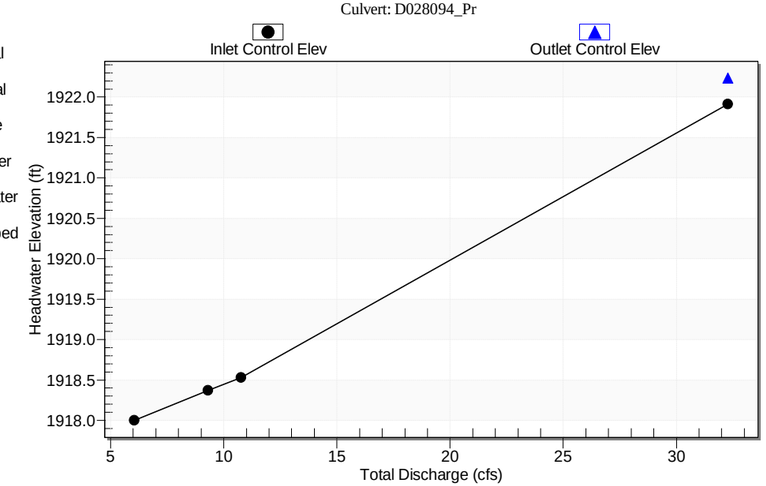
	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Proposed	2.0	CMP	76.90	Drop Inlet	Mitered	1916.32	1913.05	4.25%	1922.21	1921.7	1.9	4.7	Q10	6.04	6.04	1918	1.18	-2.63	1-S2n	0.64	0.87	0.64	0.39	6.96	8.89	0.84	PASS	PASS	PASS	PASS	PASS
													Q50	9.3	9.3	1918.37	1.55	-2.04	1-S2n	0.81	1.09	0.81	0.5	7.84	10.01	1.02	PASS	PASS	PASS	PASS	PASS
													Q100	10.76	10.76	1918.53	1.71	-1.73	1-S2n	0.87	1.18	0.87	0.53	8.15	10.41	1.11	PASS	PASS	PASS	PASS	PASS











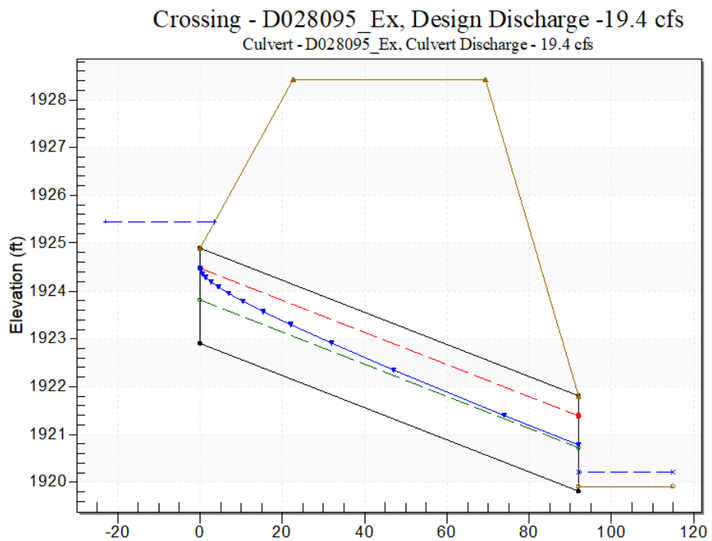
OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

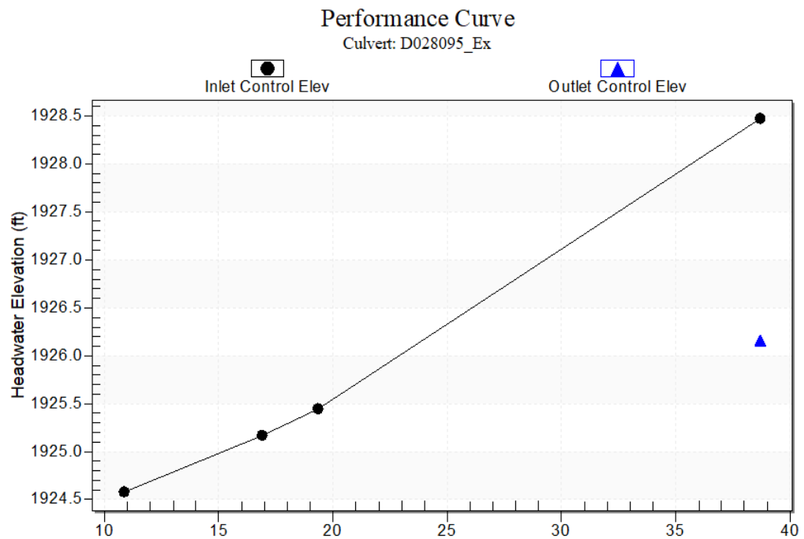
REPAIR

Culvert Name D028095 MP 44.06
Modeled By YH,PD
Date 10/22/2020

Note: Pipe cover measured from top of pipe to bottom of sub-base

	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Existing Pipe	2.0	Conc	91.97	Projecting	Projecting	1922.90	1919.81	3.36%	1928.43	1927.41	1.3	3.4	Q10	10.85	10.85	1924.58	1.68	-1.51	1-S2n	0.67	1.18	0.69	0.22	11.36	8.47	0.84	PASS	PASS	PASS	PASS	PASS
													Q50	16.9	16.9	1925.17	2.27	-0.63	5-S2n	0.85	1.48	0.89	0.28	12.54	9.98	1.13	PASS	PASS	PASS	PASS	PASS
													Q100	19.35	19.35	1925.45	2.55	-0.02	5-S2n	0.92	1.58	0.97	0.31	12.83	10.49	1.27	FAIL	PASS	PASS	PASS	PASS





OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

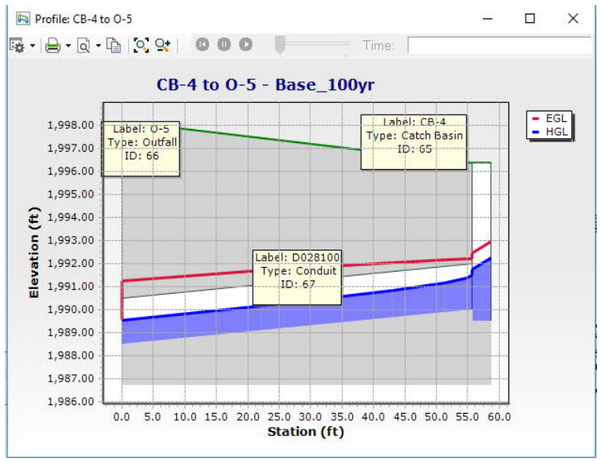
REPLACEMENT

Culvert Name D028100 MP 44.36
Modeled By YH,PD
Date 10/22/2020

Note: Pipe cover measured from top of pipe to bottom of sub-base

	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Proposed Pipe	2.0	CMP	57.21	Drop Inlet	Projecting	1987.57	1986.74	1.45%	1998.75	1998.15	7.2	7.4	Q10	9.42	9.42	1991.48	1.98	2.48	3-M1t	0.69	1.1	2.48	2.48	9.77	0	1.96	FAIL	PASS	PASS	PASS	PASS
													Q50	14.59	14.59	1992.05	2.55	2.3	7-M1t	0.88	1.38	2.69	2.69	11	3.3	2.24	FAIL	PASS	PASS	PASS	PASS
													Q100	16.85	16.85	1992.23	2.73	2.82	7-M2t	0.95	1.48	2.77	0.97	11.42	3.44	2.33	FAIL	PASS	PASS	PASS	PASS

	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Proposed Pipe	2.0	CMP	57.21	Drop Inlet	Projecting	1990.00	1988.50	2.62%	1998.75	1998.15	4.8	5.7	Q10	9.42	9.42	1991.48	1.98	2.48	3-M1t	0.69	1.1	2.48	2.48	9.77	0	0.74	PASS	PASS	PASS	PASS	PASS
													Q50	14.59	14.59	1992.05	2.55	2.3	7-M1t	0.88	1.38	2.69	2.69	11	3.3	1.02	PASS	PASS	PASS	PASS	PASS
													Q100	16.85	16.85	1992.23	2.73	2.82	7-M2t	0.95	1.48	2.77	0.97	11.42	3.44	1.12	PASS	PASS	PASS	PASS	PASS



OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

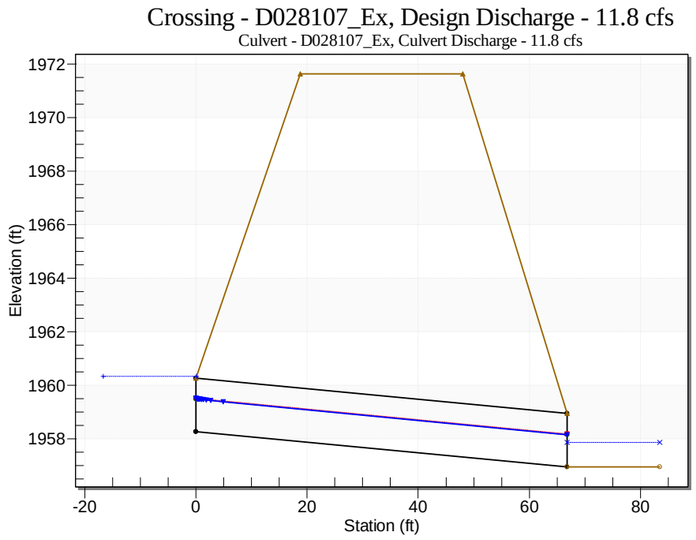
REPLACEMENT

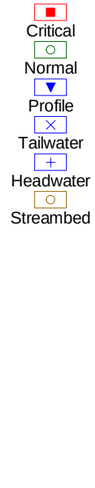
Culvert Name D028107 MP 44.96
Modeled By YH,PD
Date 10/22/2020

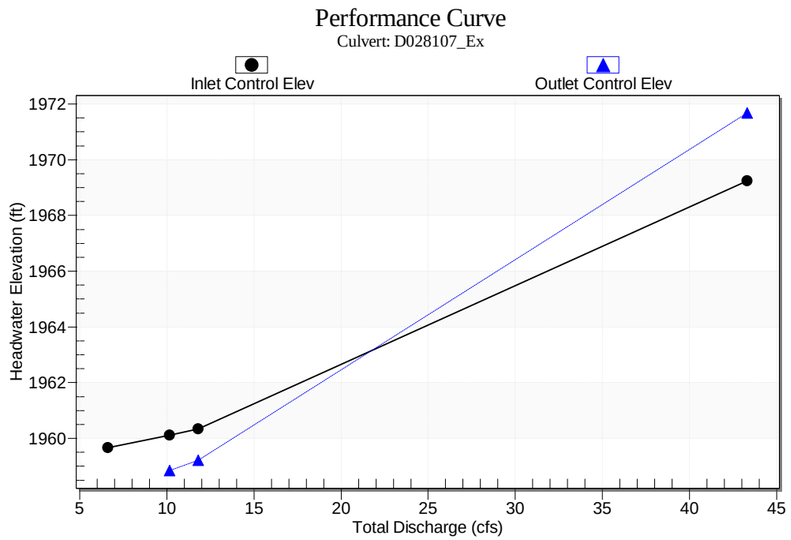
Note: Pipe cover measured from top of pipe to bottom of sub-base

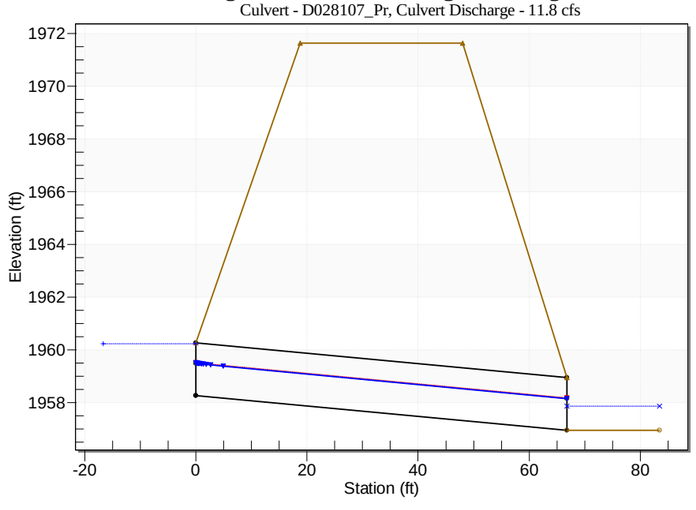
	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Existing Pipe	2.0	CMP	66.79	Projecting	Projecting	1958.28	1956.95	1.99%	1971.64	1969.82	9.4	8.9	Q10	6.62	6.62	1959.67	1.39	-0.09	1-S2n	0.86	0.91	0.86	0.67	5.15	2.52	0.70	PASS	PASS	PASS	PASS	PASS
													Q50	10.15	10.15	1960.11	1.83	0.57	1-S2n	1.1	1.14	1.1	0.85	5.73	2.86	0.91	PASS	PASS	PASS	PASS	PASS
													Q100	11.81	11.81	1960.33	2.05	0.94	5-S2n	1.21	1.23	1.21	0.92	5.93	2.98	1.02	PASS	PASS	PASS	PASS	PASS

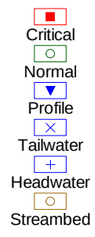
	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Proposed	2.0	CMP	66.79	Mitered	Mitered	1958.28	1956.95	1.99%	1971.64	1969.82	9.4	8.9	Q10	6.62	6.62	1959.64	1.36	-0.11	1-S2n	0.86	0.91	0.86	0.67	5.15	2.52	0.68	PASS	PASS	PASS	PASS	PASS
													Q50	10.15	10.15	1960.04	1.76	0.54	1-S2n	1.1	1.14	1.1	0.85	5.73	2.86	0.88	PASS	PASS	PASS	PASS	PASS
													Q100	11.81	11.81	1960.23	1.95	0.89	1-S2n	1.21	1.23	1.21	0.92	5.93	2.98	0.98	PASS	PASS	PASS	PASS	PASS

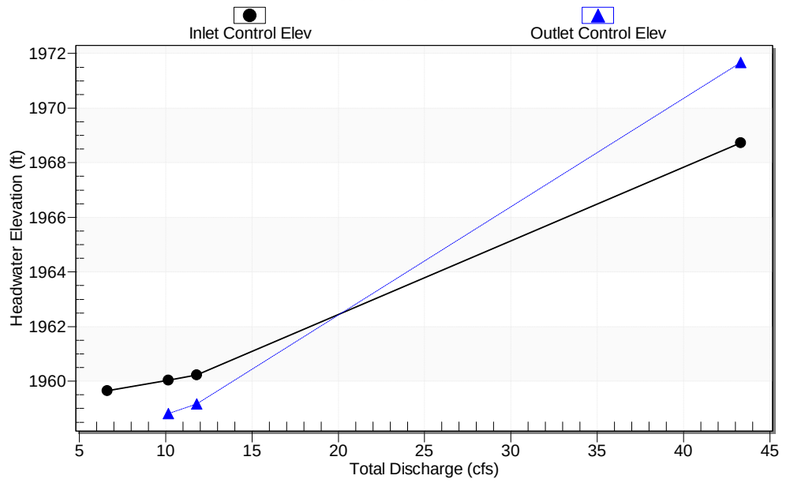












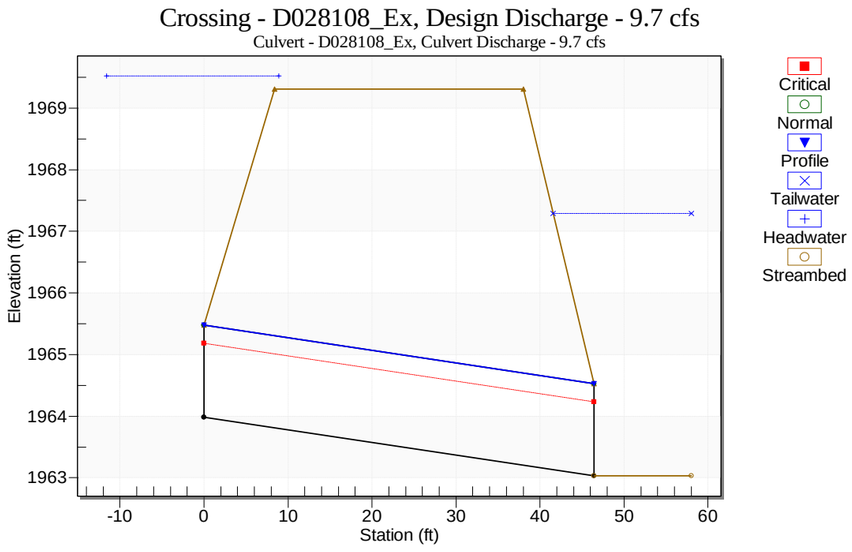
OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

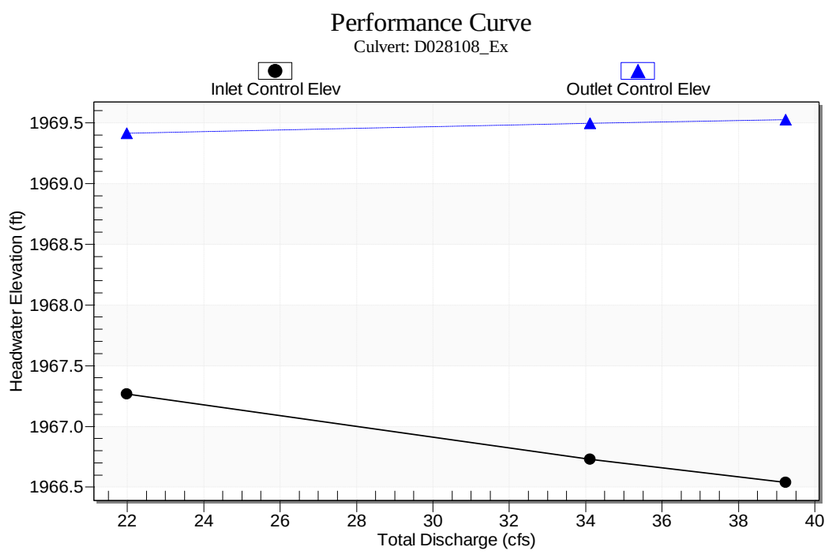
REPAIR

Culvert Name D028108 MP 45.03
Modeled By YH,PD
Date 10/22/2020

Note: Pipe cover measured from top of pipe to bottom of sub-base

	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverChec k Outlet
Existing Pipe	1.5	CMP	46.43	Projecting	Projecting	1963.98	1963.03	2.05%	1969.31	1967.53	1.8	1.0	Q10	21.98	11.69	1969.42	3.29	5.44	4-FFf	1.5	1.3	1.5	3.15	6.61	1.09	3.63	FAIL	OVERTOP	PASS	PASS	PASS
													Q50	34.11	10.27	1969.5	2.75	5.52	4-FFf	1.5	1.23	1.5	3.97	5.81	1.22	3.68	FAIL	OVERTOP	PASS	PASS	PASS
													Q100	39.24	9.7	1969.52	2.56	5.54	4-FFf	1.5	1.2	1.5	4.26	5.49	1.26	3.69	FAIL	OVERTOP	PASS	PASS	PASS





OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

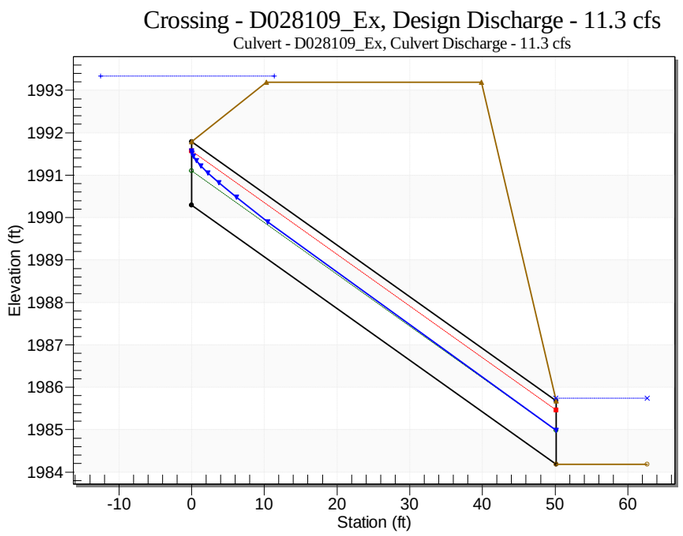
REPLACEMENT

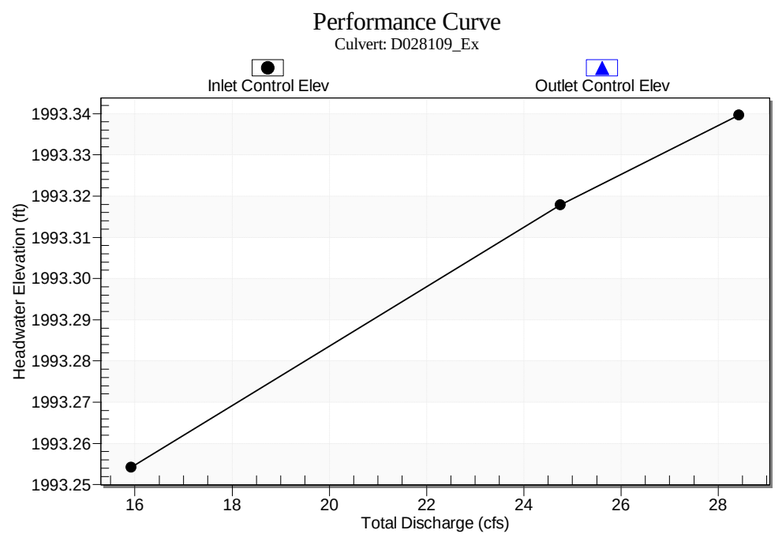
Culvert Name D028109 MP 45.35
Modeled By YH,PD
Date 10/22/2020

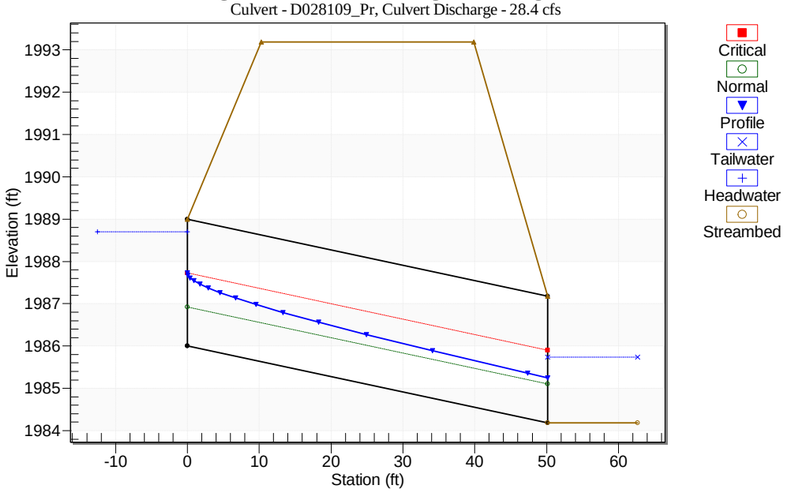
Note: Pipe cover measured from top of pipe to bottom of sub-base

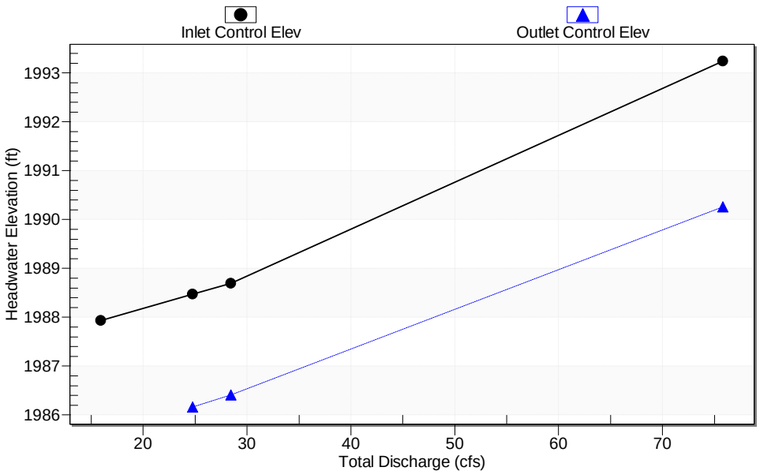
	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Existing Pipe	1.5	CMP	50.15	Projecting	Projecting	1989.67	1984.18	10.95%	1993.19	1993.59	0.0	5.9	Q10	15.92	11.06	1993.25	2.96	-1.67	5-S2n	0.8	1.27	0.8	1.09	11.56	5.77	2.39	FAIL	OVERTOP	PASS	FAIL	PASS
													Q50	24.75	11.23	1993.32	3.03	-1.53	5-S2n	0.81	1.28	0.81	1.43	11.6	6.48	2.43	FAIL	OVERTOP	PASS	FAIL	PASS
													Q100	28.43	11.28	1993.34	3.05	-1.42	5-S2n	0.81	1.28	0.81	1.56	11.61	6.71	2.45	FAIL	OVERTOP	PASS	FAIL	PASS

	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Proposed	3.0	Conc	50.15	Mitered	Mitered	1986.00	1984.18	3.63%	1993.19	1993.59	1.9	4.2	Q10	15.92	15.92	1987.93	1.93	-0.39	1-S2n	0.69	1.27	0.76	1.09	11.24	5.77	0.64	PASS	PASS	PASS	PASS	PASS
													Q50	24.75	24.75	1988.47	2.47	0.17	1-S2n	0.86	1.6	0.99	1.43	12.24	6.48	0.82	PASS	PASS	PASS	PASS	PASS
													Q100	28.43	28.43	1988.7	2.7	0.41	1-S2n	0.92	1.73	1.07	1.56	12.59	6.71	0.90	PASS	PASS	PASS	PASS	PASS







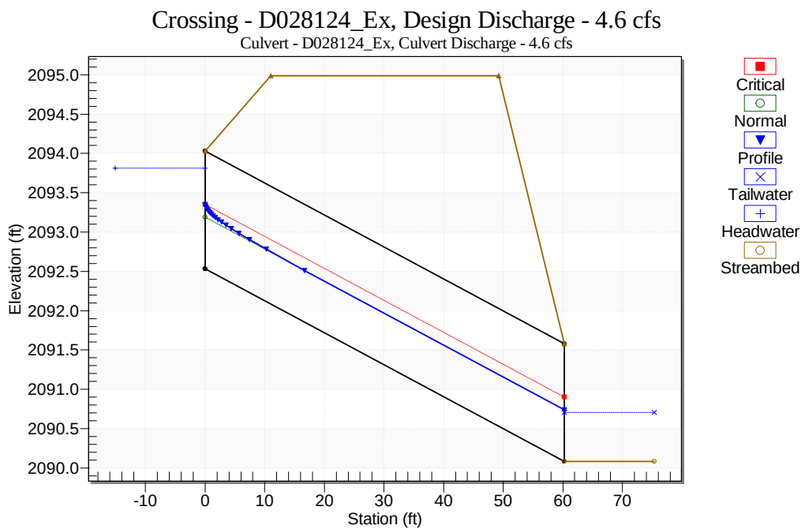


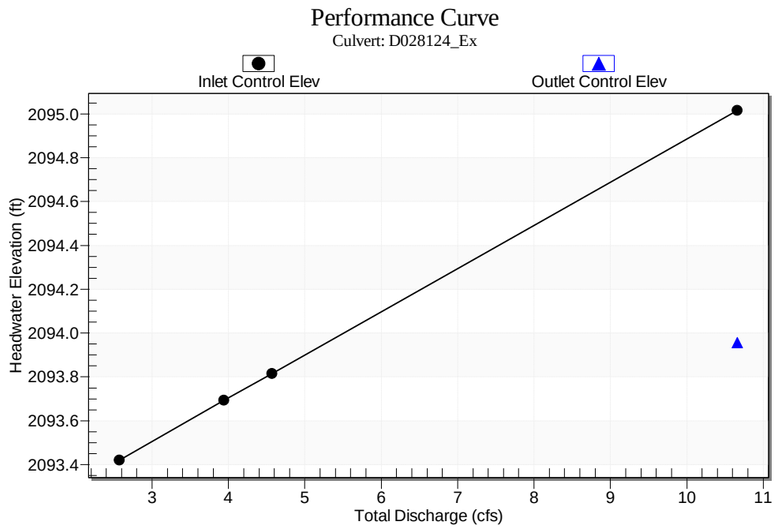
OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

Culvert Name D028124 MP 46.75
Modeled By YH,PD
Date 10/22/2020

Note: Pipe cover measured from top of pipe to bottom of sub-base

	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Existing Pipe	1.5	CMP	60.27	Projecting	Projecting	2092.53	2090.08	4.07%	2094.99	2094.26	0.0	1.7	Q10	2.57	2.57	2093.42	0.89	-1.66	1-S2n	0.48	0.61	0.48	0.45	5.24	1	0.59	PASS	PASS	PASS	FAIL	PASS
													Q50	3.94	3.94	2093.69	1.16	-1.26	1-S2n	0.61	0.76	0.61	0.57	5.9	1.16	0.77	PASS	PASS	PASS	FAIL	PASS
													Q100	4.57	4.57	2093.82	1.29	-1.05	1-S2n	0.66	0.82	0.66	0.63	6.13	1.22	0.86	PASS	PASS	PASS	FAIL	PASS





OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

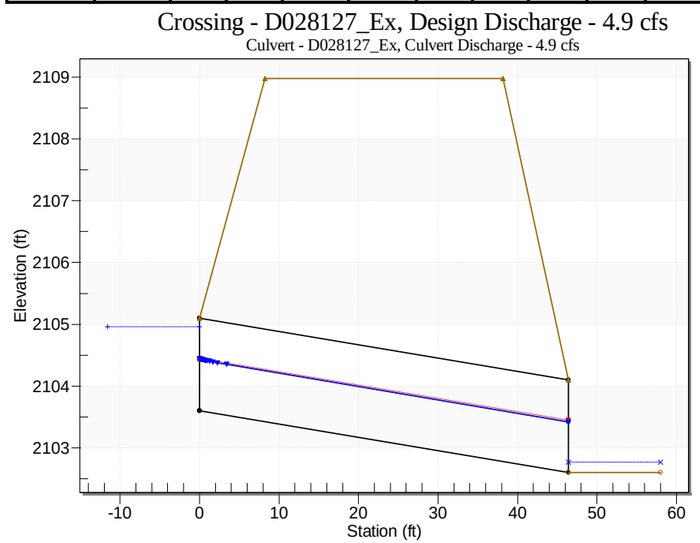
REPLACEMENT

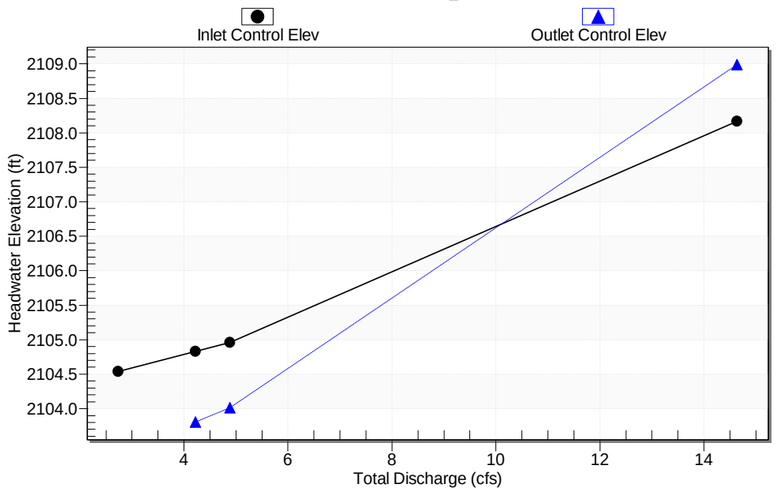
Culvert Name D028127 MP 46.89
Modeled By YH,PD
Date 10/22/2020

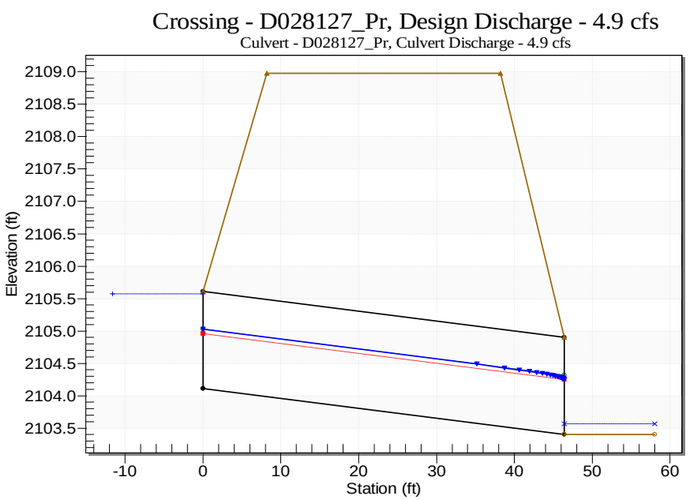
Note: Pipe cover measured from top of pipe to bottom of sub-base

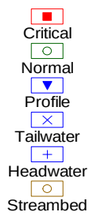
	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverChe ck Outlet
Existing Pipe	1.5	CMP	46.41	Projecting	Projecting	2103.60	2102.60	2.15%	2108.98	2108.3	1.9	2.2	Q10	2.73	2.73	2104.54	0.94	-0.2	1-S2n	0.59	0.63	0.59	0.12	4.24	0.39	0.63	PASS	PASS	PASS	PASS	PASS
													Q50	4.22	4.22	2104.83	1.23	0.21	1-S2n	0.75	0.79	0.75	0.15	4.75	0.46	0.82	PASS	PASS	PASS	PASS	PASS
													Q100	4.88	4.88	2104.96	1.36	0.41	1-S2n	0.82	0.85	0.82	0.17	4.92	0.49	0.91	PASS	PASS	PASS	PASS	PASS

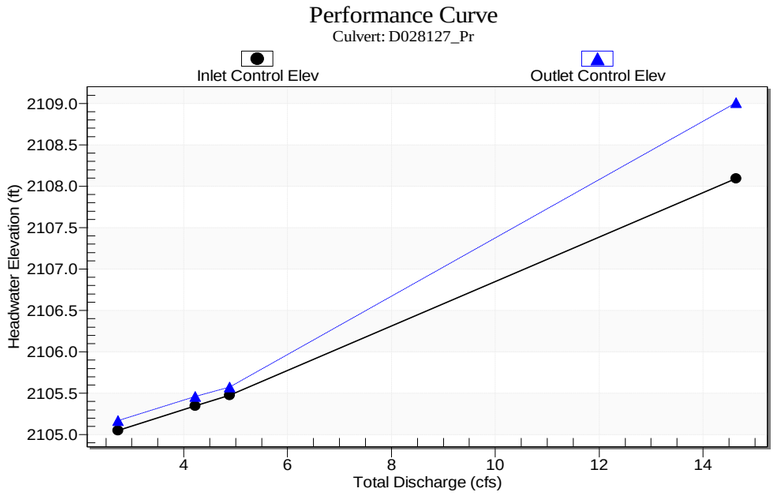
	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverChe ck Outlet
Proposed	1.5	CMP	46.41	Projecting	Projecting	2104.11	2103.40	1.53%	2108.98	2108.3	1.4	1.4	Q10	2.73	2.73	2105.17	0.94	1.06	2-M2c	0.65	0.63	0.63	0.12	3.9	0.39	0.71	PASS	PASS	PASS	PASS	PASS
													Q50	4.22	4.22	2105.46	1.24	1.35	2-M2c	0.84	0.79	0.79	0.15	4.49	0.46	0.90	PASS	PASS	PASS	PASS	PASS
													Q100	4.88	4.88	2105.58	1.37	1.47	2-M2c	0.92	0.85	0.85	0.17	4.73	0.49	0.98	PASS	PASS	PASS	PASS	PASS











OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

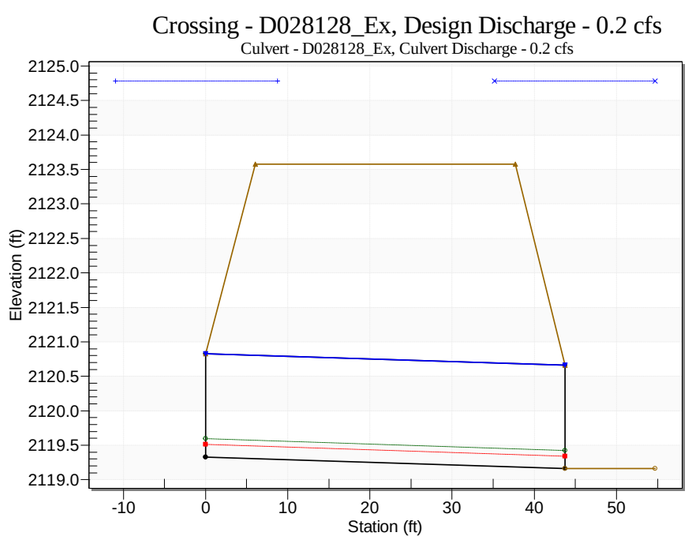
REPLACEMENT

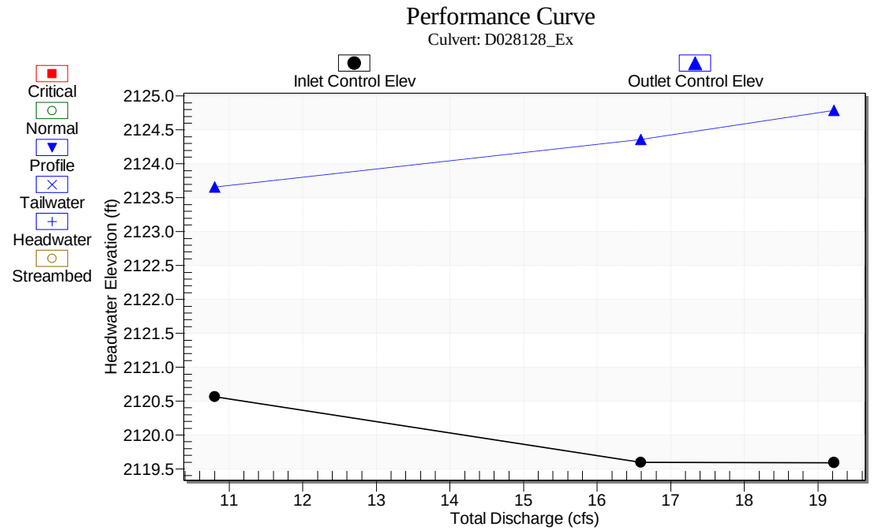
Culvert Name D028128 MP 47.07
Modeled By YH,PD
Date 7/12/2021

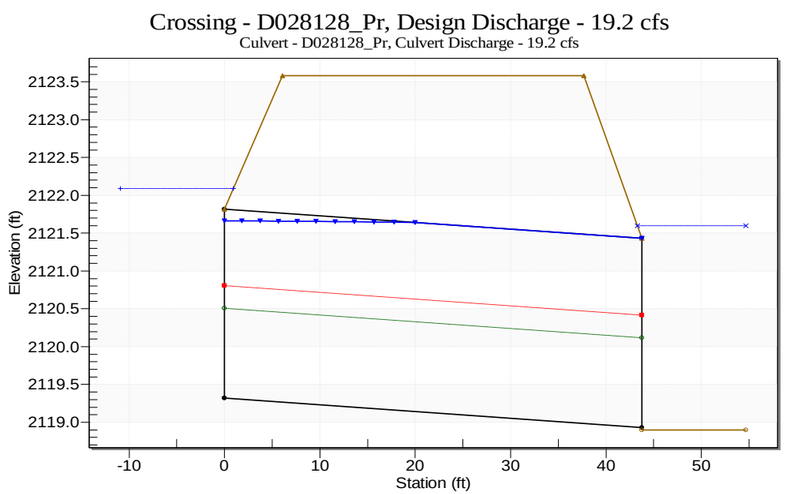
Note: Pipe cover measured from top of pipe to bottom of sub-base

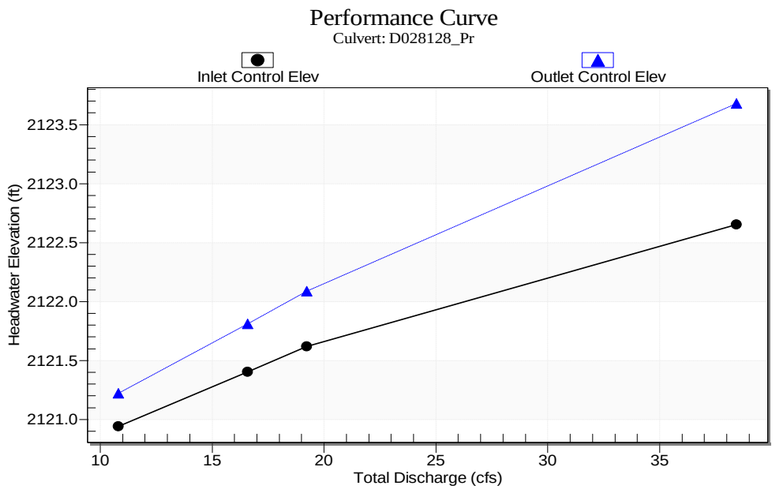
	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Existing Pipe	1.5	CMP	43.75	Projecting	Projecting	2119.33	2119.16	0.39%	2123.58	2123.42	0.8	0.8	Q10	10.8	4.18	2123.66	1.24	4.33	4-FFf	1.5	0.78	1.5	4.1	2.36	0.6	2.89	FAIL	OVERTOP	FAIL	FAIL	FAIL
													Q50	16.59	0.25	2124.36	0.27	5.03	4-FFf	0.27	0.19	1.5	5.2	0.14	0.66	3.35	FAIL	OVERTOP	FAIL	FAIL	FAIL
													Q100	19.22	0.24	2124.79	0.26	5.46	4-FFf	0.27	0.18	1.5	5.62	0.14	0.68	3.64	FAIL	OVERTOP	FAIL	FAIL	FAIL

	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Proposed	2.5	DIP	43.75	Mitered	Mitered	2119.32	2118.93	0.89%	2123.58	2123.42	-0.2	0.0	Q10	10.8	10.8	2121.22	1.62	1.9	1-S1t	0.86	1.1	2.05	2.08	2.51	0.78	0.76	PASS	PASS	PASS	FAIL	FAIL
													Q50	16.59	16.59	2121.81	2.08	2.49	1-S1t	1.09	1.38	2.5	2.53	3.38	0.87	1.00	PASS	PASS	PASS	FAIL	FAIL
													Q100	19.22	19.22	2122.09	2.3	2.77	1-S1f	1.19	1.49	2.5	2.7	3.92	0.9	1.11	PASS	PASS	PASS	FAIL	FAIL









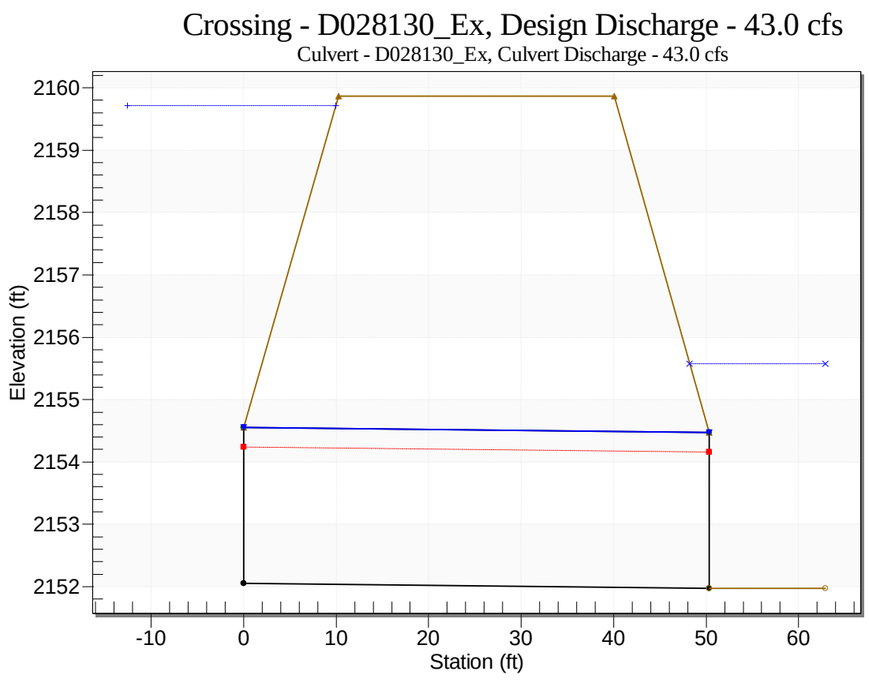
OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

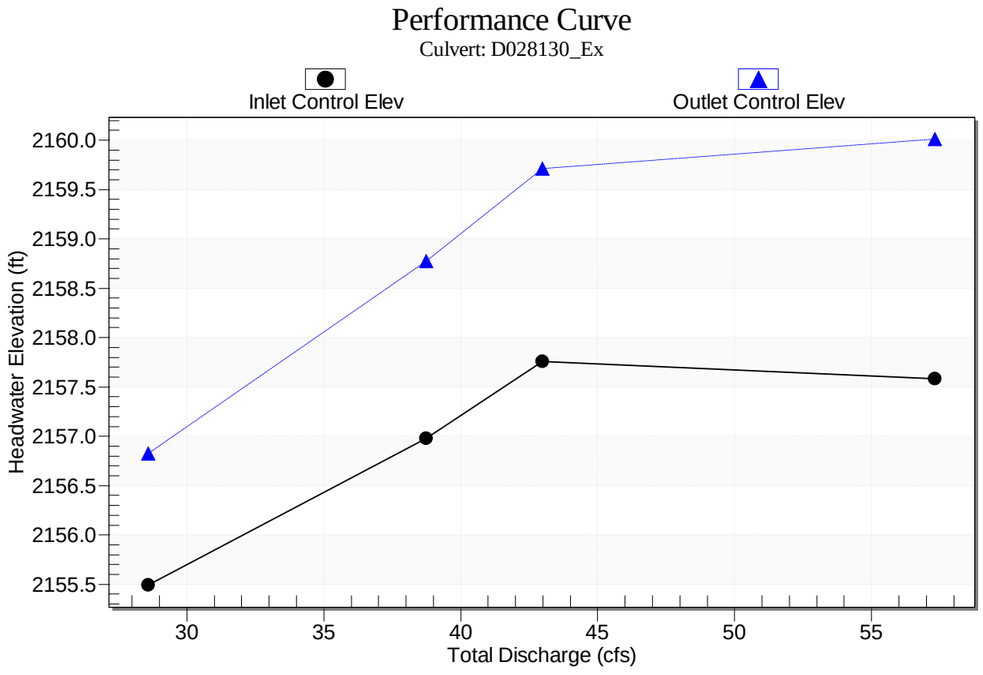
REPAIR

Culvert Name D028130 MP 47.46
Modeled By YH,PD
Date 10/22/2020

Note: Pipe cover measured from top of pipe to bottom of sub-base

	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Existing Pipe	2.5	CMP	50.33	Projecting	Projecting	2152.05	2151.97	0.16%	2159.87	2159.89	3.3	3.4	Q10	28.58	28.58	2156.82	3.45	4.77	4-FFf	2.5	1.82	2.5	3.03	5.82	1.07	1.91	FAIL	PASS	FAIL	PASS	PASS
													Q50	38.73	38.73	2158.78	4.93	6.73	4-FFf	2.5	2.1	2.5	3.45	7.89	1.16	2.69	FAIL	PASS	FAIL	PASS	PASS
													Q100	42.99	42.99	2159.71	5.71	7.66	4-FFf	2.5	2.19	2.5	3.61	8.76	1.19	3.06	FAIL	PASS	FAIL	PASS	PASS





OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

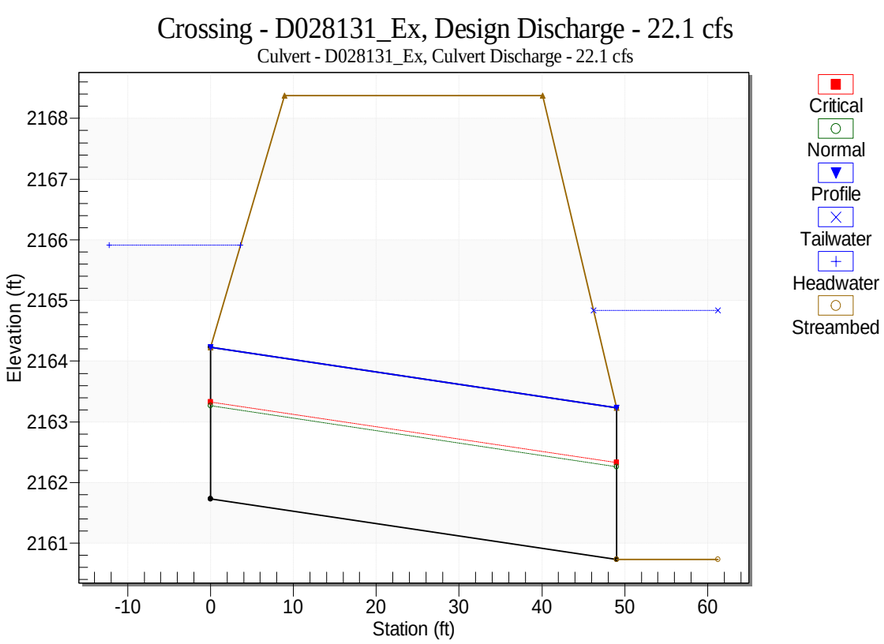
REPLACEMENT

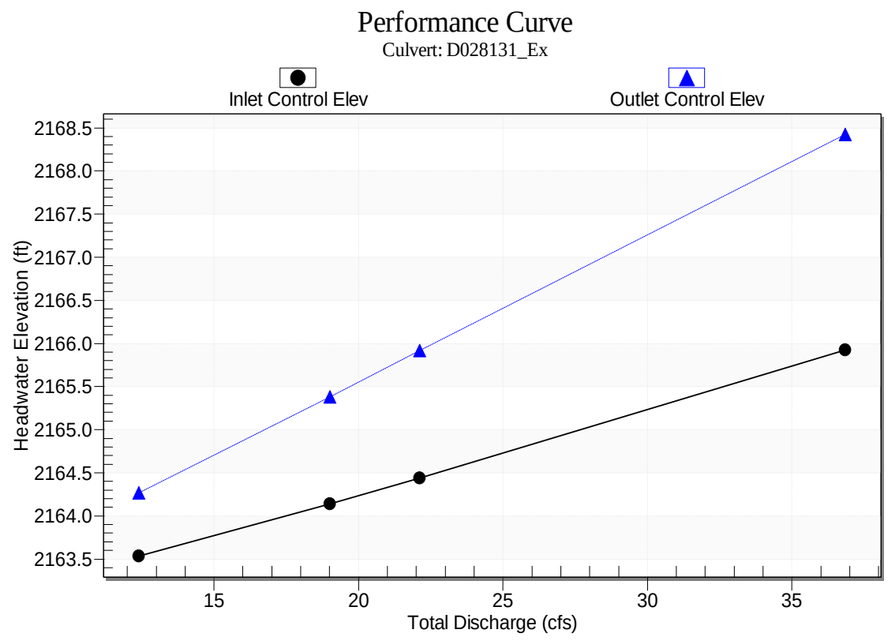
Culvert Name D028131 MP 47.57
Modeled By YH,PD
Date 10/22/2020

Note: Pipe cover measured from top of pipe to bottom of sub-base

	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Existing Pipe	2.5	CMP	49.01	Projecting	Projecting	2161.73	2160.73	2.04%	2168.38	2167.91	2.2	2.7	Q10	12.39	12.39	2164.27	1.81	2.54	1-S1f	1.08	1.18	2.5	3.2	2.52	0.34	1.02	PASS	PASS	PASS	PASS	PASS
													Q50	19.01	19.01	2165.38	2.41	3.65	4-FFf	1.39	1.48	2.5	3.85	3.87	0.38	1.46	FAIL	PASS	PASS	PASS	PASS
													Q100	22.11	22.11	2165.92	2.71	4.19	4-FFf	1.53	1.6	2.5	4.1	4.5	0.4	1.68	FAIL	PASS	PASS	PASS	PASS

	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Proposed Pipe	3.0	CMP	49.01	Projecting	Projecting	2161.73	2160.73	2.04%	2168.38	2167.91	1.7	2.2	Q10	12.39	12.39	2164.08	1.65	2.35	1-S1f	1	1.12	3	3.2	1.75	0.34	0.78	PASS	PASS	PASS	PASS	PASS
													Q50	19.01	19.01	2164.9	2.09	3.17	1-S1f	1.26	1.4	3	3.85	2.69	0.38	1.06	PASS	PASS	PASS	PASS	PASS
													Q100	22.11	22.11	2165.28	2.28	3.55	4-FFf	1.37	1.51	3	4.1	3.13	0.4	1.18	PASS	PASS	PASS	PASS	PASS





OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

REPLACEMENT

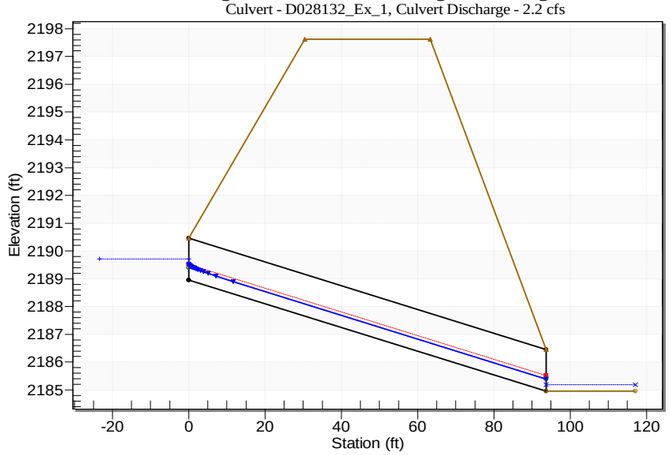
Culvert Name D028132 MP 47.80
Modeled By Yhabtemichael
Date 10/5/2020

Note: Pipe cover measured from top of pipe to bottom of sub-base

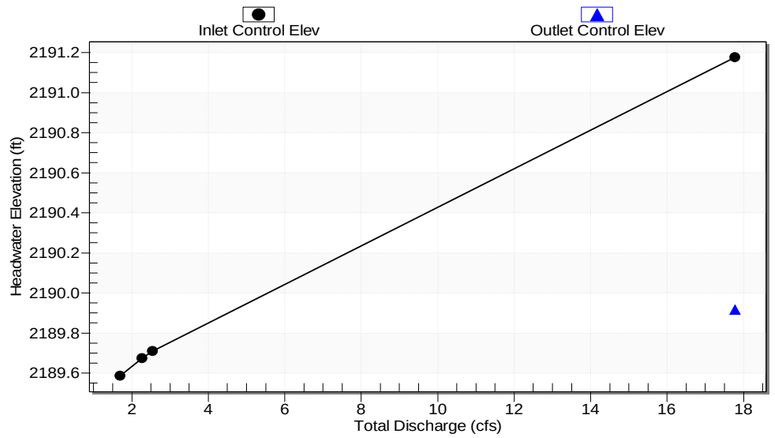
	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Existing Barrel 1	1.5	CMP	93.71	Headwall Non Engr	Projecting	2188.96	2184.95	4.28%	2197.63	2196.44	5.2	8.0	Q10	1.69	1.58	2189.59	0.63	-3.45	1-S2n	0.37	0.47	0.37	0.19	4.65	2.41	0.42	PASS	PASS	PASS	PASS	PASS
													Q50	2.27	2.01	2189.67	0.71	-3.33	1-S2n	0.42	0.53	0.42	0.22	4.98	2.65	0.47	PASS	PASS	PASS	PASS	PASS
													Q100	2.54	2.2	2189.71	0.75	-3.27	1-S2n	0.44	0.56	0.44	0.23	5.11	2.75	0.50	PASS	PASS	PASS	PASS	PASS

	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Proposed	4.0	Conc	96.5	Headwall Non Engr	Mitered	2187.99	2180.15	8.12%	2197.63	2196.44	3.4	10.0	Q10	1.69	1.69	2188.46	0.47	-7.47	1-S2n	0.17	0.37	0.17	0.19	8.75	2.41	0.12	PASS	PASS	PASS	PASS	PASS
													Q50	2.27	2.27	2188.54	0.55	-7.41	1-S2n	0.21	0.43	0.21	0.22	9.26	2.65	0.14	PASS	PASS	PASS	PASS	PASS
													Q100	2.54	2.54	2188.57	0.58	-7.38	1-S2n	0.21	0.46	0.21	0.23	9.67	2.75	0.15	PASS	PASS	PASS	PASS	PASS

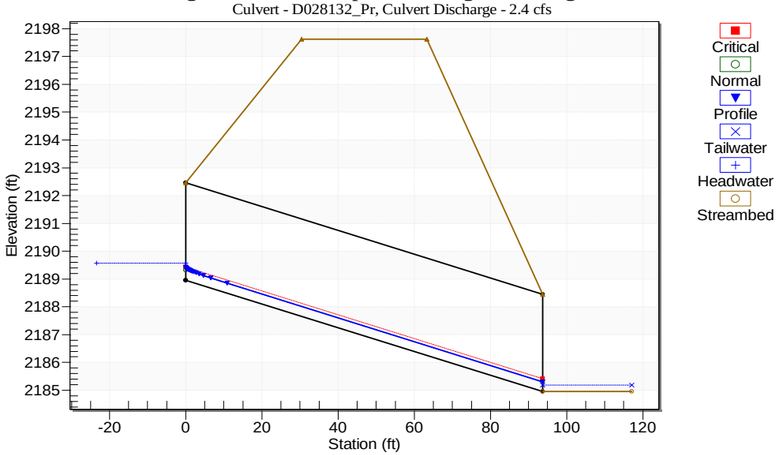
Crossing - D028132_Ex, Design Discharge - 2.2 cfs



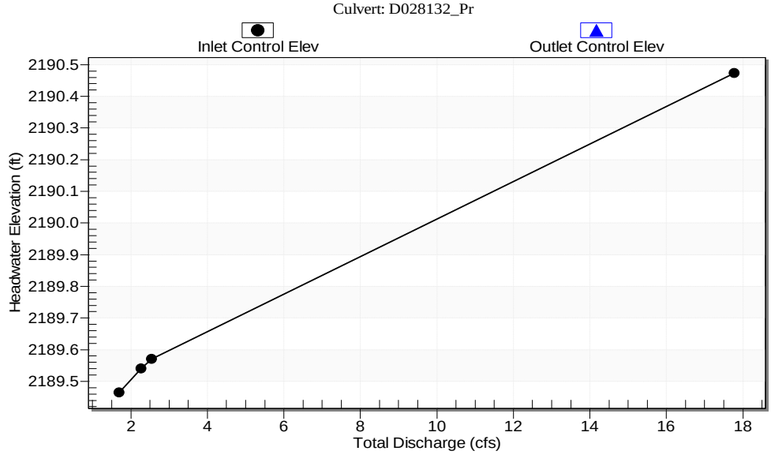
Performance Curve



Crossing - D028132_Proposed, Design Discharge - 2.4 cfs



Performance Curve



	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	REPLACEMENT	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Existing Barrel 2	1.5	CMP	94	Headwall Non Engr	Projecting	2189.43	2185.50	4.18%	2197.67	2196.4	5.7	8.4	Q10	1.69	0.11	2189.59	0.16	-3.81	1-S2n	0.1	0.12	0.1	0.09	2.1	0.45	0.11	PASS	PASS	PASS	PASS	PASS
													Q50	2.27	0.25	2189.67	0.24	-3.74	1-S2n	0.15	0.19	0.15	0.11	2.69	0.5	0.16	PASS	PASS	PASS	PASS	PASS
													Q100	2.54	0.33	2189.71	0.28	-3.71	1-S2n	0.17	0.21	0.17	0.12	2.93	0.52	0.19	PASS	PASS	PASS	PASS	PASS

OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

REPAIR

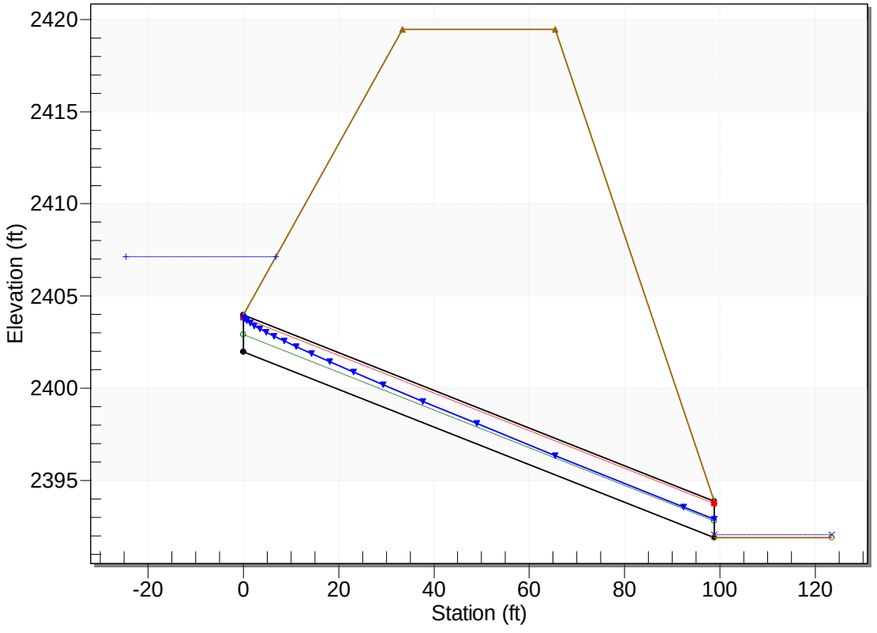
Culvert Name D028137 MP 49.41
Modeled By YH,PD
Date 10/22/2020

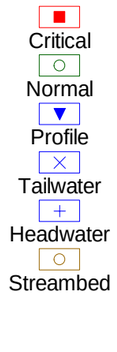
Note: Pipe cover measured from top of pipe to bottom of sub-base

	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Existing Pipe	2.0	Conc	98.83	Projecting	Projecting	2401.97	2391.88	10.21%	2419.48	2419.81	13.3	23.7	Q10	19.45	19.45	2404.46	2.49	-6.96	5-S2n	0.68	1.59	0.71	0.12	19.33	5.45	1.25	PASS	PASS	PASS	PASS	PASS
													Q50	30.27	30.27	2406.2	4.23	-4.92	5-S2n	0.86	1.87	0.92	0.16	21.49	6.48	2.12	FAIL	PASS	PASS	PASS	PASS
													Q100	34.73	34.73	2407.14	5.17	-3.9	5-S2n	0.93	1.86	1	0.18	22.03	6.84	2.59	FAIL	PASS	PASS	PASS	PASS

Crossing - D028137_Ex, Design Discharge - 34.7 cfs

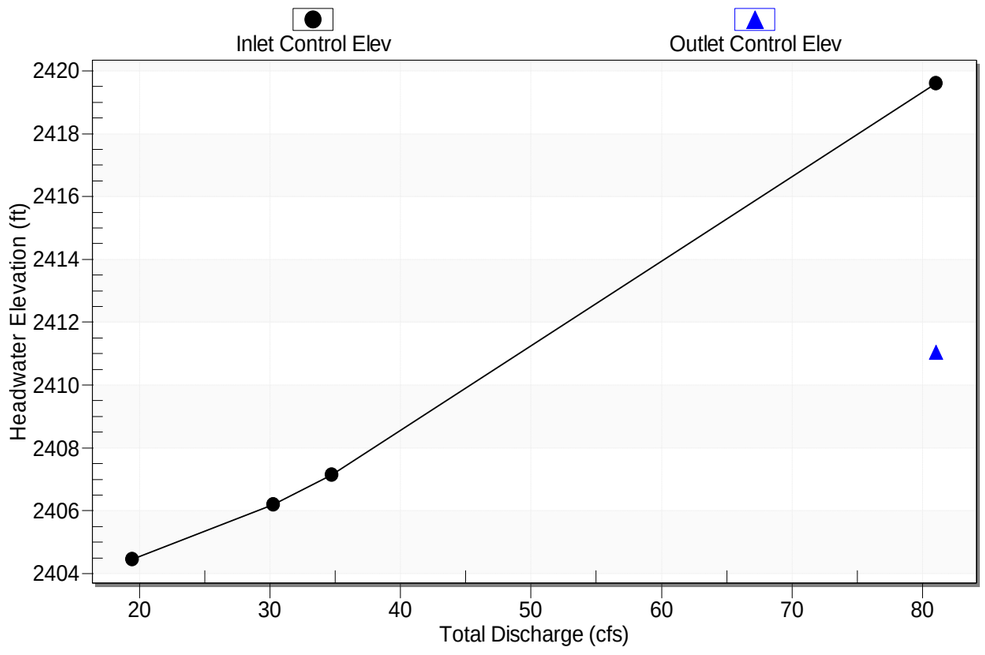
Culvert - D028137_Ex, Culvert Discharge - 34.7 cfs





Performance Curve

Culvert: D028137_Ex



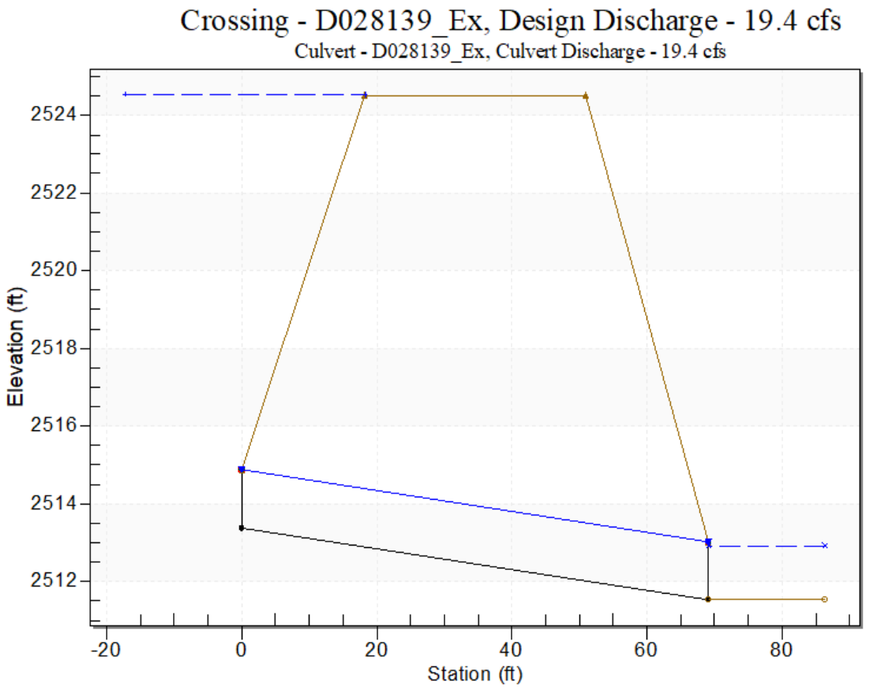
OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

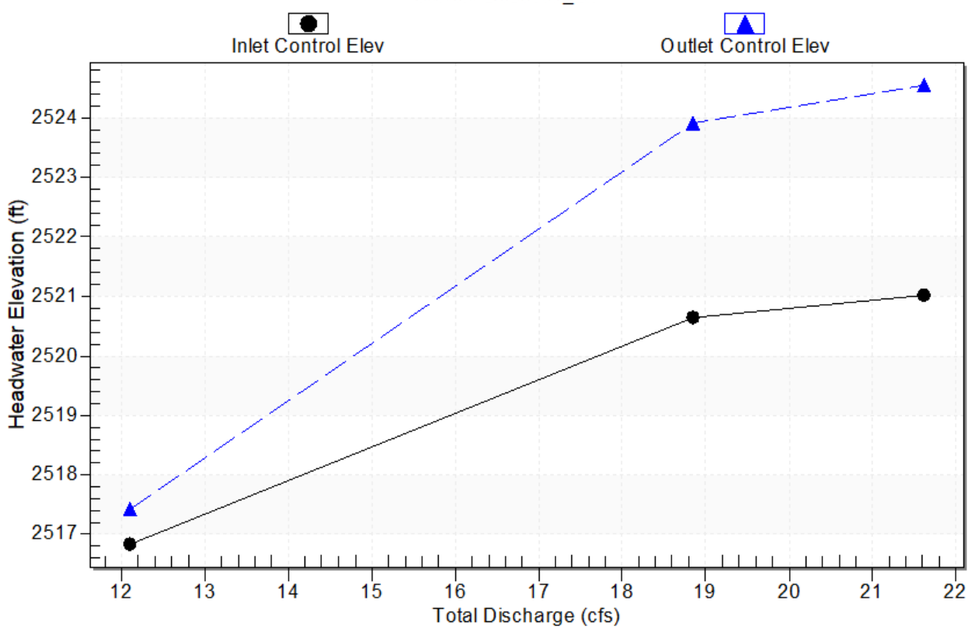
REPAIR

Culvert Name D028139 MP 49.99
Modeled By YH,PD
Date 10/22/2020

Note: Pipe cover measured from top of pipe to bottom of sub-base

	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Existing Pipe	1.5	CMP	69.06	Projecting	Projecting	2513.38	2511.52	2.69%	2524.51	2524.3	7.6	9.3	Q10	12.1	12.1	2517.41	3.45	4.03	7-M2c	1.5	1.32	1.32	1.13	7.35	0.68	2.69	FAIL	PASS	PASS	PASS	PASS
													Q50	18.85	18.85	2523.92	7.26	10.54	6-FFc	1.5	1.5	1.5	1.33	10.67	0.76	7.03	FAIL	PASS	PASS	PASS	PASS
													Q100	21.62	19.39	2524.55	7.64	11.17	6-FFc	1.5	1.5	1.5	1.4	10.97	0.79	7.45	FAIL	OVERTOP	PASS	PASS	PASS





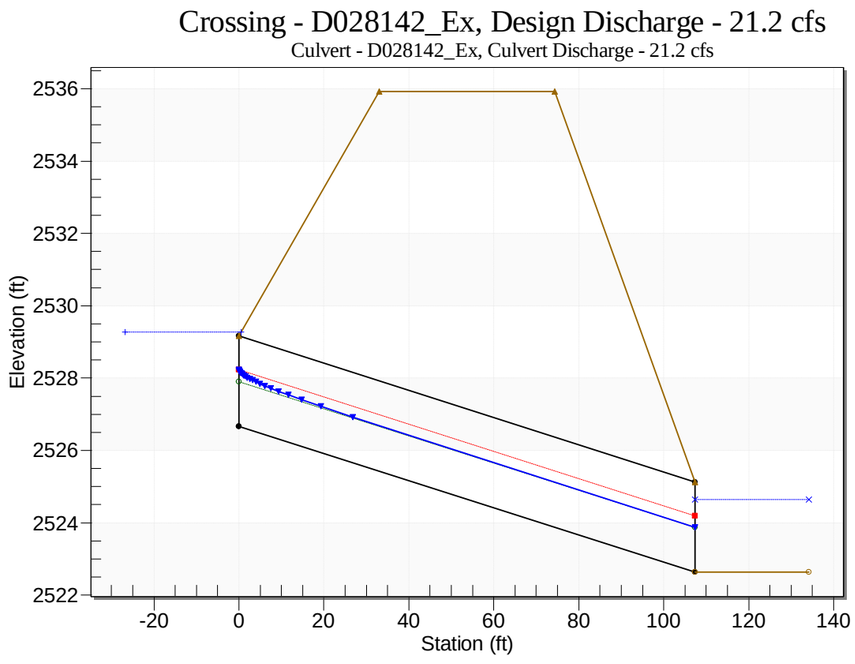
OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

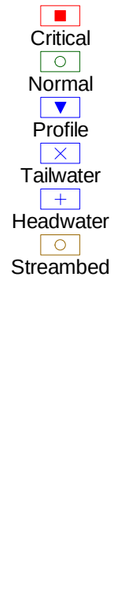
REPAIR

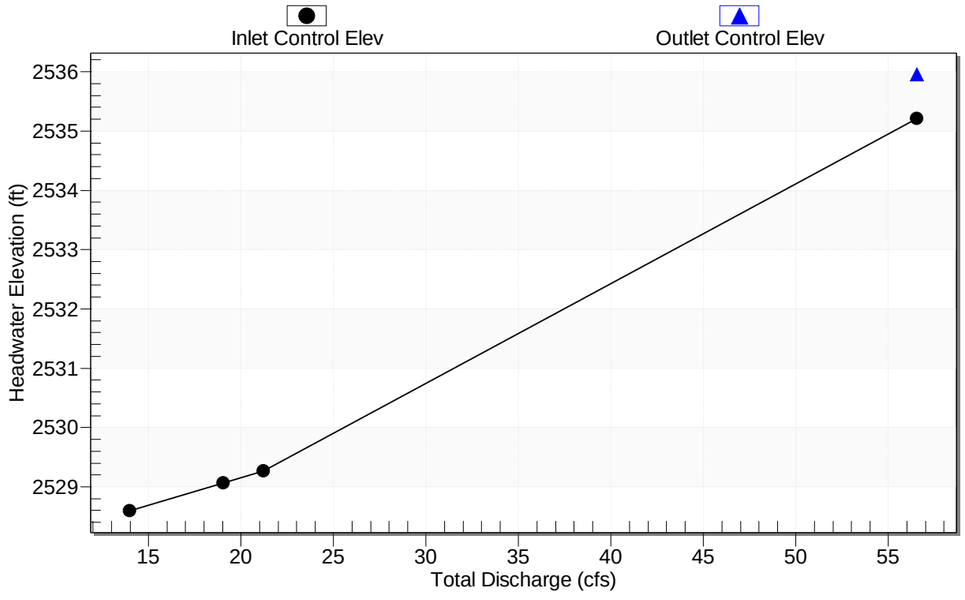
Culvert Name D028142 MP 50.30
Modeled By YH,PD
Date 10/22/2020

Note: Pipe cover measured from top of pipe to bottom of sub-base

	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Existing Pipe	2.5	CMP	107.37	Projecting	Projecting	2526.67	2522.63	3.76%	2535.93	2535.37	4.8	8.2	Q10	13.98	13.98	2528.6	1.93	-1.66	1-S2n	0.98	1.26	0.98	1.72	7.85	1.82	0.77	PASS	PASS	PASS	PASS	PASS
													Q50	19.05	19.05	2529.06	2.39	-0.88	1-S2n	1.16	1.48	1.16	1.93	8.52	1.97	0.96	PASS	PASS	PASS	PASS	PASS
													Q100	21.2	21.2	2529.27	2.6	-0.51	5-S2n	1.24	1.56	1.24	2.01	8.76	2.02	1.04	PASS	PASS	PASS	PASS	PASS







OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

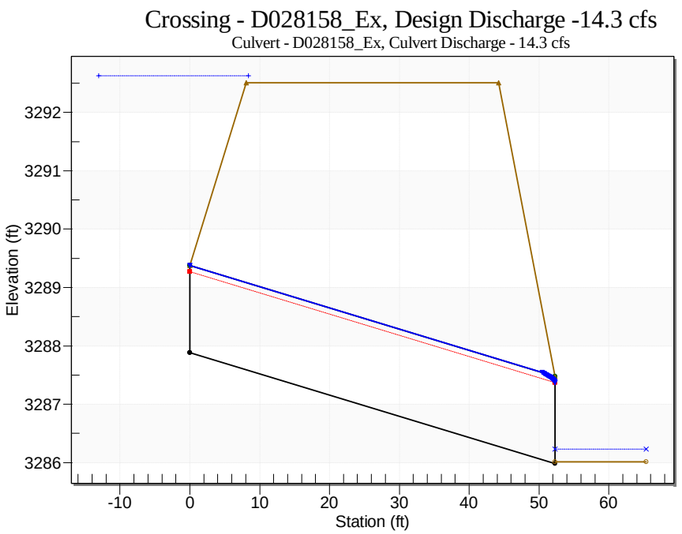
REPLACEMENT

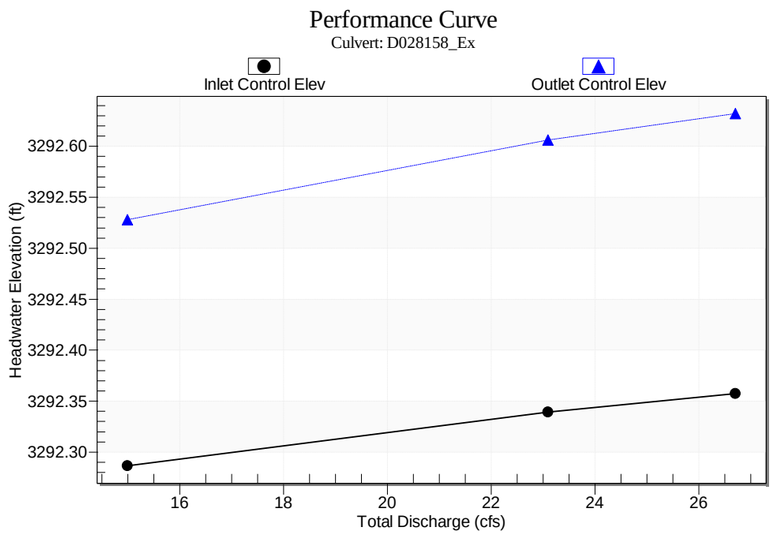
Culvert Name D028158 MP 53.56
Modeled By YH,PD
Date 10/22/2020

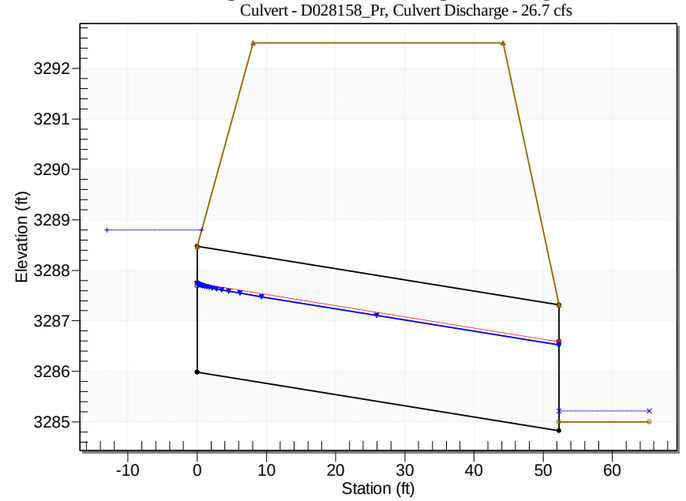
Note: Pipe cover measured from top of pipe to bottom of sub-base

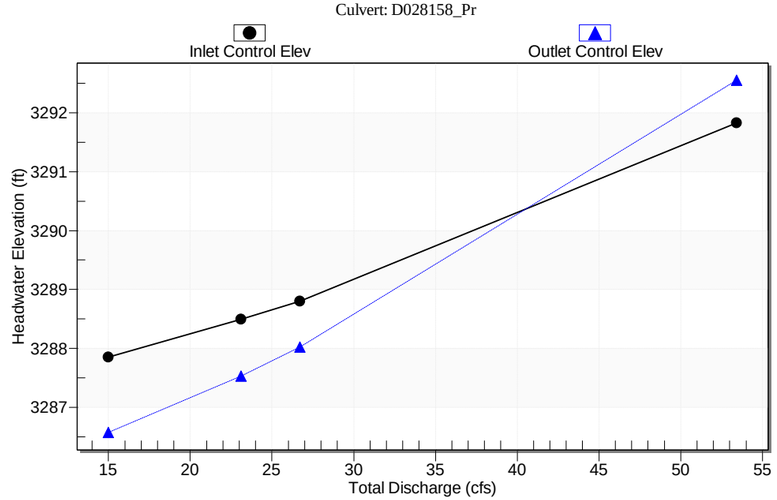
	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Existing Pipe	1.5	CMP	52.29	Projecting	Projecting	3287.88	3285.98	3.63%	3292.51	3292.46	0.9	2.8	Q10	14.99	12.61	3291.55	3.67~	3.55	7-M2c	1.5	1.34	1.34	0.15	7.58	1.63	2.45	FAIL	PASS	PASS	FAIL	PASS
													Q50	23.1	12.76	3291.62	3.74~	3.66	7-M2c	1.5	1.34	1.34	0.2	7.65	1.93	2.49	FAIL	PASS	PASS	FAIL	PASS
													Q100	26.71	12.81	3291.64	3.76~	3.69	7-M2c	1.5	1.34	1.34	0.22	7.67	2.04	2.51	FAIL	PASS	PASS	FAIL	PASS

	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Proposed	2.5	CMP	52.29	Drop Inlet	Mitered	3285.98	3284.82	2.22%	3292.51	3292.46	1.8	2.9	Q10	14.99	14.99	3287.85	1.87	0.6	1-S2n	1.18	1.31	1.18	0.15	6.59	1.63	0.75	PASS	PASS	PASS	PASS	PASS
													Q50	23.1	23.1	3288.49	2.51	1.55	5-S2n	1.54	1.64	1.54	0.2	7.3	1.93	1.00	PASS	PASS	PASS	PASS	PASS
													Q100	26.71	26.71	3288.8	2.82	2.04	5-S2n	1.7	1.76	1.7	0.22	7.51	2.04	1.13	PASS	PASS	PASS	PASS	PASS









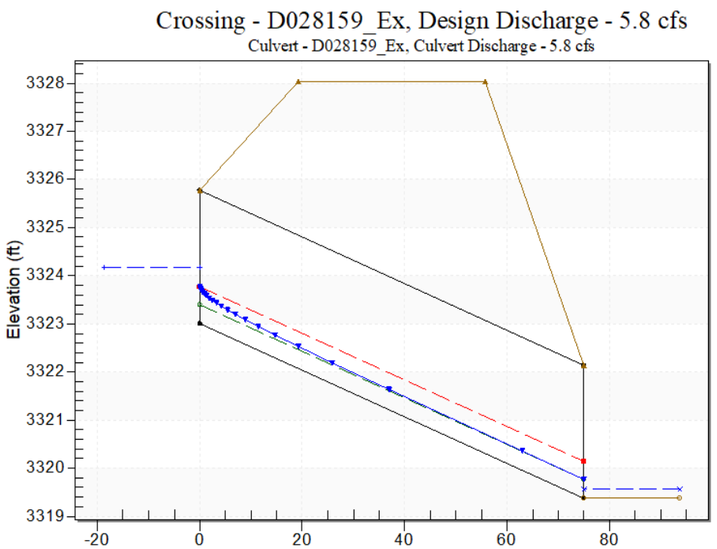
OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

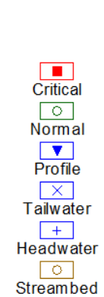
REPAIR

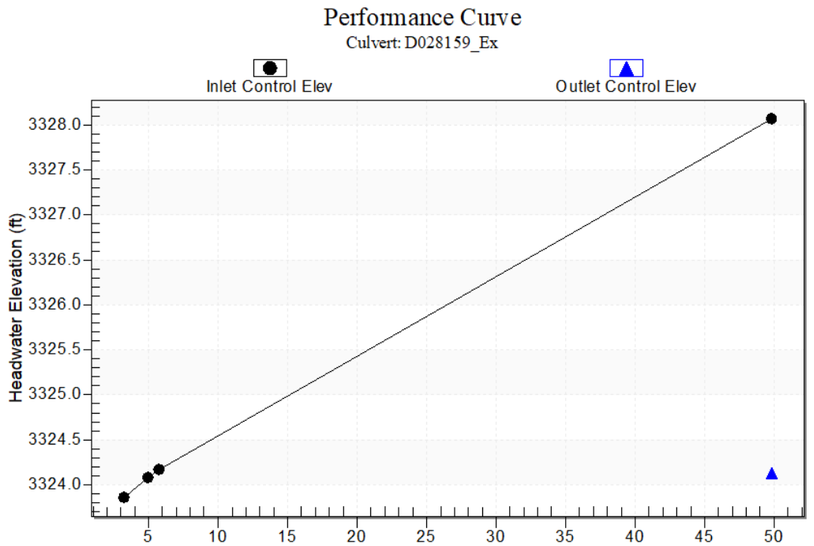
Culvert Name D028159 MP 53.69
Modeled By YH,PD
Date 10/22/2020

Note: Pipe cover measured from top of pipe to bottom of sub-base

	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Existing Pipe	2.7	Conc	75	Mitered	Projecting	3323	3319.37	4.84%	3328.04	3330.01	-0.1	5.5	Q10	3.22	3.22	3323.86	0.86	-3.05	1-S2n	0.3	0.57	0.3	0.14	9.09	5.73	0.32	PASS	PASS	PASS	FAIL	PASS
													Q50	4.96	4.96	3324.08	1.08	-2.89	1-S2n	0.37	0.71	0.37	0.18	10.19	6.74	0.41	PASS	PASS	PASS	FAIL	PASS
													Q100	5.75	5.75	3324.16	1.16	-2.83	1-S2n	0.4	0.77	0.4	0.19	10.8	7.13	0.44	PASS	PASS	PASS	FAIL	PASS







OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

REPAIR

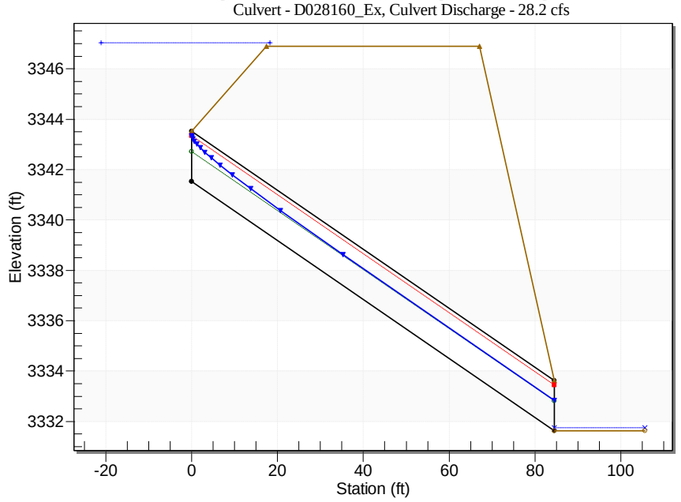
Culvert Name D028160 MP 53.76
Modeled By YH,PD
Date 10/22/2020

Note: Pipe cover measured from top of pipe to bottom of sub-base

	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Existing Pipe	2.0	CMP	84.5	Projecting	Projecting	3341.52	3331.62	11.72%	3346.89	3346.46	2.4	10.6	Q10	29.09	27.8	3346.91	5.39	-1.32	5-S2n	1.19	1.82	1.2	0.09	14.14	3.13	2.69	FAIL	OVERTOP	PASS	PASS	PASS
													Q50	40.78	28.11	3347.01	5.49	-1.17	5-S2n	1.2	1.83	1.21	0.11	14.09	3.58	2.75	FAIL	OVERTOP	PASS	PASS	PASS
													Q100	46.03	28.2	3347.04	5.52	-1.12	5-S2n	1.2	1.83	1.22	0.12	14.08	3.76	2.76	FAIL	OVERTOP	PASS	PASS	PASS

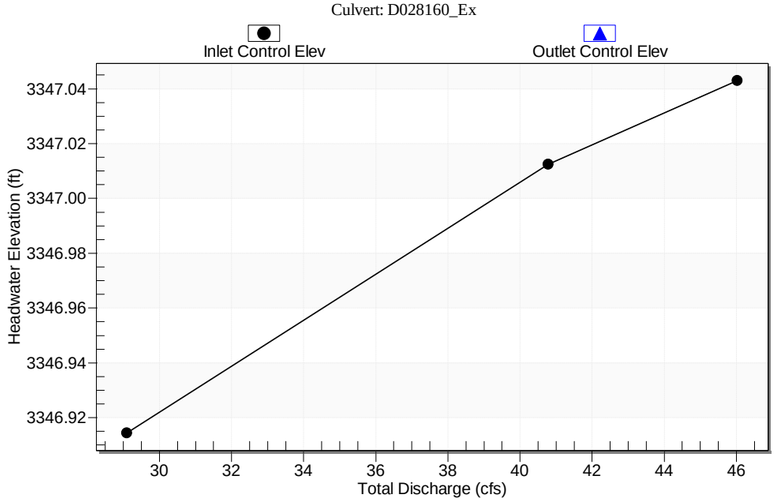
Crossing - D028160_Ex, Design Discharge - 28.2 cfs

Culvert - D028160_Ex, Culvert Discharge - 28.2 cfs



Performance Curve

Culvert: D028160_Ex



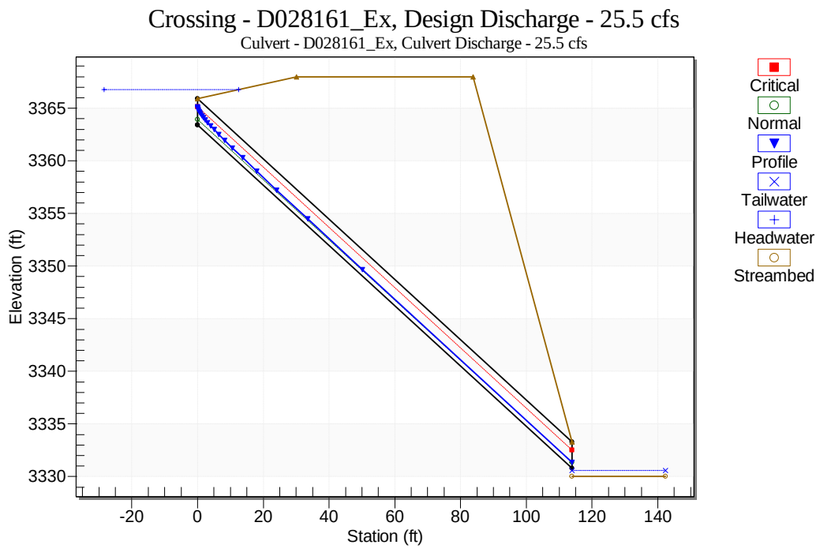
OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

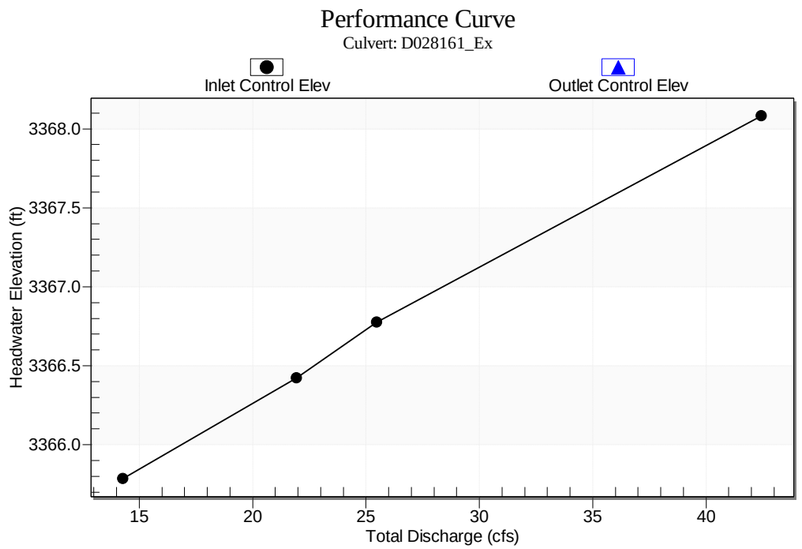
REPAIR

Culvert Name D028161 MP 53.83
Modeled By YH,PD
Date 10/22/2020

Note: Pipe cover measured from top of pipe to bottom of sub-base

	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverChec k Outlet
Existing Pipe	2.5	Conc	113.9	Mitered	Projecting	3358.84	3330.81	24.61%	3368	3363.97	4.2	28.2	Q10	14.27	14.27	3365.79	2.39	-30.97	1-S2n	0.41	1.27	0.41	0.41	26.75	6.45	2.78	FAIL	PASS	PASS	PASS	PASS
													Q50	21.93	21.93	3366.42	3.02	-30.18	5-S2n	0.51	1.59	0.54	0.52	28.03	7.43	3.03	FAIL	PASS	PASS	PASS	PASS
													Q100	25.47	25.47	3366.78	3.38	-29.77	5-S2n	0.55	1.72	0.55	0.57	31.68	7.79	3.18	FAIL	PASS	PASS	PASS	PASS





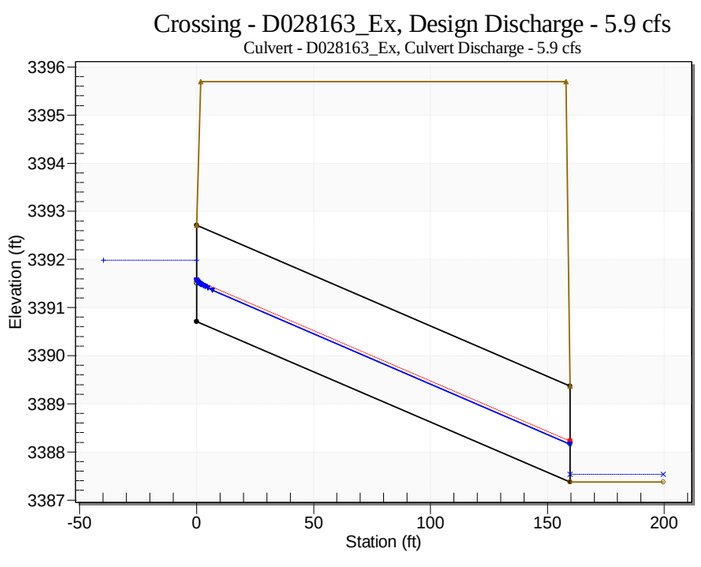
OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

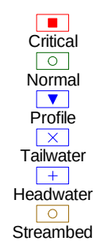
REPAIR

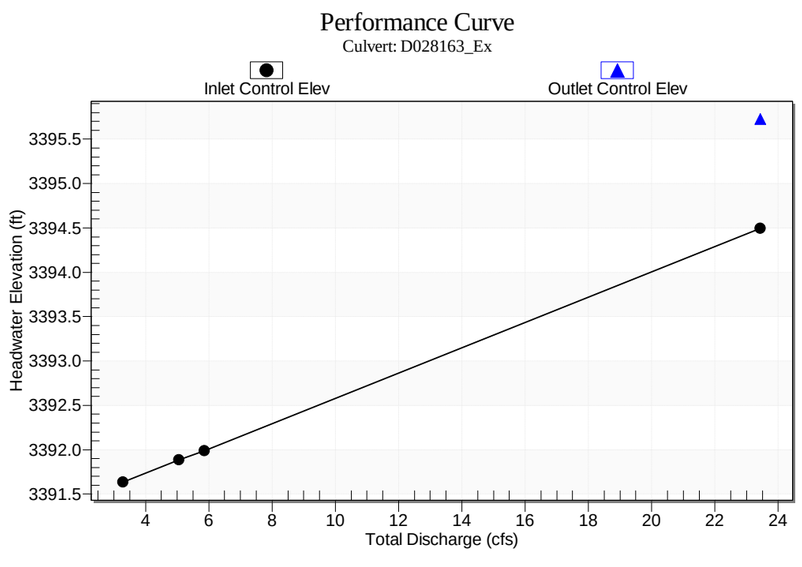
Culvert Name D028163 MP 53.95
Modeled By YH,PD
Date 10/22/2020

Note: Pipe cover measured from top of pipe to bottom of sub-base

	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Existing Pipe	2.0	CMP	159.7	Mitered	Projecting	3390.71	3387.37	2.09%	3396.36	3396.36	1.5	4.8	Q10	3.28	3.28	3391.64	0.93	-2.56	1-S2n	0.58	0.63	0.58	0.12	4.32	0.46	0.46	PASS	PASS	PASS	PASS	PASS
													Q50	5.05	5.05	3391.89	1.18	-2.21	1-S2n	0.73	0.79	0.73	0.15	4.87	0.55	0.59	PASS	PASS	PASS	PASS	PASS
													Q100	5.86	5.86	3391.99	1.28	-2.03	1-S2n	0.79	0.86	0.79	0.17	5.07	0.59	0.64	PASS	PASS	PASS	PASS	PASS







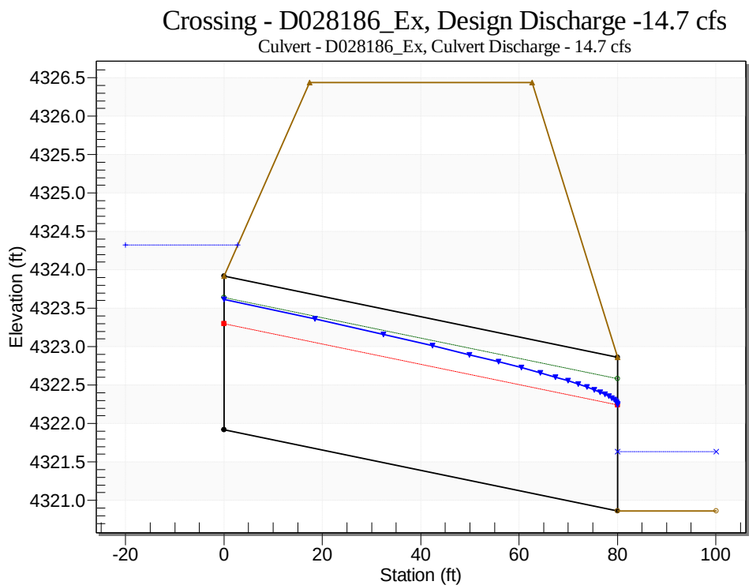
OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

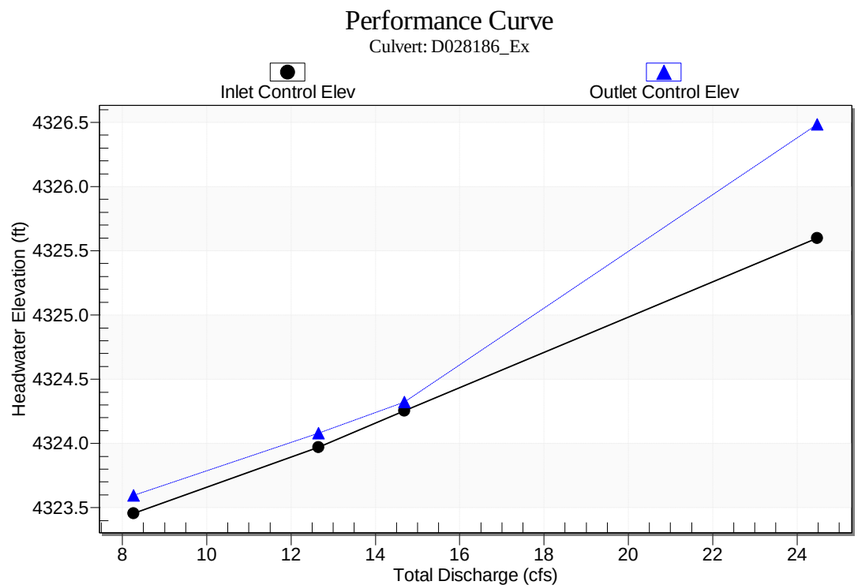
REPAIR

Culvert Name D028186 MP 57.77
Modeled By YH,PD
Date 10/22/2020

Note: Pipe cover measured from top of pipe to bottom of sub-base

	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)		Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Existing Pipe	2.0	CMP	80.05	Mitered	Projecting	4321.92	4320.86	1.32%	4326.44	4328.66	0.5	3.8	Q10	8.26	8.26	4323.6	1.54	1.68	2-M2c	1.1	1.02	1.02	0.56	5.1	1.02	0.84	PASS	PASS	PASS	FAIL	PASS
													Q50	12.65	12.65	4324.08	2.05	2.16	7-M2c	1.48	1.28	1.28	0.71	5.96	1.18	1.08	PASS	PASS	PASS	FAIL	PASS
													Q100	14.69	14.69	4324.32	2.34	2.4	7-M2c	1.72	1.38	1.38	0.78	6.35	1.24	1.20	PASS	PASS	PASS	FAIL	PASS





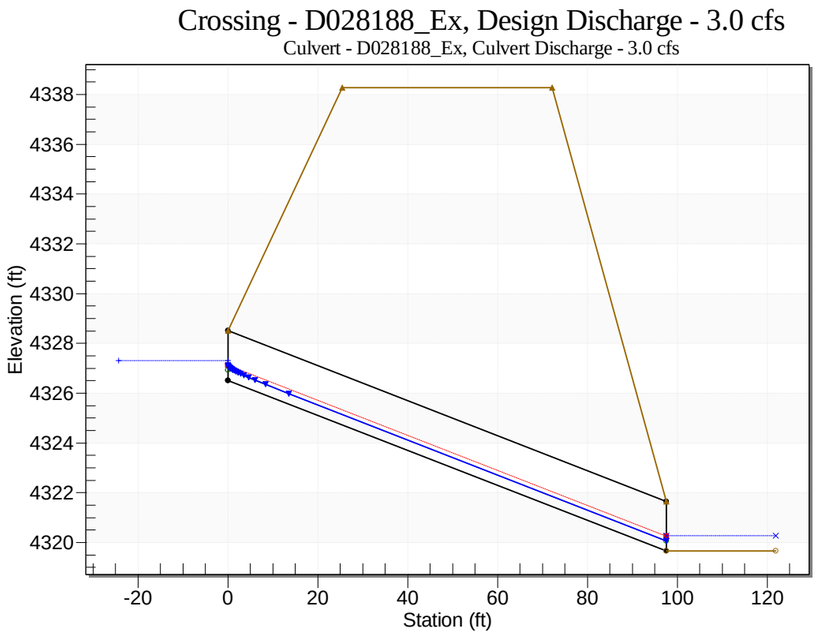
OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

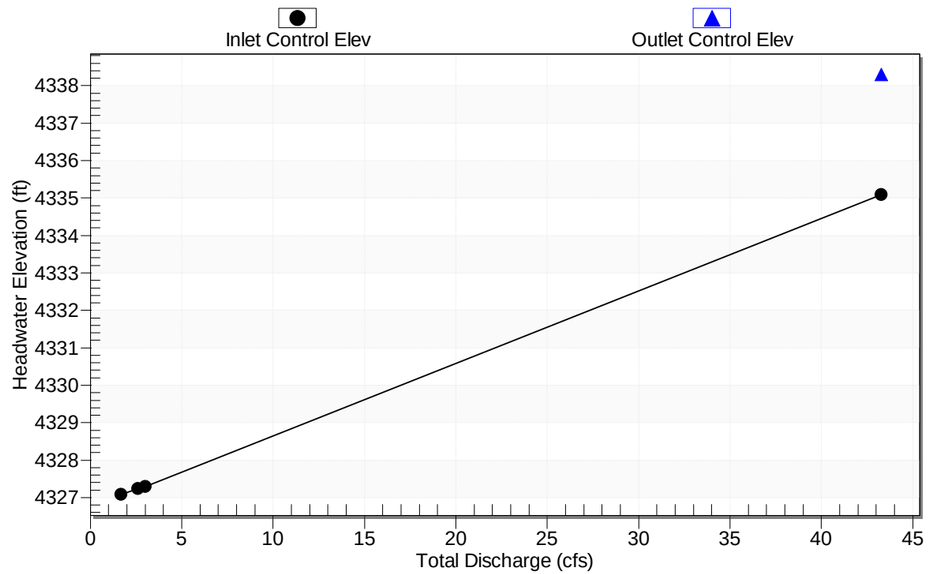
REPAIR

Culvert Name D028188 MP 57.96
Modeled By YH,PD
Date 10/22/2020

Note: Pipe cover measured from top of pipe to bottom of sub-base

	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Existing Pipe	2.0	CMP	97.54	Drop Inlet	Projecting	4326.51	4319.65	7.03%	4338.28	4335.14	7.7	11.4	Q10	1.69	1.69	4327.09	0.58	-6.38	1-S2n	0.31	0.45	0.31	0.45	5.46	1.69	0.29	PASS	PASS	PASS	PASS	PASS
													Q50	2.61	2.61	4327.24	0.73	-6.22	1-S2n	0.38	0.56	0.38	0.58	6.22	1.92	0.36	PASS	PASS	PASS	PASS	PASS
													Q100	3.02	3.02	4327.3	0.79	-6.15	1-S2n	0.41	0.61	0.41	0.63	6.48	2	0.39	PASS	PASS	PASS	PASS	PASS





OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

REPAIR

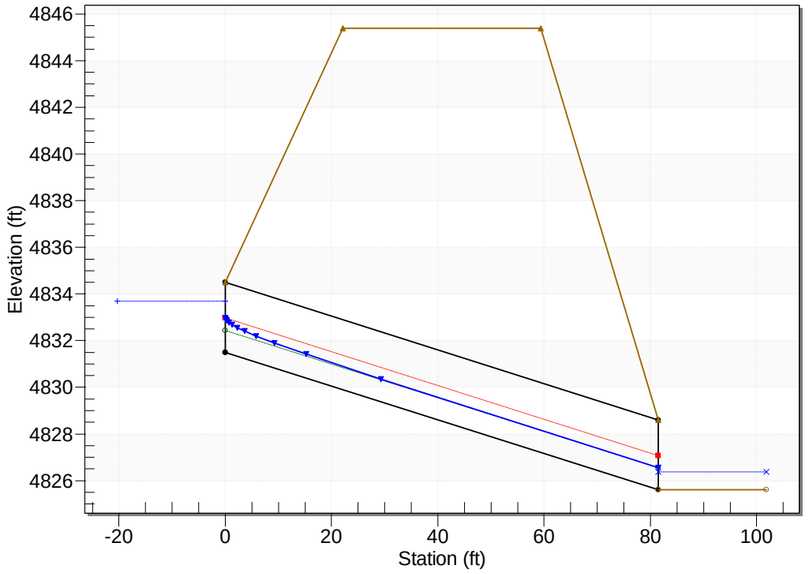
Culvert Name D028238 MP 64.27
Modeled By YH,PD
Date 10/22/2020

Note: Pipe cover measured from top of pipe to bottom of sub-base

Existing Pipe	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
	3.0	CMP	81.48	Project	Project	4831.5	4825.6	7.24%	4845.4	4844.06	8.8	13.4	Q10	13.97	13.97	4833.19	1.69	-4.47	1-S2n	0.77	1.19	0.77	0.61	9.79	2.54	0.56	PASS	PASS	PASS	PASS	PASS
													Q50	18.71	18.71	4833.53	2.03	-4.09	1-S2n	0.89	1.39	0.89	0.72	10.64	2.81	0.68	PASS	PASS	PASS	PASS	PASS
													Q100	20.94	20.94	4833.69	2.19	-3.9	1-S2n	0.94	1.47	0.94	0.77	10.99	2.91	0.73	PASS	PASS	PASS	PASS	PASS

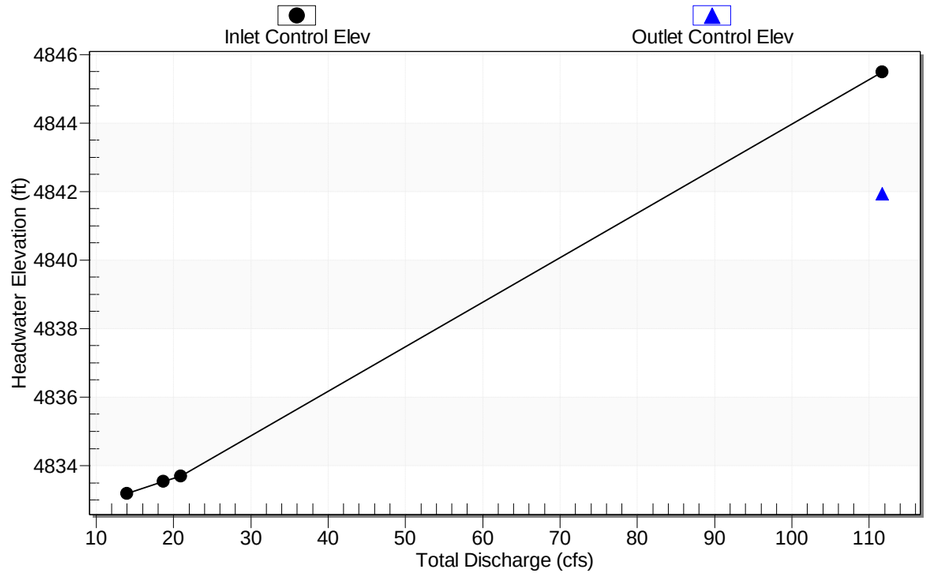
Crossing - D028238_Ex, Design Discharge - 20.9 cfs

Culvert - D028238_Ex, Culvert Discharge - 20.9 cfs



Performance Curve

Culvert: D028238_Ex



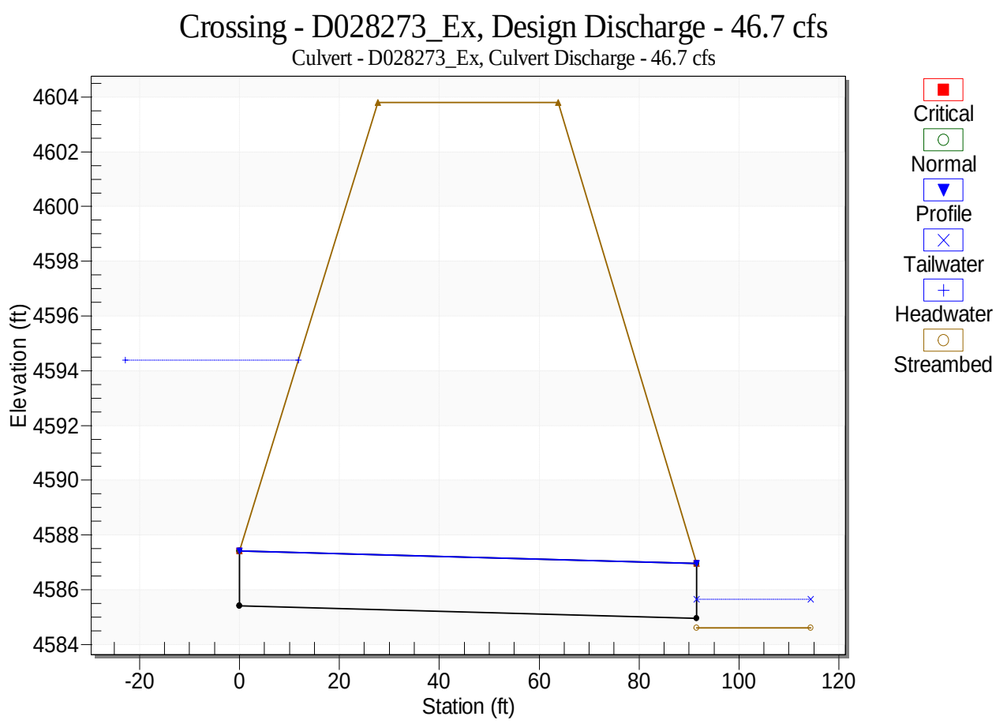
OR DOT 18(2), OR-58 FIX-IT CORRIDOR CULVERTS
SUMMARY OF PRELIMINARY HYDRAULIC RESULTS AND IMPROVEMENT STRATEGY

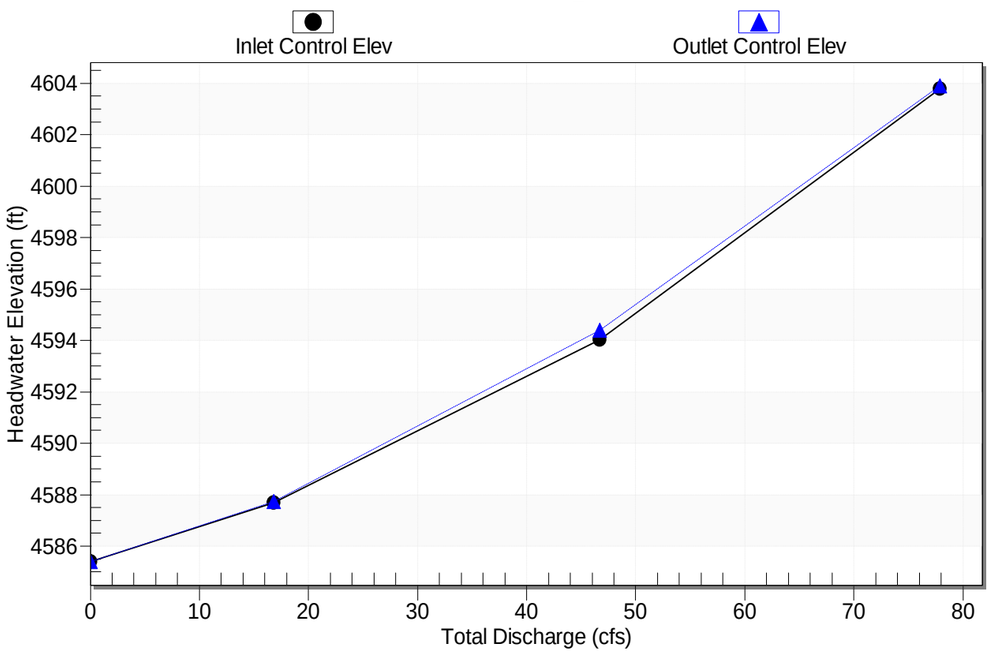
REPAIR

Culvert Name D028273 MP 84.68
Modeled By YH,PD
Date 10/22/2020

Note: Pipe cover measured from top of pipe to bottom of sub-base

	Pipe Size (ft)	Material	Length (ft)	Inlet End Treatment	Outlet End Treatment	Inlet Invert (ft)	Outlet Invert (ft)	Slope (ft/ft)	Inlet Road Elev (ft)	Outlet Road Elev (ft)	Inlet Cover (ft)	Outlet Cover (ft)	Storm	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)	HW/D	HW/D Criteria	Road Overtop	Slope Check	Cover Check Inlet	CoverCheck Outlet
Existing Pipe	2.0	Conc	91.52	Project	Project	4585.41	4584.96	0.49%	4603.73	4603.81	14.0	14.5	Q10	0	0	4585.41	0	0	0-NF	0	0	0	0	0	0	0.00	PASS	PASS	FAIL	PASS	PASS
													Q50	16.84	16.84	4587.74	2.29	2.33	7-M2c	1.6	1.48	1.48	0.58	6.76	0.71	1.16	PASS	PASS	FAIL	PASS	PASS
													Q100	46.72	46.72	4594.39	8.63	8.98	6-FFc	2	2	2	1.06	14.87	1.04	4.49	FAIL	PASS	FAIL	PASS	PASS





APPENDIX

K WATER QUALITY TREATMENT

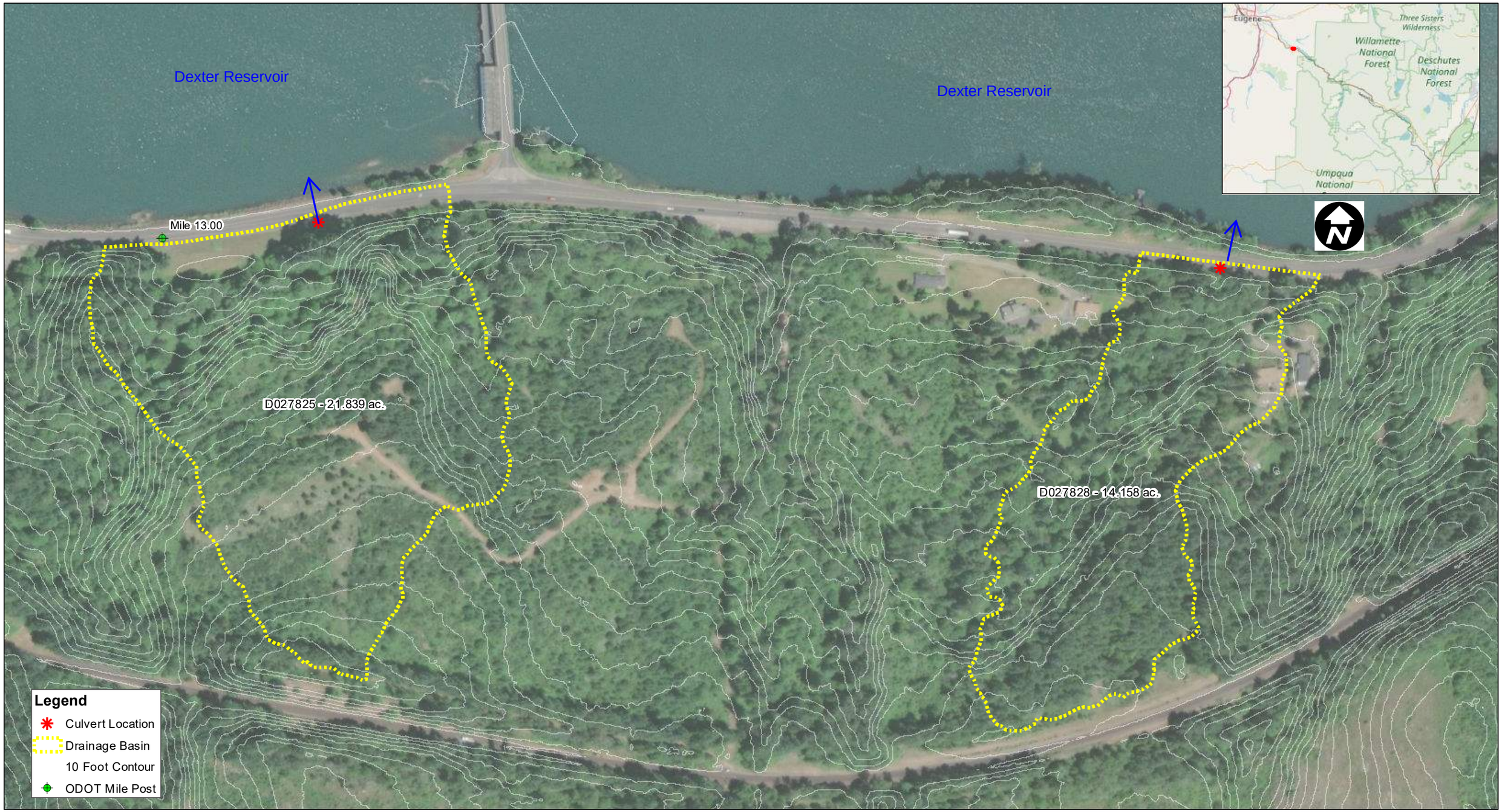


Figure 2: Drainage Basins

Federal Highway Administration/
Western Federal Lands Division

Oregon Department of Transportation

OR DOT 18(2) OR-58 Fix-It Corridor Culverts

0 125 250 500 750 1,000
Feet

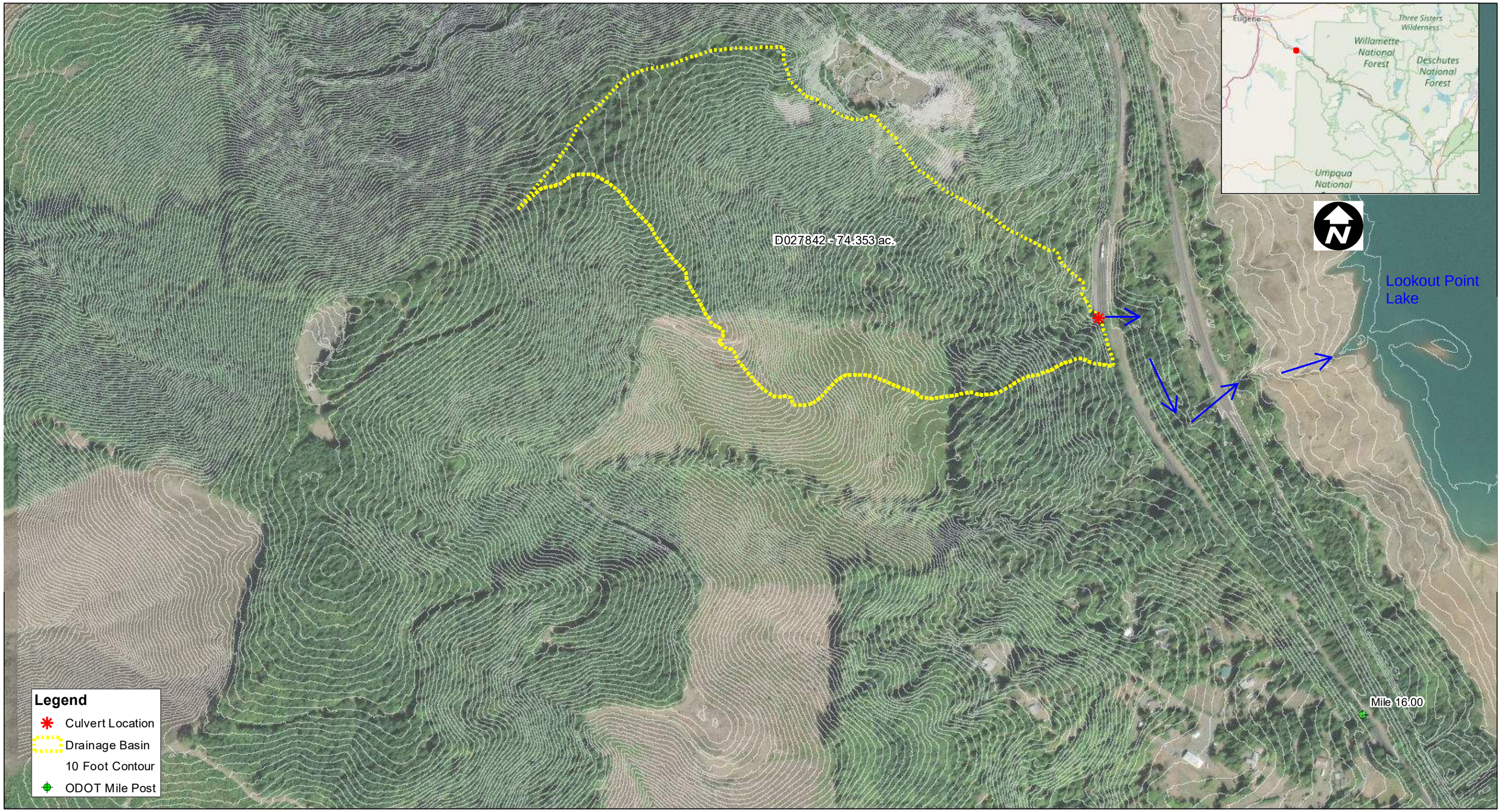


Figure 2: Drainage Basins

Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR DOT 18(2) OR-58 Fix-It Corridor Culverts

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

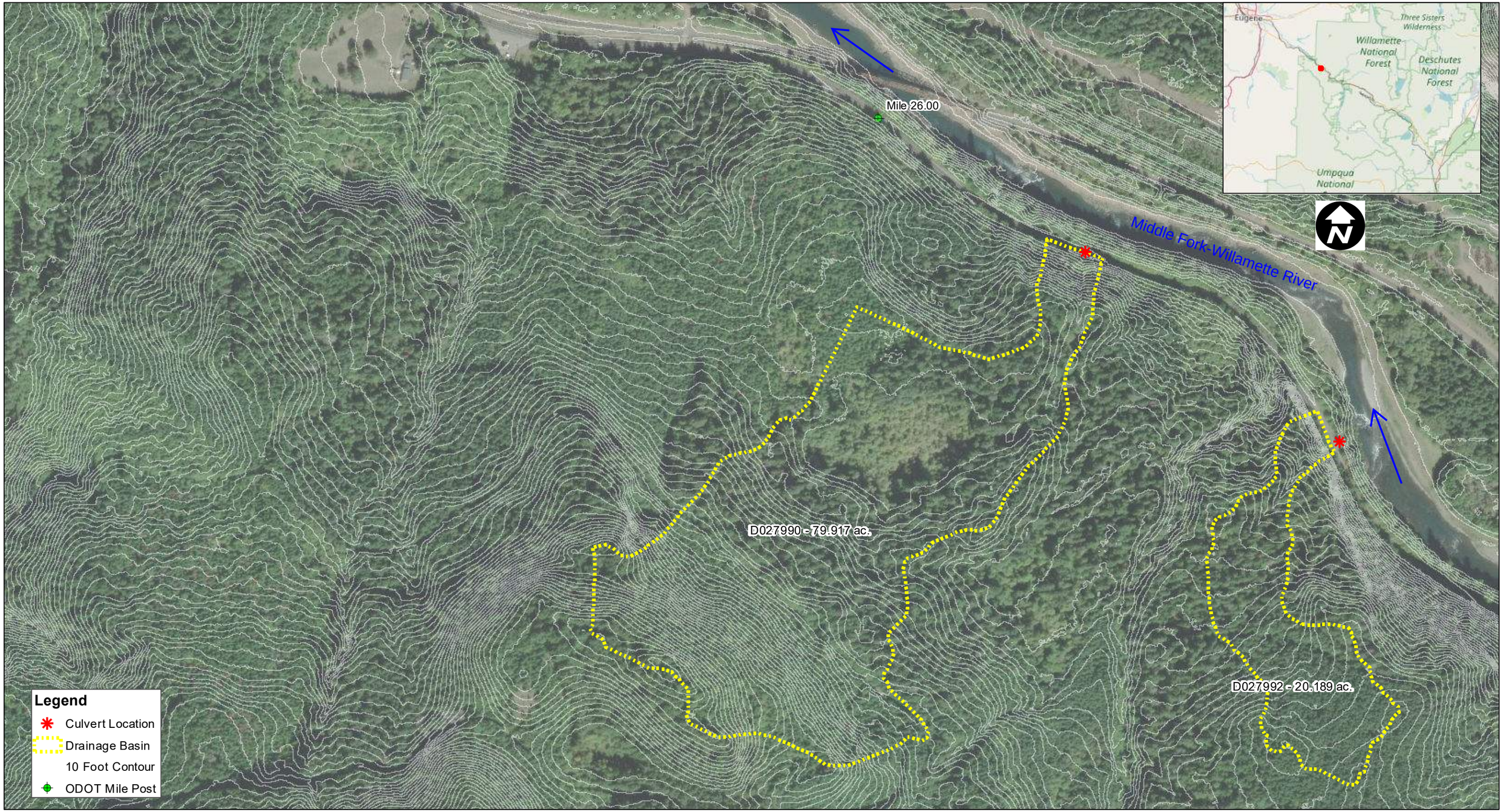


Figure 2: Drainage Basins

Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR DOT 18(2) OR-58 Fix-It Corridor Culverts

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

WSP

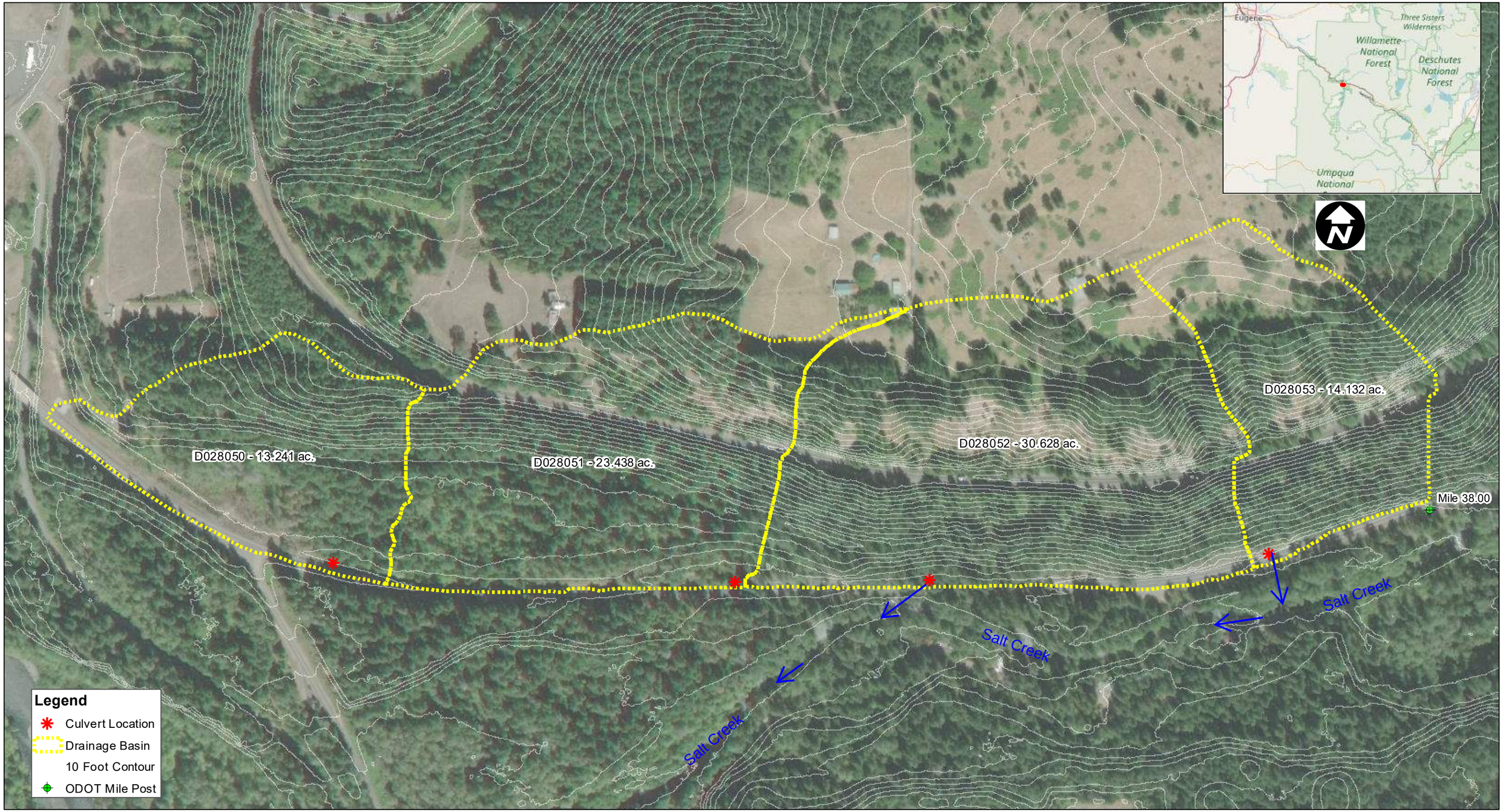


Figure 2: Drainage Basins

Federal Highway Administration/
Western Federal Lands Division

Oregon Department of Transportation

OR DOT 18(2) OR-58 Fix-It Corridor Culverts

0 150 300 600 900 1,200
Feet

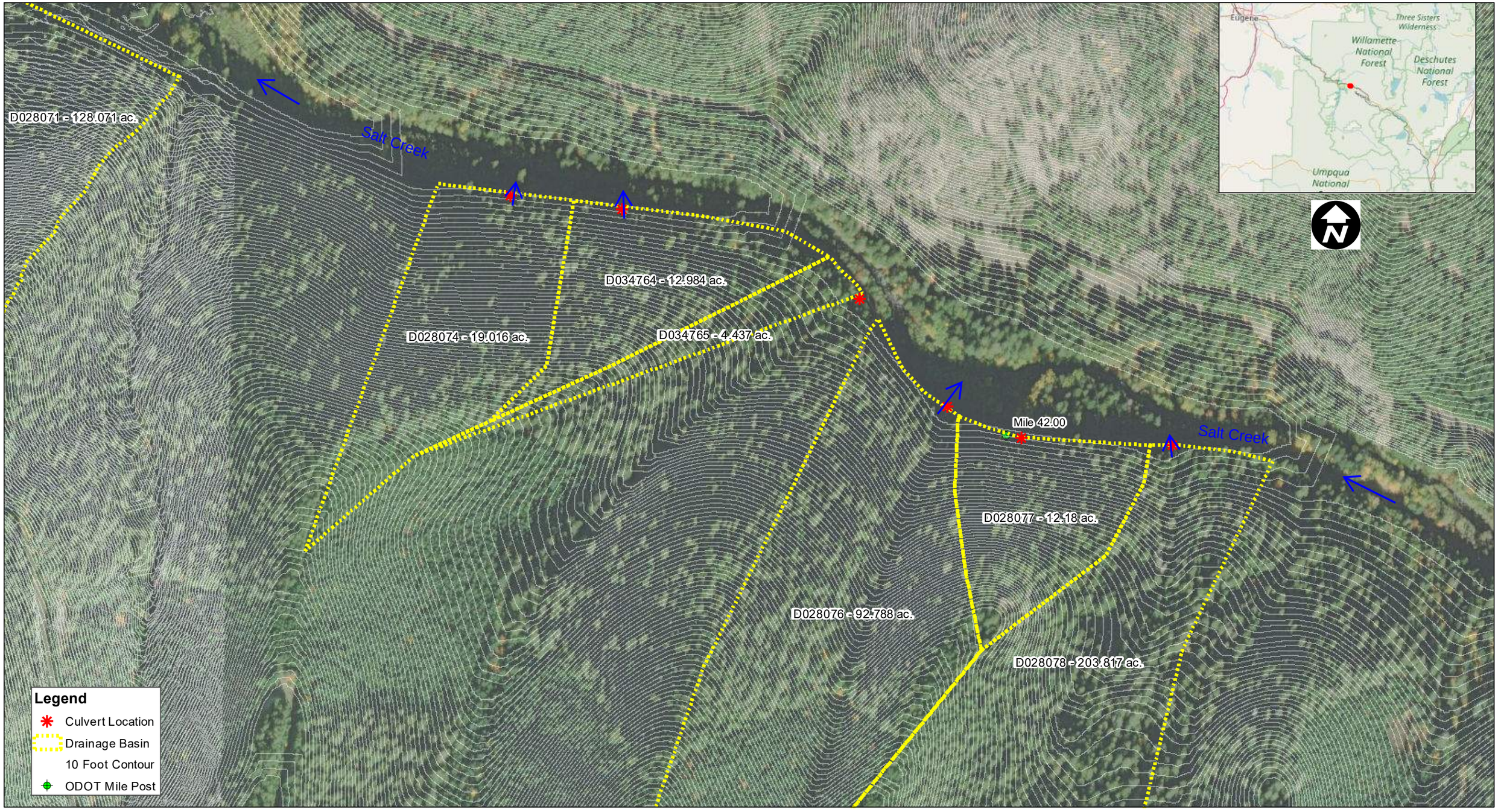


Figure 2: Drainage Basins

Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR DOT 18(2) OR-58 Fix-It Corridor Culverts

0 200 400 800 1,200 1,600 Feet

wsp

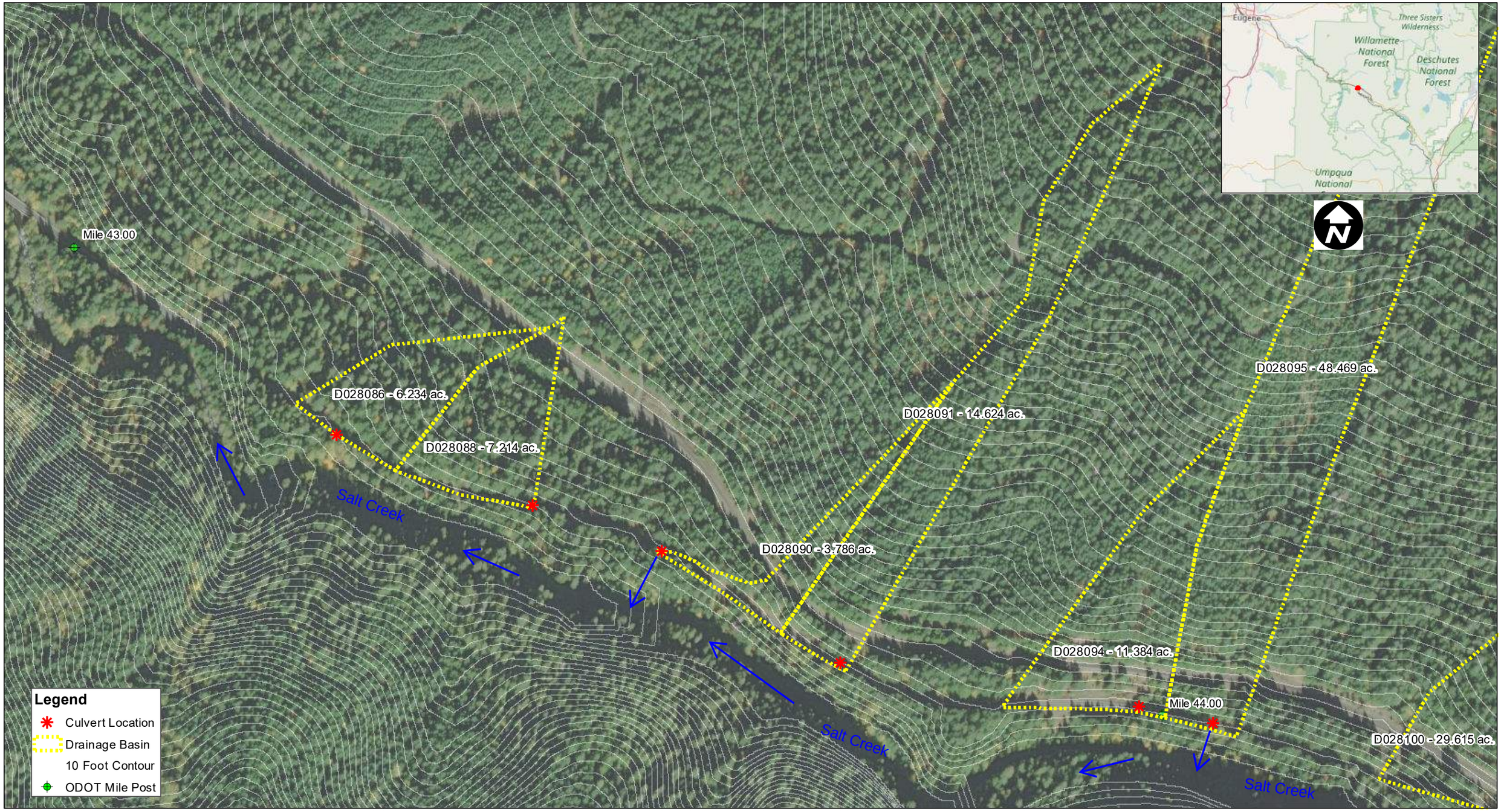


Figure 2: Drainage Basins

Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR DOT 18(2) OR-58 Fix-It Corridor Culverts

0 200 400 800 1,200 1,600 Feet

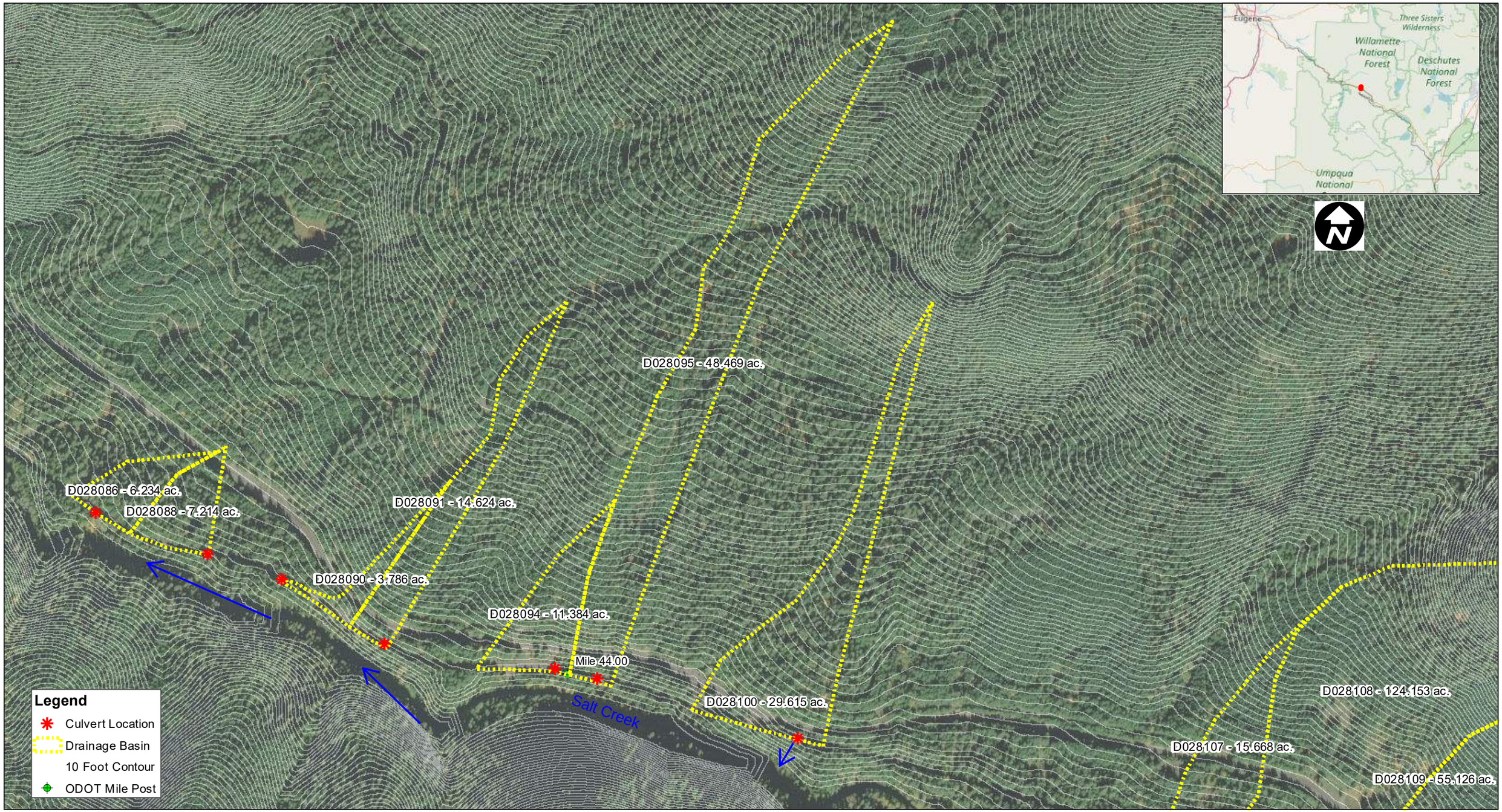


Figure 2: Drainage Basins

Federal Highway Administration/
Western Federal Lands Division

Oregon Department of Transportation

OR DOT 18(2) OR-58 Fix-It Corridor Culverts

0 350 700 1,400 2,100 2,800
Feet

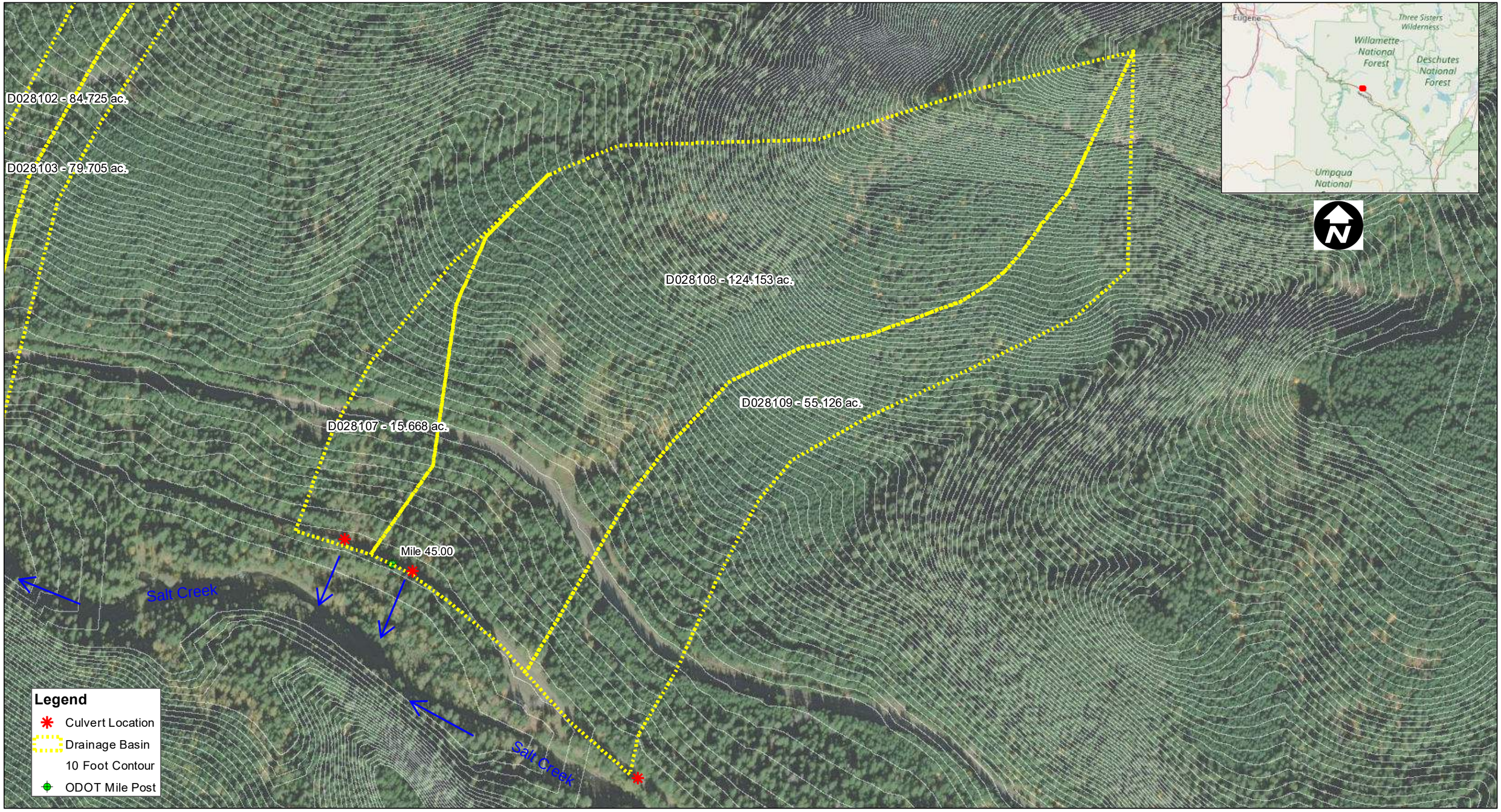


Figure 2: Drainage Basins

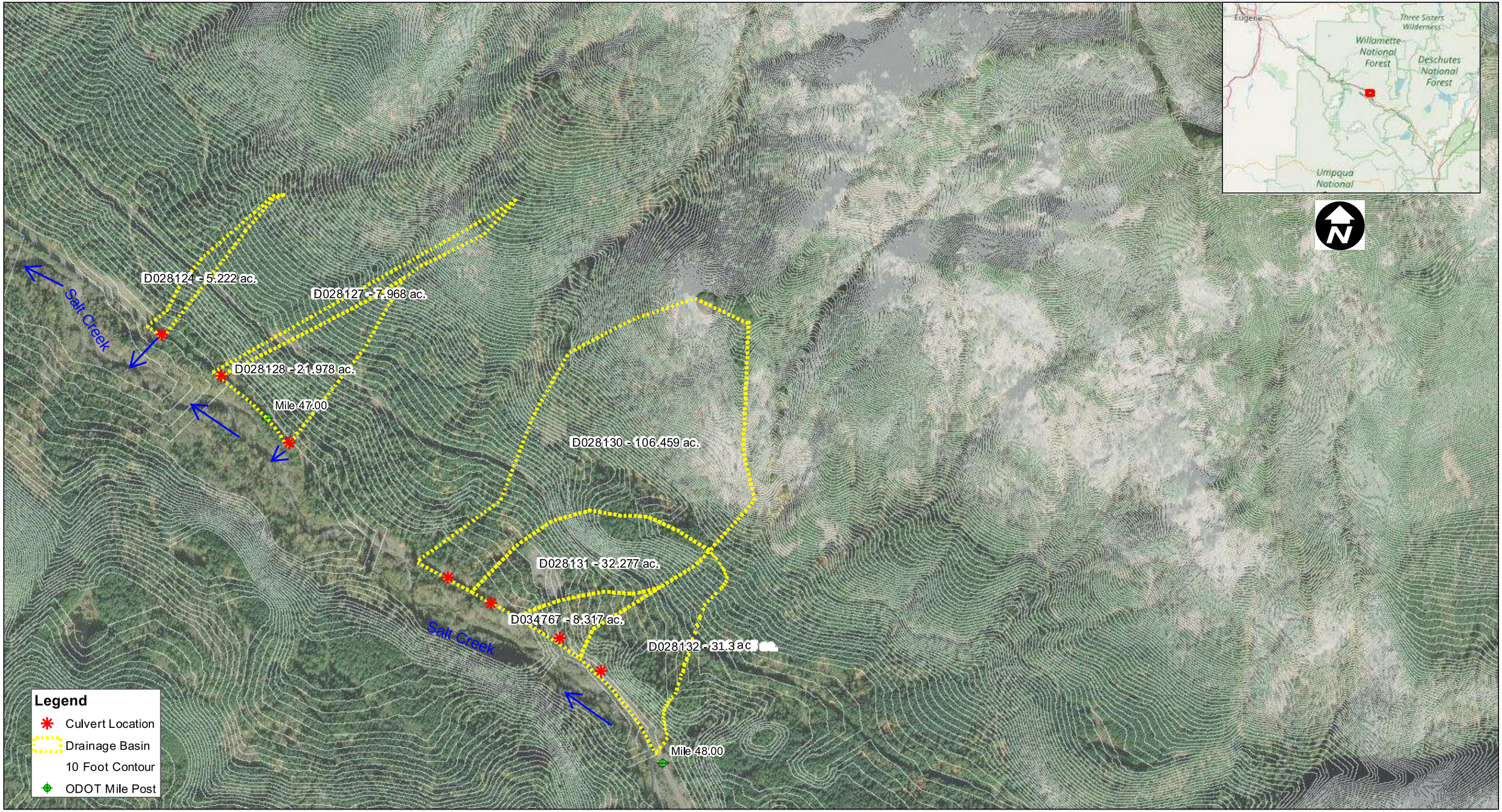
Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR DOT 18(2) OR-58 Fix-It Corridor Culverts

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

wsp



Federal Highway Administration/
Western Federal Lands Division

Oregon Department of Transportation

OR DOT 18(2) OR-58 Fix-It Corridor Culverts

0 450 900 1,800 2,700 3,600 Feet

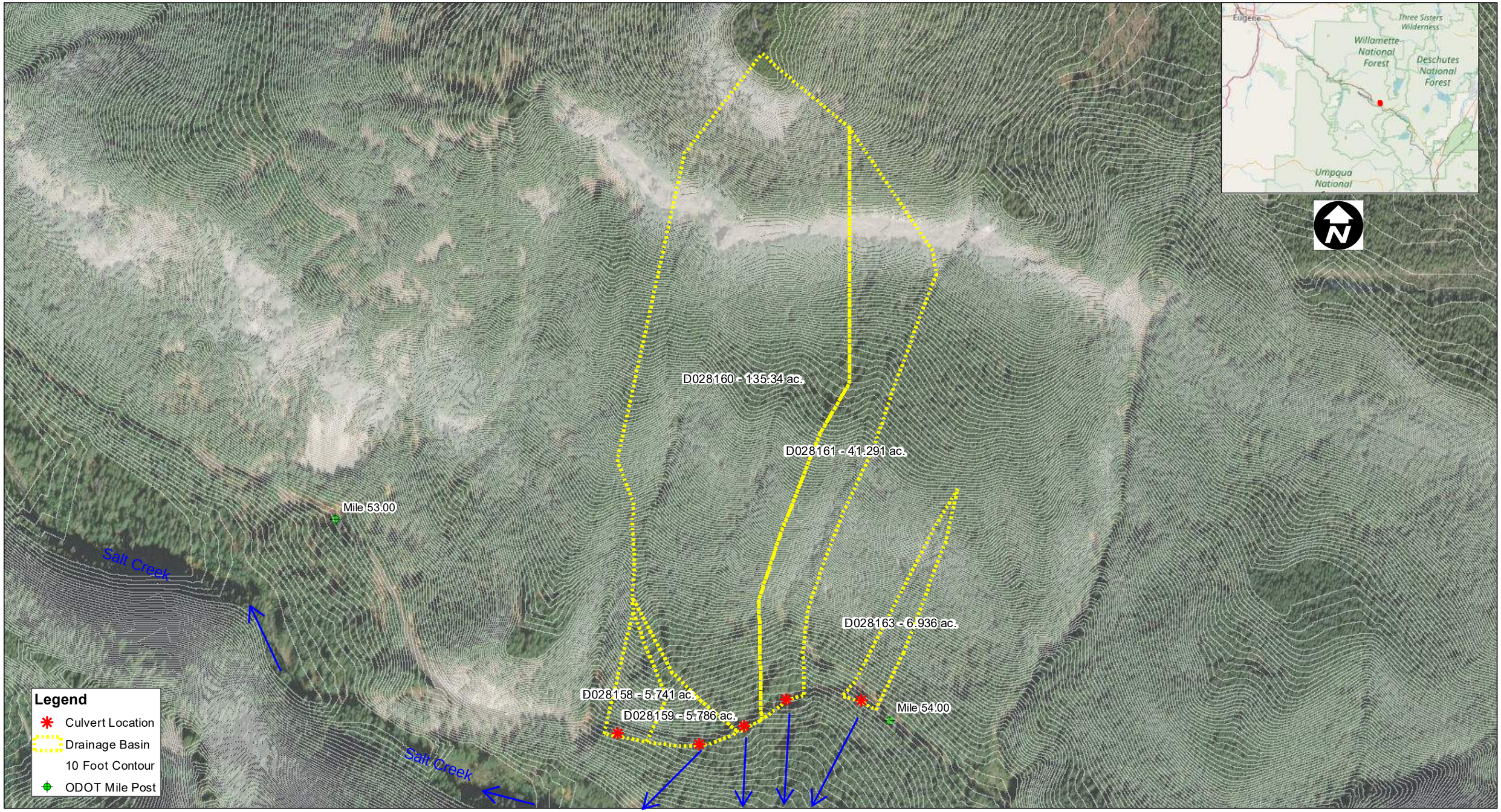


Figure 2: Drainage Basins

Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR DOT 18(2) OR-58 Fix-It Corridor Culverts

0 350 700 1,400 2,100 2,800 Feet

Figure 2: Drainage Basins

Federal Highway Administration/ Western Federal Lands Division

Oregon Department of Transportation

OR DOT 18(2) OR-58 Fix-It Corridor Culverts

0 75 150 300 450 600 Feet


D027825
Google Earth
200 ft
N
Natural tratment Area
Wetland
Pavement excavation limit
Ditch
Stream

Natural tratment Area

Wetland

Pavement excavation limit

Ditch

Stream

Natural tratment Area

Wetland

Pavement excavation limit

Ditch

Stream

Natural tratment Area

Wetland

Pavement excavation limit

Ditch

Stream


D028052
Natural tratment Area
Wetland
Pavement excavation limit
Ditch
Stream
N
Google Earth
80 ft


D028053
Google Earth
70 ft
N
Natural tratment Area
Wetland
Pavement excavation limit
Ditch
Stream

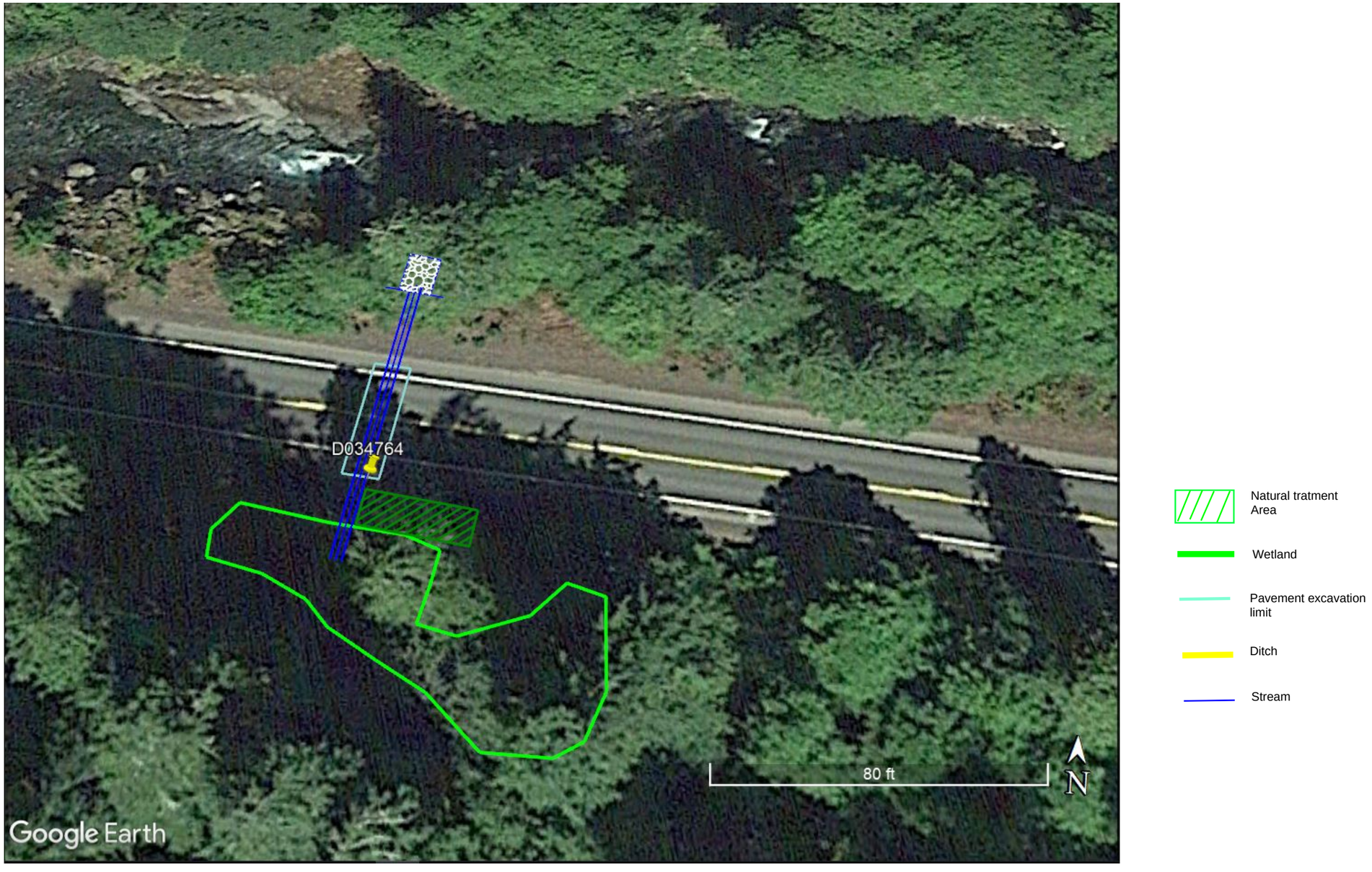
Natural tratment Area

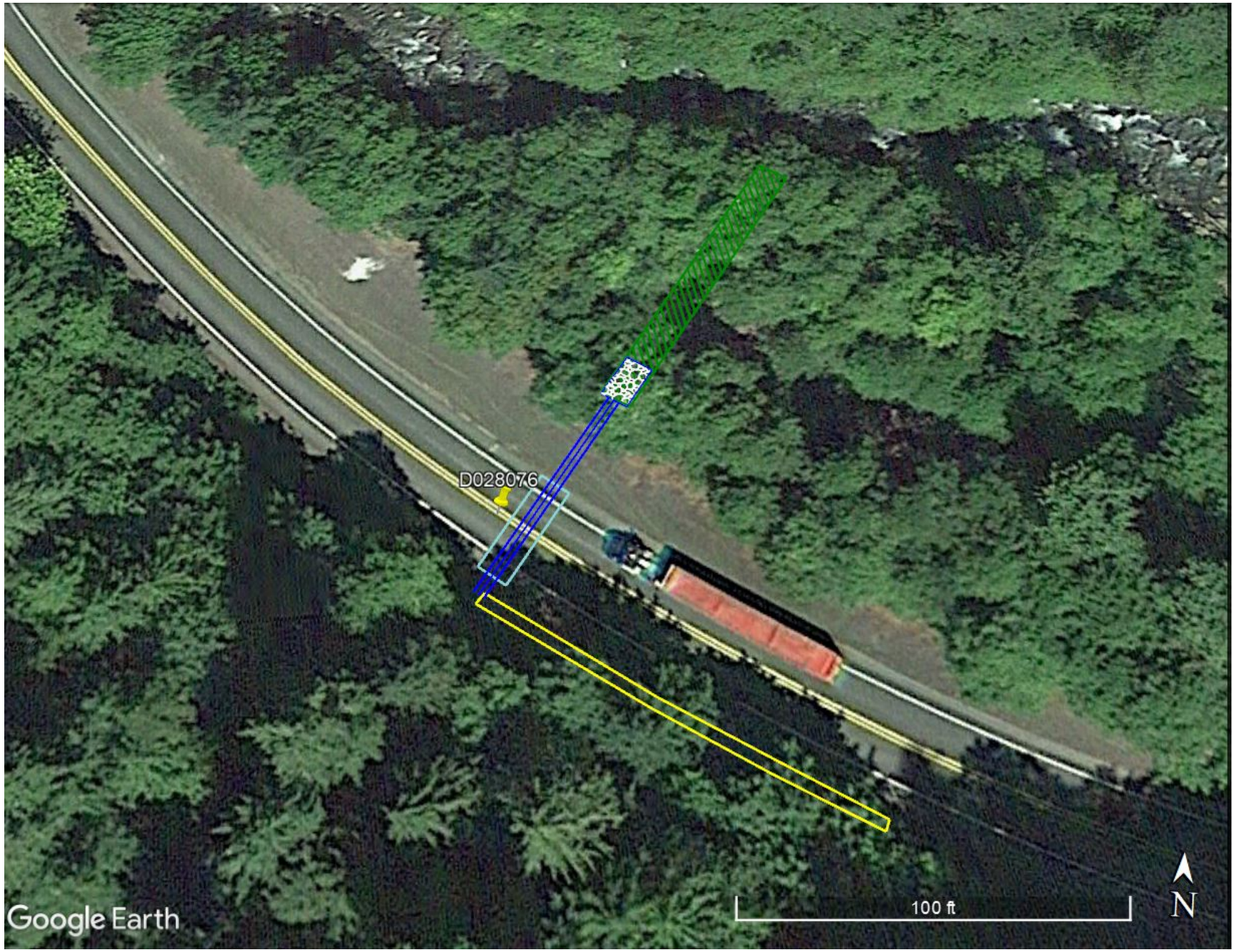
Wetland

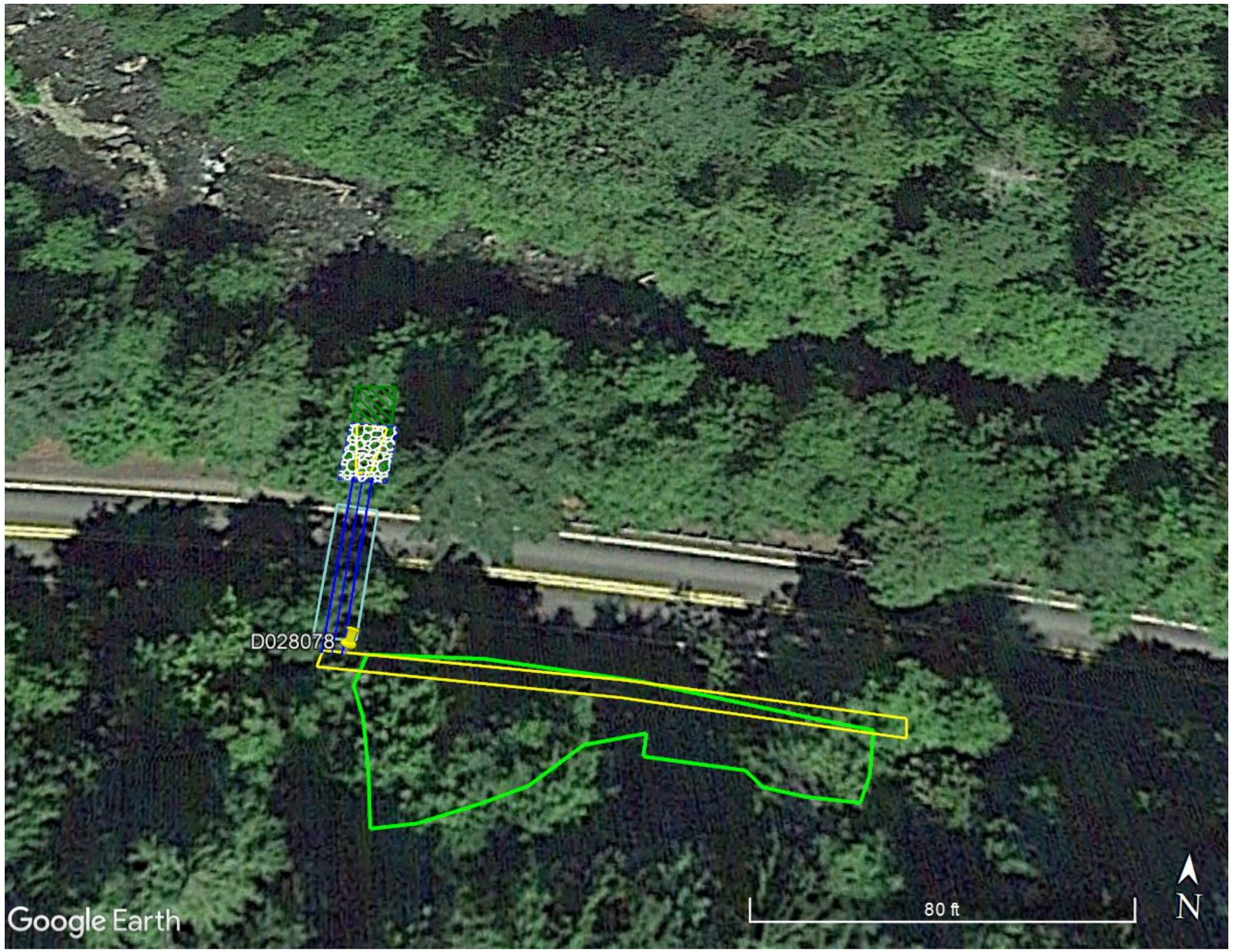
Pavement excavation limit

Ditch

Stream


D034764
80 ft
N
Google Earth
Natural tratment Area
Wetland
Pavement excavation limit
Ditch
Stream


D028076
Google Earth
100 ft
N
Natural tratment Area
Wetland
Pavement excavation limit
Ditch
Stream



Natural tratment Area

Wetland

Pavement excavation limit

Ditch

Stream


D028090
Google Earth
100 ft
N
Natural tratment Area
Wetland
Pavement excavation limit
Ditch
Stream


D028095
Google Earth
90 ft
N
Natural tratment Area
Wetland
Pavement excavation limit
Ditch
Stream

Natural tratment Area

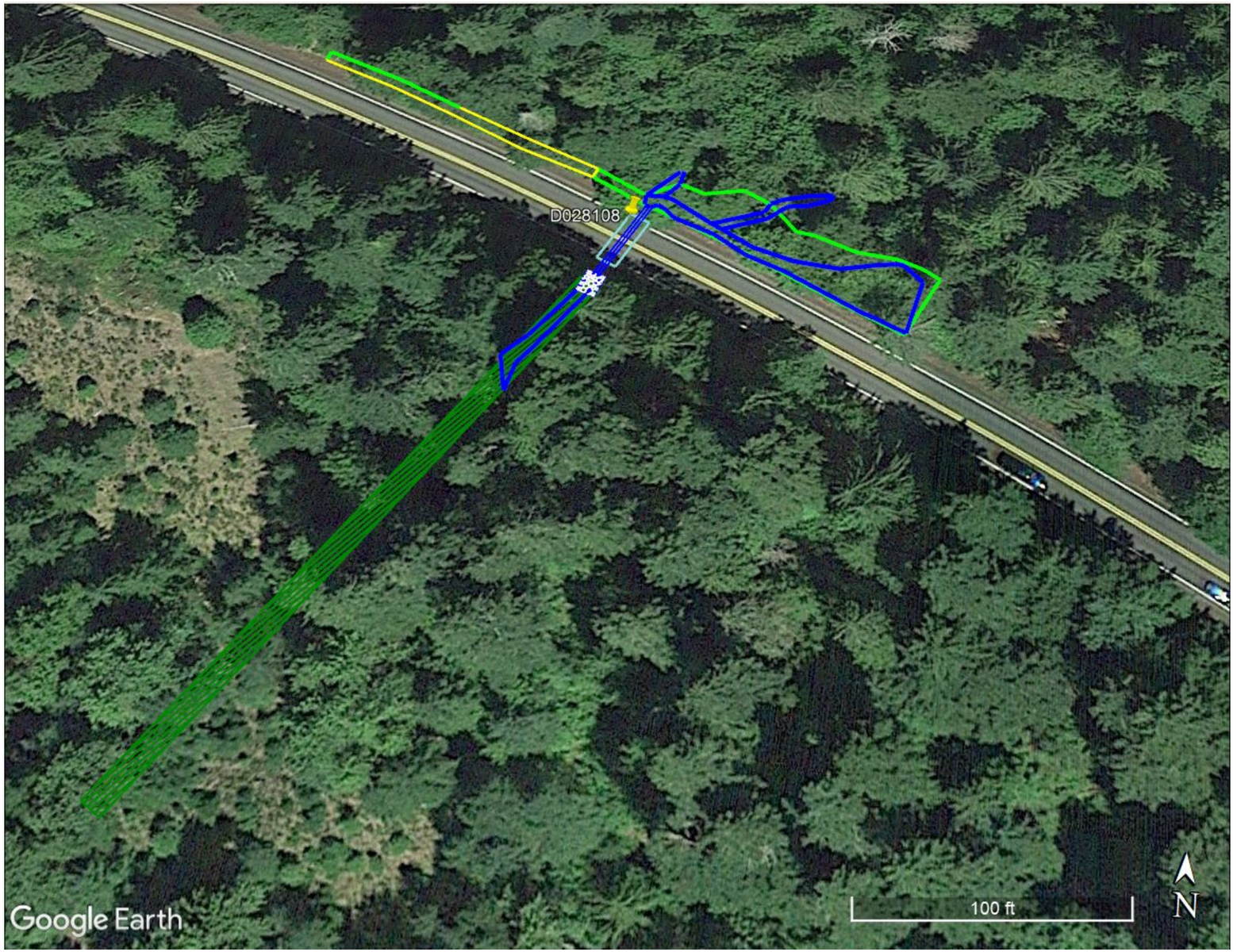
Wetland

Pavement excavation limit

Ditch

Stream


D028107
Google Earth
100 ft
N
Natural tratment Area
Wetland
Pavement excavation limit
Ditch
Stream



Natural tratment Area

Wetland

Pavement excavation limit

Ditch

Stream

Natural tratment Area

Wetland

Pavement excavation limit

Ditch

Stream

Natural tratment Area

Wetland

Pavement excavation limit

Ditch

Stream

Natural tratment Area

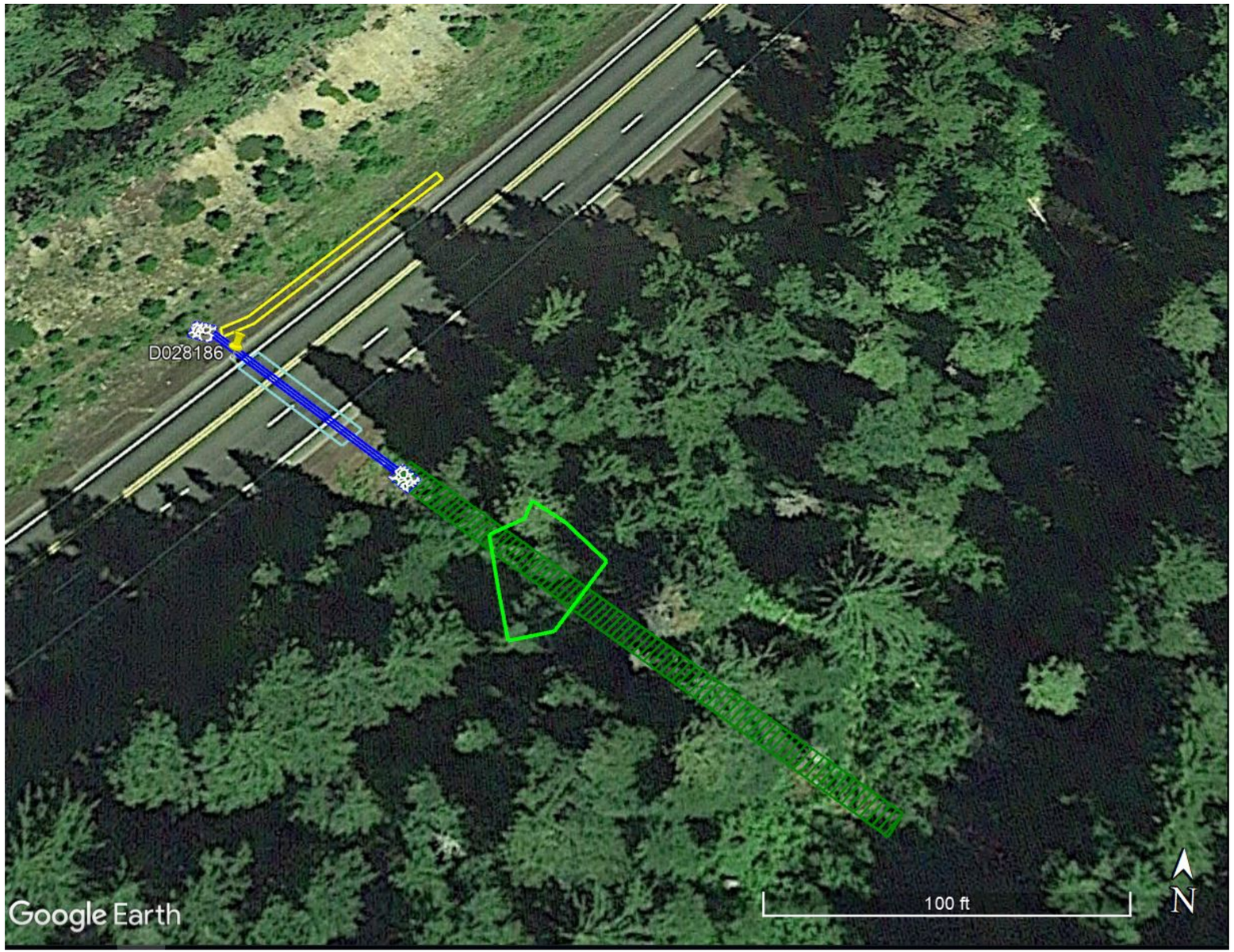
Wetland

Pavement excavation limit

Ditch

Stream


D028159
Google Earth
100 ft
N
Natural tratment Area
Wetland
Pavement excavation limit
Ditch
Stream


D028186
Google Earth
100 ft
N
Natural tratment Area
Wetland
Pavement excavation limit
Ditch
Stream

OR-58 Fix-It Corridor Culverts

Estimation of Replaced Impervious Areas and Natural Treatment

Culvert ID	MP	Existing diameter (ft)	Proposed diameter (ft)	Proposed diameter (in)	Proposed I.E. (ft)		Existing Pipe Slope (ft/ft)	Proposed Pipe Slope (ft/ft)	Pipe Length (ft)	Roadway Width (ft)	Surface elevation at edge of pavement (ft)		Elev. of top of pipe zone (ft)		Trench backfill height (ft)		"B"	Trench backfill slope (H:1V)	Width of pipe zone (ft)	Pavement excavation width (ft)		Road Cross Slope	Stream Crossing?	Embankment Geometry		Tailwater				Roadside ditch to inlet	Replaced Impervious Area (Sq. ft.)	Treatment by Natural Vegetation			Required Treatment Area (sq. ft.)
					Inlet	Outlet					Inlet	Outlet	Inlet	Outlet	Inlet	Outlet				Inlet	Outlet			Lateral Slope (H:1V)	Width (ft)	Longitudinal slope (ft/ft)	Bottom width of cross-section (ft)	Distance to water body (ft)	Water Body Name			Treatment by Embankment[1]	Treatment by Downstream Vegetation[2]	Treatment by ditch leading to inlet[3]	
D027825	13.07	2	2	24	700.30	698.33	0.025	0.025	78	47	704.74	705.55	703.30	701.33	1.44	4.22	18	0	5.0	8.0	8.0	To inlet	No	1.3	7.0	-	-	5	Dexter Reservoir	>400 LNFT, more than 40 ft wide well-maintained vegetated ditch	376	No	No	Yes	Treated
D027828	13.56	1.5	1.5	18	709.14	707.69	0.018	0.018	79	52	714.49	713.43	711.64	710.19	2.85	3.24	16	0	4.2	7.2	7.2	To inlet	No	1.3	7.0	0.640	0.0	10	Dexter Reservoir	vegetated v-ditch	373	No	Yes	Yes	Treated
D027842	15.51	3	8	96	1001.82	987.99	0.072	0.072	191	52	1014.23	1012.32	1,010.82	996.99	3.41	15.33	18	0	11.0	14.0	14.0	To outlet	Yes	12.1	85.0	0.042	6.0	750	Lookout Point Lake		728	Yes	Yes		Treated
D028052	37.68	1.5	1.5	18	1250.26	1246.93	0.059	0.059	57	35	1257.42	1257.56	1,252.76	1249.43	4.66	8.13	16	0	4.2	7.2	7.2	Crowned	No	2.5	10.0	0.318	2.0	50	Salt Creek	vegetated v-ditch	251	No	No	Yes	Treated
D028074	41.5	1.25	2.5	30	1580.25	1578.49	0.030	0.034	52	33	1586.09	1585.88	1,583.75	1581.99	2.34	3.89	24	0	6.5	9.5	9.5	Crowned	No	1.5	7.0	0.090	3.0	35	Salt Creek		314	No	Yes		Treated
D034764	41.58	2	2	24	1581.88	1580.31	0.019	0.019	83	33	1594.17	1594.1	1,584.88	1583.31	9.29	10.79	18	0	5.0	8.0	8.0	Crowned	No	1.7	22.0	0.360	Sheet flow	30	Salt Creek	vegetated v-ditch	264	No	No	Yes	Treated
D028076	41.91	2	2	24	1625.52	1618.68	0.093	0.093	73	34	1630.74	1627.04	1,628.52	1621.68	2.22	5.36	18	0	5.0	8.0	8.0	To outlet	Yes	15.2	9.0	0.200	Sheet flow	100	Salt Creek		272	Yes	Yes		Treated
D028078	42.12	2	3	36	1642.42	1642.04	0.010	0.008	47	34	1647.22	1648.97	1,646.42	1646.04	0.80	2.93	24	0	7.0	10.0	10.0	To inlet	No	2.0	5.0	0.245	0.0	25	Salt Creek	vegetated 3 ft wide trapezoidal ditch	340	No	No	Yes	Treated
D028090	43.54	1.5	1.5	18	1869.83	1866.91	0.042	0.056	53	33	1878.22	1877.03	1,872.33	1869.41	5.89	7.62	16	0	4.2	7.2	7.2	To outlet	No	1.4	7.0	0.024	4.0	185	Salt Creek		237	No	Yes		Treated
D028095	44.06	2	2	24	1922.90	1919.8	0.034	0.034	92	47	1928.43	1927.41	1,925.90	1922.81	2.53	4.6	18	0	5.00	8.0	8.0	To outlet	Yes			0.53		150	Salt Creek	vegetated v-ditch	376	No	Yes	Yes	Treated
D028100	44.36	2	2	24	1990.00	1988.5	0.015	0.026	57.2	30	1998.75	1998.15	1,993.00	1991.5	5.75	6.65	18	0	5.00	8.0	8.0	To inlet	No			0.05		275	Salt Creek		240	No	Yes		Treated
D028107	44.96	2	2	24	1958.28	1956.95	0.020	0.020	67	29	1971.64	1969.82	1,961.28	1959.95	10.36	9.87	18	0	5.0	8.0	8.0	To outlet	No	1.4	15.0	0.164	3.0	260	Salt Creek		232	No	Yes		Treated
D028108	45.03	1.5	1.5	18	1963.98	1963.03	0.020	0.020	46	30	1969.31	1967.53	1,966.48	1965.53	2.83	2	16	0	4.2	7.2	7.2	To outlet	Yes	0.4	2.0	0.006	4.0	300	Salt Creek		215	No	Yes		Treated
D028124	46.75	1.5	1.5	18	2092.53	2090.08	0.041	0.041	60	38	2094.99	2094.26	2,095.03	2092.58	-0.04	1.68	16	0	4.2	7.2	7.2	Crowned	Yes	0.8	4.0	0.037	5.0	500	Salt Creek		272	No	Yes	Yes	Treated
D028128	47.07	1.5	2.5	30	2119.32	2118.93	0.004	0.009	44	32	2123.58	2123.42	2,122.82	2122.43	0.76	0.99	24	0	6.5	9.5	9.5	To outlet	Yes	2.8	7.0	0.002	3.0	125	Salt Creek		304	No	Yes		Treated
D028131	47.57	2.5	3	36	2161.73	2160.7	0.020	0.020	49	31	2168.38	2167.91	2,165.73	2164.73	2.65	3.18	24	0	7.00	9.00	9.00	To outlet	No	1.00	6.30	0.00	3.30	230.00	Salt Creek		279	Yes	Yes		Treated
D028159	53.69	2.66	2.66	31.92	3323.00	3319.4	0.048	0.048	75	36	3328.04	3330.01	3,326.66	3323.03	1.38	6.98	24	0	6.66	9.7	9.7	To inlet	Yes			0.56	4.00	870	Salt Creek	Ditch flow mostly concentrated against cliff; downstream half of the ditch is heavily vegetated. Add a curb to allow dispersion in the vegetated dispersion area near the inlet	348	No	No	Yes	Treated
D028160	53.76	2	2	24	3341.52	3331.62	0.117	0.117	85	50	3346.89	3346.46	3,344.52	3334.62	2.37	11.84	18	0	5.0	8.0	8.0	To inlet	Yes	1.3	15.0	0.270	Sheet flow	920	Salt Creek	vegetated v-ditch that gets wider east of the inlet	400	Yes	Yes		Treated
D028161	53.83	2.5	2.5	30	3358.84	3330.81	0.246	0.246	114	54	3368	3363.97	3,362.34	3334.31	5.66	29.66	24	0	6.5	9.5	9.5	To outlet	Yes	1.4	40.0	0.195	5.0	1300	Salt Creek		513	No	Yes		Treated
D028163	53.95	2	2	24	3390.71	3387.37	0.021	0.021	160	148	3396.36	3396.36	3,393.71	3390.37	2.65	5.99	18	0	5.0	8.0	8.0	To inlet	No	-	-	0.039	Sheet flow	430	Unnamed Tributary		1,184	No	Yes		Treated
D028186	57.77	2	2	24	4321.92	4320.86	0.013	0.013	80	45	4326.44	4328.66	4,324.92	4323.86	1.52	4.8	18	0	5.0	8.0	8.0	To inlet	Yes	6.3	13.0	0.028	13.0	180	Salt Creek		360	Yes	Yes		Treated
																													Total		***Total (sq. ft.)***	*7,877*				

Notes

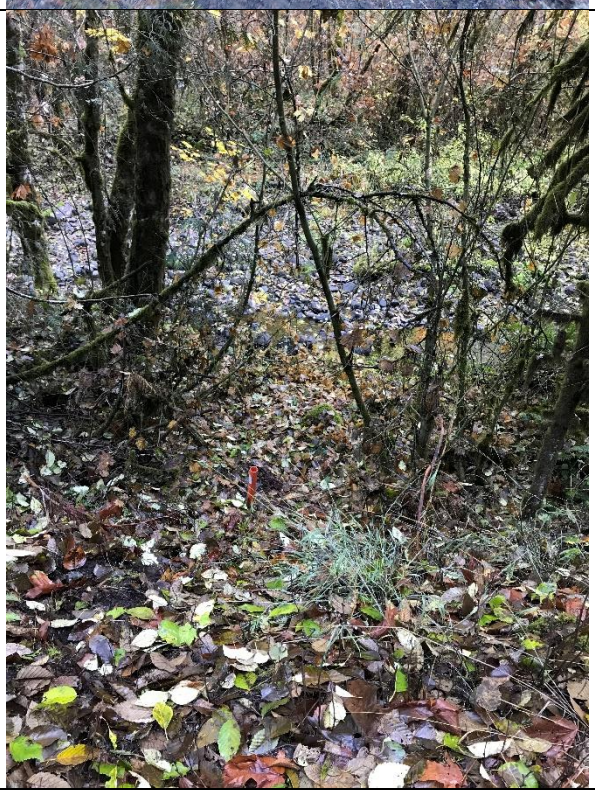
1. Assuming the natural dispersion areas are more than 6 ft. wide.
2. Assuming dispersion is provided by the vegetated areas downstream of the outlet when sheet flow conditions occur
3. Treatment by upstream ditch was not evaluated when dispersion is already provided by the embankment or downstream vegetation.

No	Culvert ID	MP	Vegetation Status	Site Visit Picture
3	D027825	13.07	Dense vegetation at entrance (sheet flow) No vegetation at outlet (discharge to Dexter Lake)	 

4	D027828	13.56	Dense vegetation at entrance (sheet flow) No vegetation at outlet (discharge to Dexter Lake)	
5	D027842	15.51	D027842 is a stream culvert. The road slopes to the outlet and sheet flows through 750 ft of dense forest to Lookout Point Lake.	

9	D028033	31.47	The flow from outlet goes through 1550 ft of a dense vegetation and discharges into the Middle Fork-Willamette River.	

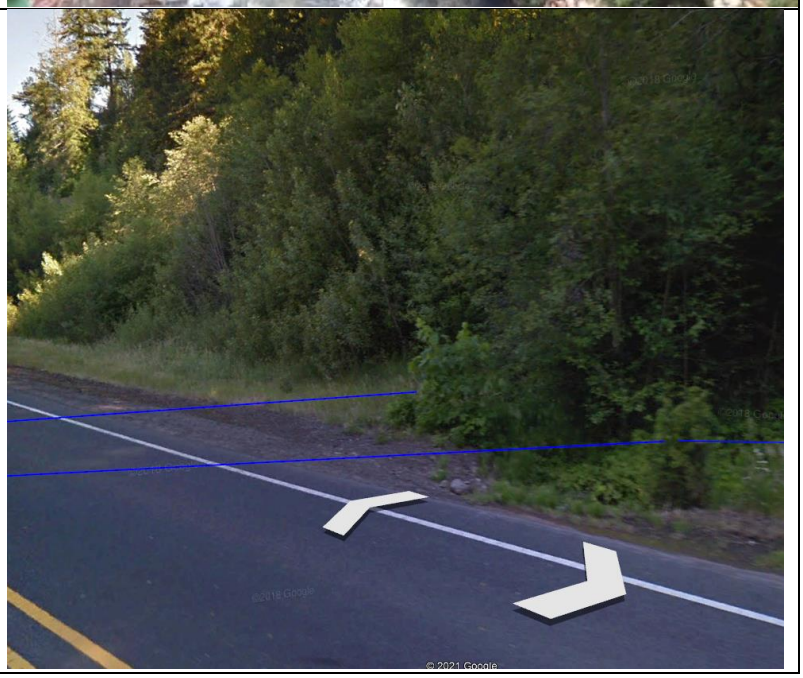
10	D028052	37.68	The flow from outlet goes through 50 ft of a dense vegetation and discharges into Salt Creek.	
11	D028053	37.89	The flow from outlet goes through 150 ft of a dense vegetation and discharges into Salt Creek.	

12	D028074	41.5	The flow from outlet goes through 35 ft of a dense vegetation and discharges into Salt Creek.		
13	D028076	41.91	Stream culvert. The road slopes to the outlet and sheet flows through 100 ft of dense forest to Salt Creek.		

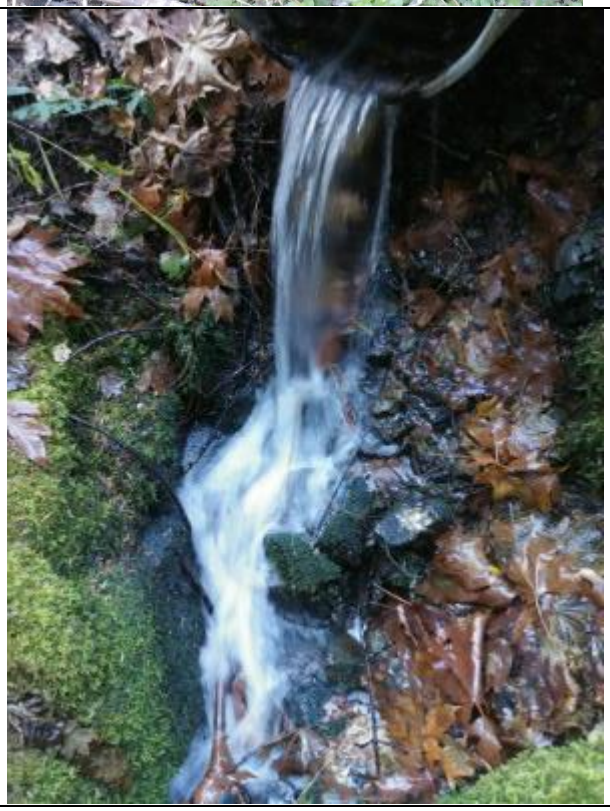
14	D028078	42.12	The flow from outlet goes through 25 ft of a dense vegetation and discharges into Salt Creek.	
15	D028090	43.54	The flow from outlet goes through a sparse vegetation and discharges into Salt Creek.	

16	D028095	44.06	Stream culvert. The road slopes to the outlet and sheet flows through 150 ft of dense forest to Salt Creek.	
17	D028100	44.36	The flow from outlet goes through 275 ft of a dense vegetation and discharges into Salt Creek.	

19	D028107	44.96	The flow from outlet goes through a dense vegetation and discharges into Salt Creek.	

20	D028108	45.03	Stream culvert. The road slopes to the outlet and sheet flows through 350 ft of dense forest to Salt Creek.	
21	D028124	46.75	Stream culvert. The road is crowned. Half of the road sheet flows over 4 ft of embankment and along a vegetated v-ditch before reaching the inlet. The other half, on the outlet side, sheet flows over 500 ft of dense forest to Salt Creek.	

22	D028128	47.07	Stream culvert. The road slopes to the outlet and sheet flows through 125 ft of dense forest to Salt Creek.	
23	D028159	53.69	Stream culvert. The road slopes towards the inlet. Flow to the culvert inlet is along a 300-foot-long ditch against the cliff. Downstream half of the v-ditch is vegetated and the depression at the culvert inlet is wide and heavily vegetated.	

				
24	D028160	53.76	Stream culvert. The road slopes towards the inlet and sheet flows over 15 ft of embankment and along a wide vegetated ditch before reaching the inlet.	

25	D028161	53.83	Stream culvert. The road slopes to the outlet and sheet flows through 1300 ft of dense forest to Salt Creek	
26	D028163	53.95	The flow from outlet goes through 430 ft of a dense forest and discharges into an unnamed tributary.	

27	D028186	57.77	Stream culvert. The road slopes towards the inlet and sheet flows over 13 ft of embankment and along a 400-foot-long vegetated ditch. 180 ft to Salt Creek from the culvert outlet.		

APPENDIX

L FISH PASSAGE

STATE	PROJECT	SHEET NUMBER
OR	DOT 18(2)	A.3

BEGIN PROJECT
OR DOT 18(2)
Milepost 2.73
132+97
43°58'43.6" N
122°57'42.5" W

END PROJECT
OR DOT 18(2)
Milepost 84.97
4474+51
43°20'46.3" N
121°46'16.1" W

EUGENE
SUTHERLIN
OAKRIDGE
GLIDE
ROSEBURG
BEND
LA PINE

5
38
58
97
20
138

MILE 10
MILE 20
MILE 30
MILE 40
MILE 50
MILE 60
MILE 70
MILE 80

Dexter Reservoir
Lookout Pt. Lake
Hills Creek Lake
Waldo Lake
Davis Lake
Odell Lake
Crescent Lake

OR58

Lane County
Deschutes County
Klamath County
Douglas County

N

Scale in miles
5 2.5 0 5 10

VICINITY MAP

Designed by: | Checked by: | -/---

1/1/0001 12:00:00 AM c:\bms\wsp-pb-us-pw-02\wsp__anthony.odonnell\d0219314\Border.dgn

Δ	total central angle
Δc	curve central angle
Ø	diameter
θs	spiral central angle
abut.	abutment
ADT	average daily traffic
AH	ahead
AOP	aquatic organism passage
appr.	approach
BK	back
BM	bench mark
BP	balance point
br.	bridge
brg.	bearing
cc or c. to c.	center to center
℄	centerline
clr.	clear
CMP	corrugated metal pipe
col.	column
conc.	concrete
conn.	connection
constr. jt.	construction joint
cont.	continuous
CS	point of curve to spiral
ctrs.	centers
CUFT	cubic foot (feet)
culv.	culvert
CUYD	cubic yard(s)
D	diameter
DHV	design hourly volume
dia.	diameter
diag.	diagonal
diaph.	diaphragm
dist.	distance
drwg(s).	drawing(s)
E	east
e	superelevation rate
El. 94.16 ft	elevation with number
elev.	elevation
emb.	embankment
EP	edge of pavement
EQ or eq.	equation
ER	edge of road
EW	edge of water
exc.	excavation
exp. jt.	expansion joint
fin.	finish
flg.	flange
ft2	square foot
ft3	cubic foot (feet)
ftg.	footing
ga.	gage (gauge)
galv.	galvanized
hdwl.	headwall
hex.	hexagon
HW	high water
ID	inside diameter
jt.	joint
L	length of curve
lam.	lamination
lat.	latitude
Ln	Lane
LNFT	linear foot (feet)
long.	longitudinal
LPSM	lump sum
Ls	length of spiral
lt. or LT	left
LW	low water

M.L.	main line
M.P.	mile post
matl.	material
max.	maximum
MGAL	thousand gallon
min.	minimum
mon.	monument
N	north
NC	normal crown
o. c.	on center
o. to o.	out to out
OD	outside diameter
OG	original ground
PC	point of curve
PCC	point of compound curve
PCS	point of curve to spiral
PI	point of intersection
pl.	plate
POC	point on curve
POS	point on spiral
POT	point on tangent
PS	point of tangent to spiral
PSC	point of spiral to curve
PST	point of spiral to tangent
PT	point of tangent
pvmt.	pavement
R	radius
R.	range
R/W	right-of-way
Rd	Road
rdwy.	roadway
reinf.	reinforcement
reqd.	required
rt. or RT	right
rte.	route
S	south
SADT	seasonal average daily traffic
SC	point of spiral to curve
sec.	section
shldr.	shoulder
SLRY	slurry unit
spa.	spacing, spaces or spaced
SQFT	square foot
SQYD	square yard
SRS	point of spiral to reverse spiral
SS	point of spiral to spiral (no curve)
ST	point of spiral to tangent
STA, Sta.	station
std.	standard
stgr.	stringer
stiff.	stiffener
struc.	structural
STS	point of spiral to tangent spiral
sym.	symmetrical
T	tangent distance
T.	township
TBM	temporary bench mark
thd.	thread
TS	point of tangent to spiral
Ts	tangent distance (spiraled curve)
typ.	typical
V	design speed
vph	vehicles per hour
VPI	vertical point of intersection
W	west
WQ	water quality
yd2	square yard
yd3	cubic yard(s)

NOTE:

1. Other symbols used in the plans will be shown in a legend on the appropriate plan sheet.

National Boundary

State Boundary

County Boundary

City Boundary

Township or Range Line

Section Line

Section Corner (Found, Projected)

¼ Section Line

¼ Section Corner (Found, Projected)

1/16 Section Line

1/16 Section Corner (Found, Projected)

Property Line w/Found Property Corner

Parcel Number

National Park Boundary

National Forest Boundary

National Wildlife Refuge Boundary

BLM Lands Boundary

Indian Reservation Boundary

Existing Roadway (Road, Paved, Gravel)

Railroad

Trail

Fiber Roll or Wattle

Silt Fence

Intermittent Drainage or Small Creek

Large Creek or River

Lake, Pond or Reservoir; Marshland

Spring or Seep

Treeline; Individual Trees

Material Source; Bore Hole; Test Pit

Spot Elevation; Coordinate Grid Tick

Above Ground Tank; Underground Tank

Boulder; Well; Satellite Dish; Grave

Cooking Grate; Garbage Can; Picnic Table

Flagpole; Fire Hydrant

Gas & Water Meter; Gas & Water Valve

Control Point (Terrestrial and GPS); Jump Hub

STATE	PROJECT	SHEET NUMBER
OR	DOT 18(2)	A.2

North Arrow

	EXISTING	PROPOSED
Slope Stake Limits	Top of Cut / Toe of Fill / Transition	
Construction limits		
Fence		
Gate with Fence		
Cattleguard		
Guardrail		
Concrete Barrier		
Retaining Wall		wall face
Signs (single, double post; portable)		
Delineators		
Pipe Culvert (arrow shows flow)		
Pipe Culvert with End Section		
Pipe Culvert with Headwall		
Pipe Culvert with Drop Inlet		
Box Culvert		
Underdrain		
Overhead/Above Ground Utilities		
Underground Utilities		

FM = force main, FO = fiber optic, G = gas, IRR = irrigation, O = oil, P = power, SA = sanitary sewer, SD = storm drain, SS = storm sewer, STEAM = steam, T = telephone, TV = CATV, W = water

Poles (Power, Telephone, Joint Use, Light, Support w/Anchor)

Miscellaneous Utility Features

EM = electric meter, T = telephone pedestal, TV = CATV pedestal, UP = transformer or junction box, WF = water fountain

Building

Right-of-Way Line with Monument

Permanent Easement

Construction Easement — - no symbol -

Riprap

NO SCALE

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
WESTERN FEDERAL LANDS HIGHWAY DIVISION

U.S. CUSTOMARY DETAIL

PLAN SYMBOLS AND ABBREVIATIONS

DETAIL APPROVED FOR USE 11/2001

REVISED: 9/2005 1/2007 10/2009 10/2014

DETAIL W101-1

NPS PMIS NO.: XXXXX DRAWING NO.: XXX-XXXXX

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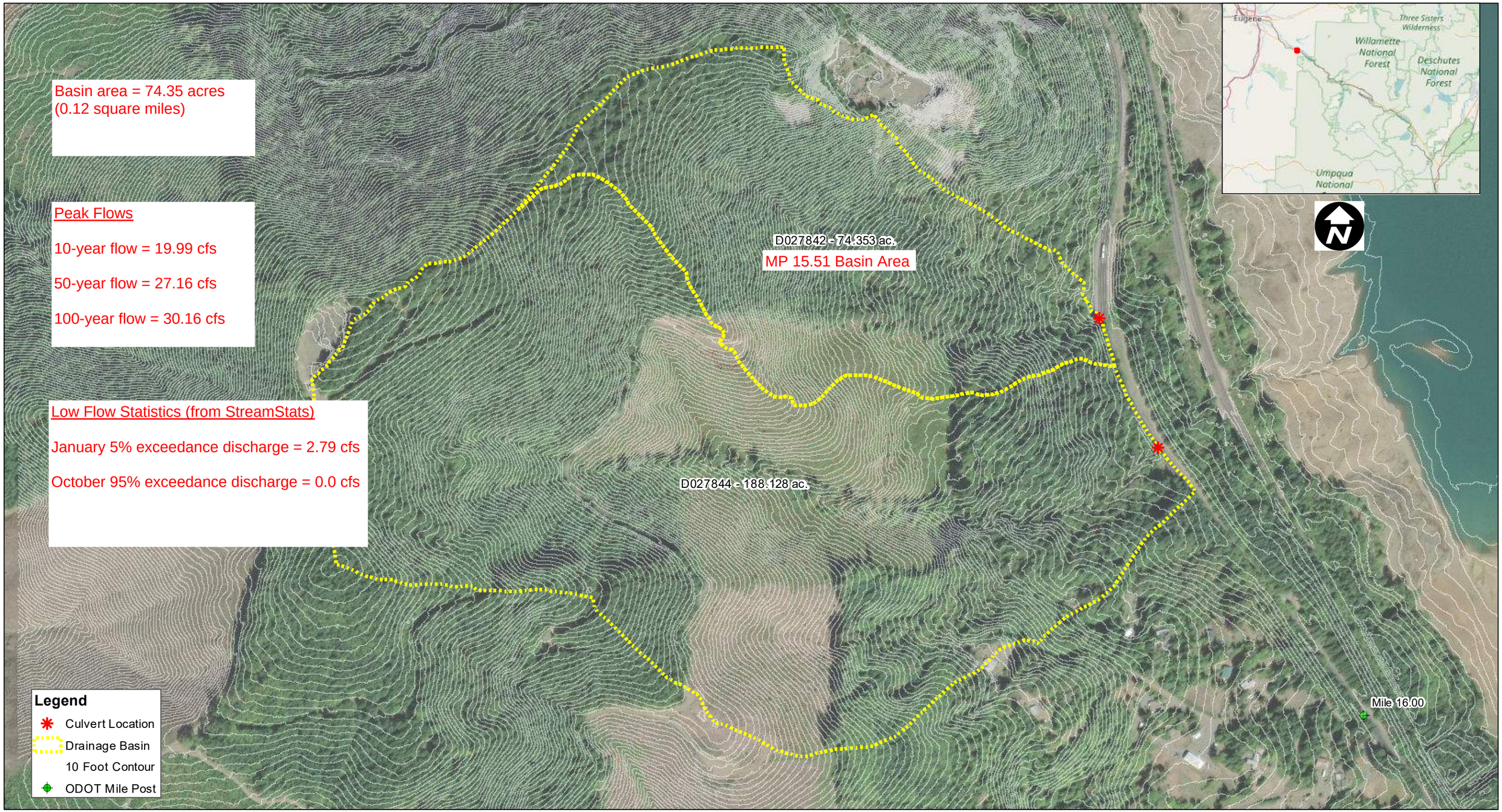
14 April 2021 3:58 PM



Appendix B: Drainage Basins

Federal Highway Administration/
Western Federal Lands Division

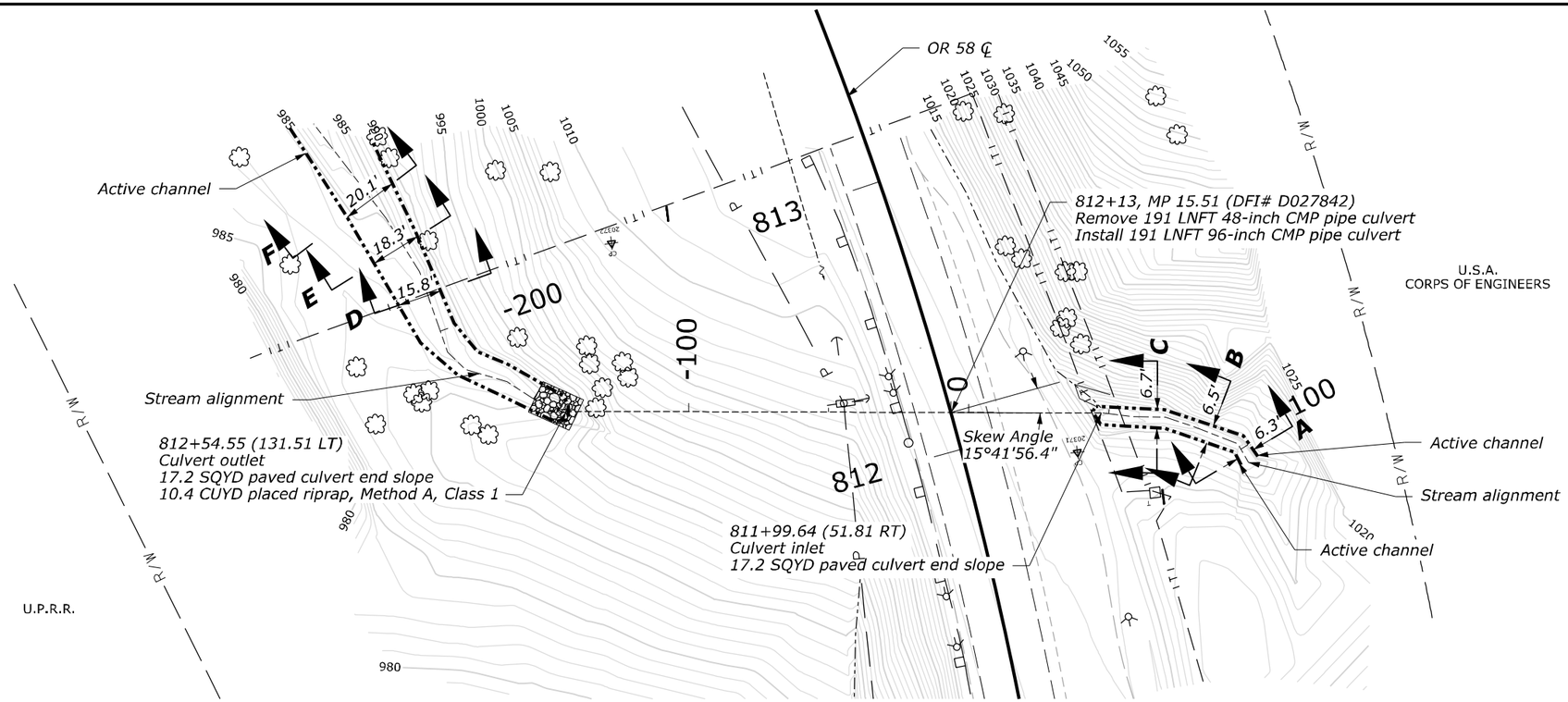
Oregon Department of Transportation

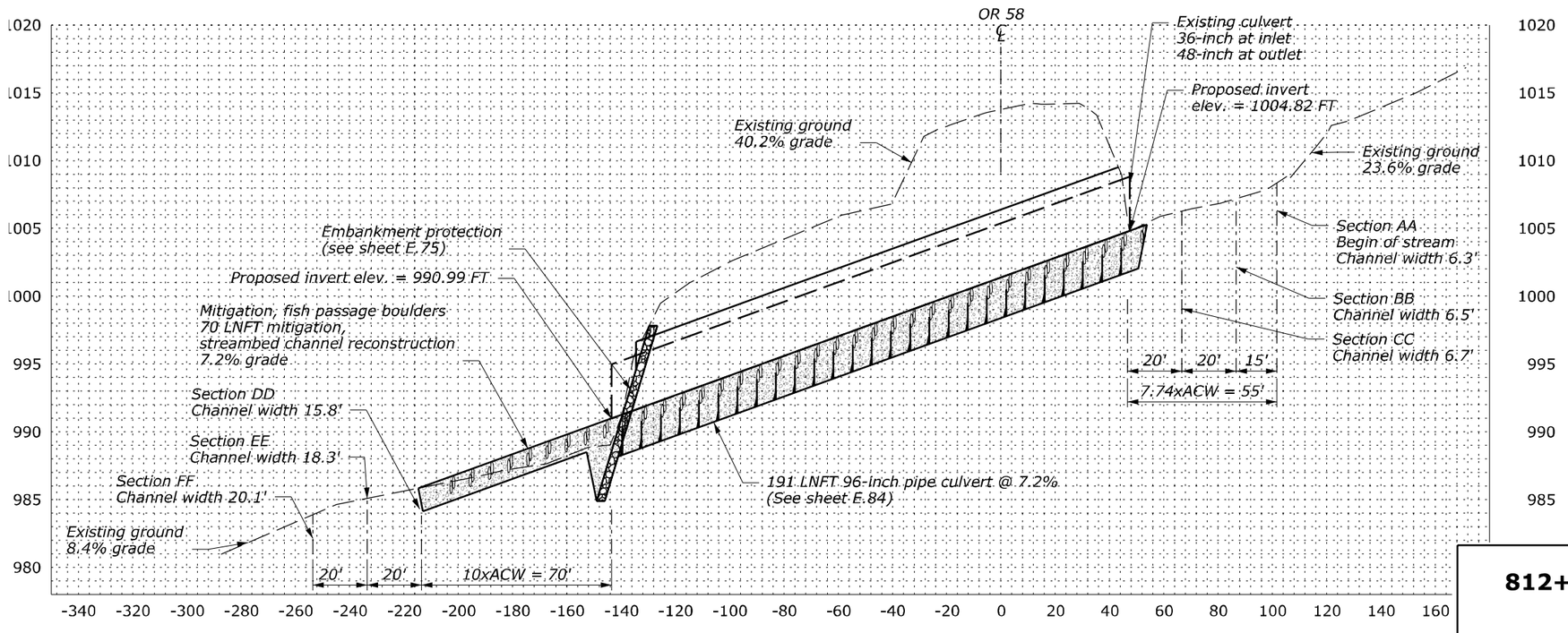
OR DOT 18(2) OR-58 Fix-It Corridor Culverts

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

WSP

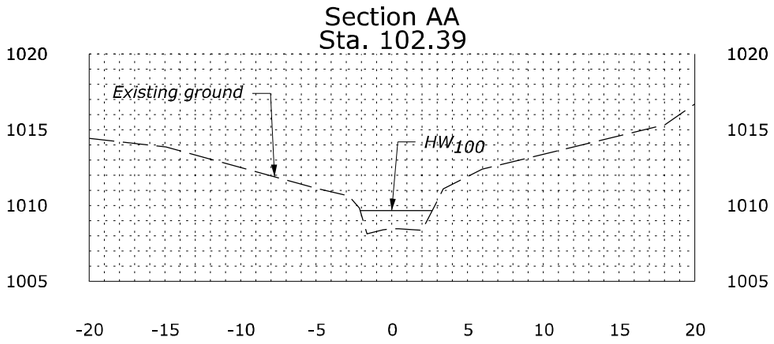
STATE	PROJECT	SHEET NUMBER
OR	DOT 18(2)	E.16

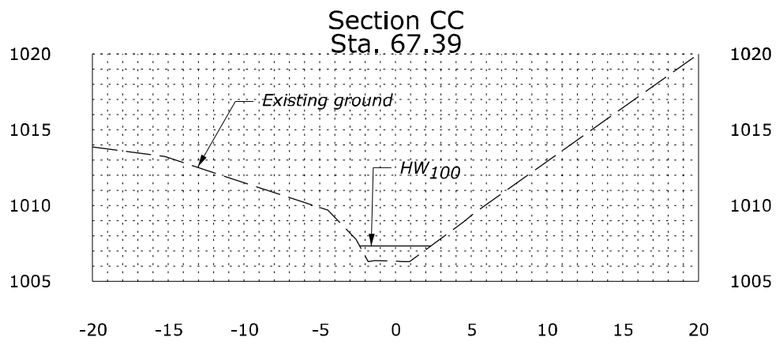


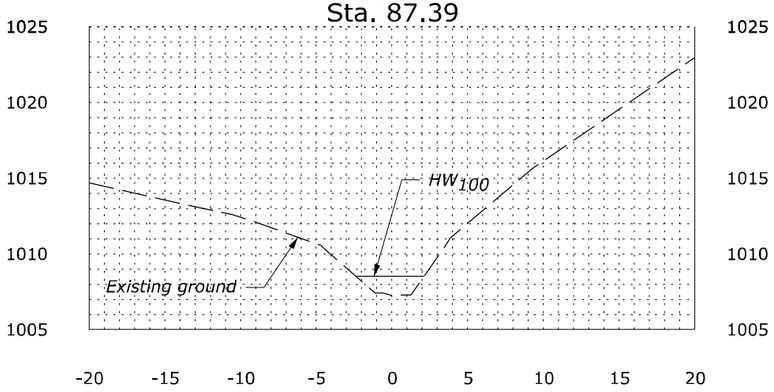


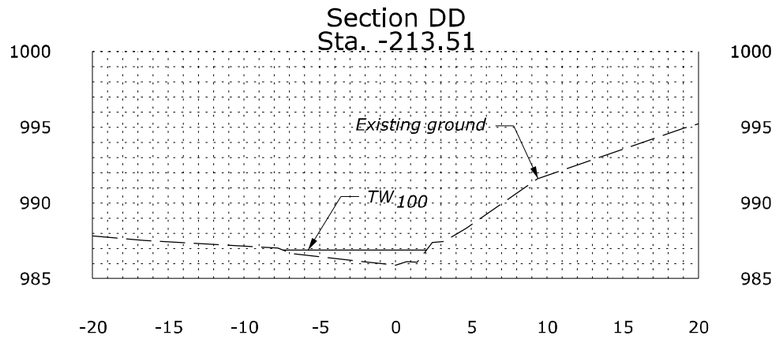
812+13, MP 15.51 (DFI# D027842)
AOP CULVERT
PLAN AND PROFILE

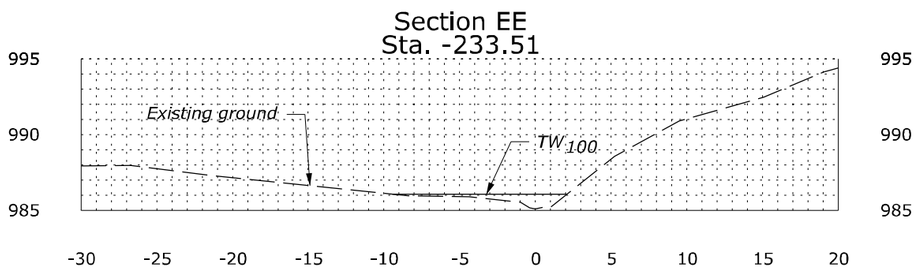
STATE	PROJECT	SHEET NUMBER
OR	DOT 18(2)	E.16

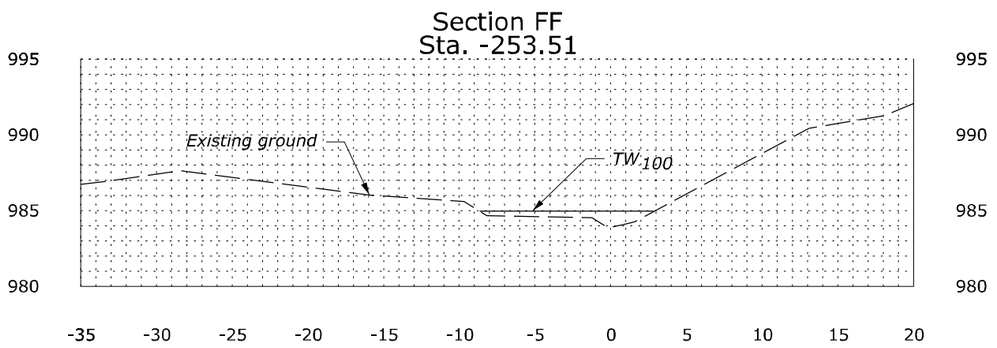






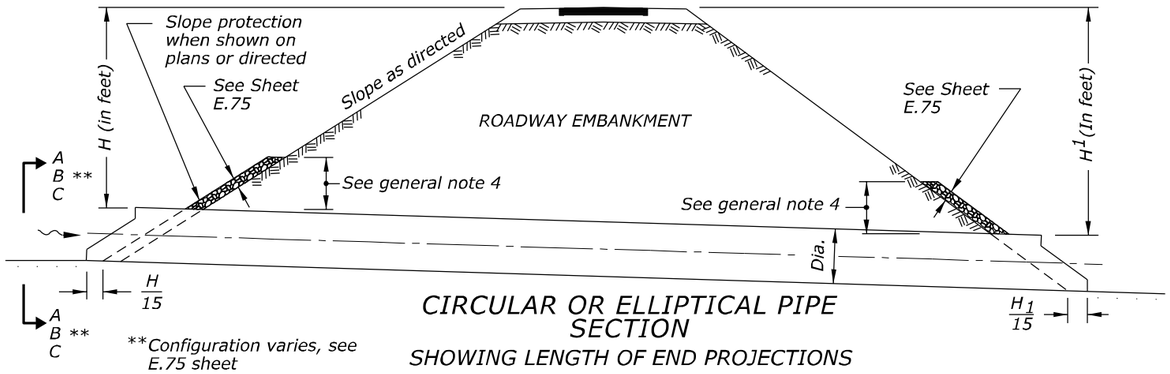






812+13, MP 15.51 (DFI# D027842)
AOP CULVERT
Stream Cross Sections

STATE	PROJECT	SHEET NUMBER
OR	DOT 18(2)	E.74



**Configuration varies, see E.75 sheet

CIRCULAR OR ELLIPTICAL PIPE
SECTION
SHOWING LENGTH OF END PROJECTIONS

CIRCULAR OR ELLIPTICAL PIPE

CORRUGATED (Dimension in inches)

SIZE	X	Y
12 to 36	4 *	0
42	8 *	8 *
48	8 *	8 *
54	8 *	8 *
60	8 *	8 *
66	12	12
72	12	12
78	12	12
84	16	16

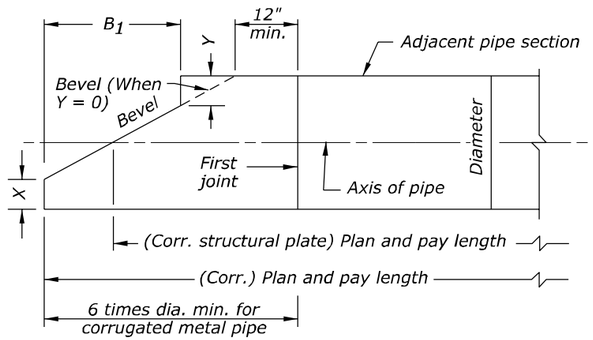
Slopes as directed.

* 0 when used with paved end slope.

CORRUGATED STRUCTURAL PLATE (Dimension in inches)

SIZE	B_1			ALTERNATE - 1						ALTERNATE - 2		
				X			Y			X & Y		
	SLOPES			SLOPES			SLOPES			SLOPES		
	1:1.5	1:2	1:3	1:1.5	1:2	1:3	1:1.5	1:2	1:3	1:1.5	1:2	1:3
60	72	72	96	5	11	13	7	13	15	6	12	15
66	72	72	96	7	15	17	11	16	18	10	16	17
72	72	96	144	11	13	11	13	13	13	12	12	12
78	72	72	144	13	20	15	17	22	16	16	22	16
84	72	96	144	17	17	17	19	19	19	18	18	18
90	72	96	144	19	20	20	23	22	22	22	22	22
96	96	96	192	15	23	16	17	25	17	16	24	17
102	96	96	168	18	26	23	20	29	24	19	28	23
108	96	96	168	20	29	25	23	31	26	22	30	26
114	96	168	168	23	15	29	26	16	30	25	28	29
120	96	168	216	26	17	23	29	19	25	28	18	24
126	96	168	216	30	20	26	32	22	28	31	22	28
132	144	168	216	17	23	29	19	25	31	18	24	30
138	144	192	288	19	20	20	23	22	22	22	22	22
144	144	144	240	23	35	31	25	37	32	24	36	32
150	144	192	288	25	26	26	29	28	28	28	28	28
156	144	192	288	29	29	29	31	31	31	30	30	30
162	144	192	288	31	32	32	35	34	34	34	34	34
168	168	168	264	26	41	40	29	43	41	28	42	40
174	168	168	288	30	44	39	32	46	40	31	46	40
180	168	192	288	42	41	41	43	43	43	42	42	42

For elliptical pipe increase X and Y dimensions by percent of ellipse.



STEP BEVEL
LONGITUDINAL SECTION
CIRCULAR OR ELLIPTICAL PIPE

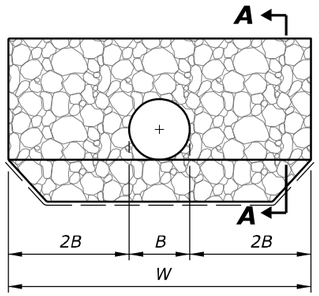
GENERAL NOTES FOR ALL DETAILS:

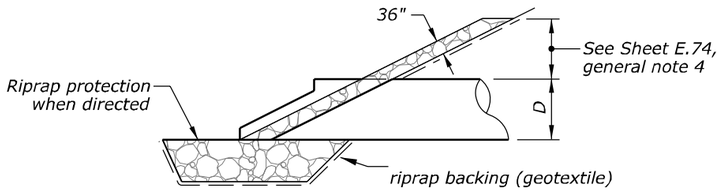
1. All dimensions are subject to necessary tolerances to meet manufacturer's requirements for plate arrangements.
2. See Std. Dwg. E.72 sheet for installation details.
3. All embankment slopes to be warped where required to provide end projections as shown.
4. Minimum elevation of top of riprap at inlet and outlet is one diameter (D) or one foot higher than design headwater or tailwater elevation respectively whichever is greater.
5. Slope protection required for hydraulic installations. See E.75 sheet.
6. $\frac{H}{15}$ and $\frac{H_1}{15}$ only applicable for non-hydraulic applications.
7. Open ends of pipes normally require a site specific design, and may require special treament (Slope ends, culvert embankment protection, paved end slopes, safety end sections, or other measures). See special details or Standard Drawings as called for on plans.
8. Cross-sectional dimensions may vary with different materials.
9. Full bevel cuts are not recommended for multiple radius shaped pipes.
10. For pipes with skew no.'s 50, 70, 110 or 130, omit the top step (Y). (For skew diagram, see E.78 sheet).
11. See E.75 sheet for culvert embankment protection and riprap pads (When reqd.).

SLOPED ENDS FOR METAL PIPE

Designed by: --/---- Checked by: --/----

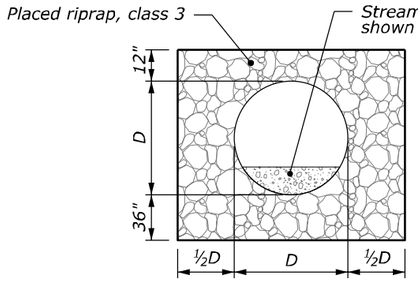
STATE	PROJECT	SHEET NUMBER
OR	DOT 18(2)	E.75

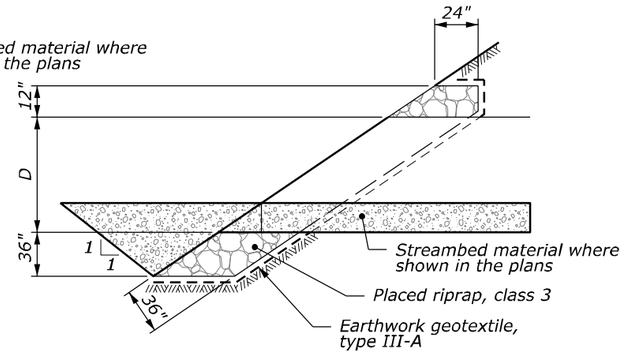




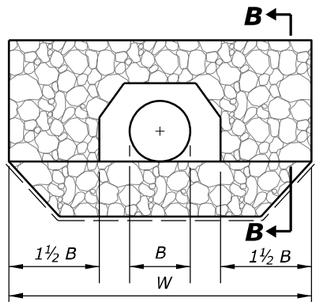
SECTION A-A

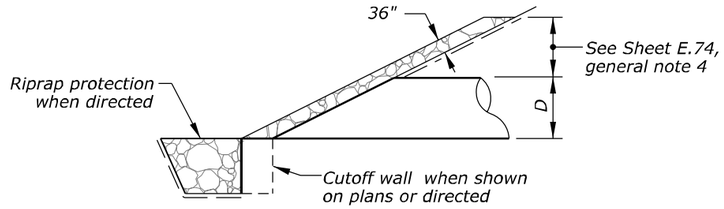
SLOPED OR PROJECTING END





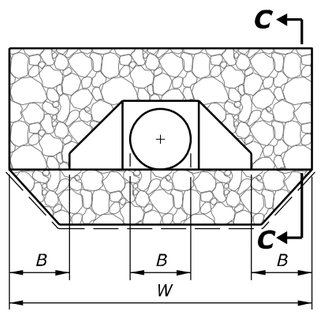
SLOPED OR PROJECTING END WITH STREAMBED MATERIAL

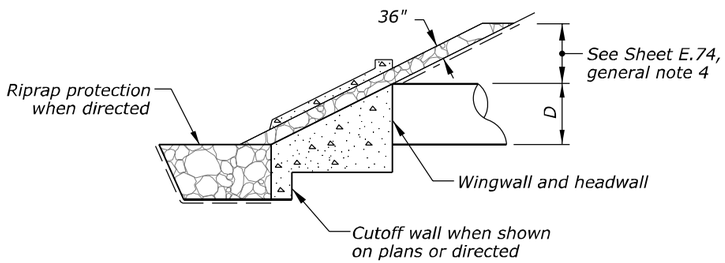




SECTION B-B

SLOPED END WITH SLOPE PAVING





SECTION C-C

HEADWALL AND WINGWALLS

B = Diameter of circular barrel or span of arch pipe, box, or open-bottom arch.
D = Diameter of circular barrel or rise of arch pipe, box, or open-bottom arch.

EMBANKMENT PROTECTION

GENERAL NOTES FOR ALL DETAILS:

1. *See Sheet E.72 for installation details.*
2. *Open ends of pipes normally require a site specific design, and may require special treatment (sloped ends, culvert embankment protection, paved end slopes, safety end sections, or other measures). See special details or Standard Drawings as called for on plans.*

CULVERT EMBANKMENT PROTECTION AND RIPRAP PADS

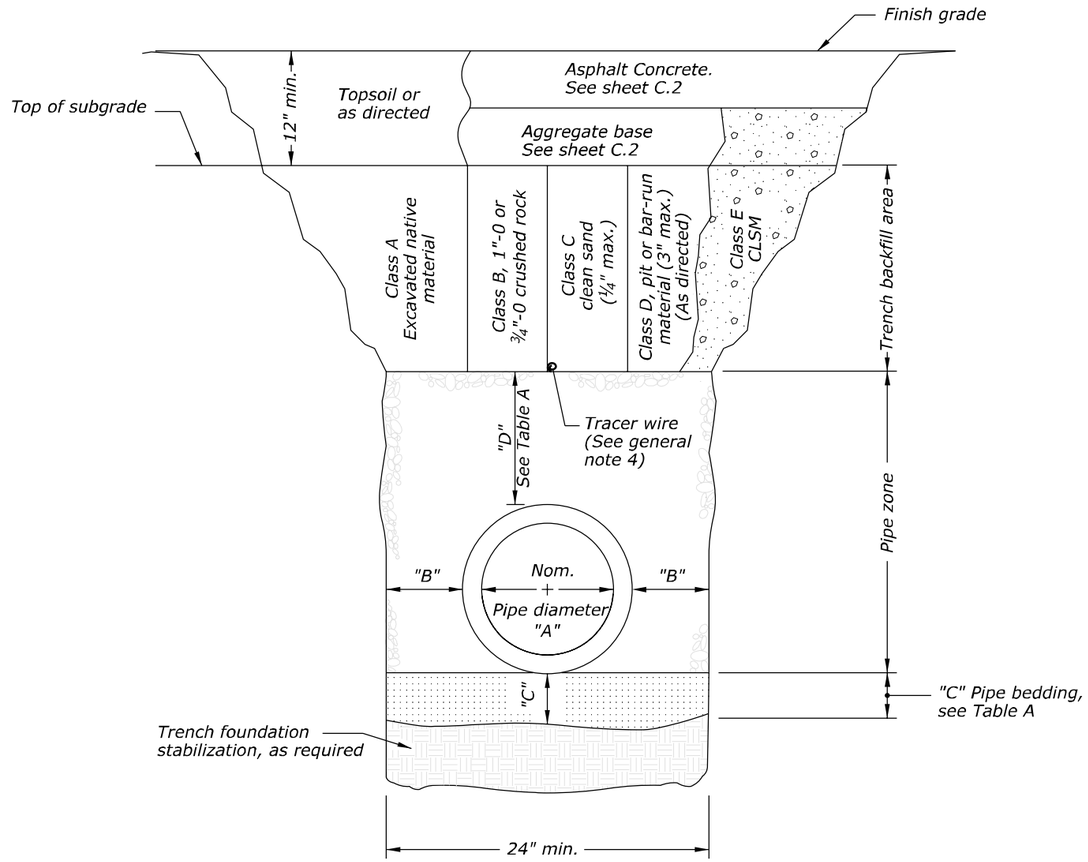
Designed by: --/---- Checked by: --/----

STATE	PROJECT	SHEET NUMBER
OR	DOT 18(2)	E.72

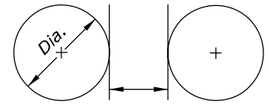
TABLE A

"A" (in)	"B" (in)	"C" (in)	"D" (in)
4	10	4	8
6	10	4	8
8	10	6	10
10	10	6	10
12	12	6	10
15	12	6	10
18	18	6	12
21	16	6	12
24	18	6	12
30	18	6	12
36	24	6	14
42	24	6	14
48	24	6	14
54	24	6	14
60	24	6	14
66	24	6	14
72	24	6	14

For pipes over 72" diameter, see general note 3.



MULTIPLE INSTALLATIONS



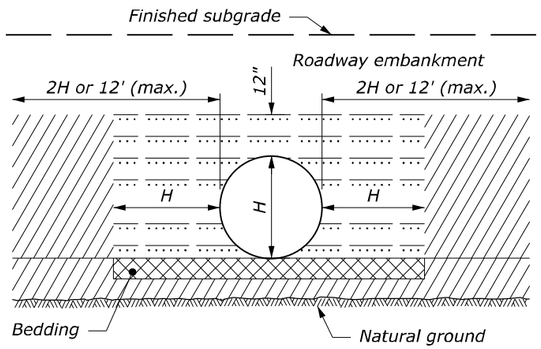
DIAMETER	MIN. SPACE BETWEEN PIPES
Up to 48"	24"
48" to 72"	One half (½) dia. of pipe

GENERAL NOTES FOR ALL DETAILS:

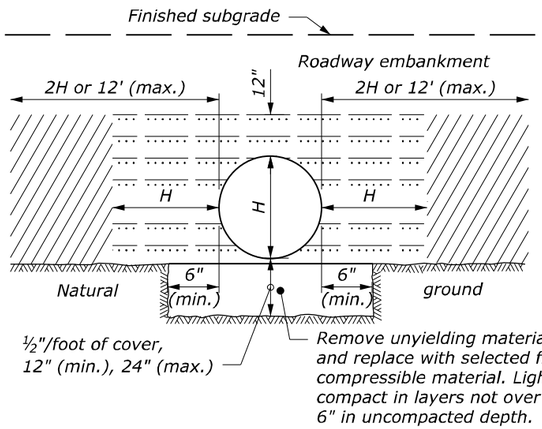
1. Surfacing of paved areas shall comply with street cut, see sheet E.73.
2. For pipe installation in embankment areas where the trench method will not be used and the pipe is ≥ 36" diameter, increase dimension "B" to nominal pipe diameter.
3. Pipes over 72" diameter are structures, and are not applicable to this drawing. See E.101 for pipes over 72" diameter.
4. Tracer wire required Metal Detection or Ground Penetrating Radar. For more info, go to website at https://www.fhwa.dot.gov/utilities/utilityrelo/4.cfm

TRENCH BACKFILL, BEDDING, PIPE ZONE AND MULTIPLE INSTALLATIONS

STATE	PROJECT	SHEET NUMBER
OR	DOT 18(02)	E.101

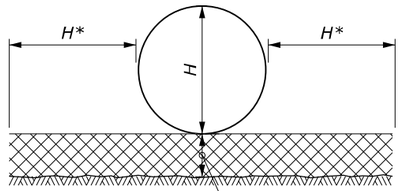


ABOVE NATURAL GROUND

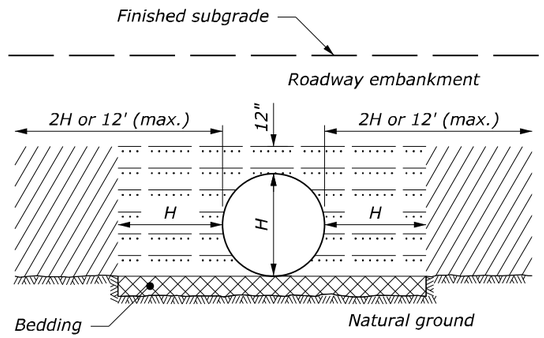


ON UNYIELDING MATERIAL

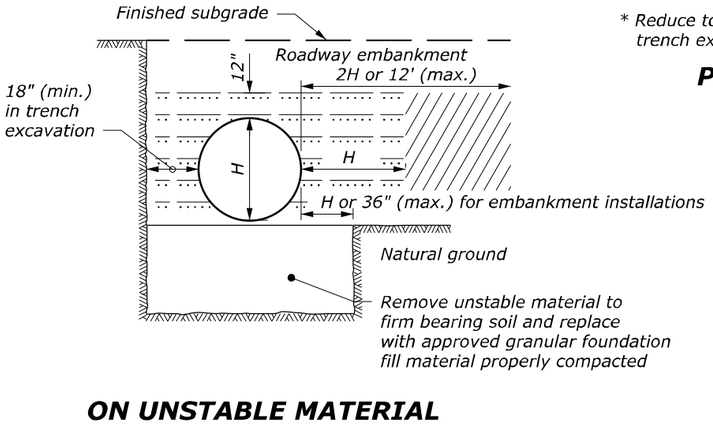
BEDDING DEPTH	
PIPE SIZE (H)	DEPTH
> 54"	6"



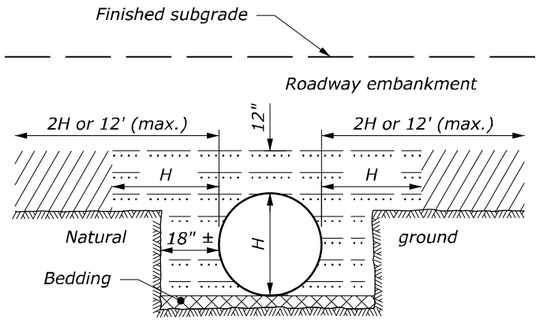
PIPE BEDDING



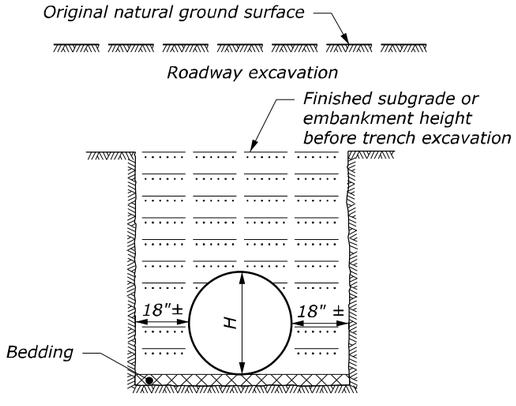
ON NATURAL GROUND



ON UNSTABLE MATERIAL



ABOVE AND BELOW NATURAL GROUND



BELOW NATURAL GROUND OR TRENCH EXCAVATION IN EMBANKMENT

LEGEND:

- Bedding material (uncompacted)
- Embankment material placed in layers not exceeding 6" compacted depth.
- Compacted backfill material placed in layers not exceeding 6" compacted depth; or lean concrete backfill in accordance with Section 614.
- Impermeable backfill material.

NOTE:

1. When directed, camber pipe culverts upward from a chord through the inlet and outlet inverts an ordinate amount equal to 1% of the pipe length. Develop camber on a parabolic curve. If the midpoint elevation on the parabolic curve as designed exceeds the elevation of the inlet invert, reduce the amount of camber or increase the pipe culvert gradient.
2. H equals the diameter of all round pipe culverts or the rise dimension of all pipe arch culverts.
3. See Section 704 for bedding and backfill requirements.

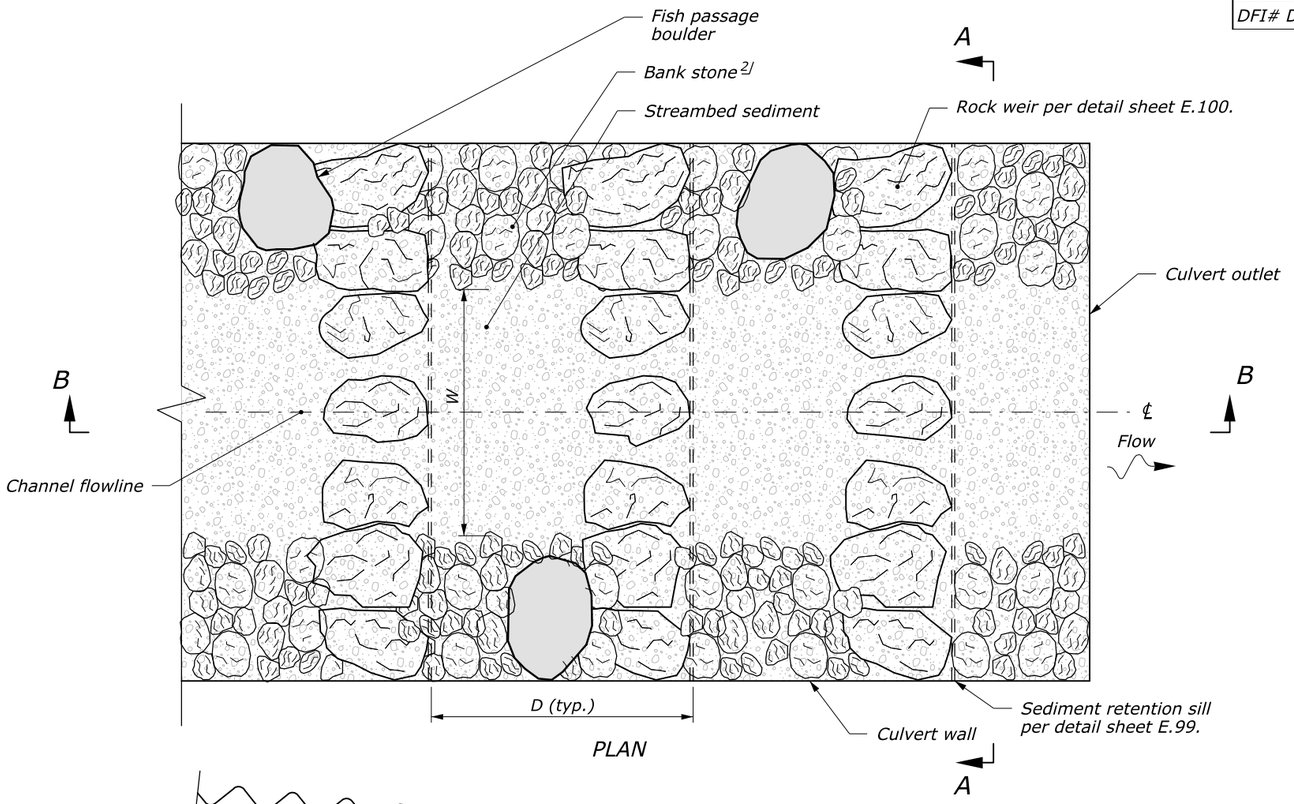
NO SCALE

METAL AND PLASTIC PIPE CULVERT BEDDING

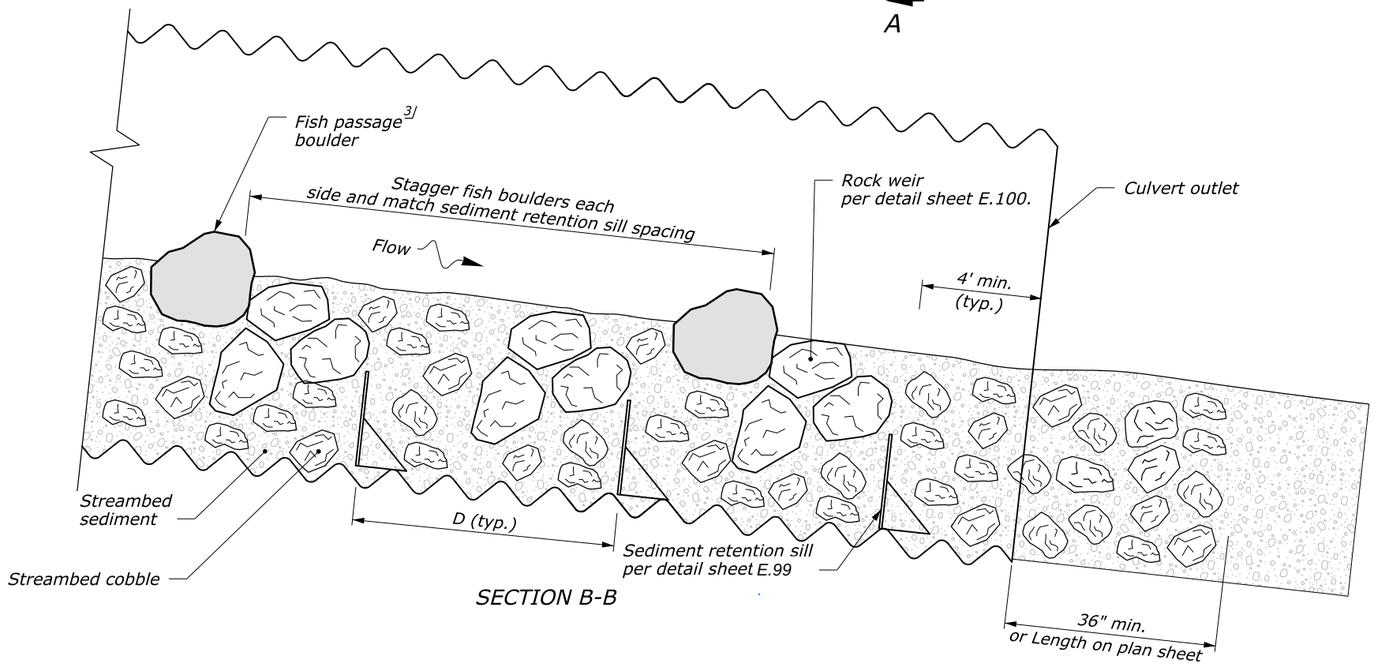
STATE	PROJECT	SHEET NUMBER
OR	DOT 18(2)	E.98

INFILL INFORMATIONAL QUANTITIES 5/

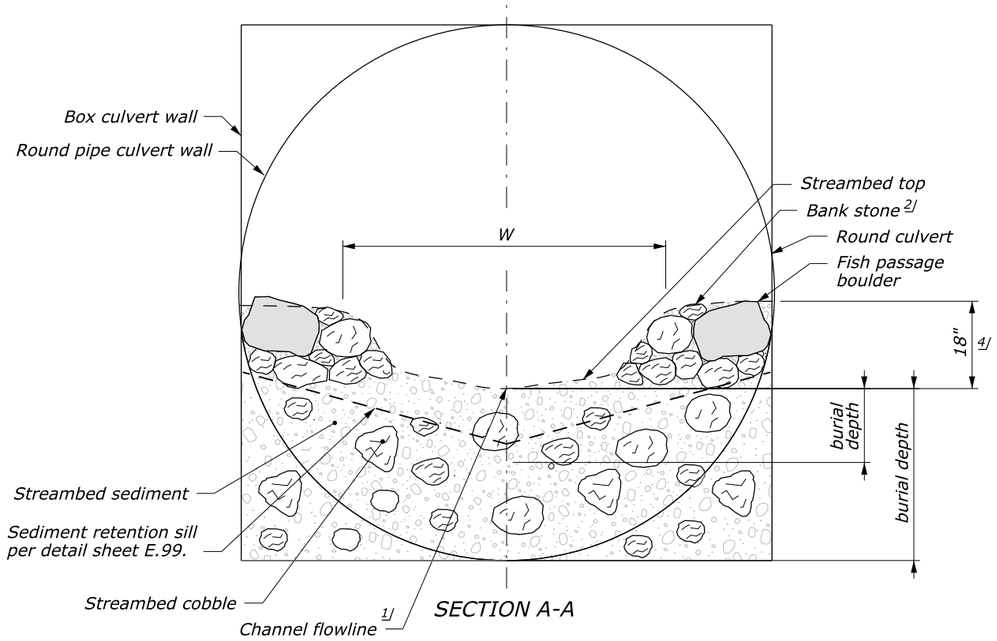
LOCATION	D (ft)	W (ft)	FISH PASSAGE BOULDER DIAMETER (in)
DFI# D027842 (MP 15.51)	7.52	6	12



PLAN



SECTION B-B



SECTION A-A

NOTE:

1. Mix streambed cobbles evenly throughout streambed sediment.
2. See special contract requirements for streambed sediment, streambed cobble, and bank stone gradations.
3. Stagger in-channel fish passage boulder within the culvert span.

FOOTNOTE:

1/ Slope streambed aggregate towards flowline to ensure parabolic shape.

2/ Construct well defined banks with bank stone and streambed sediment where listed in the infill quantities table.

3/ Embed fish passage boulders within active channel ¾ smallest dimension.

4/ 18-inches or as specified on plan sheet.

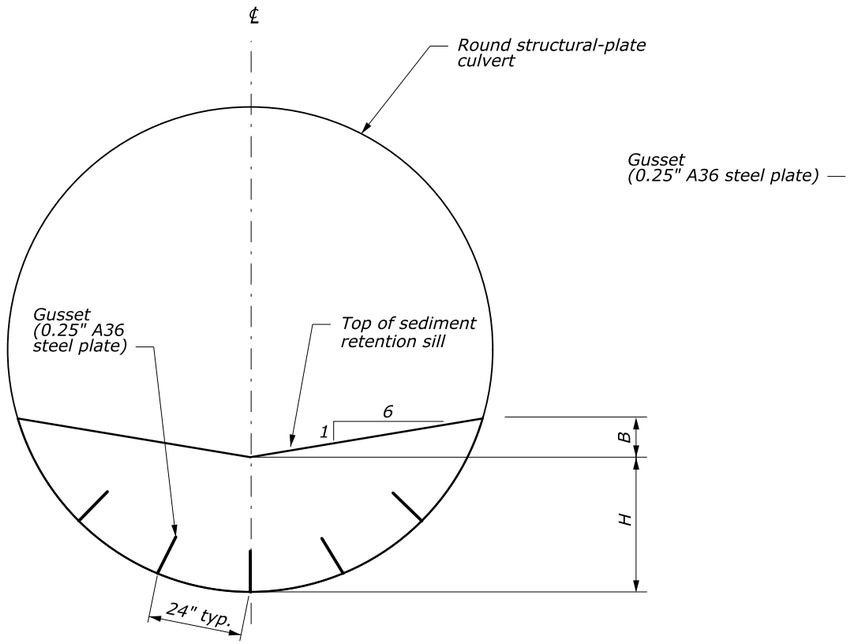
Not to scale

SIMULATED STREAM CULVERT TREATMENT (WITH RETENTION SILLS)

Designed by: -/---- Checked by: -/----

4/23/2021 6:45:16 AM c:\bms\wsp-pb-us-pw-02\wsp__anthony.odonnell\d0219312\OR-01802E98.dgn

STATE	PROJECT	SHEET NUMBER
OR	DOT 18(2)	E.99



SEDIMENT RETENTION SILLS ROUND PIPE CROSS-SECTION

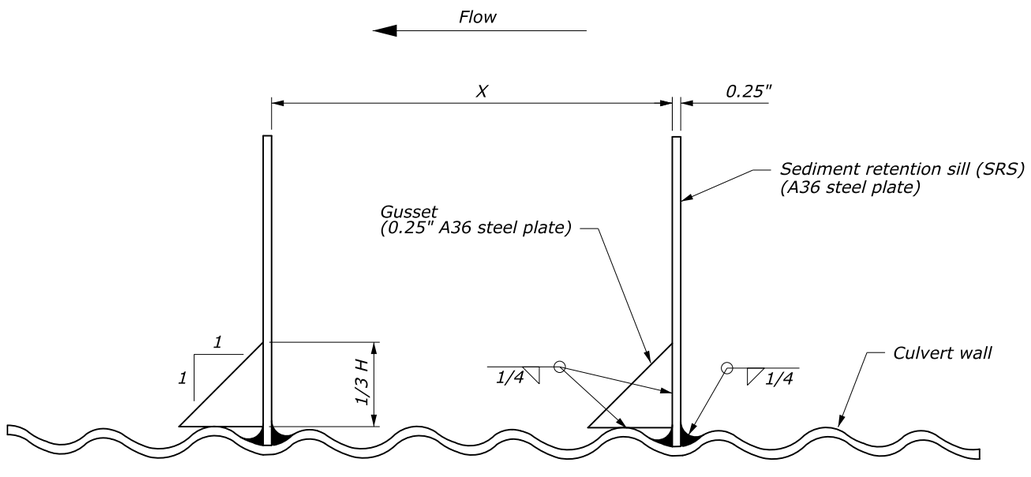


PLATE AND CONNECTOR DETAIL

SEDIMENT RETENTION SILLS

LOCATION	SRS Min. (no.)	B (in)	H (in)	X Max. (in)
MP 15.51	27	6	24	93

NOTE:

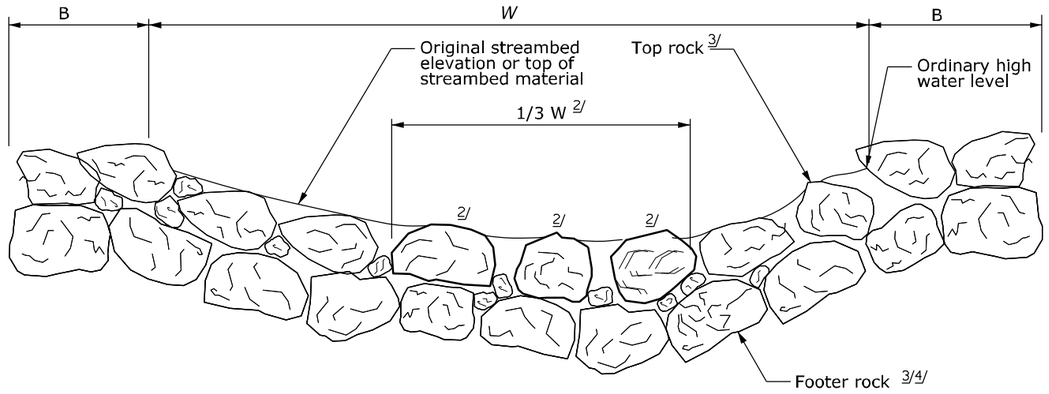
1. Hot dip galvanized baffles and gussets.
2. Apply two coats zinc paint to all welds.
3. X dimension may be varied +/- 6 inches as needed for locating SRS in corrugation valleys or away from plate seems.
4. Dimensions without units are inches.

NO SCALE

STRUCTURAL-PLATE CULVERT SEDIMENT RETENTION SILL DETAILS

Designed by: --/---
Checked by: --/---
4/23/2021 6:28:38 AM c:\bms\wsp-pb-us-pw-02\wsp__anthony.odonnell\d0219312\OR-01802E99.dgn

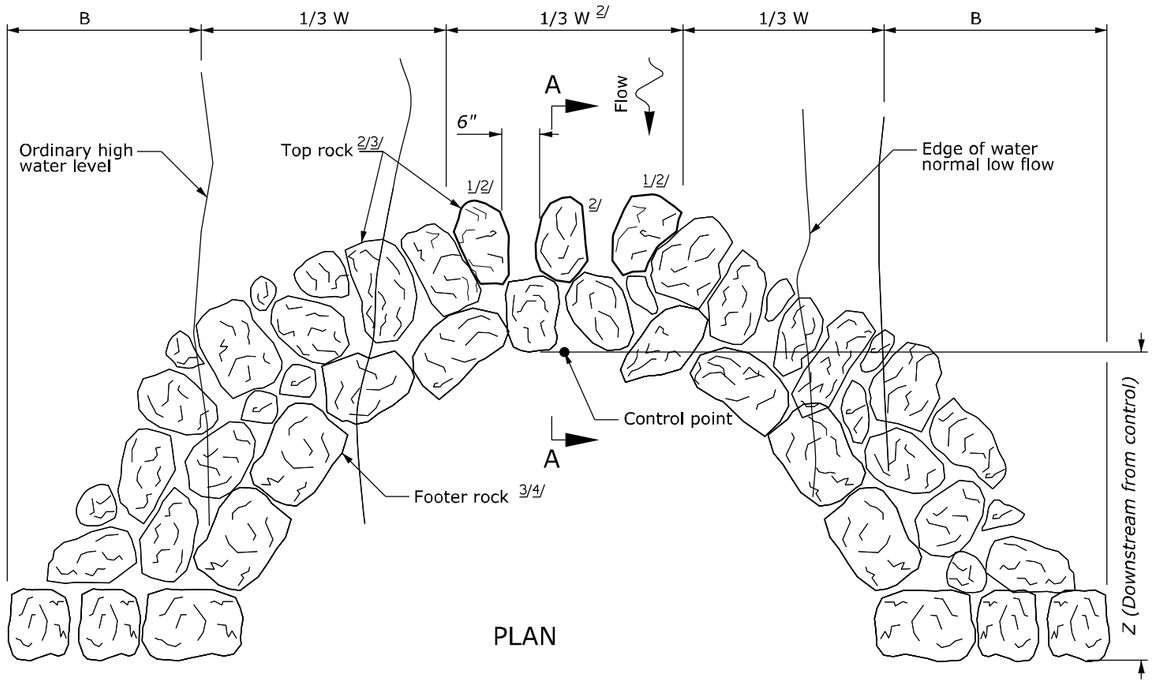
STATE	PROJECT	SHEET NUMBER
OR	DOT 18(2)	E.100



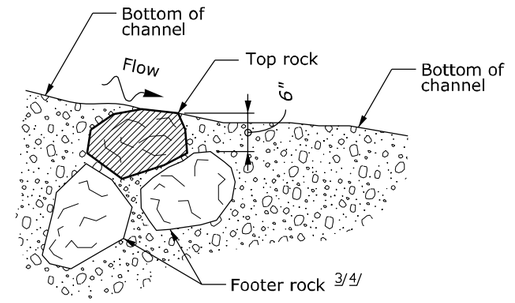
ELEVATION

ROCK WEIR INFORMATION

LOCATION	W (ft)	B (ft)	Z (ft)	TOP ROCK AND FOOTER ROCK DIAMETER (in)
D027842 (Inside Culvert)	6	1	0 5/	12±4
D027842 (Outside Culvert)	7	2	2	12±4



PLAN



SECTION A-A

NOTE:

1. Dimensions not labeled are in inches.

FOOTNOTE:

1/ Orient top rocks to deflect water towards center of stream.

2/ Space top rocks in center 1/3 only.

3/ Fill voids in top rock and footer rock with specified streambed material.

4/ Place footer rocks close together to create a tightly packed and stable foundation for the top rocks.

5/ Align footer rocks flush against bed retention sills inside culvert.

Not to scale

ROCK WEIR DETAIL

Designed by: James Neighorn 04/2012 | Checked by: Ninh Phan 06/2012

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(Existing Culvert Hydraulics)

HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: User Defined

Table 1 - Summary of Culvert Flows at Crossing: D027842 (MP15.51) Extg

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	D027842 (MP 15.51) Extg Discharge (cfs)	Roadway Discharge (cfs)	Iterations
1004.95	Oct 95% Exceedance	0.10	0.10	0.00	1
1005.53	Jan 5% Exceedance	2.79	2.79	0.00	1
1006.94	Q10	19.99	19.99	0.00	1
1007.43	Q50	27.16	27.16	0.00	1
1007.64	Q100	30.16	30.16	0.00	1
1014.23	Overtopping	83.49	83.49	0.00	Overtopping

Note: The 95% flow is close to zero and a value of 0.1 is used to avoid computation errors in HY8.

Rating Curve Plot for Crossing: D027842 (MP15.51) Extg

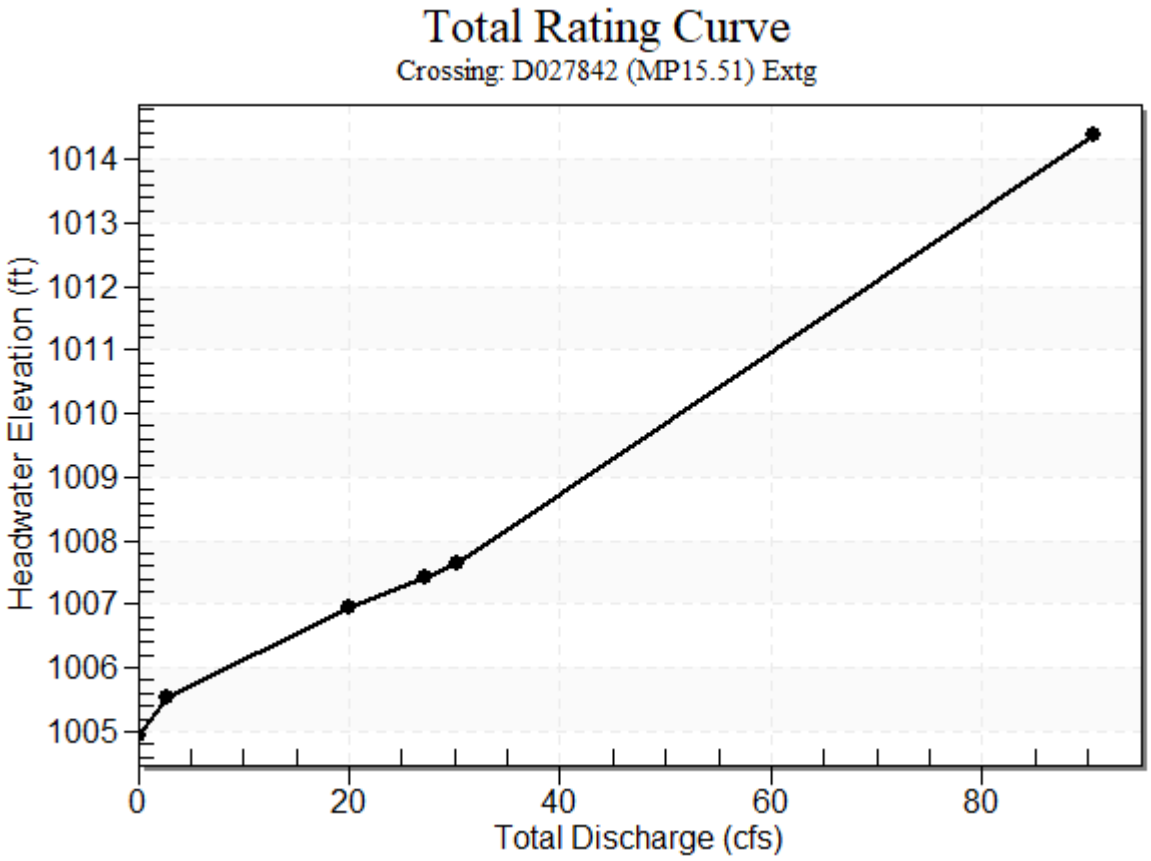


Table 2 - Culvert Summary Table: D027842 (MP 15.51) Extg

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)
Oct 95% Exceedance	0.10	0.10	1004.95	0.130	0.0*	1-S2n	0.069	0.097	0.069	0.026	2.286
Jan 5% Exceedance	2.79	2.79	1005.53	0.715	0.0*	1-S2n	0.347	0.520	0.347	0.196	6.115
Q10	19.99	19.99	1006.94	2.121	0.0*	1-S2n	0.922	1.435	0.922	0.647	10.841
Q50	27.16	27.16	1007.43	2.614	0.0*	1-S2n	1.083	1.684	1.083	0.779	11.810
Q100	30.16	30.16	1007.64	2.825	0.0*	1-S2n	1.146	1.779	1.131	0.830	12.365

* Full Flow Headwater elevation is below inlet invert.

****

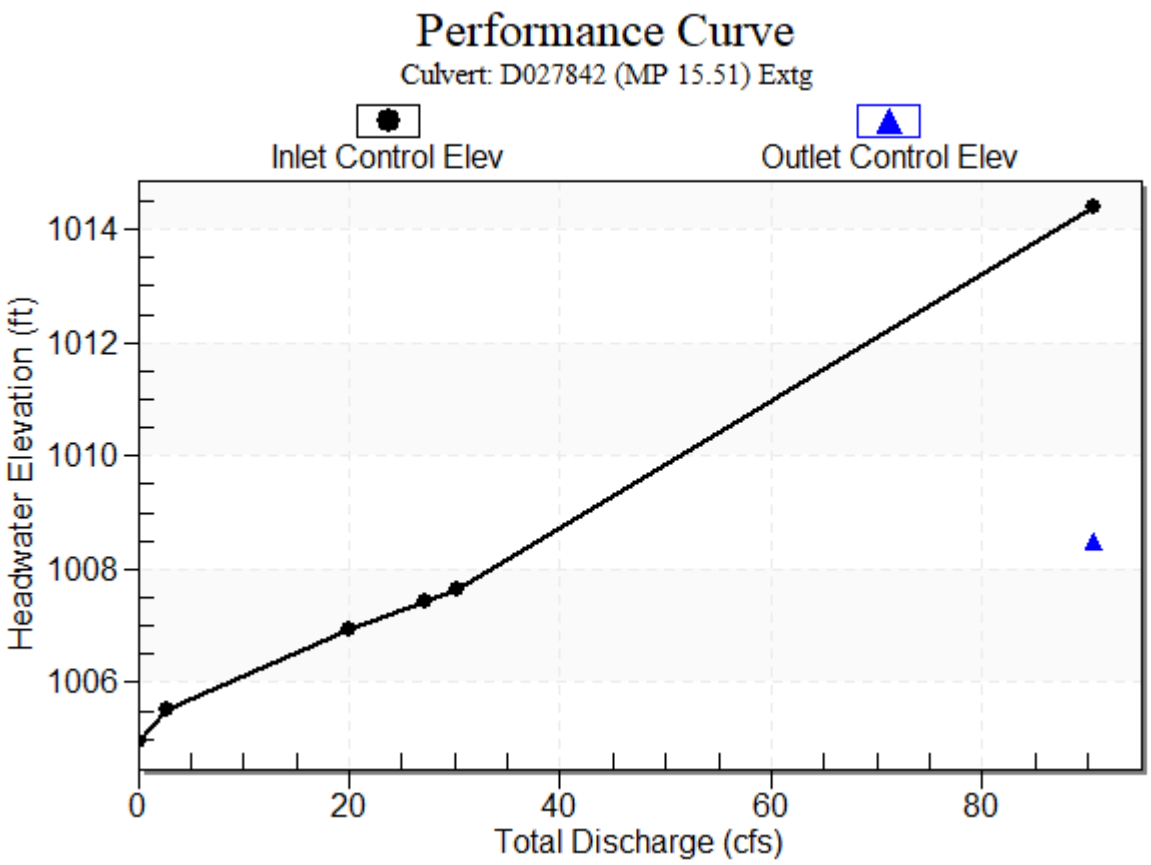
Straight Culvert

Inlet Elevation (invert): 1004.82 ft, Outlet Elevation (invert): 990.99 ft

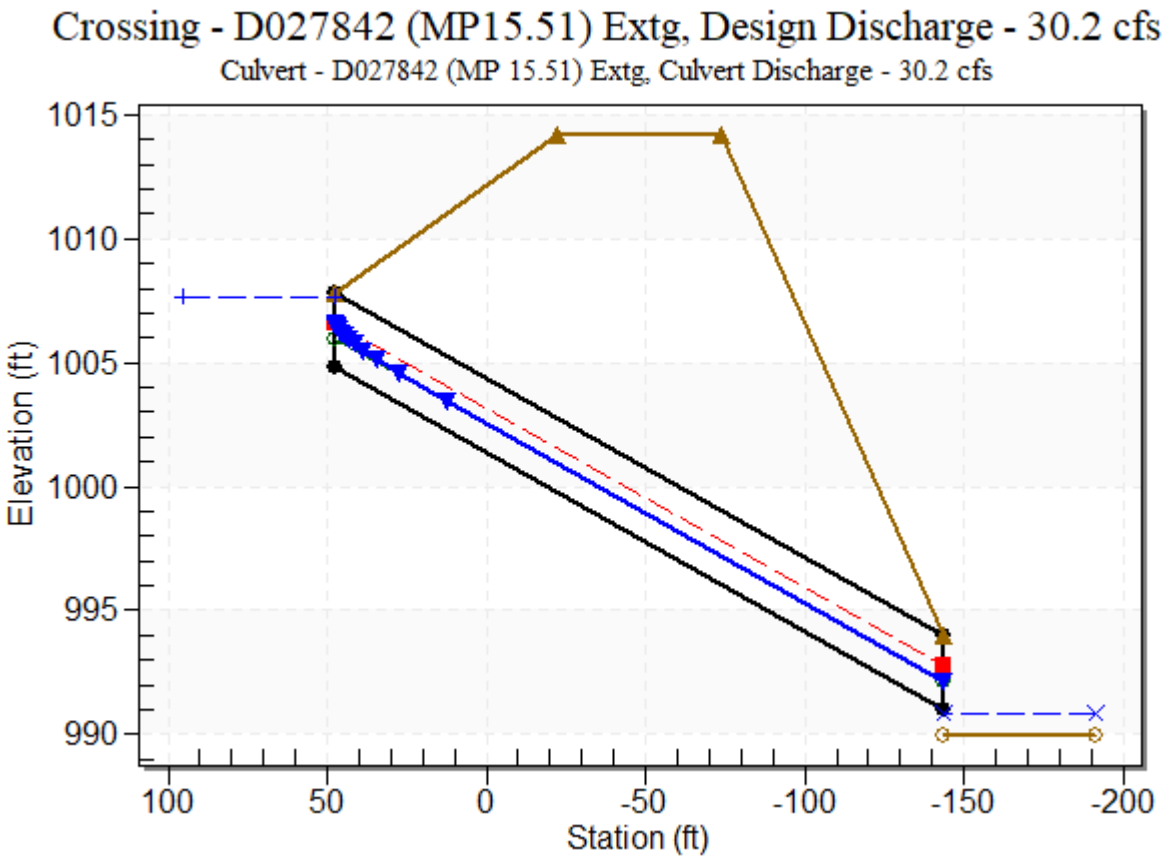
Culvert Length: 191.40 ft, Culvert Slope: 0.0724

****

Culvert Performance Curve Plot: D027842 (MP 15.51) Extg



Water Surface Profile Plot for Culvert: D027842 (MP 15.51) Extg



Site Data - D027842 (MP 15.51) Extg

Site Data Option: Culvert Invert Data

Inlet Station: 47.39 ft

Inlet Elevation: 1004.82 ft

Outlet Station: -143.51 ft

Outlet Elevation: 990.99 ft

Number of Barrels: 1

Culvert Data Summary - D027842 (MP 15.51) Extg

Barrel Shape: Circular

Barrel Diameter: 3.00 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting

Inlet Depression: None

Table 3 - Downstream Channel Rating Curve (Crossing: D027842 (MP15.51) Extg)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
0.10	990.02	0.03	0.54	0.07	0.59
2.79	990.19	0.20	1.99	0.51	0.80
19.99	990.64	0.65	4.15	1.69	0.94
27.16	990.77	0.78	4.62	2.04	0.95
30.16	990.82	0.83	4.79	2.18	0.96

Tailwater Channel Data - D027842 (MP15.51) Extg

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 7.00 ft

Side Slope (H:V): 0.70 (_:1)

Channel Slope: 0.0420

Channel Manning's n: 0.0500

Channel Invert Elevation: 989.99 ft

Roadway Data for Crossing: D027842 (MP15.51) Extg

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 30.00 ft

Crest Elevation: 1014.23 ft

Roadway Surface: Paved

Roadway Top Width: 52.00 ft

AOP Design Flow Chart (HEC-26)

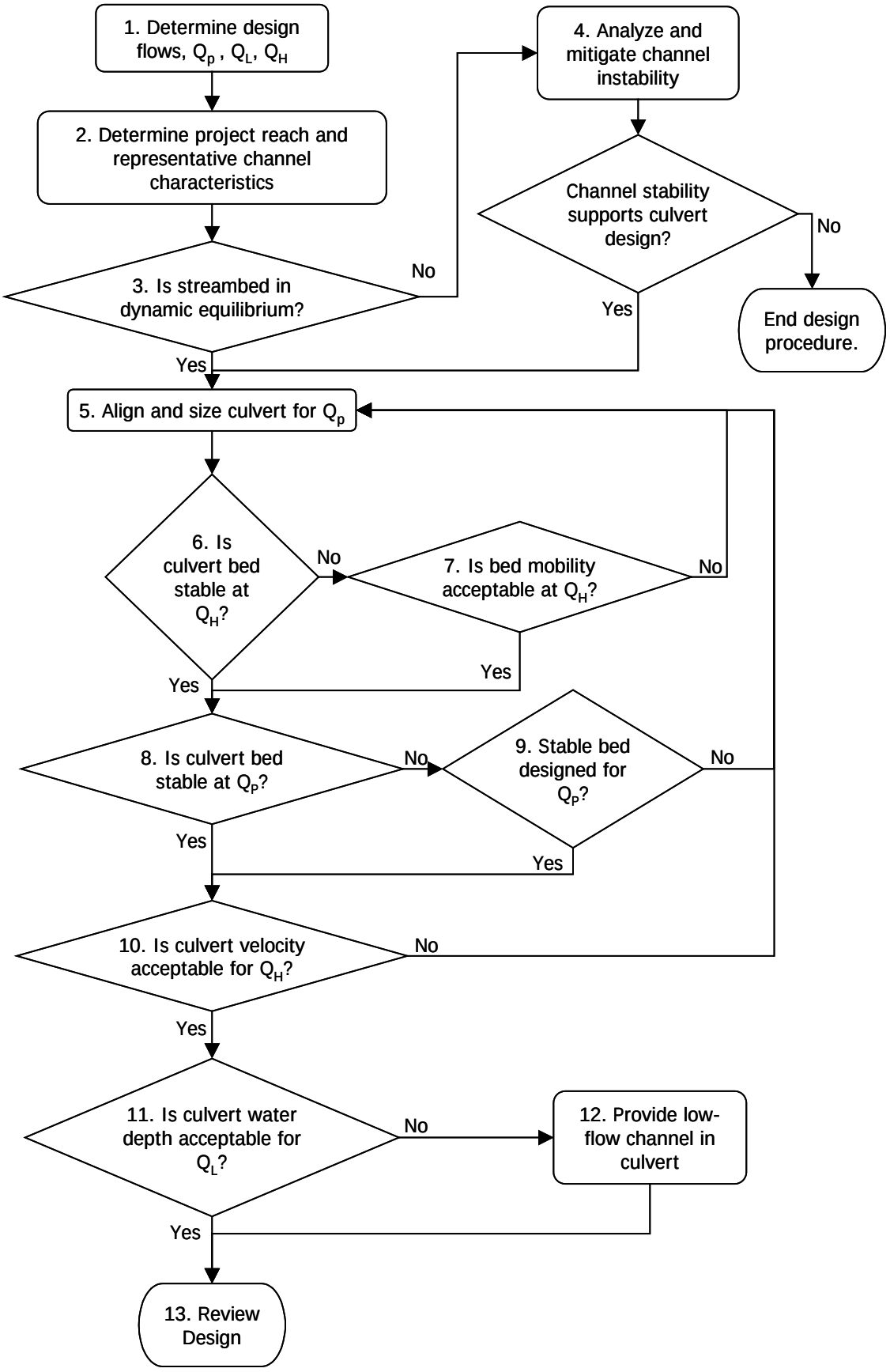


Figure 7.1. Design Procedure Overview.

(Proposed Culvert Hydraulics and AOP Modeling)
HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: User Defined

Table 1 - Summary of Culvert Flows at Crossing: D027842 (MP15.51) Proposed

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	D027842 (MP 15.51) Proposed Discharge (cfs)	Roadway Discharge (cfs)	Iterations
1005.01	Oct 95% Exceedance	0.10	0.10	0.00	1
1005.11	Jan 5% Exceedance	2.79	2.79	0.00	1
1005.69	Q10	19.99	19.99	0.00	1
1005.91	Q50	27.16	27.16	0.00	1
1006.00	Q100	30.16	30.16	0.00	1
1014.23	Overtopping	382.10	382.10	0.00	Overtopping

Rating Curve Plot for Crossing: D027842 (MP15.51) Proposed

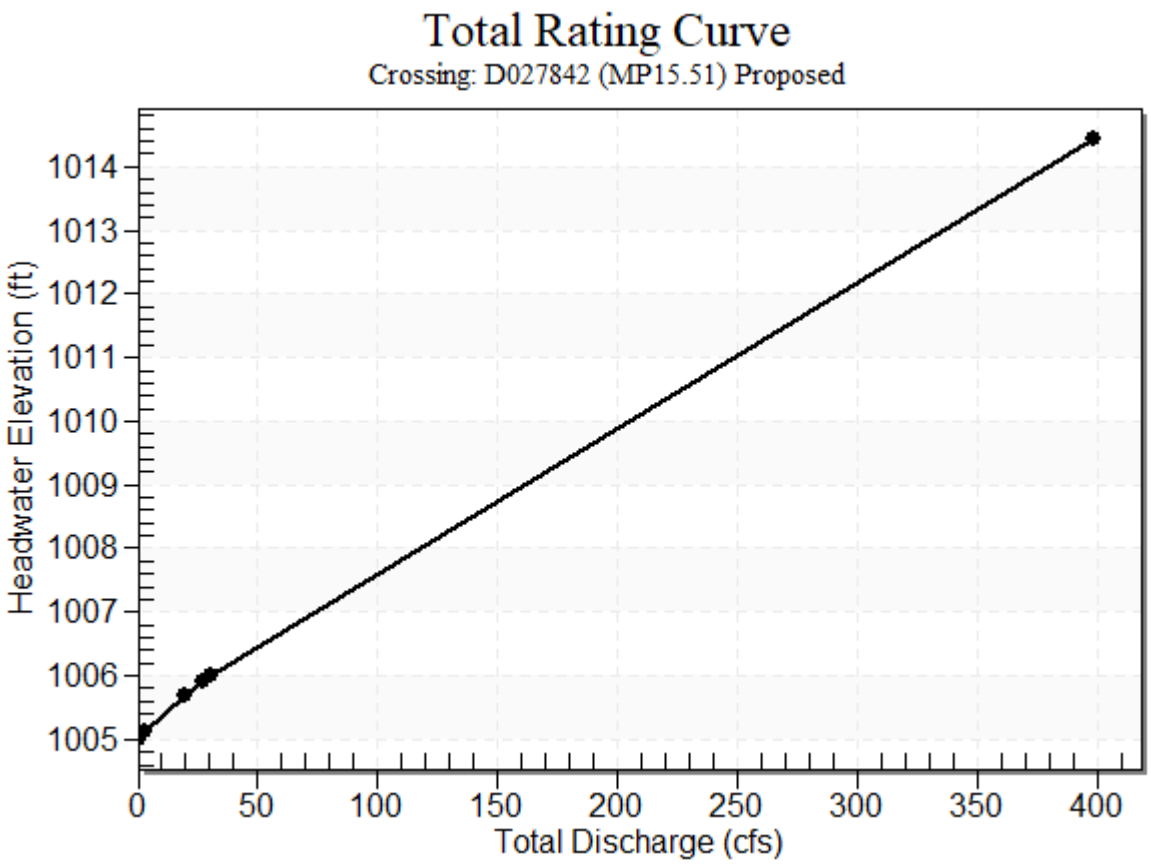


Table 2 - Culvert Summary Table: D027842 (MP 15.51) Proposed

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)
Oct 95% Exceedance	0.10	0.10	1005.01	0.191	0.0*	1-S2n	0.005	0.018	0.016	0.026	0.833
Jan 5% Exceedance	2.79	2.79	1005.11	0.289	0.0*	1-S2n	0.128	0.162	0.128	0.196	2.861
Q10	19.99	19.99	1005.69	0.872	0.0*	1-S2n	0.421	0.592	0.421	0.647	6.123
Q50	27.16	27.16	1005.91	1.091	0.0*	1-S2n	0.511	0.725	0.511	0.779	6.829
Q100	30.16	30.16	1006.00	1.179	0.0*	1-S2n	0.544	0.776	0.544	0.830	7.117

* Full Flow Headwater elevation is below inlet invert.

****

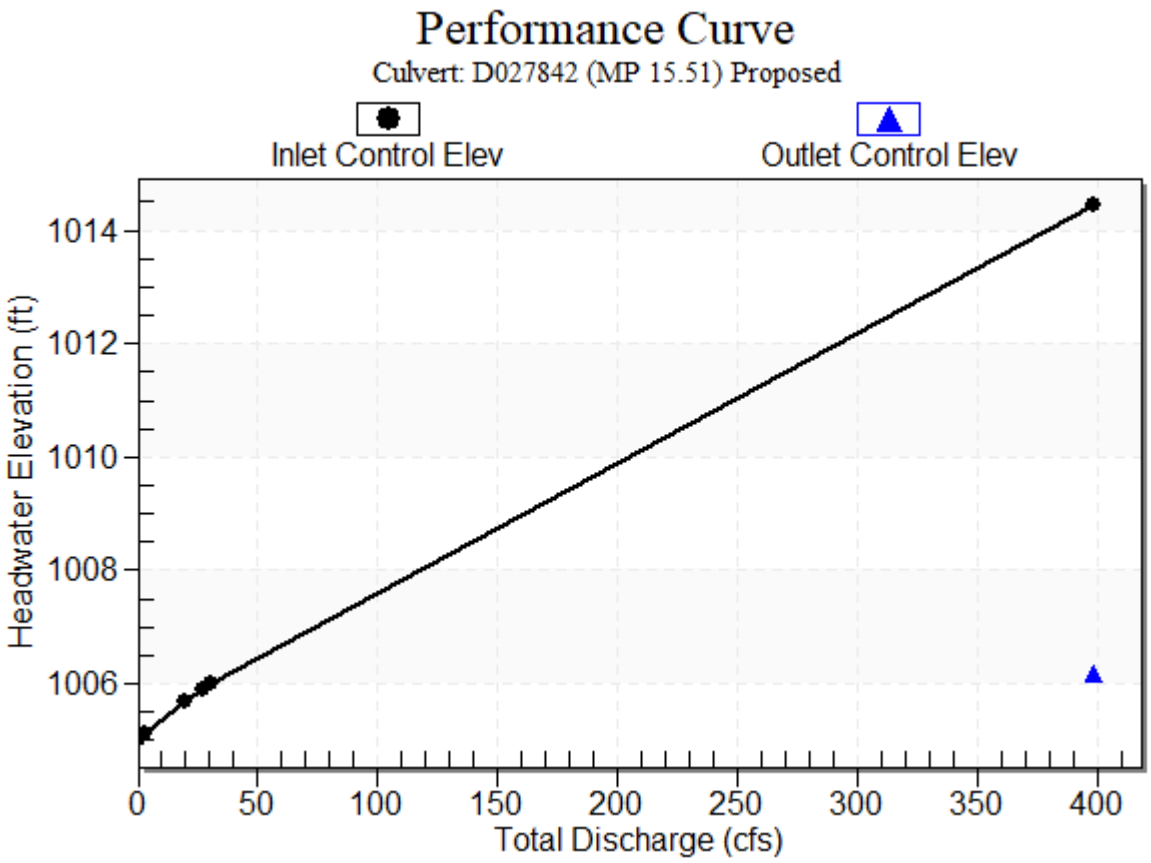
Straight Culvert

Inlet Elevation (invert): 1004.82 ft, Outlet Elevation (invert): 990.99 ft

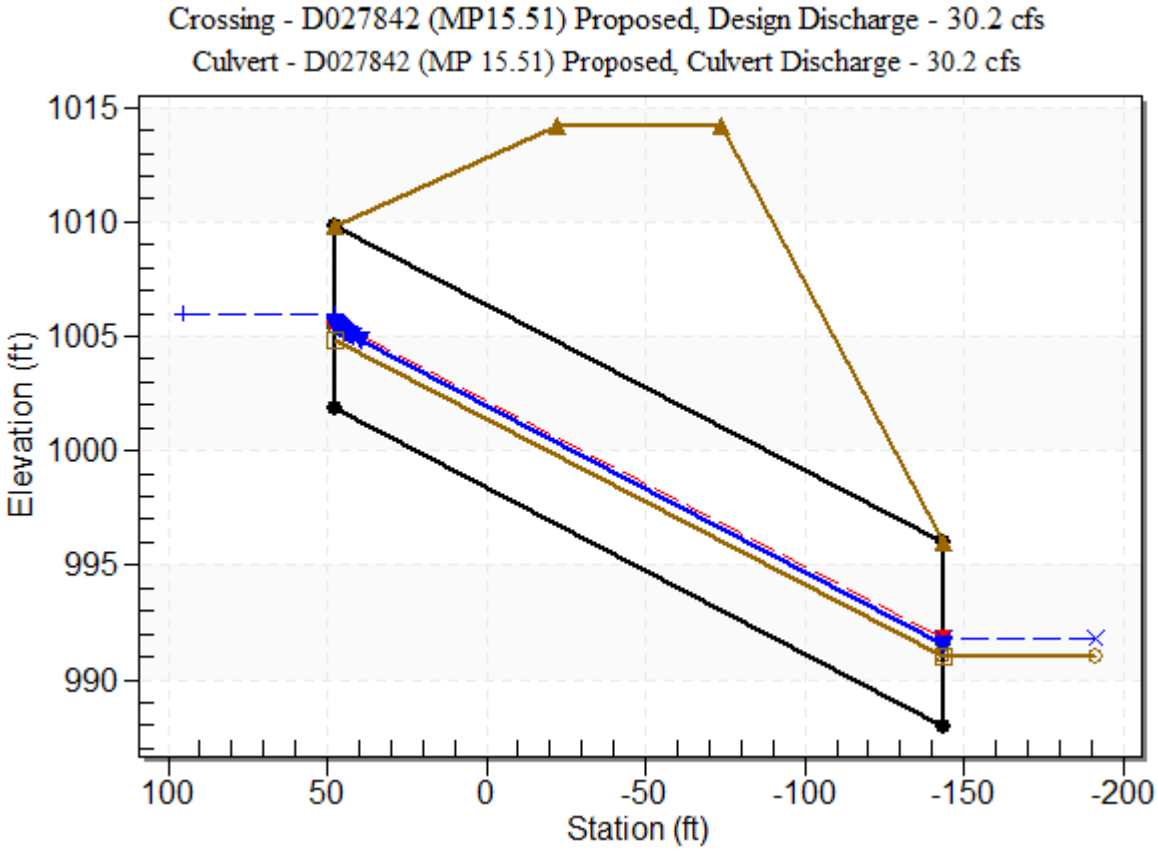
Culvert Length: 191.40 ft, Culvert Slope: 0.0724

****

Culvert Performance Curve Plot: D027842 (MP 15.51) Proposed



Water Surface Profile Plot for Culvert: D027842 (MP 15.51) Proposed



Site Data - D027842 (MP 15.51) Proposed

Site Data Option: Culvert Invert Data

Inlet Station: 47.39 ft

Inlet Elevation: 1001.82 ft

Outlet Station: -143.51 ft

Outlet Elevation: 987.99 ft

Number of Barrels: 1

Culvert Data Summary - D027842 (MP 15.51) Proposed

Barrel Shape: Circular

Barrel Diameter: 8.00 ft

Barrel Material: Corrugated Steel

Embedment: 36.00 in

Barrel Manning's n: 0.0240 (top and sides)

Manning's n: 0.0350 (bottom)

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Table 3 - Downstream Channel Rating Curve (Crossing: D027842 (MP15.51)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
0.10	991.02	0.03	0.54	0.07	0.59
2.79	991.19	0.20	1.99	0.51	0.80
19.99	991.64	0.65	4.15	1.69	0.94
27.16	991.77	0.78	4.62	2.04	0.95
30.16	991.82	0.83	4.79	2.18	0.96

Tailwater Channel Data - D027842 (MP15.51) Proposed

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 7.00 ft

Side Slope (H:V): 0.70 (_:1)

Channel Slope: 0.0420

Channel Manning's n: 0.0500

Channel Invert Elevation: 990.99 ft

Roadway Data for Crossing: D027842 (MP15.51) Proposed

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 30.00 ft

Crest Elevation: 1014.23 ft

Roadway Surface: Paved

Roadway Top Width: 52.00 ft

AOP Reach Data

AOP Discharges

Low AOP Flow: 0.10 cfs

High AOP Flow: 2.79 cfs

Peak AOP Flow: 30.16 cfs

Embedment Depth Check

Embedment Depth is Acceptable

Embedment Depth: 3.00 ft

Acceptable Embedment Depth: 3.00 ft

Shear computed in Reach and Culvert Barrel

Bed is Stable under High Flow

Bed Mobility is Acceptable under High Flow

Shear Applied to Culvert Bed under High Flow: 0.60 lb/ft^2

Shear Permissible to Culvert Bed's Upper Layer: 0.77 lb/ft^2

Maximum Shear Applied to Reach Cross-Sections under High Flow: 1.70 lb/ft^2

Bed is NOT Stable under Peak Flow

Lower Layer Bed is Stable under Peak Flow

Shear Applied to Culvert Bed under Peak Flow: 2.41 lb/ft^2

Shear Permissible to Culvert Bed's Lower Layer: 2.41 lb/ft^2

Maximum Shear Applied to Reach Cross-Sections under Peak Flow: 4.66 lb/ft^2

Velocity computed in Reach and Culvert Barrel

Culvert Velocity is Acceptable

Maximum Velocity within Culvert under High Flow: 1.46 ft/s

Maximum Velocity within Reach Cross-Sections under High Flow: 4.00 ft/s

Velocity computed in Reach and Culvert Barrel

Culvert Depth is Acceptable

Minimum Depth within Culvert under Low Flow: 0.52 ft

Minimum Depth within Reach Cross-Sections under Low Flow: 0.06 ft

Low Flow Channel Depth: 0.50 ft

Low Flow Channel Side Slope: 8.00 ft

AOP Reach Cross Sections

AOP Reach Upstream Cross Sections

Number of Cross-Sections: 3

Cross Section at Station 102.39

Channel Analysis: AA

Notes:

Input Parameters

Channel Type: Custom Cross Section

Cross Section Data

Elevation (ft)	Elevation (ft)	Manning's n
-20.00	1014.43	0.0359
-14.93	1013.87	0.0359
-5.00	1011.14	0.0359
-2.86	1010.62	0.0359
-2.16	1009.82	0.0359
-1.65	1008.14	0.0359
-0.59	1008.40	0.0359
0.00	1008.46	0.0359
0.47	1008.46	0.0359
2.00	1008.35	0.0359
2.92	1010.15	0.0359
3.40	1011.09	0.0359
5.95	1012.40	0.0359
18.01	1015.31	0.0359
20.00	1016.70	-----

Longitudinal Slope: 0.0600 ft/ft

Flow: 30.1600 cfs

Result Parameters

Depth: 1.1914 ft

Area of Flow: 3.9455 ft^2

Wetted Perimeter: 6.0357 ft

Hydraulic Radius: 0.6537 ft

Average Velocity: 7.6442 ft/s

Top Width: 4.5133 ft

Froude Number: 1.4408

Critical Depth: 1.4433 ft

Critical Velocity: 5.9043 ft/s

Critical Slope: 0.0285 ft/ft

Critical Top Width: 4.72 ft

Calculated Max Shear Stress: 4.4606 lb/ft^2

Calculated Avg Shear Stress: 2.4474 lb/ft^2

Composite Manning's n Equation: Lotter method

Manning's n: 0.0359

Cross Section at Station 87.39

Channel Analysis: BB

Notes:

Input Parameters

Channel Type: Custom Cross Section

Cross Section Data

Elevation (ft)	Elevation (ft)	Manning's n
-20.00	1014.68	0.0355
-13.51	1013.22	0.0355
-10.51	1012.59	0.0355
-9.58	1012.27	0.0355
-9.35	1012.21	0.0355
-4.69	1010.56	0.0355
-4.49	1010.34	0.0355
-1.11	1007.42	0.0355
-0.58	1007.41	0.0355
0.00	1007.24	0.0355
0.82	1007.30	0.0355
1.25	1007.27	0.0355
3.47	1010.43	0.0355
3.84	1011.05	0.0355
9.26	1015.63	0.0355
20.00	1022.96	-----

Longitudinal Slope: 0.0475 ft/ft

Flow: 30.1600 cfs

Result Parameters

Depth: 1.2799 ft

Area of Flow: 4.0835 ft^2

Wetted Perimeter: 5.5977 ft

Hydraulic Radius: 0.7295 ft

Average Velocity: 7.3858 ft/s

Top Width: 4.5113 ft

Froude Number: 1.3680

Critical Depth: 1.5137 ft

Critical Velocity: 5.8124 ft/s

Critical Slope: 0.0247 ft/ft

Critical Top Width: 4.95 ft

Calculated Max Shear Stress: 3.7936 lb/ft^2

Calculated Avg Shear Stress: 2.1622 lb/ft^2

Composite Manning's n Equation: Lotter method

Manning's n: 0.0355

Cross Section at Station 67.39

Channel Analysis: CC

Notes:

Input Parameters

Channel Type: Custom Cross Section

Cross Section Data

Elevation (ft)	Elevation (ft)	Manning's n
-20.00	1013.85	0.0367
-15.21	1013.24	0.0367
-10.90	1011.80	0.0367
-4.45	1009.71	0.0367
-2.59	1007.76	0.0367
-1.79	1006.30	0.0367
-1.38	1006.36	0.0367
0.00	1006.31	0.0367
0.48	1006.29	0.0367
0.93	1006.30	0.0367
4.46	1008.89	0.0367
5.22	1009.51	0.0367
20.00	1019.99	-----

Longitudinal Slope: 0.0735 ft/ft

Flow: 30.1600 cfs

Result Parameters

Depth: 1.0166 ft

Area of Flow: 3.6479 ft^2

Wetted Perimeter: 5.5753 ft

Hydraulic Radius: 0.6543 ft

Average Velocity: 8.2678 ft/s

Top Width: 4.6436 ft

Froude Number: 1.6439

Critical Depth: 1.3503 ft

Critical Velocity: 5.6868 ft/s

Critical Slope: 0.0260 ft/ft

Critical Top Width: 5.28 ft

Calculated Max Shear Stress: 4.6627 lb/ft^2

Calculated Avg Shear Stress: 3.0008 lb/ft^2

Composite Manning's n Equation: Lotter method

Manning's n: 0.0367

AOP Reach Downstream Cross Sections

Number of Cross-Sections: 3

Station: -213.51 ft

Channel Analysis: DD

Notes:

Input Parameters

Channel Type: Custom Cross Section

Cross Section Data

Elevation (ft)	Elevation (ft)	Manning's n
-20.00	987.81	0.0369
-16.56	987.51	0.0369
-7.77	987.03	0.0369
-6.83	986.64	0.0369
-2.14	986.13	0.0369
-0.53	985.96	0.0369
0.00	985.88	0.0369
0.72	986.12	0.0369
1.44	986.10	0.0369
2.44	987.38	0.0369
3.21	987.44	0.0369
4.67	988.32	0.0369
9.39	991.58	0.0369
19.00	994.93	0.0369
20.00	995.22	-----

Longitudinal Slope: 0.0400 ft/ft

Flow: 30.1600 cfs

Result Parameters

Depth: 0.9844 ft

Area of Flow: 5.5226 ft^2

Wetted Perimeter: 9.9074 ft

Hydraulic Radius: 0.5574 ft

Average Velocity: 5.4612 ft/s

Top Width: 9.4081 ft

Froude Number: 1.2561

Critical Depth: 1.0868 ft

Critical Velocity: 4.6379 ft/s

Critical Slope: 0.0244 ft/ft

Critical Top Width: 9.73 ft

Calculated Max Shear Stress: 2.4571 lb/ft^2

Calculated Avg Shear Stress: 1.3913 lb/ft^2

Composite Manning's n Equation: Lotter method

Manning's n: 0.0369

Station: -233.51 ft

Channel Analysis: EE

Notes:

Input Parameters

Channel Type: Custom Cross Section

Cross Section Data

Elevation (ft)	Elevation (ft)	Manning's n
-20.00	987.16	0.0362
-8.40	985.95	0.0362
-4.37	985.90	0.0362
-0.96	985.51	0.0362
-0.37	985.15	0.0362
0.00	985.08	0.0362
0.49	985.20	0.0362
0.98	985.18	0.0362
5.23	988.55	0.0362
9.51	990.88	0.0362
15.07	992.46	0.0362
19.04	994.13	0.0362
20.00	994.39	-----

Longitudinal Slope: 0.0595 ft/ft

Flow: 30.1600 cfs

Result Parameters

Depth: 1.1041 ft

Area of Flow: 5.4740 ft^2

Wetted Perimeter: 13.3972 ft

Hydraulic Radius: 0.4086 ft

Average Velocity: 5.5097 ft/s

Top Width: 12.8901 ft

Froude Number: 1.4900

Critical Depth: 1.2461 ft

Critical Velocity: 4.0675 ft/s

Critical Slope: 0.0251 ft/ft

Critical Top Width: 14.43 ft

Calculated Max Shear Stress: 4.0991 lb/ft^2

Calculated Avg Shear Stress: 1.5170 lb/ft^2

Composite Manning's n Equation: Lotter method

Manning's n: 0.0362

Station: -253.51 ft

Channel Analysis: FF

Notes:

Input Parameters

Channel Type: Custom Cross Section

Cross Section Data

Elevation (ft)	Elevation (ft)	Manning's n
-20.00	986.55	0.0362
-15.99	986.03	0.0362
-9.68	985.60	0.0362
-8.19	984.67	0.0362
-1.26	984.51	0.0362
-0.29	983.94	0.0362
0.00	983.89	0.0362
0.81	984.07	0.0362
1.58	984.25	0.0362
7.78	987.58	0.0362
13.09	990.43	0.0362
18.07	991.25	0.0362
20.00	992.05	-----

Longitudinal Slope: 0.0400 ft/ft

Flow: 30.1600 cfs

Result Parameters

Depth: 1.1049 ft

Area of Flow: 5.9317 ft^2

Wetted Perimeter: 12.1595 ft

Hydraulic Radius: 0.4878 ft

Average Velocity: 5.0846 ft/s

Top Width: 11.6774 ft

Froude Number: 1.2572

Critical Depth: 1.1926 ft

Critical Velocity: 4.3278 ft/s

Critical Slope: 0.0243 ft/ft

Critical Top Width: 11.98 ft

Calculated Max Shear Stress: 2.7578 lb/ft^2

Calculated Avg Shear Stress: 1.2176 lb/ft^2

Composite Manning's n Equation: Lotter method

Manning's n: 0.0362

AOP Reach Gradations

Gradation at station 160 through station -125

D50: 1.40 in

D84: 3.94 in

AOP Culvert Upper Bed Gradation

D5: 0.0066 in

D16: 0.5809 in

D50: 5.8089 in

D84: 8.1325 in

D95: 11.0370 in

AOP Culvert Lower Bed Gradation

D5: 0.0140 in

D16: 0.1400 in

D50: 1.4000 in

D84: 3.9400 in

D95: 5.0400 in